

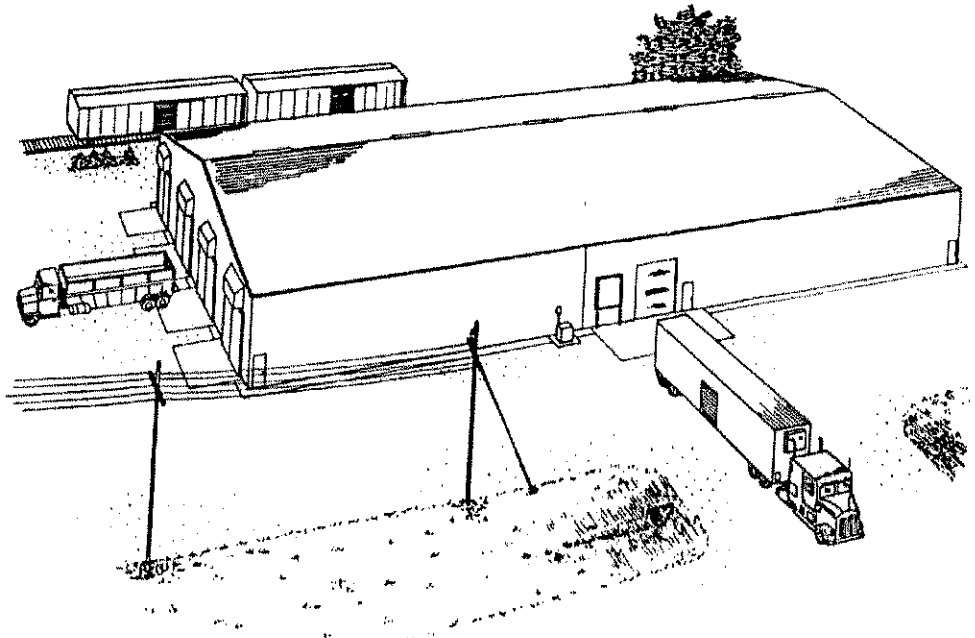
NOTES: 1. THREE SIZES OF BUILDINGS ARE REPRESENTED:

80 x 172 88,000 C.W.T. SINGLE EXTERIOR WALL (CROSS ALLEY)
 80 x 204 88,000 C.W.T. SINGLE EXTERIOR WALL (CROSS ALLEY)
 88 x 204 88,000 C.W.T. DOUBLE EXTERIOR WALL (CROSS ALLEY)

CAUTION: THE DIFFERENT SIZE BUILDINGS HAVE STORAGE BINS WITH DIFFERENT VENTILATION DUCTS AND AIR REQUIREMENTS. SEE SHEET 8 FOR VARIATIONS IN DUCT DIMENSIONS.

WHEN DETAILS ARE THE SAME FOR EACH, ONE VIEW OR SECTION SUFFICES FOR ALL 3 SIZES. ON SOME DRAWINGS ONLY ONE BASIC VIEW IS GIVEN WITH DIMENSION ALTERNATIVES GIVEN ACCORDING TO BUILDING SIZE. BE SURE TO DETERMINE WHICH VIEW AND WHICH DIMENSION APPLIES. WHERE 2 SIMILAR VIEWS OR SECTIONS APPEAR, THE 88 x 204 IS DRAWN AT A LARGER SCALE THAN THE OTHER SIZES. THE ORIGINAL PLANS WERE COOPERATIVELY DEVELOPED BY EXTENSION AGRICULTURAL ENGINEERING NORTH DAKOTA STATE UNIVERSITY (NDSU) FARGO, ND, THE USDA RED RIVER VALLEY POTATO RESEARCH CENTER, AND THE RED RIVER VALLEY POTATO GROWERS ASSOC. A COMPLETE SET FOR A SPECIFIC SIZE MAY BE PURCHASED FROM EXTENSION AGRICULTURAL ENGINEERING, NDSU, FARGO ND 58105-6626

2. THESE DRAWINGS ARE NOT COMPLETE BUILDING PLANS - RATHER, THEIR INTENT IS TO SHOW CONCEPTS, SELECTED DESIGN RECOMMENDATIONS AND APPLICATION DIFFERENCES BASED ON RECENT USDA RESEARCH AND FIELD EXPERIENCES. THESE DRAWINGS IN TURN CAN BE USED IN PREPARATION OF MORE COMPLETE, SITE SPECIFIC DRAWINGS ENGINEERED DESIGNS.



GENERAL DESIGN CRITERIA:

- FLOOR/FOUNDATION DESIGN BASED ON 2000 LBS/SQ FT SOIL BEARING CAPACITY AND A CONCENTRATED TRUCK WHEEL LOAD OF 4500 LB.
- POTATO SPECIFIC WEIGHT OF 42 LBS. PER CUBIC FOOT (52 LBS/BU).
- CLEAN, WET, SMOOTH SKINNED, ROUNDED POTATOES (w.g. NORCHIP) THAT EXERT A HORIZONTAL WALL PRESSURE OF AN EQUIVALENT FLUID DENSITY OF 13 LBS PER CUBIC FOOT.
- MAXIMUM POTATO DEPTH OF 17 FT WITH BINWALL STUD HEIGHT OF 18 FT ON A 3 FT HIGH ABOVE THE FLOOR FOUNDATION.
- LUMBER BENDING STRESS ($F_b = 1775 \text{ psi}$) WAS MORE CRITICAL THAN HORIZONTAL SHEAR STRESS ($F_v = 95$) FOR STUDS. THE ALLOWABLE COMPRESSION FORCE USED WAS 625 PSI PERPENDICULAR TO GRAIN.
- LUMBER DESIGN ALLOWABLE STRESSES WERE NOT ADJUSTED FOR MOISTURE OR TEMPERATURE AS PERMITTED BY THE 1986 NATIONAL DESIGN SPECIFICATIONS.
- NO SPECIAL DESIGN CONDITIONS WERE USED FOR SNOW OR WIND LOADS. THE DESIGN SNOW LOAD WAS 25 LBS PER SQ FT OF ROOF.
- VAPOR BARRIERS MUST BE CORRECTLY INSTALLED (SO INSULATION STAYS DRY) CAULKED ALONG EDGES WITH ROLLED AND TAPED JOINTS.
- PURCHASE TRUSSES TO CONFORM WITH BUILDING WIDTH/POTATO AND LOCAL SNOW LOAD CONDITIONS. SECURELY FASTEN AGAINST HORIZONTAL AND VERTICAL LOADS.

VENTILATION DESIGN:

- VENTILATION DUCT AIRFLOW OF 1 CU. FT. PER MINUTE PER C.W.T. (1 CFM/CWT).
- VENT LUCT MAXIMUM AIRSPEED OF 1500 FEET PER MINUTE (17 MPH).
- "THROUGH" TYPE VENTILATION WITH $\frac{1}{4}$ THE NEEDED AIRFLOW FOR POTATOES ALONG EACH SIDEWALL AND $\frac{1}{4}$ THROUGH THE BOTTOM-CENTER OF THE BIN. EXTRA DUCT CAPACITY IS REQUIRED FOR WALL VENTING THE SINGLE-WALL DESIGNS.
- SINGLE-WALL INSIDE SHELL VENTILATION RATE OF 1 CU. FT. PER MINUTE PER SQ. FT. OF WALL SURFACE WITH AIRFLOW REGULATED BY RESTRICTION AT TOP WALL VENT OPENING.
- AT VENT DUCT TRANSITIONS, A DOWNSTREAM DUCT CROSS-SECTION AREA OF 0.75 TO 0.67 MINIMUM OF UPSTREAM CROSS-SECTION DUCT AREA.
- A 1:3 APPROXIMATE RATIO OF GROSS DUCT CROSS-SECTION AREA TO AIR EXIT SLOT AREA OR AN EFFECTIVE SLOT AREA TO DUCT CROSS-SECTION AREA OF 0.9:1.
- EXPERIENCE IS LIMITED WITH THE PLYWOOD-COVERED LEANER DUCTS. UNDER EXTREME CONDITIONS OF WET, MUDDY, SMALL POTATOES AND VERY LARGE DUCTS A CENTER SLOT IN THE PLYWOOD MAY BE NEEDED TO LET SOME AIR THROUGH - THEN DESIGN FOR 3 SLOTS INSTEAD OF 2.
- SEE THE MOST UP TO DATE PUBLICATION FOR AIR HEATING DESIGN RECOMMENDATIONS.

TABLE 1

POTATO STORAGE WALL FORCES WITHOUT A LEANER DUCT (EFD-13) CENTROID ADJUSTED. SEE TRANSACTIONS OF THE ASAE, 1983, pp. 179-187.

POTATO DEPTH FT.	WALL HEIGHT FT.	TOTAL LATERAL FORCE #/FT.	STILL FORCE #/FT.	PLATE FORCE #/FT.	BENDING MOMENT IN LB.	REQUIRED MOMENT IN LB.	STUD SIZE	MAX. STUD SPACING $F_b = 1775 \text{ psi}$	MAX. ANCHOR SPACING $F_c = 625 \text{ psi}$
10	12	860	460	181	10,000	3.8	2 x 12	60.8 in	87.0
12	14	958	509	207	20,100	11.7	2 x 12	32.8 in	49.6
14	16	1,274	692	372	31,000	16.3	2 x 12	20.7 in	33.2
16	18	1,864	1,171	493	48,250	26.8	2 x 12	10.0	18.2
18	20	2,108	1,474	632	68,250	37.8	2 x 12	7.4	14.4
20	22	2,600	1,812	789	88,300	51.2	2 x 12	5.0	11.0
22	24	3,148	2,185	961	116,900	67.8	2 x 12	4.4	9.8
24	26	3,744	2,593	1,152	150,300	87.1	2 x 12		

(1) Assumptions: 1. Vert. Building Load = 4000 PL
 2. Plywood Bin Lining Friction Coefficient of 0.3
 3. Wood-Concrete Friction Coefficient of 0.38
 4. 2-3 x 12 BIN, 1" Anchor Bolt
 $F_b = 1775 \text{ psi}$ Douglas Fir, No. 1, 3 x 12, n.d.s. & temp. design factors not used
 $F_c = 625 \text{ psi}$ Douglas Fir, 3 x 12, perpendicular to grain, n.d.s. & temp. design factors not used
 $F_v = 95 \text{ psi}$ stud section modulus = 31.84 in³
 n.s. = DO NOT SPACE STUDS FURTHER THAN 16" O.C. APART

TABLE 2

POTATO STORAGE WALL FORCES WITH A FT. LEANER DUCT 2 FT. FROM WALL (EFD-13) CENTROID ADJUSTED. SEE TRANSACTION OF THE ASAE, 1983, pp. 179-187.

POTATO DEPTH FT.	WALL HEIGHT FT.	HORIZONTAL FORCE AT TOP OF LEANER LB./FT.	TOTAL FORCE AT LATERAL LB./FT.	STILL FORCE LB./FT.	PLATE FORCE LB./FT.	BENDING MOMENT IN LB.	REQUIRED MOMENT IN LB.	STUD SIZE	MAXIMUM STUD SPACING INCHES	MAXIMUM ANCHOR SPACING INCHES
10	12	372	778	338	200	14,550	8.3	2 x 12	45.2 in	208
12	14	333	470	507	200	22,918	13.3	2 x 12	28.5 in	83.0
14	16	394	717	711	400	34,370	20.5	2 x 12	18.0 in	48.0
16	18	454	1018	949	821	46,520	28.7	2 x 12	13.2	32.5
18	20	516	1367	1222	850	60,150	40.1	2 x 12	10.0	23.7
20	22	578	1770	1530	815	82,000	53.7	2 x 12	7.4	18.0
22	24	636	2225	1873	806	102,080	70.1	2 x 12	5.0	14.3
24	26	696	2732	2248	1179	124,675	89.7	2 x 12	4.4	11.0

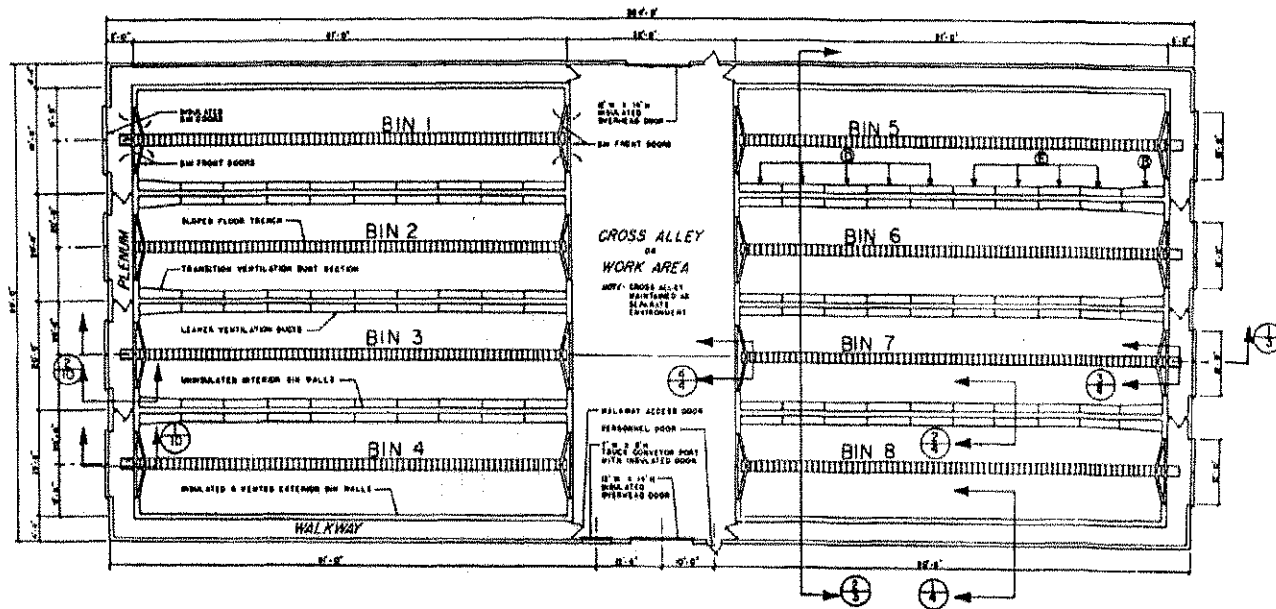
(1) Assumptions: 1. Vert. Building Load = 4000 PL
 2. Plywood - Bin Lining Friction Coefficient of 0.3
 3. Wood-Concrete Friction Coefficient of 0.38
 4. 2-3 x 12 BIN, 1" Anchor Bolt
 $F_b = 1775 \text{ psi}$ Douglas Fir, No. 1, 3 x 12, n.d.s. & temp. design factors not used
 $F_c = 625 \text{ psi}$ Douglas Fir, 3 x 12, perpendicular to grain, n.d.s. & temp. design factors not used
 $F_v = 95 \text{ psi}$ stud section modulus = 31.84 in³
 n.s. = DO NOT SPACE STUDS FURTHER THAN 16" O.C. APART

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88,000 TO 88,000 C.W.T. INSULATED
 POTATO STORAGE

ND 88 6398 SHEET 1 OF 11

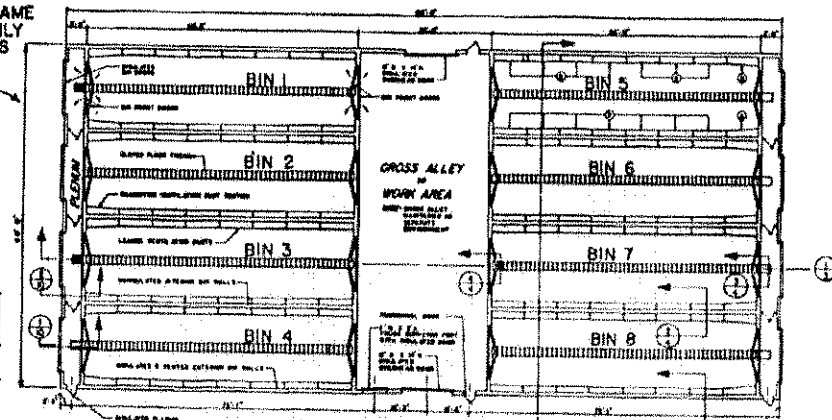


(86' x 204') FLOOR PLAN

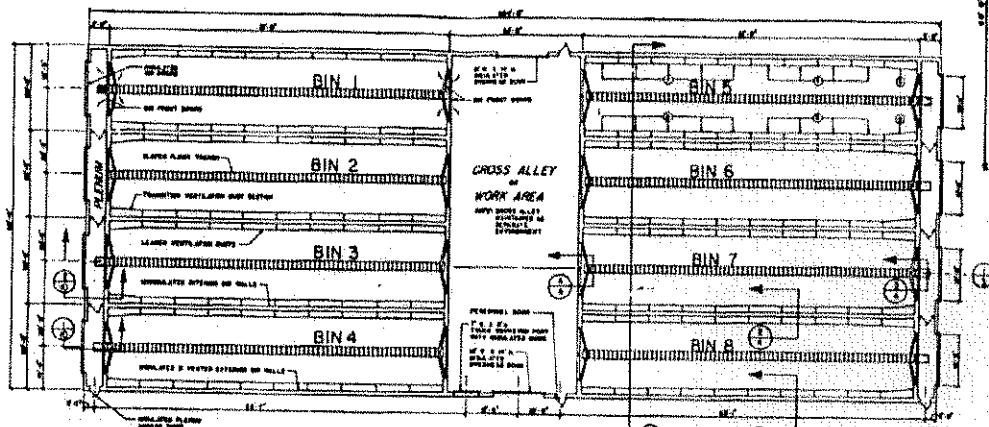
NOTES:

1. LEENER DUCTS DIFFER WITH EACH OF THE THREE BUILDING SIZES. SEE LETTER A, B, C, D, E, F, AND G AS APPROPRIATE.
2. BOTH 80' x 172' and 80' x 204' ARE OF SIMILAR DESIGN. THE MAJOR DIFFERENCES ARE THE USE OF LARGER BINS. THIS IN TURN AFFECTS VENTILATION AIR SYSTEM DESIGN WHICH IS A MAJOR PART OF CONTROLLED ENVIRONMENT POTATO STORAGE.

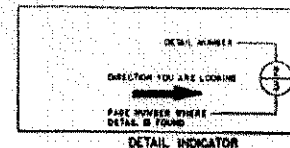
DIMENSION THE SAME AS 80' x 204', ONLY THE LEENER DUCTS DIFFER



(80' x 172') FLOOR PLAN



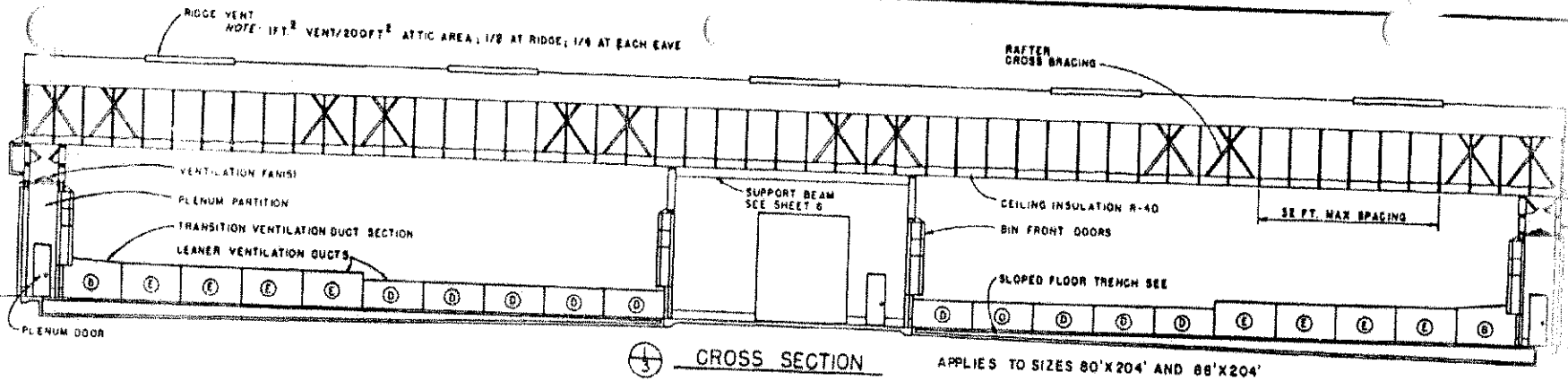
(80' x 204') FLOOR PLAN



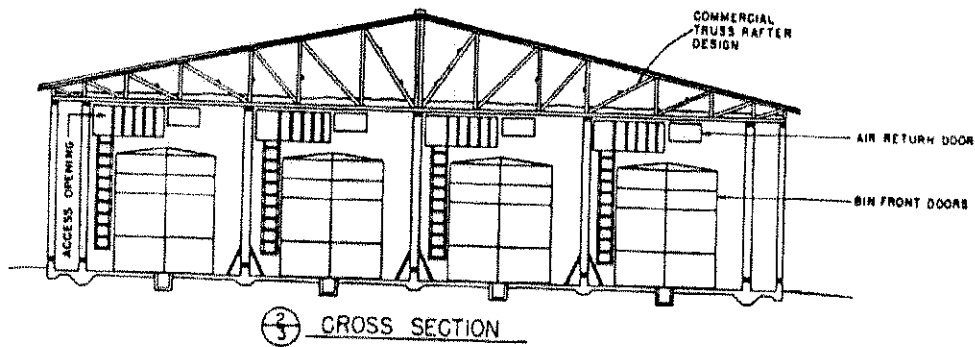
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68,000 TO 86,000 C.W.T. INSULATED
POTATO STORAGE

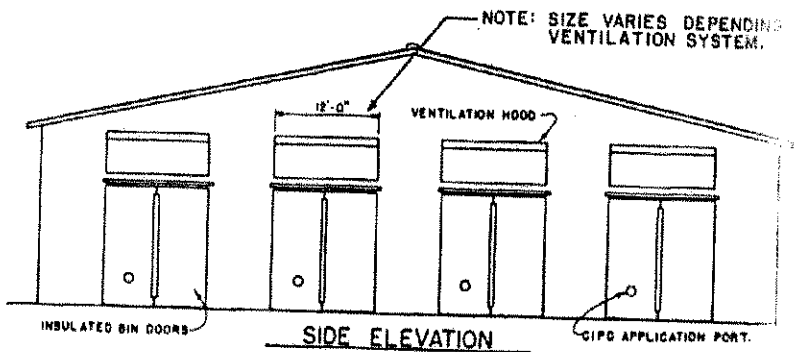
ND 88 6398 SHEET 2 OF 11



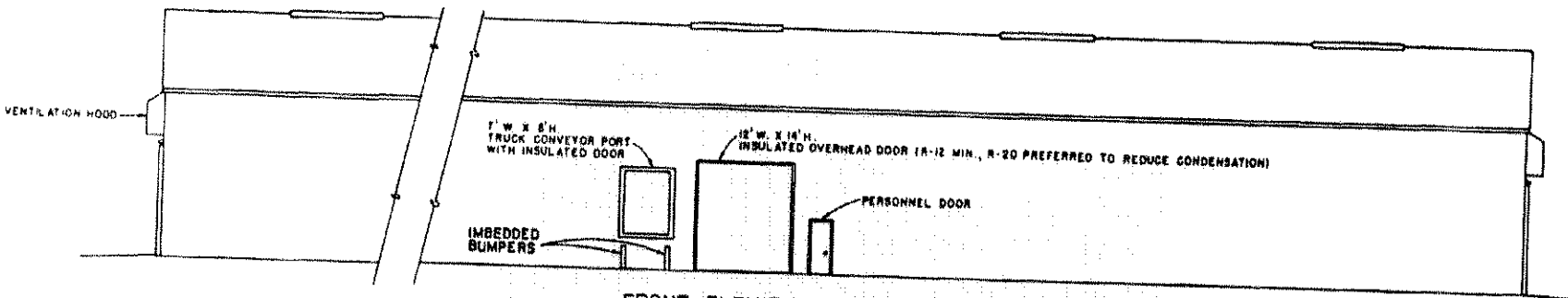
1 CROSS SECTION APPLIES TO SIZES 80'X204' AND 88'X204'



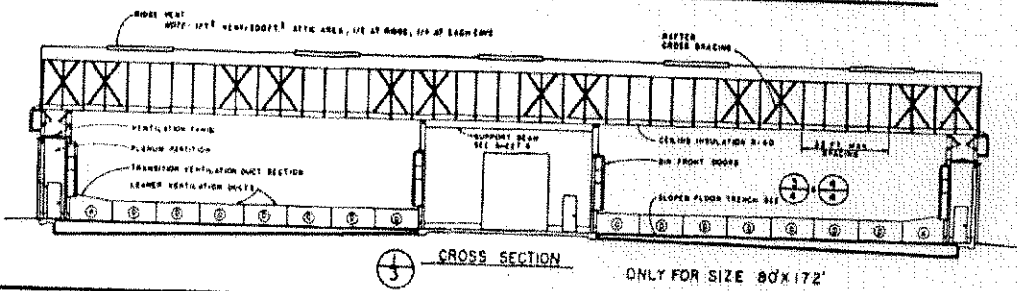
2 CROSS SECTION



3 SIDE ELEVATION



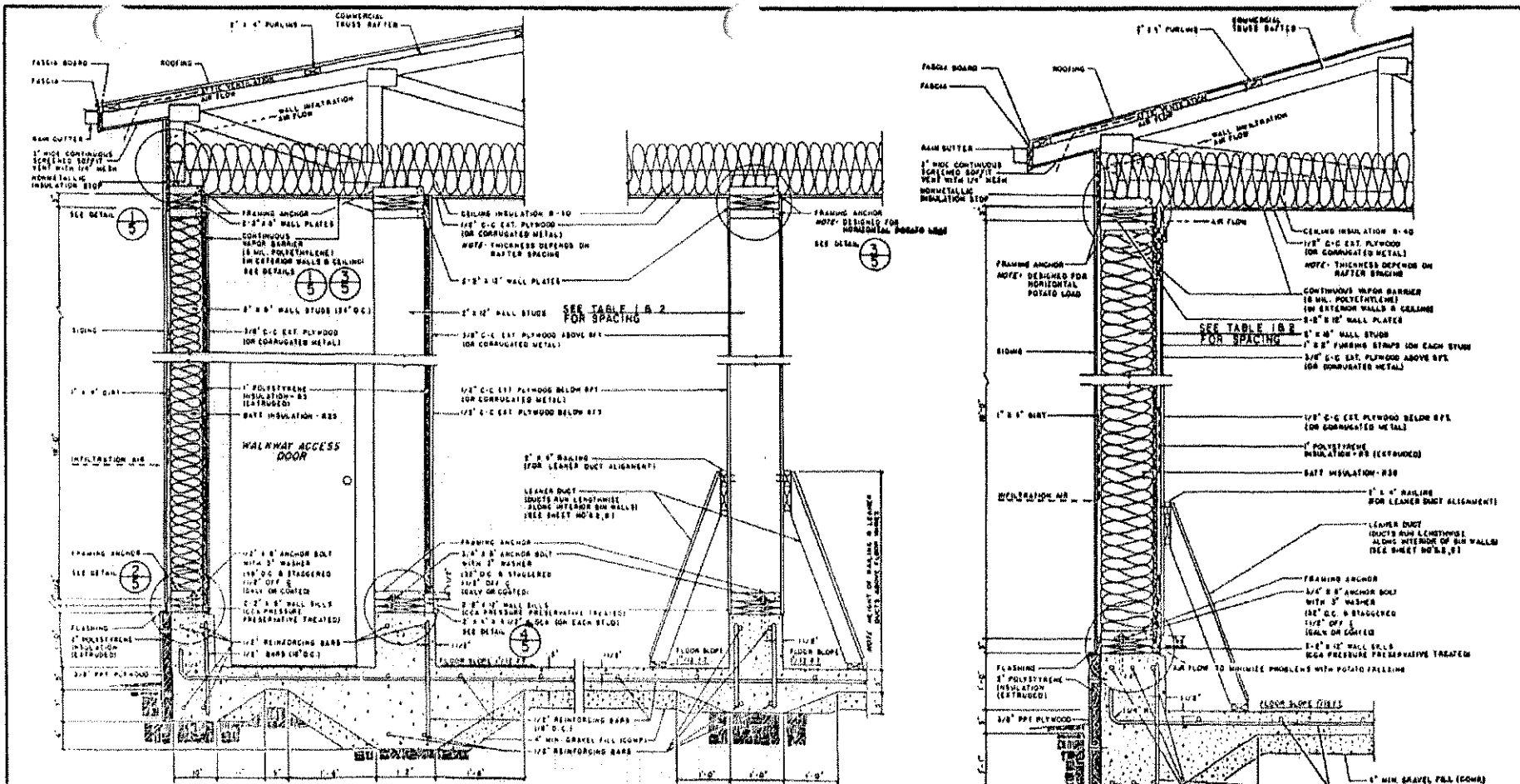
4 FRONT ELEVATION



5 CROSS SECTION ONLY FOR SIZE 80'X172'

NOTE: LEANER VENTILATION DUCT SIZES DIFFERENTIATED BY LETTERS INDICATED (i.e. A, B, C, ect.) REFER TO SHEETS 2, 7, & 8

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68,000 TO 86,000 C.W.T. INSULATED POTATO STORAGE		
ND 88	6398	SHEET 3 OF 4

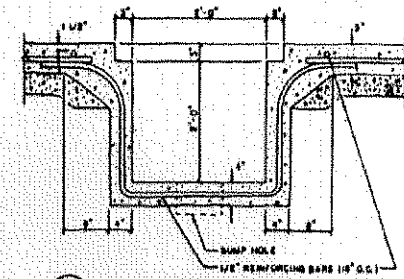
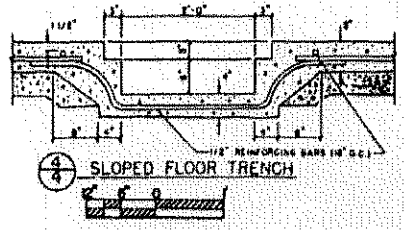


1/4 EXTERIOR DOUBLE WALL SECTION
88' x 204' SIZE

2/4 INTERIOR WALL SECTION
ALL SIZES

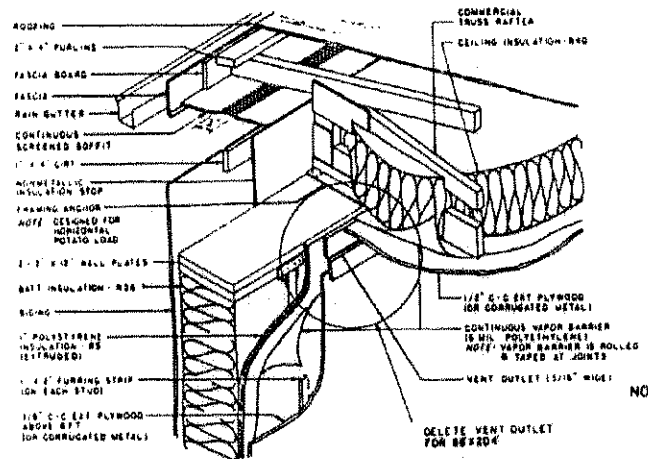
3/4 SINGLE EXTERIOR WALL SECTION
80' x 204' & 80' x 172' SIZES

NOTE: COVER TRENCH WITH PLANK
DETAIL, SEE SHEET 8.



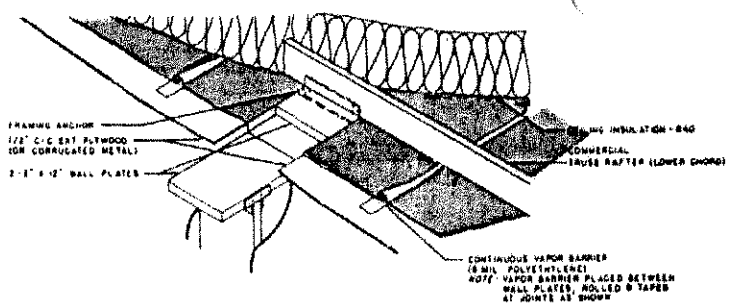
NOTE: THIS END OF TRENCH LOCATED BELOW PLENUM
THE 2' DEPTH COULD BE REDUCED TO 18"
FOR 80' x 172' BIN.

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UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING		
68,000 TO 86,000 C.W.T. INSULATED POTATO STORAGE		
ND 88	6398	SHEET 4 OF 11

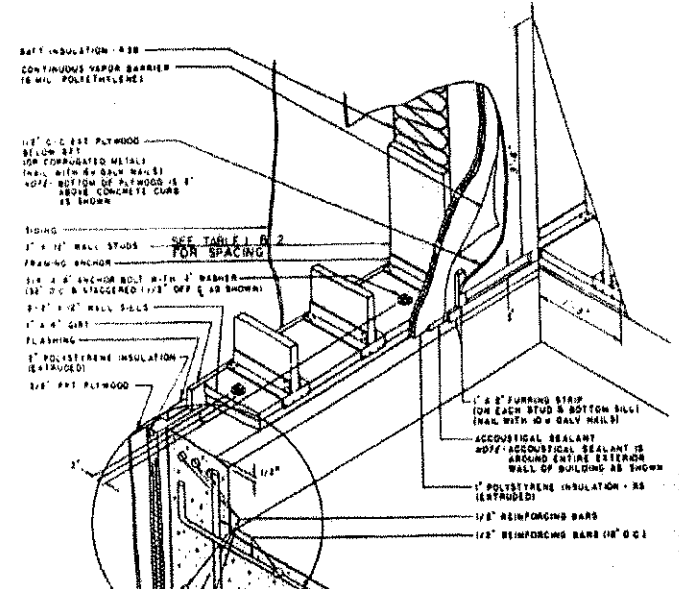


1
5
EXTERIOR WALL PLATE DETAIL FOR 80' x 172' & 80' x 204 SIZES.

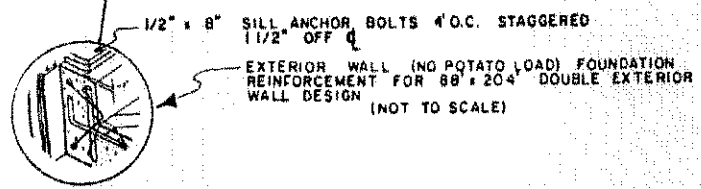
NOTE: FOR 88' x 204' DOUBLE EXTERIOR WALL THERE IS NO EXTERIOR WALL POTATO LOAD. USE R-25 BATT INSULATION, 2' x 8' WALL STUDS (24" O.C.) 2' x 8' WALL SILLS. THERE IS NO SHELL VENTILATION AND NO VENT OUTLET.



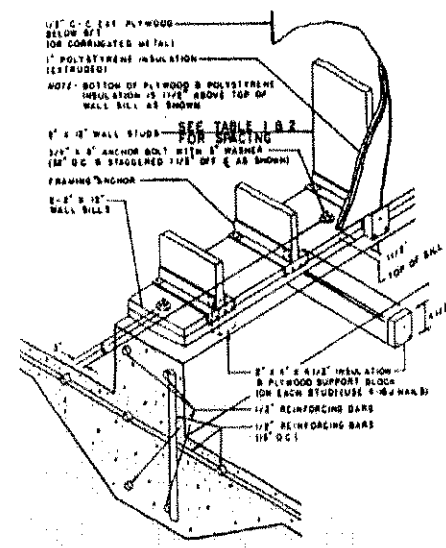
3
5
INTERIOR WALL PLATE DETAIL



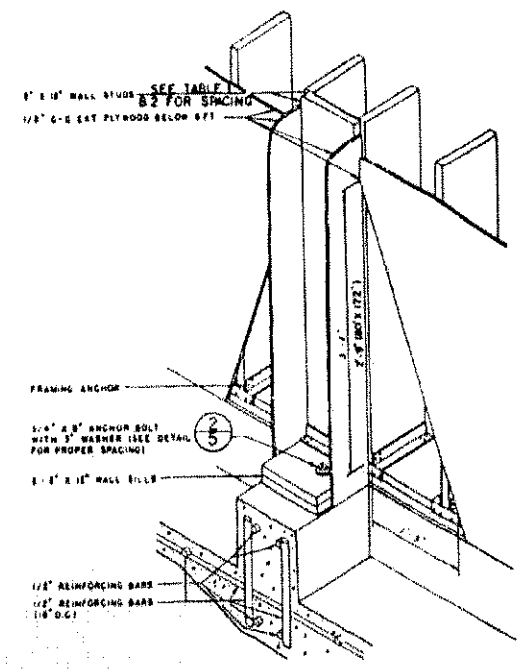
2
5
SINGLE EXTERIOR WALL SILL & ADJACENT LEANER VENTILATION DUCT INLET DETAIL (TO RESIST POTATO LOAD)



NOTE: DESIGN AND DIMENSIONS ARE SAME FOR ALL SIZES EXCEPT WHERE SPECIFIED

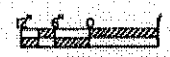


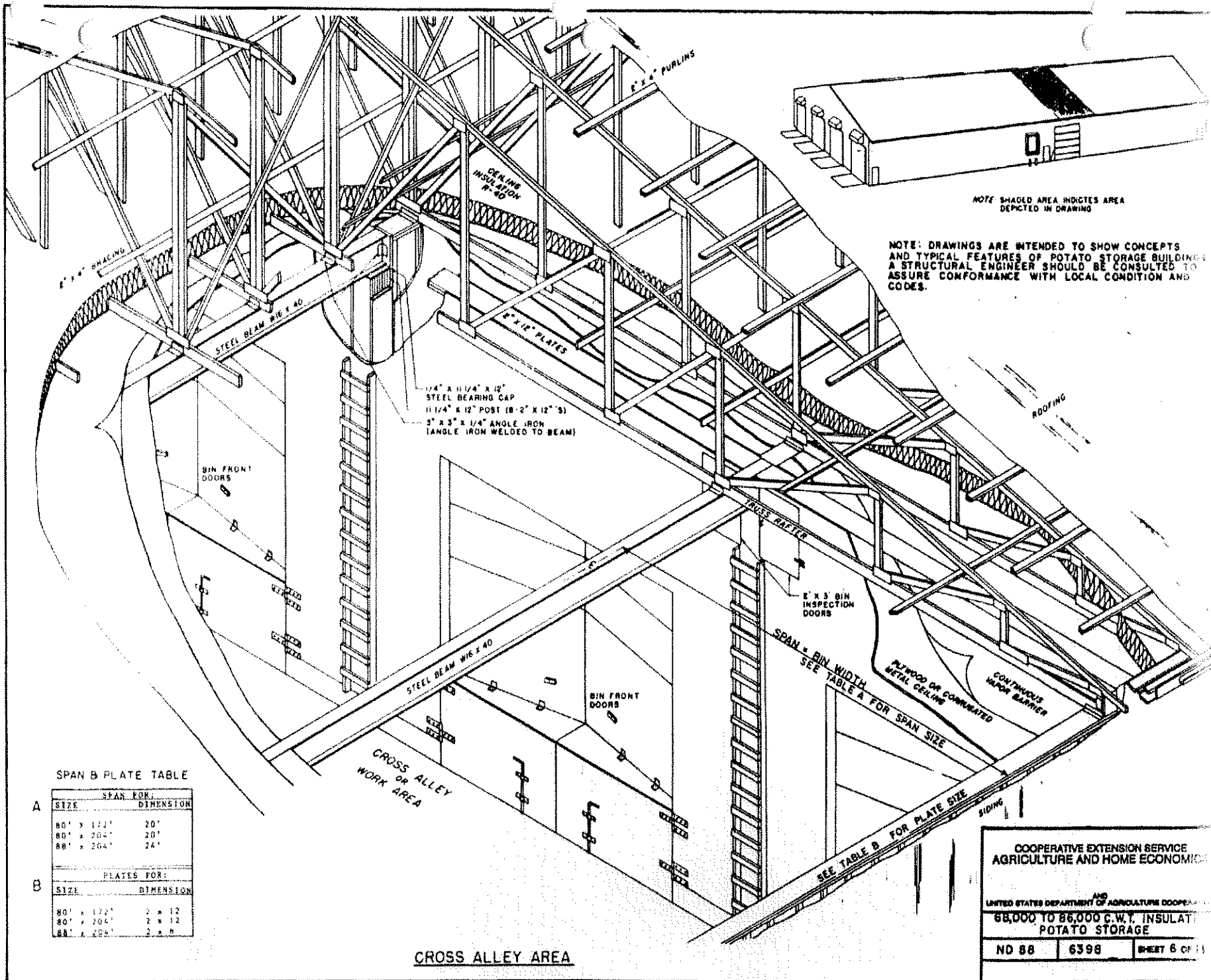
5
5
WALL SLOT OUTLET DETAIL



4
5
INTERIOR WALL SILL & ADJACENT LEANER VENTILATION DUCT INLET DETAIL

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68,000 TO 86,000 C.W.Y. INSULATED POTATO STORAGE		
ND 88	6398	SHEET 5 OF 11





NOTE: SHADED AREA INDICATES AREA DEPICTED IN DRAWING

NOTE: DRAWINGS ARE INTENDED TO SHOW CONCEPTS AND TYPICAL FEATURES OF POTATO STORAGE BUILDINGS. A STRUCTURAL ENGINEER SHOULD BE CONSULTED TO ASSURE CONFORMANCE WITH LOCAL CONDITIONS AND CODES.

SPAN B PLATE TABLE

SPAN FOR:		DIMENSION
SIZE	DIMENSION	
80'	122'	20'
80'	204'	20'
88'	264'	24'

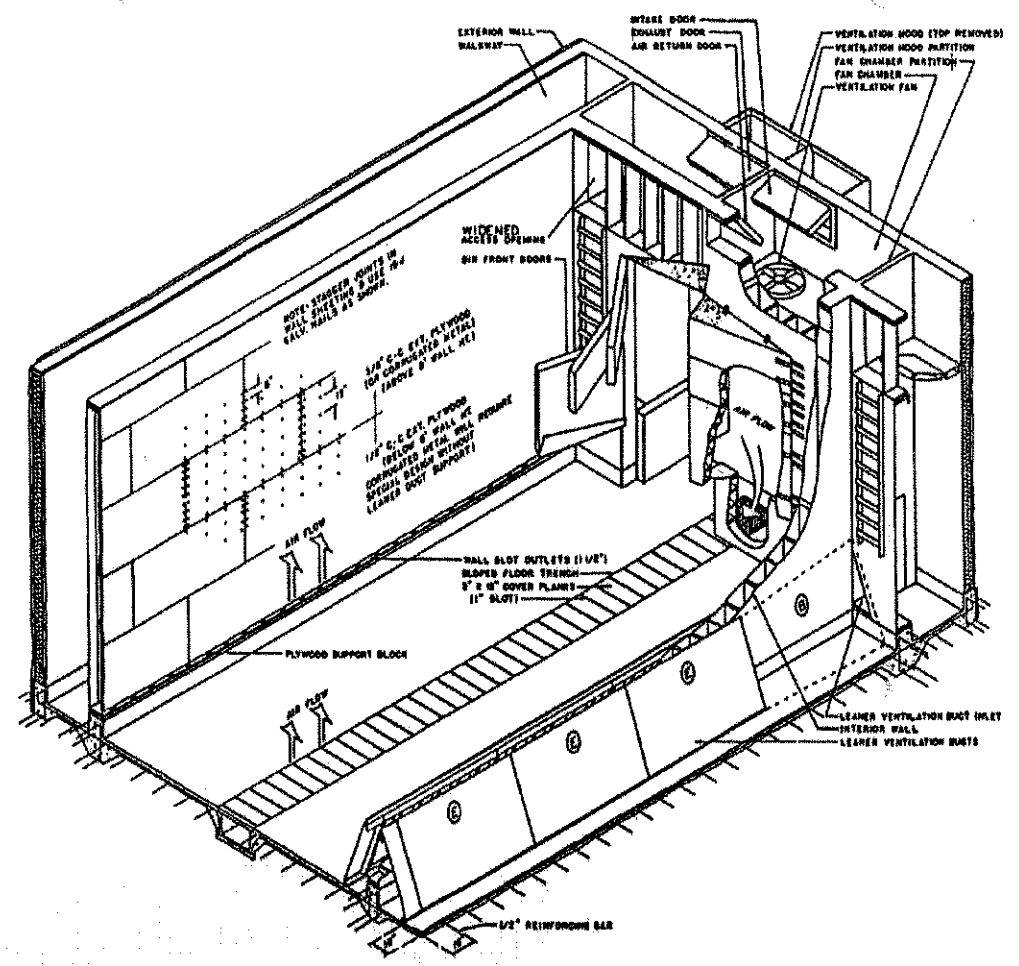
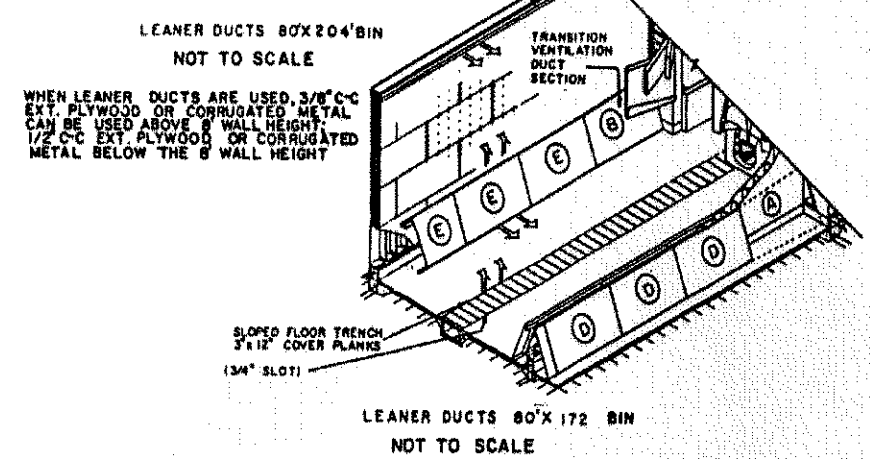
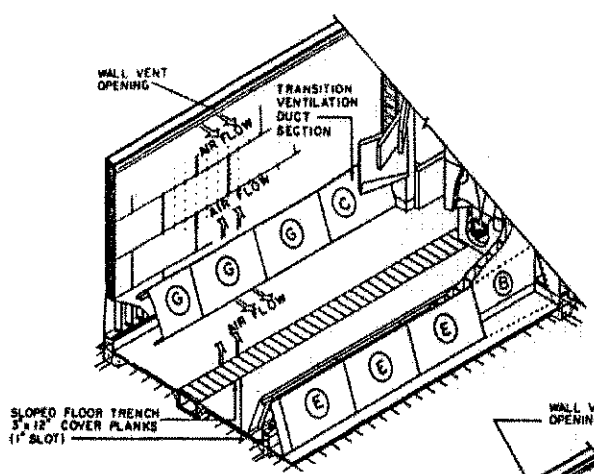
PLATES FOR:		DIMENSION
SIZE	DIMENSION	
80'	122'	2 x 12
80'	204'	2 x 12
88'	264'	2 x 8

CROSS ALLEY AREA

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 AGRICULTURE AND HOME ECONOMICS

AND
 UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATIVE
 68,000 TO 86,000 C.W.T. INSULATED
 POTATO STORAGE

ND 88	6398	SHEET 6 OF 11
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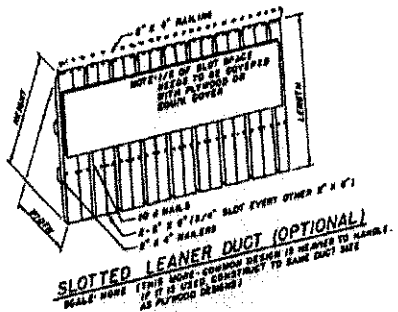
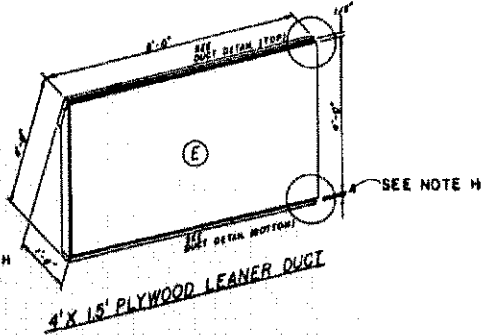
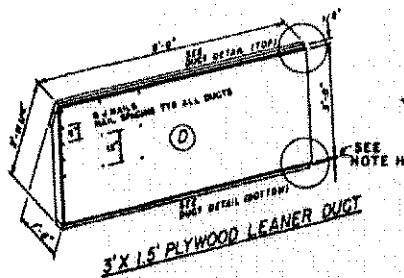
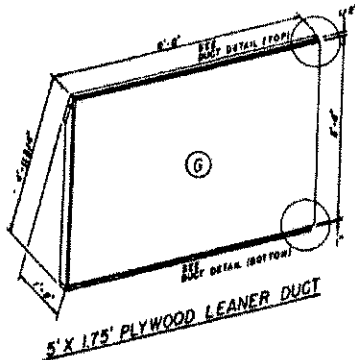
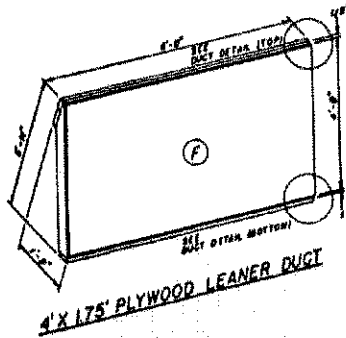
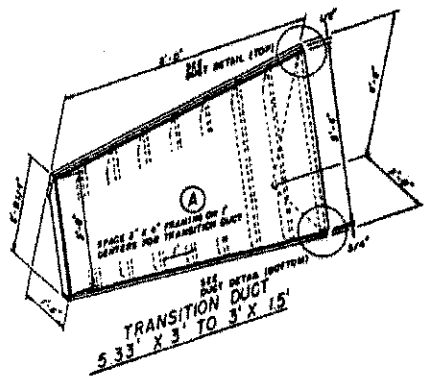
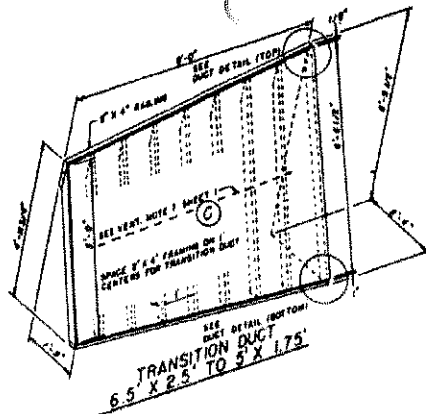
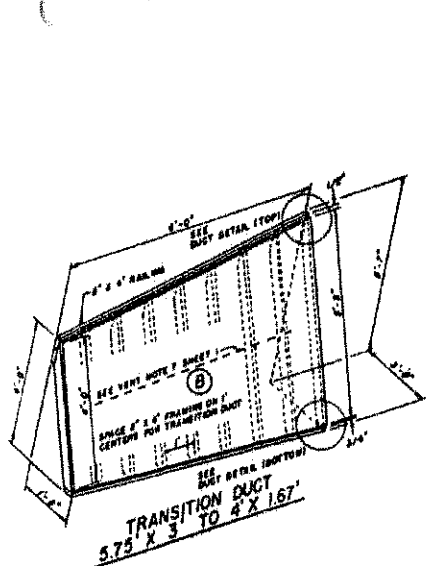


BIN VENTILATION DIAGRAM - 88'x204' BIN

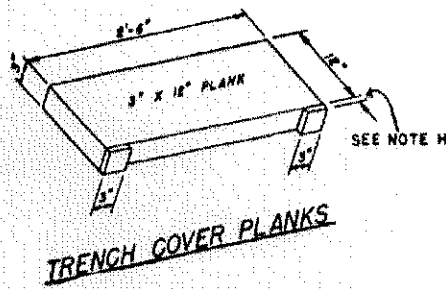


- NOTES:
1. NO WALKWAY NEAR EXTERIOR WALL WITH 80' x 172' AND 80' x 204'.
 2. AIR DUCTING AND TRENCH F, SLOT SIZES DIFFER AMONG BUILDING SIZES.
 3. CHECK PLACEMENT OF A, B, C, D, E, F AND G LEANER DUCT ELEMENTS ON SHEET 2.

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68,000 TO 88,000 C.W.T. INSULATED POTATO STORAGE		
ND 88	6398	SHEET 7 OF 11



NOTE H: LEANER BOTTOM SLOT AND PLANK SLOT SIZES VARY WITH BUILDING SIZE 1' FOR 80'x204' AND 88'x204'; 3/4" FOR 80'x172'

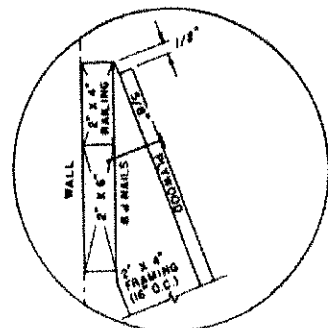


NOTES:
Proper slot size is critical to provide uniform air distribution.
Changing dimensions of potato bin ventilation is as follows:

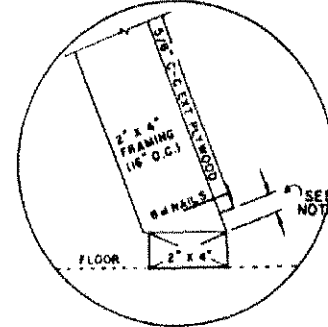
	DUCT CHART						
	A	B	C	D	E	F	G
68,000 C.W.T.	X	X		X	X		
86,000 C.W.T. (single ext.)		X	X	X	X	X	X
86,000 C.W.T. (double ext.)			X	X	X		

The below details apply to all potato bin sizes

- DUCT DETAIL (TOP)
- DUCT DETAIL (BOTTOM)
- SLOTTED LEANER DUCT (OPTIONAL)
- TRENCH COVER PLANKS



DUCT DETAIL (TOP)



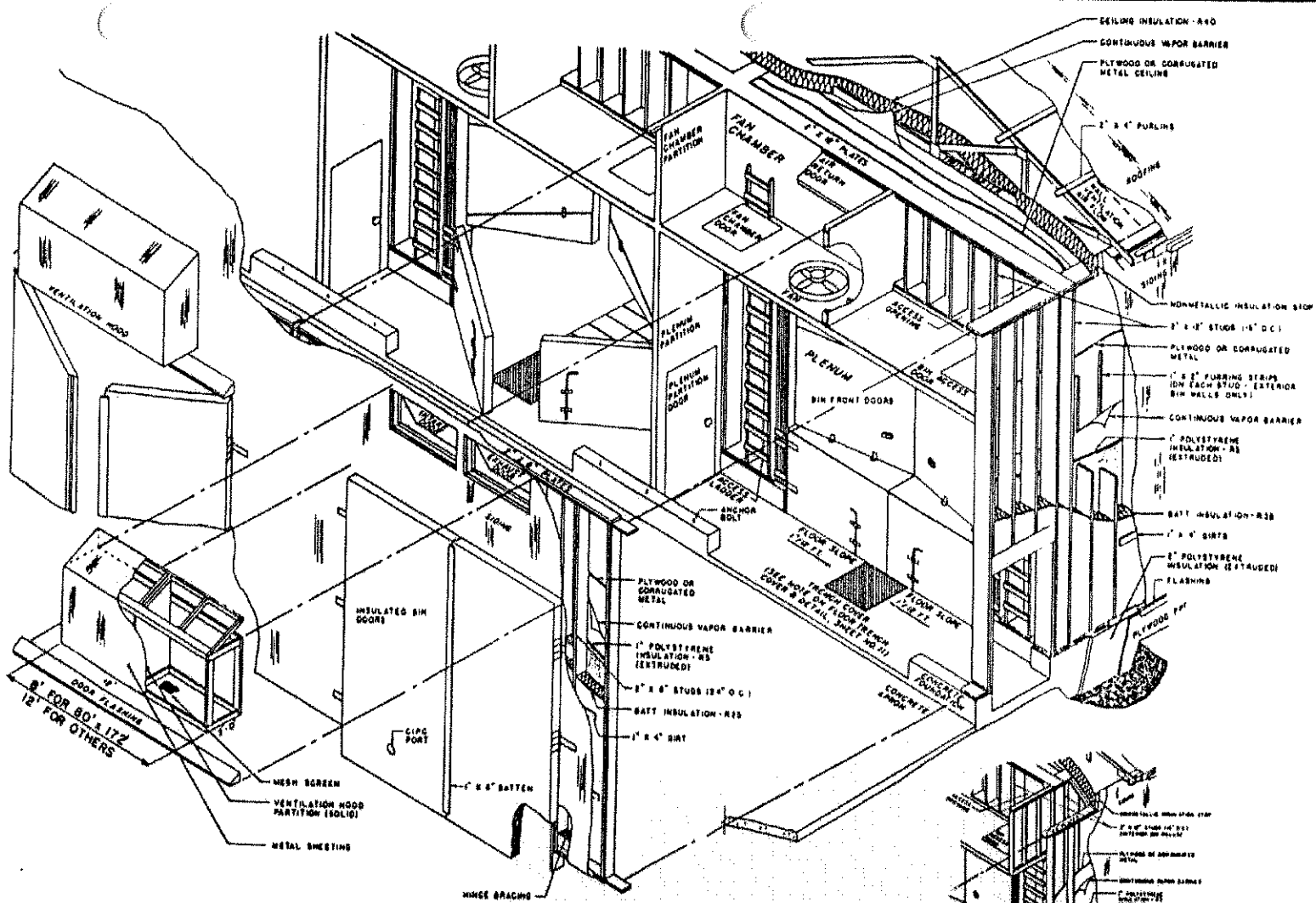
DUCT DETAIL (BOTTOM)

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UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING

68,000 TO 86,000 C.W.T. INSULATED
POTATO STORAGE

ND 88	639B	SHEET 8 OF 11
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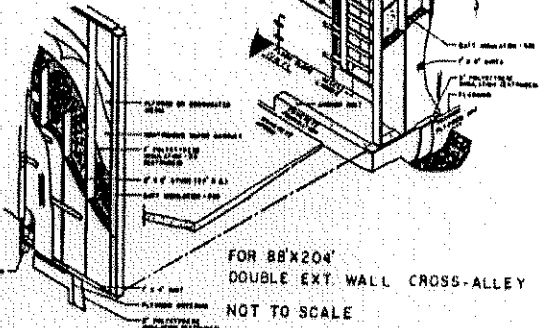


PLENUM AREA - EXPLODED VIEW

NOT TO SCALE

FOR SINGLE EXT. WALL (CROSS-ALLEY)
80'X172' AND 80'X204'

NOTE: Drawings are intended to show concepts and typical features of potato storage buildings; a structural engineer should be consulted when a specific building is to be built.



FOR 88'X204'
DOUBLE EXT. WALL CROSS-ALLEY

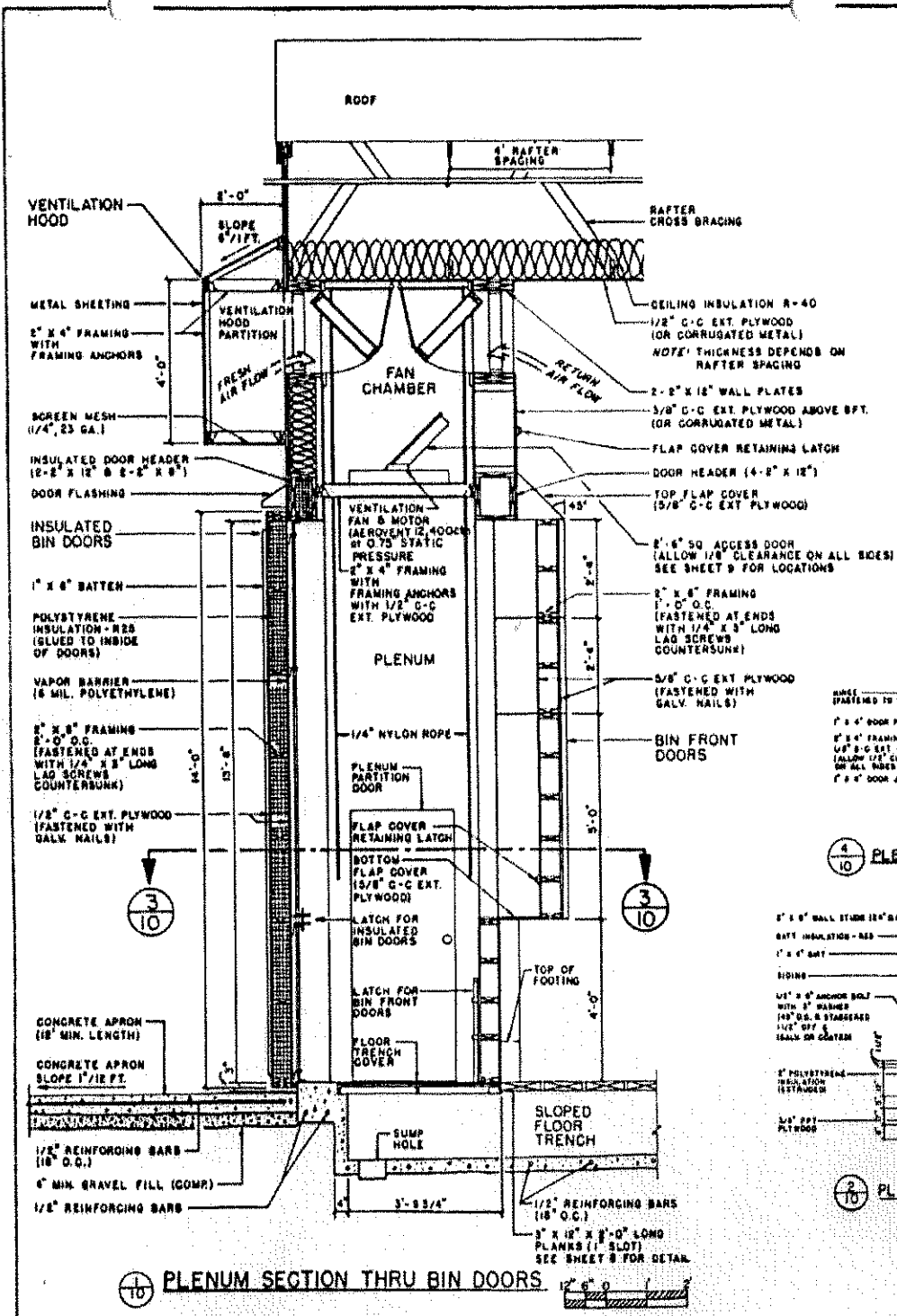
NOT TO SCALE

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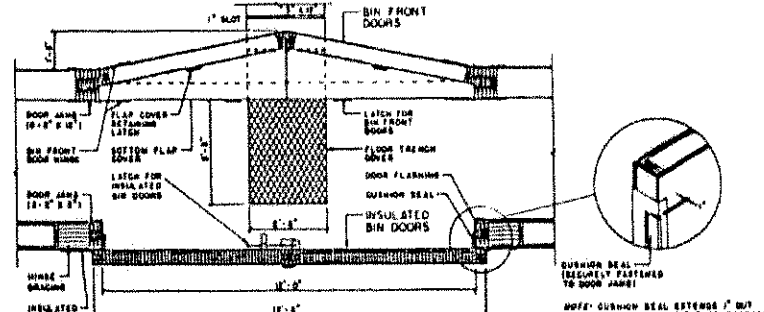
68,000 TO 86,000 C.W.T. INSULATED
POTATO STORAGE

NO 88	6398	SHEET 9 OF 11
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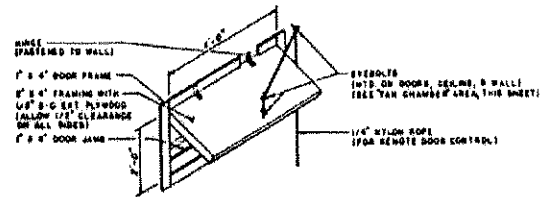


NOTE: SEE SHEET 11 FOR DETAIL DRAWINGS OF THE FOLLOWING ITEMS:

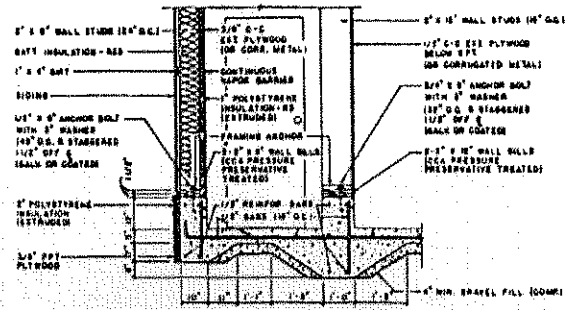
1. INSULATED BIN DOOR HINGES
2. BIN FRONT DOOR HINGES
3. FLAP COVER RETAINING LATCH
4. LATCH FOR BIN FRONT DOORS
5. LATCH FOR INSULATED BIN DOORS
6. FLOOR TRENCH COVER



3 BIN DOORS CROSS SECTION & DETAIL NOT TO SCALE



4 PLENUM INTAKE & EXHAUST DOORS



5 PLENUM SECTION THRU WALLS (PARTIAL)

10 PLENUM SECTION THRU BIN DOORS

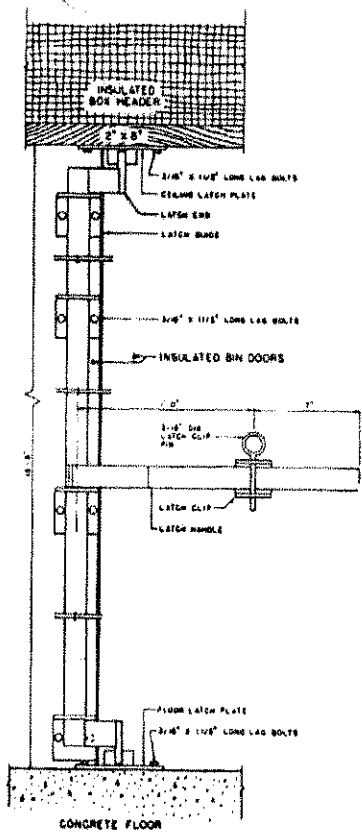
CAUTION: SOME AREAS CANNOT USE "FINISHING" SLAB FOUNDATIONS SHOWN.

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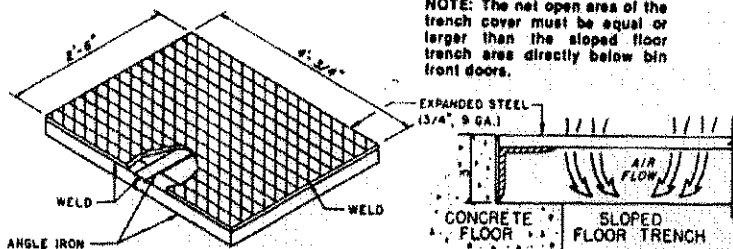
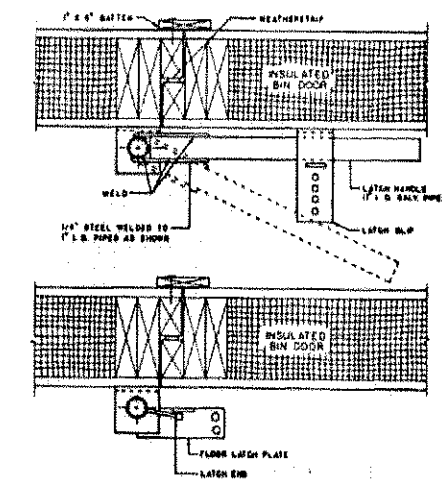
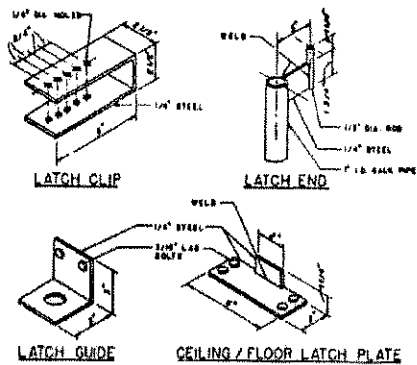
UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING

50,000 TO 86,000 C.W.T. INSULATED
 POTATO STORAGE

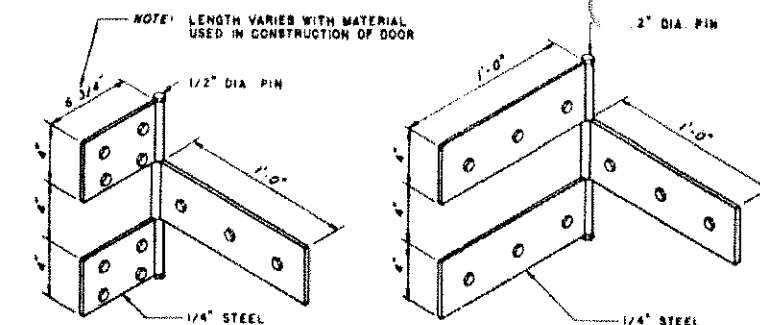
ND 88	6398	SHEET 10 OF 11
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LATCH FOR INSULATED (EXTERIOR) BIN DOORS

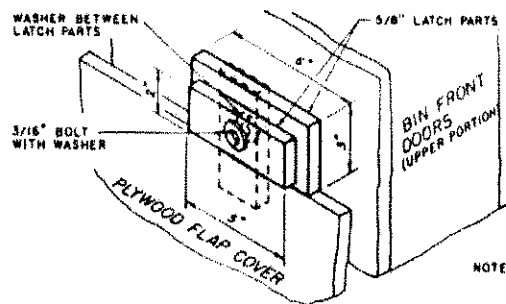


FLOOR TRENCH COVER & DETAIL

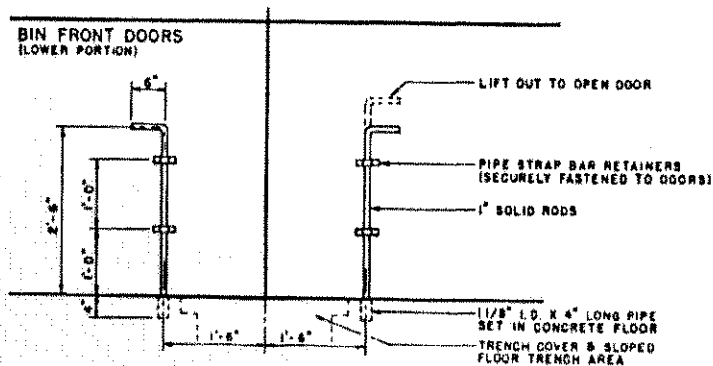


INSULATED BIN DOOR HINGES
SCALE: NOT TO SCALE

BIN FRONT DOOR HINGES
SCALE: NOT TO SCALE



FLAP COVER RETAINING LATCH



BIN FRONT DOOR LATCHES

COOPERATIVE EXTENSION SERVICE
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68,000 TO 86,000 C.W.T. INSULATED
POTATO STORAGE

ND 88 6398 SHEET 11 OF 11