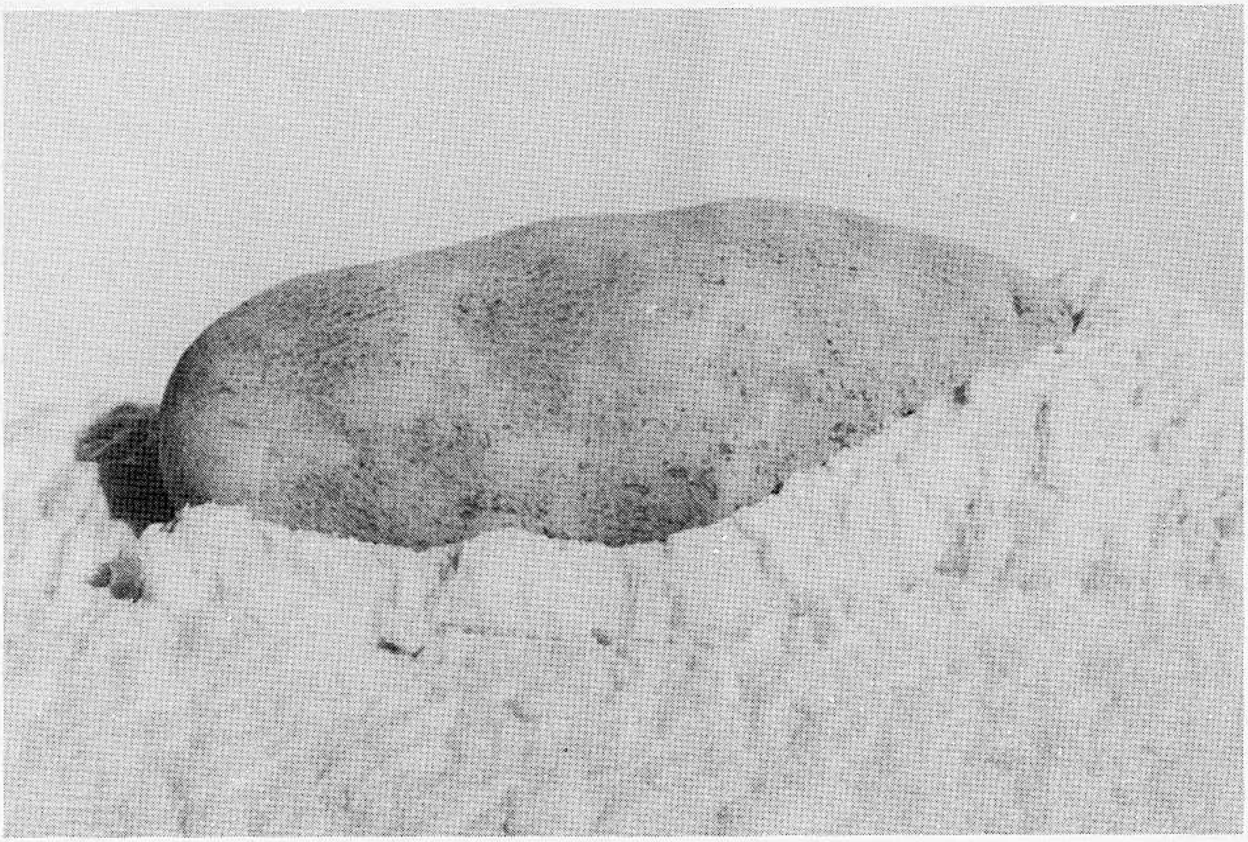


PROTECT YOUR POTATOES

TABLE OF CONTENTS

INTRODUCTION

Much is written about potato storage. The purpose here is not to add another treatise but to try to consolidate the theories useful to the storage manager.

The information presented is from field experience, potato storage studies and reference material provided by the experts area potato specialists, university researchers, etc.

Much more research is needed before the perfect storage can be built. Nevertheless todays storages are more efficient than their predecessors.

The Author
David B. South

STORING THE POTATO

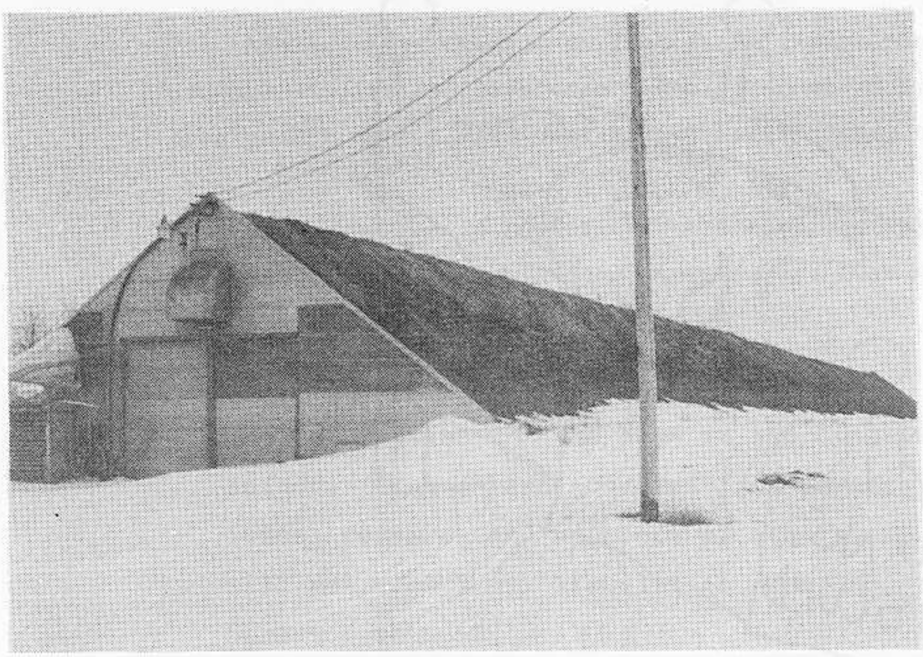
Storage of a potato is probably the simplest and yet most complex of the events leading to the final consumption of a potato.

A potato, properly stored, "thinks" it is in the ground in a nice, cool, moist bed waiting for winter to retreat. It is important to keep this in mind. The potato, properly stored, never gets the "spring grow" signal.

Given half a chance, a potato will store for a moderate period of time. It draws on its own resources to heal wounds, toughen the skin and develop heat. To obtain maximum storage efficiency it is important to consider these factors: longer storage periods, shrinkage, sugar conversion, sprouting and wound healing, etc. The storage manager must try to maintain proper temperature and humidity to minimize shrinkage and rot and to "maximize" the storage season.

Straw and Dirt Covered Cellars

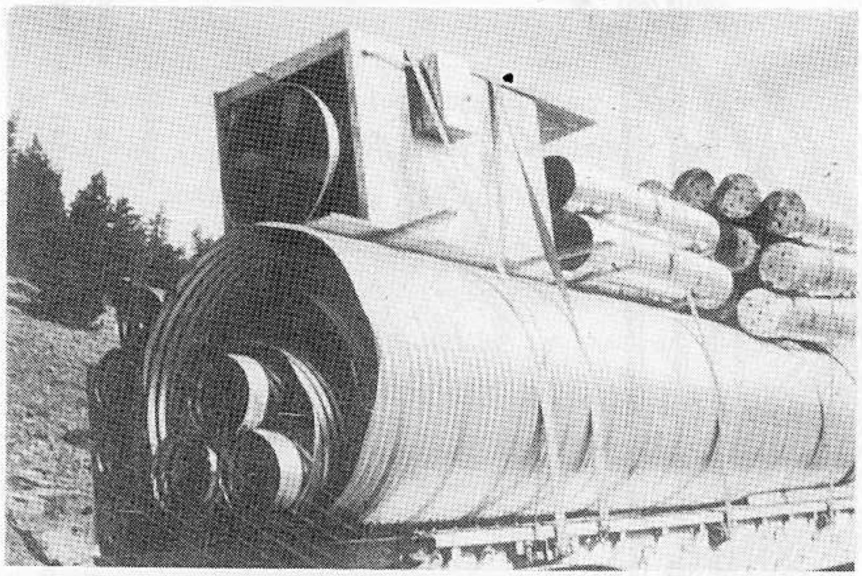
Potatoes can be stored successfully in a number of types of facilities. These range from simple straw and dirt covered cellars to complex storage facilities built above ground. No "super best" storage is clearly indicated. The straw and dirt covered cellar has been very successful for short term storage. Generally this type of storage is cheapest to construct. The narrow dirt banks act as heat sinks for the potatoes. Before the potatoes are put into storage the floors and banks should be soaked with water. The water will then be released to increase the humidity in the pile during the storage season. The straw in the roof absorbs water; this minimizes condensation. As storages of this type were built larger the distance between the banks became greater. This changed the ratio of wall to pile. Cooling by conduction was cut. Available water from the soil was reduced.



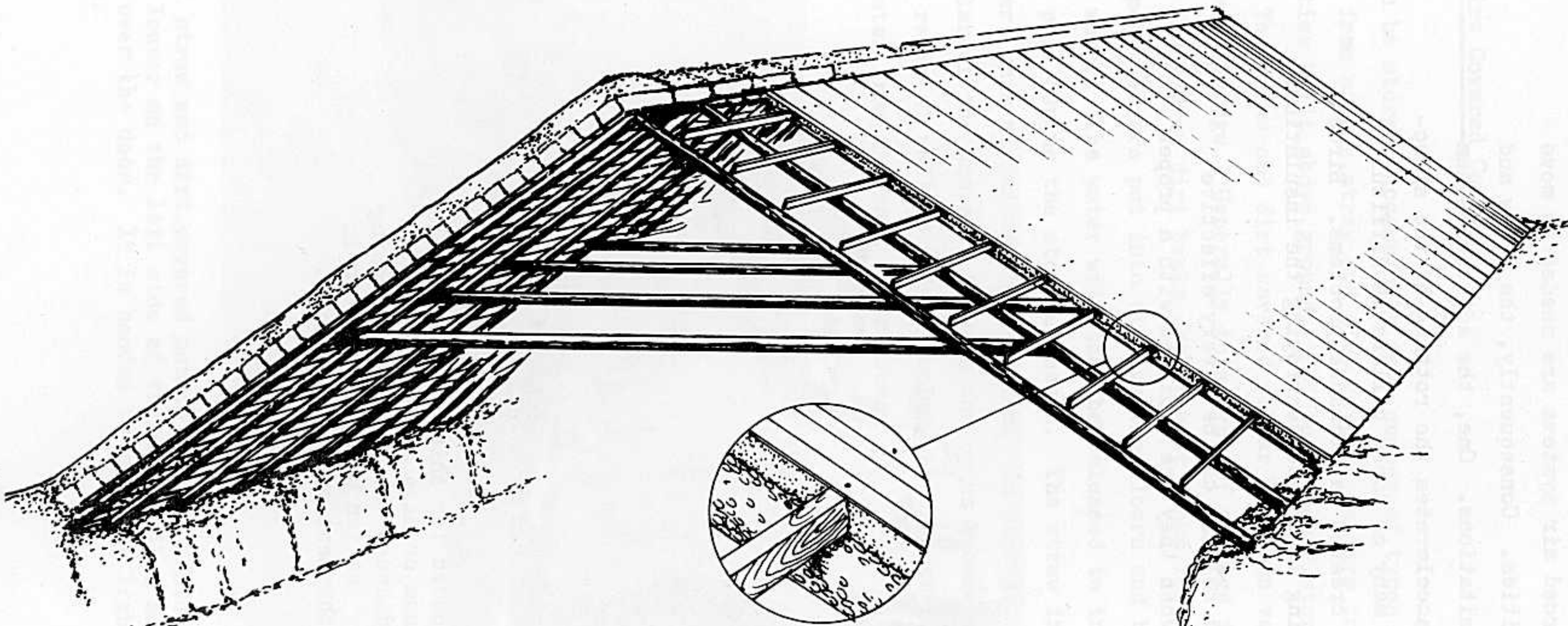
Typical straw and dirt covered potato cellar. Note the air-intake louver on the left side of the door. Also note exhaust damper over the door. It is hooded to keep out light when it is open.

To lengthen the storage season it becomes necessary to add water to maintain humidity in the pile. Forced air systems are needed to move the air through these larger facilities. Consequently, the straw and dirt storages are found to have limitations. One, the additional humidity and extended storage season accelerates the rotting of the structure. Two, access into and out of many of these cellars is difficult. Three, erosion from wind and water creates maintenance problems. Birds and vermin nest in the straw creating leaks and destroying the insulation.

Nevertheless straw and dirt covered cellars can be a very effective storage. This is especially true when they are equipped with a proper air system.



Complete air system loaded for shipment. The larger pipes are for the plenum or main air duct. The smaller pipes are laid under the potatoes branching from the main plenum. The fan unit is complete in one package for easy shipment and installation.



CROSS SECTION OF A POTATO STORAGE

The left side shows straw, dirt and sheathing. The right side shows the straw and dirt has been removed and replaced with 2 x 4 purlins, metal roofing and urethane insulation.

Evaluation

An evaluation of the existing cellar must be made first. The following questions should be kept in mind:

Is the existing cellar large enough?
Is it located where it should be?
Are the cellar ends in good shape? The doors?
Are the walls firm and solid?
Is the foundation solid and secure?
Are the timbers in reasonable shape?
Does the cellar have an air system or can one be installed? This can be anything from the simple to the complex.

Stripping

The dirt must be removed and pulled far enough away from the cellar to allow for good drainage from off the cellar. Probably the best method for removal is to pull both the straw and the dirt with a drag-line. After the straw and dirt have been removed the sheathing can be taken off. If a tractor is used to remove the sheathing care must be taken not to disturb the timbers. As the sheathing is removed temporary angle braces should be nailed to the underside of the logs to prevent racking until the urethane foam is in place. The logs----timbers should be swept clean and checked for problems. Removal of the dirt and straw and replacement by metal and urethane will lighten the load on the timbers by nearly 100 pounds per square foot. Because the load will be much lighter it is not necessary that the logs be perfect.

Re-building

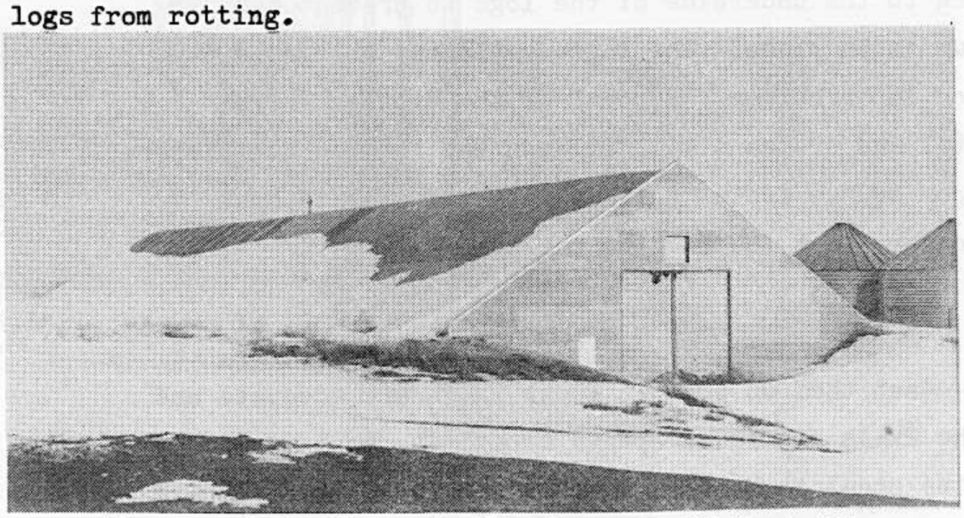
Secure 2x4's to logs----set them on edge. (Rough 2x4's are adequate and generally cheaper) The 2x4's should be spaced from 3 ft. to 5 ft. on centers depending on the steel to be used and the spacing of the timbers. If the timbers are 2 ft. on center and a moderate gauge of steel is used then the 2x4's may be spaced 5 ft. apart. It must be remembered that the urethane foam will impart a tremendous amount of strength to the sheets of steel. Snow load is the factor to consider in spacing of both stringers and 2x4 purlins.

The 2x4's may be attached most easily by laying them in position first. Next the high spots on the logs should be trimmed off. Then 2x4's should be repositioned. It would be best to use 6 inch or 8 inch ring shank spikes. Holes, slightly smaller than spike, should be drilled through 2x4's. Drive spikes in taking care to position any shimms necessary.

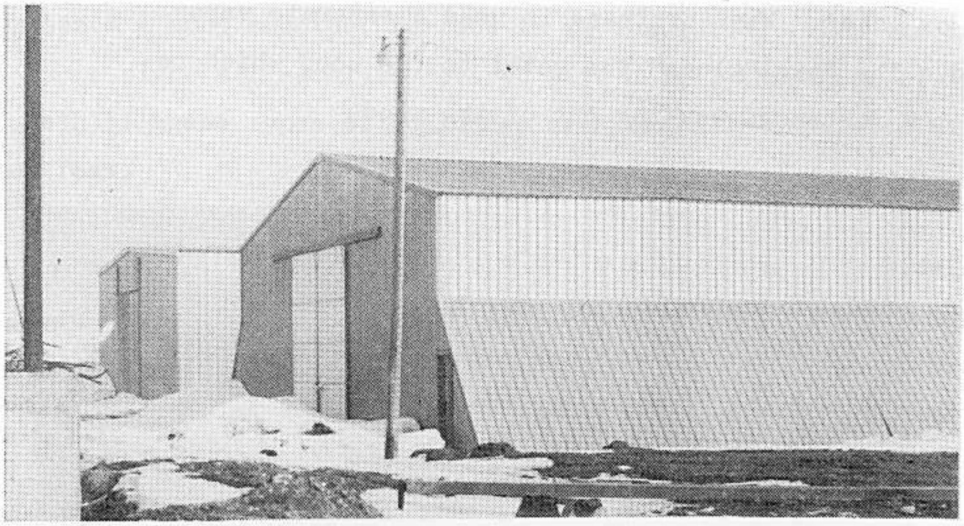
After the 2x4's are in place attach the metal sheathing. Sheathing is best fastened with ring shank nails or screws that have a neopreme or lead washer. All metal laps should be made away from the prevailing winds. Metal flashings should be used on the ends of the cellar between the metal sheets and the end itself. It is important that the completed roof doesn't leak.

Insulation

From the underside apply 2½ to 4 inches of urethane foam to the metal sheathing. After the insulation is in place remove the temporary bracing. Then the timbers can be sprayed with a preservative to help prevent the logs from rotting.



When complete the re-built storage will look like this. It will have a very long useful life and give relatively few maintenance problems.



Steel siding over a wooden framework is used for this building. The sloped knee walls are to brace the sides of the building. They are sheathed and insulated to form air plenums.

WOOD-FRAME METAL CLAD

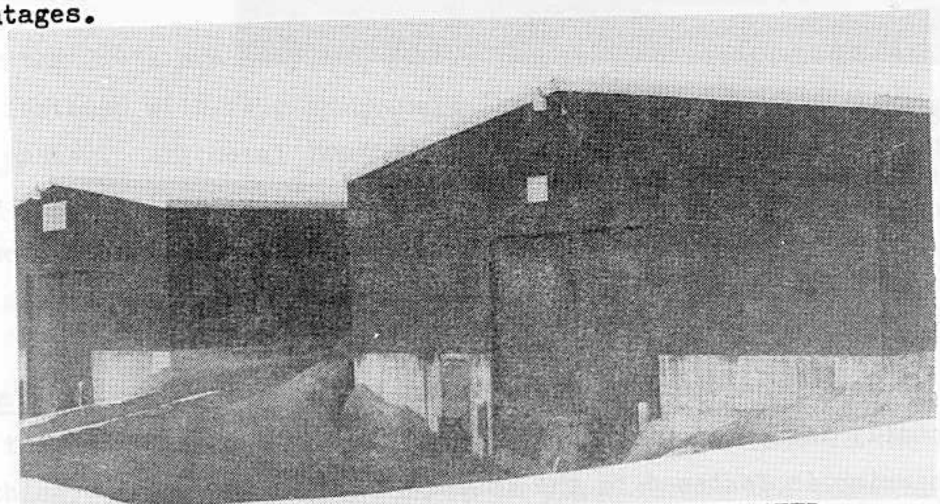
Wood-frame metal-clad above-ground storages are popular in some areas. These buildings are usually insulated with up to 10 inches of fiberglass. A polyethylene vapor barrier is fastened to the inside to help protect the fiberglass from the humidity in the storage. Proper construction and careful maintenance are absolute necessities with this type of storage. Even small "leaks" in the roof or vapor barrier will have disasterous results. The fiberglass will waterlog. When fiberglass becomes waterlogged its insulation value is nil. Occassionally the weight of water accumulated in the insulation will tear it out of the ceiling. Rotting of the structural wooden frame can occur if the insulation waterlogs.

These storages can be excellent when they are built properly and maintained carefully. As part of the maintainance they should be inspected regularly both inside and out. Special attention should be given to the fasteners of the wood to the metal to insure watertight fit. The vapor barrier should be repaired immediately if it is punctured.

Many of these buildings have been insulated with urethane foam either in initial construction or later. When urethane is used a separate vapor barrier is not needed. The foam "glues" the metal to the wood which reduces the problem of the fasteners working out of the wood.

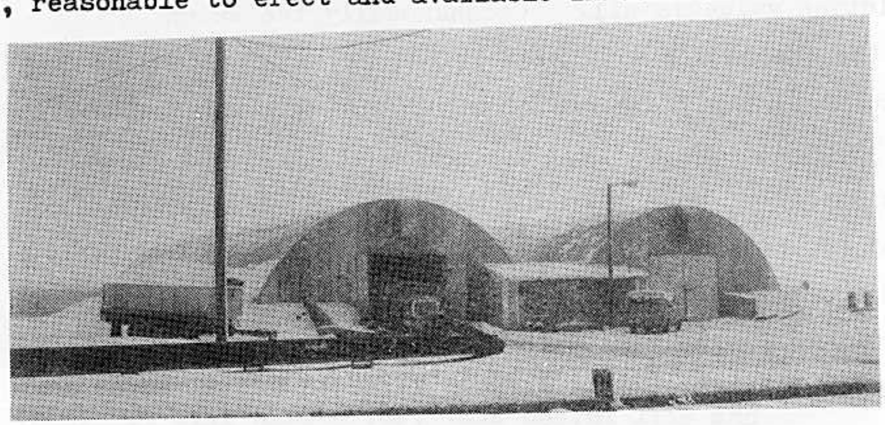
Metal Buildings

Metal buildings insulated with urethane are the most popular of the modern storage buildings. These give benefit of long life at reasonable cost with minimal maintenance. Metal buildings can be separated into two types - rigid frame and stressed skin buildings. With each there are advantages.



RIGID FRAME BUILDING - URETHANE INSULATED

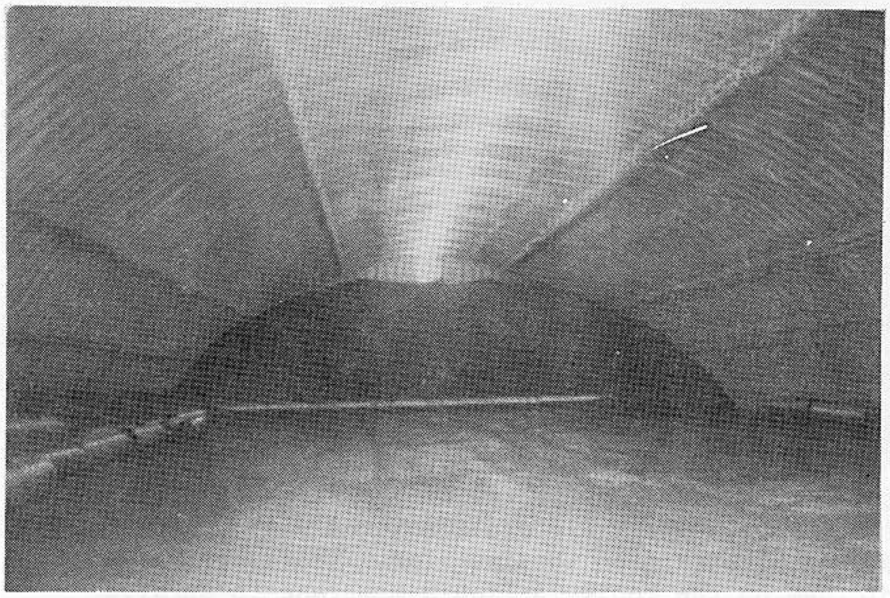
The rigid frame building is often called a red iron building because the framework is usually painted red. They are built in many sizes and with either straight or slope side walls. This building is usually very competitive, reasonable to erect and available in color.



STRESSED SKIN BUILDING - URETHANE INSULATED

With stressed skin metal buildings there is the advantage of no framework

This presents a much smoother surface to be insulated. When the insulation is in place all metal is covered with a full thickness of insulation. Both of these types of buildings are generally insulated with urethane foam.

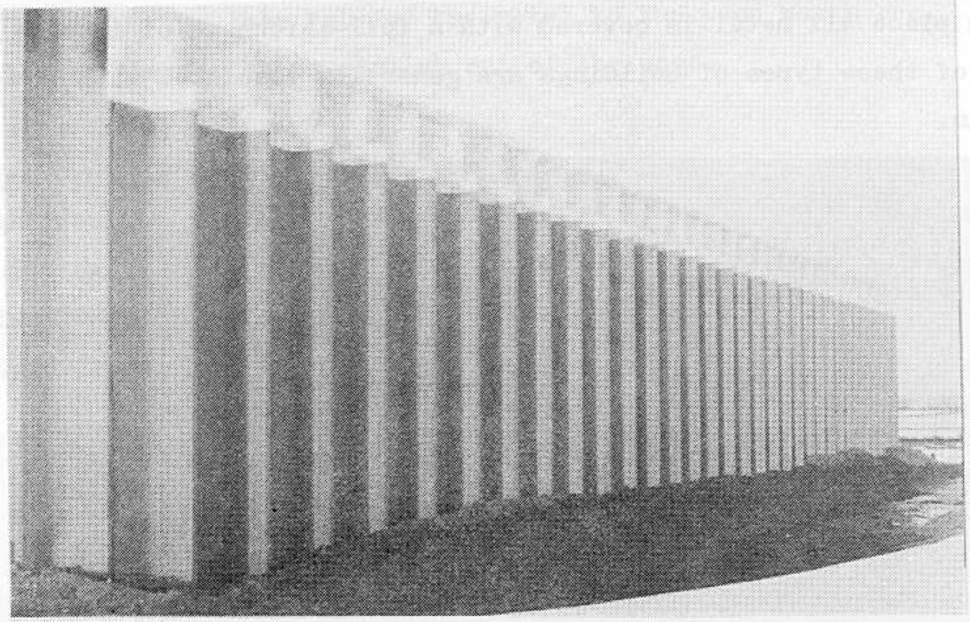


Interior of stressed skin building. The entire building is lined with spray applied urethane foam.

Concrete Buildings

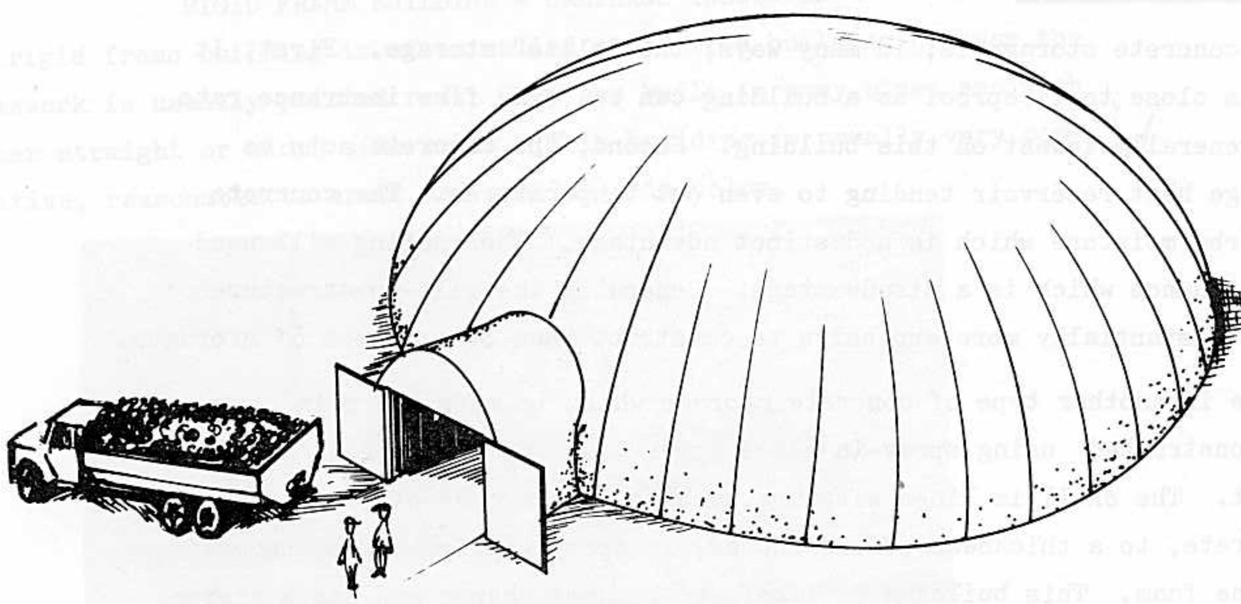
The concrete storage is, in many ways, the "elite" storage. First, it is as close to fireproof as a building can be. The fire insurance rate is generally lowest on this building. Second, the concrete acts as a huge heat reservoir tending to even out temperatures. The concrete absorbs moisture which is a distinct advantage. The roofing will need maintenance which is a disadvantage. Generally the tilt-up structures are substantially more expensive to construct than other types of storages.

There is another type of concrete storage which is much lower in cost. It is constructed using spray-in-place concrete. An air shell is formed first. The shell is lined with urethane to a thickness of four inches. Concrete, to a thickness of two inches, is spray applied on the underside of the foam. This building is likely to be dome shaped and has a tremendous snow load capacity. A storage of this type is best built from 50,000



This potato storage is constructed of pre-stressed tilt-up walls and roof. The walls are insulated with urethane foam and then plastered on the interior. There are three inches of foam on the roof. A liquid membrane is sprayed over the foam to protect the foam from sunshine.

hundred weight to 70,000 hundred weight capacity. When additional storage capacity is needed - build two or three or a cluster.



Spray-in-place concrete potato storage. The building has a vertical center air plenum with the fan mounted in the plenum. Built 105 Ft. to 130 ft. in diameter--these buildings have capacities of 50-70,000 cwt.

Fibered Insulation such as rock wool, fiberglass, shredded wood, etc. are generally used only in the wood-frame metal-clad buildings. They must be carefully protected from moisture. The most common potato storage insulation is now cellular plastics.

Urea Formaldehyde Insulation has not proved to be very successful in potato storages. It absorbs too much water and is therefore limited to a fiber type insulation installation.

Expanded Polystyrene Insulation is only available in sheet form. The problem of sealing cracks as well as fastening it to the building usually prohibit its use.

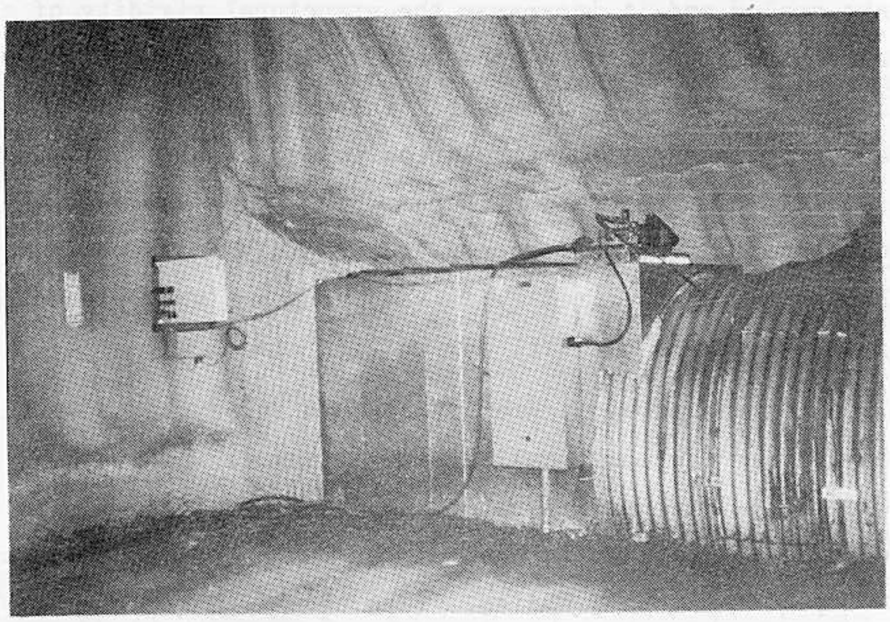
Polyurethane Foam Insulation is one of the most versatile of all insulations. It is sprayed in place to form a solid sheet of insulation. Cracks are filled, leaks sealed and it increases the structural rigidity of a building. When urethane foam is used no separate vapor barrier is needed. It will last almost indefinitely. So what's the problem?------foam burns! Foam burns because of its excellent insulation value. When a building is lined with the world's best insulation there is no escape for heat when a fire starts. Consequently the heat accumulates rapidly and becomes many times hotter than any ordinary fire. This same urethane when placed on the exterior of a building is of little or no fire danger.

Urethane foams are being improved. Nearly all foam fires have been in the so-called standard foams (formerly called self-extinguishing). The U L rated foams are definitely more fire retardant. Nevertheless, a fire barrier, called a thermal barrier is needed over the urethane to satisfy most insurance companies and code bodies. This thermal barrier is to be equal to 1/2 inch of portland cement plaster mechanically fastened to the building. Several products have been developed for use as thermal barriers. Unfortunately most of these products deteriorate in the wet conditions of a potato storage.

RESISTANCE, CONDUCTIVITY OF INSULATING MATERIALS

k-factor	Material	R-value / in
0.14	RIGID URETHANE FOAM	7.14
0.25	GLASS FIBER	4.0
0.28	EXP. POLYSTYRENE BEAD BOARD	3.57
0.35	FOAM GLASS	2.86
0.39	EXPANDED PERLITE	2.56
0.48	VERMICULITE	2.08

With the lowest k-factor and the highest R-value, urethane foam can provide more thermal resistance with less material than any other insulation.



Air system installed in urethane foam insulated potato storage. Note that all metal in contact with the outside is fully insulated.

Insulation Values

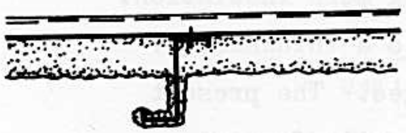
A potato pile is like a low temperature furnace. As the potatoes breathe, they give off heat, water vapor, and carbon dioxide. Depending on the dormancy and condition of the potatoes in a storage various quantities of heat will be given off. This may vary from 10 BTU per ton on up. This is generally not a large amount. In any case the heat given off by the potatoes will usually heat the storage if it has air circulating and any reasonable amount of insulation. The major problem is condensation control. As can be seen from the following table, the higher the relative humidity the higher the dew point. When the weather is cold it takes a lot of insulation to prevent condensation. Many farmers are using more insulation. Formerly, urethane foam has most commonly been applied to a thickness of 2 inches to 2 1/2 inches for insulation in potato storages. The present trend is to use 3 or 4 or more inches of urethane---primarily for condensation control.

Relative Humidity	Air Temperature	Dew Point Temperature
100%	50°F	50.00°F
99%	50°F	49.64°F
97%	50°F	49.28°F
95%	50°F	48.56°F
90%	50°F	47.12°F
85%	50°F	45.68°F
80%	50°F	43.88°F

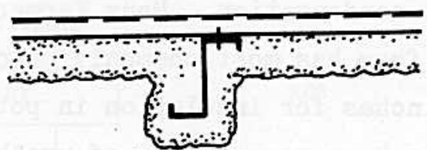
From the above dew point table it can be seen that a lot of insulation is needed to prevent condensation. University researchers recommend a minimum R-value of 20. This is equal to approximately 3 inches of urethane foam. Example: Consider a metal storage where outside the temperature is -20°F and inside the temperature is 50°F. Assume that the air on the inside and also on the outside of the storage is still. The interior surface of this metal storage insulated with 2½ inches of urethane foam will be approximately 47.71°F. The interior surface of the same storage insulated with 4 inches of urethane will be approximately 48.54°F. This difference of .83°F on the interior surface of the storage makes it possible to raise the relative humidity in the storage 5%.

INSULATION TECHNIQUES

It is of utmost importance that no metal be allowed to conduct heat from the inside to the outside. When insulating the rigid frame building the typical method is to coat all of the red iron with 1/4 to 1/2 inch of urethane foam. The metal skin is then insulated from 2 1/2 inches to 5 inches thick. Even though this is adequate, a better method is to "bed" the red iron purlins and girts in urethane. This helps eliminate the streaks of condensation drips in many of these buildings. It is expensive, but worth it, to bed the purlins.



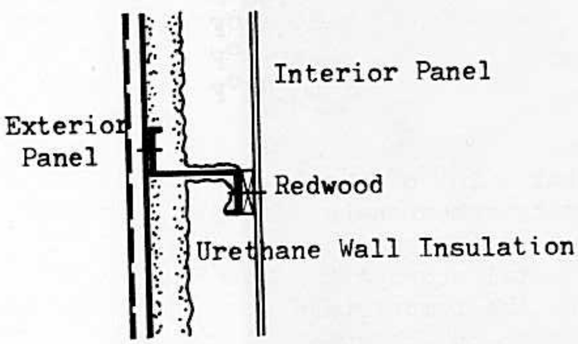
TYPICAL



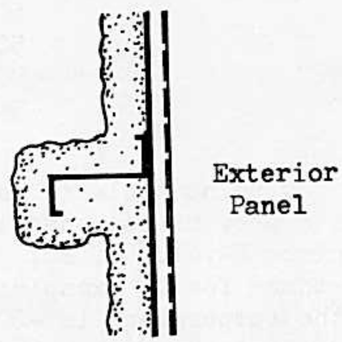
BETTER

In many buildings a liner panel is used. These panels should be affixed to redwood or treated wood strips that are fastened to the girts.

Some insurance companies will accept the bare liner panel as a thermal barrier in a potato storage.



WALL SECTION WITH LINER PANEL



WALL SECTION WITHOUT LINER PAENL

The urethane foam on the purlins and girts should be a minimum of one inch in thickness.

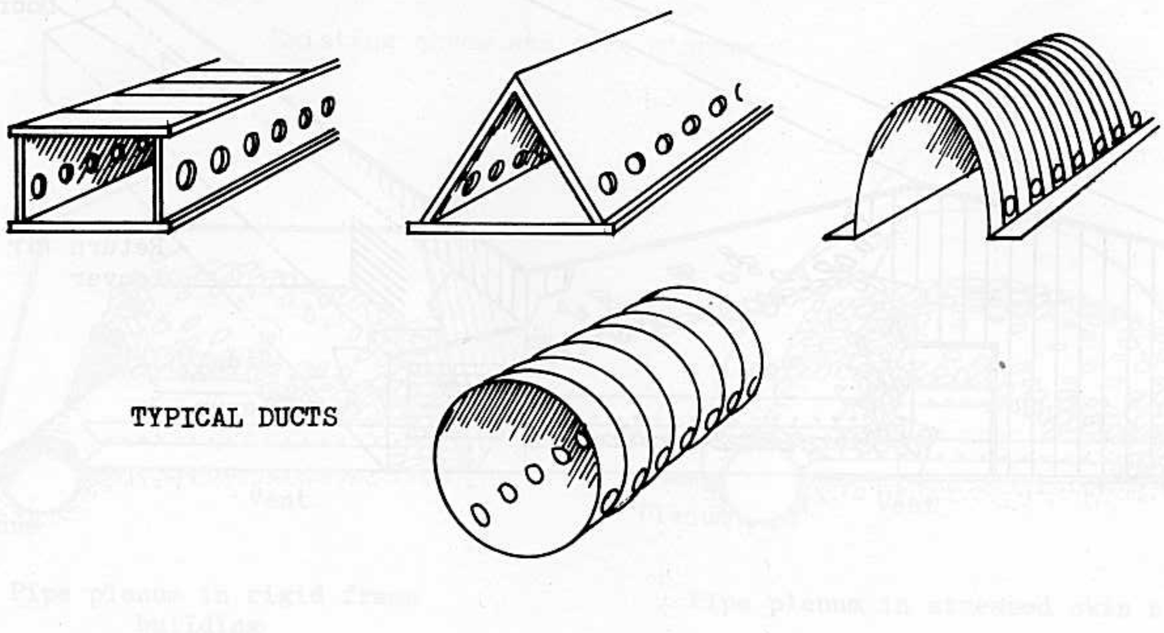
Potatoes live and breathe and give off heat, water vapor and carbon dioxide. When they are put in the storage they also carry a latent heat load. All of the heat above the desired storage temperature must be carried off. This is done by forcing cooler air through the potato pile and exhausting or cooling the warm air. The cool air can come from either of two sources:

1. Natural cool air outside of the storage.
2. Refrigerated cool air.

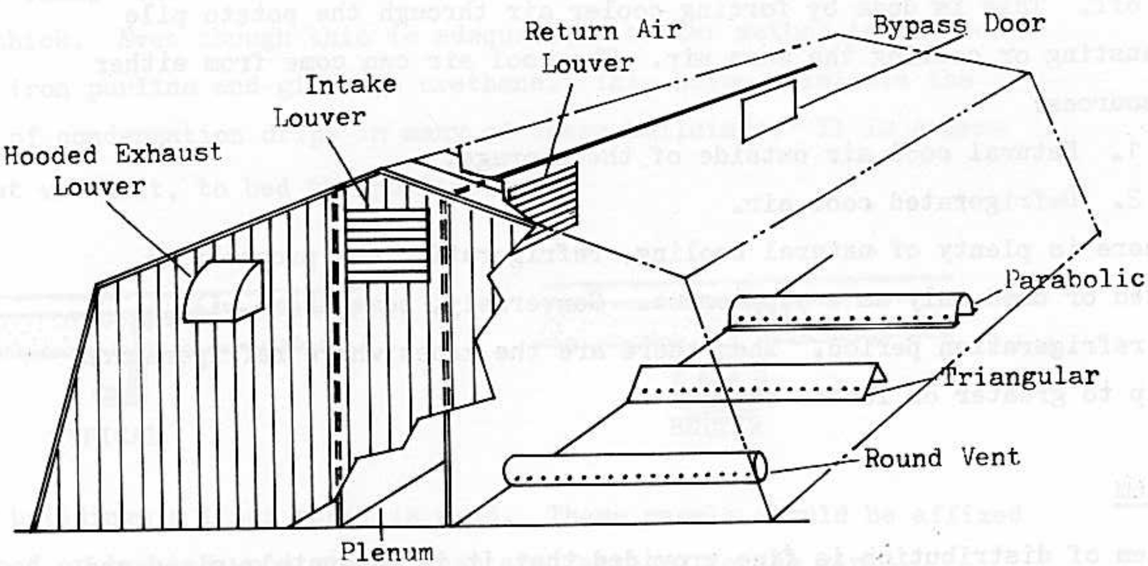
Where there is plenty of natural cooling, refrigeration can probably be eliminated or used only as a supplement. Conversely, some areas will require refrigeration period. Then there are the zones where refrigeration will help to greater or lesser extent.

Air System

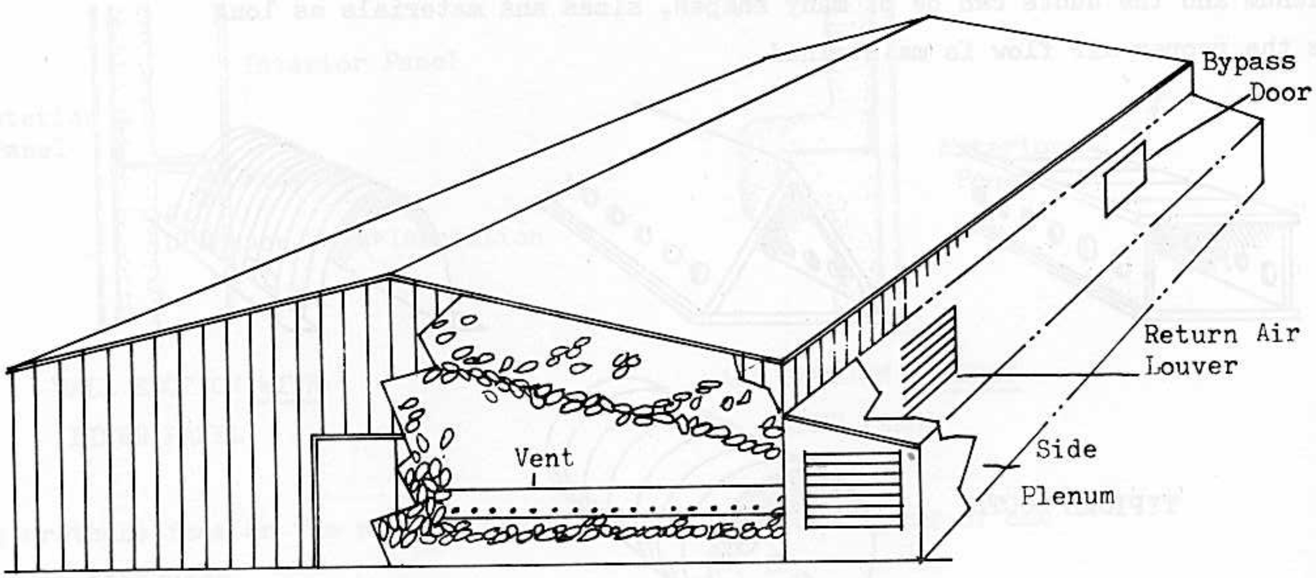
Any system of distribution is fine provided that it is adequately sized and allows even flow of air. In a narrow storage it may consist of two or three rows of vents under the pile. Usually there is a main air chamber called a plenum and smaller air passages called vents or ducts. Both the plenum and the ducts can be of many shapes, sizes and materials as long as the proper air flow is maintained.

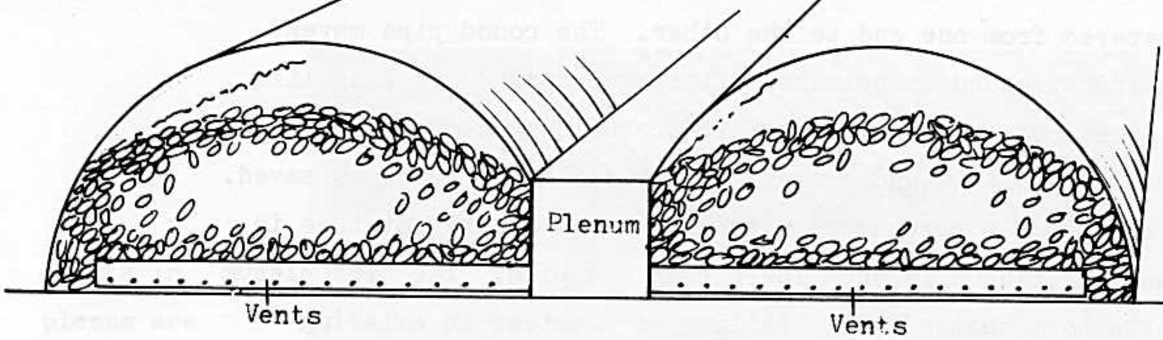


TYPICAL DUCTS

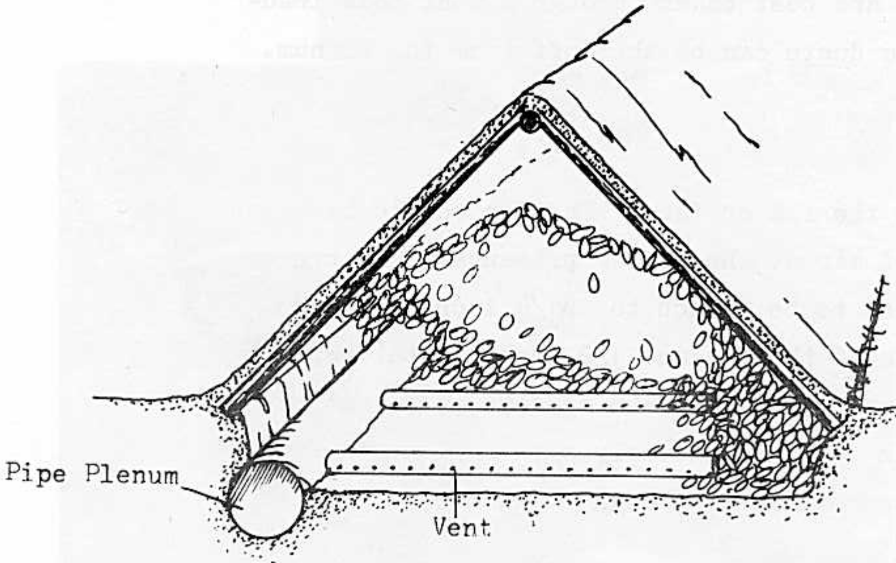


RIGID FRAME METAL BUILDINGS

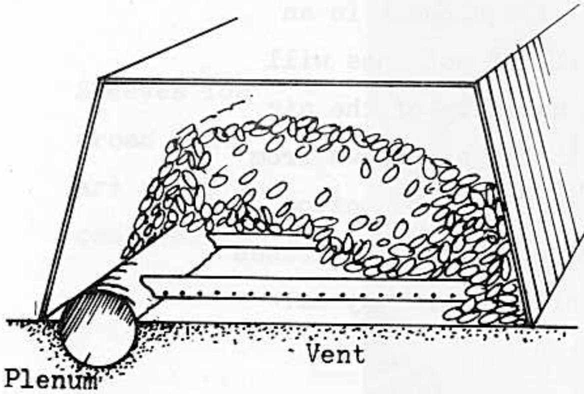




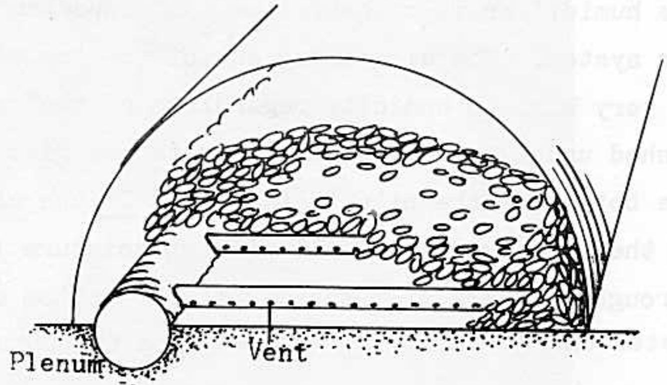
Center plenum or stressed skin storage



Existing straw and dirt storage



Pipe plenum in rigid frame building



Pipe plenum in stressed skin building

Currently a considerable number of pipe plenum are being installed. They can be made tapered from one end to the other. The round pipe moves air with less friction and turbulance. It is galvanized for long life. This type of plenum can be removed easily for building conversion and because it is predominately underground valuable storage space is saved. The possibility of water getting from the plenum under the potatoes is minimal because the plenum is much lower than the pile. The pipe plenum is generally the best choice for installing air systems in existing storages, especially the straw-dirt cellar.

Plenums <u>must</u> be adequately drained. They should be accessable. Many times temperatures of potatoes are best taken through a vent hole leading out from the plenum. Cross ducts can be shut off from the plenum.

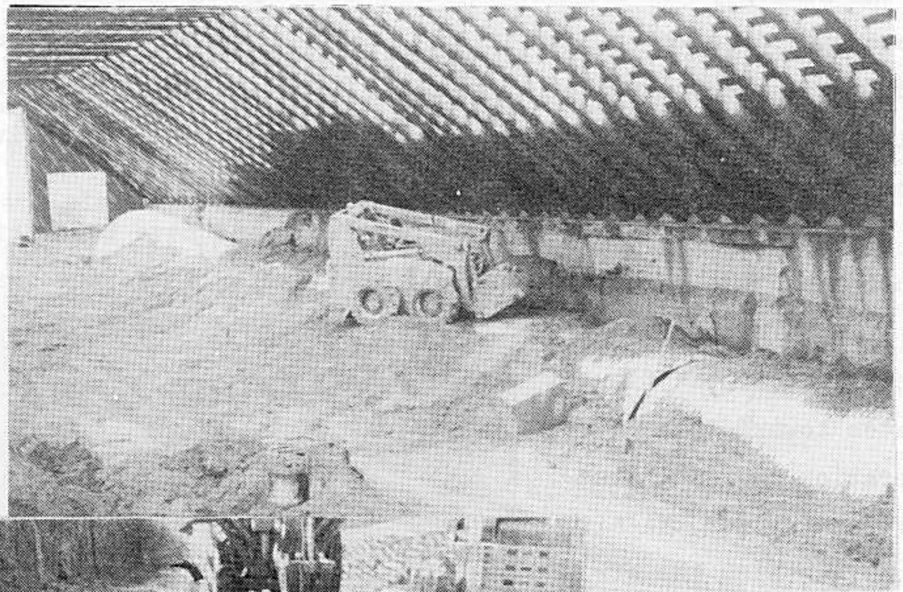
Air System - Fans

The heart of any air system is the fan or fans. The fan should be sized to provide the proper volume of air at the proper pressure. The proper pressure is generally considered to be 1 inch to 1 1/4 inch of static pressure on the downstream side of the fan and 1/2 inch of static pressure in the ducts. Many fans are not designed to operate at 1 inch pressure. It is important that fans be sized properly.
Note: the potato pile exerts approximately 1/20th of an inch of static back pressure.

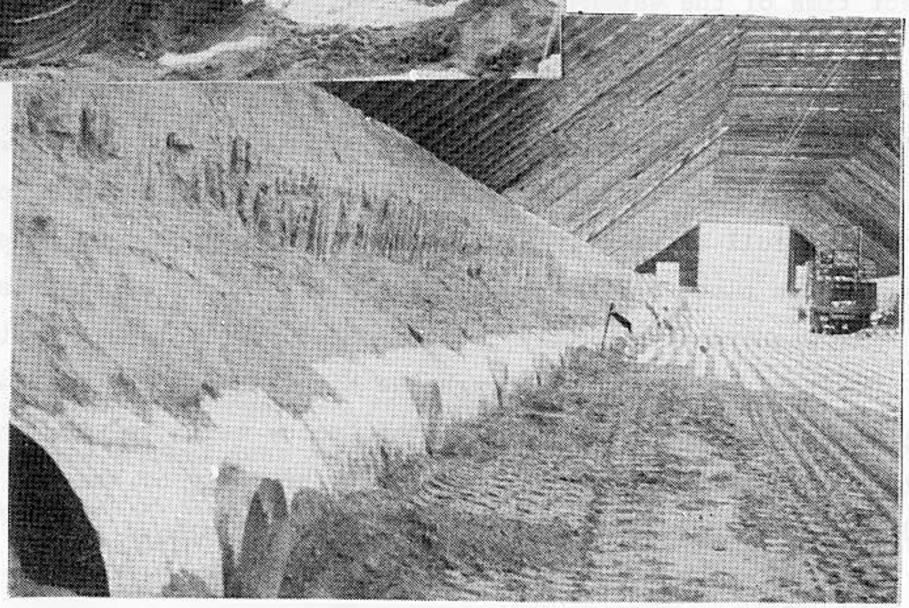
Air System - Humidifier

The humidifier is probably the most important piece of equipment in an air system. The air coming out of the top of the pile of potatoes will be very high in humidity regardless of the relative humidity of the air pushed under the pile. As the potatoes give off heat the air flows from the bottom of the pile to the top. <u>If</u> the air available at the bottom of the pile is dry it will pick up moisture from the potatoes as it rises through the pile. <u>If</u> the air at the bottom of the pile is already saturated only the heat is removed from the potatoes.

Joints in plenum are sealed with urethane foam.



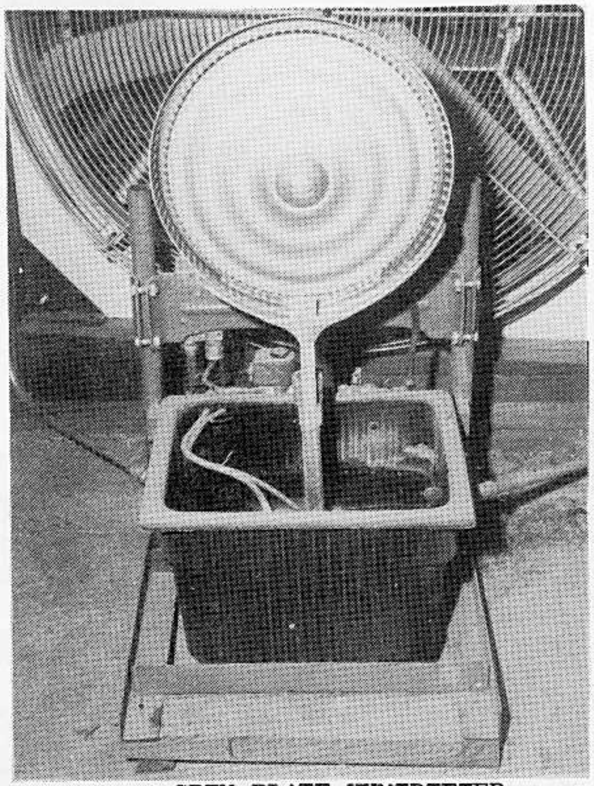
Typical installation of pipe plenum in a pole supported potato storage.



Sleeves for cross vents are on 10 foot centers.

The storage manager must decide if he would rather have the potatoes furnishing the humidity--or a humidifier. Obviously tap water costs very little compared to water lost in shrinkage. Pressure bruise seems to be directly related to lack of humidity. Potatoes have been stored successfully to 24 feet without any pressure bruise in a 98% relative humidity environment.

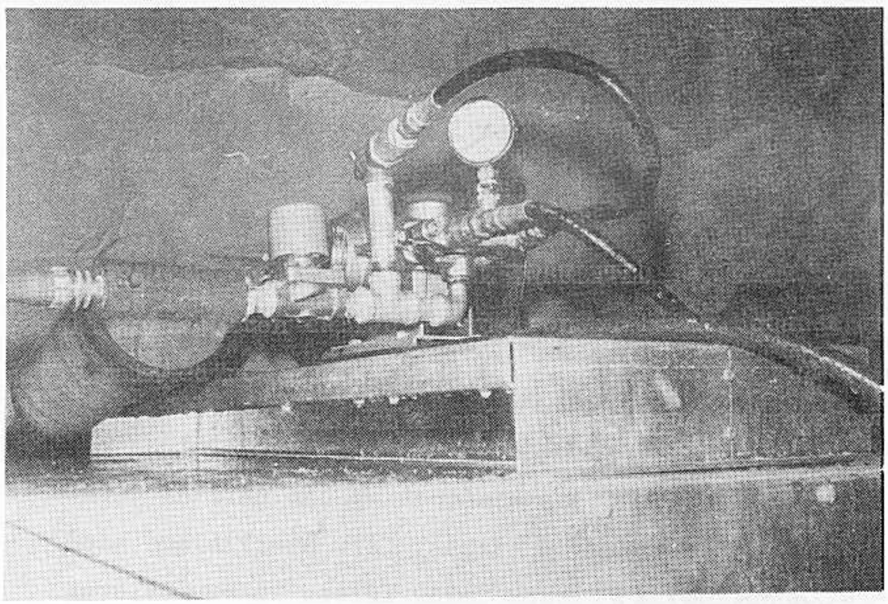
Many types of humidification systems are available and have been tried. The most common are the spin plate humidifiers. Water is forced against a spinning disc. The spinning of the disc accelerates the flow of drops of water toward the edges. This acceleration and impinging creates a fine mist for the air stream. The fans blow the air past the spin plate humidifier. Most of these units have a method of recirculating the particles of water too big to go into the air-stream. Contact time for the air and water is limited to the single pass over the humidifier.


SPIN PLATE HUMIDIFIER

Air washers are used to increase the contact time of the water with the air. Air is drawn through a large chamber that has many "fountains" of water cascading through it. The water is moved by a low pressure--high volume recirculating pump. A float mechanism is used to keep the catch basin full of water. Undoubtedly the air washer is more efficient than a spin plate humidifier. The air-water contact time is much greater. Air washers are usually located ahead of the fans. In this position the fans pull the air through the air-washer. The fans are generally direct-driven. The heat from the motor tends to warm the air passing over it thereby reducing the relative humidity of the air stream. This is a serious disadvantage as also is the high cost of an air washer.

Steam humidifiers and compressed air humidifiers are not treated here because field applications seem impractical.

High pressure nozzle humidifiers have many advantages for most storages. They consist of a pump which will operate continously at 500 to 700 pounds per square inch (psi) and nozzles designed for ultra-fine break up of the water. The nozzles are placed in the plenum near the fan to create a "high pressure air washer". In field experiments it has been shown that the ducts nearest the fan usually get more of the humidity. By spreading some of the nozzles down the plenum this problem is mitigated. Achieving high relative humidity in the air stream seems to be a function of reducing water droplet size and increasing contact time with the air stream. The high pressure nozzle humidification system seems to have many advantages in humidification of an air stream.

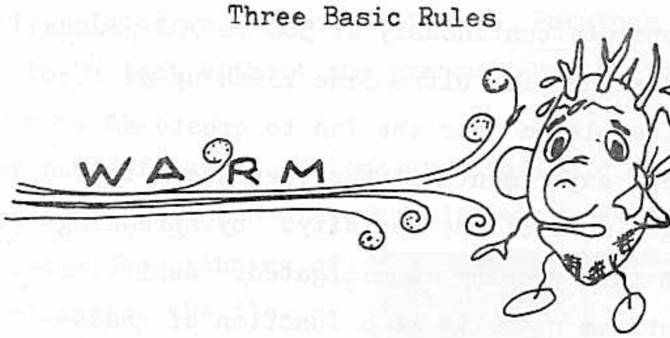


HIGH PRESSURE NOZZLE HUMIDIFIER

Air System - Control

The control of an air system can range from very simple to complex. The simplest may be to open the cellar door and plug in the fan and humidifier. The most sophisticated would be to use electronic controllers with precision sensors. The object is to control the temperature without serious fluctuations. Fluctuations will "awaken" the potato and cause it to sprout.

Three Basic Rules



Never blow warm air against a potato.........this will cause beads of condensation to form on the potato.

Never blow dry air under a pile................dehydration and pressure bruising will occur.

Don't reduce pile temperature too low..........45^{o}F could be too low for french fry potatoes........34^{o}F could be too low for seed potatoes.

Air System - Sizing

From the Zone map it can be seen that most of the potatoes grown in the United States are grown in a Zone I region. The volume of air required for Zone I is generally accepted to be .5 cubic feet of air per minute (cfm) per hundred pounds (cwt) of potatoes. The volume of air required in Zone II is .67 cubic feet of air per minute per hundred pounds of potatoes. The volume of air required in Zone III is .85 cubic feet of air per minute per hundred pounds of potatoes. Those areas that are warmer than Zone III will generally require refrigeration. Where storages are refrigerated use Zone I sizing for air system requirements. To size an air system for a potato storage determine the following:

1. Total the hundred weight (cwt) of potatoes in storage. To determine this-----calculate the total cubic footage and multiply by four-tenths (length x width x pile depth x .4). Always calculate realistically. Potatoes weigh approximately 40 pounds per cubic foot.

2. From the Air System Requirement Map determine proper Zone. From the Capacity Table determine the air volume, water and plenum requirements. Usually refrigerated storages are considered Zone I.

   The fan or fans used to provide the air should be capable of moving the proper volume at a minimum of 1 inch of static pressure at storage altitude and temperature.

   The humidifier should be able to make available the rated amount of water in fine enough droplets to be assimilated easily as water vapor. Some humidifiers will require much more input of water to deliver the same volume of useful water vapor. The balance is "fallout"-----free water that ends up on the bottom of the plenum. All humidifiers have "fallout", some more than others, therefore drains in the plenum must be provided.

3. The plenum size shown is based on the movement of 1000 cubic feet of air per minute. When figuring plenum size allow for any obstructions. For instance, a pipe plenum with an end area of 24 square feet is approximately equal to a smooth square plenum of 25 square feet. But a

plenum that has a lot of cross bracing in it may need to be 30-35 square feet to be equal. A plenum can be tapered as long as it has the size to carry the volume of air to those ducts it reaches. A plenum larger than minimum requirement is often desireable. In a larger plenum the air doesn't have to move as fast so there is less friction and turbulence.

Theoretically exhaust dampers should be sized to allow full air flow out of the building. This means the area of the dampers should combine to equal the area needed for the plenum. Because most buildings have some air leaks some undersizing is all right----10% to 20% reduction. Exhaust dampers can be located nearly anywhere as long as they are high enough to exhaust the warm air. Generally they are located in the ends of the buildings.

The bypass area should be from 25% to 35% of the required plenum area. The bypass should be located in the end of the plenum farthest from the fan near the ceiling. It should be fitted with a door or cover to close off the bypass when it is not in use.

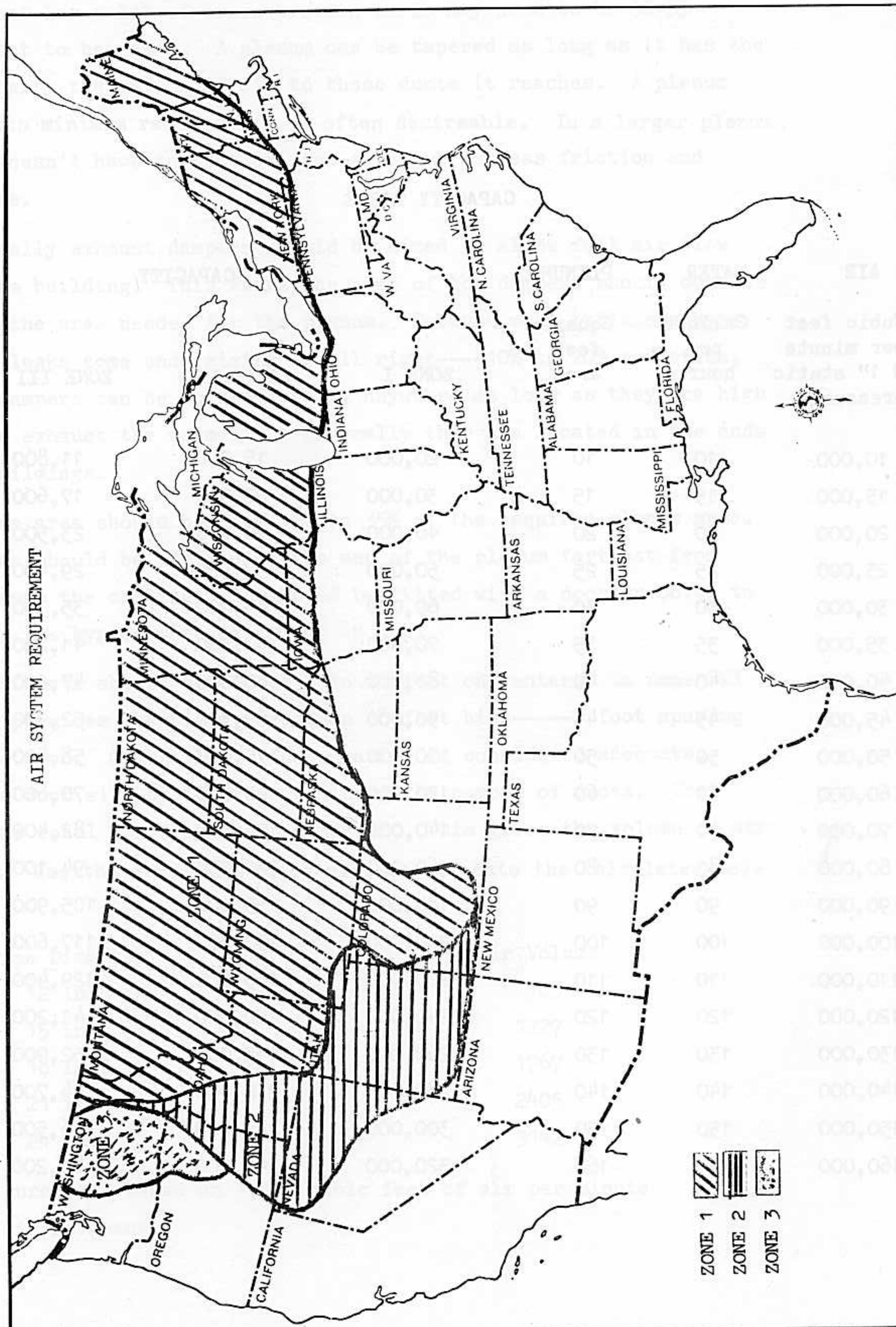
The cross ducts should be placed 8 to 10 feet on center. In Zone III or where potatoes are piled more than 18 feet high-----8 foot spacing should be used. Generally 10 foot spacing is considered adequate. Calculate duct size by first determining the number of ducts. Then divide the total air flow by that number. This gives the volume of air per duct. Use the duct size which will accommodate the calculated volume.

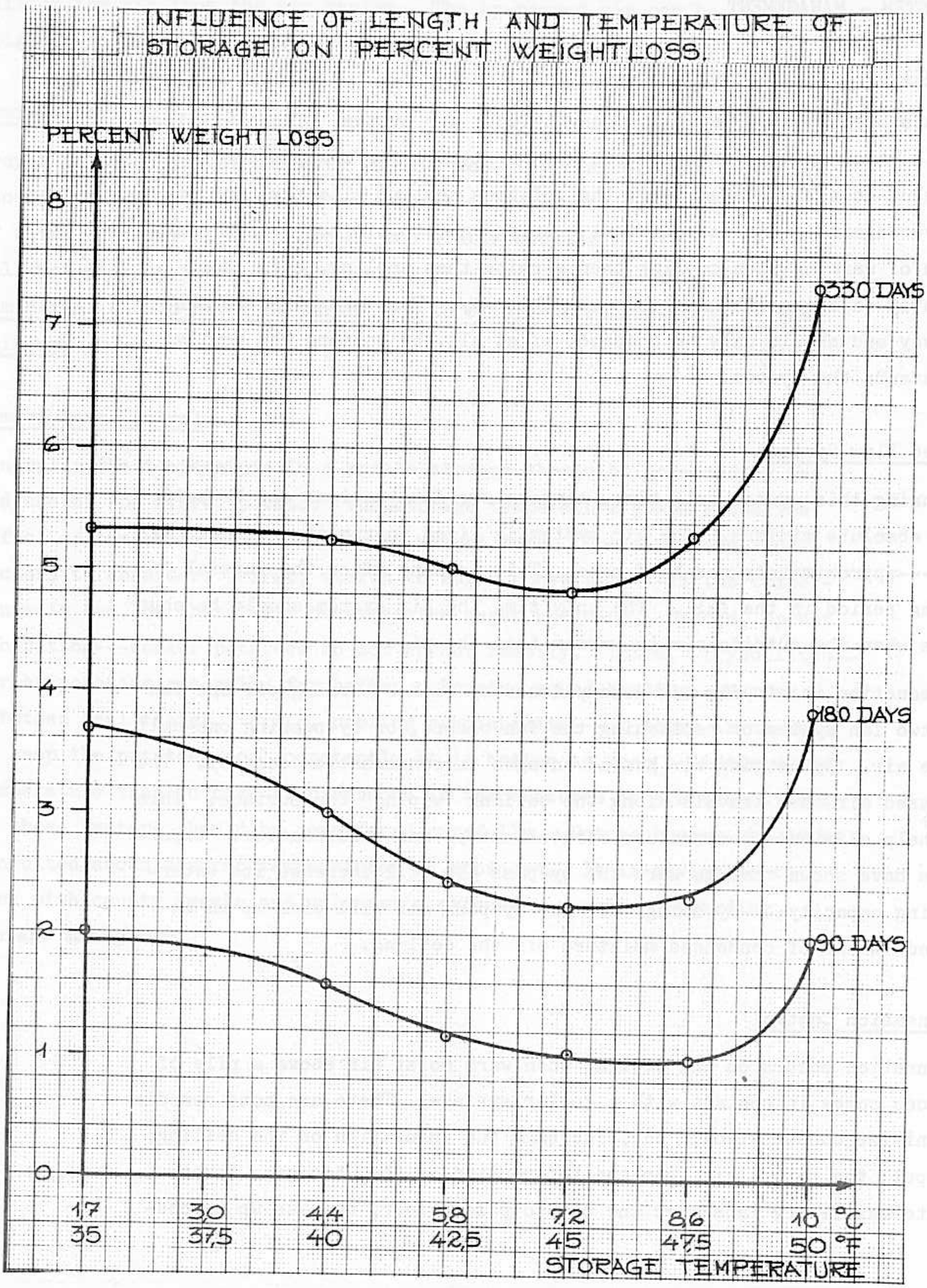
Pipe Diameter	Air Volume
12 inch	785
15 inch	1227
18 inch	1767
21 inch	2405
24 inch	3142

These figures are based on 1,000 cubic feet of air per minute minimum air movement.

CAPACITY TABLE

AIR	WATER	PLENUM	CAPACITY		
Cubic feet per minute @ 1" static pressure	Gallons per hour	Square feet area	ZONE I	ZONE II	ZONE III
10,000	10	10	20,000	15,000	11,800
15,000	15	15	30,000	22,500	17,600
20,000	20	20	40,000	30,000	23,500
25,000	25	25	50,000	37,500	29,400
30,000	30	30	60,000	45,000	35,300
35,000	35	35	70,000	52,500	41,200
40,000	40	40	80,000	60,000	47,100
45,000	45	45	90,000	67,500	52,900
50,000	50	50	100,000	75,000	58,800
60,000	60	60	120,000	90,000	70,600
70,000	70	70	140,000	105,000	82,400
80,000	80	80	160,000	120,000	94,100
90,000	90	90	180,000	135,000	105,900
100,000	100	100	200,000	150,000	117,600
110,000	110	110	220,000	165,000	129,400
120,000	120	120	240,000	180,000	141,200
130,000	130	130	260,000	195,000	152,900
140,000	140	140	280,000	210,000	164,700
150,000	150	150	300,000	225,000	176,500
160,000	160	160	320,000	240,000	188,200


AIR SYSTEM REQUIREMENT
ZONE 1
ZONE 2
ZONE 3
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
S.CAROLINA
N.CAROLINA
VIRGINIA
W.VA
MD
PENNSYLVANIA
NEW YORK
MAINE
CONN
R.I.


INFLUENCE OF LENGTH AND TEMPERATURE OF STORAGE ON PERCENT WEIGHTLOSS.
PERCENT WEIGHT LOSS
8
7
6
5
4
3
2
1
0
330 DAYS
180 DAYS
90 DAYS
1,7
35
3,0
37,5
4,4
40
5,8
42,5
7,2
45
8,6
47,5
10 °C
50 °F
STORAGE TEMPERATURE

Conventional Air Systems

Much has been written about the conventional air system. These writings are all based on this premise: run the air system for maximum cooling; then shut down the system until the potatoes heat up slightly and start all over again. This intermittent running and stopping creates a condition of warming then cooling then warming then cooling, etc. Most presently existing installations run this way. They are sized to run this way and should only be changed, if at all, by someone who really understands the system.

Reduced Flow System

By running this system full time, temperature fluctuations can be held to an absolute minimum. The air system is sized to run at a reduced air flow----approximately one-half rate. This is done after the initial cooling period in the fall. The only time the air system should be shut off is when the outside air is warmer than the pile.

The reduction in air flow is accomplished by either turning off one fan of a two fan system or repitching the fan blades, or by-passing one-half of the air. By-passing air has advantages in condensation control. The by-passed air then travels along the ceiling "wiping" the surface. This will help eliminate temperature stratification and condensation. Experiments have shown that to warm the by-pass air will increase its water-carrying capacity----by doing this the by-pass air will pick up an increased amount of condensed moisture off the ceiling.

Condensation Control

Condensation occurs on the ceiling when warm moist air above a pile of potatoes comes in contact with a cooler surface. There are some remedies to minimize condensation: one, increase the insulation on the ceiling; two, pull the return air from the top portion of the storage; three, operate auxilliary fans over the potato pile; four, by-pass up to one-half of the air from the air system. The by-passed air can be warmed slightly to increase its water carrying capacity if necessary.

Humidification

Proper introduction of humidity is of utmost importance. The humdifier should be operating whenever the air system is operating. The volume of water used may be decreased in the winter because re-circulated air will not pick up as much water as the fresh air does in the fall. A humidifier should never be turned off to eliminate condensation on the ceiling.

Temperature Control

Generally the temperature in a potato storage should be governed by the end use of the stored potato. The storage temperature graph shows the effect of temperature in relation to weight loss. There are additional factors to consider: First, starch to sugar conversion---if the temperature is too low there will be excessive sugar build-up. Second, sprout inhibiting---cooler potatoes do not sprout readily. Third, "fryability"---warmer potatoes generally fry better. Fourth, wound healing---warmer potatoes heal faster. Fifth, cooling availability---if there is no way to keep the potatoes cool constantly it is better to keep a little warmer temperature than to have fluctuations in temperatures in a storage. All of these factors should be considered carefully. Potato buyers should be consulted about desired temperatures in storages. It is advisable to work with county agents and university extension services regarding storage management.