RECEIVING GRAIN AT COUNTRY ELEVATORS

—HARD WINTER WHEAT AREA

U. S. DEPARTMENT OF AGRICULTURE ● Agricultural Marketing Service ● Transportation and Facilities Research Division
In Cooperation with the KANSAS AGRICULTURAL EXPERIMENT STATION
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PREFACE

The research on which this report is based is part of a broader project on handling grain in commercial storages. This report discusses methods, equipment, and layout for receiving grain by truck at country elevators in the Hard Winter Wheat area of the United States. This research was conducted in cooperation with the Kansas Agricultural Experiment Station.

Leo E. Holman, supervisory project leader, Agricultural Marketing Service, contributed valuable suggestions. Many grain storage operators made their facilities available for this study. Also, manufacturers, elevator contractors, insurance representatives, and power suppliers furnished information and made valuable suggestions.

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SUMMARY

During harvest, the emphasis at country elevators is on receiving grain from trucks as fast as possible. In the Hard Winter Wheat area, grain receipts usually start out slowly in the morning but reach a peak during midafternoon or late afternoon. At this time, the elevator crew must be prepared to handle a steady line of trucks as rapidly as possible to avoid having long waiting lines develop.

This report presents improvements in weighing truckloads of grain and unloading grain from trucks that would increase the speed of these operations to the maximum rate of receiving grain in the drive pits. The study is based on a 200,000-bushel concrete country elevator with an elevating leg with a capacity of 5,000 bushels per hour and two drive pits with a total capacity of 2,000 bushels. The maximum rate of receiving grain in the drive pits is 7,000 bushels for 1 hour (the capacity of the leg plus the capacity of the pits), or 45 or 46 trucks. In this analysis, the trucks arriving at the elevator are equally divided among standard farm trucks, with and without underbody hoists, of 200-bushel capacity, and pickup trucks with 60-bushel capacity. The two types of standard farm truck are equipped with sliding, removable, or complete endgates, and the pickup trucks have sliding or complete endgates.

Unloading grain from trucks, at a rate of 38 trucks per hour, was the slowest of the three receiving operations. The unloading time per truck can be reduced by better coordinating the tasks of the workers, by properly positioning the truck-lift cradle, and by shortening the time interval between trucks leaving and entering the pit driveway. These improvements can increase the number of trucks unloaded per hour to 48. This number of trucks can also be weighed in an hour if the scale operator instructs drivers delivering grain to move off the scale immediately after the weight of the load has been imprinted. Only one worker is needed at the scale if determination of test weight or moisture is not required.

Because of their smaller capacity, pickup trucks limit the number of bushels that can be received each hour, even when the weighing and unloading time per truck is reduced. Standard farm trucks with sliding endgates also slow down the receiving rate. If elevator operators can convince their customers of the advantages of using only standard trucks (with or without underbody hoists) and either complete or removable endgates when delivering grain, the receiving rate at the elevator can be increased to 48 trucks per hour, or 9,600 bushels. Two elevating legs, with a total capacity of 10,000 bushels per hour, would be needed to maintain this level of receiving. Only two men would be required to unload trucks instead of three.

The improvements suggested here can be used by elevators of greater capacity than the concrete country elevator used as the basis of this study. Recommendations for maintaining the elevating leg at its best capacity and for improving the layout of the scale house, weighing area, and drive pits are presented.

RECEIVING GRAIN AT COUNTRY ELEVATORS--HARD WINTER WHEAT AREA

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BACKGROUND

Lines of trucks waiting to unload grain at country elevators were a familiar sight in grain-producing areas 40 years ago. Waiting lines are still common at harvesttime in the Hard Winter Wheat area (fig. 1).

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Figure 1. --During the study, this line of trucks was observed waiting to unload wheat at a country elevator.

The farmer, who is the customer, does not like to have the combine waiting in the field while his truck waits in a line at the elevator; nor does the elevator manager like to delay a customer.

How long each truck waits at the elevator depends on a number of factors--how many trucks arrive during the day, the handling capacity of the elevator, the time interval between truck arrivals, and efficiency of receiving operations at the elevator. Another study[1] will deal with the rate and pattern of truck arrivals and the handling capacity of elevators.

The study reported here is concerned with speeding up receiving operations at the elevator. Receiving begins when a loaded truck arrives at the truck scale. The platform scale, with a small office (scale house) beside it, is usually located a short distance from

[1] Bouland, Heber. Selecting the Best Capacity of Truck Receiving Facilities for Country Grain Elevators. U. S. Dept. Agr. (In preparation.)

the elevator. After driving his loaded truck onto the scale, the driver waits while the truck is weighed and a worker in the scale house fills out the scale ticket. While the truck is on the scale, test weight of the grain may be determined, and a moisture test may be made. The truck is then driven to the drive pit where the grain is unloaded and conveyed to the storage bins. After the grain is unloaded, the driver returns the empty truck to the scale for weighing and receives a copy of the completed scale ticket.

The crew size, methods, and equipment used in receiving grain, and the design and layout of the receiving area may all affect the rate of receiving. A well-planned layout in the scale house is necessary for the scale personnel to handle the greatest number of trucks, maintain accurate records, and reduce the cost of the weighing operation. Similarly, the layout of the driveway and drive pit are important to efficient unloading.

This study was made to appraise methods, labor, layouts, and equipment used in receiving grain at concrete country elevators and to find ways to speed up receiving while maintaining economy of operation. The observed methods of receiving described in this report were the most efficient noted during the field studies.

A basic grain elevator (200,000-bushel headhouse) was chosen to illustrate receiving operations (see cover). The elevator is equipped with two drive pits, each having a capacity of 1,000 bushels, and an elevating leg with a capacity of 5,000 bushels per hour. Although the continuous rate for moving grain from the drive pits is 5,000 bushels per hour, grain can be received into the pits at a peak (surge) rate of 7,000 bushels per hour for 1 hour (the capacity of the leg plus the capacity of the pits).

The elevator headhouse is used primarily for receiving and shipping grain and for some short-term storage. It consists of six large bins, each 18 feet in diameter and 100 feet high, plus a number of handling bins of various sizes. The driveway, with two drive pits, runs through the center of the headhouse. Handling bins are located between the large bins and over the driveway. A unit of this size is representative of many country elevators in Kansas, Nebraska, Missouri, and Colorado, and the handling equipment is representative of a wide range of storage capacities.

Improvements in receiving developed in this study are applicable to similar elevators of different capacities and to elevators other than concrete but of similar design.

Labor and equipment costs for receiving operations are based on information obtained from elevator managers, power measurements, time study data, and other study observations.

Annual labor and equipment costs of receiving grain were analyzed for elevators of three sizes: (1) 200,000-bushel headhouse; (2) 750,000-bushel elevator consisting of a 200,000-bushel headhouse and a 550,000-bushel storage annex; and (3) 1,500,000-bushel elevator consisting of a 200,000-bushel headhouse and 1,300,000 bushels in storage annexes.

Improved layouts for the scale house working area and dock, the elevator driveway, and the drive pit area were also developed.

A limited study was made of truck receiving operations at times other than the harvest season. At these times, one man at the truck scale and one man at the elevator frequently performed these operations. The study included observations of three combinations of operations at the scale, and one man unloading different types of trucks and controlling the movement of grain from the drive pit to the headhouse.

Guiding Assumptions

The assumed general operating schedule for the 200,000-bushel headhouse is to receive and ship 475,000 bushels annually as follows:

Most of the grain is received during wheat harvest in the summer and milo harvest in the fall. Immediately before wheat harvest, the elevator is empty, but during summer harvest enough grain is received to fill the headhouse bins. Immediately after harvest the grain in four handling bins over the driveway is shipped out. Grain in four large headhouse bins is turned and treated during the summer, using the handling bins as turning space. The grain in one large headhouse bin is then shipped to make additional space available for the grain to be received by truck during the early fall. During the fall season, the grain in the headhouse is shipped out, leaving the headhouse empty in preparation for milo harvest.

The milo received in the fall again fills the headhouse, and it is necessary to ship the grain from four handling bins for operating space. During the early spring additional grain is shipped to provide space for normal receiving operations. Grain is received during the spring at the rate of a few trucks each day. All grain in the headhouse is shipped before summer harvest, leaving the headhouse empty, and completing the annual operating schedule.

Truck capacity.--In this report the capacity of trucks received at country elevators is assumed to be 200 bushels for standard farm trucks, 200 bushels for standard farm trucks with underbody hoist,[2] and 60 bushels for pickup trucks. When an equal number of each of the three types of trucks is received at an elevator, the average capacity is approximately 153 bushels per truck. This was the average capacity per truck received at one central Kansas elevator during one year. The percentages of the three types of trucks arriving at elevators--and therefore the average capacity per truck--varies from place to place in the Hard Winter Wheat area.

Equipment ownership and operating costs.--The equipment ownership and operating costs (appendix, table 14) are for equipment used only in receiving grain. The ownership costs include depreciation, interest, insurance, and taxes. Operating costs include power, maintenance, and repairs. A power cost of 5 cents per kilowatt hour is used in all tables.

Labor cost.--A wage rate of $1.50 an hour is used for calculating the labor cost for receiving wheat from trucks in the Hard Winter Wheat area. Costs of management and office help are not included. Only direct labor costs for receiving grain are included; such indirect costs as vacation pay, old-age and unemployment compensation, and other fringe benefits are not included. Unless otherwise noted, labor requirements shown are for operations during peak receiving hours at harvesttime when there is a steady line of trucks delivering grain. There is therefore no wait time for the workers. It is assumed that the employees have had experience at grain elevators and are familiar with their job assignments.

Cost comparison.--Comparative labor and equipment costs for performing receiving operations are presented. Only direct costs of labor and equipment are used. Such direct costs of receiving are not the total costs of grain elevator operation as reflected in annual business statements.

Comparative labor and equipment costs for performing receiving operations at the truck scale and unloading operations at the drive pit are computed on the basis of cost per vehicle. These costs are based on information obtained from observations of both 200-bushel trucks and 60-bushel pickup trucks. Combined costs of receiving at the truck scale,

[2] The standard farm truck and the standard farm truck with underbody hoist have a grain body about 8 feet wide and 13 to 18 feet long with grain-tight side panels about 2 1/2 feet high.

drive pit, and elevator are listed as a cost per 1,000 bushels. These combined costs are based on the assumption that grain is received from an equal number of 200-bushel standard farm trucks, 200-bushel standard farm trucks with underbody hoist, and 60-bushel pickup trucks.

Equipment and Facilities Used for Receiving Grain

Truck scale.--Because the truck scale with printing dial was the most frequently observed type of scale used for weighing farm trucks, it is used in this report. The operator inserts the ticket in the scale, and the scale imprints the weight of the vehicle on the ticket. Elevator managers prefer the dial scale because the truck driver can observe the weight recorded. Truck scales with a manual beam were observed at only a few elevators.

Scale house.--Several different designs of scale houses were observed. Dock heights varied from ground level to 44 inches and door locations were different at each facility. Moisture testers and test-weight equipment were located in various places. Usually the desks used when filling out tickets were located immediately behind or to the right of the dial of the scale.

Drive pits.--Several sizes and combinations of drive pits were observed. The single elevator driveway with two drive pits was the most common in the Hard Winter Wheat area, and information obtained for that type of layout is used in this report.

Truck lift.--A cable hoist truck lift with 7 1/2-horsepower electric motor is used in this report.

Elevator leg.--The continuous operating rate used for each elevator leg is 5,000 bushels per hour; the peak capacity of the drive pits and elevator leg is 7,000 bushels, as described on page 4. Other equipment operated in connection with the leg is a dust collector.

Distributor.--A manually operated distributor (fig. 20, page 24) is attached to the head of the leg and can be positioned to direct the flow of grain from leg to headhouse handling bins, headhouse large bins, railroad car loadout spout, truck loadout spout, or to other special equipment. The 750,000- and 1,500,000-bushel elevators have additional spouts which direct the flow of grain from the leg to the gallery belt.

Tunnel and gallery belt.--The tunnel and gallery belts used are 24 inches wide with a capacity of 5,000 bushels per hour. These belts are used only in the 750,000- and 1,500,000-bushel elevators.

Tripper.--The 750,000- and 1,500,000-bushel elevators have a tripper for removing grain from a 24-inch gallery belt when grain is moved to the annex bins.

Test weight bucket and beam.--Two types of equipment were observed for determining test weight: The portable test weight bucket and beam and the test weight apparatus with funnel and beam attached to a stand. In this report the first type is used for operations during the harvest season, the second type for operations at times other than at harvest.

Moisture tester and gram scale.--The moisture testers observed were of the dielectric type with a gram scale for weighing the grain sample.

Man lift.--A cage man lift, with a 1 1/2-horsepower motor, a capacity of 300 pounds, and a rate of lift of 90 feet per minute, is used to convey employees from one level to another in the elevator.

Other items.--An intercom is normally found in 750,000- and 1,500,000-bushel elevators to provide communications throughout the facility.

Windows and lights are included in operating expenses. Windows are opened and closed during grain movement to provide ventilation. Breakage is included as a maintenance expense.

DEFINITION OF TERMS

Annex.--A storage structure usually separated from the headhouse, but connected to the headhouse for movement of grain.
Avoidable delay.--Time not contributing to the operation for which the worker is personally responsible.
Base time.--The time recorded during a time study adjusted to the normal pace of an average experienced worker.
Fatigue allowance.--A percentage added to the base time to provide a rest period for the worker to overcome fatigue resulting from physical effort.
Gallery belt.--Conveyor belt for moving grain to the annex bins.
Handling machinery.--Equipment used in movement of grain by elevating, horizontal conveying, gravity drop, etc. Includes related items associated with grain movement such as intercom, man lift, lights, and windows.
Headhouse.--Basic grain elevator unit which houses driveway area, elevator legs and associated equipment, and integral storage and handling bins.
Headhouse handling bin.--Any small bin over the driveway or between large bins of a headhouse used for receiving, blending, and mixing grain.
Leg.--Bucket elevator for elevating grain.
Man-minute.--One man's time for one minute.
Personal allowance.--A percentage added to the base time to provide time for the worker's personal needs.
Productive time.--The time recorded during a time study, adjusted to the pace of an average experienced worker, with avoidable delays removed, and allowances added for fatigue and personal needs. (See appendix tables 16, 17, and 18.) The productive time is used in the activity charts.
Surge rate.--The operating capacity of the leg plus the capacity of the drive pits.
Tripper.--A mechanism for removing the grain from the gallery belt and dropping it into an annex bin.
Tunnel belt.--Conveyor belt for moving grain from the annex bins to the leg.
Unavoidable delay.--Wait time which is beyond the worker's immediate control.

OBSERVED METHODS OF RECEIVING GRAIN AT HARVESTTIME

Operations at the Truck Scale

At most of the elevators observed the truck scale and the scale house were separated from the grain elevator to provide space for the loaded trucks to wait between the scale and the elevator. The loaded truck is weighed at the scale and unloaded at the elevator pit, and the empty truck is returned to the scale to be weighed.

While the loaded truck is on the scale, the test weight and the moisture content of the grain may be determined. At the beginning of harvest, test weight of the grain may be checked for each truck. As the harvest progresses, the general crop condition will determine the number of truckloads for which test weight will be checked. A moisture test is normally performed on grain combined during the early morning or late evening. Occasional rains, nonuniform grain ripening, and unusual crop conditions influence the need for additional moisture testing.

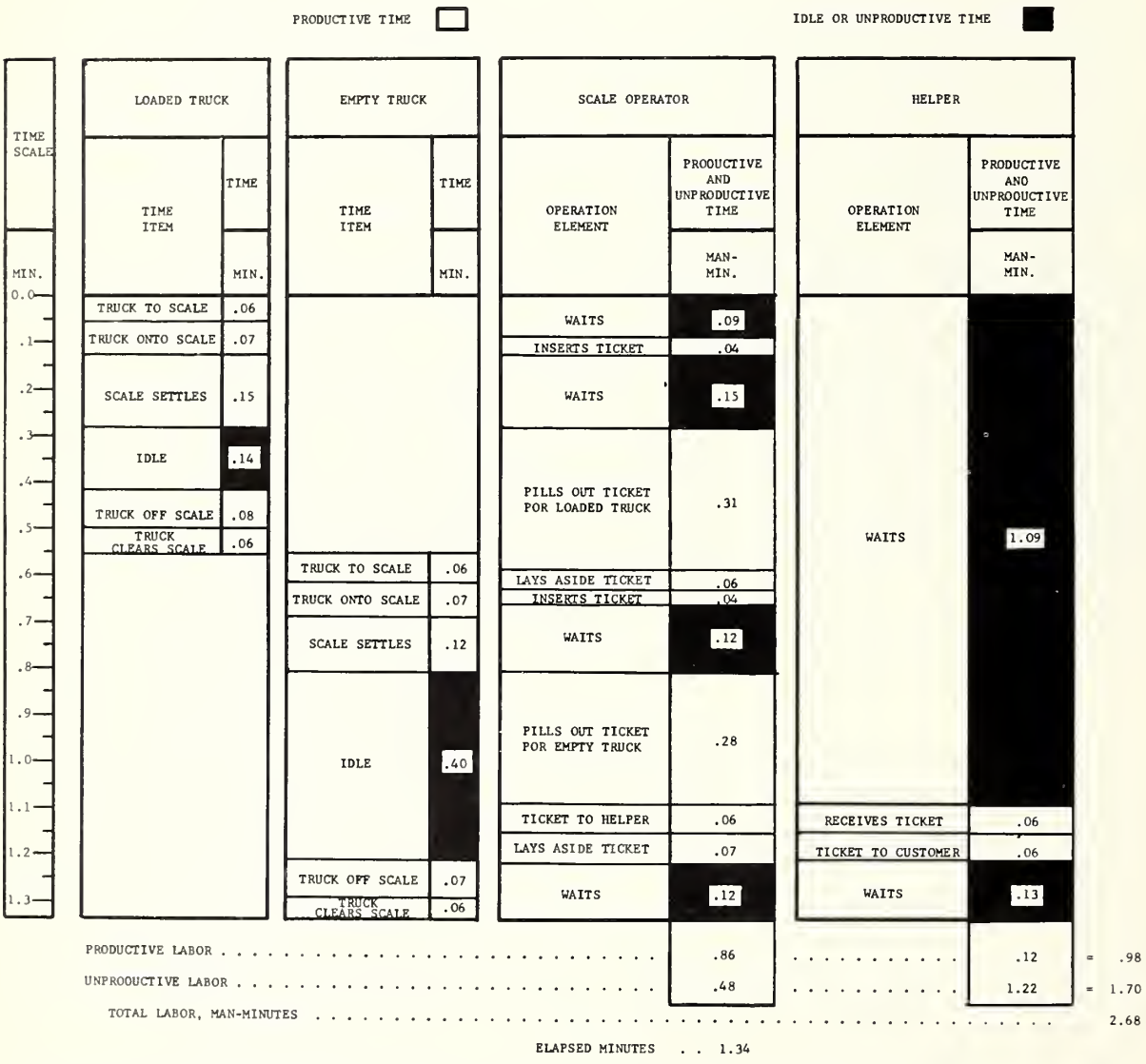
Two men usually performed the work when the only task was weighing the trucks and when the trucks were weighed and the test weight was taken. Three men performed the tasks of weighing, taking test weight, and making the moisture test.

The labor requirements for a two-man crew weighing a truck following the usual sequence of work are shown in figure 2. With a steady line of trucks delivering grain, 44 to 45 trucks could be weighed in an hour and the receiving rate at the scale would be about 6,870 bushels.

Observed Method

WEIGHING WITH 2-MAN CREW

Truckload of Grain Weighed with Printing Dial Scale



NOTE: "TRUCK TO SCALE" INCLUDES DRIVING THE TRUCK FORWARD UNTIL THE FRONT WHEELS CONTACT THE SCALE PLATFORM. "TRUCK ONTO SCALE" INCLUDES DRIVING THE TRUCK ONTO THE SCALE AND STOPPING. "TRUCK OFF SCALE" INCLUDES DRIVING UNTIL THE REAR WHEELS CLEAR THE SCALE PLATFORM. "TRUCK CLEARS SCALE" INCLUDES ORIVING TO A POINT OUTSIDE THE LINE OF TRAFFIC WAITING TO ORIVE TO THE SCALE.

Figure 2.

The scale operator weighs both the loaded truck and the empty truck. He inserts the scale ticket in the printing attachment, presses the weigh button, fills out the ticket, and lays aside the ticket [3]. After the empty truck is weighed and the ticket filled out, the scale operator hands a copy of the ticket to the helper (fig. 3), who hands it to the driver. This was the most common method of giving the driver his copy of the completed scale ticket. The scale operator then files or lays aside the original.

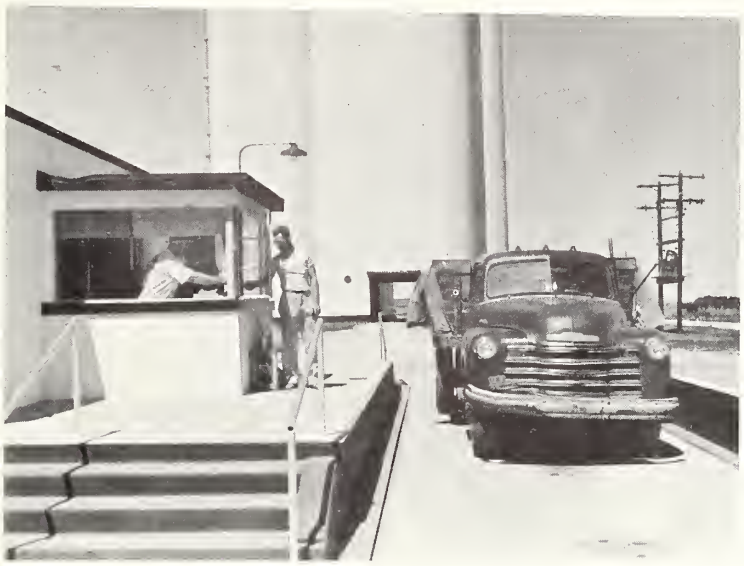


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Figure 3. --Weighing with a two-man crew at the truck scale--the scale operator hands a copy of the ticket to the helper, who gives it to the truck driver.

The scale operator fills out about one-half of the required information on a scale ticket when the loaded truck is weighed and completes the ticket when the truck is weighed empty. The gross weight is stamped on the ticket when the weigh button of the printing mechanism is pressed. The date, customer's name, type of grain, and sometimes other data are then written on the ticket. The tare weight is stamped on this same ticket when the empty truck returns from the elevator. The operator calculates the net weight of the grain and usually converts it to bushels. He records the net weight and the number of bushels on the scale ticket.

Weighing and Making Test Weight

The labor requirements and sequence of elements for a two-man crew to weigh a loaded truck and an empty truck and to determine the test weight are shown in figure 4. With a steady line of trucks, the receiving rate at the scale would average 5,820 bushels per hour.

The scale operator weighs the loaded and empty truck as outlined in the previous section.

[3] As each loaded truck is weighed, the ticket is placed on the bottom of the stack of partially filled out tickets and becomes the top ticket when the same truck returns empty to the scale. Or, as each loaded truck is weighed, the ticket is attached as the left ticket on a movable line across the top of the desk and will then be on the right-hand side when the truck returns empty to the scale.

Observed Method

WEIGHING AND MAKING TEST WEIGHT WITH 2-MAN CREW
Printing Dial Scale, Test Weight Bucket at Truck

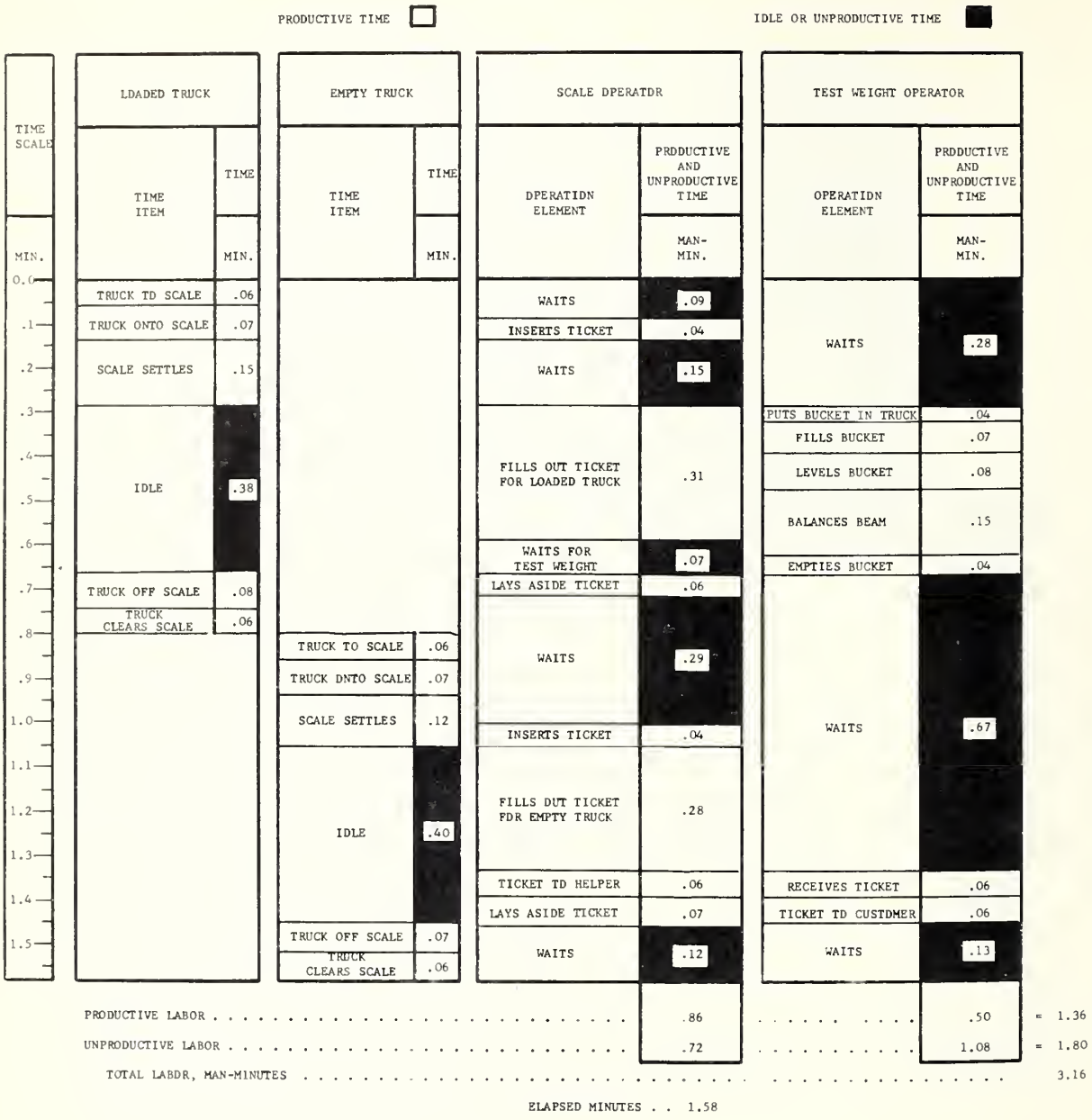

Figure 4.

The test weight operator determines the test weight, using a portable test weight bucket and beam (fig. 5). He places the bucket on the grain (usually filling it with cupped hands), uses the beam to level the grain in the bucket, hooks the beam on the bail of the bucket, lifts the bucket, moves the poise until the beam is blanced, calls out the test weight to the scale operator, and empties the bucket. He then waits for the carbon copy of the scale ticket, which he gives to the truck driver.

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Figure 5. --Determining the test weight with portable test weight bucket and beam. Sideboards on pickup increase its capacity.

The test weight operation added 0.24 minute to the elapsed time at the truck scale.

Weighing and Making Test Weight and Moisture Test

The labor requirements and sequence of elements for a three-man crew to weigh a loaded truck and an empty truck, and to determine the test weight and moisture content are shown in figure 6. With a steady line of trucks, the receiving rate at the truck scale would be about 4,740 bushels per hour.

The scale operator and test weight operator weigh the loaded and empty truck and determine the test weight of the grain as outlined previously.

The moisture test operator obtains a sample of grain, takes it into the scale house, and pours 150 grams into the scale pan. Next, he pours the grain into the moisture tester, levels the grain, lays aside the scale pan, and flips the trap door open dropping the grain into the cell. Then he reads the dial, consults a chart, and calculates the actual moisture by compensating for test weight and temperature. After this, he empties the grain and goes to the dock with the container.

Time is not shown in figure 6 for determining the temperature of the sample for the moisture test. During harvest none of the operators waited for the thermometer in the temperature drawer to stabilize before taking the temperature reading. They reasoned that all grain coming from the harvest field was about the same temperature and that only an occasional check was necessary. The data for the moisture test operation included in this report are what were observed and do not necessarily reflect the manufacturer's recommendations.

The moisture test operation added 0.36 minute to the elapsed time.

Unloading Farm Trucks at the Drive Pit

The method of unloading trucks at country elevators has not changed appreciably in the past two or three decades. At harvesttime, the trucks frequently wait in line between the truck scale and the elevator driveway.

Observed Method

WEIGHING AND MAKING TEST WEIGHT AND MOISTURE TEST
3-Man Crew, Printing Dial Scale, Test Weight Bucket at Truck

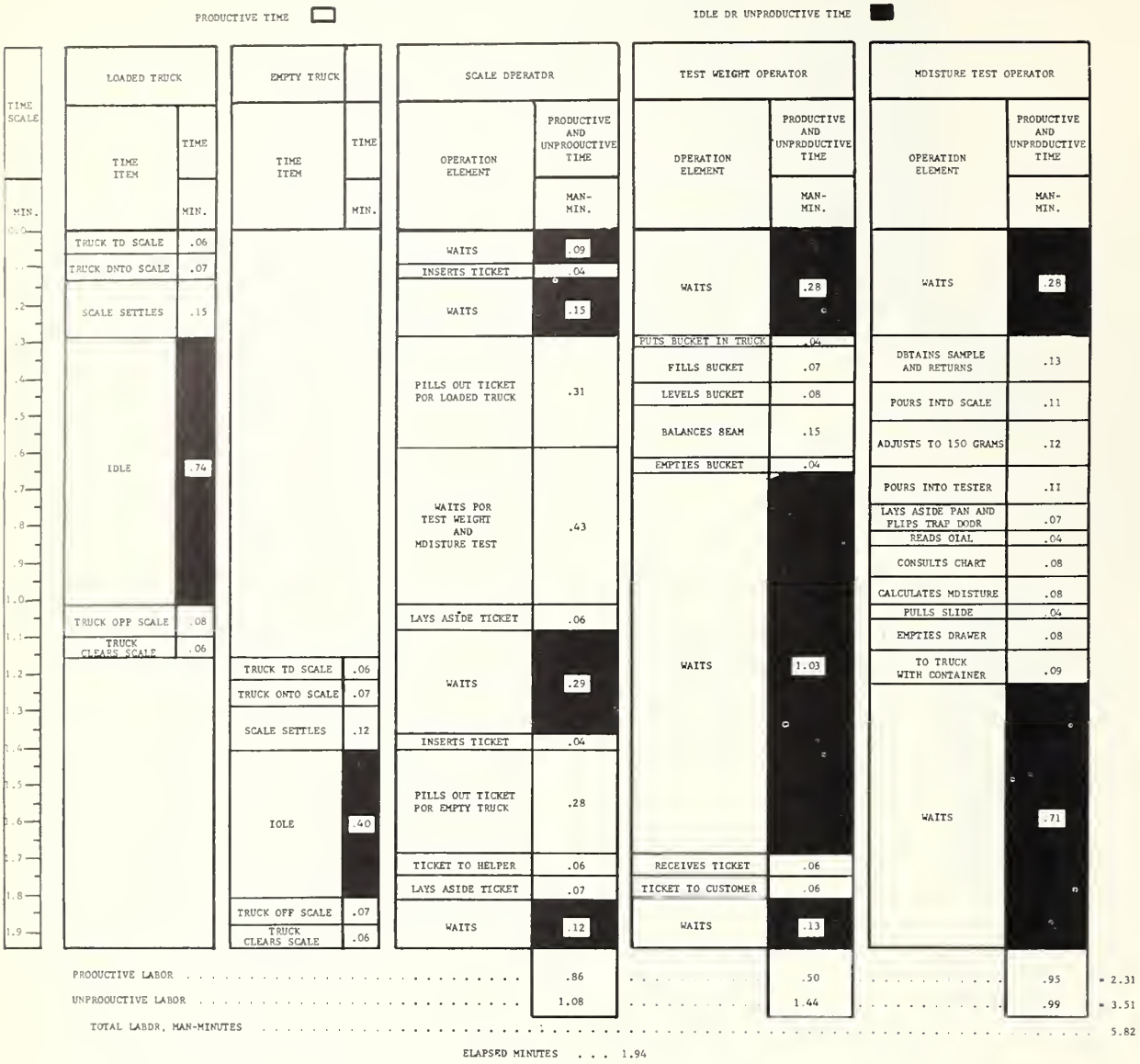

Figure 6.

The unloading operation begins when the front wheels of the truck cross the driveway entrance. When necessary, the truck driver is directed to drive the truck backward or forward to position the endgate over the drive pit. One man opens the endgate while another controls the raising of the truck as the grain flows from the truck. The third man and the endgate man shovel the grain from the corners of the grain body by lifting or pushing the grain to the endgate with a shovel. Most employees start shoveling shortly before the grain stops flowing from the endgate. The endgate man usually closes the endgate immediately after the shoveling is completed, while the truck is being lowered. With a complete endgate no shoveling is required, and the endgate is closed as soon as the bed is empty. The unloading operation ends when the rear wheels of the truck pass the driveway exit door.

Three types of trucks were studied: (1) The standard farm truck (fig. 7), also referred to as a road truck, straight truck, or bobtail truck, is unloaded by placing the front wheels on a truck lift, which raises the front end of the truck. (2) The standard farm truck with the underbody hoist (fig. 8), also referred to as a self-dump, hydraulic, or lift truck, has a hoist permanently attached between the frame and grain body. The truck motor provides the power for operating the hoists to raise the grain body. (3) The pickup truck (fig. 5) usually has sideboards attached to increase the grain-hauling capacity.

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Figure 7. --Standard farm truck in raised position on cable hoist lift.

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Figure 8. --Standard farm truck with underbody hoist.

The two standard trucks may be equipped with any one of three types of endgate: Sliding, removable, or complete. The pickup truck may have either the sliding or complete endgate. Thus, a total of eight combinations of truck and endgate may occur.

The sliding endgate (fig. 9), usually 12 inches high and from 12 to 36 inches wide, is flat and fits between vertical guides. It is opened or closed by a center handle which slides the endgate in the guides. The removable endgate (fig. 10) is approximately 36 inches wide and 36 inches high; it extends to the top of the grain body. The complete endgate (fig. 11) opens across the entire width of the grain body; it may vary in height from 6 inches to the full height of the grain body. On pickups the complete endgate is hinged at the bottom, and on standard farm trucks at the top.

The type of endgate used affects the elapsed time required for unloading trucks.

The primary differences in elapsed times due to the type of endgate occurred during four elements of the unloading operation, namely: (1) Open endgate, (2) raise truck as bed empties, (3) shovel grain, and (4) close endgate (table 17, appendix).

(1) Open endgate. The elapsed time was 0.06 minute for a sliding endgate, 0.14 minute for a removable endgate, and 0.13 minute for a complete endgate for standard farm trucks with or without hoists. For pickup trucks, the elapsed time was 0.07 minute for a sliding endgate and 0.34 minute for a complete endgate.

(2) Raise truck as bed empties. The elapsed time for raising the truck or grain body while the grain bed emptied was 0.79 minute for a sliding endgate, 0.56 minute for a removable endgate, and 0.51 minute for a complete endgate. The length of time required

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Figure 9. --A sliding endgate. The small opening delays unloading.

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Figure 10. --Removable endgate set aside during unloading.

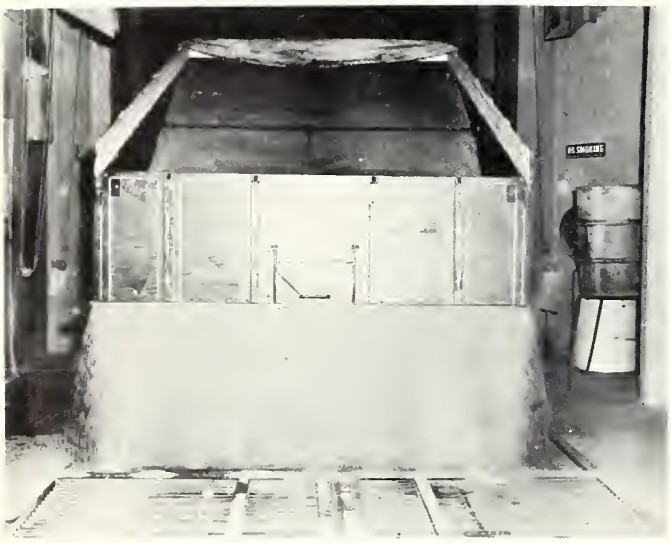

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Figure 11.--A complete endgate opens across the entire width of the grain body. This type of complete endgate is as high as the grain body.

to raise a truck body as the grain flowed out varied between elevators and between trucks. In addition to the quantity of grain in the truck and the size of the endgate, the method of raising a truck, either on a truck lift or with underbody hoist, greatly affected the elapsed time for this element. In nearly all cases, the lifting of the truck or grain body was stopped and started repeatedly until it reached its maximum height. Therefore, the elapsed time was determined also by the way the lift operator or truck driver operated the hoist. Other variables included the type of grain, condition of the grain, material used in the grain body floor, and the angle of the raised grain body.

(3) Shovel grain. The elapsed time required to shovel grain from trucks was 0.25 minute with sliding endgates and 0.21 minute with removable endgates. The amount of grain to be removed by shoveling is primarily affected by endgate width, and not by height. The average width of a sliding endgate was 26 inches and of a removable endgate, 35 inches.

(4) Close endgate. The elapsed time was 0.10 minute for a sliding endgate, 0.24 minute for a removable endgate, and 0.24 minute for a complete endgate for standard farm trucks with or without underbody hoists. For pickup trucks, the elapsed time was 0.10 minute for a sliding endgate and 0.28 minute for a complete endgate.

Time studies were made to determine the sequence and time required for the various elements of the operation, the productive time, the unproductive time, and the elapsed time to unload trucks. Crews of various sizes were studied, but a three-man crew was most frequently observed at harvesttime.

Standard Farm Truck

Standard farm trucks are used in many parts of the Hard Winter Wheat area. During these studies, for example, it was estimated that in the wheat-producing area of south central Kansas, 60 percent of the trucks used to haul grain to the elevator were standard farm trucks. In contrast, in southwestern Kansas, where wheat farms are large and custom combines are widely used, 90 percent of the trucks had underbody hoists.

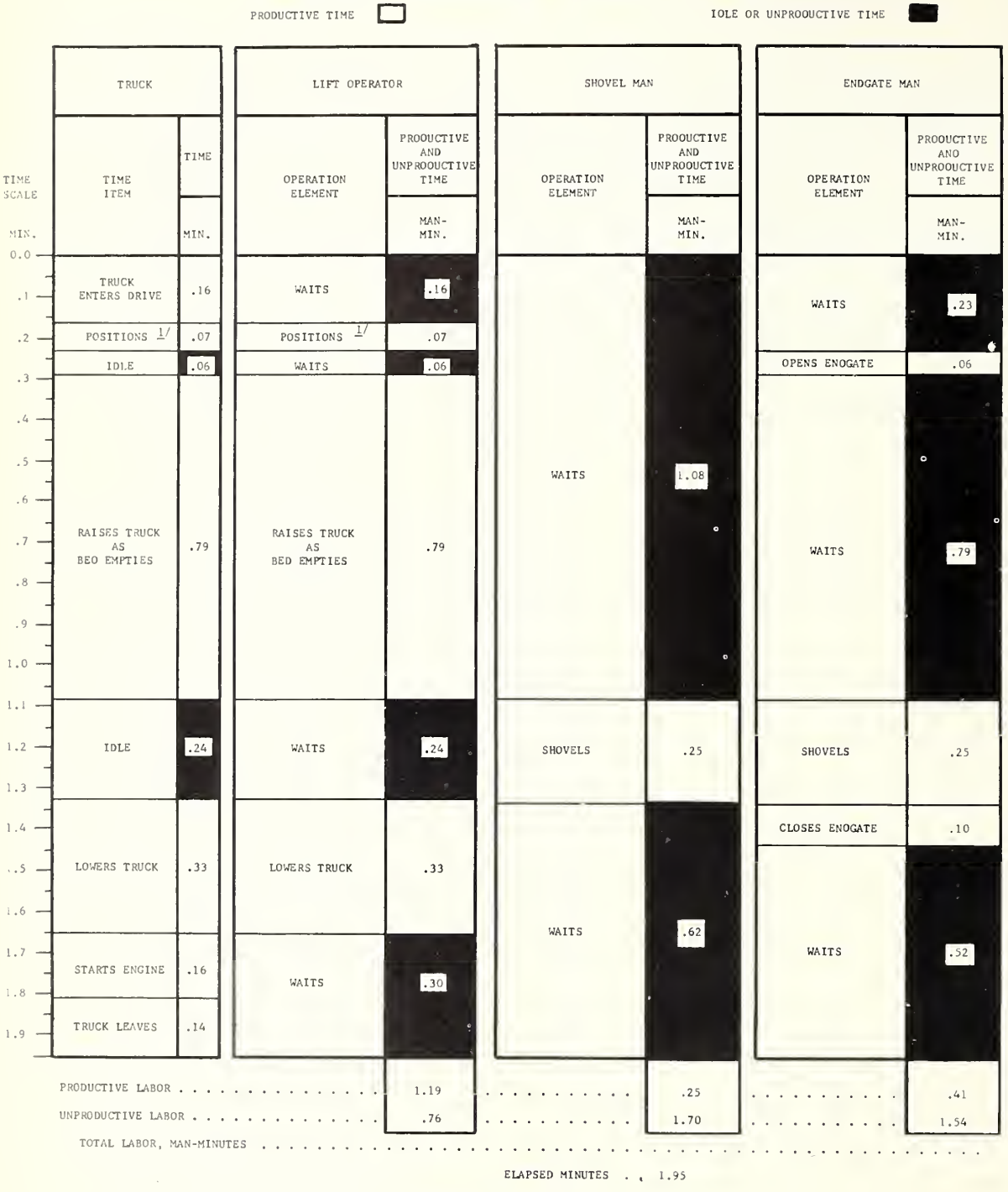
After entering the driveway the standard farm truck must be stopped with the front wheels on the truck-lift cradle. Then it is frequently necessary to move the truck backward or forward to position it over the drive pit. The driver shuts off the engine and leaves the truck while workers open the endgate and start to raise the truck.

Starting the engines of these trucks after unloading caused considerable delay because most engines were easily flooded when raised on the truck lift. The element, "start engine," included time for the driver to enter the truck before starting the engine.

The labor requirements and sequence of elements for unloading standard farm trucks equipped with sliding, removable, or complete endgates, are shown in figures 12, 13, and 14, respectively.

Observed Method

UNLOADING 200-BUSHEL TRUCK SLIDING ENDGATE, 3-MAN CREW

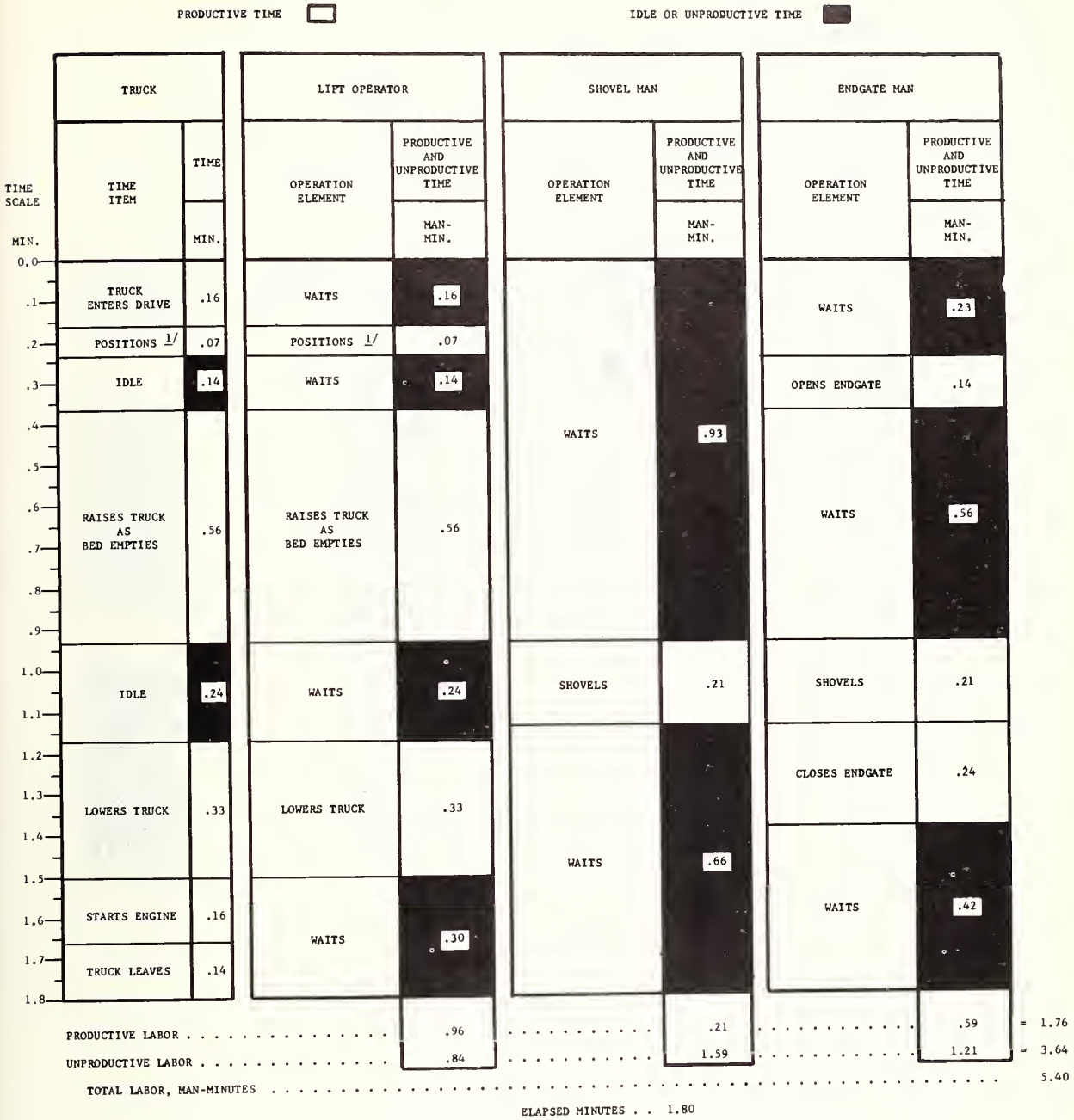


1/ This is a weighted time. The frequency of occurrence was 34 percent.

Figure 12.

Observed Method

UNLOADING 200-BUSHEL TRUCK, REMOVABLE ENDGATE, 3-MAN CREW

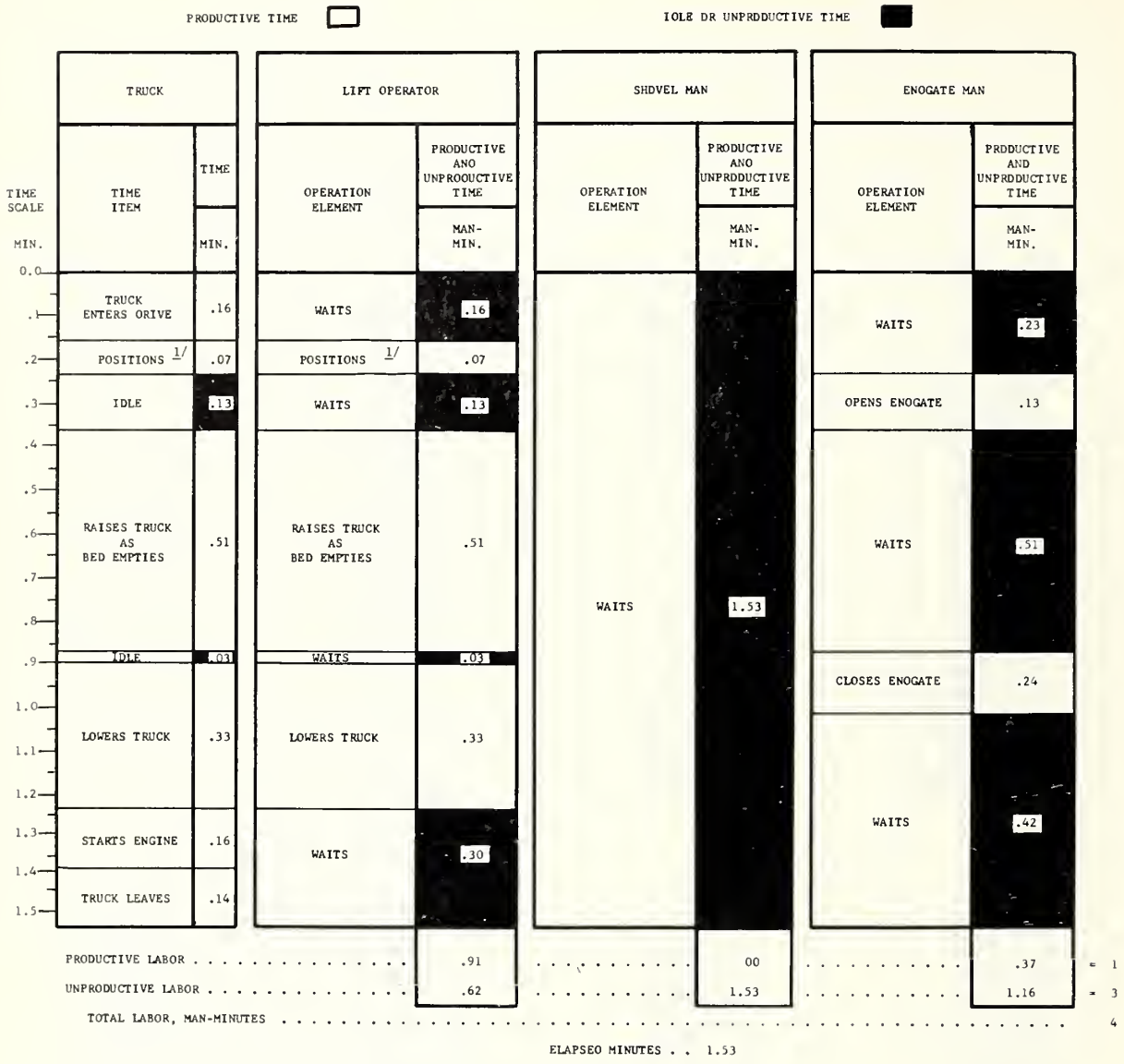


1/ This is a weighted time. The frequency of occurrence was 34 percent.

Figure 13.

Observed Method

UNLOADING 200-BUSHEL TRUCK, COMPLETE ENDGATE, 3-MAN CREW



1/ This is a weighted time. The frequency of occurrence was 34 percent.

Figure 14.

A truck equipped with underbody hoist is an efficient vehicle for unloading at the grain elevator. The lift operator need not operate the truck lift and can concentrate on giving directions to the truck driver or on assisting the other employees when needed.

Two ways of positioning standard farm trucks with underbody hoists are used: The driver stops the truck and is then directed to move the truck until the endgate is positioned over the drive pit, or the lift operator directs the truck driver to stop with the endgate positioned over the drive pit.

The labor requirement and sequence of elements for unloading standard farm trucks with underbody hoists equipped with sliding, removable, and complete endgates are shown in figures 15, 16, and 17, respectively.

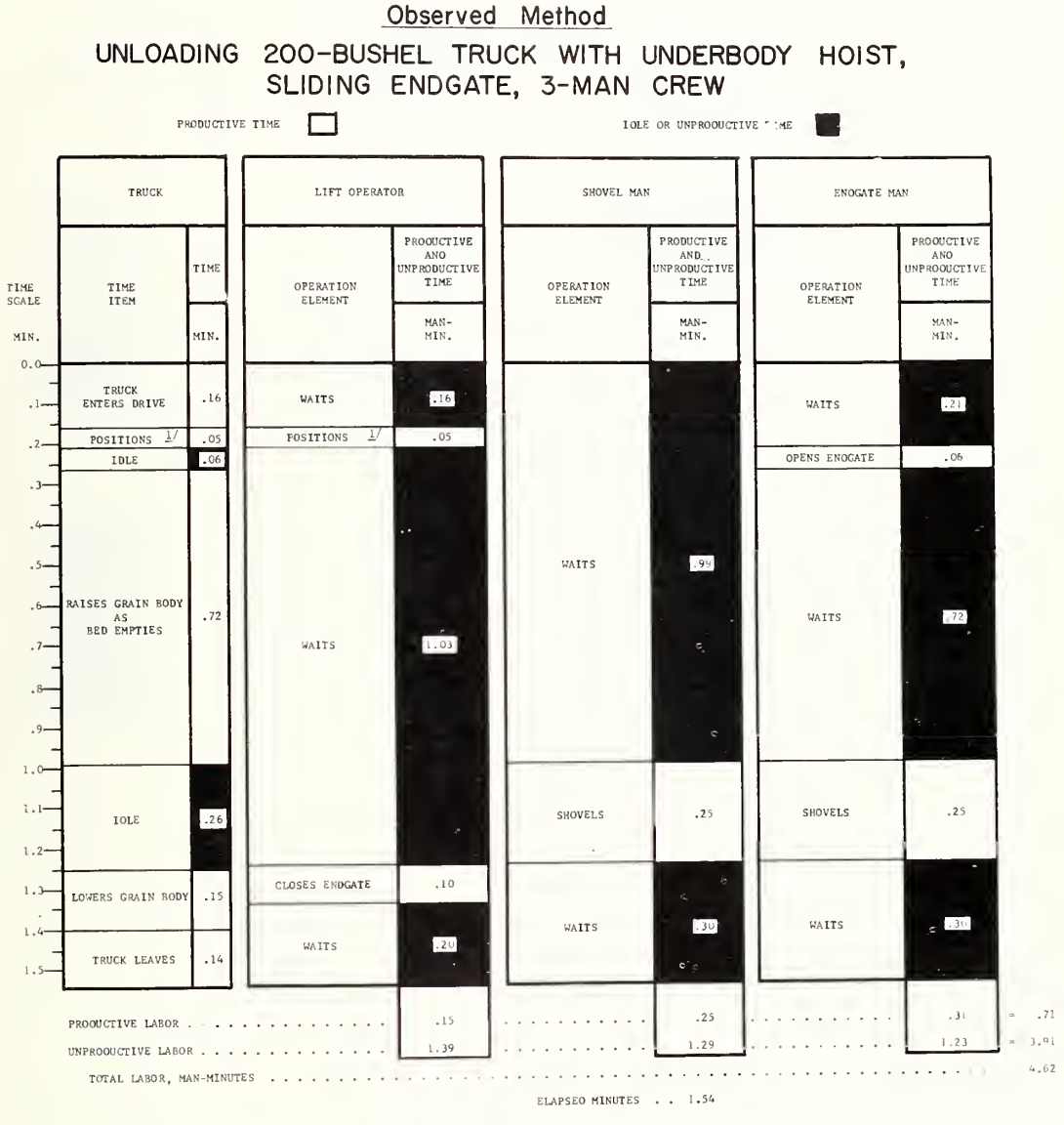
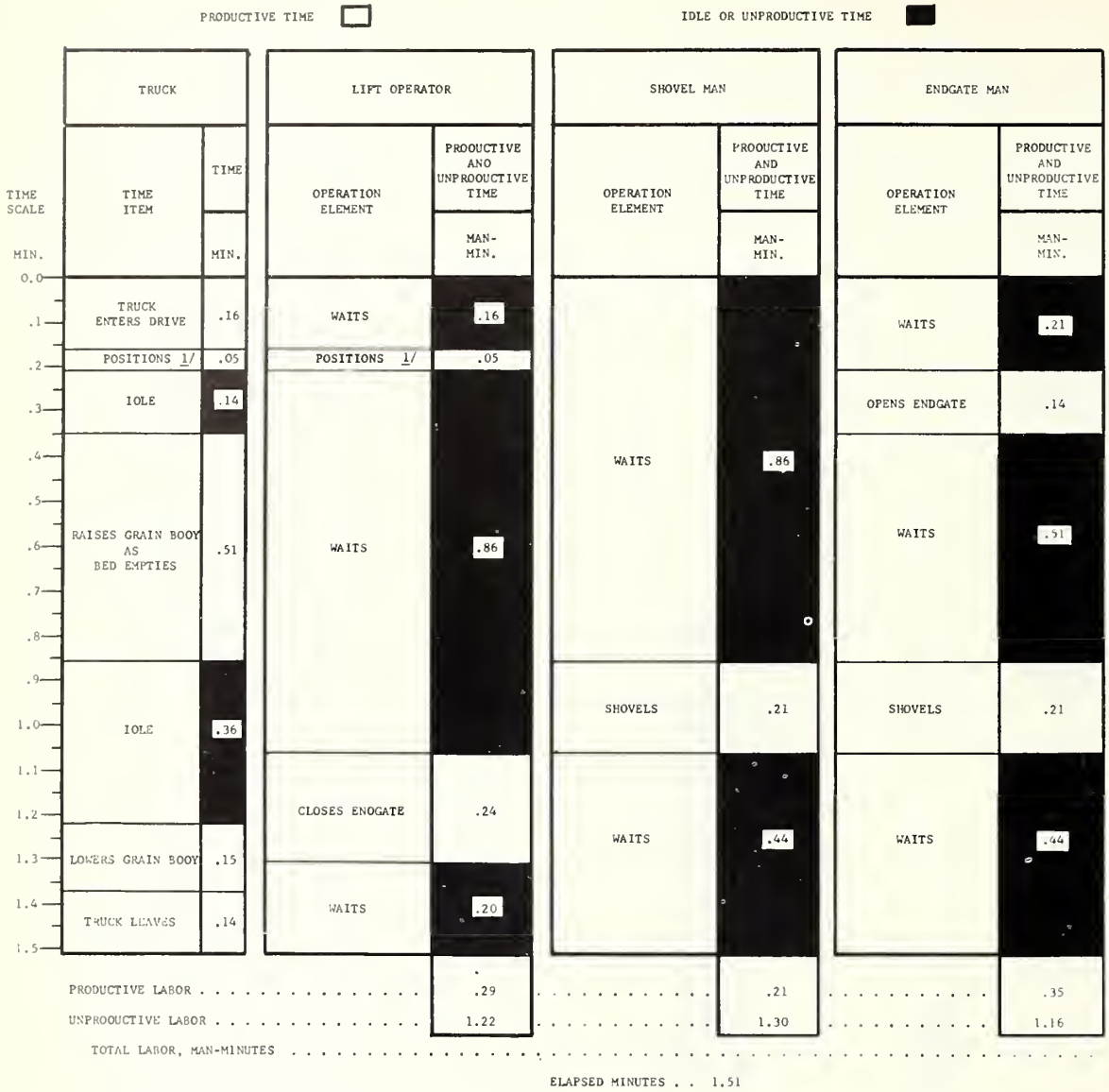


Figure 15.

Observed Method

UNLOADING 200-BUSHEL TRUCK WITH UNDERBODY HOIST, REMOVABLE ENDGATE, 3-MAN CREW

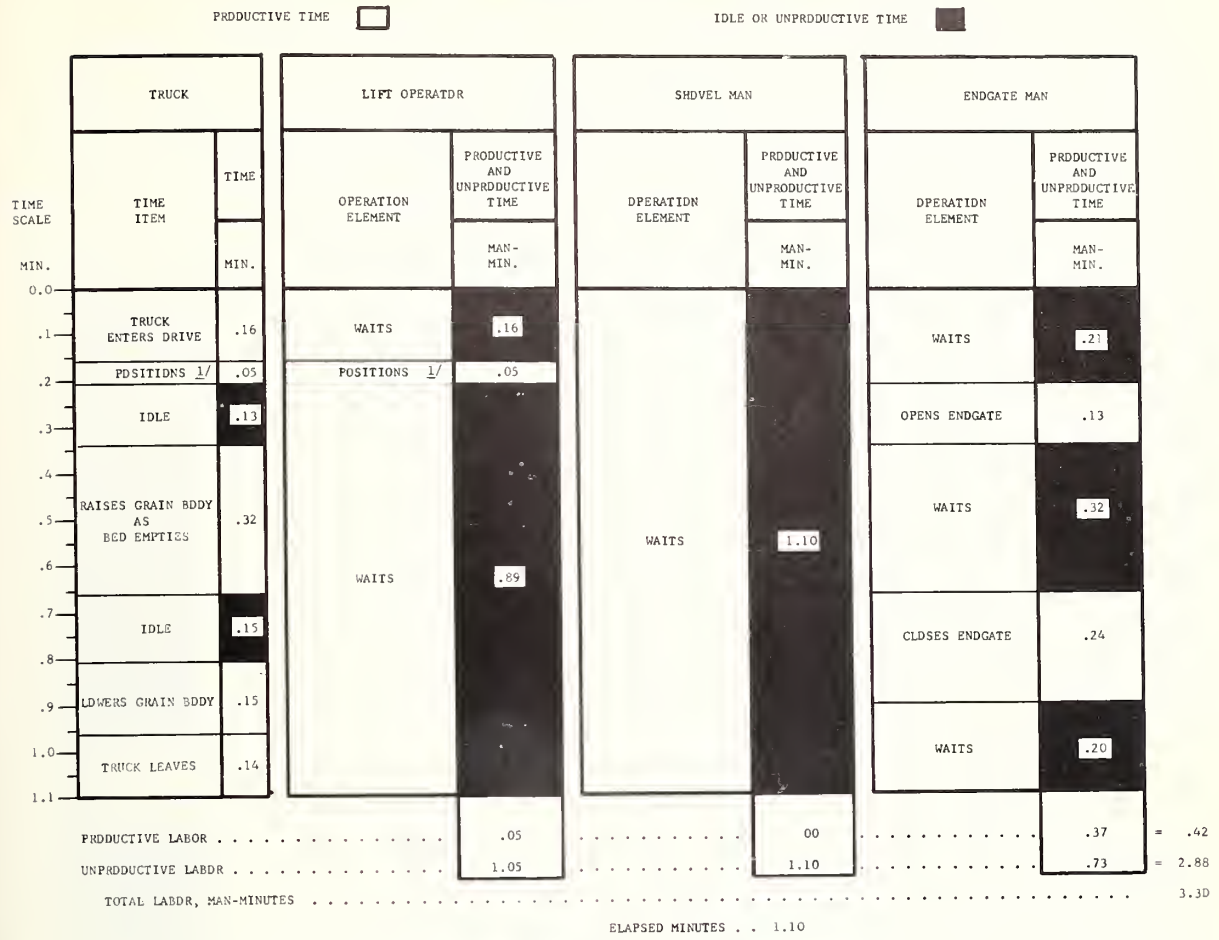


1/ This is a weighted time. The frequency of occurrence was 19 percent.

Figure 16.

Observed Method

UNLOADING 200-BUSHEL TRUCK WITH UNDERBODY HOIST, COMPLETE ENDGATE, 3-MAN CREW



1/ This is a weighted time. The frequency of occurrence was 19 percent.

Figure 17.

Pickup Truck

Pickups are used to deliver grain to the elevator in diversified farming areas where farms are relatively small and the use of custom combines is limited, in other areas where the elevator is a short distance from the farm, and occasionally after rains when large trucks cannot enter the fields.

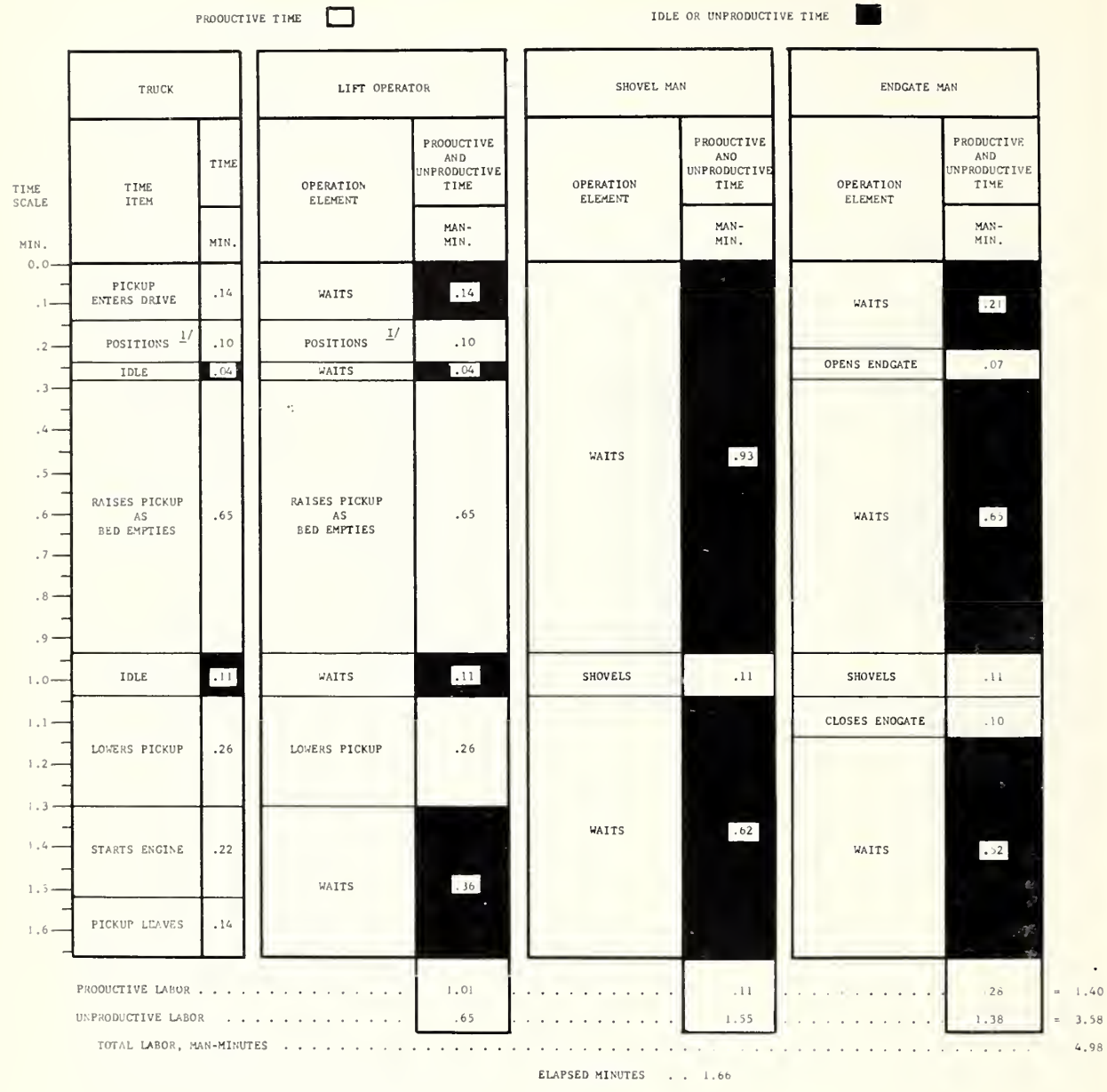
Pickups enter the drive faster than standard trucks because of a higher rate of acceleration and more clearance between the sides of the pickup and the entrance door. A higher percentage of pickups (40 percent) had to be moved forward or backward to position them over the drive pit than of standard farm trucks (34 percent).

Opening and closing a complete endgate on a pickup requires more time than any other type of endgate on any truck because of the latching arrangement, or because the endgate is frequently sprung out of shape.

The labor requirements and sequence of elements for unloading pickup trucks equipped with sliding and complete endgate are shown in figures 18 and 19, respectively.

Observed Method

UNLOADING 60-BUSHEL PICKUP, SLIDING ENDGATE, 3-MAN CREW



1/ This is a weighted time. The frequency of occurrence was 40 percent.

Figure 18.

Observed Method

UNLOADING 60-BUSHEL PICKUP, COMPLETE ENDGATE, 3-MAN CREW

PRODUCTIVE TIME ☐ IDLE OR UNPRODUCTIVE TIME ■

TIME SCALE MIN.	TRUCK: TIME ITEM	TRUCK: TIME MIN.	LIFT OPERATOR: OPERATION ELEMENT	LIFT OPERATOR: PRODUCTIVE AND UNPRODUCTIVE TIME MAN-MIN.	SHOVEL MAN: OPERATION ELEMENT	SHOVEL MAN: PRODUCTIVE AND UNPRODUCTIVE TIME MAN-MIN.	ENOGATE MAN: OPERATION ELEMENT	ENOGATE MAN: PRODUCTIVE AND UNPRODUCTIVE TIME MAN-MIN.
0.0	PICKUP ENTERS ORIVE	.14	WAITS	.14	WAITS	.11	WAITS	.11
.1	POSITIONS 1/	.10	POSITIONS 1/	.10	OPENS ENDGATE	.34	OPENS ENDGATE	.34
.2	IOLE	.22	WAITS	.22				
.3								
.4								
.5	RAISES PICKUP AS BEO EMPTIES	.41	RAISES PICKUP AS BEO EMPTIES	.41	WAITS	.41	WAITS	.41
.6								
.7								
.8								
.9	LOWERS PICKUP	.26	LOWERS PICKUP	.26	CLOSES ENOGATE	.28	CLOSES ENOGATE	.28
1.0								
1.1								
1.2	STARTS ENGINE	.22	WAITS	.36	WAITS	.35	WAITS	.35
1.3								
1.4	PICKUP LEAVES	.14						

PRODUCTIVE LABOR	.77	.62	.62	= 2.01
UNPRODUCTIVE LABOR	.72	.87	.87	= 2.46
TOTAL LABOR, MAN-MINUTES				4.47

ELAPSED MINUTES . . 1.49

1/ This is a weighted time. The frequency of occurrence was 40 percent.

Figure 19.

Elevating Grain from Drive Pit to Headhouse

After grain is unloaded, it is elevated to the top of the headhouse where it is carried by gravity through the distributor to the bins. The continuous capacity of the elevating equipment studied averaged 5,000 bushels per hour. Two drive pits with a total capacity of 2,000 bushels were commonly used.

During harvest the setup for this operation occurs when the elevator is opened in the morning. The doors and windows are opened, the distributor is positioned to a selected bin (fig. 20), the leg is started, and the drive pit gate is opened. As each bin fills, the drive pit gate is closed, the distributor is set to a different bin, and the drive pit gate is re-

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Figure 20. --This manually operated distributor (A) near the top of the elevator is positioned from ground level (B) to a selected bin to move grain from drive pit to headhouse.

opened. The time required to sweep around the drive pit after trucks have been unloaded and to sweep the elevator once each week is included in the sweep time. The cleanup is performed in the late afternoon; it includes closing the drive pit gate, stopping the leg, and closing windows and elevator doors.

The labor required for one man to perform the setup, cleanup, and other work involved in elevating 1,000 bushels of grain from drive pit to headhouse is shown below:

Operation element	Productive labor required
	Man-minutes
Setup	[1] 0.13
Changing distributor and pit gate	[2] .05
Sweeping	[3] .60
Cleanup	[1] .12
Total labor	.90
	Minutes
Elapsed time	0.90

[1] Weighted time with frequency of occurrence being 2 percent.
[2] Weighted time with frequency of occurrence being 11 percent.
[3] Weighted time with frequency of occurrence being 0.8 percent.

Equipment used is the leg, dust collector, manually operated distributor, and man lift.

The lift operator, as leader of the unloading crew, is generally assigned the responsibility for setup and cleanup, which are performed once each day. Since several thousand bushels will be received during a day at harvesttime, the time required for setup and cleanup may be prorated over the entire day's receipts.

Overall Rate of Receiving

Calculations of receiving rates in this study are based on a steady line of trucks delivering grain to the elevator. In another study[4] it was found that this situation usually occurs 1 or 2 hours during the day; grain receipts at elevators during harvesttime usually start out slowly in the morning and build up to a peak for an hour or two in the afternoon.

The individual receiving rates for the operations of weighing, unloading, and moving grain from the drive pits, when there is a steady line of trucks at the elevator, are given in bushels and number of trucks per hour in table 1. These are average rates, based on receiving an equal number of 200-bushel standard farm trucks, 200-bushel standard farm trucks with underbody hoist, and 60-bushel pickup trucks.

The table also shows receiving rates for the weighing operation when the test weight of grain is taken and when both test weight and moisture content are determined. The requirement for these determinations depends on the grain quality and harvest conditions encountered. Assuming, however, that they are made when a steady line of trucks is at the elevator, the overall receiving rate would be 38 trucks an hour when test weight is taken, and 31 trucks an hour when the moisture test is also made.

Considering peak delivery time, when the test weight and moisture tests are not taken, the operation that slows up receiving is unloading. The number of trucks that could be weighed in an hour is 44 or 45, and the peak rate at which grain could be received in the drive pits for one hour is 45 or 46 trucks, but only 38 trucks could be unloaded.

[4] See footnote 1.

TABLE 1.--Observed methods: Receiving rates for the operations of weighing, unloading, and moving grain from the drive pits for eight combinations of truck and endgate

Truck type	Weighing			Unloading trucks at drive pits (3-man crew)		Moving grain from drive pits to headhouse[1]
	Weigh only (2-man crew)	Weigh and make test weight (2-man crew)	Weigh and make test weight and moisture test (3-man crew)	Elapsed time per truck	Receiving rate	
	Bu. per hr.	Bu. per hr.	Bu. per hr.	Min.	Bu. per hr.	
Standard farm truck:						
Sliding endgate.....	9,000	7,600	6,200	1.95	6,200	Operating capacity of elevator leg, 5,000 bushels per hour, and total capacity of two drive pits, 2,000 bushels.
Removable endgate.....	9,000	7,600	6,200	1.80	6,700	
Complete endgate.....	9,000	7,600	6,200	1.53	7,800	
Standard farm truck with underbody hoist:						
Sliding endgate.....	9,000	7,600	6,200	1.54	7,800	
Removable endgate.....	9,000	7,600	6,200	1.51	7,900	
Complete endgate.....	9,000	7,600	6,200	1.10	10,900	
Pickup truck:						
Sliding endgate.....	2,700	2,300	1,900	1.66	2,200	
Complete endgate.....	2,700	2,300	1,900	1.49	2,400	
	Minutes	Minutes	Minutes	Minutes		
Average elapsed time per truck	1.34	1.58	1.94	[2] 1.57	--	
	Number	Number	Number	Number		Number
Trucks per hour.....	44-45	38	31	38	--	45-46 for 1 hour 32-33 continuous rate
	Bu. per hr.	Bu. per hr.	Bu. per hr.	--	Bu. per hr.	Bu. per hr.
Average receiving rate...	6,870	5,820	4,740	--	5,850	Surge rate--7,000 bu. for 1 hour; continuous rate--5,000 bu. per hr.

[1] Operation performed by one of the crew members also assigned to unload trucks.

[2] Average is based on the elapsed time per truck and weighted on the basis of receiving an equal number of 200-bushel standard farm trucks, 200-bushel standard farm trucks with underbody hoist, and 60-bushel pickup trucks.

SPEEDING UP RECEIVING AT HARVESTTIME

All the receiving operations at country elevators must be coordinated if a smooth flow of farm trucks is to be maintained at harvesttime. The receiving rate at the truck scale must be approximately the same as the receiving rate at the drive pits (unloading trucks) and in the elevator (elevating grain from drive pits to headhouse). A bottleneck will occur at the area which is operating at the slowest rate.

Shaving seconds off the handling time per truck, especially during the unloading operation, can better balance receiving operations so that the maximum overall receiving rate can be attained.

Weighing Trucks

Some time was lost in the weighing operation because loaded trucks were not moved off the scale quickly enough. The scale operator's helper usually gave truck drivers a hand signal to drive off, after he was notified by the scale operator that the weight of the truck had been imprinted.

Truck drivers can be directed more quickly to move off the scale by the scale operator himself, using an audible signal (bell or intercom speaker). The scale operator should give the signal immediately after the weight is stamped on the scale ticket. The scale operator may deliver the completed tickets to the truck drivers after the empty trucks are weighed.

The labor requirement and sequence of elements when the scale operator uses a bell or intercom to control truck movements, weighs a loaded and an empty truck, carries the copy of the scale ticket from his desk to the truck driver, and returns to the desk are shown in figure 21. The elapsed time for weighing is reduced from 1.34 to 1.25 minutes per truck and the weighing crew is reduced from two workers to one. The number of trucks that can be weighed in an hour increased from 44 or 45 to 48.

While they were not tested, signal lights (green and red) could be used to control the movement of both loaded and empty trucks onto and off the scale.

Unloading Trucks

The unloading operation can be improved by having only one employee, the lift operator, give directions to truck drivers, by better coordinating the individual elements of work involved in unloading, and by properly positioning the truck-lift cradle. These changes in handling trucks were tested with the cooperation of truck drivers delivering grain. Each truck driver was given an instruction sheet when he brought the first load of grain to the elevator. The sheet described the procedure the elevator employees would follow and also what the truck driver could do to help speed the unloading of trucks. The truck driver was requested to stop the loaded truck 5 feet in front of the driveway entrance as a safety measure for employees and to prevent damage to the truck if the truck in the driveway rolled backward.

Some of the revised elements of the unloading operation are:

(1) Truck enters drive. --Loaded truck starts to enter drive as empty truck leaves with driver of loaded truck watching that empty truck does not roll backwards as its rear wheels cross truck lift.

(2) Position. --The first time a truck enters the driveway, the lift operator marks, with chalk, on the left front corner of the grain body, an "S" for standard farm truck and

WEIGHING WITH I MAN

Operator Takes Ticket to Driver

PRODUCTIVE TIME ☐ IDLE OR UNPRODUCTIVE TIME ■

TIME SCALE MIN.	LOADED TRUCK: TIME ITEM	LOADED TRUCK: TIME MIN.	EMPTY TRUCK: TIME ITEM	EMPTY TRUCK: TIME MIN.	SCALE OPERATOR: OPERATION ELEMENT	SCALE OPERATOR: PRODUCTIVE AND UNPRODUCTIVE TIME MAN-MIN.
0.0	TRUCK ONTO SCALE	.07			WAITS	.03
					INSERTS TICKET	.04
.1	SCALE SETTLES	.15			WAITS	.15
.2	IDLE	.02				
.3	TRUCK OFF SCALE	.08			FILLS OUT TICKET FOR LOADED TRUCK	.31
	TRUCK CLEARS SCALE	.06				
.4			TRUCK TO SCALE	.06		
.5			TRUCK ONTO SCALE	.07		
.6			SCALE SETTLES	.12	LAYS ASIDE TICKET	.06
					INSERTS TICKET	.04
.7					FILLS OUT TICKET FOR EMPTY TRUCK	.28
.8			IDLE	.43		
.9						
1.0					TICKET TO TRUCK	.09
					TICKET TO CUSTOMER	.06
1.1			TRUCK OFF SCALE	.07	RETURNS TO SCALE	.09
			TRUCK CLEARS SCALE	.06		
1.2	TRUCK TO SCALE	.06			LAYS ASIDE TICKET	.07
					WAITS	.03

PRODUCTIVE LABOR	1.04
UNPRODUCTIVE LABOR	.21
TOTAL LABOR, MAN-MINUTES	1.25

ELAPSED MINUTES . . . 1.25

Figure 21.

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Figure 22. --Opening endgate as rear of truck crosses drive pit.

an "H" for standard farm truck with underbody hoist. This assists him in positioning the endgate over the drive pit. He keeps the truck lift placed so that a standard farm truck can stop on the lift and dump into the pit without moving backward or forward. When a truck with an underbody hoist enters the driveway, he commands the driver to stop when the endgate is located over the pit. As a result, trucks other than pickups do not have to be moved backward and forward to position them.

(3) Open endgate. --By eliminating the positioning element, the endgate can be opened immediately after the rear of the truck crosses the dump pit (fig. 22).

(4) Raise truck. --The lift operator starts raising the standard farm truck as soon as it stops on the truck lift. For trucks with underbody hoists, he directs the truck driver to raise the grain body as soon as the truck stops. These trucks are raised fast enough to keep the endgate opening full. Most standard farm trucks with underbody hoists and complete endgates can be raised in one continuous motion.

(5) Close endgate. --The endgate is closed, usually by the endgate man, as soon as the men finish shoveling the grain from the truck. For trucks with underbody hoist the lift operator may close it.

(6) Lower truck. --Lowering of standard farm trucks is started a few seconds before shoveling is completed. Drivers of trucks with underbody hoists are told to lower the grain body as soon as shoveling is completed. This decreases the time that the truck is in the elevator drive and also places the endgate in a better position for closing.

(7) Start engine. --The lift operator tells the driver of the standard farm truck to start the engine a few seconds before the truck lift is lowered completely. This alerts the truck driver to enter the truck as soon as he can safely do so to start the engine and eliminates some wait time caused by the driver's delay in entering the cab.

Various methods of shoveling were tried. Pushing grain to the endgate instead of lifting it required less time and effort for some employees. However, times listed for shoveling in the improved unloading operation are the same as for the observed.

Three-Man Crew Unloading Eight Combinations of Truck and Endgate

The changes in unloading methods were tested for the eight combinations of truck and endgate in common use for delivering grain to country elevators during harvest.

Although only one or two men are required to unload trucks with complete or removable endgates, three men are necessary for rapid unloading of pickups and standard trucks with sliding endgates. Labor requirements and costs for unloading therefore show a three-man crew unloading all types of trucks and endgates. It is impractical to release one or two members of the crew to other operations remote from the drive pits when the different types of trucks and endgates are intermixed on arrival at the elevator. The manager's requirement for rapid unloading at harvesttime was considered more important than the labor savings possible with a smaller crew.

The elapsed time and labor required for a three-man crew using the improved method to unload each of the eight common types of trucks and endgates are compared with the time and labor required for the observed method in table 2.

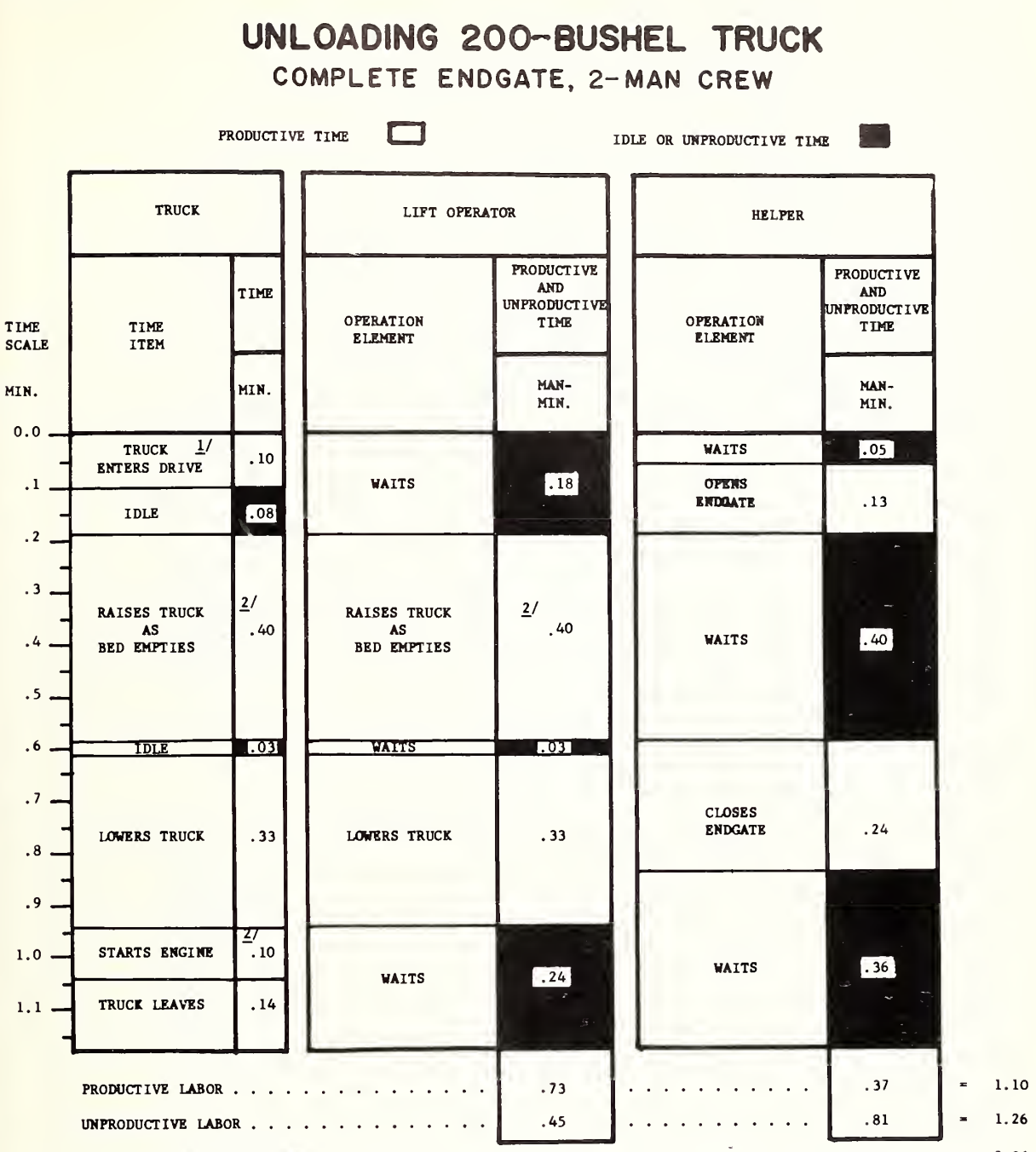
TABLE 2.--Unloading truckload of grain with three-man crew: Elapsed time and labor required to unload each of eight combinations of truck and endgate, by observed and improved methods

Type of truck and endgate	Observed methods		Improved methods	
	Elapsed time	Labor required	Elapsed time	Labor required
	Minutes	Man-minutes	Minutes	Man-minutes
Standard farm truck:				
Sliding endgate.....	1.95	5.85	1.60	4.80
Removable endgate.....	1.80	5.40	1.43	4.29
Complete endgate.....	1.53	4.59	1.18	3.54
Standard farm truck with underbody hoist:				
Sliding endgate.....	1.54	4.62	1.38	4.14
Removable endgate.....	1.51	4.53	1.22	3.66
Complete endgate.....	1.10	3.30	.88	2.64
Pickup:				
Sliding endgate.....	1.66	4.98	1.23	3.69
Complete endgate.....	1.49	4.47	1.10	3.30

One- and Two-Man Crews Unloading Four Selected Combinations of Trucks and Endgates

Elevator managers who want to use the smallest crew possible and maintain the maximum unloading rate should suggest to their customers that certain types of trucks and endgates can be unloaded more rapidly than others. Four activity charts in this section show advantages in both faster unloading and greater labor savings for selected types of grain bodies and endgates over the observed methods.

A two-man crew is sufficient to unload standard farm trucks with complete or removable endgates; the labor requirements and sequence of elements are shown in figures 23 and 24.



1/ Truck enters drive while previous truck leaves with an overlap of operations of 0.06 minute.

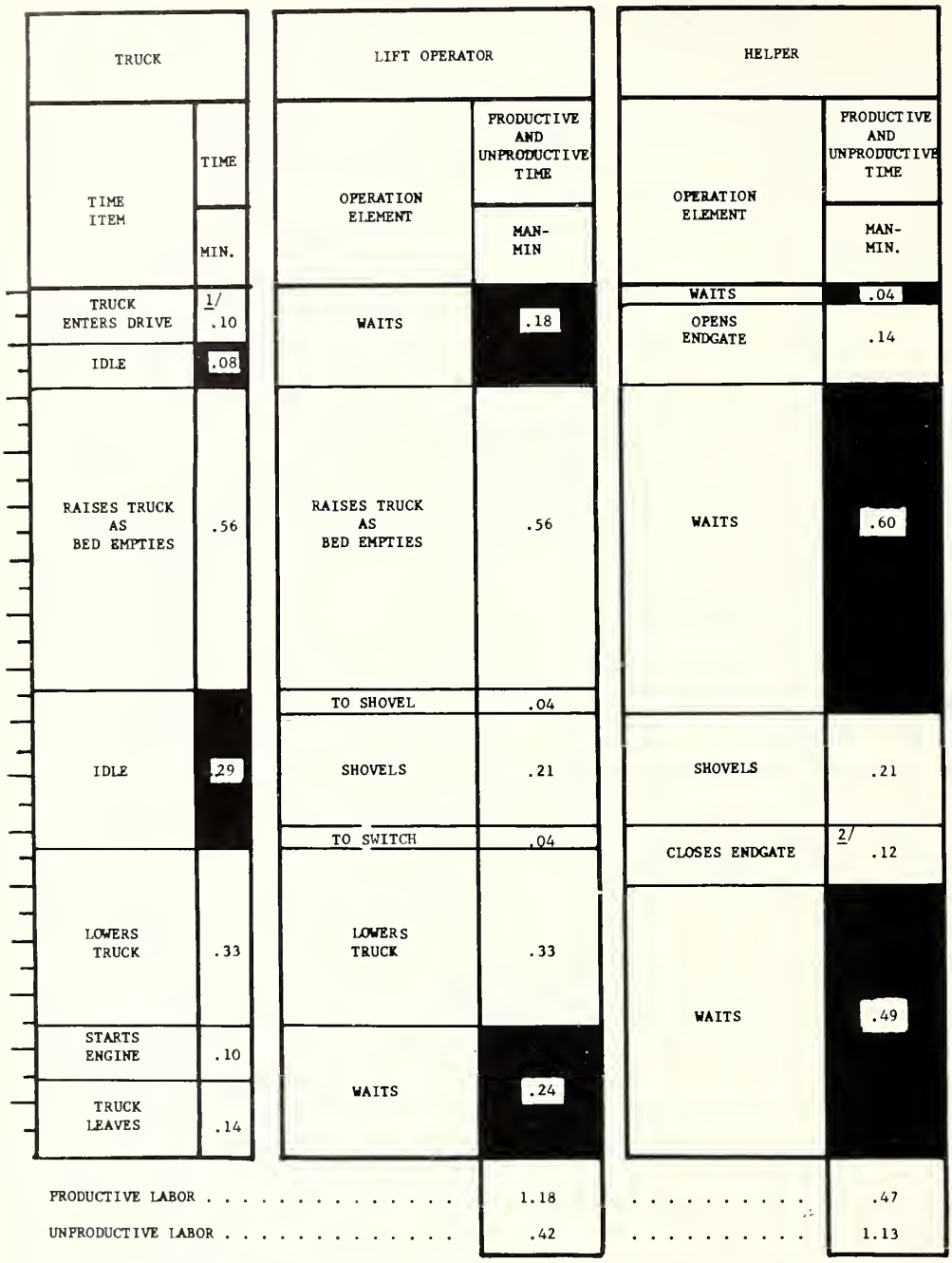
2/ Element time is shorter for the improved method.

Figure 23.

UNLOADING 200-BUSHEL TRUCK

REMOVABLE ENDGATE, 2-MAN CREW

PRODUCTIVE TIME ☐ IDLE OR UNPRODUCTIVE TIME ■



PRODUCTIVE LABOR	1.18		.47	= 1.65
UNPRODUCTIVE LABOR	.42		1.13	= 1.55
TOTAL LABOR, MAN-MINUTES				3.20

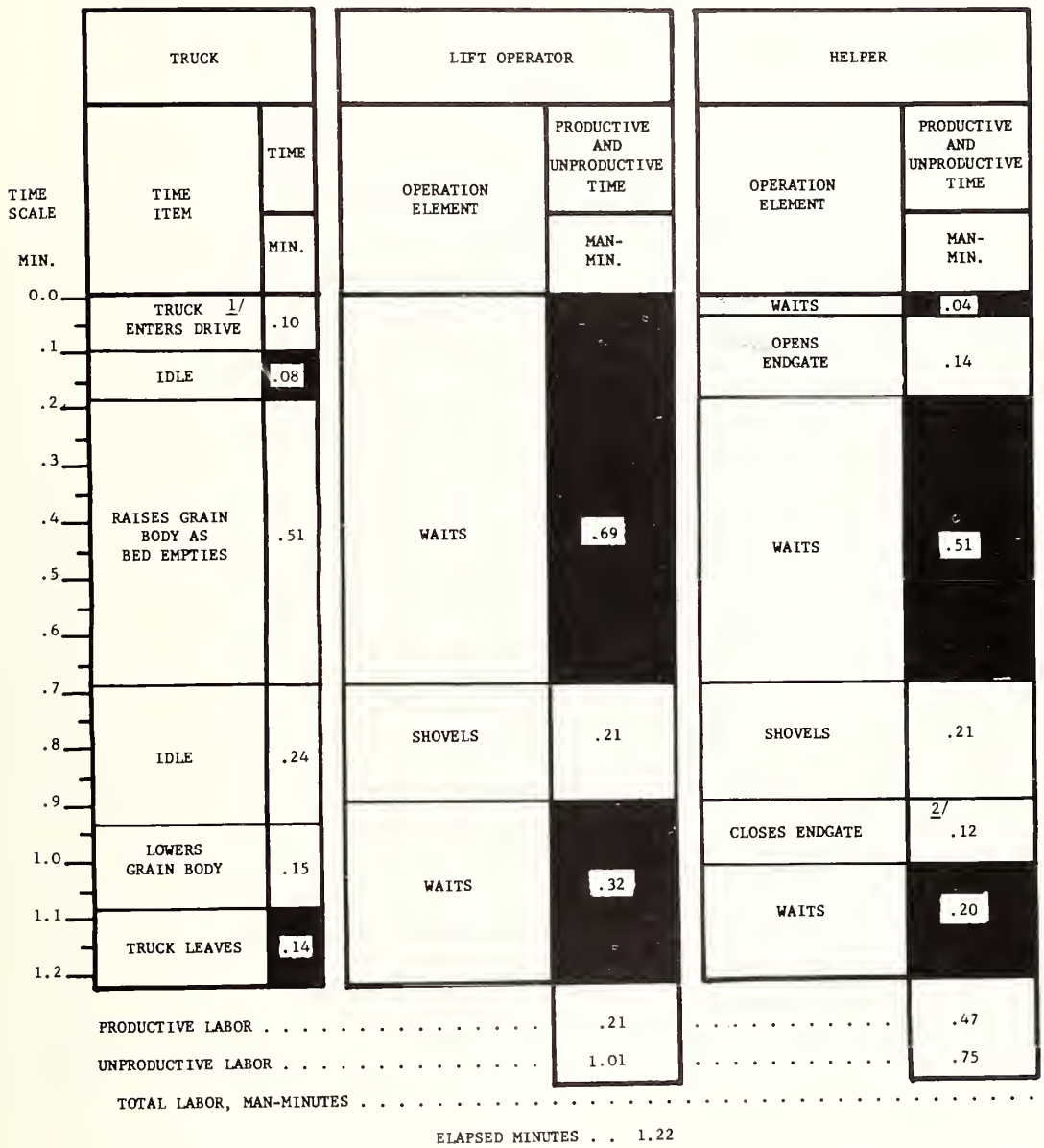
ELAPSED MINUTES . . 1.60

1/ Truck enters drive while previous truck leaves with overlap of operations of 0.06 minute.

2/ Element time is shorter for the improved method.

Figure 24.

Trucks with underbody hoists and removable endgate require only a two-man crew; the labor requirement and sequence of elements are shown in figure 25.



1/ Truck enters drive while previous truck leaves with an overlap of operations of 0.06 minute.

2/ Element time is shorter for the improved method.

Figure 25.

A complete endgate (fig. 26), which opens the full width and height of the grain body and is hinged at the top and closed with a latch handle, provides the fastest method of unloading that can be done by one man. Plans and specifications for constructing a complete endgate are available.[5] A small sliding gate can be installed as shown in figure 26.

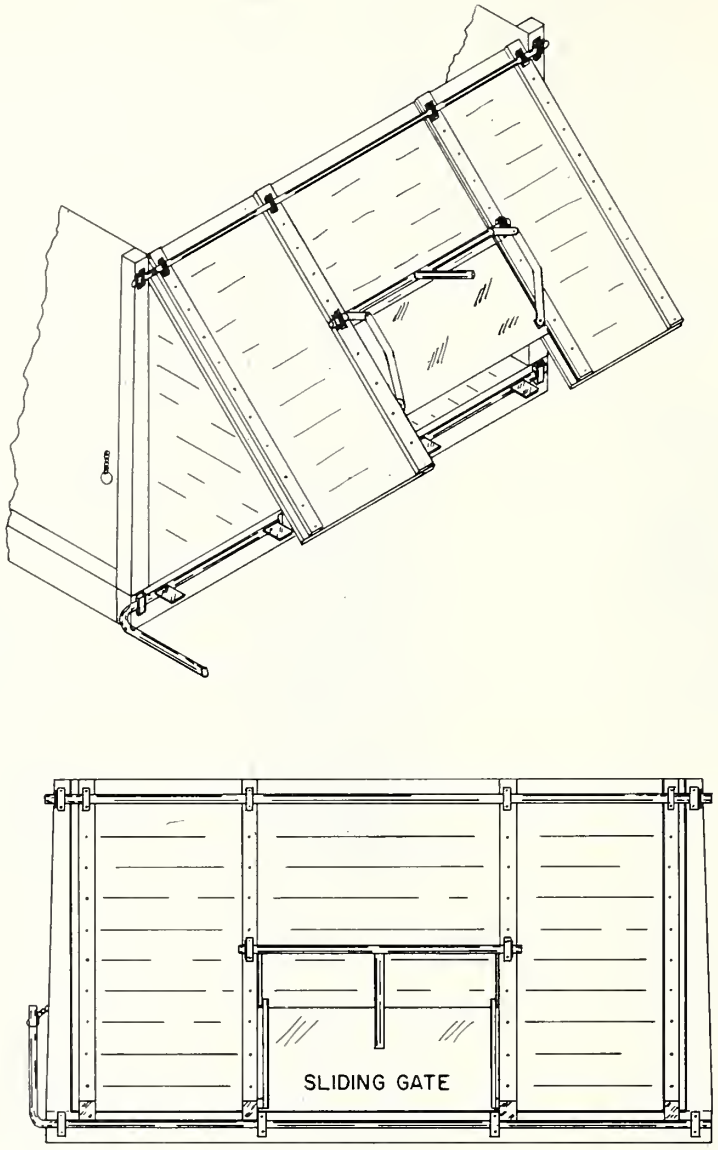
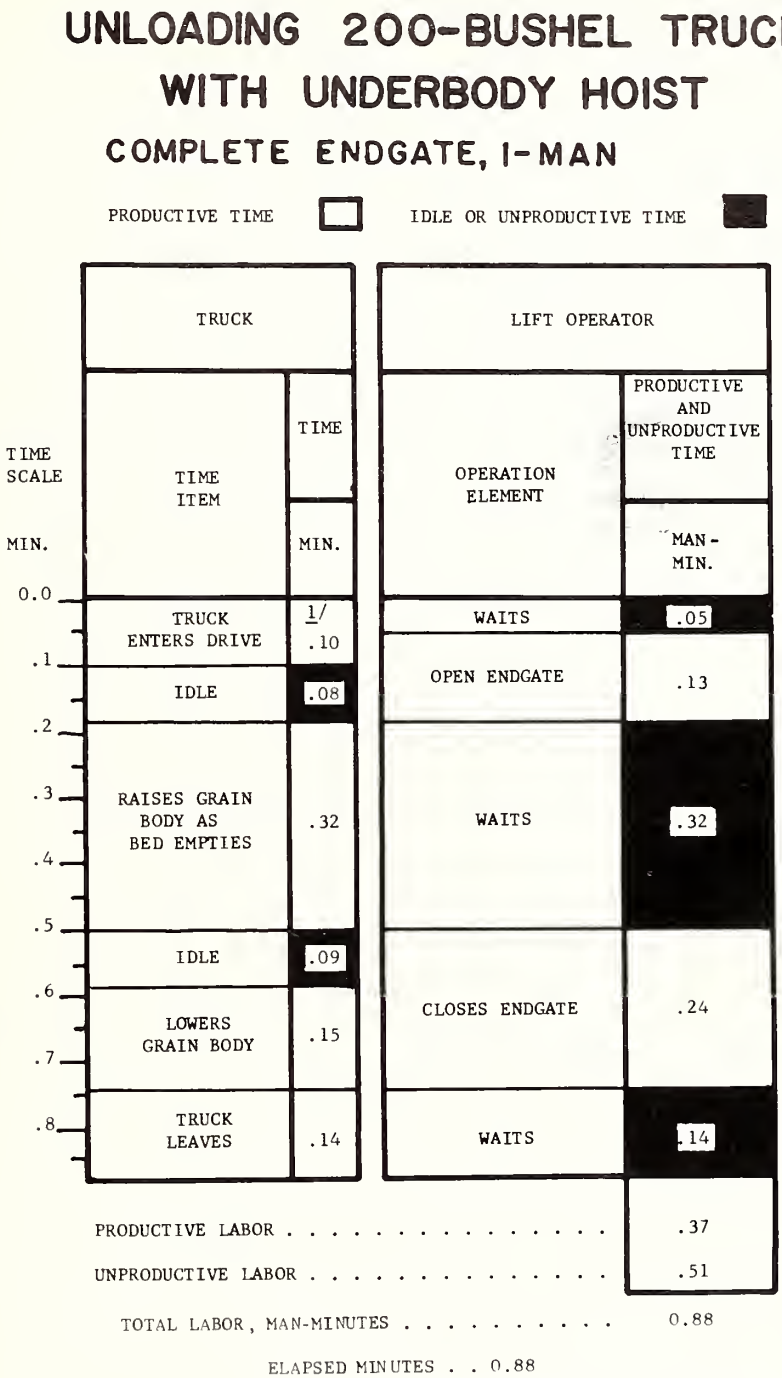


Figure 26.--A complete-opening endgate. A small sliding gate can be installed for use when unloading grain at the farm.

[5] Graves, Albert H. A Complete-Opening Endgate for Faster Unloading of Grain From Farm Trucks. U.S. Dept. Agr. Mktg. Bul. 23, 6 pp., illus. April 1963.

Using the improved methods developed in this study, one man can unload standard farm trucks equipped with underbody hoists and complete endgates as fast as three men. The labor requirement and sequence of elements for one man to unload a standard farm truck equipped with underbody hoist and a complete endgate are shown in figure 27.



1/ Truck enters drive while previous truck leaves with an overlap of operations of 0.06 minute.

Figure 27.

Overall Receiving Rate

Table 3 shows the receiving rates per hour in bushels and in number of trucks when improvements in weighing and unloading are used with eight combinations of trucks and endgates, in the percentages assumed in this study.

When the receipt of grain in the drive pits is at peak capacity (7,000 bushels for 1 hour), the three receiving operations are nearly balanced, and a maximum of 45 to 46 trucks can be received in the hour.

TABLE 3.--Improved method: Receiving rates for the operations of weighing, unloading, and moving grain from drive pits for eight combinations of truck and endgate

Truck type	Weighing only (1 man)-receiving rate	Unloading trucks at drive pit (3-man crew)		Moving grain from drive pits[1]
		Elapsed time per truck	Receiving rate	
	Bu. per hr.	Minutes	Bu. per hr.	Bu. per hr.
Standard farm truck:				
Sliding endgate	9,600	1.60	7,500	Operating capacity of elevator leg, 5,000 bushels per hour, and total capacity of two drive pits, 2,000 bushels
Removable endgate	9,600	1.43	8,400	
Complete endgate	9,600	1.18	10,200	
Standard farm truck with underbody hoist:				
Sliding endgate	9,600	1.38	8,700	
Removable endgate	9,600	1.22	9,800	
Complete endgate	9,600	.88	13,600	
Pickup truck:				
Sliding endgate	2,900	1.23	2,900	
Complete endgate	2,900	1.10	3,300	
	Minutes	Minutes		
Average elapsed time per truck	1.25	[2] 1.24		
	Number		Number	Number
Trucks per hour	48	--	48	45-46 for 1 hr. 32-33 continuous rate.
	Bu. per hr.		Bu. per hr.	Bu. per hr.
Average receiving rate[2]	7,360	--	7,400	Surge rate: 7,000 bushels for 1 hour; Continuous rate: 5,000 bu. per hr.

[1] Operation performed by one of the crew members also assigned to unload trucks.
[2] Average is based on the elapsed time per truck and weighted on the basis of receiving an equal number of 200-bushel standard farm trucks, 200-bushel standard farm trucks with underbody hoist, and 60-bushel pickup trucks.

The overall receiving rate can be increased to 48 trucks per hour (the rates for weighing and unloading), if the elevator is equipped with one or two elevating legs with a minimum rated capacity of 8,000 bushels per hour.

Table 4 shows the receiving rates for weighing by one man and unloading four selected combinations of trucks and endgates by two men. For this computation it was assumed that the elevator manager can control the types of trucks received and that he receives only 200-bushel trucks with complete or removable endgates--none with sliding endgates, and no pickup trucks. The weighing rate with one man at the truck scale is 9,600 bushels per hour and the average unloading rate at the drive pit with a two-man crew is 9,800 bushels per hour. The elevating equipment required to keep up with these rates of weighing and unloading is two 5,000-bushel-per-hour elevator legs used at the same time. With a total drive pit capacity of 2,000 bushels, the rate of receiving grain into the pit could be 12,000 bushels per hour for one hour and 10,000 bushels per hour continuously.

TABLE 4.--Improved method: Receiving rates for the operations of weighing, unloading, and moving grain from drive pits for four selected combinations of truck and endgate

Truck type	Weighing only (1 man)-Receiving rate	Unloading trucks at drive pit (2-man crew)		Moving grain from drive pits[1]
		Elapsed time per truck	Receiving rate	
	Bu.per hr.	Minutes	Bu. per hr.	Bu. per hr.
Standard farm trucks:				
Removable endgate.....	9,600	1.60	7,500	Two elevator legs, operating capacity 10,000 bu.per hr., and two drive pits with total capacity of 2,000 bu.
Complete endgate.....	9,600	1.18	10,200	
Standard farm truck with underbody hoist:				
Removable endgate.....	9,600	1.22	9,800	
Complete endgate.....	9,600	.88	13,600	
	Minutes	Minutes		
Average elapsed time per truck	1.25	[2] 1.22	--	--
	Number		Number	Number
Trucks per hour.....	48	--	49	60 for 1 hr.; 50 continuous rate
	Bu.per hr.		Bu.per hr.	Bu. per hr.
Average receiving rate[2].....	9,600	--	9,800	Surge rate: 12,000 bushels for 1 hour. Continuous rate: 10,000 bushels per hour.

[1] Operation performed by one of the crew members also assigned to unload trucks.

[2] The average receiving rate is based on elapsed time per truck on the basis of receiving an equal number of 200-bushel standard farm trucks equipped with removable or complete endgates and 200-bushel standard farm trucks with underbody hoist and equipped with removable or complete endgates.

Increasing Elevating Capacity

No advantage is gained in speeding up weighing and unloading unless the elevating equipment has sufficient capacity to handle the additional quantity of grain.

Sometimes the capacity of existing elevating legs can be increased, particularly if they are not being operated at their rated capacity. To insure that legs are operated properly and at their rated capacity, an operator should (1) check the manufacturers' specifications on belt speed, cup spacing and size, horsepower requirements, and size of boot and head pulley and make any changes necessary to meet these specifications: (2) keep the belt properly adjusted and the head pulley lagged to prevent slipping; (3) replace worn discharge plates on the throat of the down leg; and (4) install an ammeter in the motor circuit of the leg to show the load being imposed on the motor and the degree of loading.

It may also be possible to increase the number, and the size, of the buckets on the leg belt or to replace existing buckets with higher speed buckets. This may require a new and heavier belt and possibly a larger motor.

The elevating rate is also reduced if a bin overflows during movement of grain from the drive pit to the headhouse. When this occurs, the excess grain backs up through the distributor into the leg and stalls the leg, requiring extra labor and time to free the leg. Also, this is a potential fire hazard.

An overflow spout can be installed at the head of the leg to direct excess grain to the drive pit. The spout should be attached to the side of the discharge housing of the leg at a point slightly above the distributor spout. Then grain backing up through the distributor spout flows down the overflow spout, and not down the back side of the leg.

A few country elevators were observed using the overflow spout to their advantage. When a bin filled, the pit gate was not closed to stop the grain flow. The distributor was moved to another bin while the leg continued to elevate grain. If any grain backed up the distributor spout into the head of the leg, the excess grain flowed down the overflow spout into the drive pit.

A decision must be made whether to install one or two legs when building a new elevator. In some elevators one leg is installed at the time of construction, and provision is made in the structure for installing a second leg at a later date. Among the factors to be considered before installing a second elevator leg are initial cost, operating capacity for receiving, flexibility of flow, and operating costs.

The estimated $12,000 initial cost of a second leg (table 14, appendix) may be amortized in the 750,000-bushel elevator at the rate of 0.032 cent per bushel handled during the entire life of the leg. The initial cost can be considered also from the standpoint of storage income. The installed cost of a new leg is equal to the gross storage income from 88,856 bushels stored for 1 year at 0.037 cent per bushel per day.

An operating capacity for receiving grain should be selected when planning a new elevator. If there is a need for rapid receiving, two legs may be required. If the anticipated receiving rate is less than the operating capacity of one leg, there is no advantage in providing two legs unless the second leg is needed for some other purpose.

Provision for flexibility of flow must be planned before installing a second leg to increase the receiving capacity. The leg must be positioned to receive grain from the drive pit by gravity flow, conveyor belt, or auger. The distributor for the second leg should provide for grain movement to all elevator bins if possible. Provision should be made on the distributor floor for positioning the distributors for both legs to one bin simultaneously. Grain spouts and conveyor belts should be large enough to accommodate the flow of grain from two legs.

The operating expense of a second leg should be analyzed before installation, particularly the rate schedule used by the power company. The demand charge for the motor of the second leg will frequently increase the cost of electric power for the elevator.

TIME, LABOR REQUIREMENTS, AND COSTS FOR RECEIVING OPERATIONS

Table 5 lists the elapsed times, labor required, and labor and equipment costs, for both the observed and the improved methods, for each operation performed at the truck scale. These times, labor requirements, and costs varied with the type of operation and the crew size. A printing dial scale was used with each method of weighing. A test weight bucket and beam was used for taking test weight and a moisture tester and gram scale for moisture tests.

TABLE 5.--Labor and equipment costs for weighing a loaded and an empty truck, and for making test weight and moisture tests of wheat, by specified methods

Method	Crew size	Elapsed time per truck	Labor required per truck	Labor and equipment costs per truck		
				Labor[1]	Equipment[2]	Total
	Men	Minutes	Man-minutes	Cents	Cents	Cents
Observed methods:						
Weigh truck loaded and empty..	2	1.34	2.68	6.7	32.0	38.7
Weigh truck loaded and empty, and make test weight.....	2	1.58	3.16	7.9	32.1	40.0
Weigh truck loaded and empty, make test weight and moisture test.....	3	1.94	5.82	14.6	34.0	48.6
Improved method:						
Weigh truck loaded and empty..	1	1.25	1.25	3.1	32.0	35.1

[1] Wage rate, $1.50 per hour.
[2] Table 10, appendix.

Table 6 lists the elapsed time, labor required, and labor equipment costs, for both the observed and the improved methods, for unloading trucks at the drive pit. These times, labor requirements, and costs varied with the unloading method, crew size, and type of truck and endgate used. The only equipment cost listed is for the truck lift at the drive pit. This cost was estimated to be 10.2 cents per truck, based on the assumption that 3,100 trucks were received annually and that one-third of them had underbody hoists and did not use the lift.

The estimated total labor and equipment cost for unloading each of eight common combinations of truck and endgate varied from 8.2 cents to 24.8 cents per truck for a three-man crew using the observed methods and from 6.6 cents to 22.2 cents for a three-man crew using the improved methods. For unloading each of four selected combinations of truck and endgate, the cost varied from 4.4 cents to 18.2 cents per truck for a two-man crew using the improved methods.

TABLE 6.--Labor and equipment costs for unloading grain from 200-bushel standard farm trucks and 60-bushel pickup trucks by observed and improved methods

Type of truck and endgate	Crew size	Elapsed time per truck	Labor required per truck	Labor and equipment costs per truck		
				Labor[1]	Equipment[2]	Total
	Men	Minutes	Man-minutes	Cents	Cents	Cents
Observed methods:						
When 8 types of truck and endgate are received:						
Standard farm truck:						
Sliding endgate.....	3	1.95	5.85	14.6	10.2	24.8
Removable endgate.....	3	1.80	5.40	13.5	10.2	23.7
Complete endgate.....	3	1.53	4.59	11.5	10.2	21.7
Standard farm truck with underbody hoist:						
Sliding endgate.....	3	1.54	4.62	11.6	--	11.6
Removable endgate.....	3	1.51	4.53	11.3	--	11.3
Complete endgate.....	3	1.10	3.30	8.2	--	8.2
Pickup truck:						
Sliding endgate.....	3	1.66	4.98	12.4	10.2	22.6
Complete endgate.....	3	1.49	4.47	11.2	10.2	21.4
Improved methods:						
When 8 types of truck and endgate are received:						
Standard farm truck:						
Sliding endgate.....	3	1.60	4.80	12.0	10.2	22.2
Removable endgate.....	3	1.43	4.29	10.7	10.2	20.9
Complete endgate.....	3	1.18	3.54	8.8	10.2	19.0
Standard farm truck with underbody hoist:						
Sliding endgate.....	3	1.38	4.14	10.4	--	10.4
Removable endgate.....	3	1.22	3.66	9.2	--	9.2
Complete endgate.....	3	.88	2.64	6.6	--	6.6
Pickup truck:						
Sliding endgate.....	3	1.23	3.69	9.2	10.2	19.4
Complete endgate.....	3	1.10	3.30	8.2	10.2	18.4
When 4 types of truck and endgate are received:						
Standard farm truck:						
Removable endgate.....	2	1.60	3.20	8.0	10.2	18.2
Complete endgate.....	2	1.18	2.36	5.9	10.2	16.1
Standard farm truck with underbody hoist:						
Removable endgate.....	2	1.22	2.44	6.1	--	6.1
Complete endgate.....	2	.88	1.76	4.4	--	4.4

[1] Wage rate, $1.50 per hour.
[2] Equipment costs, table 10, appendix.

The following tabulation shows the labor required and costs for elevating 1,000 bushels of grain from the drive pit to the headhouse using a leg, dust collector, manually operated distributor, man lift, and lights:

Labor required	0.90 man-minute
Costs:	
Labor[1]	.02 dollars
Equipment[2]	1.85 dollars
Total	1.87 dollars

[1] Wage rate, $1.50 per hour
[2] Equipment costs, table 10, appendix.

These requirements include setup and cleanup and the opening and closing of windows for ventilation.

IMPROVED LAYOUT FOR SCALE HOUSE AND DRIVE PIT

A satisfactory layout for the scale house and grain elevator driveway makes it possible to receive the maximum amount of grain efficiently at harvesttime. The flow of trucks to the truck scale, between the scale and the elevator driveway, and returning to the scale also affects efficiency of receiving.

Scale House

The dock at the scale house should be high enough to permit the operator to easily inspect and obtain a sample of the grain in the truckbed. With a man of average height standing on a dock 42 inches high, the top of the grain body of large trucks would be approximately the height of his elbow (fig. 28). If there are many pickups, a dock 26 inches high may be used. Then the top of the body of large trucks will be approximately at armpit height for a man standing on the dock (fig. 29).

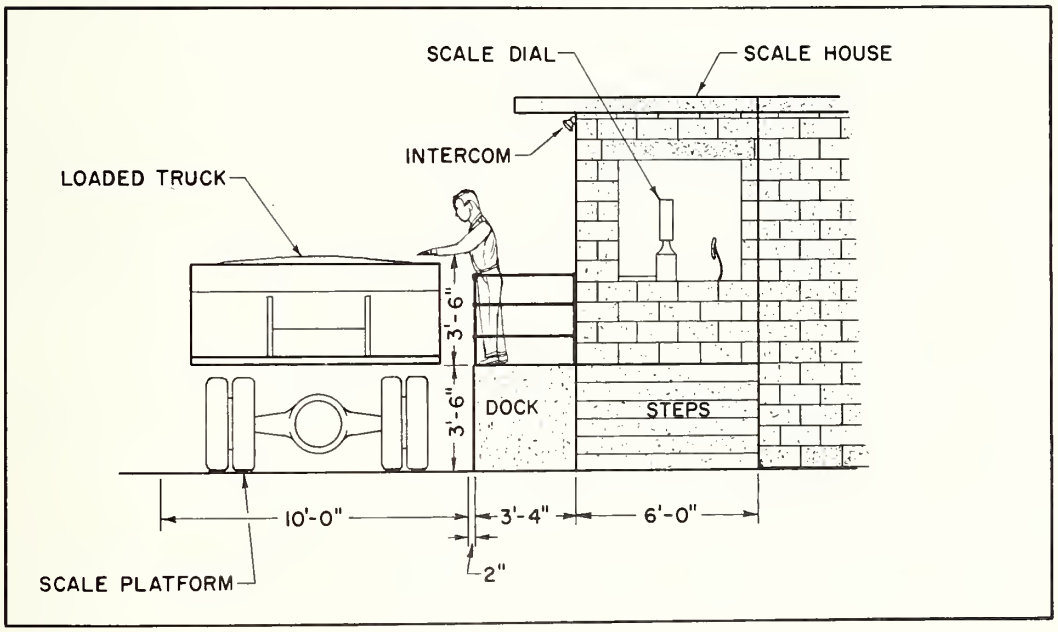


Figure 28.--Scale house layout with a scale dock 42 inches high.

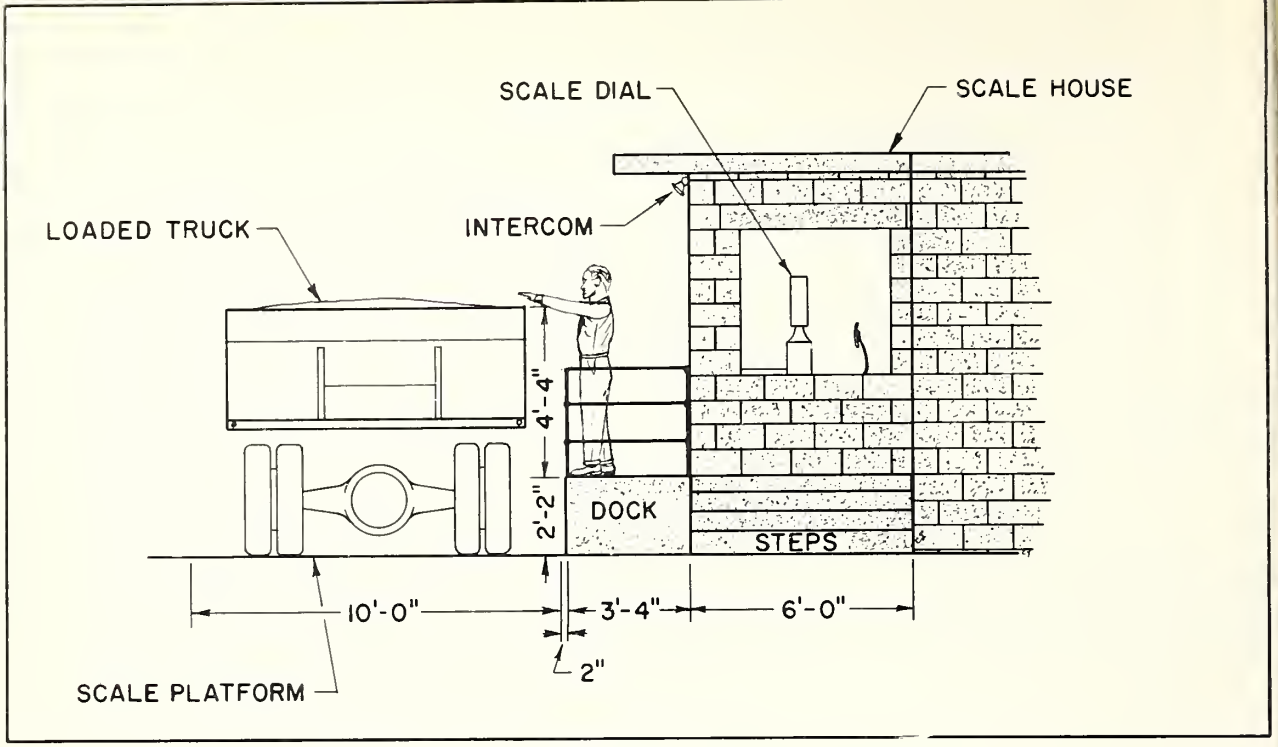


Figure 29.--Scale house layout with a scale dock 26 inches high.

The scale dock should be 40 inches wide in front of the bay window part of the scale house to provide an area for two men to walk along the dock. The dock should extend at least 20 feet from a point opposite the dial of the scale in the direction of the arriving loaded trucks, as shown in figure 30. Then, when a loaded truck is stopped on the scale with the driver in line with the dial, the test weight operator can walk along the dock for the full length of the truckbed. The scale platform should be centered approximately on the dial of the scale. The bay window part of the scale house should extend out onto the dock area. The side windows give the scale operator a clear view of the trucks driving onto the scale.

Equipment inside the scale house should be arranged to permit rapid and accurate weighing of trucks and the performance of other operations while the truck is on the scale platform. The desk used to fill out the tickets should be located on the right-hand side of and approximately in line with the dial of the scale. The scale operator working at the desk should be not more than 30 inches from the window so that he can easily hand the scale ticket through the window opening to the crew member outside on the scale dock.

The moisture tester should be located on the operator's right and within his reach when he is in his normal working area at the scale.

During harvest, the test weight bucket and beam should be kept on the dock for the test weight operator's convenience. At other times, they should be kept in the office beside the path of the scale operator as he walks to the truck.

The scale house should have doors on each side of the bay window section of the scale house (fig. 30). These doors should open inward and away from the scale operator's work area. The doors must not be located beside the desk; this location would permit air to channel across the desk and blow tickets onto the floor.

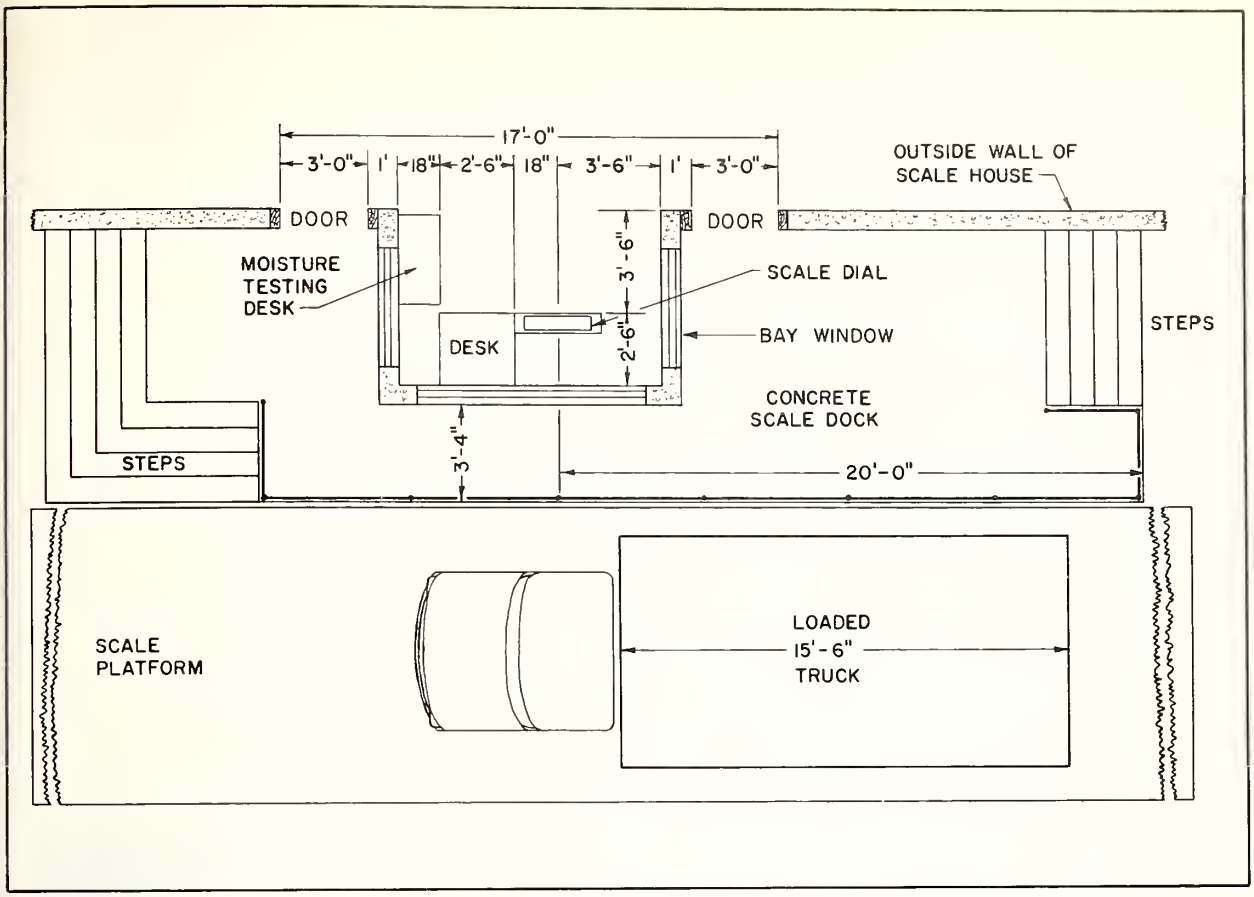


Figure 30.--Scale house layout.

Elevator Driveway

The layout of the elevator driveway and the equipment in it are important to efficient unloading of trucks. Each piece of equipment should be located in a place convenient to the operation for which it will be used.

Two drive pits are provided at most country elevators (fig. 35, p. 46). The first pit should be at least 6 feet inside the elevator entrance door (fig. 31). This will prevent scattering grain outside the elevator driveway, particularly when unloading large trucks equipped with complete endgates.

Each drive pit should be at least 10 feet long to permit all farm trucks to dump in the same pit from a single position of the truck lift. The drive pits should not be more than 2 feet apart, to prevent an excessive quantity of grain accumulating between pits during unloading and to reduce shoveling and sweeping. Most drive pits observed were 9 feet wide. When structural design permits, drive pits 10 feet wide may be used to reduce shoveling and sweeping around the drive pits.

Three types of drive pit gratings were observed during the studies. One type had rectangular grate bars placed on edge and positioned lengthwise of the driveway (fig. 32). This grating allows grain to flow rapidly into the pit and reduces splattering of grain in the driveway. However, some elevator managers find that the grate bars split the wood sills on standard farm trucks when the trucks are raised to such a height that the rear wheels are off the driveway and the weight is transferred to the sills. A second type of grating has

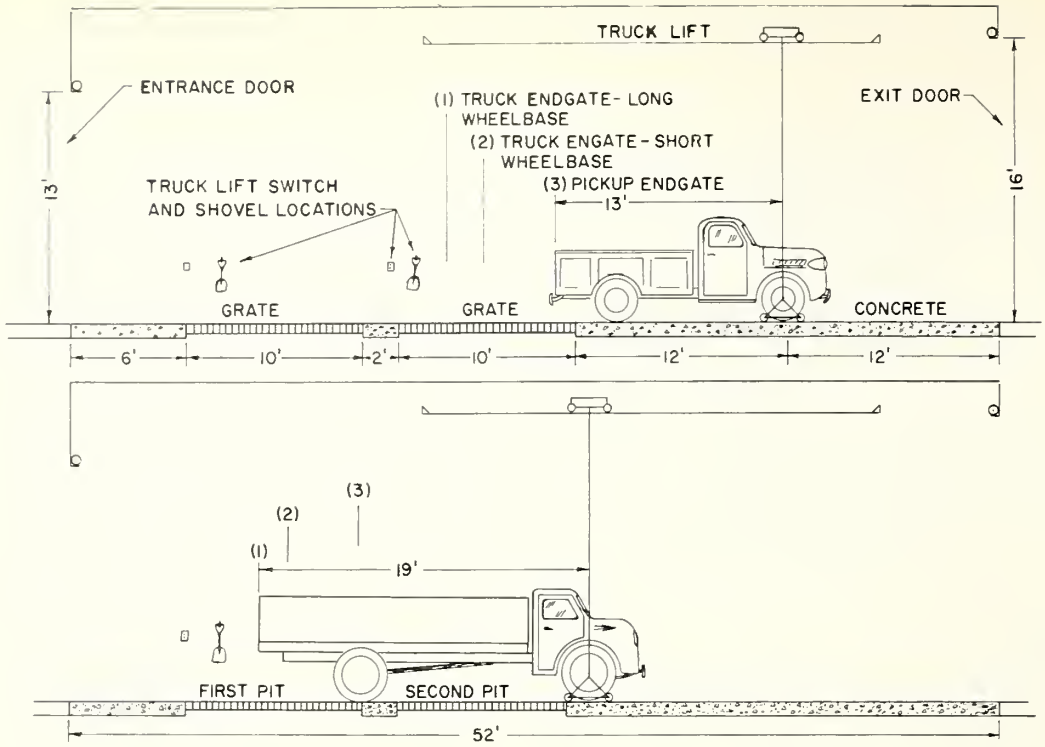
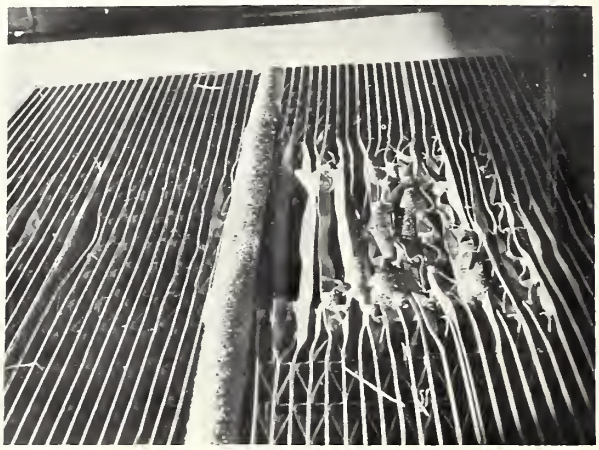


Figure 31.--Country elevator driveway layout.

BN-20136

Figure 32.--Drive pit grating with bars placed lengthwise of the driveway.



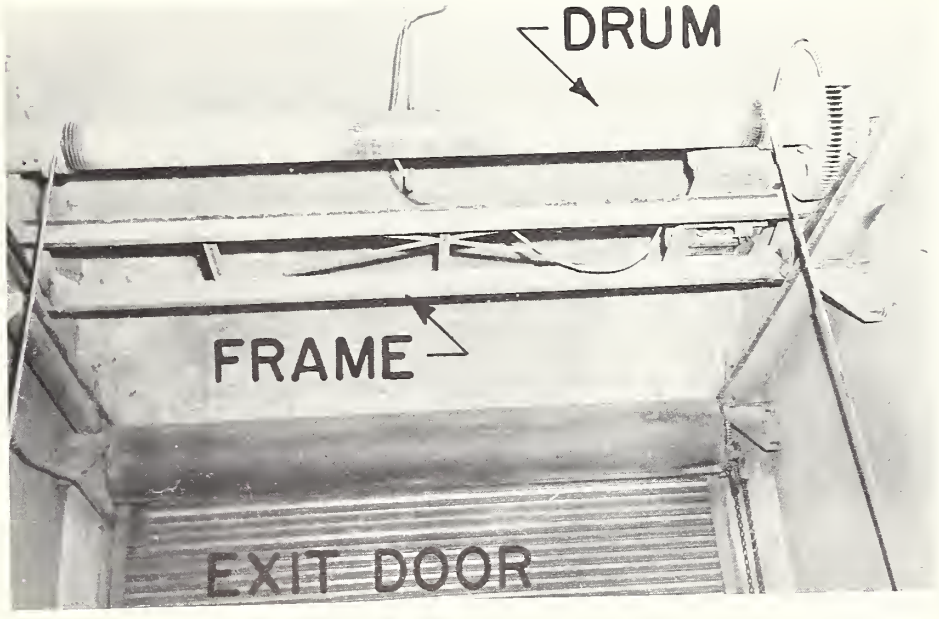
BN-20146

Figure 33.--Drive pit grating of the mesh type. Note that truck equipment has damaged grate.

rectangular bars placed on edge and positioned crosswise of the driveway (fig. 35, p. 46). This grating is satisfactory, except that it has a tendency to splatter the grain and necessitate more sweeping. A third type of grate is the mesh type (fig. 33). This grating catches a large quantity of trash and foreign material, retarding the flow of grain. Moreover, the trailer hitches on farm trucks damage this grating.

The truck lift is installed beyond the drive pits near the exit door of the elevator driveway. Support rails for the lift should be 16 feet high to permit raising standard farm trucks to an angle greater than 35 degrees. The lift frame and cable drum should be positioned on the rails with the drum nearest the truck or driveway entrance door and the frame nearest the exit door (fig. 34). Otherwise, when standard farm trucks are raised the truck hood occasionally strikes the supporting frame. A truck-lift switch should be located at the rear of each drive pit (fig. 31), on the left side of the driveway as viewed from the driveway entrance (fig. 35).

(A) BN-20055



(B) BN-20054

Figure 34. --Truck lift mechanism position (A) with support frame nearest the truck and (B) with cable drum nearest the truck to avoid support frame damaging the truck hood.

BN-20144

Figure 35.--Elevator driveway with two drive pits, viewed from entrance. Pit grating bars are placed crosswise of driveway. (A) The truck switch at the rear of the front pit. (B) The distributor wheel on the left side of the driveway near the pits. (C) Pit gate handle near drive pit. (D) Shovels located near rear of front pit.

The distributor wheel and the pit gate handles should be located on the left side of the driveway adjacent to the drive pits (fig. 35). Hooks for shovels should be conveniently located on each side of the driveway at the rear of each pit.

Most driveway entrance and exit doors are 11 feet wide and 13 or 14 feet high. Although this width is satisfactory, a greater width will allow the truck driver to drive the truck into the driveway without fear of damaging the truck. Driveway entrance doors 13 feet high are adequate for farm trucks, but exit doors should be 16 feet high. Then, trucks equipped with underbody hoists may start to leave the elevator while the grain body is lowering without danger of catching the grain body on the top of the exit door.

Flow of Trucks

A uniform flow of trucks at a grain elevator is important for rapid receiving of grain at harvesttime. All loaded trucks are weighed at the scale, moved from the scale to the elevator driveway, unloaded at the elevator drive pit, and returned to the scale to be weighed when empty. The movement of trucks is affected by the location of the scale house, headhouse, storage annexes, other buildings, streets, railroads, and property lines.

The scale house should be located a sufficient distance from the elevator driveway to allow four or five loaded trucks to wait in line between the scale and the driveway. When convenient, placing the scale house at a slight angle to the entrance of the elevator driveway permits workers in the scale house to have a better view of operations in the driveway.

With conventional flow, the empty trucks return to the scale and cross the scale in the opposite direction of the loaded trucks (fig. 36). An empty truck waits while a loaded truck clears the scale, and then the empty truck is driven onto the scale. The scale house should be positioned so that the driver is beside the dock when the empty truck is on the scale.

The scale operator can direct the movement of empty and loaded trucks to the scale platform by using "stop and go" lights. Such lights would be visible to truck drivers approaching the scale from either direction and would be controlled by the scale operator.

One-way flow of trucks, with the scale house located on the opposite side of the driveway, so that the truck driver is always beside the dock, can eliminate as much as 0.24 minute per truck from the weighing operations of the conventional two-way flow. Sufficient space must be available for an empty truck to make a U-turn to enter and leave the scale (fig. 37). Trucks to be weighed should move onto the scale immediately behind the leaving truck to reduce to a minimum the time required for weighing operations. A disadvantage of one-way flow is the problem of getting the empty trucks back into the line of loaded trucks waiting at the scale. Loaded and empty trucks must alternate across the scale whenever trucks are waiting in line between the scale and the elevator driveway.

BN-20143

Figure 36.--Empty trucks cross the scale in the opposite direction of loaded trucks in conventional flow. Drivers of empty trucks are on the dock side of the scale. (Courtesy Hi Plains Journal, Dodge City, Kansas.)

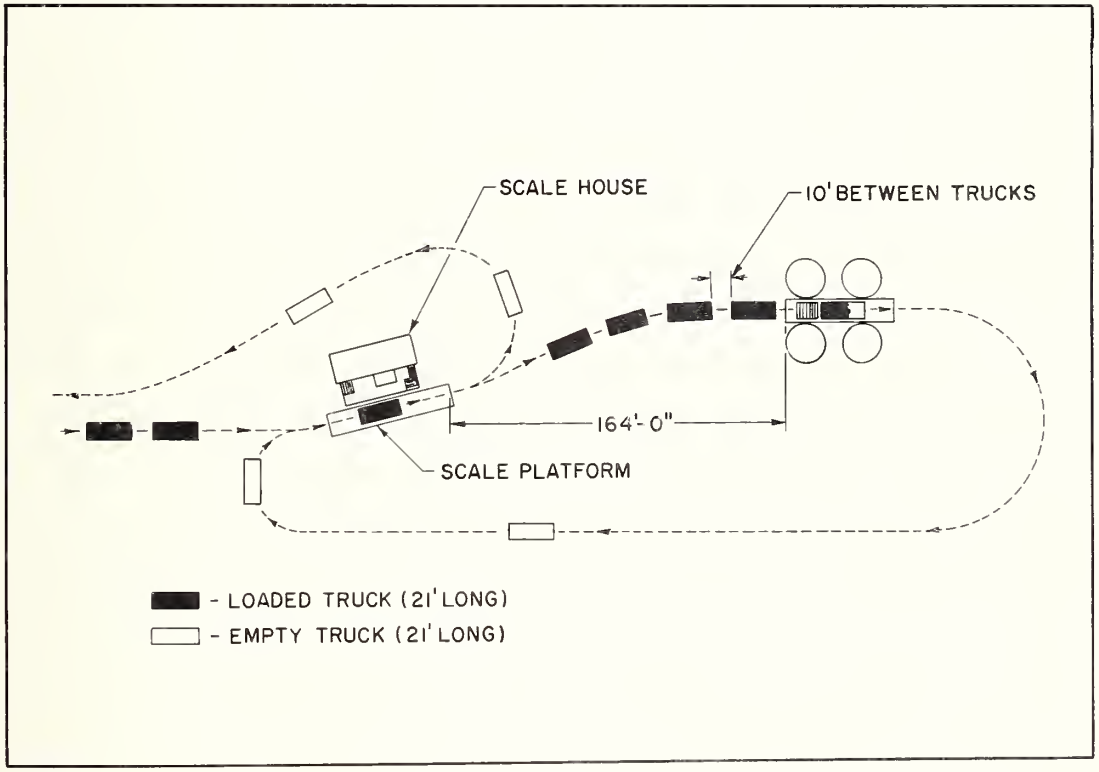


Figure 37.--One-way flow of trucks across scale, with the scale house located so that truck drivers are on the dock side of the scale.

RECEIVING GRAIN OTHER THAN AT HARVESTTIME

The receiving operations at times other than harvest are often performed by one man at the truck scale and one man at the drive pit. Quantities of grain received daily are small in comparison with those received at harvesttime, and there is little justification in keeping crew members that remain idle during the winter months.

Operations at Truck Scale

The labor requirements and sequence of elements for one man to weigh a loaded truck and an empty truck are shown in figure 38. After the empty truck has been weighed, the truck driver drives the empty truck off the scale platform and walks back to the office for his copy of the ticket, which the operator has placed on the counter. While this is the fastest method of weighing shown in this publication, it is not recommended for use during harvest, because the driver may stop to visit with the operator or the empty truck may be parked in the path of loaded trucks.

The labor requirement and sequence of elements for one man to weigh a loaded and an empty truck and determine test weight are shown in figure 39.

A convenient arrangement of the testing equipment for one man to weigh trucks and determine the test weight and moisture content of the grain is shown in figure 40. Using this arrangement, one man was able to handle one truck in 2.45 minutes (fig. 41).

When the test weight or both test weight and,moisture content of the grain are determined, the truck driver leaves the empty truck on the scale while he picks up the ticket from the scale office; figures 39 and 41 therefore show time for the driver to return to the scale and start the truck engine.

WEIGHING WITH I MAN

Truck Driver Returns for Ticket

PRODUCTIVE TIME ☐ IDLE OR UNPRODUCTIVE TIME ■

TIME SCALE

MIN.
0.0
.1
.2
.3
.4
.5
.6
.7
.8
.9

LOADED TRUCK	
TIME ITEM	TIME MIN.
TRUCK TO SCALE	.06
TRUCK ONTO SCALE	.07
SCALE SETTLES	.15
IDLE	.14
TRUCK OFF SCALE	.08
TRUCK CLEARS SCALE	.06

EMPTY TRUCK	
TIME ITEM	TIME MIN.
TRUCK TO SCALE	.06
TRUCK ONTO SCALE	.07
SCALE SETTLES	.12
TRUCK OFF SCALE	.07
TRUCK CLEARS SCALE	.06

OPERATOR	
OPERATION ELEMENT	PRODUCTIVE AND UNPRODUCTIVE TIME MAN-MIN.
COMPLETES TICKET FOR EMPTY TRUCK	.15
LAYS ASIDE TICKET	.07
INSERTS NEW TICKET	.04
WAITS	.02
FILLS OUT TICKET FOR LOADED TRUCK	.31
LAYS ASIDE TICKET	.06
INSERTS TICKET	.04
WAITS	.12
STARTS FILLING OUT TICKET FOR EMPTY TRUCK	.13

PRODUCTIVE LABOR 80

UNPRODUCTIVE LABOR 14

TOTAL LABOR, MAN-MINUTES 0.94

ELAPSED MINUTE . . 0.94

Figure 38.

WEIGHING AND MAKING TEST WEIGHT
1 Man, Printing Dial Scale, Test Weight Bucket at Truck

PRODUCTIVE TIME ▭ IDLE OR UNPRODUCTIVE TIME ■

TIME SCALE MIN.	LOADED TRUCK: TIME ITEM	LOADED TRUCK: TIME MIN.	EMPTY TRUCK: TIME ITEM	EMPTY TRUCK: TIME MIN.	OPERATOR: OPERATION ELEMENT	OPERATOR: PRODUCTIVE AND UNPRODUCTIVE TIME MAN-MIN.
0.0	TRUCK TO SCALE	.06			WAITS	.09
.1	TRUCK ONTO SCALE	.07			INSERTS TICKET	.04
.2	SCALE SETTLES	.15			TO DOCK WITH BUCKET	.09
.3					PUTS BUCKET IN TRUCK	.04
.4	IDLE	.41			FILLS BUCKET	.07
.5					LEVELS BUCKET	.08
.6					BALANCES BEAM	.15
.7	TRUCK OFF SCALE	.08			EMPTIES BUCKET	.04
.8	TRUCK CLEARS SCALE	.06			RETURNS TO OFFICE	.09
.9			TRUCK TO SCALE	.06	FILLS OUT TICKET FOR LOADED TRUCK	.31
1.0			TRUCK ONTO SCALE	.07		
1.1			SCALE SETTLES	.12	LAYS ASIDE TICKET	.06
1.2					INSERTS TICKET	.04
1.3			IDLE	.43	FILLS OUT TICKET FOR EMPTY TRUCK	.28
1.4					TICKET TO CUSTOMER	.06
1.5					LAYS ASIDE TICKET	.07
1.6			DRIVER TO TRUCK	.18		
1.7					WAITS	.42
1.8			STARTS ENGINE	.11		
1.9			TRUCK OFF SCALE	.07		
			TRUCK CLEARS SCALE	.06		

PRODUCTIVE LABOR	1.42
UNPRODUCTIVE LABOR	.51
TOTAL LABOR, MAN-MINUTES	1.93

ELAPSED MINUTES . . 1.93

Figure 39.

BN-20138

Figure 40.--Arrangement of equipment in the scale house when one man weighs trucks and determines the test weight and moisture content of grain. The moisture test equipment is at the right of the scale dial and the test weight equipment is at the left. The operator is placing a ticket in the scale printing mechanism.

WEIGHING AND MAKING TEST WEIGHT AND MOISTURE TEST

1 Man, Printing Dial Scale, Test Weight in Office, Dielectric Moisture Tester

PRODUCTIVE TIME ▭ IDLE OR UNPRODUCTIVE TIME ■

TIME SCALE MIN.	LOADED TRUCK: TIME ITEM	LOADED TRUCK: TIME MIN.	EMPTY TRUCK: TIME ITEM	EMPTY TRUCK: TIME MIN.	OPERATOR: OPERATION ELEMENT	OPERATOR: PRODUCTIVE AND UNPRODUCTIVE TIME MAN-MIN.
0.0	TRUCK TO SCALE	.06			WAITS	.04
.1	TRUCK ONTO SCALE	.07			TO TRUCK	.09
.2	SCALE SETTLES	.15			OBTAINS SAMPLE WITH CAN AND RETURNS TO MOISTURE TESTER	.13
.3	IDLE	.33			POURS 150 GRAMS INTO SCALE	.12
.4					POURS INTO TEST FUNNEL	.09
.5					INSERTS TICKET, WEIGHS AND ADDS NAME OF CUSTOMER	.14
.6						
.7	TRUCK OFF SCALE	.08			LEVELS GRAIN	.14
.8	TRUCK CLEARS SCALE	.06	TRUCK TO SCALE	.06	BALANCES BEAM	.17
.9			TRUCK ONTO SCALE	.07		
1.0			SCALE SETTLES	.12	WRITES TEST WEIGHT ON TICKET	.17
1.1					POURS INTO MOISTURE TESTER	.11
1.2						
1.3					DROPS GRAIN, READS DIAL AND CONSULTS CHART	.22
1.4						
1.5			IDLE	1.03	COMPLETES TICKET	.21
1.6					EMPTIES PANS	.02
1.7					INSERTS TICKET	.04
1.8					FILLS OUT TICKET FOR EMPTY TRUCK	.28
1.9						
2.0					TICKET TO CUSTOMER	.06
2.1			DRIVER TO TRUCK	.18	LAYS ASIDE TICKET	.07
2.2						
2.3			STARTS ENGINE	.11	WAITS	.35
2.4			TRUCK OFF SCALE	.07		
			TRUCK CLEARS SCALE	.06		

PRODUCTIVE LABOR	2.06
UNPRODUCTIVE LABOR	.39
TOTAL LABOR, MAN-MINUTES	2.45
ELAPSED MINUTES	2.45

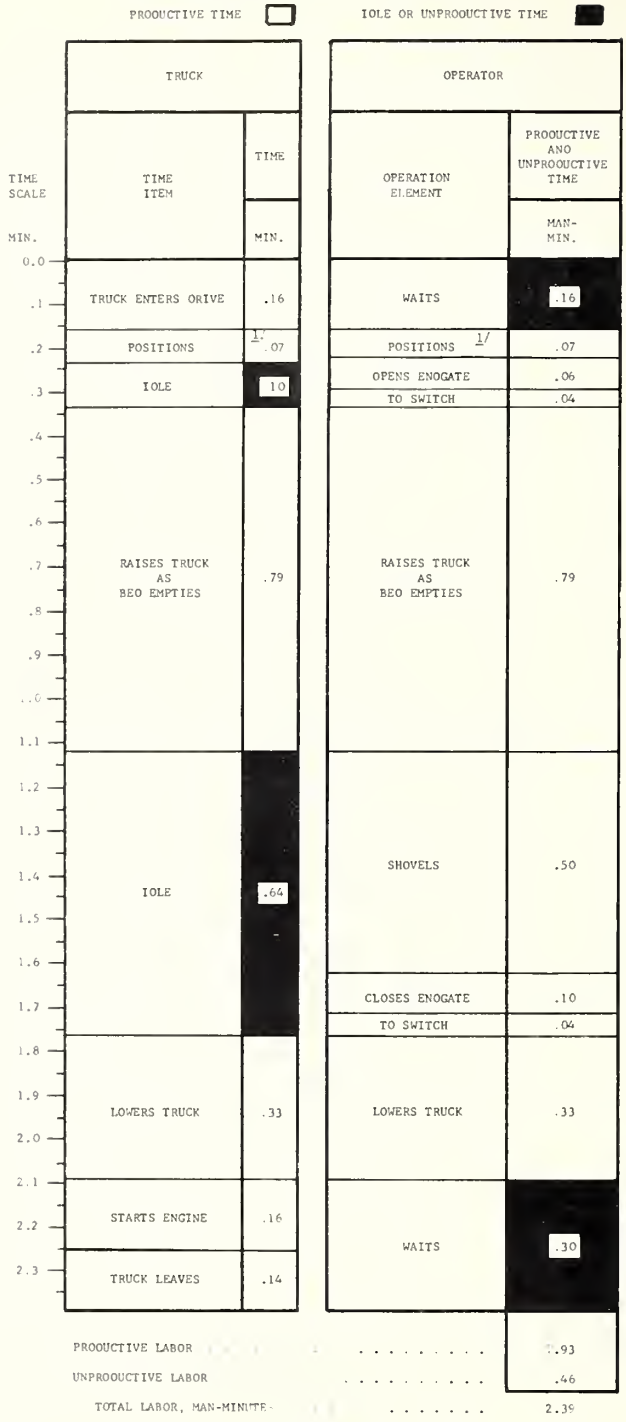
Figure 41.

Unloading Trucks

At times other than harvest, one man may unload farm trucks at the drive pit; the labor requirement and sequence of elements are shown in figures 42, 43, 44, and 45. Included are the unloading of standard farm trucks (with and without underbody hoist), each equipped with a sliding endgate, and of pickup trucks, one equipped with a sliding endgate and one with a complete endgate.

Observed Method

UNLOADING 200-BUSHEL TRUCK, SLIDING ENDGATE, 1 MAN



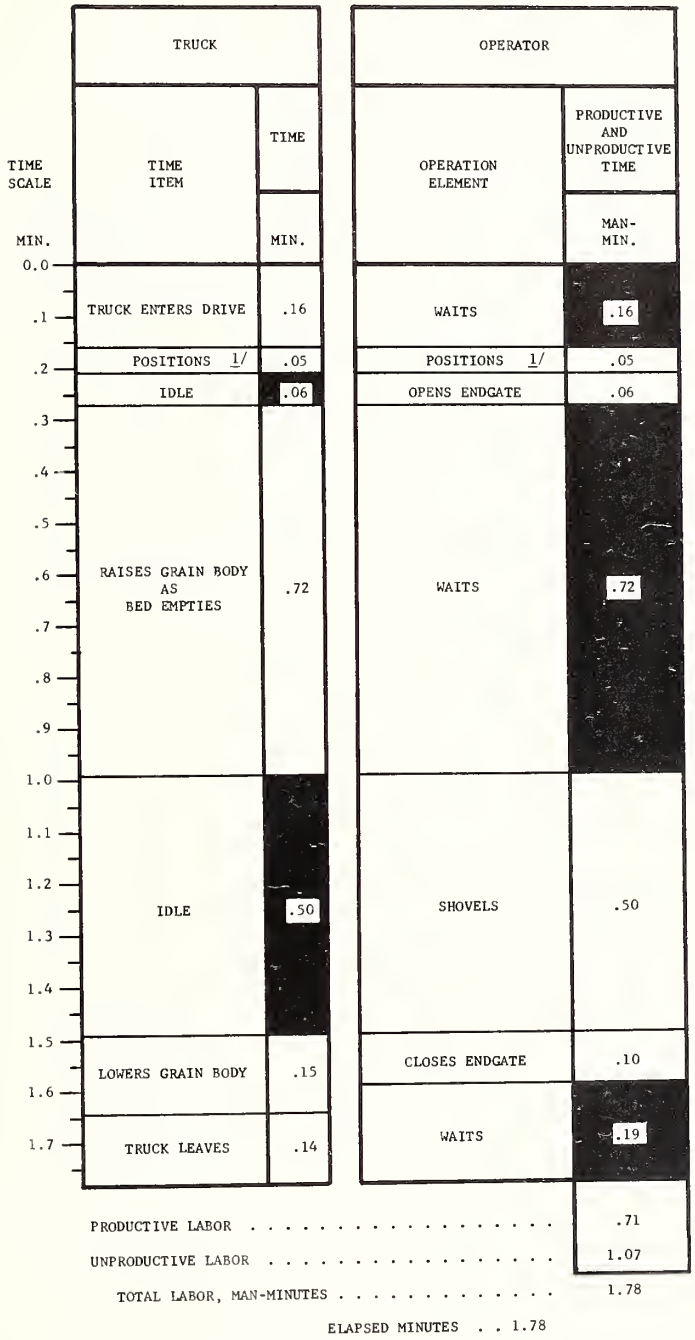
1/ This is a weighted time. The frequency of occurrence was 34 percent.

Figure 42.

Observed Method

UNLOADING 200-BUSHEL TRUCK WITH UNDERBODY HOIST, SLIDING ENDGATE, 1 MAN

PRODUCTIVE TIME ☐ IDLE OR UNPRODUCTIVE TIME ■



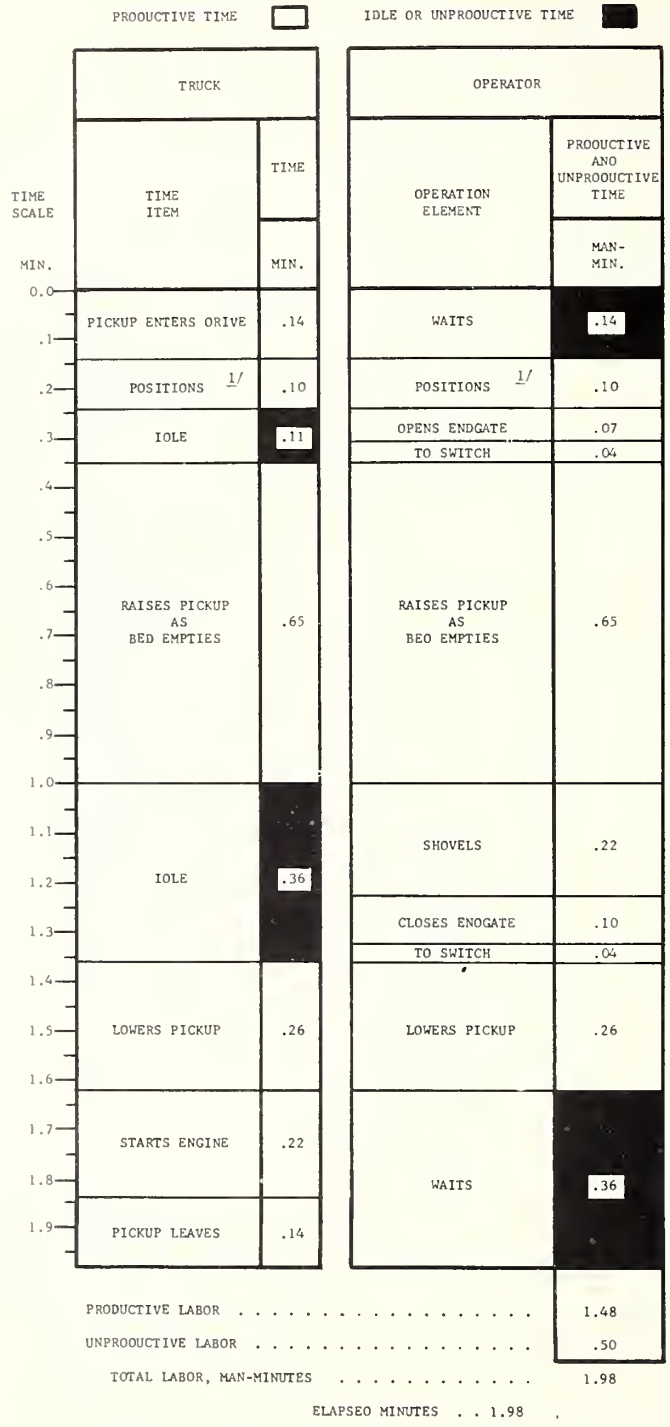
PRODUCTIVE LABOR	.71
UNPRODUCTIVE LABOR	1.07
TOTAL LABOR, MAN-MINUTES	1.78
ELAPSED MINUTES	1.78

1/ This is a weighted time. The frequency of occurrence was 19 percent.

Figure 43.

Observed Method

UNLOADING 60-BUSHEL PICKUP, SLIDING ENDGATE, 1 MAN



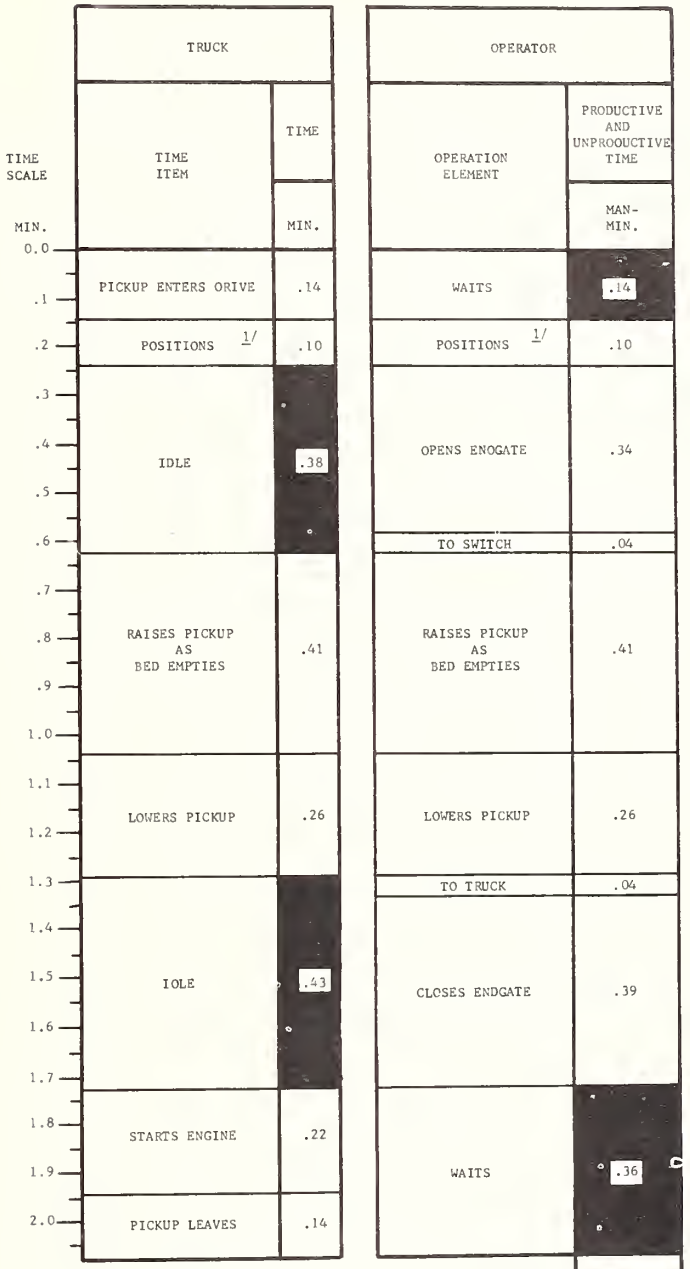
1/ This is a weighted time. The frequency of occurrence was 40 percent.

Figure 44.

Observed Method

UNLOADING 60-BUSHEL PICKUP COMPLETE ENDGATE, 1 MAN

PRODUCTIVE TIME ☐ IOLE OR UNPRODUCTIVE TIME ■



PROOUCTIVE LABOR	1.58
UNPRODUCTIVE LABOR	.50
TOTAL LABOR, MAN-MINUTES	2.08

ELAPSEO MINUTES . . . 2.08

1/ This is a weighted time. The frequency of occurrence was 40 percent.

Figure 45.

Elevating Grain From Drive Pit to Headhouse

The labor required for one man to perform the operations involved in transferring 153 bushels of grain from drive pit to headhouse, utilizing a manually operated distributor, is shown below. These operations include opening the elevator, starting the machinery, sweeping around the drive pit, waiting for the leg to elevate 153 bushels of grain, stopping the machinery, and closing the elevator. These operations are performed at times other than harvest when an occasional truck arrives at the elevator.

Operation element	Labor required
	Man-minutes
Productive labor:	
Setup	6.62
Sweeping around drive pit	.23
Cleanup	5.84
Total productive labor	12.69
Unproductive labor:	
Machine-regulated wait time	1.84
Total unproductive labor	1.84
Total labor	14.53
	Minutes
Elapsed time	14.53

If the elevator is opened in the morning, left open all day, and closed at night, the setup and cleanup time can be prorated among the total number of trucks arriving during the day.

Labor is included for sweeping around the drive pit after each load, but not for sweeping the complete elevator once each week.

Several factors such as the size of the leg motor, the power company's rate schedule, and the monthly minimum demand influence the manager's decision of whether or not to stop the leg between trucks. A suggested rule of thumb is to turn off the leg unless there is a loaded truck in sight.

Combined Operations

The one-man operations at the truck scale and drive pit that most nearly balance with an elevating leg with an operating capacity of 5,000 bushels per hour are (1) weighing and making test weight at 4,750 bushels per hour and (2) unloading 200-bushel standard farm trucks equipped with sliding endgates at 5,000 bushels per hour. With one man at the scale and one man at the drive pit a truck would be at the elevator about 5 minutes.

One man can perform all the receiving operations in this manner: Weigh the loaded truck, determine test weight, go to the drive pit with the loaded truck, unload the truck, move grain from drive pit to headhouse, return to the scale house with the empty truck,

and weigh the empty truck. For these combined operations the truck would be at the elevator about 8 minutes. The complete cycle, including opening and closing the elevator drive doors (setup and cleanup), requires about 20 minutes.

ANNUAL COSTS OF RECEIVING GRAIN FROM FARM TRUCKS

The costs of receiving grain at country elevators were computed for weighing and determining test weight of grain, unloading trucks, and moving grain from drive pit to storage bins. Direct labor costs and equipment ownership and operating costs are listed for a 200,000-bushel headhouse, a 750,000-bushel elevator, and a 1,500,000-bushel elevator.

The calculated annual cost and the cost of receiving 1,000 bushels of grain from farm trucks by the observed methods at a 200,000-bushel headhouse are shown in table 7. The operating schedule provides for receiving 475,000 bushels annually from 3,100 trucks. A weighted averate cost[6] of receiving at the truck scale and unloading at the drive pit (tables 12 and 13, appendix) is used in table 7. The calculated cost of the weighing and test weight operations was about 1/4 cent per bushel, of unloading trucks at the drive pit about 1/8 cent per bushel, and of moving grain from drive pit to headhouse nearly 1/5 cent per bushel. This cost represents only the direct labor costs and the equipment ownership and operating costs.

TABLE 7.--Cost of receiving grain from farm trucks by observed methods: 200,000-bushel country elevator using one leg, receiving 475,000 bushels annually from 3,100 trucks

Operation	Crew size	Cost per 1,000 bushels			Annual cost		
		Labor	Equipment	Total	Labor	Equipment	Total
	Men	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Weigh loaded and empty trucks and determine test weight.....	2	0.52	2.09	2.61	247.00	992.75	1,239.75
Unload trucks.....	3	.77	.44	1.21	365.75	209.00	574.75
Move grain from drive pits to storage bins...	([1])	.02	1.85	1.87	9.50	878.75	888.25
Total.....	--	--	--	--	622.25	2,080.50	2,702.75
					Percent	Percent	Percent
Percent of receiving cost.....					23	77	100
							Cents
Cost per bushel received							[2] 0.57

[1] Operation performed by one of the crew members also assigned to unloading trucks.
[2] $2,702.75 ÷ 475,000.

[6] Weighted average cost based on two-thirds of the trucks being 200-bushel standard farm trucks (half with and half without underbody hoists) and one-third being 60-bushel pickup trucks.

The calculated cost of receiving grain from farm trucks by the observed methods at a 750,000-bushel elevator is shown in table 8. The operating schedule provides for receiving 725,000 bushels annually from 4,730 trucks.

The calculated cost of receiving grain from farm trucks by the observed methods at a 1,500,000-bushel elevator is shown in table 9. The operating schedule provides for receiving 1,125,000 bushels annually from 7,340 trucks.

The distribution of the annual receiving costs between labor and equipment was approximately the same for the three elevators and was divided approximately 1/4 for labor and 3/4 for equipment.

TABLE 8.--Cost of receiving grain from farm trucks by observed methods: 750,000-bushel country elevator using one or two legs, receiving 725,000 bushels annually from 4,730 trucks

Type of operation and number of legs	Crew size	Annual quantity of grain	Cost per 1,000 bushels			Annual cost		
			Labor	Equipment	Total	Labor	Equipment	Total
	Men	Bushels	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
One elevator leg:								
Weigh loaded and empty trucks and make test weight	2	725,000	0.52	1.59	2.11	377.00	1,152.75	1,529.75
Unload trucks	3	725,000	.77	.38	1.15	558.25	275.50	833.75
Move grain from drive pit to headhouse	(1)	600,000	.02	1.15	1.17	12.00	690.00	702.00
Move grain from drive pit to annex	(1)	125,000	.05	2.06	2.11	6.25	257.50	263.75
Mix grain from headhouse to annex[2]	(1)	125,000	.05	2.06	2.11	6.25	257.50	263.75
Total		--	--	--	--	959.75	2,633.25	3,593.00
						Percent	Percent	Percent
Percent of receiving cost						27	73	100
								Cents
Cost per bushel received								[3] 0.50
Two elevator legs:								
Weigh loaded and empty trucks and make test weight	2	725,000	.52	1.59	2.11	377.00	1,152.75	1,529.75
Unload trucks	3	725,000	.77	.38	1.15	558.25	275.50	833.75
Move grain from drive pit to headhouse	(1)	600,000	.02	1.46	1.48	12.00	876.00	888.00
Move grain from drive pit to annex	(1)	125,000	.05	2.38	2.43	6.25	297.50	303.75
Mix grain from headhouse to annex[2]	(1)	125,000	.05	2.38	2.43	6.25	297.50	303.75
Total						959.75	2,899.25	3,859.00
						Percent	Percent	Percent
Percent of receiving cost						29	71	100
								Cents
Cost per bushel received								[4] 0.53

[1] Operation performed by one of the crew members also assigned to unload trucks.
[2] Annual handling schedule assumes this quantity of grain is received into the headhouse and mixed during movement from headhouse to storage annex.
[3] $3,593 ÷ 725,000.
[4] $3,859 ÷ 725,000.

TABLE 9.--Cost of receiving grain from farm trucks by observed methods: 1,500,000-bushel country elevator using one or two legs, receiving 1,125,000 bushels annually from 7,340 trucks

Type of operation and number of legs	Crew size	Annual quantity of grain	Cost per 1,000 bushels			Annual cost		
			Labor	Equipment	Total	Labor	Equipment	Total
One elevator leg:	Men	Bushels	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Weigh loaded and empty trucks and test weight	2	1,125,000	0.52	1.32	1.84	585.00	1,485.00	2,070.00
Unload trucks	3	1,125,000	.77	.33	1.10	866.25	371.25	1,237.50
Move grain from drive pit to headhouse	(1)	800,000	.02	.92	.94	16.00	736.00	752.00
Move grain from drive pit to annex	(1)	325,000	.08	1.79	1.87	26.00	581.75	607.75
Mix grain from headhouse to annex[2]	(1)	325,000	.08	1.79	1.87	26.00	581.75	607.75
Total						1,519.25	3,755.75	5,275.00
						Percent	Percent	Percent
Percent of receiving cost						29	71	100
								Cents
Cost per bushel received								[3] 0.47
Two elevator legs:								
Weigh loaded and empty trucks and make test weight	2	1,125,000	.52	1.32	1.84	585.00	1,485.00	2,070.00
Unload trucks	3	1,125,000	.77	.33	1.10	866.25	371.25	1,237.50
Move grain from drive pit to headhouse	(1)	800,000	.02	1.04	1.06	16.00	832.00	848.00
Move grain from drive pit to annex	(1)	325,000	.08	1.91	1.99	26.00	620.75	646.75
Mix grain from headhouse to annex[2]	(1)	325,000	.08	1.91	1.99	26.00	620.75	646.75
Total						1,519.25	3,929.75	5,449.00
						Percent	Percent	Percent
Percent of receiving cost						28	72	100
								Cents
Cost per bushel received								[4] 0.48

[1] Operation performed by one of the crew members also assigned to unload trucks.

[2] Annual handling schedule assumes this quantity of grain is received into the headhouse and mixed during movement from headhouse to storage annex.

[3] $5,275 ÷ 1,125,000.

[4] $5,449 ÷ 1,125,000.

APPENDIX

Research Methods and Techniques

Time study was used to determine the time taken by various crew members to perform various elements of the operation. Since the level of productivity varied, the times taken were adjusted to a normal level, called base time. Base time with the addition of allowances for fatigue and personal time constitutes the productive times (tables 16-18). Unproductive time was classified under two general categories, avoidable and unavoidable. Unavoidable time was subdivided into causes and then analyzed for improvement or elimination. Avoidable time was removed from the data.

Cooperators supplied detailed data of their annual handling operations. Their reports listed trucks and railroad cars received, grain turned, and grain loaded into trucks and railroad cars. Schedules and grain handling practices of the industry were determined from these reports.

Equipment Ownership and Operating Costs

Ownership and operating costs for basic equipment used for receiving grain are given for elevators of three different sizes: 200,000-bushel headhouse (table 10); 750,000-bushel elevator (table 14); and 1,500,000-bushel elevator (table 15). The ownership and operating costs are for concrete upright elevators in the Hard Winter Wheat area. Elevator structures and buildings are not included.

The replacement cost listed is the initial cost of the equipment at the factory plus freight to the elevator and the installation cost. The installation cost includes labor, wiring, and other costs necessary to prepare the equipment for operation. Sources of cost information were manufacturers, elevator contractors, elevator managers, and owners.

The expected life is based on the best information available from cooperating elevators. Elevators may have equipment in use that has actually lasted longer than listed, but obsolescence is considered.

Depreciation was calculated on a straight-line basis, which permitted the management to charge off the same decrease in value each year during the life of the equipment.

Interest was based on a rate of 5 percent per year. The annual interest charge was determined by applying the 5-percent rate to one-half of the replacement cost, obtaining an average interest charge over the life of the equipment. The interest rate paid by the elevators during the period of the study was lower than 5 percent. After discussions with banks, the 5-percent interest rate seemed to be a reasonable figure for the long-range plan.

An insurance rate of 0.1 percent of the replacement cost is used. The insurance rate was obtained from actual premiums paid by elevator managers and discussions with insurance companies. The insurance for most elevators is carried by a group of insurance companies who make up a mutual insurance company.

A tax rate of 1.3 percent of replacement cost is used. The actual rates were obtained from various sections of the Hard Winter Wheat area. They were found to range from 1.75 percent of the replacement cost for elevators within city limits to 0.82 percent of the replacement cost for elevators in the country. They were assessed from 20 to 30 percent of actual value with levy ranging from 31.68 to 76.23 mills.

Power readings for various items of grain handling machinery were obtained at elevators during actual operations (table 11). Elevator records listed the cost per kilowatt hour

from 2 cents to 10 cents due to the range in the demand charges. A power cost of 5 cents per kilowatt hour was determined from handling schedules of elevators similar to the three basic elevators used in this report and from schedules of four different power companies.

Maintenance costs include routine maintenance and repairs and labor and material.

The amount of grain moved annually in elevators of three different sizes is based on an annual operating schedule developed for each size of elevator. The bushels listed are those moved annually, at a rate of 5,000 bushels per hour, for each item of grain handling equipment. The bushels listed for man lift, lights, and distributor are the total bushels moved annually in the elevator, which are prorated over the annual cost.

The cost per truck was obtained by dividing the total annual cost by the number of trucks that use that piece of equipment. The cost-per-truck data were recorded for equipment used at the truck scale and for the truck lift in the elevator driveway.

The cost per bushel was calculated for equipment in the elevator. The cost per bushel is recorded for the amount of grain moved by each item of grain handling machinery in the elevator. The cost for the man lift, lights, and distributor is distributed over the total bushels handled annually.

TABLE 10.--Ownership and operating costs for various types of grain handling equipment: 200,000-bushel elevator with 1,050,000 bushels of grain moved annually

Equipment	Amount of Equipment	Expected life	Replacement cost	Ownership cost				
				Depreciation	Interest	Insurance	Taxes	Total
		Years	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Truck scale (printing dial).	1	27	12,000	444.44	300.00	12.00	156.00	912.44
Moisture tester..	1	20	475	23.75	11.88	.48	6.18	42.29
Gram scale.....	1	20	45	2.25	1.13	.05	.59	4.02
Test weight bucket and beam.	1	20	30	1.50	.75	.03	.39	2.67
Truck lift.....	1	24	2,350	97.92	58.75	2.35	30.55	189.57
Leg.....	1	32	12,000	375.00	300.00	12.00	156.00	843.00
Dust collector...	1	32	2,000	62.50	50.00	2.00	26.00	140.50
Distributor.....	1	35	150	4.29	3.75	.15	1.95	10.14
Man lift.....	1	30	1,750	58.33	43.75	1.75	22.75	126.58
Lights.....	--	--	--	--	--	--	--	--
Windows.....	--	--	--	--	--	--	--	--

Equipment	Operating cost			Total annual cost	Grain moved annually	Cost per truck[1]	Cost per bushel moved
	Power	Maintenance	Total				
	Dollars	Dollars	Dollars	Dollars	Bushels	Cents	Cents
Truck scale (printing dial).	23.25	57.00	80.25	992.69	475,000	32.0	--
Moisture tester..	4.65	10.00	14.65	56.94	475,000	1.8	--
Gram scale.....	--	--	--	4.02	475,000	.1	--
Test weight bucket and beam.	--	--	--	2.67	475,000	.1	--
Truck lift.....	5.14	15.20	20.34	209.91	268,500	10.2	--
Leg.....	244.12	111.80	355.92	1,198.92	1,050,000	--	0.1142
Dust collector...	21.00	.69	21.69	162.19	1,050,000	--	.0154
Distributor.....	--	4.33	4.33	14.47	1,050,000	--	.0014
Man lift.....	2.05	5.46	7.51	134.09	1,050,000	--	.0128
Lights.....	417.30	10.90	428.20	428.20	1,050,000	--	.0408
Windows.....	--	4.26	4.26	4.26	1,050,000	--	.0004

[1] Based on 3,100 trucks per year except for the truck lift, which is used for 1,033 standard farm trucks and 1,033 pickups.

TABLE 11.--Electric power cost for grain handling equipment: 200,000-bushel elevator with 1,050,000 bushels of grain moved annually

Equipment	Rated power	Capacity per hour	Observed power consumption	Cost per hour[1]	Annual use	Annual cost	Grain moved annually	Cost per 1,000 bushels
	Horsepower	Bushels	Kilowatts	Cents	Hours	Dollars	Bushels	Cents
Truck scale (printing dial).	([2])	-	0.15	0.75	3,100	23.25	475,000	4.90
Moisture tester...	([3])	-	.03	.15	3,100	4.65	475,000	.98
Truck lift.....	7-1/2	-	[4] 3.43	17.15	30	5.14	[5] 268,500	1.91
Leg.....	40	5,000	23.25	116.25	210	244.12	1,050,000	23.25
Dust collector....	3	5,000	2.00	10.00	210	21.00	1,050,000	2.00
Man lift.....	1-1/2	-	1.00	5.00	41	2.05	1,050,000	.20
Lights.....	-	-	[6] 2.69	13.46	3,100	417.30	1,050,000	39.74

[1] Electric power rate estimated at $0.05 per kw.-hr.
[2] 150 watts.
[3] 30 watts.
[4] Weighted average for truck lift up and down.
[5] 1,033 standard farm trucks (200 bushels) and 1,033 pickup trucks (60 bushels).
[6] Average for 3,100 hours annual use.

TABLE 12.--Observed methods: Labor and equipment costs for a 2-man crew to perform weighing operations at a 200,000-bushel country elevator receiving grain from 3,100 trucks annually[1]

Item	Cost per truck			Cost per 1,000 bushels		
	Labor	Equipment	Total	Labor	Equipment	Total
	Cents	Cents	Cents	Dollars	Dollars	Dollars
Weigh loaded and empty trucks and make test weight:						
Standard farm truck.....	7.9	32.1	40.0	0.40	1.60	2.00
Standard farm truck with underbody hoist.....	7.9	32.1	40.0	.40	1.60	2.00
Pickup truck.....	7.9	32.1	40.0	1.32	5.35	6.67
Average[2].....				.52	2.09	2.61

[1] Equal number of 200-bushel standard farm trucks, 200-bushel standard farm trucks with underbody hoist, and 60-bushel pickup trucks.
[2] Average is weighted on the basis of the number of bushels received annually at the elevator from each type of truck.

TABLE 13.--Observed methods: Labor and equipment costs for a 3-man crew to unload wheat from eight combinations of truck and endgate at a 200,000-bushel country elevator receiving grain from 3,100 trucks annually[1]

Type of truck and endgate	Cost per truck			Cost per 1,000 bushels		
	Labor	Equipment	Total	Labor	Equipment	Total
	Cents	Cents	Cents	Dollars	Dollars	Dollars
Standard farm truck:						
Sliding endgate	14.6	10.2	24.8	0.73	0.51	1.24
Removable endgate	13.5	10.2	23.7	.68	.51	1.19
Complete endgate	11.5	10.2	21.7	.58	.51	1.09
Average				.66	.51	1.17
Standard farm truck with underbody hoist:						
Sliding endgate	11.6	--	11.6	.58	--	.58
Removable endgate	11.3	--	11.3	.56	--	.56
Complete endgate	8.2	--	8.2	.41	--	.41
Average				.52	--	.52
Pickup truck:						
Sliding endgate	12.4	10.2	22.6	2.07	1.70	3.77
Complete endgate	11.2	10.2	21.4	1.87	1.70	3.57
Average				1.97	1.70	3.67
Average for three types of trucks[2]				.77	.44	1.21

[1] Equal number of 200-bushel standard farm trucks, 200-bushel standard farm trucks with underbody hoist, and 60-bushel pickup trucks.

[2] Average is weighted on the basis of the number of bushels unloaded annually at the elevator from each type of truck.

TABLE 14.--Ownership and operating costs for various types of grain handling equipment: 750,000-bushel elevator with 2,500,000 bushels of grain moved annually

Equipment	Amount of equipment	Expected life	Replacement cost	Ownership cost				
				Depreciation	Interest	Insurance	Taxes	Total
One Elevator Leg:	Years	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Truck scale (printing dial)	1	20	12,000	600.00	300.00	12.00	156.00	1,068.00
Moisture tester	1	10	475	47.50	11.88	.48	6.18	66.04
Gram scale	1	10	45	4.50	1.13	.05	.59	6.27
Test weight bucket and beam	1	10	30	3.00	.75	.03	.39	4.17
Truck lift	1	15	2,350	156.67	58.75	2.35	30.55	248.32
Leg	1	20	12,000	600.00	300.00	12.00	156.00	1,068.00
Dust collector	1	20	2,000	100.00	50.00	2.00	26.00	178.00
Distributor	1	15	150	10.00	3.75	.15	1.95	15.85
Spout (gallery)	1	25	110	4.40	2.75	.11	1.43	8.69
Gallery belt	1	25	9,000	360.00	225.00	9.00	117.00	711.00
Tripper	1	25	2,600	104.00	65.00	2.60	33.80	205.40
Man lift	1	15	1,750	116.67	43.75	1.75	22.75	184.92
Intercom	1	15	150	10.00	3.75	.15	1.95	15.85
Lights	--	--	--	--	--	--	--	--
Windows	--	--	--	--	--	--	--	--
Two Elevator Legs:								
Legs	2	30	24,000	800.00	600.00	24.00	312.00	1,736.00
Dust collector	2	30	4,000	133.33	100.00	4.00	52.00	289.33
Distributor	2	33	300	9.09	7.50	.30	3.90	20.79
Gallery spout	2	38	220	5.79	5.50	.22	2.86	14.37

Equipment	Operating cost			Total annual cost	Grain moved annually	Cost per truck	Cost per bushel moved
	Power	Maintenance	Total				
One Elevator Leg:	Dollars	Dollars	Dollars	Dollars	Bushels	Cents	Cents
Truck scale (printing dial)	23.25	58.00	81.25	1,149.25	725,000	24.3	--
Moisture tester	4.65	10.00	14.65	80.69	725,000	1.7	--
Gram scale	--	--	--	6.27	725,000	.1	--
Test weight bucket and beam	--	--	--	4.17	725,000	.1	--
Truck lift	7.84	20.00	27.84	276.16	409,900	8.8	--
Leg	581.25	267.00	848.25	1,916.25	2,500,000	--	0.0766
Dust collector	50.00	1.65	51.65	229.65	2,500,000	--	.0092
Distributor	--	10.30	10.30	26.15	2,500,000	--	.0010
Spout (gallery)	--	14.02	14.02	22.71	1,175,000	--	.0019
Gallery belt	58.75	69.00	127.75	838.75	1,175,000	--	.0714
Tripper	--	7.26	7.26	212.66	1,175,000	--	.0181
Man lift	2.32	8.35	10.67	195.59	2,500,000	--	.0078
Intercom	10.85	6.00	16.85	32.70	2,500,000	--	.0013
Lights	436.05	12.95	449.00	449.00	2,500,000	--	.0180
Windows	--	18.10	18.10	18.10	2,500,000	--	.0007
Two Elevator Legs:							
Legs	581.25	267.00	848.25	2,584.25	2,500,000	--	.1034
Dust collector	50.00	1.65	51.65	340.98	2,500,000	--	.0136
Distributor	--	10.30	10.30	31.09	2,500,000	--	.0012
Gallery spout	--	14.02	14.02	28.39	1,175,000	--	.0024

TABLE 15.--Ownership and operating costs for various types of grain handling equipment: 1,500,000-bushel elevator with 5,000,000 bushels of grain moved annually

Equipment	Amount of equipment	Expected life	Replacement cost	Ownership cost				
				Depreciation	Interest	Insurance	Taxes	Total
One Elevator Leg:		Years	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Truck scale (printing dial).	1	13	12,000	923.08	300.00	12.00	156.00	1,391.08
Moisture tester...	1	6	475	79.17	11.88	.48	6.18	97.71
Gram scale.....	1	6	45	7.50	1.12	.05	.59	9.26
Test weight bucket and beam.....	1	6	30	5.00	.75	.03	.39	6.17
Truck lift.....	1	10	2,350	235.00	58.75	2.35	30.55	326.65
Leg.....	1	10	12,000	1,200.00	300.00	12.00	156.00	1,668.00
Dust collector....	1	10	2,000	200.00	50.00	2.00	26.00	278.00
Distributor.....	1	8	150	18.75	3.75	.15	1.95	24.60
Spout (gallery)...	2	20	220	11.00	5.50	.22	2.86	19.58
Gallery belt.....	2	20	19,500	975.00	487.50	19.50	253.50	1,735.50
Tripper.....	2	20	5,200	260.00	130.00	5.20	67.60	462.80
Man lift.....	1	8	1,750	218.75	43.75	1.75	22.75	287.00
Intercom.....	1	15	150	10.00	3.75	.15	1.95	15.85
Lights.....	--	--	--	--	--	--	--	--
Windows.....	--	--	--	--	--	--	--	--
Two Elevator Legs:								
Legs.....	2	20	24,000	1,200.00	600.00	24.00	312.00	2,136.00
Dust collector....	2	20	4,000	200.00	100.00	4.00	52.00	356.00
Distributor.....	2	15	300	20.00	7.50	.30	3.90	31.70
Gallery spout.....	4	34	440	12.94	11.00	.44	5.72	30.10

Equipment	Operating Cost			Total annual cost	Grain moved annually	Cost per truck	Cost per bushel moved
	Power	Maintenance	Total				
One Elevator Leg:	Dollars	Dollars	Dollars	Dollars	Bushels	Cents	Cents
Truck scale (printing dial)	23.25	59.70	82.95	1,474.03	1,125,000	20.1	-
Moisture tester..	4.65	10.00	14.65	112.36	1,125,000	1.5	-
Gram scale.....	-	-	-	9.26	1,125,000	.1	-
Test weight bucket and beam	-	-	-	6.17	1,125,000	.1	-
Truck lift.....	11.94	34.00	45.94	372.59	636,000	7.6	-
Leg.....	1,162.50	534.42	1,696.92	3,364.92	5,000,000	-	0.0673
Dust collector...	100.00	3.30	103.30	381.30	5,000,000	-	.0076
Distributor.....	-	20.60	20.60	45.20	5,000,000	-	.0009
Spout (gallery)..	-	35.82	35.82	55.40	3,000,000	-	.0018
Gallery belt.....	150.00	180.00	330.00	2,065.50	3,000,000	-	.0688
Tripper.....	-	18.54	18.54	481.34	3,000,000	-	.0160
Man lift.....	3.13	12.14	15.27	302.27	5,000,000	-	.0060
Intercom.....	10.85	6.00	16.85	32.70	5,000,000	-	.0007
Lights.....	461.60	13.89	475.49	475.49	5,000,000	-	.0095
Windows.....	-	24.72	24.72	24.72	5,000,000	-	.0005
Two Elevator Legs:							
Legs.....	1,162.50	534.42	1,696.92	3,832.92	5,000,000	-	.0767
Dust collector...	100.00	3.30	103.30	459.30	5,000,000	-	.0092
Distributor.....	-	20.60	20.60	52.30	5,000,000	-	.0010
Gallery spout....	-	35.82	35.82	65.92	3,000,000	-	.0022

TABLE 16.--Productive time to perform various elements of the weighing, test weight, and moisture test operation at the truck scale

Operation element	Base time	Fatigue and personal allowance[1]	Productive time
	Man-minutes	Man-minutes	Man-minutes
Inserts ticket in scale	0.04	0	0.04
Fills out ticket for loaded truck	.28	.03	.31
Lays aside ticket for loaded truck	.05	.01	.06
Fills out ticket for empty truck	.25	.03	.28
Gives copy of ticket to helper	.05	.01	.06
Lays aside original ticket for empty truck	.06	.01	.07
Helper receives ticket	.05	.01	.06
Helper gives ticket to customer	.05	.01	.06
Goes to dock with sample bucket	.08	.01	.09
Places sample bucket in loaded truck	.04	0	.04
Fills bucket	.06	.01	.07
Levels bucket	.07	.01	.08
Balances beam of portable test weight equipment	.14	.01	.15
Empties bucket	.04	0	.04
Obtains sample of grain for moisture test and returns to office	.12	.01	.13
Pours sample into scale pan	.10	.01	.11
Adjusts scale to 150 grams	.11	.01	.12
Pours sample into moisture tester	.10	.01	.11
Lays aside pan and flips trap door of tester open	.06	.01	.07
Reads dial on tester	.04	0	.04
Consults moisture chart	.07	.01	.08
Calculates moisture	.07	.01	.08
Pulls slide on tester	.04	0	.04
Empties drawer into container	.07	.01	.08
Goes to truck with container	.08	.01	.09
Goes to dock with sample bucket	.08	.01	.09
Returns to office	.08	.01	.09

[1] Fatigue allowance for each element is 5 percent of the base time for the element and personal allowance is 5 percent of the base time for the element.

TABLE 17.--Productive time required to unload standard farm trucks, standard farm trucks with underbody hoist, and pickup trucks

Type of truck and operation element	Base time	Fatigue and personal allowances[1]	Productive time
Standard farm truck and standard farm truck with underbody hoist (200 bushels):	Man-minutes	Man-minutes	Man-minutes
Positions truck over drive pit:			
Standard farm truck	0.20	0.02	0.22
Standard farm truck with underbody hoist	.22	.02	.24
Opens endgate (1 man):			
Sliding	.05	[2] .01	.06
Removable	.12	[3] .02	.14
Complete	.11	[2] .02	.13
Goes to switch	.04	0	.04
Raises standard farm truck as bed empties:			
Sliding endgate	.72	.07	.79
Removable endgate	.51	.05	.56
Complete endgate	.46	.05	.51
Shovels grain from truck:			
Sliding endgate (1 man)	.40	[4] .10	.50
Sliding endgate (2 men):			
Shovel man	.20	[4] .05	.25
Endgate man	.20	[4] .05	.25
Removable endgate (2 men):			
Shovel man	.17	[4] .04	.21
Endgate man	.17	[4] .04	.21
Closes endgate (1 man):			
Sliding	.09	[2] .01	.10
Removable	.20	[3] .04	.24
Complete	.21	[2] .03	.24
Lowers standard farm truck	.30	.03	.33
Pickup truck (60 bushels):			
Positions truck	.23	.02	.25
Opens endgate:			
Sliding (1 man)	.06	[2] .01	.07
Complete (1 man)	.28	[2] .06	.34
Complete (2 men):			
Shovel man	.28	[2] .06	.34
Endgate man	.28	[2] .06	.34
Goes to switch	.04	0	.04
Raises truck as bed empties:			
Sliding endgate	.59	.06	.65
Complete endgate	.37	.04	.41
Shovels grain from truck:			
Sliding endgate (1 man)	.18	[4] .04	.22
Sliding endgate (2 men):			
Shovel man	.09	[4] .02	.11
Endgate man	.09	[4] .02	.11
Goes to truck	.04	0	.04
Closes endgate:			
Sliding (1 man)	.09	[2] .01	.10
Complete (1 man)	.34	[2] .05	.39
Complete (2 men):			
Shovel man	.24	[2] .04	.28
Endgate man	.24	[2] .04	.28
Lowers truck	.24	.02	.26

[1] Personal allowance for each element is 5 percent of the base time for the element; fatigue allowance is 5 percent of the base time for the element unless otherwise noted.
[2] Fatigue allowance is 10 percent of the base time for the element.
[3] Fatigue allowance is 15 percent of the base time for the element.
[4] Fatigue allowance is 20 percent of the base time for the element.

TABLE 18.--Productive time required to perform various elements in moving grain from drive pits to headhouse bins

Operation element	Base time	Fatigue and personal allowance	Productive time
	Man-minutes	Man-minutes	Man-minutes
Setup	5.76	0.86	6.62
Change distributor and pit gate	.38	.06	.44
Sweep	65.20	9.78	74.98
Cleanup	5.08	.76	5.84

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