On farm grain handling & storage layouts

Alberta
AGRICULTURE

Agdex 732-16

Copies of this publication maybe obtained from:

Print Media Branch
Alberta Agiculture
7000 - 113 Street
Edmonton, Alberta, T6H 5T6
OR
Alberta Agiculture's district offices

1989 03 3M

ON FARM GRAIN HANDLING AND STORAGE LAYOUTS

Prepared by:

Kris Chawla - Alberta Agriculture, Edmonton
Duane Wood - Alberta Agriculture, Fairview
Lindsay Gowler - Alberta Agriculture, Edmonton
Murray Tenove - B.C. Ministry of Agriculture and Fisheries, Dawson Creek B.C.

TABLE OF CONTENTS

INTRODUCTION

ON FARM GRAIN HANDLING AND STORAGE LAYOUTS

INTRODUCTION

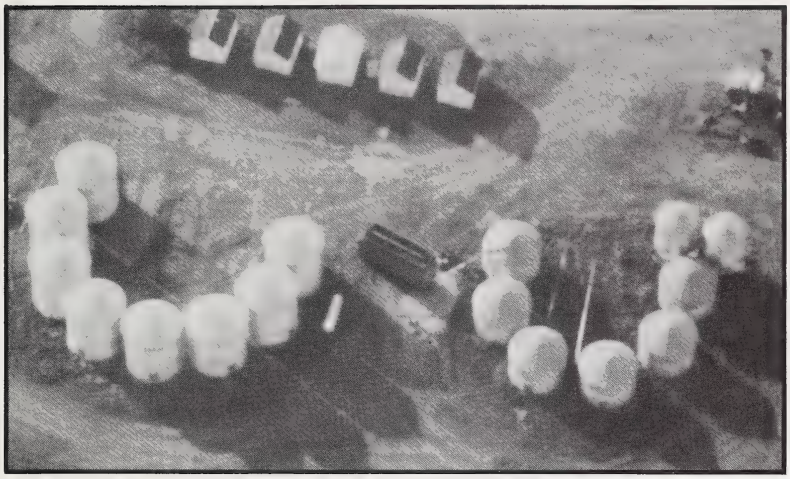
A grain handling and storage system on a farm represents a major expenditure. As well it can be a major source of frustration and time consuming if advance planning isn't done. Due to the complexity of grain handling and storage systems an organized planning process is necessary to avoid costly mistakes.

This publication is primarily for the use of grain producers, extension staff and other agri-service groups involved with the planning of grain storage and handling systems. The format consists of:

- 22 layouts drawn to the same scale. These are arranged into seven series of expansion possibilities. Each drawing includes a description of capacity, equipment components, and a grid showing 10 ft increments for area requirements (assuming 19 ft diameter bins are used for 5,000 bu capacity)
- a series of design aids
- appendix showing the individual components as an aid in selecting/matching the equipment in the system, as well as a series of do's and don'ts to remind planners of many of the more common mistakes

Further design assistance can be obtained from your regional agricultural engineer or various equipment suppliers.

LAYOUTS



Semi-circular layout - Stage 1

In the semi-circular arrangement bins do not occupy more than half of the circle. This arrangement allows for several bins to be positioned around a central receiving point. The receiving auger can be swung to several bins with a minimum of labor. Aeration and unloading equipment are initially positioned to allow unloading from outside of the circle. This can be changed to allow unloading to the center in the future.

Components

- six 5,000-bushel bins
  (equipped with aeration floors and unloading tubes)
- one 51 ft portable auger (receiving)
- one 36 ft portable auger (unloading)

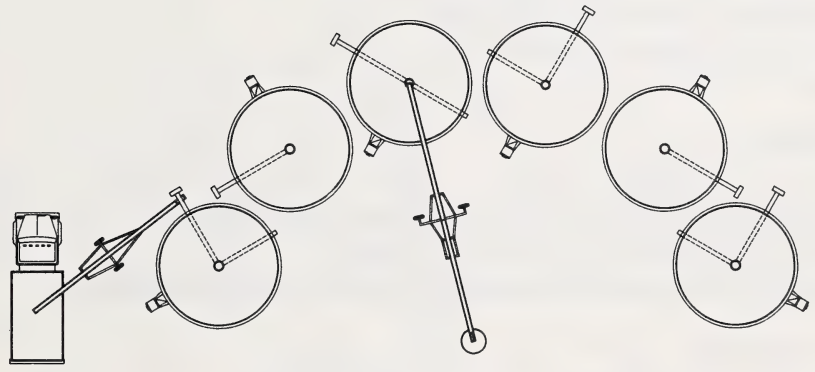
Advantages

- requires no additional equipment
- central receiving

Disadvantages

- several unloading points
- grain movement from bin to bin difficult

for next stage of expansion see SC2



30 000 bu SC1

Semi-circular layout - Stage 2

The expansion of SC1 includes a grain dryer and wet surge bin. The wet surge bin allows for continuous harvesting even with a batch dryer. This facility provides a convenient system to receive, dry and store the grain crop. Stationary inclined augers handling grain around the dryer require little or no supervision. For continuous flow dryers, it is recommended to have a dry surge bin to hold grain while receiving other crop from the field.

Components

- six 5,000-bushel bins
  (equipped with aeration floors and unloading tubes)
- one 1,600-bushel hopper bin (wet surge)
- two portable farm augers (receiving)
- one portable farm auger (unloading)
- two utility transfer augers
- one grain dryer

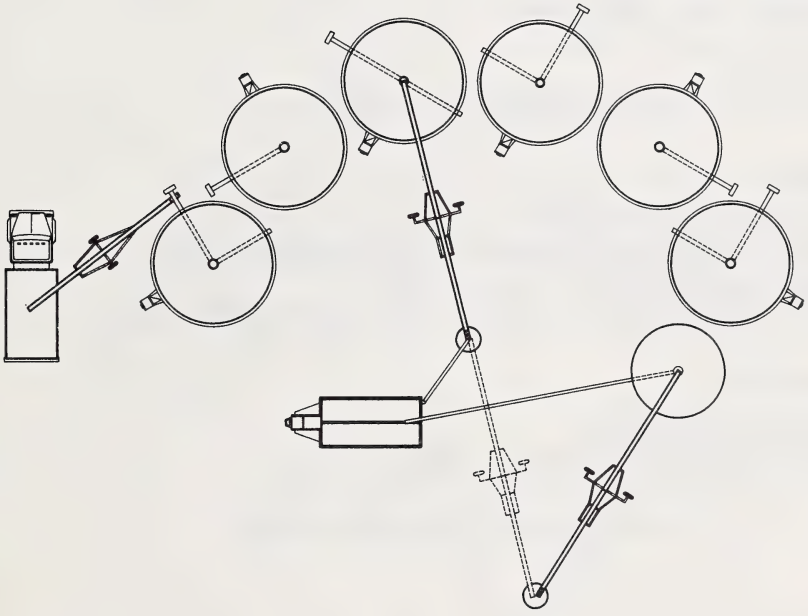
Advantages

- central receiving for all grain
- grain dryer extends the number of harvest days available
- minimal auger movement at harvest time
- unloading from outside the system where snow removal is easier

Disadvantages

- several unloading points
- grain movement from bin to bin is difficult

for next stage of expansion see SC3



30 000 bu SC2

Semi-circular layout - Stage 3

The semi-circular system expansion includes a row of bins in-line. As this stage requires a horizontal conveyor over top of the bins for filling, it is recommended to plan for at least three bins in-line. The horizontal conveyor must be sized to handle the capacity of the inclined auger. A second hopper bin is added to give more wet grain surge capacity and to allow changing from one crop to the next.

Components

- nine 5,000-bushel bins
  (equipped with aeration floors and unloading tubes)
- two 1,600-bushel hopper bins (wet surge)
- two portable farm augers (receiving)
- one portable auger (unloading)
- three utility transfer augers
- one grain dryer
- one overhead horizontal conveyor (receiving)

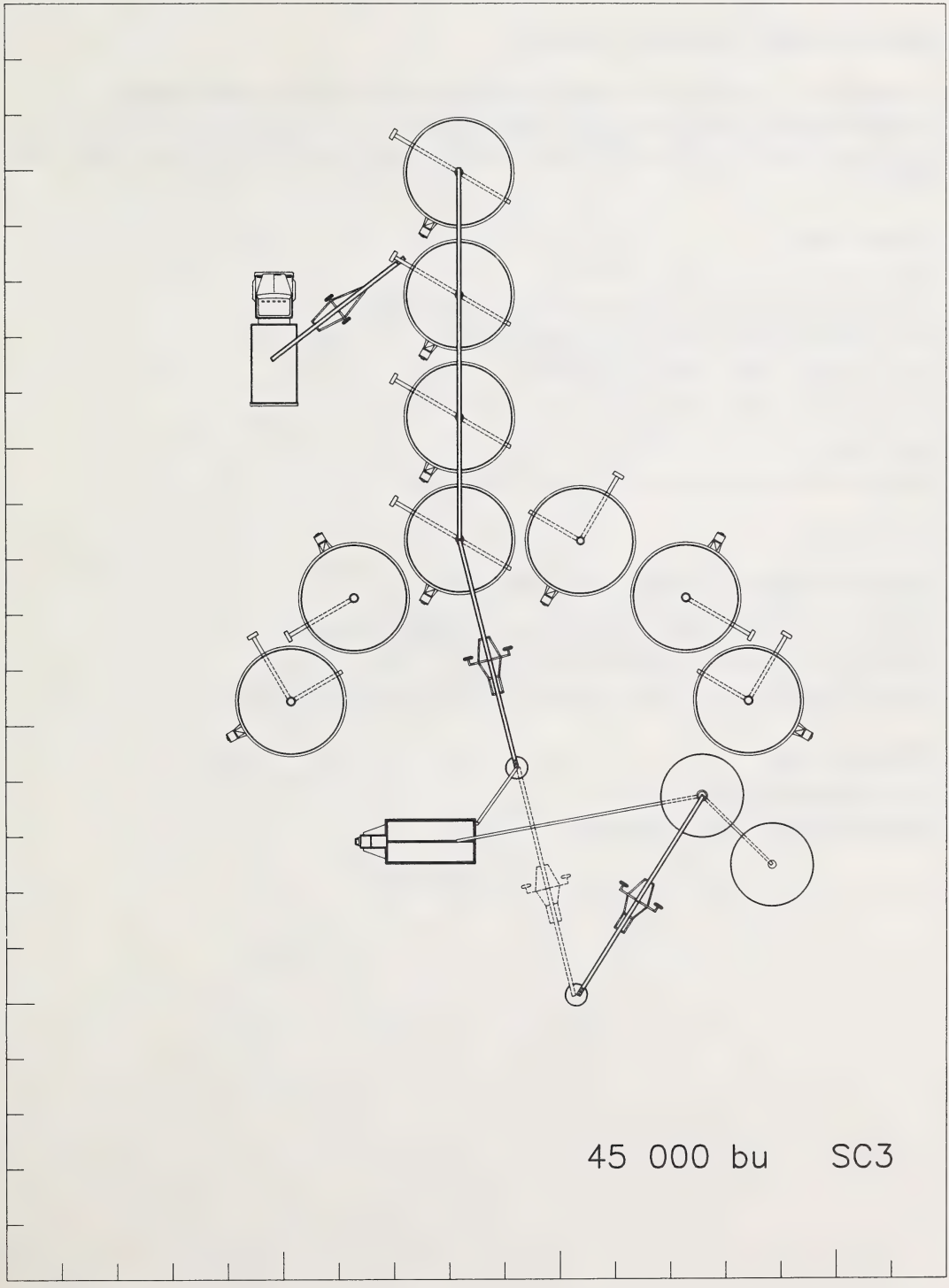
Advantages

- central receiving for all grain
- grain dryer extends the number of harvest days available
- minimal auger movement at harvest time
- unloading from outside the system where snow removal is easier

Disadvantages

- several unloading points
- grain movement from bin to bin is difficult

for next stage of expansion see SC4


45 000 bu SC3

Semi-circular Layout - Stage 4

The additional row of bins increases the capacity by 15,000 bushels without increasing significantly the equipment required.
The bins are unloaded from outside of the system, however bin to bin transfers will be difficult.

Components

- twelve 5,000-bushel bins
  (equipped with aeration floors and unloading tubes)
- two 1,600-bushel hopper bins (wet surge)
- two portable farm augers (receiving)
- one portable auger (unloading)
- three utility transfer augers
- one grain dryer
- two overhead horizontal conveyors (receiving)

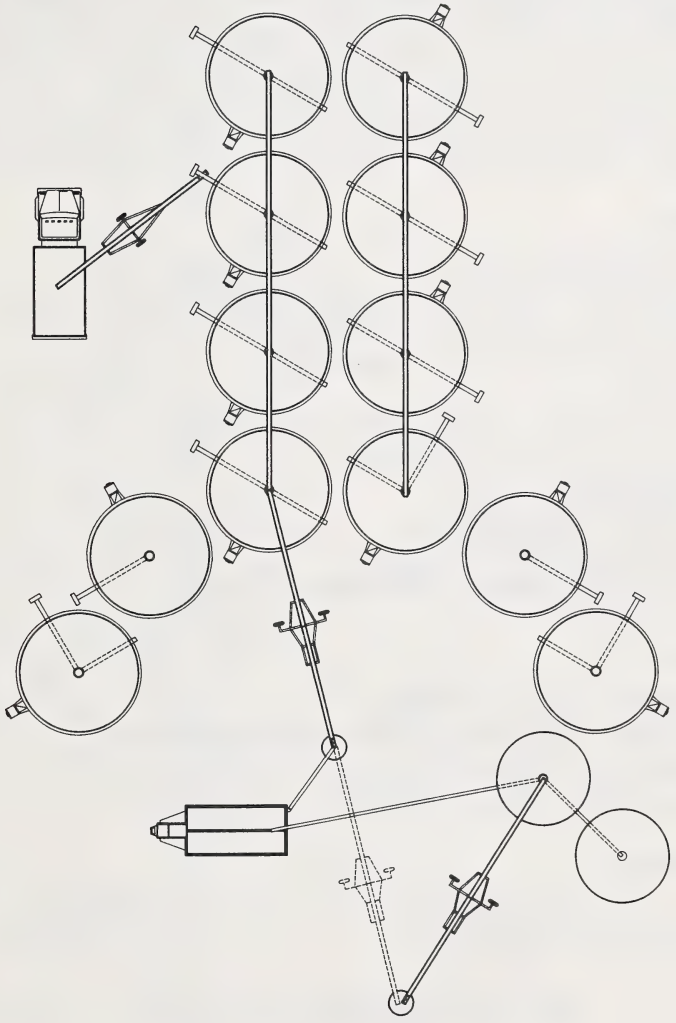
Advantages

- minimal additional equipment investment
- central receiving for all grain
- grain dryer extends the number of harvest days available
- minimal auger movement at harvest time
- unloading from outside the system where snow removal is easier

Disadvantages

- several unloading points
- grain movement from bin to bin is difficult

for next stage of expansion see SC5



60 000 bu SC4

Semi-circular Layout - Stage 5

A bucket elevator is added to fully mechanize grain transfer. Gravity spouts are connected from the bucket elevator to the bins in the semi-circle. This allows room for two additional bins to be added inside the semi-circle. Horizontal conveyors at ground level are employed to return grain to the bucket elevator for loadout. To make receiving more convenient, a driveway with a drive-over pit is added. A dry surge bin would be needed to allow the bucket elevator to handle both wet and dry grain. A control center is added to house the electrical panel and controls.

Components

- fourteen 5,000-bushel bins
  (all equipped with aeration floors and unloading tubes)
- two 1,600-bushel hopper bins (wet surge)
- one 350-bushel hopper bin (dry surge)
- one grain dryer
- two overhead horizontal conveyors (receiving)
- three horizontal conveyors (return)
- three utility transfer augers
- bucket elevator and spouting
- raised driveway and receiving pit
- cross conveyor (receiving pit to bucket elevator)

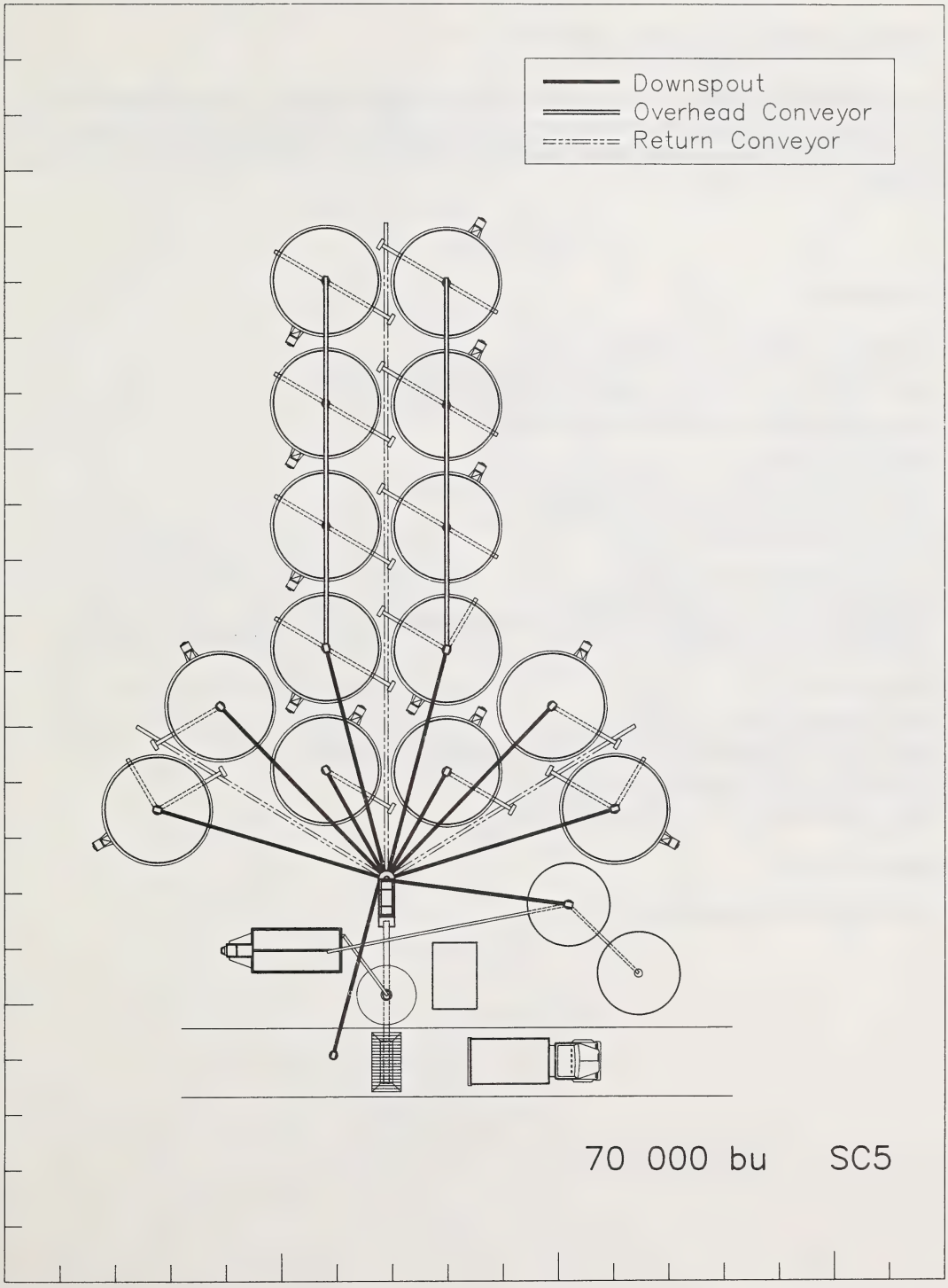
Advantages

- fully mechanized grain handling
- can receive dry grain from field while drying other crop
- one unloading point (over driveway)
- bin to bin grain transfer easily done

Disadvantages

- expansion to bucket elevator expensive while not adding significant storage capacity

for next stage of expansion see SC6


Downspout
Overhead Conveyor
Return Conveyor
70 000 bu SC5

Semi-Circular Layout - Stage 6

The expansion of layout SC5 includes more storage capacity. The two hopper bins (wet surge) are moved over the driveway to be used as wet surge or loadout bins. The space where the hopper bins were located can be utilized for feed or seed processing facilities.

Components

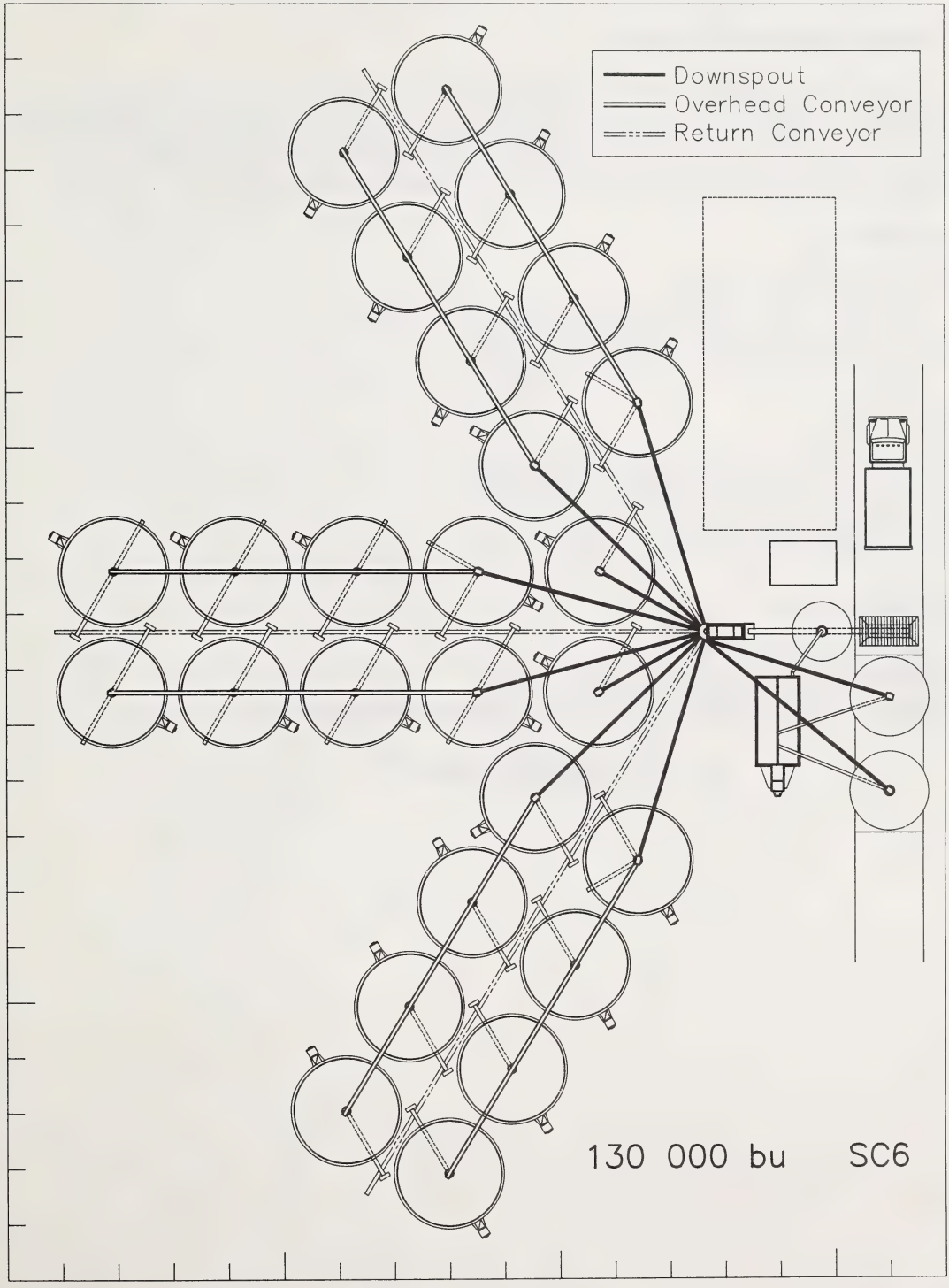
- twentysix 5,000-bushel bins
  (all equipped with aeration floors and unloading tubes)
- two 1,600-bushel hopper bins (wet surge or loadout)
- one 350-bushel hopper bin (dry surge)
- one grain dryer
- six overhead horizontal conveyors (receiving)
- three horizontal conveyors (return)
- three utility transfer augers
- bucket elevator and spouting
- raised driveway and receiving pit
- cross conveyor (receiving pit to bucket elevator)

Advantages

- fully mechanized grain handling
- can receive dry grain from field while drying other crop
- bin to bin grain transfers easily done
- one unloading point (over driveway)

Disadvantages

- total system is expensive


Downspout
Overhead Conveyor
Return Conveyor
130 000 bu SC6

In-line Layout - Stage 1

An in-line bin arrangement is one way to centralize grain storage on a smaller farm. This start up phase is suitable for once-in-once-out grain handling. Unloading can be through man doors but should be developed to include an under floor auger. Unloading tubes should be positioned to facilitate future expansion.

Components

- four 5,000-bushel bins
  (equipped with aeration floors and unloading tubes)
- one 51 ft portable farm auger (receiving)
- one 36 ft portable farm auger (unloading)

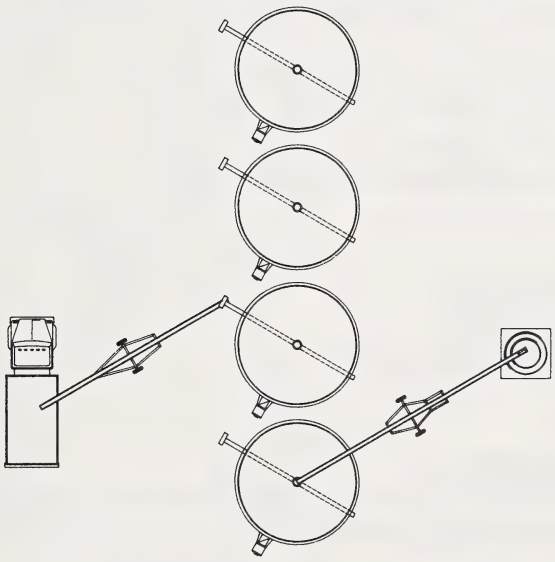
Advantages

- minimum of handling equipment needed
- bins can be different height and diameter
- easier snow removal than circular
- capability of expansion in stages

Disadvantages

- several unloading points
- difficult to transfer grain from bin to bin
- auger(s) must be moved from bin to bin to receive grain

for next expansion stage see IL2



20 000 bu IL1

In-line Layout - Stage 2

A dryer added to the grain storage facility can give more control of the harvesting operations. To make maximum use of this dryer a wet surge bin should be incorporated with a dry grain transfer auger to storage. With this grain transfer system a central receiving pit is used. When using a continuous flow dryer a dry surge bin is recommended to hold dry grain from the dryer while receiving other crop from the field.

Components

- four 5,000-bushel bins
  (equipped with aeration floors and unloading tubes)
- one 1,600-bushel hopper bin (wet surge)
- one grain dryer
- two portable farm augers (receiving)
- one portable farm auger (unloading)
- two utility transfer augers
- one overhead horizontal conveyor (receiving)

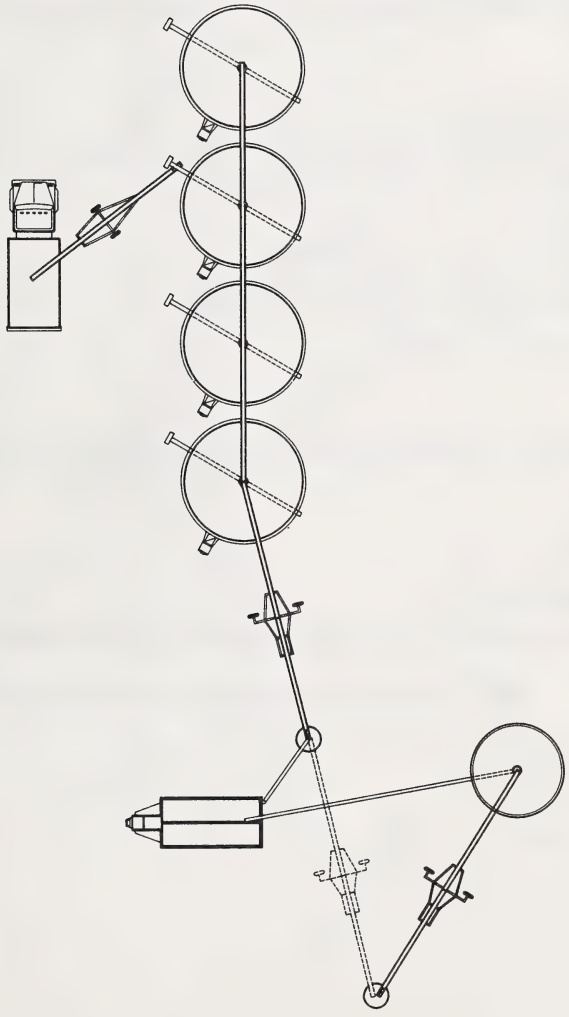
Advantages

- central receiving point
- less labor requirements
- more flexible harvest operations

Disadvantages

- several unloading points
- not convenient to receive dry grain from field while drying other crop
- difficult to transfer grain from bin to bin

for next expansion stage see IL3



20 000 bu IL2

In-line Layout - Stage 3

A second row of bins is added in this stage with an additional overhead conveyor. The unloading tube orientations and bin separations should allow room to add the central return conveyor between rows of bins. A second hopper bin is added to give more wet grain surge and to allow changing from one crop to the next.

Components

- eight 5,000-bushel bins
  (equipped with aeration floors and unloading tubes)
- two 1,600-bushel hopper bins (wet surge)
- one grain dryer
- two portable farm augers (receiving)
- one portable farm auger (unloading)
- two overhead horizontal conveyors (receiving)
- three utility transfer augers

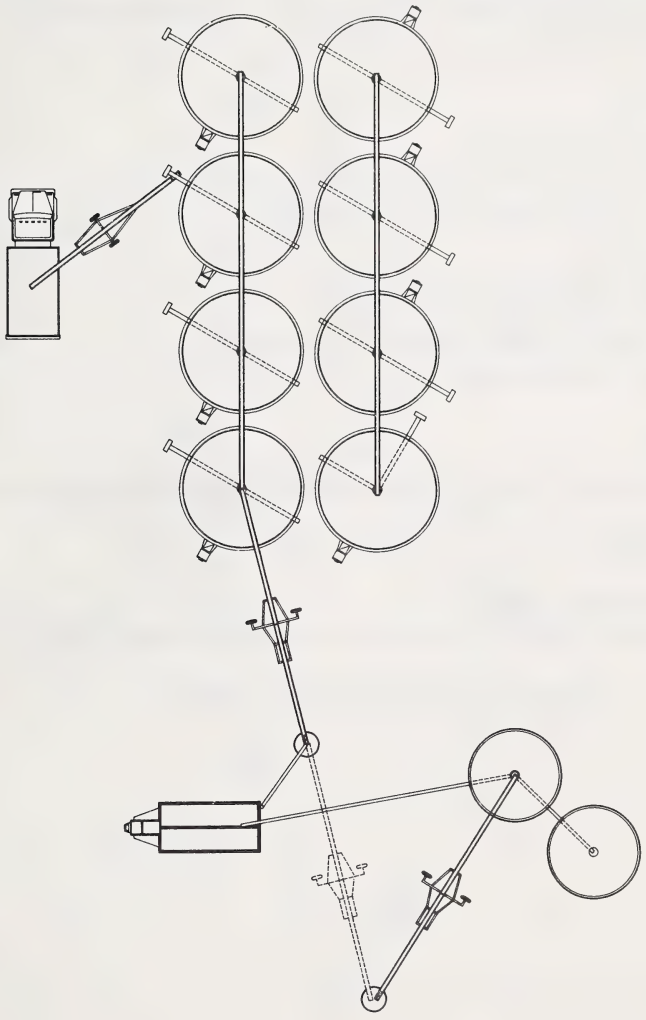
Advantages

- increased storage with minimal additional handling equipment and space requirements

Disadvantages

- several unloading points
- not convenient to receive dry grain from field while drying other crop

for next expansion stage see IL4a, IL4b, or IL4c



40 000 bu IL3

In-line Layout - Stage 4a

Storage capacity is increased by four additional bins placed in a semi-circle. This semi-circle includes the first two bins of the in-line system and is centered around the second receiving auger.

Components

- twelve 5,000-bushel bins
  (equipped with aeration floors and unloading tubes)
- two 1,600-bushel hopper bins (wet surge)
- one grain dryer
- two portable farm augers (receiving)
- one portable farm auger (unloading)
- two overhead horizontal conveyors (receiving)
- three utility transfer augers

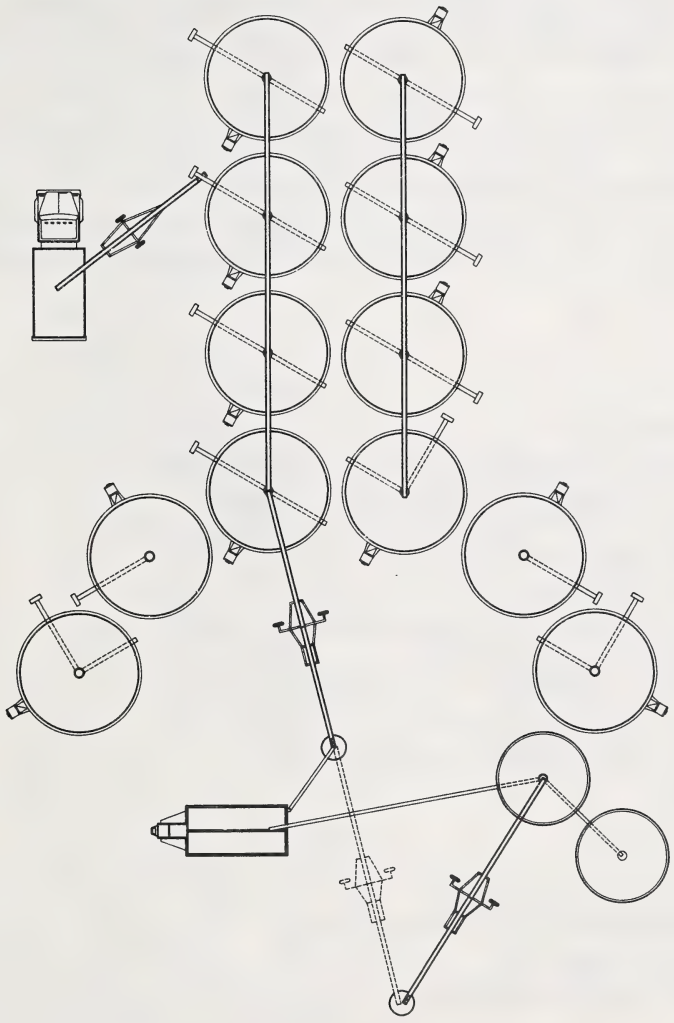
Advantages

- increased storage with minimal additional handling equipment

Disadvantages

- several unloading points
- not convenient to receive dry grain from field while drying other crop

for next expansion stage see IL5a



60 000 bu IL4a

In-line Layout - Stage 4b (parallel driveway)

This system is an alternate expansion of the basic double in-line system from IL3 with parallel driveway and bucket elevator. It provides one overhead hopper bin over the dryer as wet surge and one overhead hopper bin over the driveway for loadout. The bin over the driveway can be used for wet grain storage in an emergency. However, the wet grain must be transferred to the bin over the dryer. Another hopper bin is used for dry surge to hold dry grain from the dryer while receiving other crop from the field. Four 10,000-bushel bins are added on the other side of the dryer. Two 5,000-bushel bins are added between the existing bins and the dryer. The dryer has not been moved from its position in IL3. A control centre is added to house the electrical panels and controls. Feed and seed processing facilities can be added adjacent to the control centre.

Components

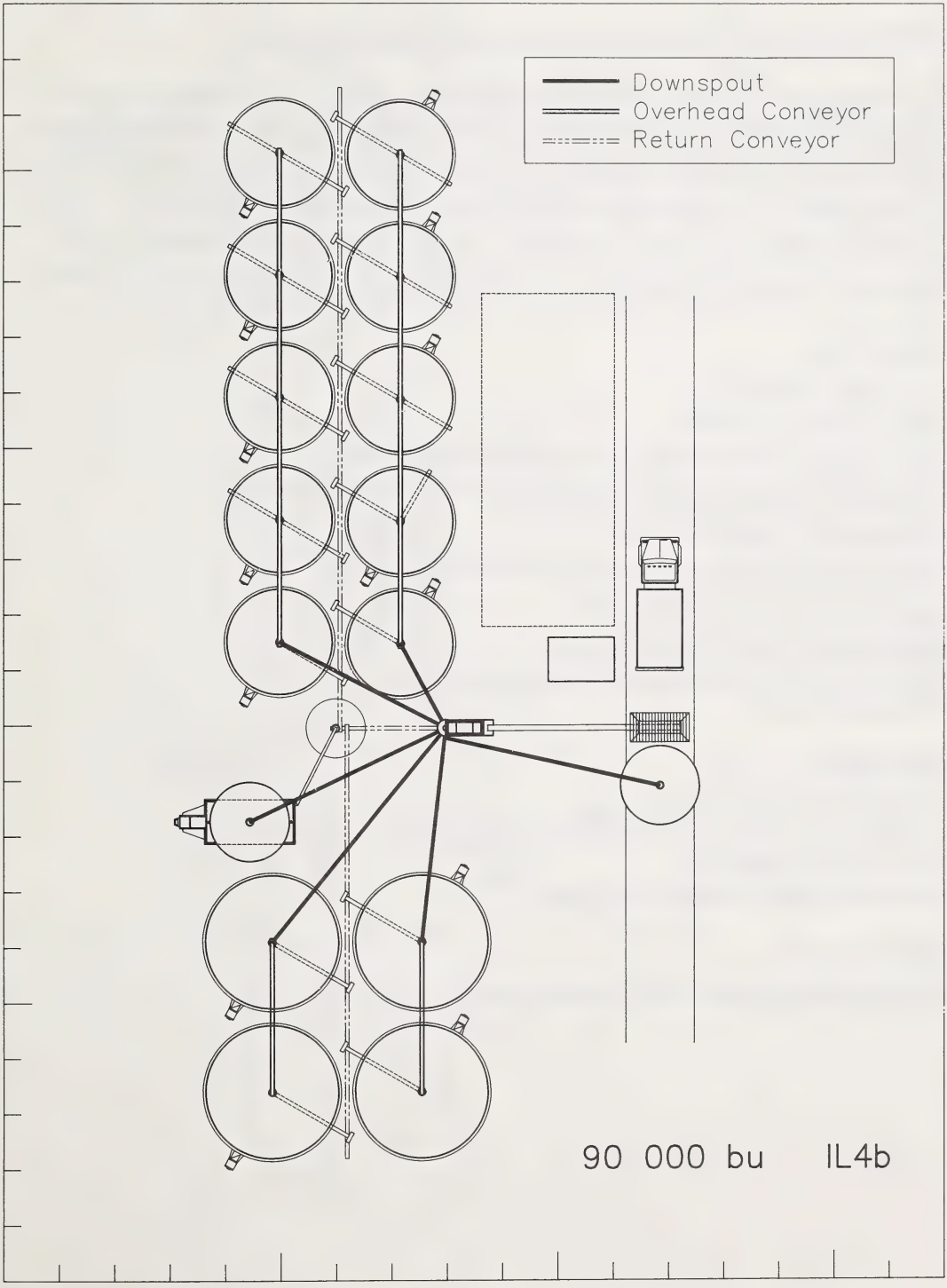
- ten 5,000-bushel bins
- four 10,000-bushel bins
  (all equipped with aeration floors and unloading tubes)
- one 1,600-bushel hopper bins (overhead as loadout)
- one 1,600-bushel hopper bins (overhead as wet surge)
- one 350-bushel hopper bins (dry surge)
- one utility transfer auger
- four overhead horizontal conveyors (receiving)
- three horizontal conveyors (return)
- bucket elevator and spouting
- raised driveway and receiving pit
- cross conveyor (receiving pit to bucket elevator)
- one grain dryer

Advantages

- central receiving and unloading
- can dry and receive other crop simultaneously
- can use bins of two sizes
- bin to bin grain transfer easily done

Disadvantages

- expansion is expensive for the added storage
- requires one more horizontal conveyor (return) than the perpendicular driveway system


Downspout
Overhead Conveyor
Return Conveyor
90 000 bu IL4b

In-line Layout - Stage 4c (perpendicular driveway)

This system is an alternate expansion of the basic double in-line system from IL3 with perpendicular driveway and bucket elevator. It provides two overhead hopper bins for wet surge or loadout. Another hopper bin is used for dry surge to hold dry grain from the dryer while receiving other crop from the field. Four 10,000-bushel bins are added on the other side of the driveway. Two 5,000-bushel bins are added between the existing bins and the dryer. The dryer has not been moved from its position in IL3. A control centre is added to house the electrical panels and controls. Feed and seed processing facilities can be added adjacent to the control centre.

Components

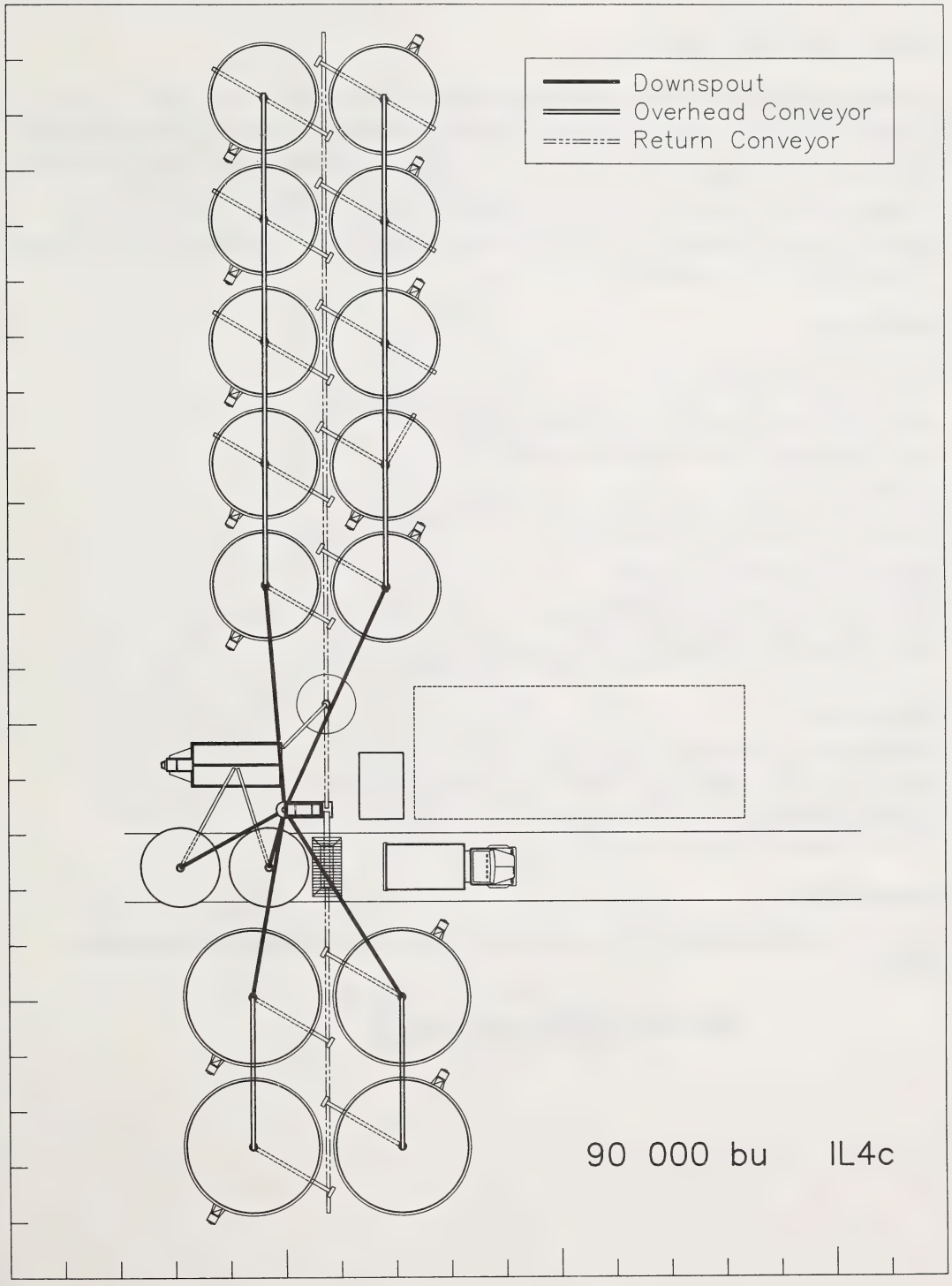
- ten 5,000-bushel bins
- four 10,000-bushel bins
  (all equipped with aeration floors and unloading tubes)
- two 1,600-bushel hopper bins (overhead as wet surge or loadout)
- one 350-bushel hopper bins (dry surge)
- three utility transfer augers
- four overhead horizontal conveyors (receiving)
- two horizontal conveyors (return)
- bucket elevator and spouting
- raised driveway and receiving pit
- cross conveyor (receiving pit to bucket elevator)
- one grain dryer

Advantages

- central receiving and unloading
- can dry and receive other crops simultaneously
- can use bins of two sizes
- bin to bin grain transfer easily done

Disadvantages

- expansion is expensive for the added storage


Downspout
Overhead Conveyor
Return Conveyor
90 000 bu IL4c

In-line Layout - Stage 5a

A bucket elevator is added to stage 1L4a to fully mechanize grain transfer. Gravity spouts are run to the semi-circle bins. This allows room for two additional bins to be added inside the semi-circle. Horizontal conveyors at ground level are used to return grain to the bucket elevator for loadout. To make receiving more convenient, a driveway with drive-over pit has been added. A dry surge bin would be needed to allow the bucket elevator to handle both wet and dry grain. A control center is added to house the electrical panel and controls.

Components

- fourteen 5,000-bushel bins
  (all equipped with aeration floors and unloading tubes)
- two 1,600-bushel hopper bins (wet surge)
- one 350-bushel hopper bin (dry surge)
- one grain dryer
- two overhead horizontal conveyors (receiving)
- three horizontal conveyors (return)
- three utility transfer augers
- bucket elevator and spouting
- raised driveway and receiving pit
- cross conveyor (receiving pit to bucket elevator)

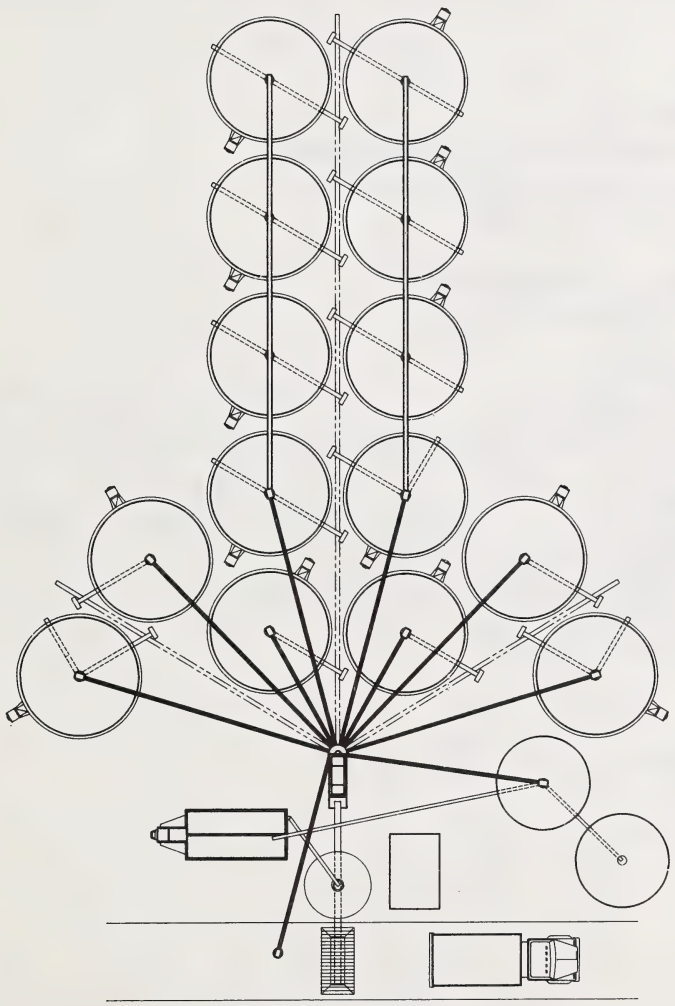
Advantages

- fully mechanized grain handling
- can receive dry grain from field while drying other crop
- one unloading point (over driveway)
- bin to bin grain transfer easily done

Disadvantages

- expansion to bucket elevator is expensive while not adding significant storage capacity

for next expansion stage see IL6a



70 000 bu IL5a

In-line Layout - Stage 6a

The expansion of layout IL5a includes more storage capacity. The two hopper bins (wet surge) are moved over the driveway to be used as wet surge or loadout bins. The space where the hopper bins were located can be utilized for feed or seed processing facilities.

Components

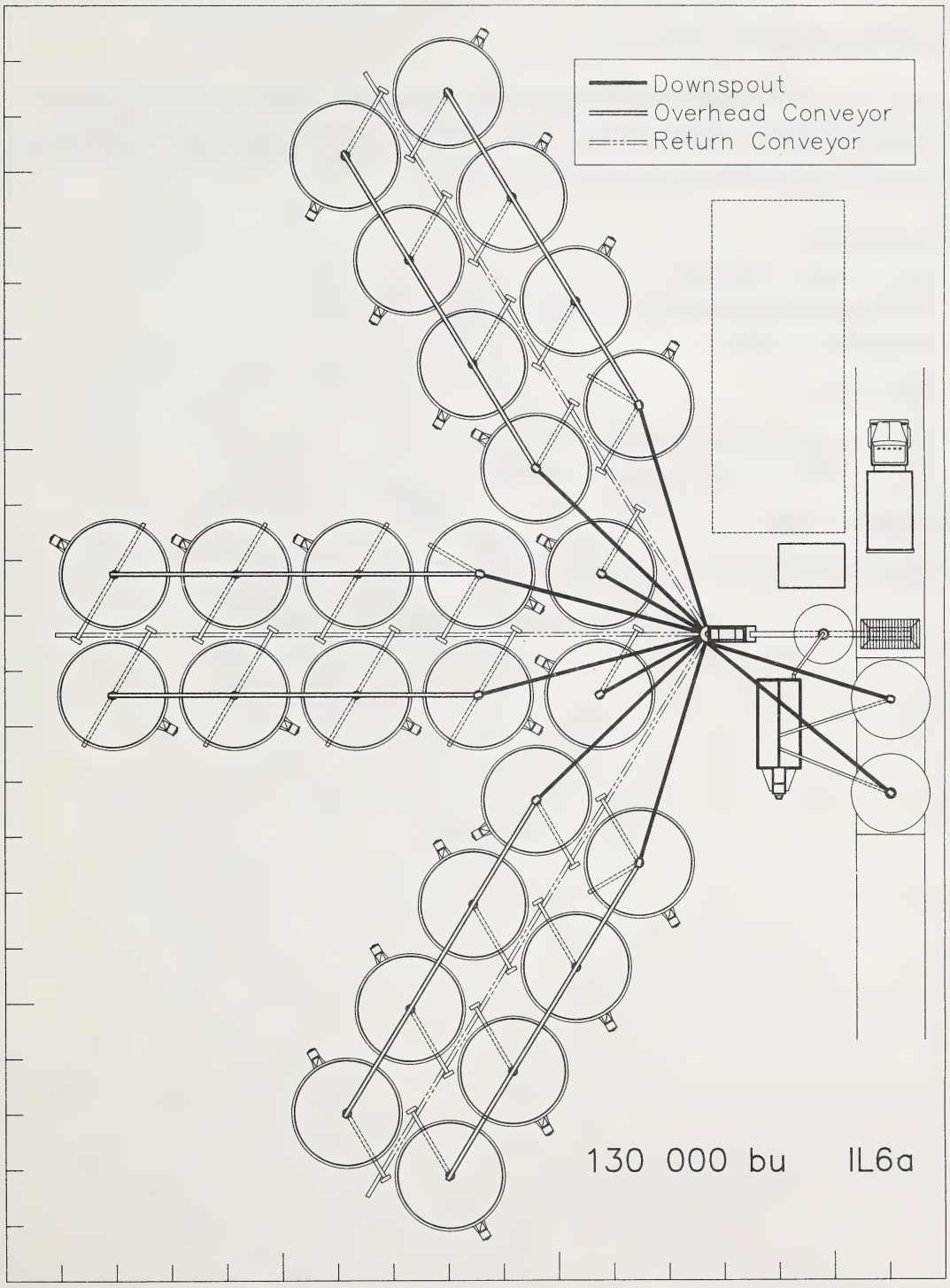
- twentysix 5,000-bushel bins
  (all equipped with aeration floors and unloading tubes)
- two 1,600-bushel hopper bins (wet surge or loadout)
- one 350-bushel hopper bin (dry surge)
- one grain dryer
- six overhead horizontal conveyors (receiving)
- three horizontal conveyors (return)
- three utility transfer augers
- bucket elevator and spouting
- raised driveway and receiving pit
- cross conveyor (receiving pit to bucket elevator)

Advantages

- fully mechanized grain handling
- can receive dry grain from field while drying other crop
- bin to bin grain transfers easily done
- one unloading point (over driveway)

Disadvantages

- total system is expensive


Downspout
Overhead Conveyor
Return Conveyor
130 000 bu IL6a

Circular layout - Stage 1

In the circular arrangement bins can occupy more than half of the circle. This system provides the most storage space utilizing portable augers. Grain is transferred to central pit to unload or transfer the grain from bin to bin. This system will be limited in expansion possibilities if yard space is small.

Components

- eight 5,000-bushel bins
  (equipped with aeration floors and unloading tubes)
- two portable augers

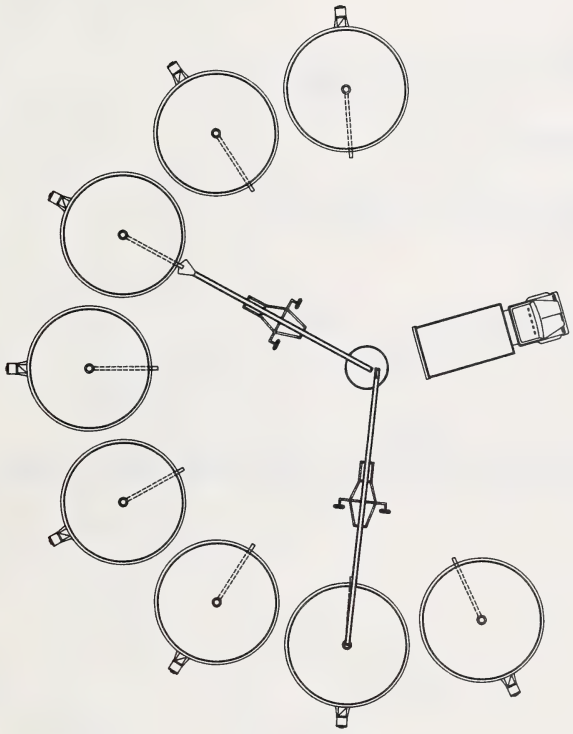
Advantages

- minimal equipment requirements
- grain transfer from bin to bin is possible

Disadvantages

- high degree of auger movement will require good snow removal

for next stage of expansion see C2A or C2B



40 000 bu C1

Circular Layout - Stage 2

The next stage after C1 is to add a grain dryer, wet and dry surge bins. Dry grain is transferred from the dryer to the dry surge bin to load into the storage bins. Grain is brought back to the central pit to unload or to transfer the grain from bin to bin.

Components

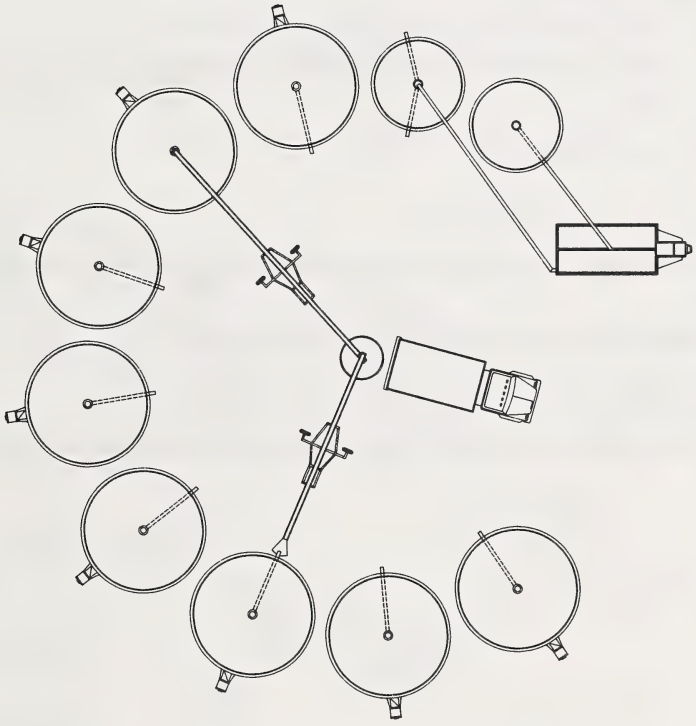
- eight 5,000 bushel bins
  (equipped with aeration floors and unloading tubes)
- two portable augers
- two utility transfer augers
- one grain dryer
- two 1,600-bushel hopper bin (wet and dry surge)

Advantages

- minimal equipment requirements
- grain transfer from bin to bin is possible

Disadvantages

- snow removal inside the circle is important because of greater auger movement



40 000 C2

Circular Layout - Stage 3a

A second circle can be added for increased storage capacity. This system allows for transfer from one circle to the other, by using the dry surge hopper bin common to both circles. Grain can be transferred from one circle to the other as well as from bin to bin within the same circle.

Components

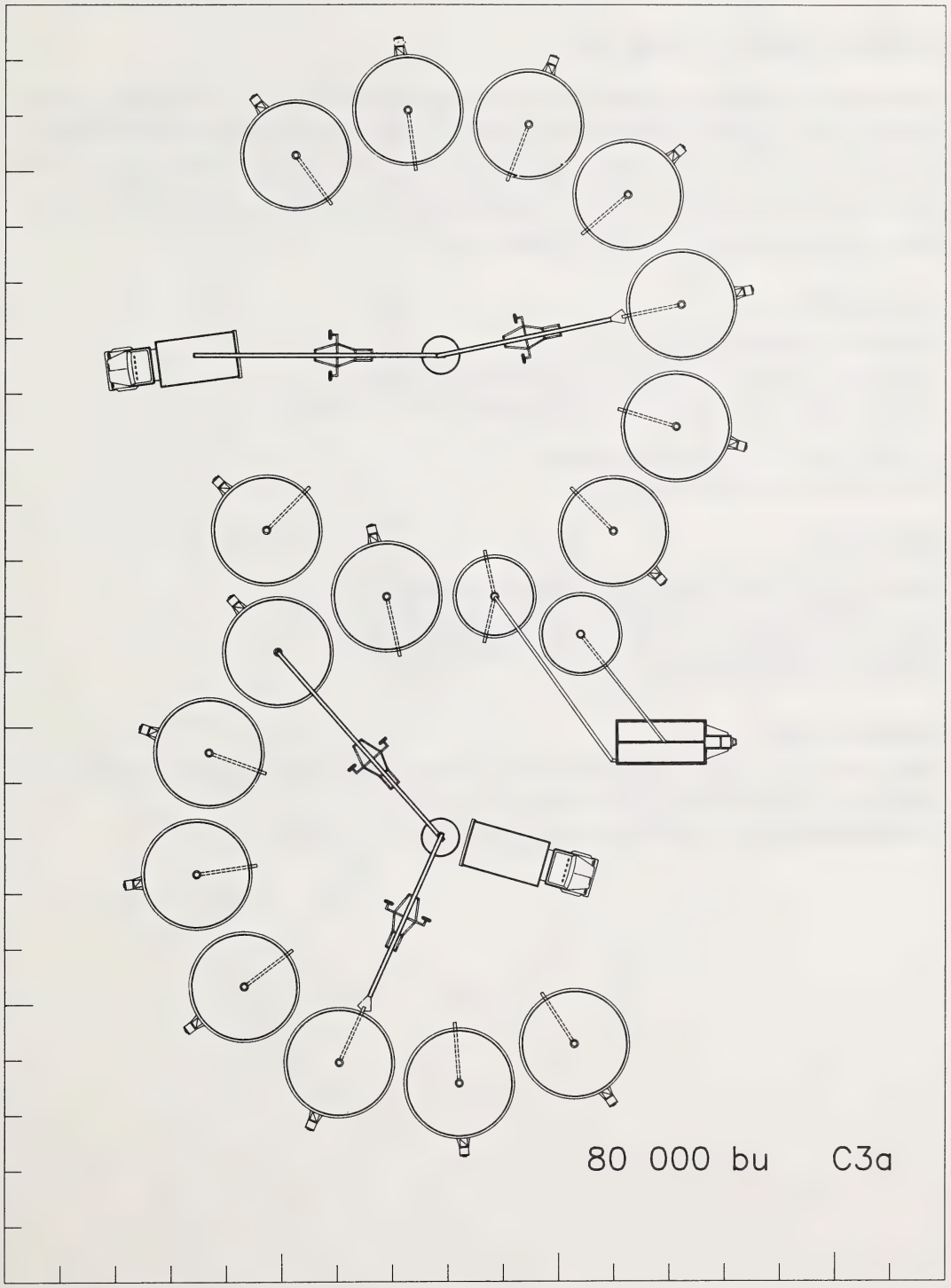
- eight 5,000-bushel bins
  (equipped with aeration floors and unloading tubes)
- two 1,600-bushel hopper bins (wet and dry surge)
- one grain dryer
- a minimum of four portable augers
- two utility transfer augers

Advantages

- large volume of grain storage with relatively small investment in handling equipment
- can dry grain and receive other crop independently

Disadvantages

- one bin can be tied up to transfer grain from one circle to the other (four augers required)


80 000 bu C3a

Circular Layout - Stage 3b

This shows an alternative layout for the double circular system. This system has one common receiving point for both sides of the facility Grain can be transferred from one circle to the other. Note that the position of the grain dryer must be moved from its original position in C2. One hopper bin acts as wet surge for the dryer and the other two hopper bins are dry surge. (either from the dryer or from the field) These three hopper bins can be used for loadout bins.

Components

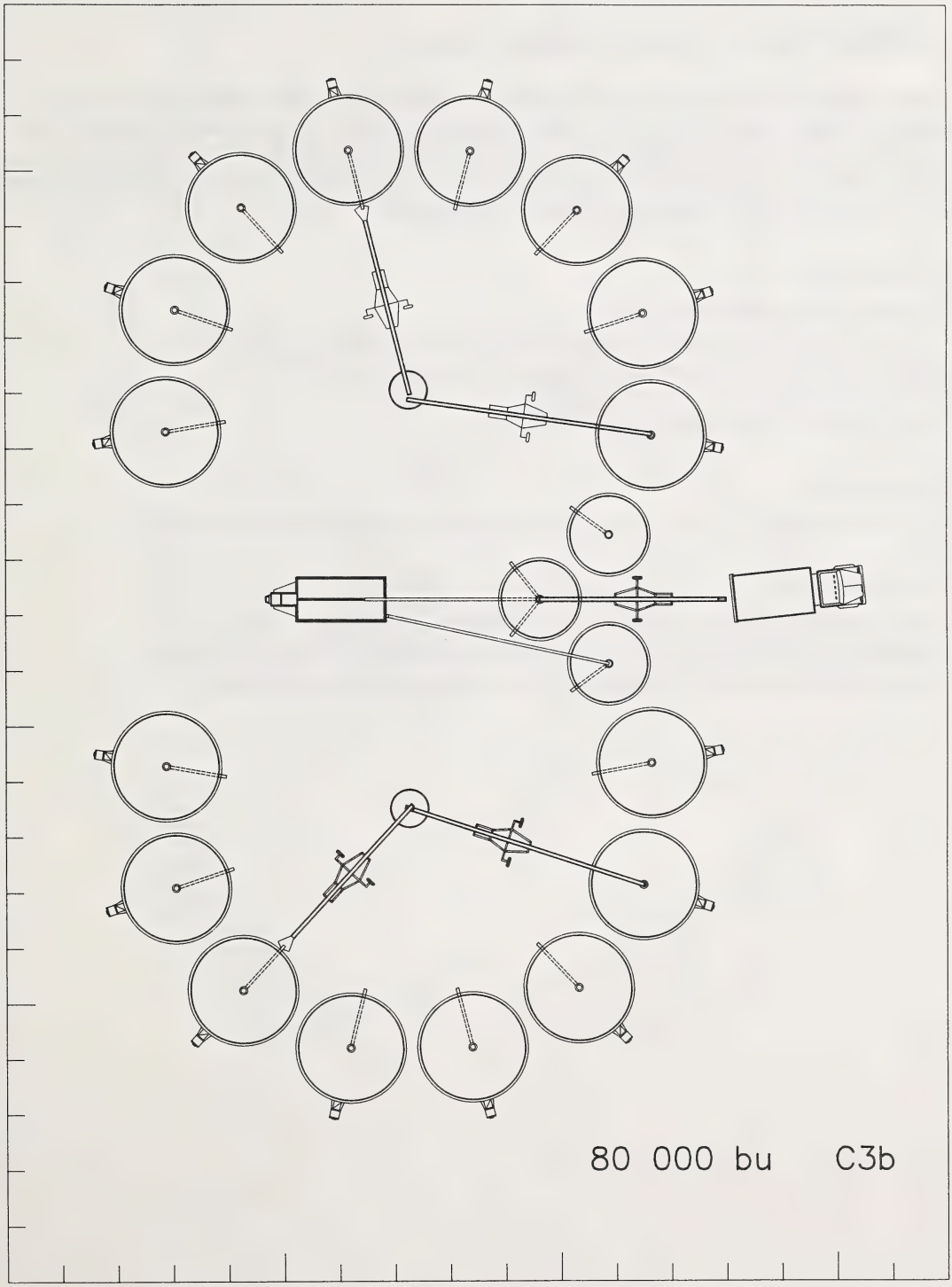
- sixteen 5,000-bushel bins.
  (equipped with aeration floors and unloading tubes)
- three 1,600-bushel hopper bin (one wet and two dry surge)
- one grain dryer
- a minimum of five portable augers
- two utility transfer augers

Advantages

- one receiving point for 80,000 bushels of storage.
- can dry grain and receive other crop independently.
- large volume of grain storage with a relatively small investment in handling equipment

Disadvantages

- five portable augers required if drying and receiving other crop at the same time.
- snow removal from inside the system is very difficult.
- re-positioning of two augers in the same circle is difficult.


80 000 bu C3b

Modified Double Semi-circular Layout

The modified double semi-circular system provides nearly four times the storage capacity as the semi-circular with only the addition of a longer transfer auger. This system is particularly well suited to a recirculating batch dryer. The system is made large enough to provide access to the interior of the facility. Optional wet surge bin(s) would provide more convenience around the dryer.

Components

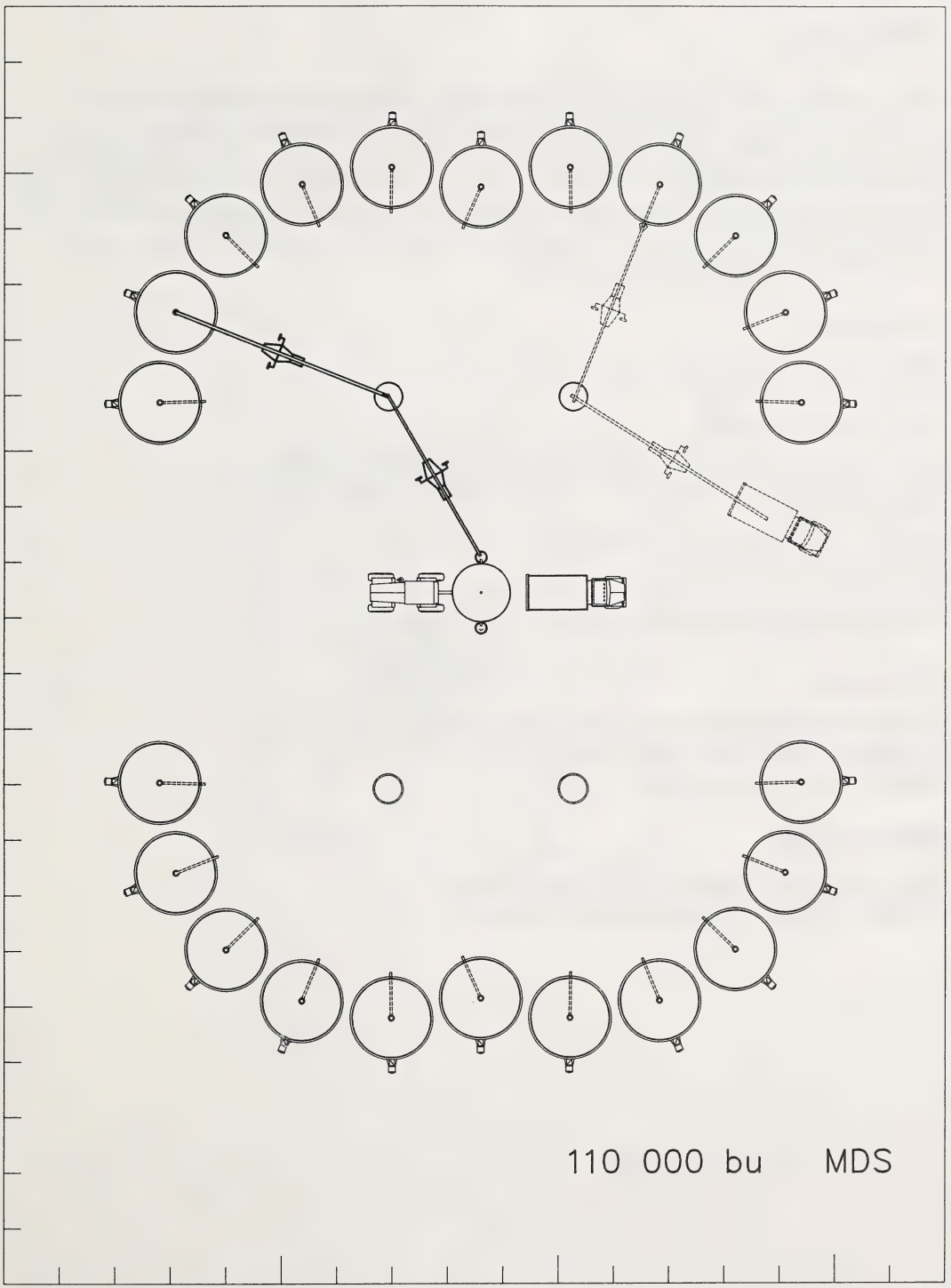
- twentytwo 5,000-bushel bins
  (all equipped with aeration floors and unloading tubes)
- one 1,600-bushel hopper bin (optional wet surge)
- one grain dryer (recirculating batch)
- minimum of two portable farm augers

Advantages

- 110,000 bushels of storage with a minimum of equipment investment

Disadvantages

- four receiving points for dry grain, another for wet grain to dryer
- drying and receiving other crops would require extra transfer augers
- to transfer grain from bin to bin, the augers must be repositioned


110 000 bu MDS

"H" Layout

The H system is well suited to a few large bins, bins of various sizes, or a feed processing center. A divided pit below the driveway acts as surge capacity for receiving wet or dry grain as well as dry surge from the dryer. The surge capacity before the bucket elevator allows the system to operate at a lower handling capacity, thus reducing the cost. An overhead hopper bin acts as wet surge for the dryer or as a loadout bin. This system can be expanded in the future as an inline system with perpendicular driveway. (see layout IL4c)

Components

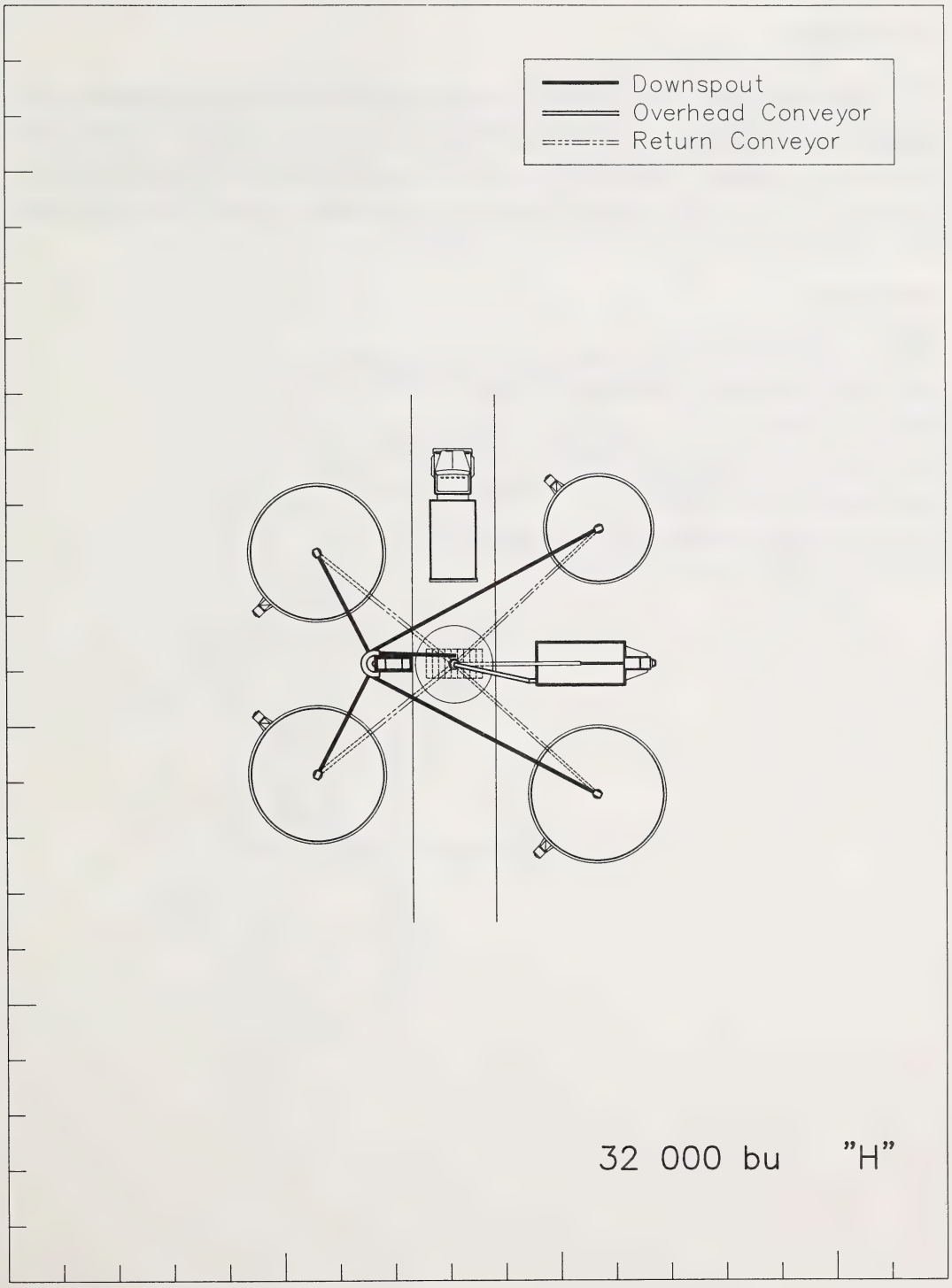
- two 10,000-bushel bins
- one 5,000-bushel bin
- one 7,000-bushel bin
  (all bins equipped with aeration floors and unloading tubes)
- one 1,600-bushel hopper bin (overhead, as wet surge or loadout)
- one grain dryer
- one bucket elevator and spouting
- driveway with divided pit
- two utility transfer augers
- four horizontal conveyors (return)

Advantages

- a number of bin sizes can be used in this system
- a large volume of storage in a small area
- central receiving/loadout

Disadvantages

- few varieties or grades of grain can be stored
- bucket elevator required at start of system

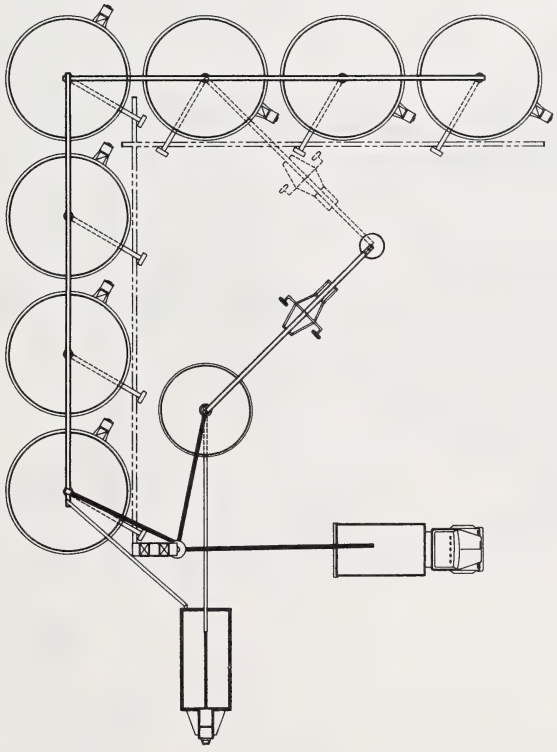

Downspout
Overhead Conveyor
Return Conveyor
32 000 bu "H"

"L" Layout

If the bins are arranged in a "L" layout close to a shelter belt the grain movement can be mechanized by using a series of horizontal conveyors and a short bucket elevator. The drying system uses the hopper bin or alternatively one of the grain storage bins for wet surge capacity. Dry grain from the field can be loaded directly into storage bins while drying the other crop. Two horizontal conveyors (return) bring grain back to the bucket elevator for unloading or recirculation.

Components

- seven 5,000-bushel bins
  (all equipped with aeration floors and unloading tubes)
- one 1,600-bushel hopper bin (wet surge)
- one grain dryer
- one bucket elevator and spouting
- two utility transfer augers
- one portable farm auger
- two overhead horizontal conveyors (receiving)
- two horizontal conveyors (return)



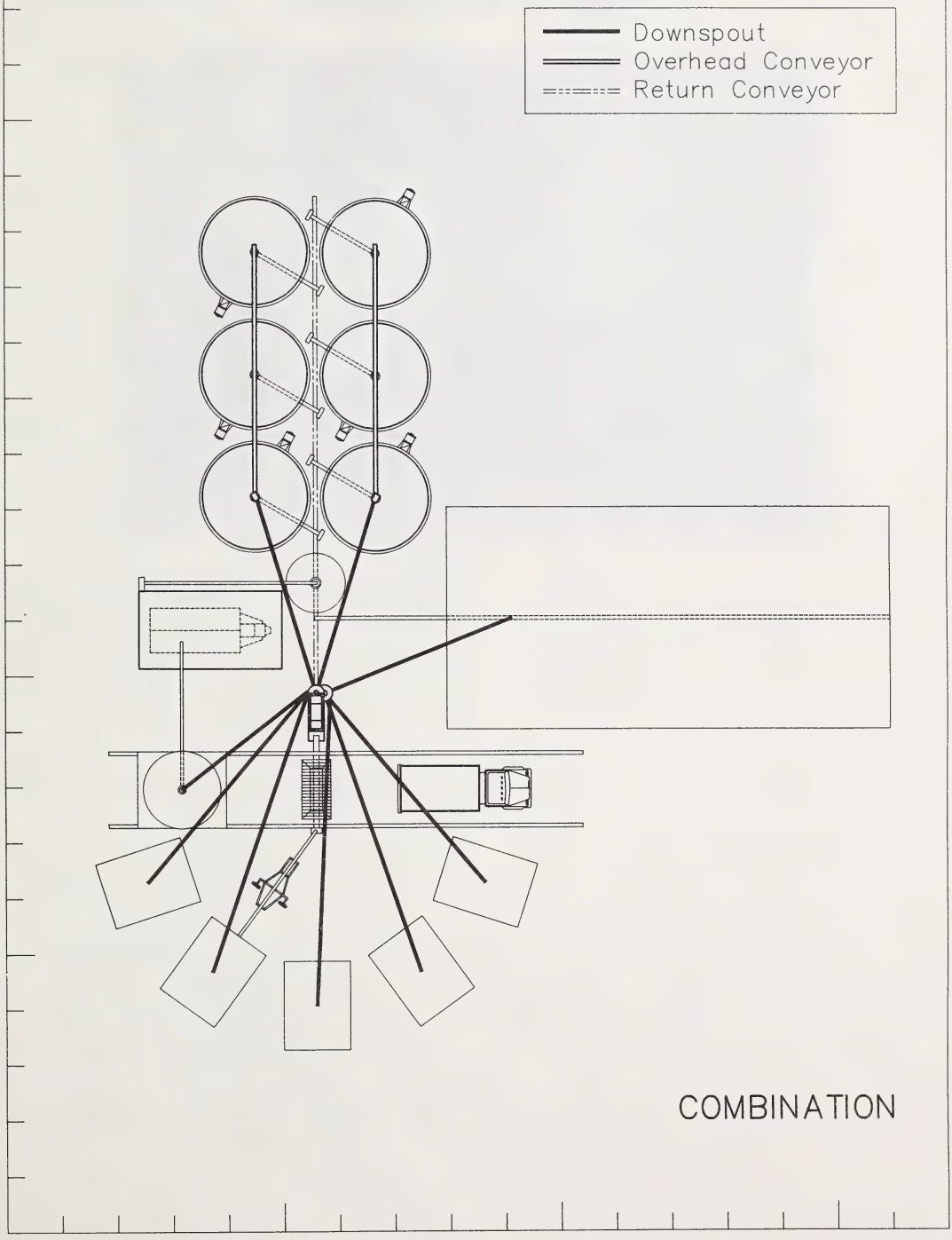
35 000 bu "L"

Combination Layout

This layout illustrates how various types of storage already present on the farm can be positioned to centralize and mechanize grain handling. The small rectangular bins are placed on one side of the driveway in an independent semi-circle. The quonset is filled with a downspout and distribution auger. Downspouting also feeds the two horizontal conveyors over the steel bins in the double in-line system. One horizontal conveyor returns grain back to the bucket elevator from the in-line system. The quonset is unloaded with a tractor loader and utility transfer auger to the return conveyor. The overhead hopper bin is used as wet surge for the dryer, or as loadout. A dry surge bin located over the horizontal return conveyor is fed from the dryer.

Components

- six 5,000-bushel bins
  (equipped with aeration floors and unloading tubes)
- five 1,300-bushel wooden granaries
- one quonset
- one grain dryer
- one driveway and receiving pit
- one 1,600-bushel hopper bin (over driveway as loadout or wet surge)
- one 350-bushel hopper bin (dry surge)
- one bucket elevator and spouting
- two overhead horizontal conveyors (receiving)
- one horizontal conveyor (return)
- three utility transfer augers
- one distribution auger
- one portable farm auger
- one cross conveyor (receiving pit to bucket elevator)


Downspout
Overhead Conveyor
Return Conveyor
COMBINATION

DESIGN AIDS

Worksheet

		expected yield		area		storage volume	
wheat	1	_____ bu/ac	x	_____ acres	=	_____	bushels
	2	_____ bu/ac	x	_____ acres	=	_____	bushels
	3	_____ bu/ac	x	_____ acres	=	_____	bushels
barley	1	_____ bu/ac	x	_____ acres	=	_____	bushels
	2	_____ bu/ac	x	_____ acres	=	_____	bushels
canola	1	_____ bu/ac	x	_____ acres	=	_____	bushels
	2	_____ bu/ac	x	_____ acres	=	_____	bushels
other	1	_____ bu/ac	x	_____ acres	=	_____	bushels
					Total =	_____	bushels

Wet Surge capacity

estimated combine capacity _____ bu/hr (1)

estimated dryer capacity _____ bu/hr (2)

hours combined per day _____ hrs/day (3)

Wet Surge capacity = ((1) - (2)) x (3) = _____ bushels

Grain Receiving Capacity

With no dump pit, the grain receiving conveyor must have high capacity to keep up with harvesting. With a large dump pit, the conveyor's capacity can be as low as the harvesting rate.
For transport vehicles of different capacities, size grain receiving conveyor capacity based on the time to unload the largest vehicle. In a two vehicle system, the largest vehicle must travel to the grain centre, unload, and return while the smallest vehicle fills. Estimate grain receiving capacity for a two-vehicle system using the following steps.

1. Estimate maximum harvest rate (bu/hr) ..... (1)
2. Determine grain capacity of the largest vehicle (bu) ..... (2)
3. Determine grain capacity of the smallest vehicle (bu) ..... (3)
4. Estimate travel time for the largest vehicle to go from the farthest field to the grain centre (min) ..... (4)
5. Estimate travel time for the largest vehicle to return to the field (min) ... (5)

   If calculated: (4) or (5) = $\frac{60 \times \text{distance (mi)}}{\text{speed (mi/hr)}}$
6. Miscellaneous activities (minimum 5 min) ..... (6)
7. Time to fill the smallest vehicle (min)
   $\frac{(3) \times 60}{(1)}$ = ... (7)
8. Time available for the largest vehicle to unload at the receiving area (min)
   = (7) - (4) - (5) - (6) = ... (8)
9. Minimum receiving pit capacity required
   = $(2) - \frac{((1) \times (8))}{60}$ = ... (9)
10. If actual pit capacity (bu) is equal or greater than required pit capacity then unloading conveyor capacity (bu/hr) can be as low as the harvesting rate.
    Actual pit capacity (bu) = ... (10)
11. If actual pit capacity (10) is less than minimum required (9) or if there is no pit, the unloading capacity (bu/hr) = $((2) - (10)) \times \frac{60}{(8)}$ ..... (11)

Example

Determine unloading capacity for a 400 bu/hr, (1) harvest rate, one 500 bu, (2) vehicle, and one 300 bu, (3) vehicle. The largest vehicle's speed averages 10 mph (both ways) from the farthest field one mile from the grain centre.

$$(4) = (5) = \frac{60 \times 1 \text{ mile}}{10 \text{ mph}} = 6 \text{ min each way}$$

Assume 5 min for miscellaneous activities (6)

Calculate the time to fill the smallest vehicle

$$(7) = \frac{300 \times 60}{400} = 45 \text{ min}$$

Calculate time available for the largest vehicle to unload (8)

$$(8) = 45 - 6 - 6 - 5 = 28 \text{ min}$$

Calculate minimum receiving pit capacity (9) for unloading to keep up with harvesting rate

$$(9) = 500 \text{ bu} - \frac{(400 \times 28)}{60} = 313 \text{ bu}$$

If actual pit capacity (10) is 313 bu or larger, unloading conveyor capacity (11) can be as low as 400 bu/hr (1)

If (10) is 250 bu

$$(11) = (500 - 250) \times \frac{60}{28} = 536 \text{ bu/hr}$$

If 10 = 0 (No dump pit)

$$(11) = (500-0) \times \frac{60}{28} = 1071 \text{ bu/hr}$$

Radius of Semi-circular Bin Arrangement

Bin Diameter (ft)	No. of bins in semi-circle 4	5	6	7	8
14	22 - 2	27 - 6	32 - 10	38 - 2	43 - 7
15	23 - 6	29 - 0	34 - 9	40 - 5	46 - 2
16	24 - 10	30 - 9	36 - 9	42 - 8	48 - 8
17	26 - 0	32 - 4	38 - 8	45 - 0	51 - 3
18	27 - 5	34 - 0	41 - 9	47 - 2	53 - 10
19	28 - 9	35 - 7	42 - 6	49 - 5	56 - 5
20	30 - 0	37 - 3	44 - 5	51 - 8	59 - 0
21	31 - 4	38 - 10	46 - 4	54 - 0	61 - 6
24	35 - 3	43 - 8	52 - 2	60 - 8	---
30	43 - 0	53 - 5	63 - 9	---	---
36	51 - 0	63 - 0	---	---	---
42	58 - 9	---	---	---	---

Note: Assuming two feet clearance between bin, foundations and diameter of bin, foundation is one foot larger than bin diameter.

All radius dimensions are in feet and inches (ft -in)

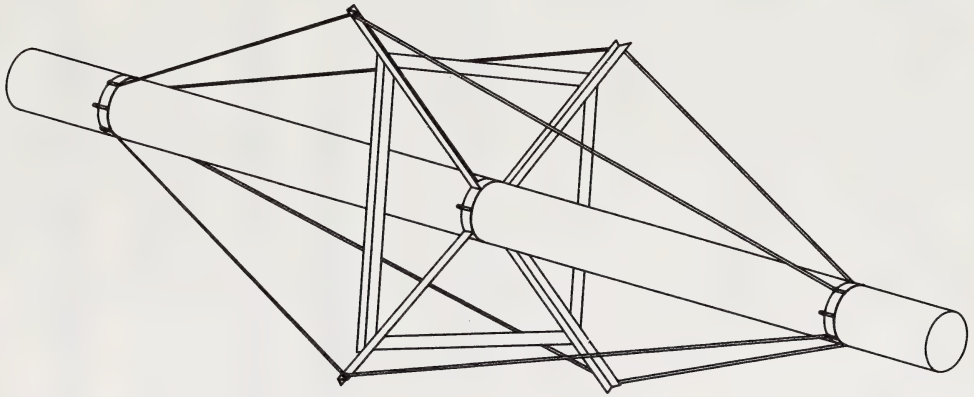
Radius of Circular Bin Arrangement

Bin Diameter (ft)	No. of bins	Radius of Circle (ft - in)
14	7	31 - 0
	9	36 - 7
	11	42 - 0
	13	46 - 5
19	5	28 - 6
	6	30 - 2
	7	38 - 10
	8	41 - 5
	9	44 - 6
	10	46 - 8
25	5	31 - 7
	6	37 - 8
	7	43 - 6

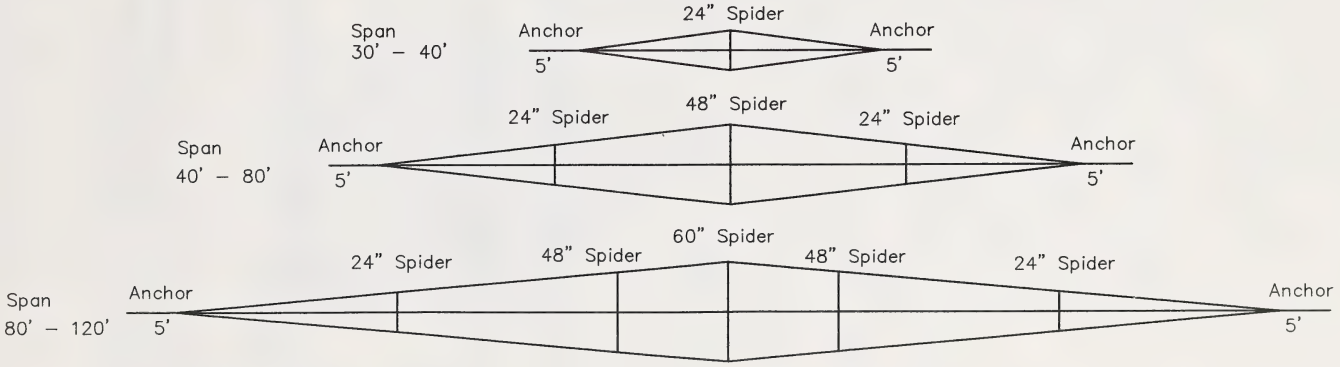
Estimated Capacity of Down Spouts for Dry Grain

Downspout Diameter (in.)	Capacity (bu/hr)
4	800
6	1800
8	3200
10	5100
12	7300

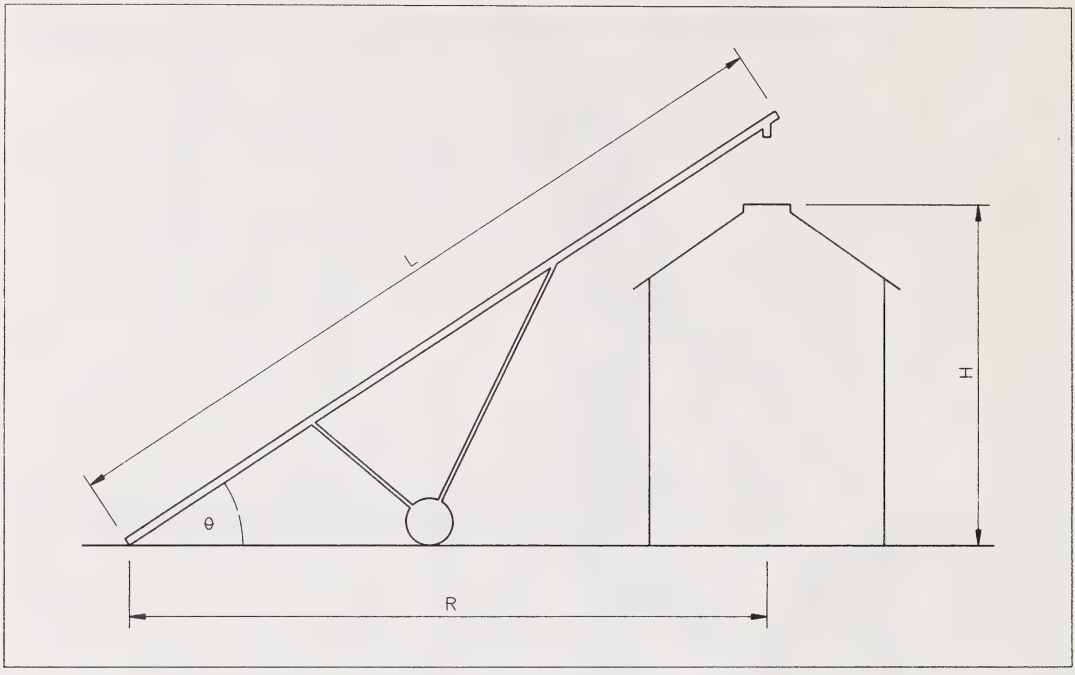
Note: Spout angle of 45° slope have a capacity of about 65 bu/hr/in^2 of downspout open area.



Recommended Truss Layout



SPOUT TRUSS REQUIREMENTS



CONVEYOR LENGTH, ANGLE, DISTANCE AND HEIGHT VARIABLES

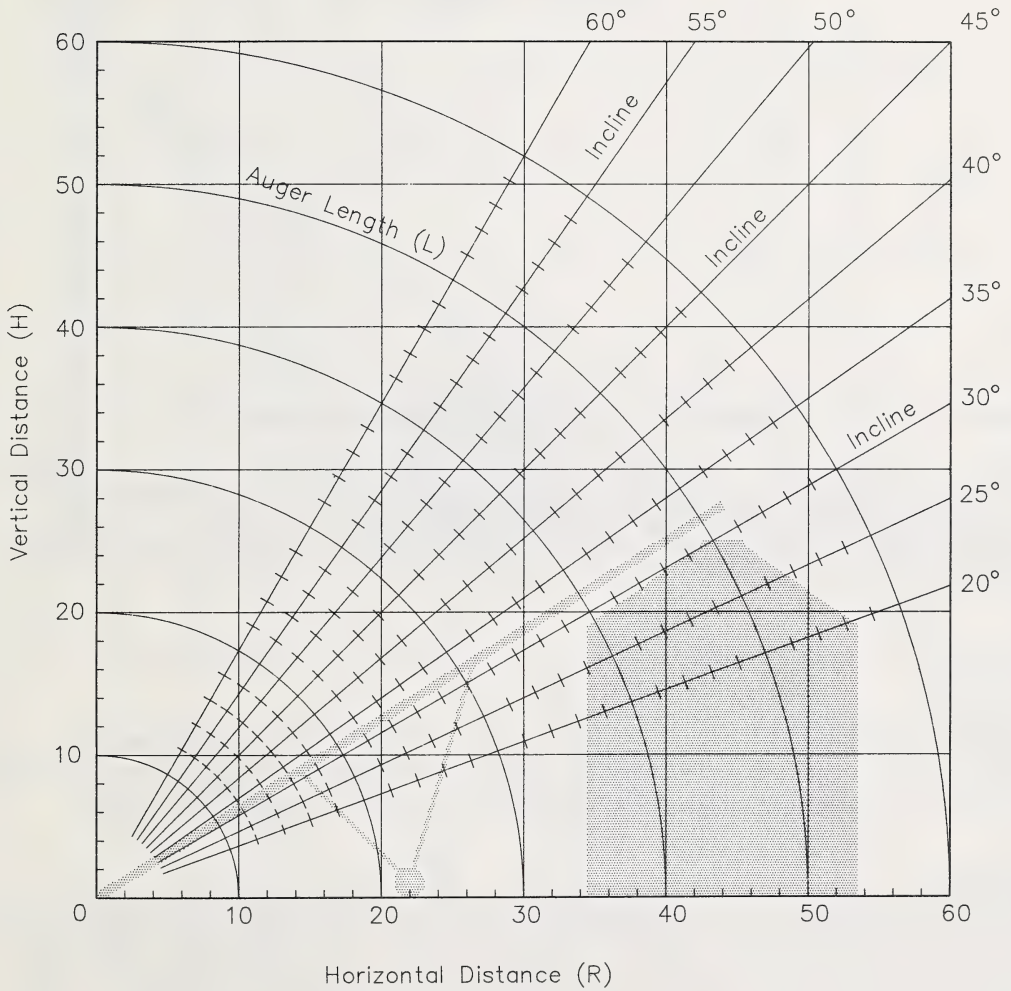
Conveyor Length, Angle, Distance and Height Chart

The figure above shows four dimensions and one angle. If any two are known the other two can be calculated.

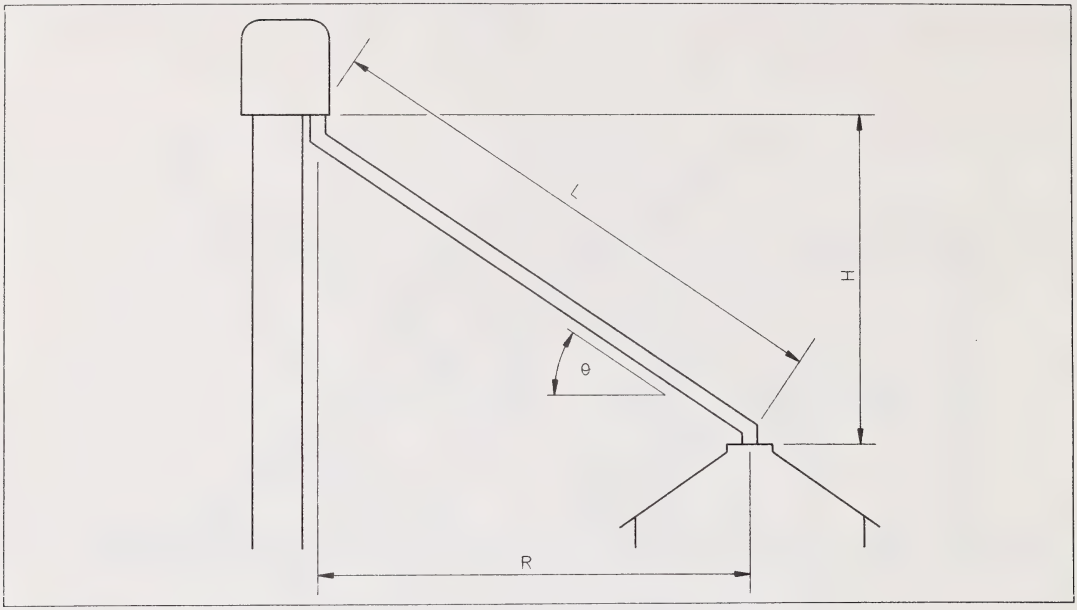
Example

Problem:
A farmer has 25 ft high bins arranged in a 44 ft radius (R) bin circle. What length of auger is required.?

Solution:
Find the distance of 44 ft (R) along the bottom of the chart. Move up the chart, vertically until a bin height of 25 is read along the left hand scale. An auger length of 51 ft (L) is read on the curved lines.



CONVEYOR LENGTH, ANGLE, DISTANCE, AND HEIGHT CHART



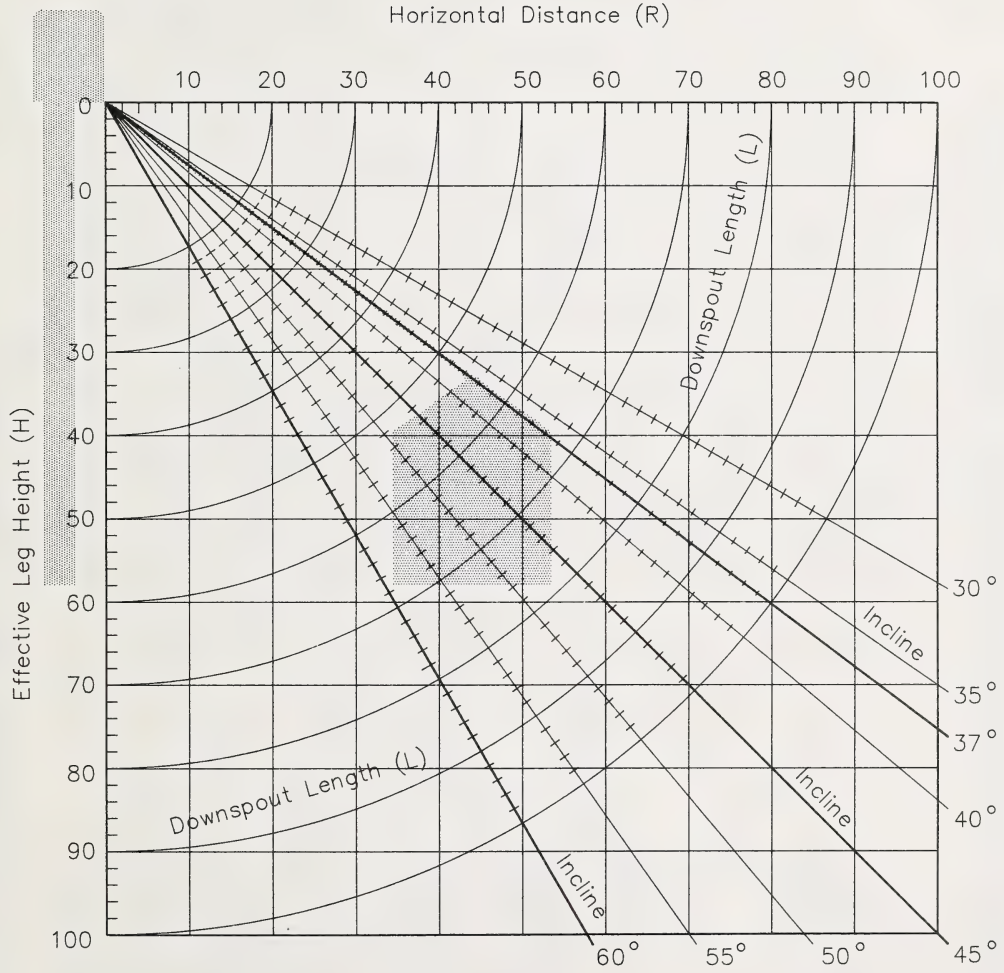
Spout Length, Angle and Discharge Height Chart

If the development of a grain handling and storage system requires the addition of a vertical leg this chart can be used to determine the required dimensions. The following figure shows four dimensions. Given any two of these the other two can be determined.

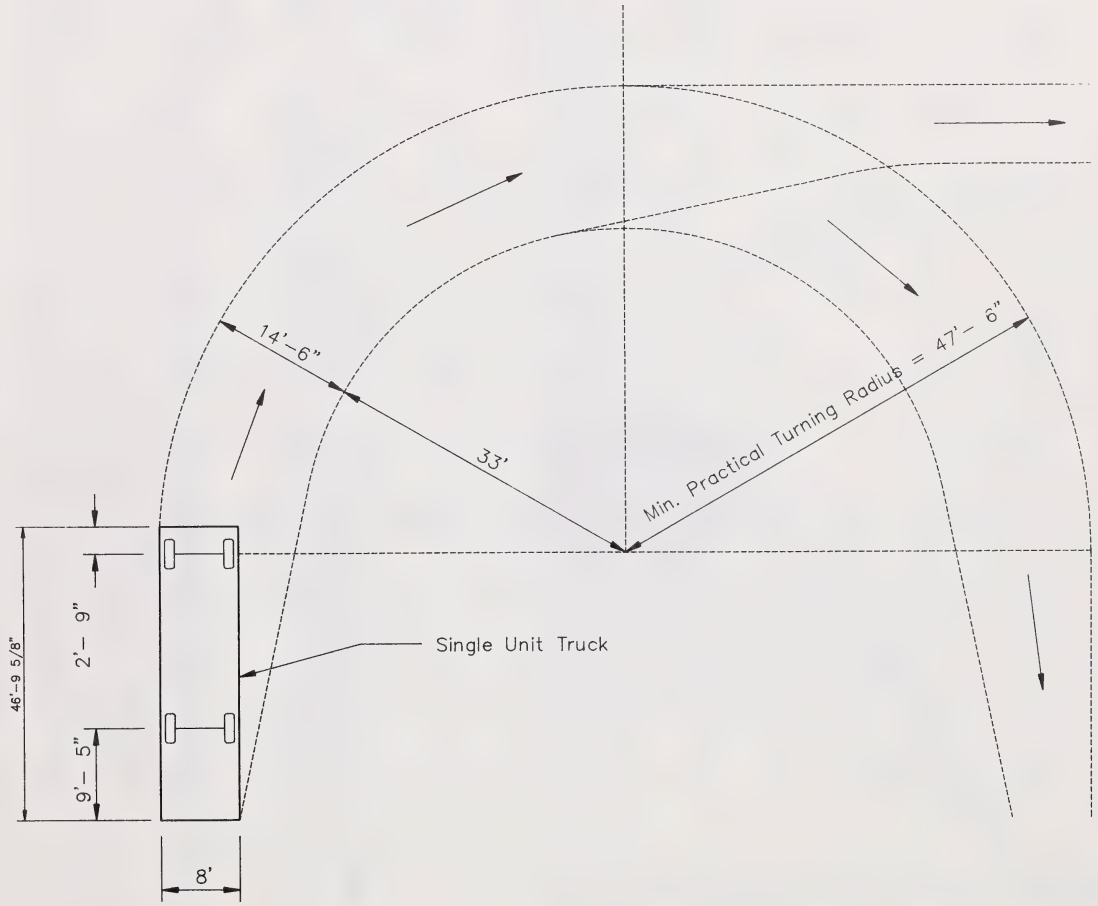
Example

Problem:
A farmer knows that his 25 ft high bin is located 44 ft (R) from the proposed leg location. He wants to maintain the spout angle at the minimum 37° recommended for dry grain. What effective height of leg and length of downspout are required?

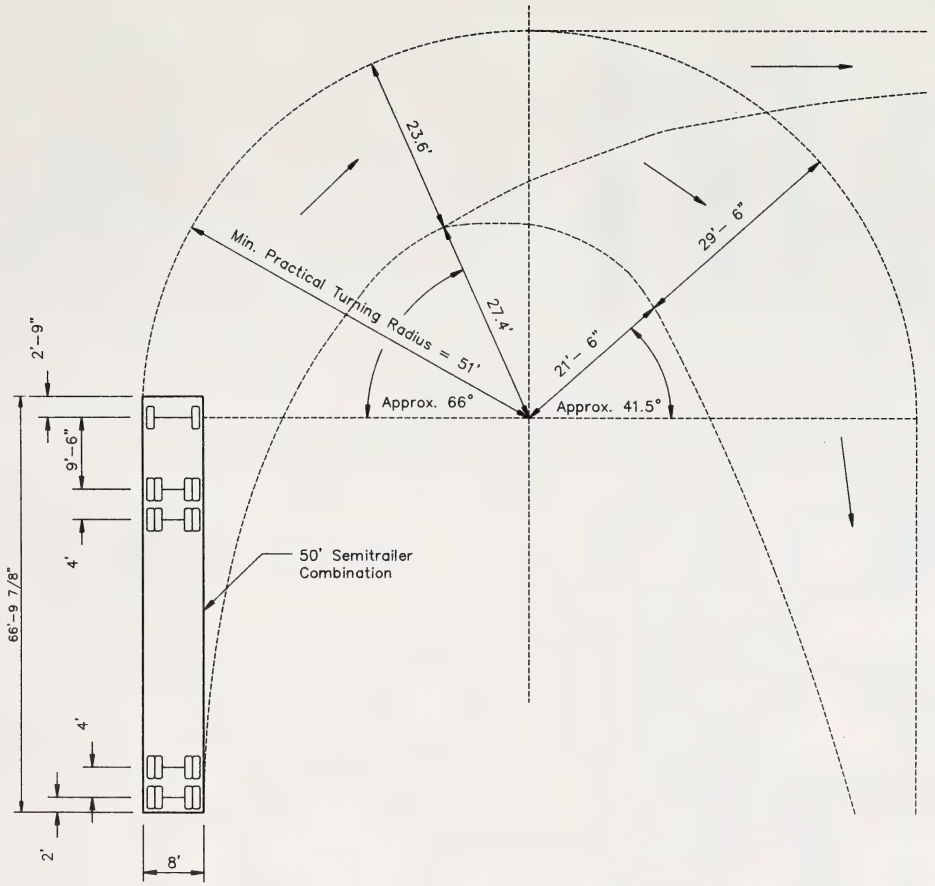
Solution:
Locate the bin peak 44 ft (R) from the leg by moving right horizontally along the top of the chart and vertically downward to the 37° slope line. The length of downspout (L) is read as 55 ft from the scale on the diagonal slope line. The height of the leg above the bin is determined by moving left horizontally to the left hand scale and read as 33 ft (H). Add the height of the bin (25 ft) to this to determine the effective leg height of 58 ft. Room for the distributor is required above this.



SPOUT LENGTH, ANGLE, AND DISCHARGE HEIGHT



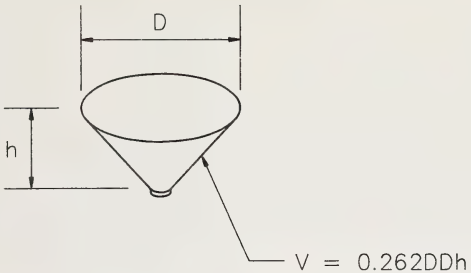
SINGLE UNIT TRUCK — MINIMUM PRACTICAL TURNING RADIUS

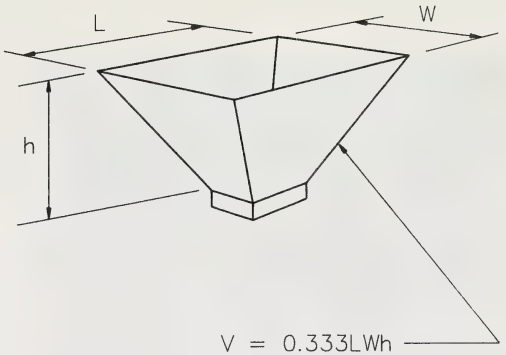


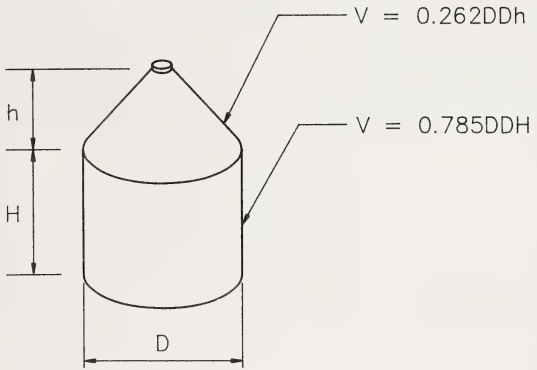
SEMITRAILER COMBINATION - MINIMUM PRACTICAL TURNING RADIUS

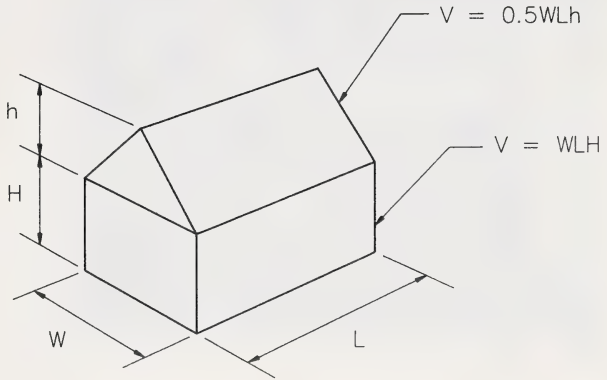
Conversion Constants

Imperial Units	Multiply By	Results In
1 foot (ft)	x .3048	metre (m)
1 mile	x 1.61	kilometre (km)
1 square foot	x .093	square metre (m^2)
1 bushel	x .036	cubic metre (m^3)
1 cubic foot	x .0283	cubic metre (m^3)
1 cubic foot per minute (cfm)	x .47	litres per second (L/S)
1 cubic foot per minute per bushel (cfm/bu)	x 13	litres per second per cubic metre (L/S m^3)
1 inch of water (pressure)	x 250	pascals (Pa) (pressure)



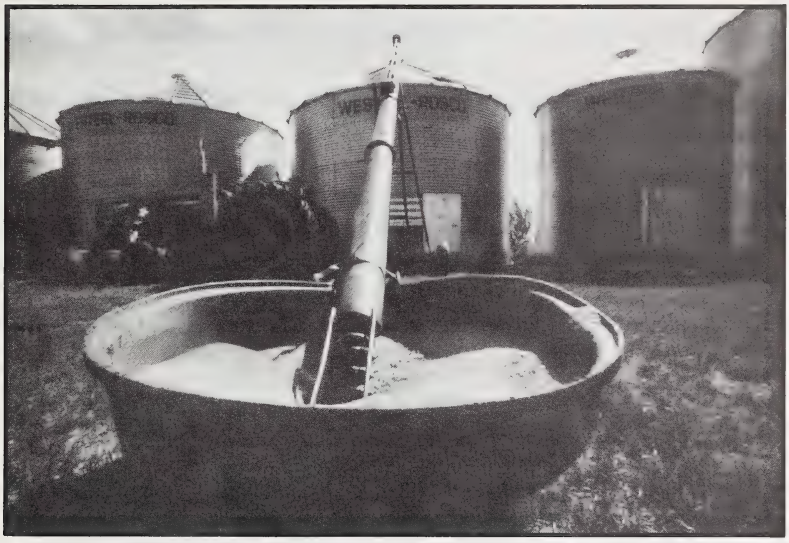






VOLUME CALCULATIONS

APPENDIX



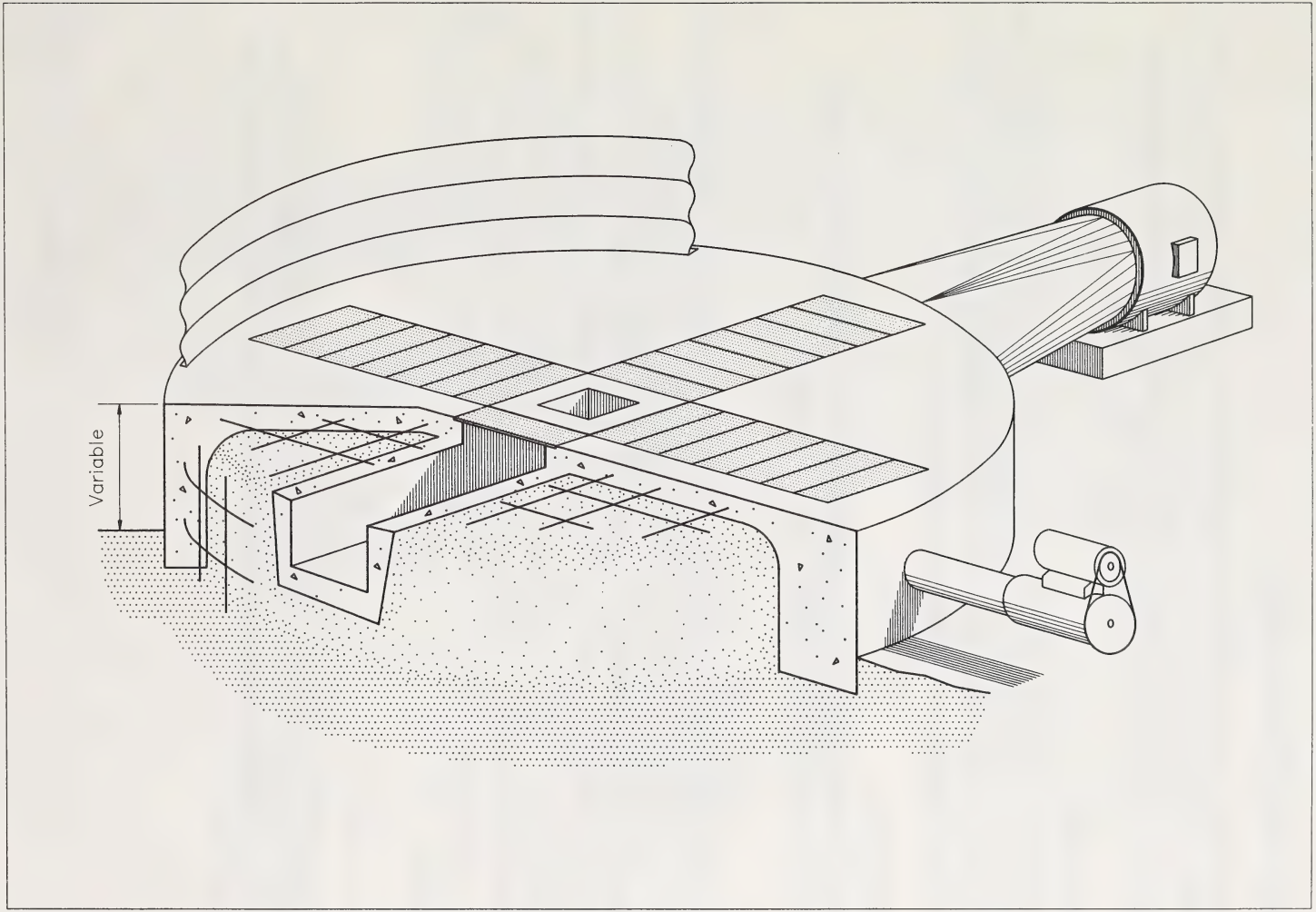
Flat Bin Foundations

The foundation and floor for a grain bin must protect the grain from moisture and rodents, as well as anchor the bin. A method for removing the grain must be provided.
A vapor barrier of 4 mil polyethylene should be placed under the floor to prevent moisture form coming through the concrete.
Grain bins should be located in a well drained site, with access for convenient filling and emptying. Before placing any grain on the floor, allow the concrete to cure for 30 days. If grain must be placed in the bin prior to the 30 days a layer of polyethylene will prevent the grain from drawing moisture from the concrete.

Before constructing foundation consult the manufacturer of the steel bins on details such as:
-foundation and bin diameter
-bin anchors
-unloading equipment requirements
-aeration equipment requirements

The foundation is high enough to allow room under the unloading tube for grain conveying equipment.

Aeration ducts are cast into the floor with appropriate reinforcing. The ducts are sized according to aeration fan capacity and unloading tubes, if placed within a duct.



GRAIN BIN FOUNDATION AND FLOOR

Hopper Bin Foundations

Hopper bins require a carefully designed foundation as the bin stand concentrates the load to 6-8 points.
There are three types of footings for steel hopper bottom bins: slab, ring and pile. Each type is best suited for a specific application.

Slab Footing

A slab footing is easy to form. The steel is easy to place. The low pressure on the soil makes it suitable for almost any soil situation. A large slab provides flexibility in placing the bin on the slab and makes clean-up around the bin very easy. However, there is considerable extra cost for steel and concrete.

Ring Footing

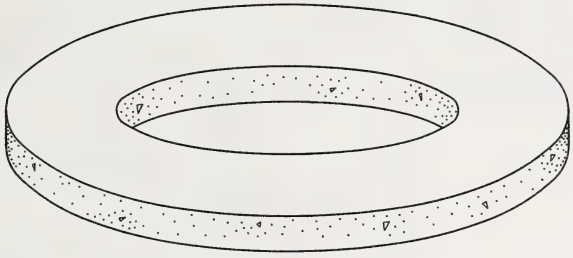
The ring footing usually requires the least material, although it may require somewhat more labor to build than the other two types.

Piles

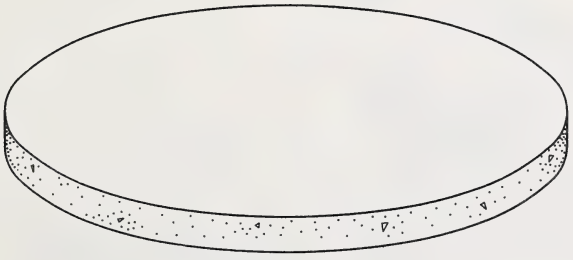
Generally, piles are best suited for situations when an extremely strong layer of soil, gravel or rock is present at 8 to 14 ft below the surface. These situations are relatively uncommon and are very site specific so piles cannot be recommended without a soil test performed by a geotechnical soil testing firm.
Because of frost action on soils, no benefit can be considered from friction on the top 6 ft of a pile. For a 12 ft pile, only 6 ft of friction effect can be considered. This is relatively minor. What becomes more important with most farm foundation is the end area of the pile. For a pile with an end area of 1.77 ft^2 (18 in. diameter) on a soil with a bearing capacity of 6,000 lb/ft^2, the allowable load per pile would be 10,000 lb. For a bin with six legs on six piles, the maximum bin size should not exceed 1,000 bu (60,000 lb).

Construction

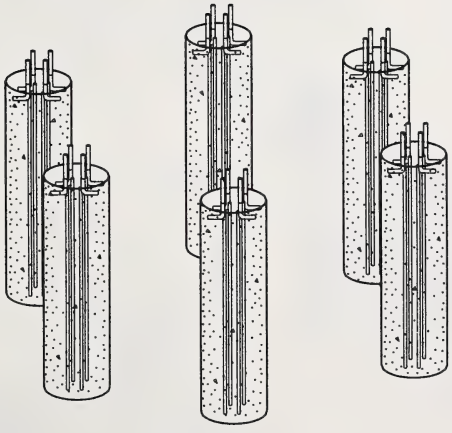
When constructing a slab or ring footing, pay careful attention to limits of soil strength, concrete strength and number of legs. It is important that the topsoil be removed to firm subsoil and compacted gravel be placed to bring the level up to the footing base.



Ring Footing

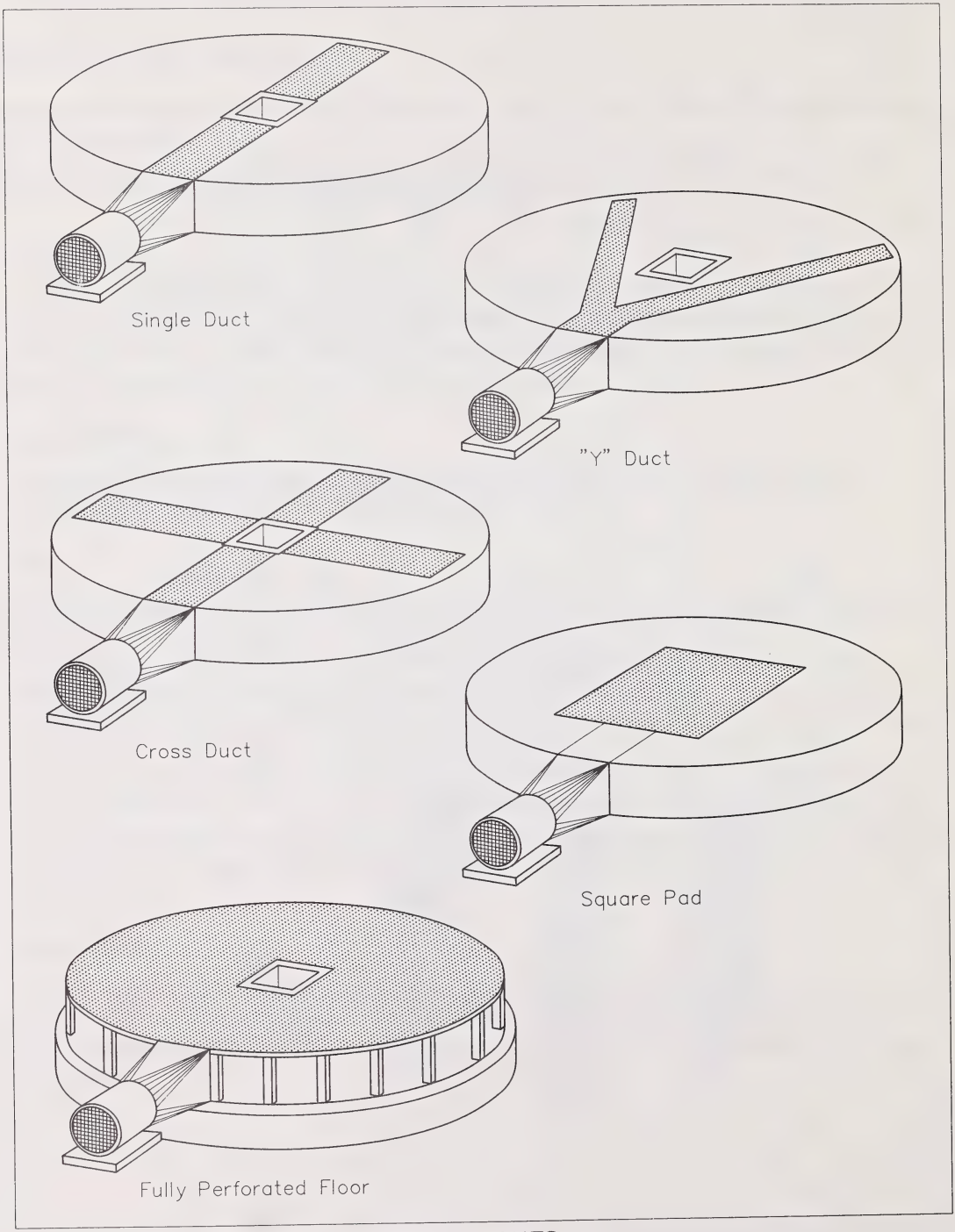


Slab Footing

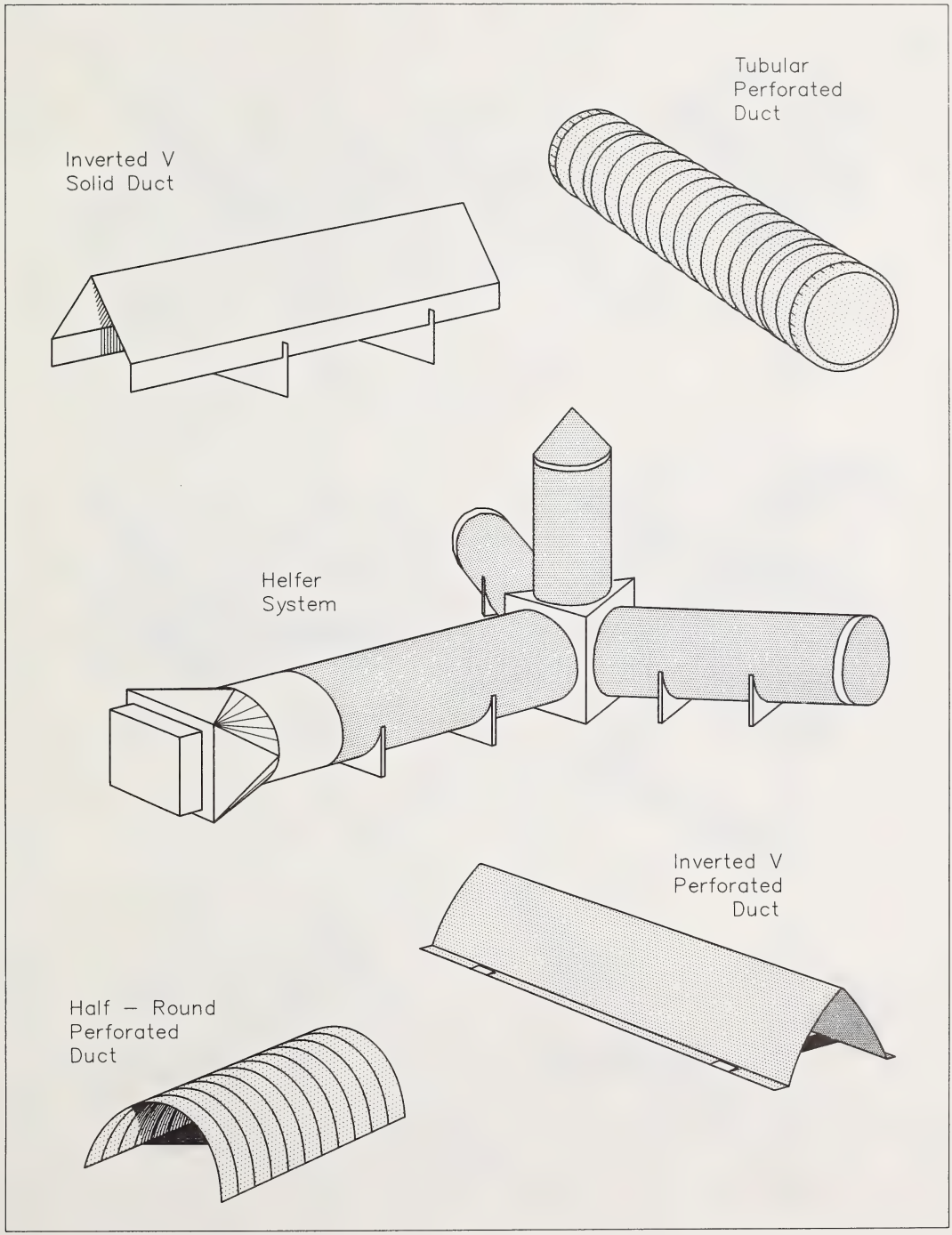


Piles

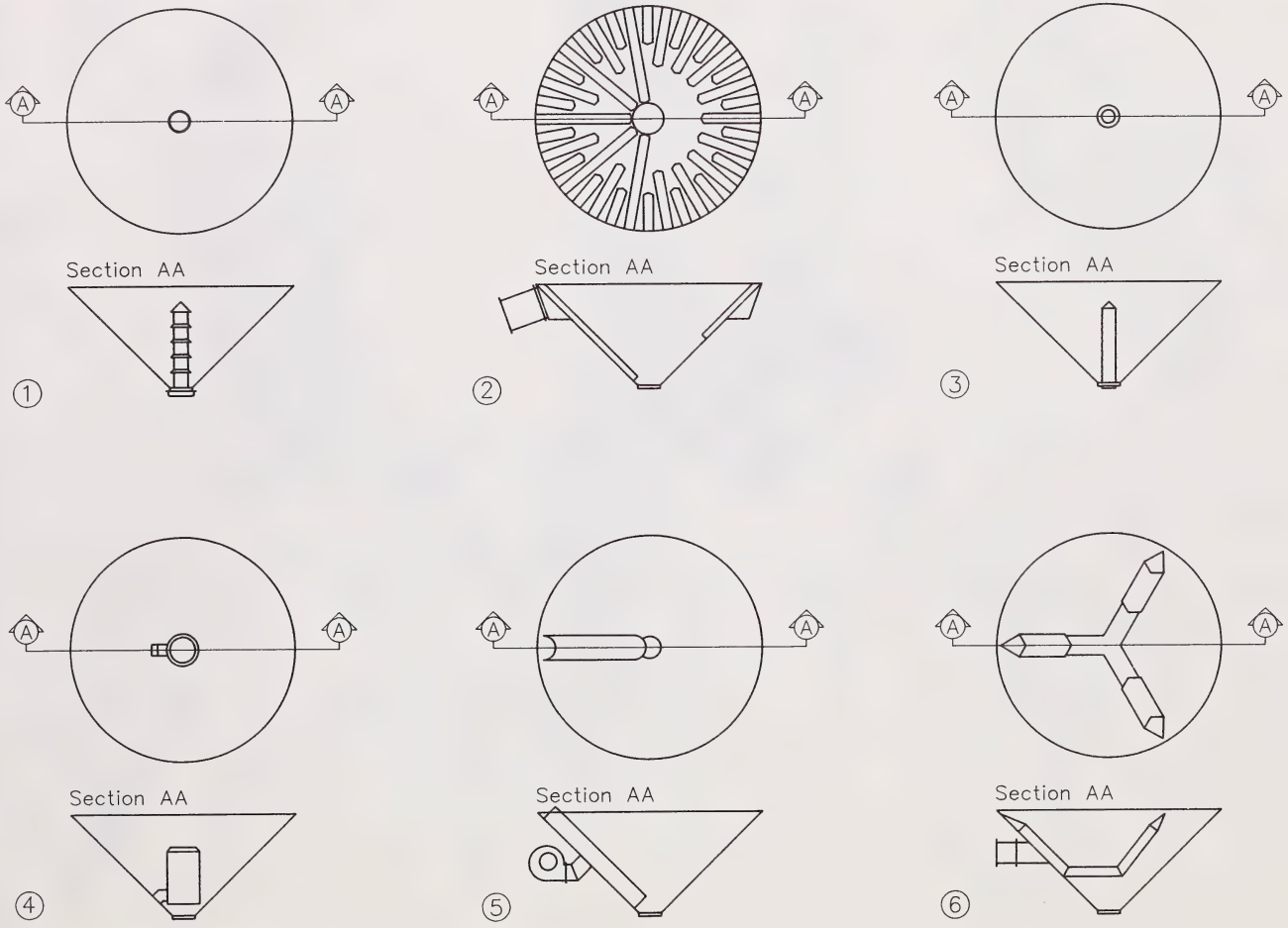
HOPPER BIN FOUNDATIONS



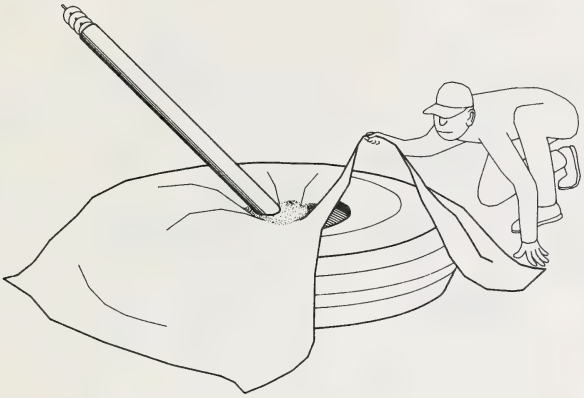
FLUSH FLOOR AERATION SYSTEM LAYOUTS



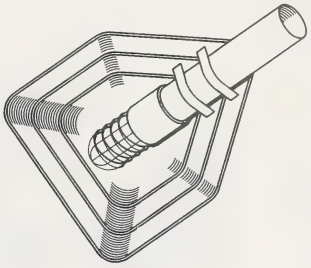
ABOVE FLOOR AERATION SYSTEM LAYOUTS



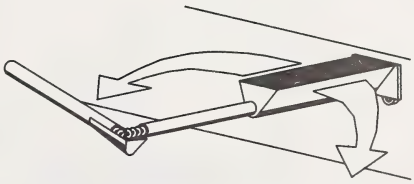
HOPPER BOTTOM AERATION SYSTEMS



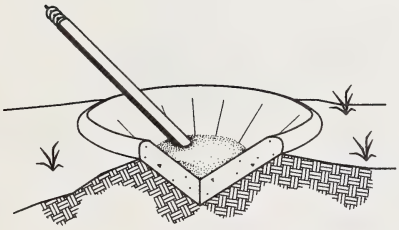
Tractor tire (or truck tire) with canvas



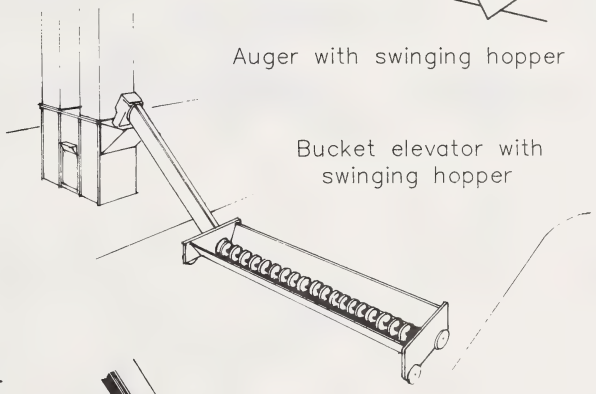
Flexible hopper



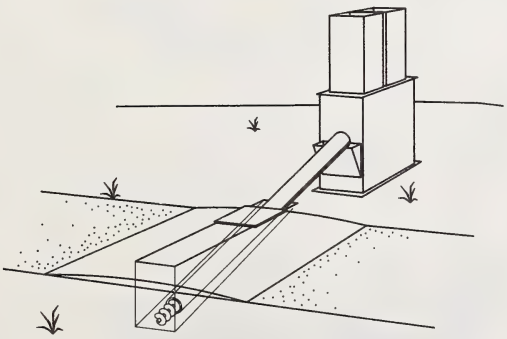
Auger with swinging hopper



Concrete hopper



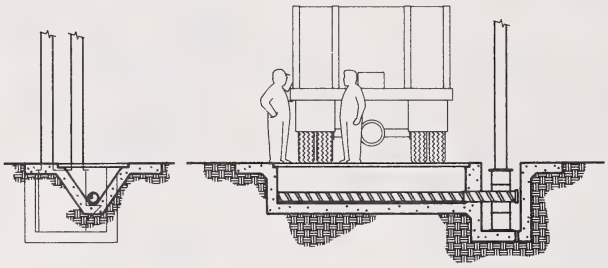
Bucket elevator with swinging hopper



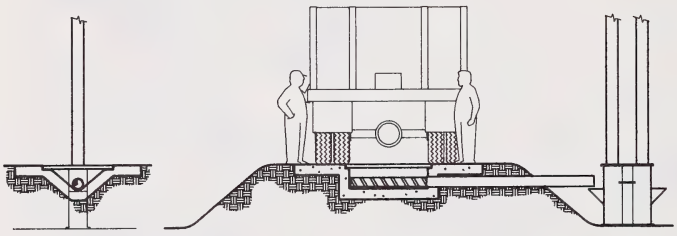
Inclined auger from pit to bucket elevator outside of pit

Auger with fold down hopper

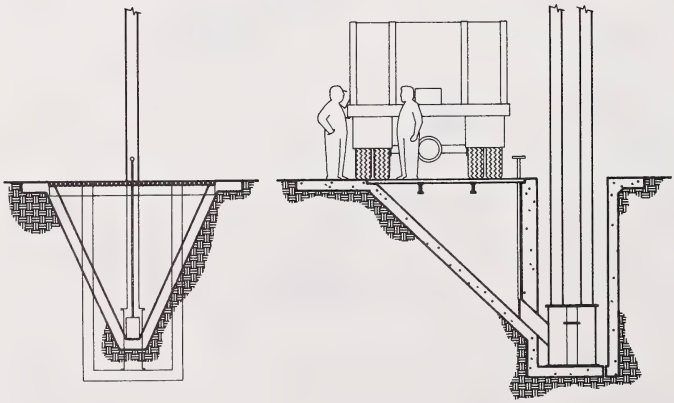
RECEIVING FACILITY DETAILS



Dump pit with cross auger to bucket elevator

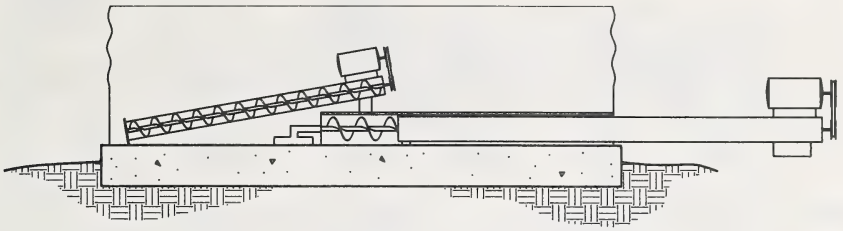


Raised driveway and dump pit with cross auger to bucket elevator

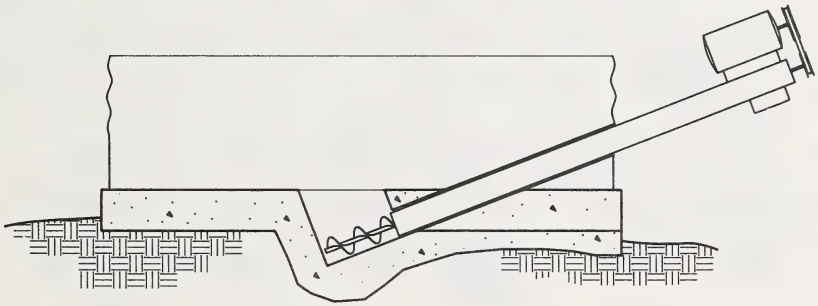


Dump pit with gravity flow

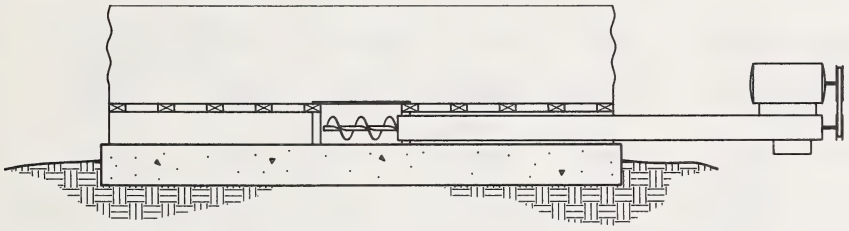
RECEIVING FACILITY DETAILS continued



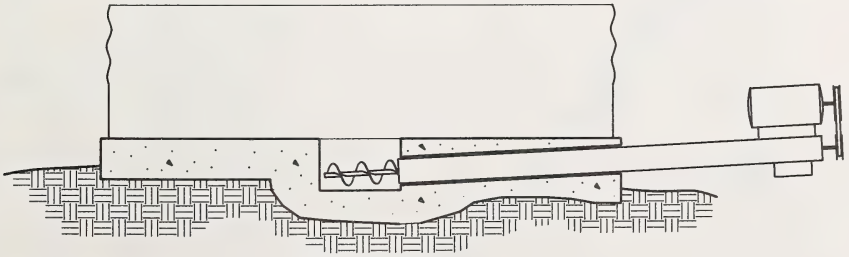
Top – of – the – floor auger with sweep



Underfloor auger – inclined above floor at wall



Underfloor auger – false floor bins

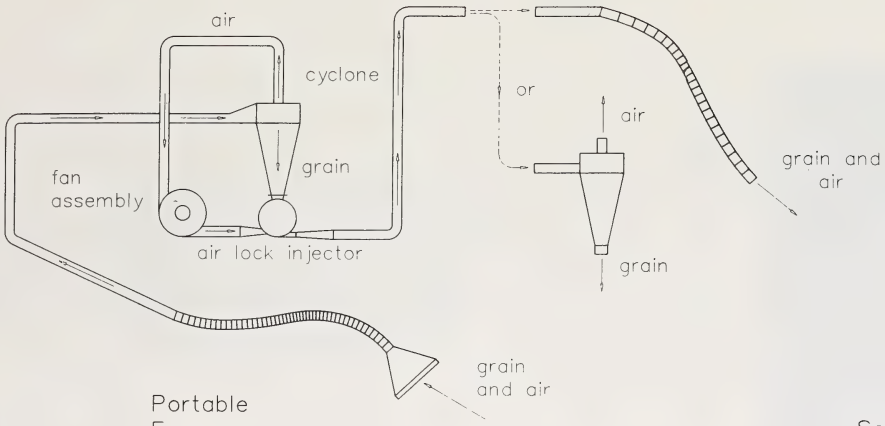


Underfloor auger – concrete floor bins

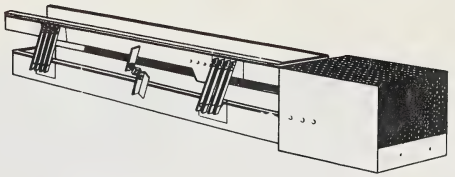
Comparison of Types of Conveyors

	Portable Auger	Screw Conveyor	Bucket Elevator	Chain & Flight Conveyor	Belt Conveyor	Vibration	Portable Farm Pneumatic
Capacity (bu/hr)	400-10,000	100-4,000	200-over 50,000	500-20,000	300-over 50,000	100-1,000	800-2,000
Application	Horizontal or Vertical	Horizontal or Slight Incline	Vertical	Horizontal or Slight Incline	Horizontal or Slight Incline	Slight Decline	Horizontal & Vertical
Power Requirements (hp/1000 bu/10 ft)*	1.2-1.8	0.5-0.9	0.4-0.5	0.4-0.5	0.15-0.17	1-2 hp	≈5-10
Wear Factor	Med - High	Low	Low	Med	Low	Med	Med
Maintenance	Med	Low	Low	Low	Low	Med	Med
Cleanability	Poor	Poor	Good	Fair	Excellent	Excellent	Self-Cleaning
Conveyor Length (ft)	Up to 70	Up to 300	Up to 200	Up to 300	Up to 1500	Up to 25	100
Grain Damage	High	Med	Low	Low	Nil	Nil	High
Initial Cost/Ton	Low	Low-med	Med-high	Low	High	Med	High
Operating Cost	Med	Low	Low	Low	Low	Low	High

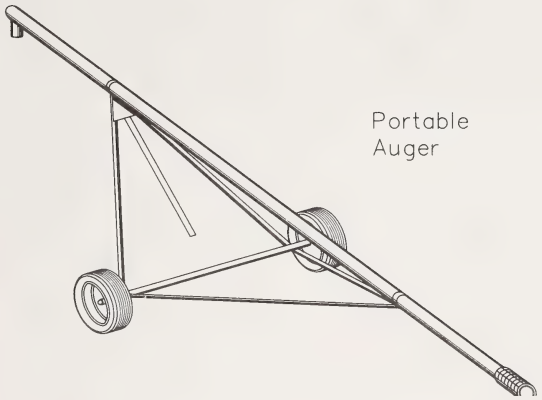
* based on dry wheat



Portable
Farm
Pneumatic

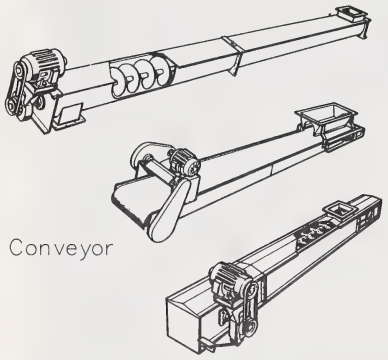


Vibration Conveyor



Portable
Auger

Screw Conveyor



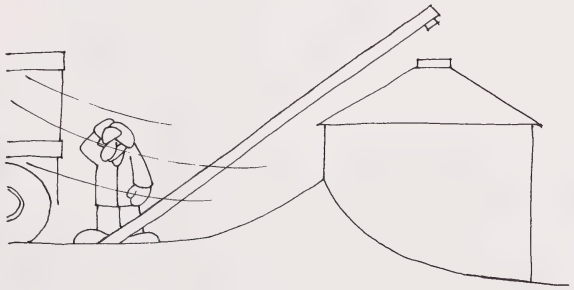
Belt Conveyor

Chain and Flight
Conveyor

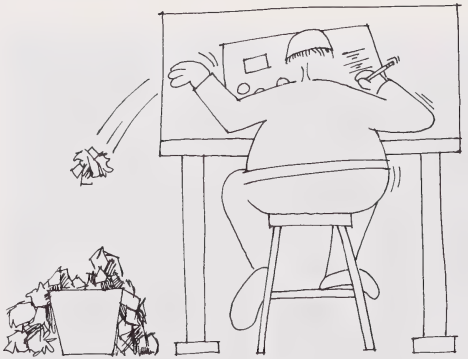
Bucket Elevator

CONVEYOR TYPES

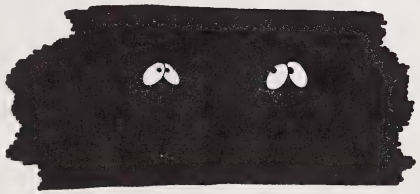
DO'S AND DONT'S



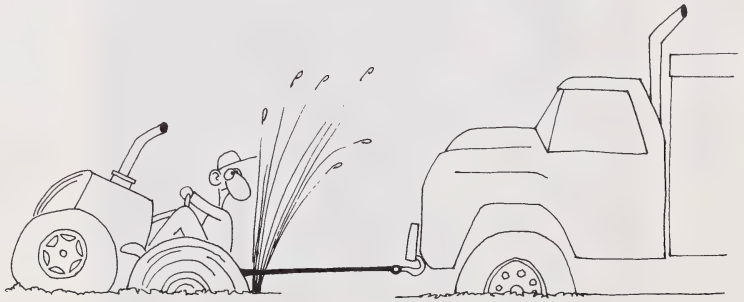
Consider winter snow drifting.



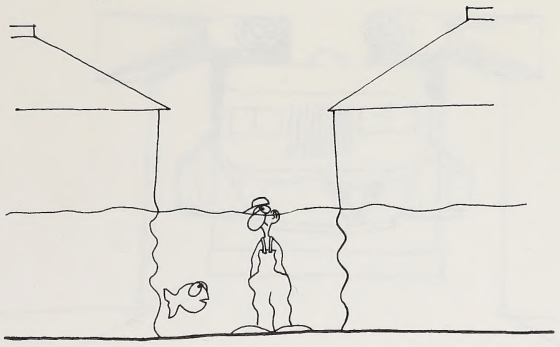
Have a plan before you start.



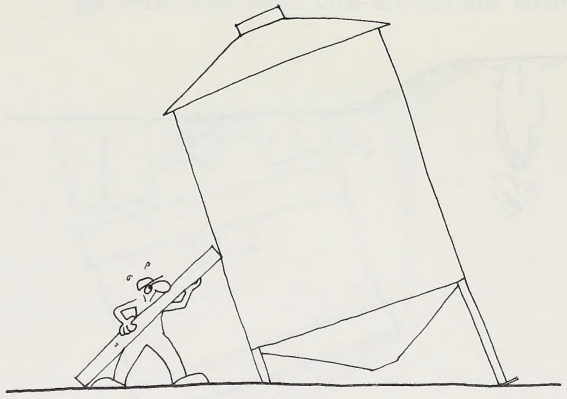
Be sure of adequate electrical supply.



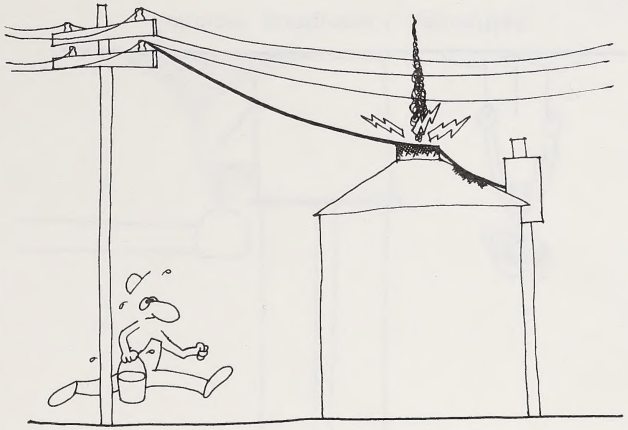
Provide all weather roads.



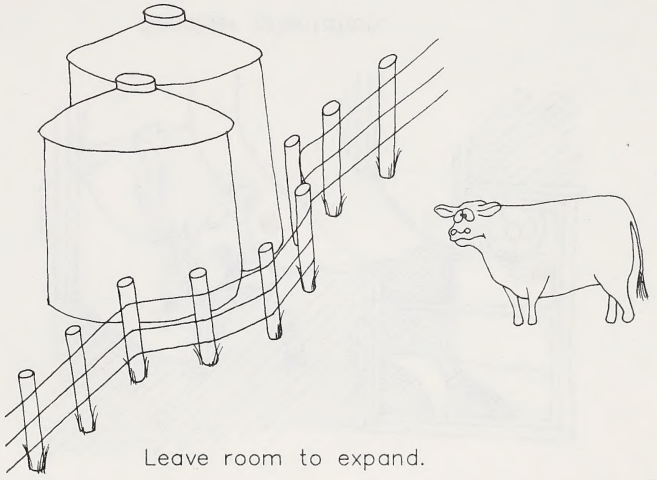
Choose a well drained site.



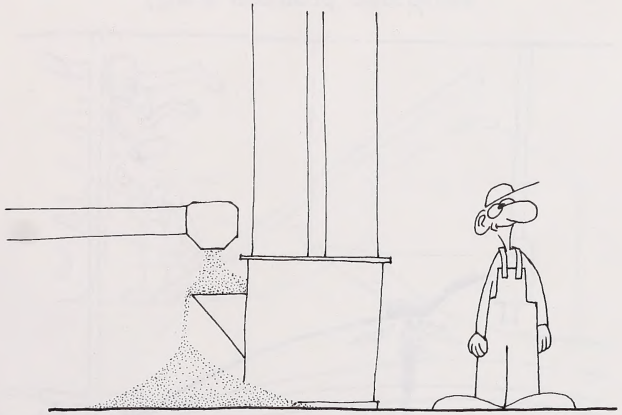
Be sure soil will support the load.



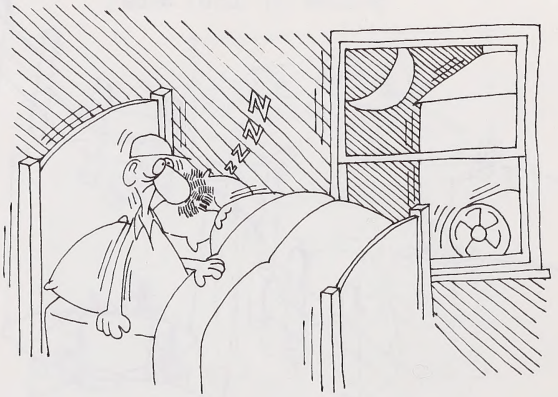
Check overhead clearances.



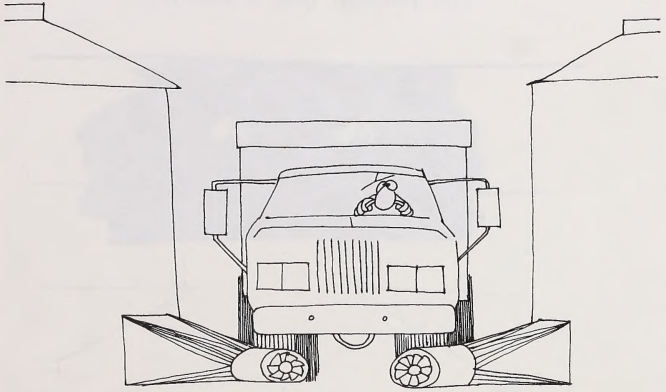
Leave room to expand.



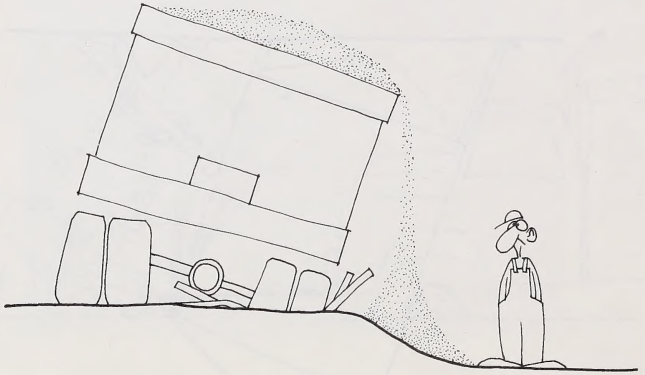
Consider component capacities.



Consider orientation.



Allow ample space for larger vehicles.



Be sure drive over pits are strong enough.