

Penn State **Extension**

Horizontal Silos, Concrete and Wood

Agricultural and Biological Engineering

abe.psu.edu

No. IP 733-42

This Idea Plan is intended to provide educational information and ideas concerning corn cribs for storing ear corn. The following attached drawings are based on historical plans and may not meet design and construction standards for your area:

Concrete Trench Silo (USDA 6347)
Reinforced Concrete Horizontal Silos (PSU 502)
Wood Bunker Silo (PSU 91)
Braced Wall Silo (USDA 6021)
Silo Types A, B & C (USDA 6048)

If you decide to build a facility similar to any of these plans, be sure to check building requirements for your area. Your local building inspector, engineer, building supplier, or building contractor can help you determine what is a safe and legal facility for housing rabbits in your area. In addition to the rules and regulations covering design and construction of buildings, be sure to consider how you will handle the manure and potential nuisance problems for neighbors, including flies, odor, and noise.

The Department of Agricultural and Biological Engineering at Penn State has a variety of educational material available related to agricultural and biological engineering. This material is intended to help Pennsylvania farmers and others develop buildings and facilities for modern, environmentally-compatible farm facilities. The material can be used in conjunction with county extension staff, builders, suppliers, consulting engineers, the Natural Resources Conservation Service, financial management advisors, farm lenders, veterinarians, and others to assemble a facilities plan suitable for local conditions.

Publications are available in the areas of agricultural safety and health, animal housing systems, building and farmstead planning, crops and greenhouses, machinery systems and tractors, residential housing, soil and water resources, and solid waste management. Contact your county Penn State Extension Office for more information on these subjects. You can also obtain an index of publications concerning the above areas by calling, writing, faxing or e-mailing:

Department of Agricultural and Biological Engineering
246 Agricultural Engineering Building
University Park, PA, 16802-1909
Telephone: 814-865-7685
Fax: 814-863-1031
Email: agbioeng@psu.edu

An OUTREACH program of the
College of Agricultural Sciences

Penn State College of Agricultural Sciences research and cooperative extension programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

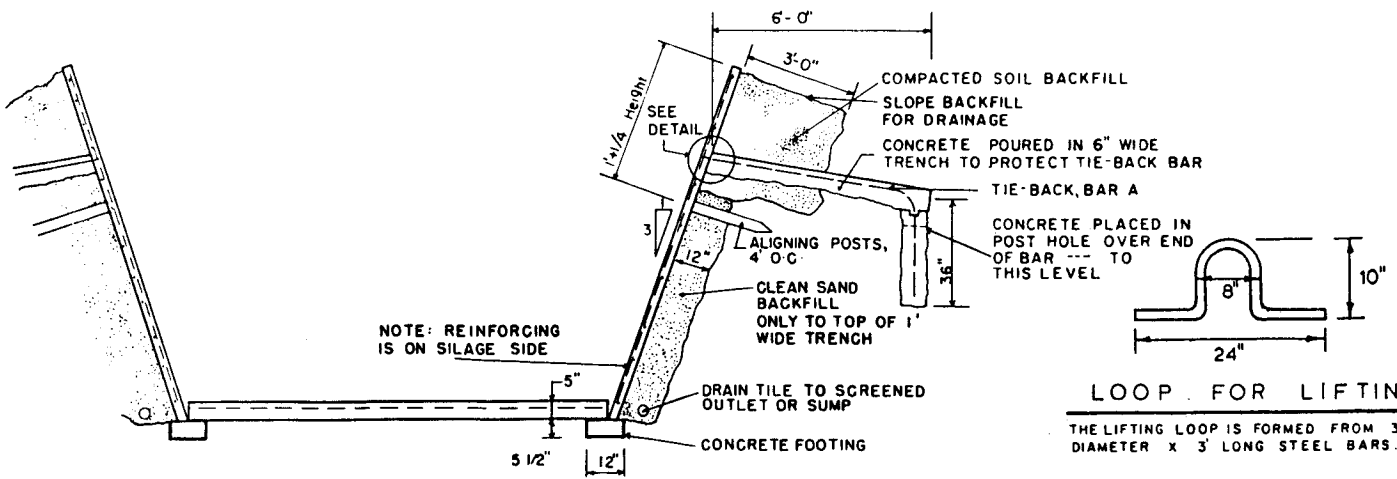
Visit Penn State Extension on the web: extension.psu.edu

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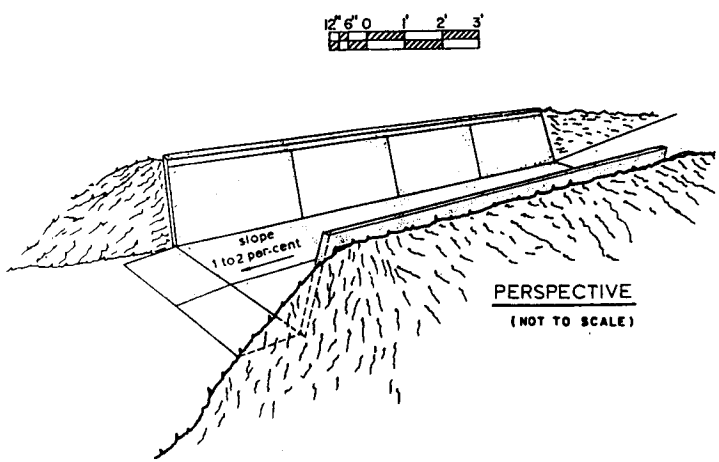
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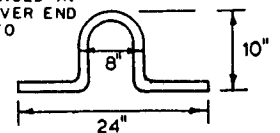
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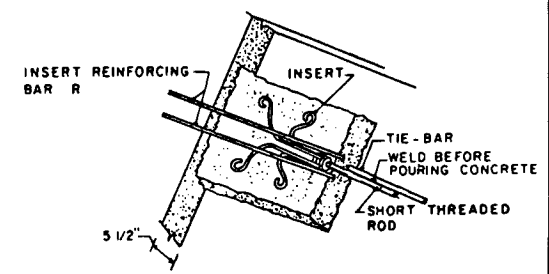
CROSS SECTION



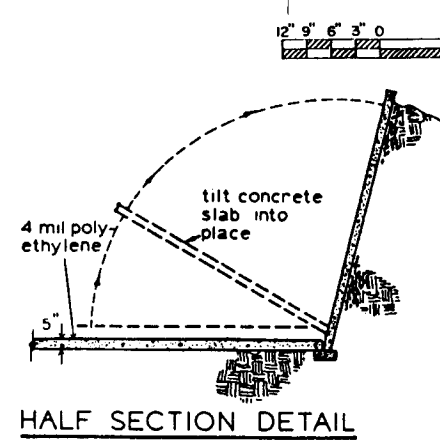
PERSPECTIVE
(NOT TO SCALE)



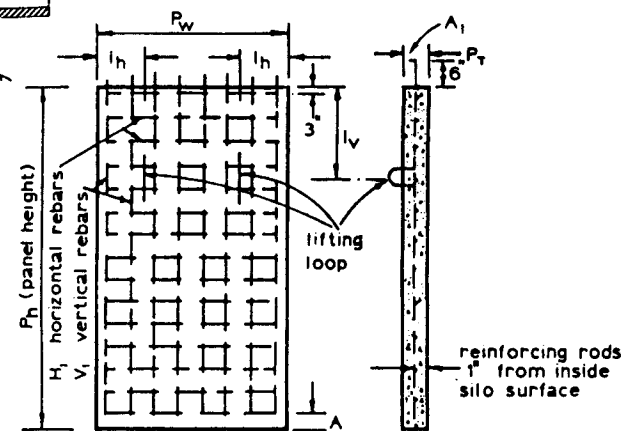
LOOP FOR LIFTING
THE LIFTING LOOP IS FORMED FROM 3/4" DIAMETER X 3' LONG STEEL BARS.



TIE BAR INSERT DETAIL
(NOT TO SCALE)



HALF SECTION DETAIL



ELEVATION

SECTION

BUNKER SILO CAPACITIES IN TONS/FOOT OF LENGTH

depth	width							
	20'	30'	40'	50'	60'	70'	80'	
8'	35	5	6.5	8.1	10.0	11.3	13.0	
10'	45	6.2	8.4	10.2	12.2	14.2	16.2	
12'	55	7.5	10.0	12.3	14.6	17.0	20.0	
14'	66	8.7	11.5	14.3	17.0	20.0	22.7	
16'	75	10.0	13.1	16.3	20.0	22.7	26.0	
18'	88	11.1	14.7	18.3	22.0	27.6	29.1	

NOTES

1. Capacity is based on 40 pounds per cubic foot.
2. A daily use rate of 4' of silage is recommended in warm weather to keep silage fresh.
3. The aggregate should contain 40% sand, 60% gravel; and not more than 6 gallons of water per sack of cement.
4. Set grade so water will drain away from silo.

PANEL HT	DIMENSION			SCHEDULE		
	P _w	P _T	A	l _h	l _v	WT
8'-0"	7'-11"	3 1/2"	3"	1'-6"	2'-6"	2600
10'-0"	7'-11"	3 1/2"	3"	1'-6"	3'-0"	3200
12'-0"	7'-11"	5 1/2"	3"	1'-6"	3'-6"	6100
14'-0"	7'-11"	5 1/2"	3"	1'-6"	4'-0"	7200

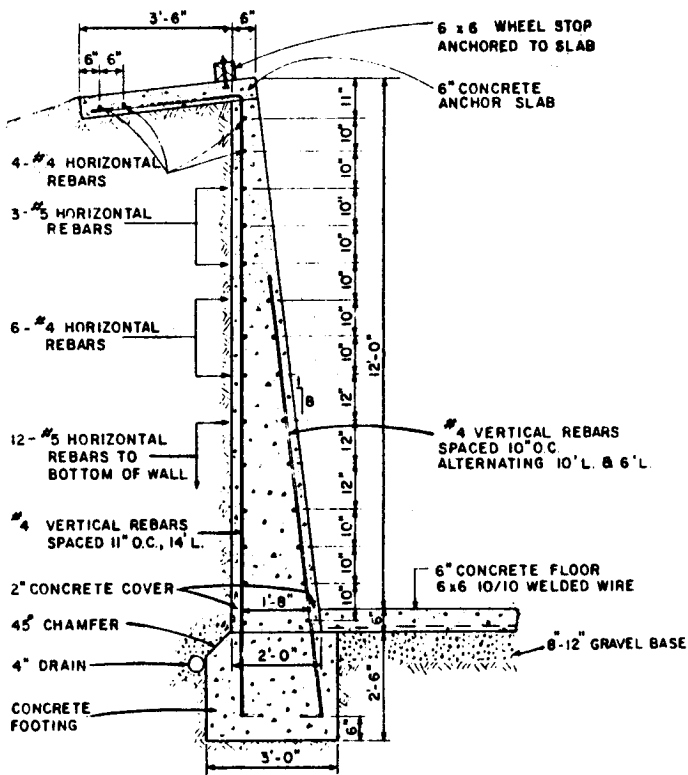
	PANEL REINFORCEMENT				SCHEDULE											
	8 FOOT				10 FOOT				12 FOOT				14 FOOT			
	shape	no.	size	lgth	shape	no.	size	lgth	shape	no.	size	lgth	shape	no.	size	lgth
H ₁	—	9	1/2"	7'-6"	—	11	1/2"	7'-6"	—	13	1/2"	7'-6"	—	15	1/2"	7'-6"
V ₁	—	8	1/2"	7'-6"	—	8	1/2"	9'-6"	—	8	1/2"	11'-6"	—	8	1/2"	13'-6"
A ₁	—	2	1/2"	2'-6"	—	2	1/2"	2'-6"	—	2	1/2"	2'-6"	—	2	1/2"	2'-6"

COOPERATIVE EXTENSION SERVICE
AGRICULTURE AND HOME ECONOMICS
The Pa. State University
AND
UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING

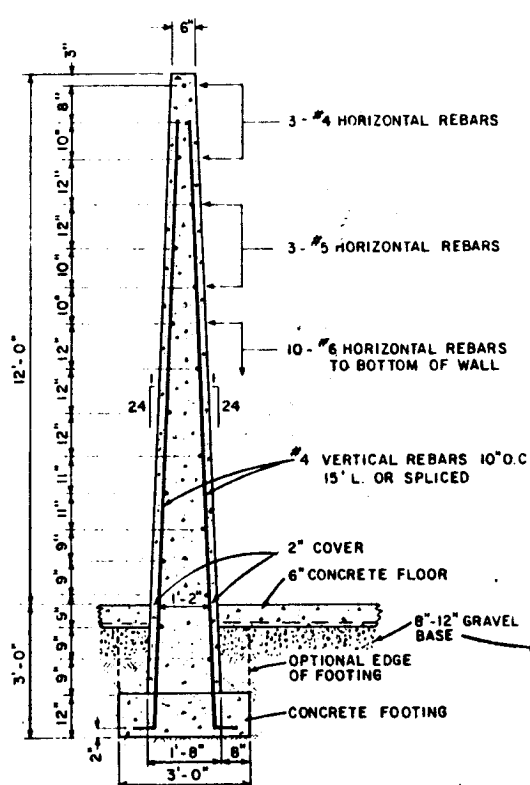
CONCRETE TRENCH SILO

SC' 81 | 6347 | SHEET 1 OF 1

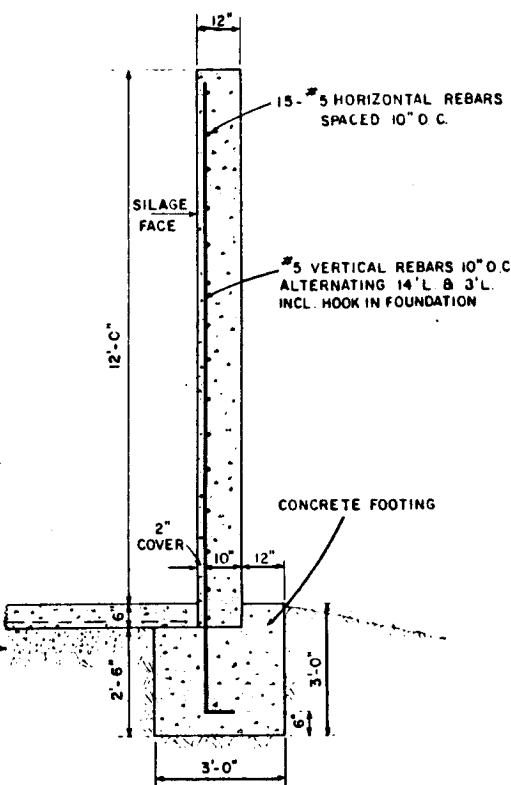
REV 85 733-6347



DETAIL A SLOPING RETAINING WALL
SILAGE ON ONE SIDE EARTH ON OTHER SIDE



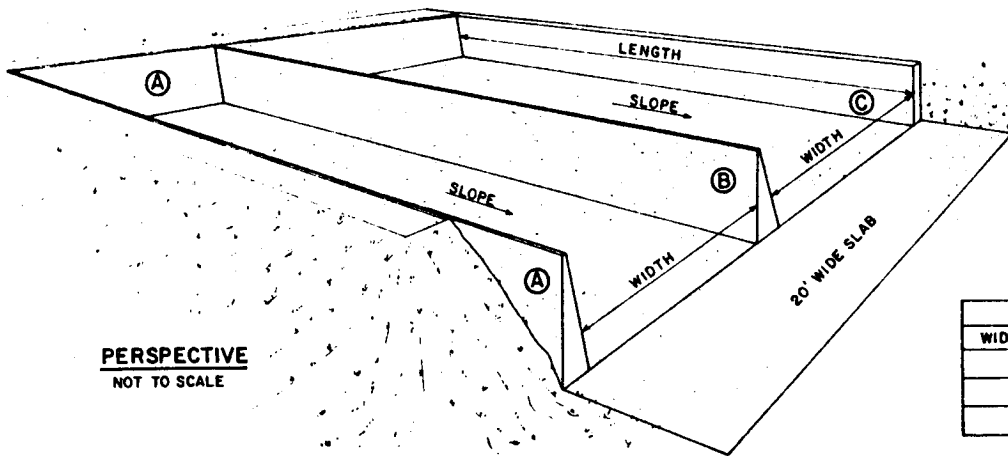
DETAIL B TAPERED WALL
SILAGE ON ONE SIDE OR BOTH SIDES



DETAIL C VERTICAL FACE WALL
SILAGE ON ONE SIDE ONLY

NOTES:

- 1) SPECIFY 4,000 psi COMPRESSIVE STRENGTH CONCRETE FOR WALLS & FOOTINGS.
- 2) SPECIFY 3,000 psi COMPRESSIVE STRENGTH CONCRETE FOR SLAB FLOORS. REINFORCE FLOOR WITH 6"x6", 10/10 WELDED WIRE MESH.
- 3) SPECIFY 40,000 psi REINFORCING BARS.
- 4) LAP REBARS 12" FOR SPLICE WELDING.
- 5) PROVIDE A 2" COVER OF CONCRETE OVER REBARS. EXTEND REBARS 2" INTO FOOTINGS WITH 90° HOOKS, 6" L. FOR #4 REBARS & 8" L. FOR #5 REBARS.
- 6) MAINTAIN A UNIFORM FLOOR SLOPE OF 2 PERCENT.
- 7) GRADE TO DRAIN WATER AWAY FROM SILOS.
- 8) LENGTH OF 120' ALLOWS FEEDING 4"/DAY FOR 360 DAYS.
- 9) SILAGE BULK DENSITY VARIES FROM 35 TO 50 lbs/ft³ & DEPENDS ON MOISTURE CONTENT, LENGTH OF CUT, PACKING EFFECT & DEPTH OF SILAGE.
- 10) CAPACITY TABLE BASED ON 45 psi SILAGE & LEVEL FULL-CROWN SURCHARGE ADDS & SLOPING ENDS SUBTRACT.



PERSPECTIVE
NOT TO SCALE

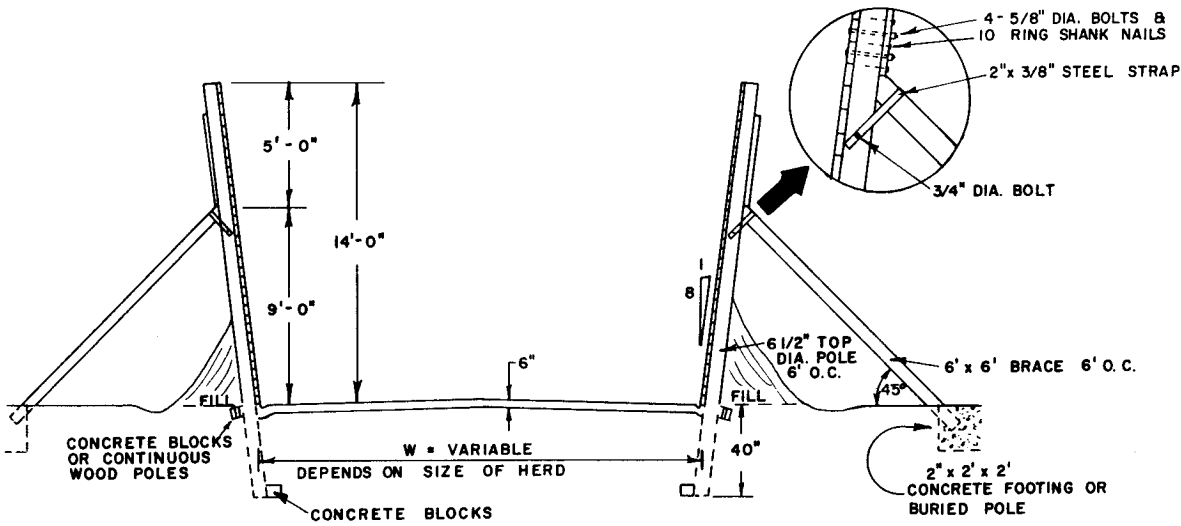
SILO CAPACITY TABLE		
WIDTH, ft	CWT/ft	TONS/120 ft
20	108	848
30	162	972
50	270	1620

THE PENNSYLVANIA STATE UNIVERSITY
AGRICULTURAL EXTENSION SERVICE

REINFORCED CONCRETE
HORIZONTAL SILOS

DR. BY R.J.K. CK. BY R.W.G. Sheet 1 of 1

DATE 6/81 ORDER NO. 733-502



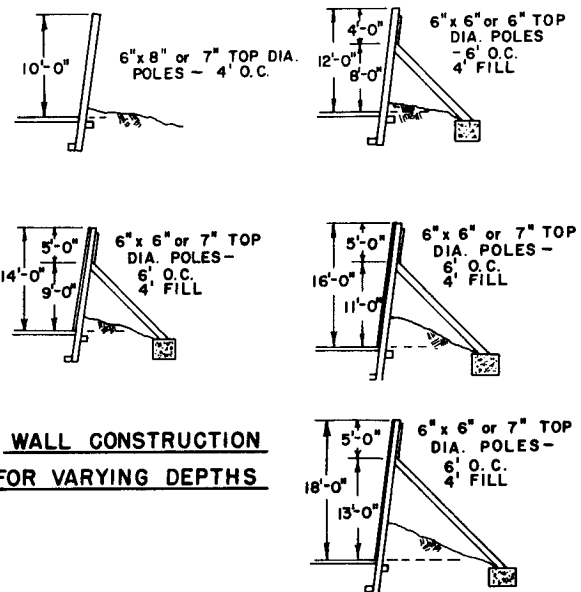
CROSS SECTION OF SILO

NOTES

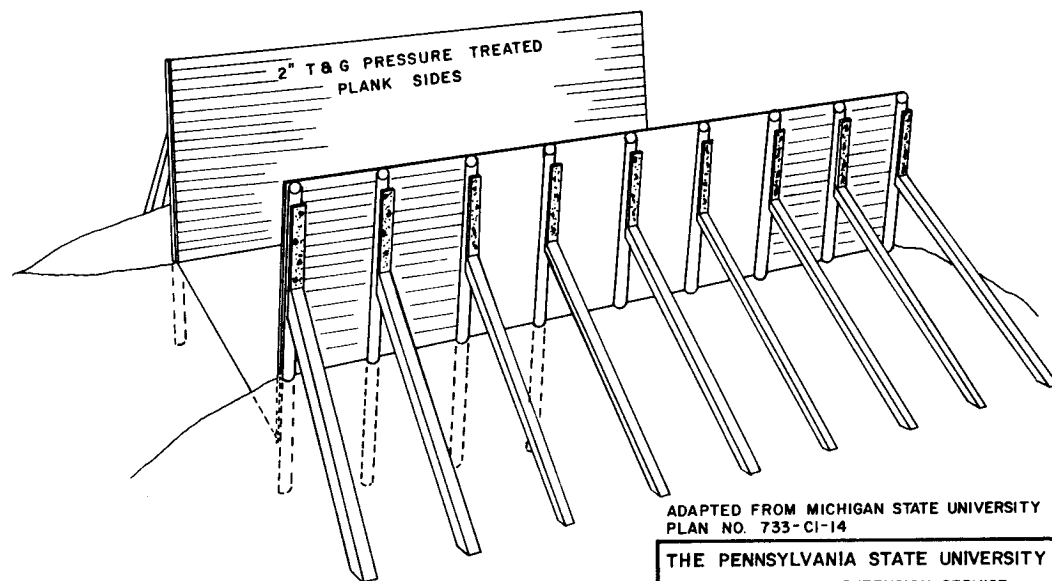
1. CAPACITY IS BASED ON 40 POUNDS PER CUBIC FOOT.
2. A DAILY USE RATE OF 4" OF SILAGE IS RECOMMENDED IN WARM WEATHER TO KEEP SILAGE FRESH.
3. ALL CONCRETE SHOULD CONTAIN 40% SAND, 60% GRAVEL AND NOT MORE THAN 6 GALLONS OF WATER PER SACK OF CEMENT.
4. ALL WOOD SHOULD BE PRESSURE TREATED WITH 8 POUND RETENTION PER CUBIC FOOT OF WOOD.
5. STAGGER JOINTS IN THE CENTER AND END MATCHED SIDING.
6. BE SURE TO SET GRADE SO WATER WILL DRAIN AWAY FROM SILO.
7. USE RUST PROOF 16d NAILS FOR THE SIDING.

**BUNKER SILO CAPACITIES
TONS/FOOT OF LENGTH**

DEPTH	WIDTH					
	30'	40'	50'	60'	70'	80'
8'	5	6.5	8.1	10.0	11.3	13.0
10'	6.2	8.4	10.2	12.2	14.2	16.2
12'	7.5	10.0	12.3	14.6	17.0	20.0
14'	8.7	11.5	14.3	17.0	20.0	22.7
16'	10.0	13.1	16.3	20.0	22.7	26.0
18'	11.1	14.7	18.3	22.0	27.6	29.1



**WALL CONSTRUCTION
FOR VARYING DEPTHS**



PERSPECTIVE

ADAPTED FROM MICHIGAN STATE UNIVERSITY
PLAN NO. 733-CI-14

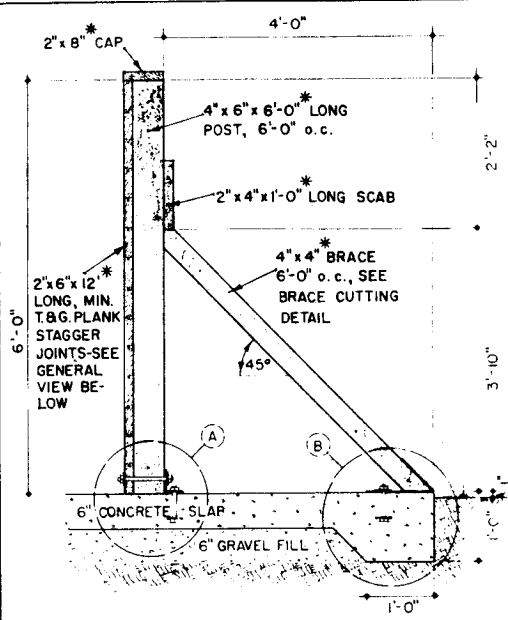
THE PENNSYLVANIA STATE UNIVERSITY
AGRICULTURAL EXTENSION SERVICE

WOOD BUNKER SILO

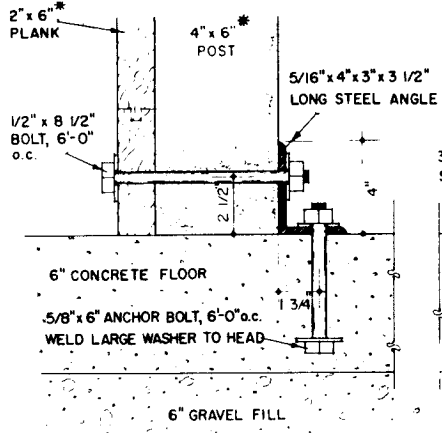
DRWN. BY: SLB
CHKD. BY: LSC
DATE: 9/1/69

ORDER NO.
733-91

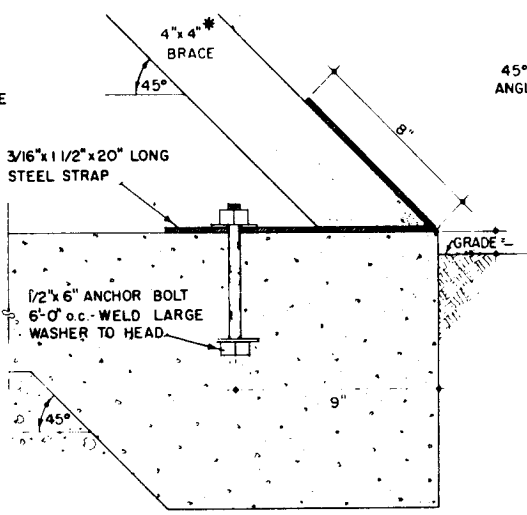
SHEET 1 OF 1



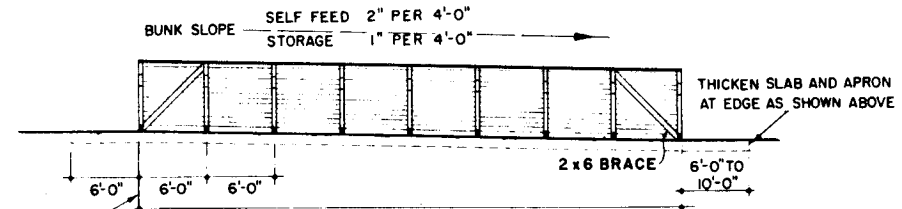
WALL SECTION



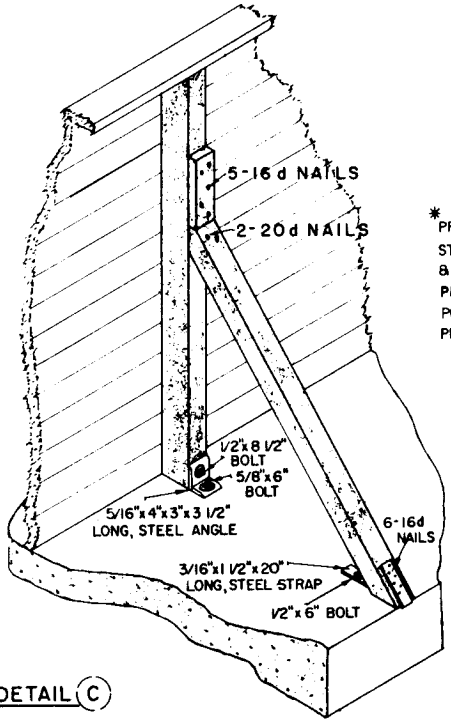
DETAILS A & B



BRACE CUTTING DETAIL

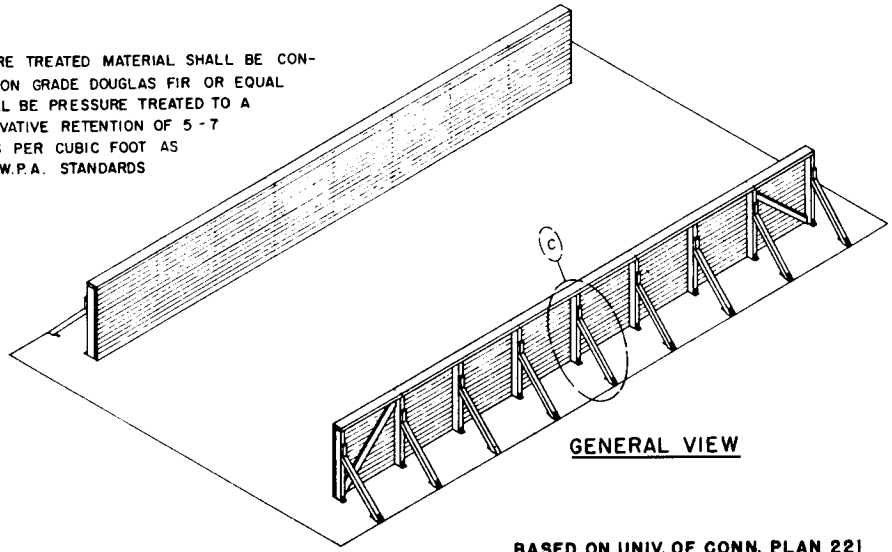


SIDE ELEVATION



DETAIL C

* PRESSURE TREATED MATERIAL SHALL BE CONSTRUCTION GRADE DOUGLAS FIR OR EQUAL & SHALL BE PRESSURE TREATED TO A PRESERVE RETENTION OF 5-7 POUNDS PER CUBIC FOOT AS PER A.W.P.A. STANDARDS



GENERAL VIEW

NOTES

GENERAL

- 1 SITE LOCATION TO BE WELL DRAINED
- 2 IF SELF-FEEDING IS DESIRED, ORDER PLAN 5872, 'SELF-FEEDING FENCES'
- 3 IF SOLID END WALL IS DESIRED, USE 2' x 6" PLANK WALL IS DRAWING 6'-0" AS SHOWN ON THIS DRAWING.
4. USE GALVANIZED OR CADMIUM PLATED 10d NAILS TO FASTEN PLANK TO POSTS.

LUMBER

1. USE "STANDARD" GRADE DOUGLAS FIR OR STRESS GRADED LUMBER WITH A MINIMUM FIBER STRESS OF 1200 p.s.i.

CONCRETE

- 1 USE 3000 p.s.i. AIR ENTRAINED MIX CONTAINING 6% AIR.
2. SLOPE FLOOR AS INDICATED ON THE SIDE ELEVATION.

SILLO CAPACITIES

WIDTH (FEET)	LENGTH (FEET)	CAPACITY (TONS FOR EA. ADDITIONAL 4')	
		(TONS)	(TONS)
12	36	55	67
16	48	106	94
20	60	175	123
24	72	265	154
28	84	378	187
32	96	516	222
36	108	680	259
40	120	936	324

CAPACITIES SHOWN ARE APPROX & ARE BASED ON A SILAGE WEIGHT OF 40 LBS PER CU FT.

COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS
THE PENNSYLVANIA STATE UNIVERSITY
 AND
 UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING

BRACED WALL SILO

CONN. '67 EX. 6021 SHEET 1 OF 1

ORDER NO. 733-6021

BASED ON UNIV. OF CONN. PLAN 221

TYPES A, B, & C SILO

APPROXIMATE CAPACITIES

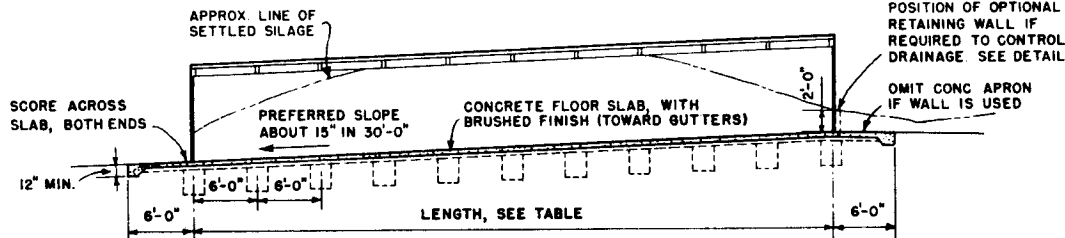
FEEDING PERIOD		120 DAYS	175 DAYS	210 DAYS	CAPACITY FOR EACH 6 FT. OF LENGTH
HERD SIZE	WIDTH OF SILO	LENGTH OF SILO			
		60 FT.	78 FT.	90 FT.	
30 HEAD	16 FT.	114 TONS	163 TONS	196 TONS	16 TONS
37 "	20 "	141 "	202 "	242 "	20 "
44 "	24 "	168 "	240 "	288 "	24 "
51 "	28 "	195 "	278 "	334 "	28 "
58 "	32 "	222 "	317 "	380 "	32 "

CAPACITY IS BASED ON SILAGE WEIGHT OF 40 LBS. PER CUBIC FOOT AND SETTLED DEPTH OF 8 FEET, EXCEPT AT ENDS.

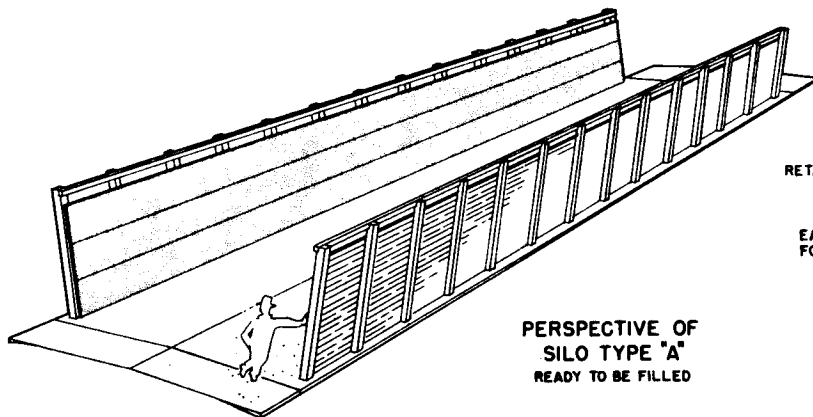
WIDTH OF SILO IS BASED ON HERD SIZE AND ON AN AVERAGE CONSUMPTION OF 60 LBS. OF SILAGE PER ANIMAL PER DAY.

LENGTH OF SILO IS BASED ON 4" DAILY RATE OF USE FOR WARM WEATHER CONDITIONS. LENGTH MAY BE VARIED IN UNITS OF 6 FEET.

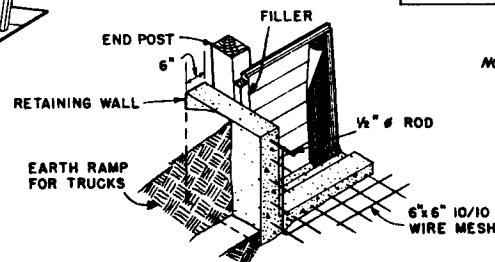
FOR SELF-FEEDING, WITH FREE ACCESS, A SILO WIDTH OF 3" TO 6" PER HEAD IS REQUIRED.



LONGITUDINAL SECTION
TYPE "A" SILO



PERSPECTIVE OF
SILO TYPE "A"
READY TO BE FILLED

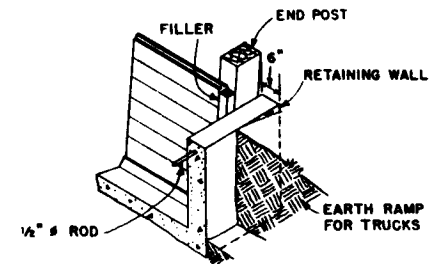


DETAIL OF OPTIONAL RETAINING WALL
TYPE "A" SILO

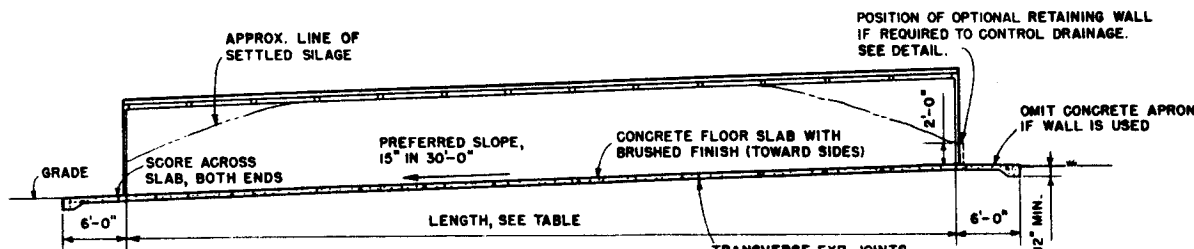
NOTE: ALL CONCRETE TO BE 1:2 1/2:3 1/2 MIX, WITH NOT MORE THAN 6 GALLONS OF WATER PER BAG OF CEMENT.

ALL WOOD SHOULD BE PRESSURE-TREATED WITH PRESERVATIVE (AFTER CUTTING) TO 8 LBS. PER CUBIC FOOT RETENTION.

STAGGER END JOINTS OF PLANKS IN EACH ROW SO JOINTS FALL ON ALTERNATE POSTS.



DETAIL OF OPTIONAL RETAINING WALL
TYPES "B & C" SILO



LONGITUDINAL SECTION
TYPES "B & C" SILO

TRANSVERSE EXP. JOINTS
NOT OVER 12'-0" O.C.
TYPE "C" SILO ONLY

COOPERATIVE EXTENSION WORK IN
AGRICULTURE AND HOME ECONOMICS

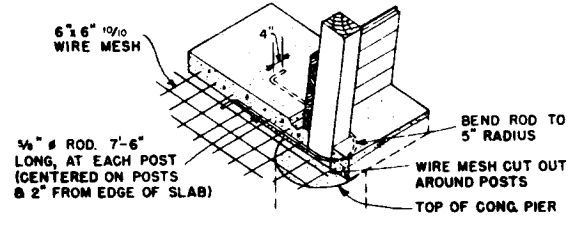
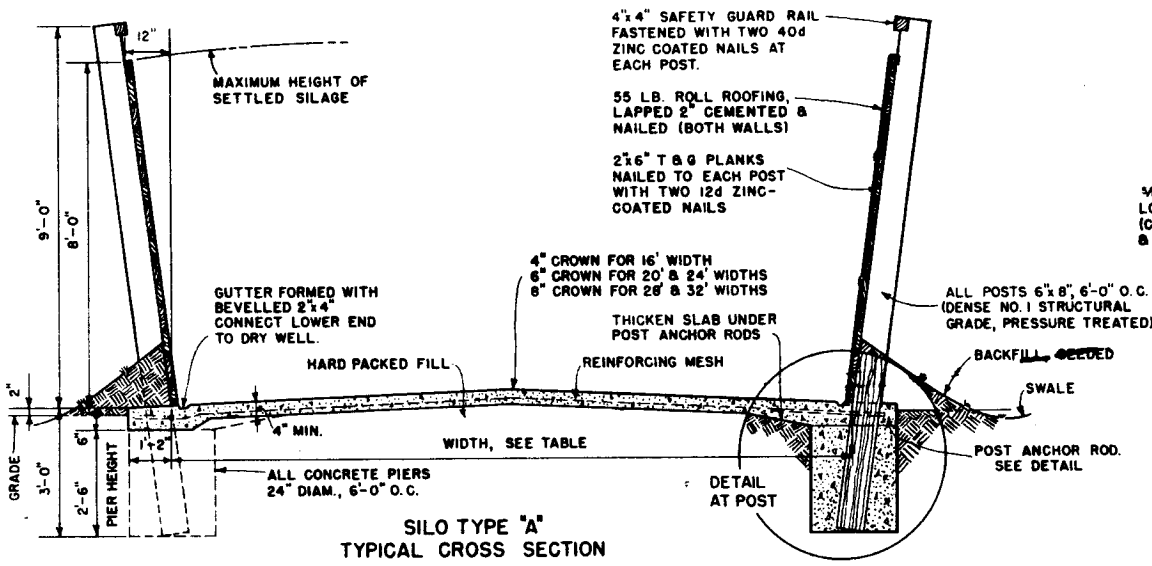
THE PENNSYLVANIA STATE UNIVERSITY

AND
UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING

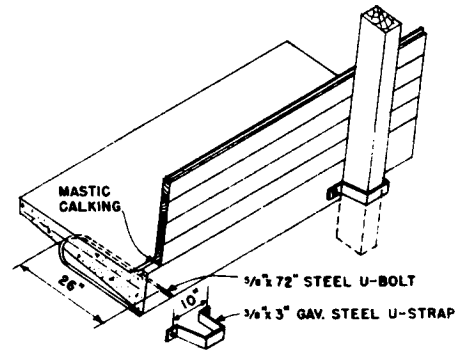
SILO TYPES A, B, & C

USDA '68 EX 6048 SHEET 1 OF 2

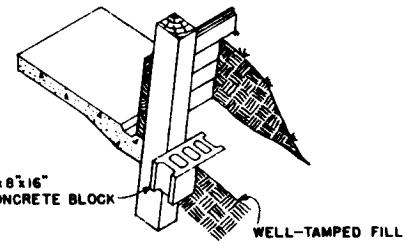
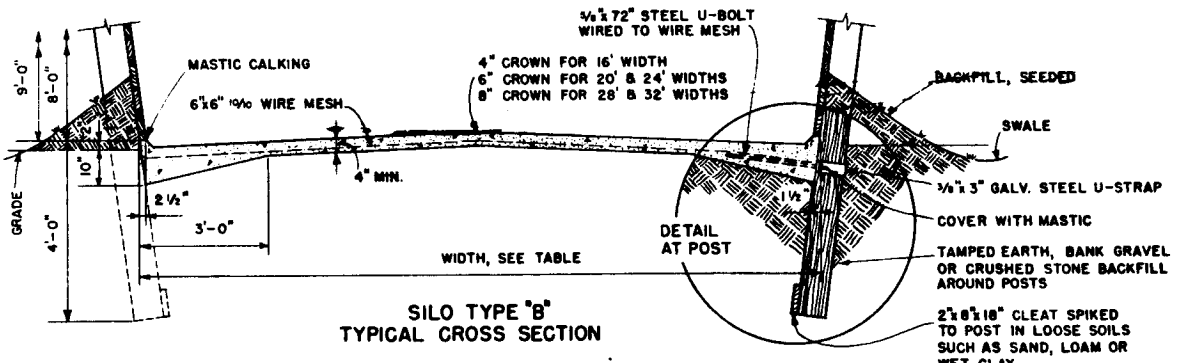
ORDER NO. 733-6048



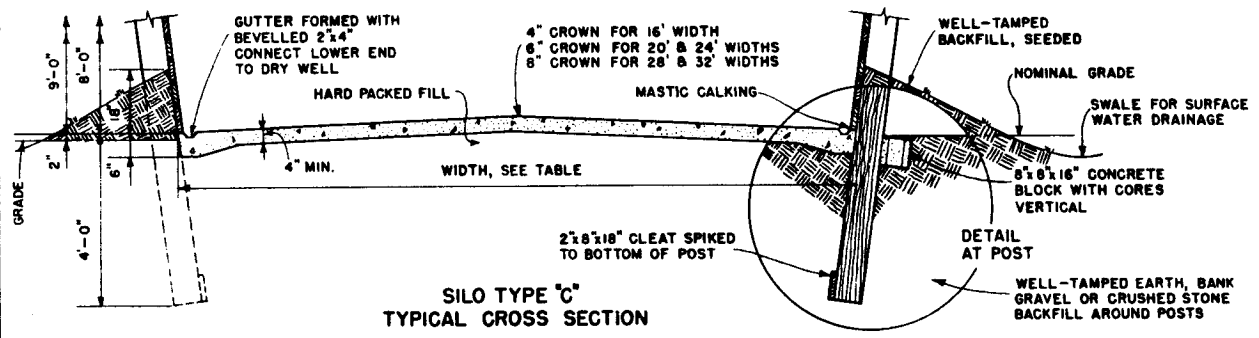
SILO TYPE "A" TYPICAL CROSS SECTION



DETAIL OF POST ANCHORAGE SILO TYPE "B"



POST DETAIL SILO TYPE "C"



COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS
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SILO TYPES A, B, & C.

USDA	'68	EX 6048	SHEET 2 OF 2
ORDER NO. 733-6048			