POTATO STORAGE STRUCTURES

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The necessity of maintaining high quality sprout-free potatoes over an extended storage period for the fresh market, and the processing industry has resulted in an increased emphasis on the proper construction and management of potato storage facilities.

In years past a hole under the ground covered with straw and soil usually kept tubers in good condition until spring. Now, with increased emphasis on maintaining high quality and appearance over a longer storage period, improved temperature and humidity control are necessary. Well designed, trackside and farm storages with automatic air ventilation and temperature control systems are becoming a necessity and are replacing the older types. A potato storage, properly constructed and managed, prevents the development of rot, retards growth of sprouts, reduces dehydration, and reduces the number of pressure bruises and black spot.

TYPES OF STORAGE

Many types and sizes of structures are used to store potatoes. Each has its advantages and disadvantages. Choice of the type depends upon cost, available material, convenience, space requirements inside the cellar, and local conditions, such as water table, soil and rock structure, and subsoil winter temperatures.

Most structures used for storing potatoes can be classified into two types: (1) the partially below ground pole-type structure, and (2) the above ground wood, steel or concrete building.

Pole Type, Partially Below Ground

The partially below ground pole type cellar is still common in some areas. It may have either a soil or metal roof. The soil roof is not too satisfactory in areas where erosion is apt to be high from either wind or water.

Since wind erosion is a problem in the Columbia Basin, it is likely that most of this type of structure will be covered with sheet metal with a baled straw layer serving as the insulation. A minimum depth of 1 bale of straw should be used. Loose straw is stuffed in the cracks among the bales before cutting the bale ties. The sheet metal is fastened to nailing strips, laid on top of the straw and fastened to the rafters below with wire.

A vapor barrier may be made be placing a plastic sheet underneath the rafters, this will serve two useful purposes. (1) it will tend to keep the straw dry, thus reducing deterioration and maintaining insulating value, and (2) it will tend to keep the humidity high within the structure, thus maintaining the tubers in better condition. Ordinarily, the vapor barrier would be placed on top of the rafters and on the sheeting which holds the straw. However, with this type of roof, and where wires are frequently run through the straw to attach the nailing strips, there would necessarily be so many holes in the vapor barrier that it would be worthless.

Figure 1 shows that rafters may be sawed 6 X 6's or poles of equivalent strength. The foundation should be reinforced concrete constructed to withstand the weight of the roof. Slope the toe of the foundation so accumulating moisture, if any, will drain off.

Making the face of the footing at right angles to the rafter increases its bearing capacity, and reduces the amount of sawing necessary in fitting the rafter to the foundation. The pole type partially below ground cellar has the advantage of low first cost. If the soil is wetted before filling, it will tend to add humidity to the air surrounding the potatoes.

Above Ground Potato Storage

Above ground potato storage buildings are usually designed and sold by commercial manufacturers. The basic structural members are steel, wood, concrete or masonry blocks. Any building adequately constructed to the proper dimensions, properly insulated and ventilated, will serve satisfactorily.

An example of this kind of structure is seen in figures 2 and 3. (Steel covered pole frame structure). Figures 4, 5, 6 and 7 show details during construction. Notice in figure 5 that black Vis-queen is used as a vapor barrier both on top and below the insulation. This protects the insulation from getting wet, and helps to maintain high humidity in the cellar. When insulation gets wet its effectiveness is greatly reduced. Figure 7 shows the chicken wire netting being stretched in place. Figure 3, shows how the finished structure looks from the inside. Figure 8 shows the inside view of a well insulated and ventilated potato bin.

Figures 2, 3, 4, 5, 6, 7, and 8 were supplied courtesy of the Union Pacific Railroad.

The insulation used for above ground storages is usually commercially produced, it may be any of the insulation fibers put up in blankets or bats, or it may be the newer expanded polystyrene or polyurethane foams. Either type must be sealed against moisture penetration. Expanded polystyrene or polyurethane must have the joints sealed with a mastic compound unless the entire insulation is protected with a vapor barrier film of sheet material. Blanket insulations usually have a vapor barrier on one side, but it is advisable to place an additional vapor barrier such as polyethelene film between the insualation and the potato storage area.

The heat transfer rate through the walls and ceiling should not be greater than 0.05 BTU's per foot of surface area per degree F. difference between inside and outside temperature. (U value no greater than 0.05).

Since potatoes are best stored at a high relative humidity, provisions must be made to protect the building and insulating materials from condensation. Therefore, the main purpose of the insulation is to prevent condensation on the inside surface so it will not drip down on the potatoes. The purpose of the vapor barrier is as stated previously, to keep moisture out of the insulation and maintain humidity.

STORAGE MANAGEMENT

Proper management of a potato storage includes control of temperature, humidity and air circulation so that stored tubers retain maximum appearance and food value with a minimum loss from rot, shrinking and sprouting. Storage managment can be divided into three definite periods, (1) the wound, healing and curing period, (2) the storage or holding period, and (3) the removal, or grading and sacking period.

The Wound, Healing and Curing Period

The wound, healing and curing period is that period immediately following harvest. During this period, the bruises and other wounds caused in harvesting operations heal over. Two conditions are usually considered necessary for rapid healing, (1) a temperature of 45° F. or higher, and (2) a relative humidity in the surrounding air of 90% or higher. If the storage has a dirt floor, soak it thoroughly before bringing in potatoes. At the time of storage, the floor should be moist, but not muddy.

The second phase of management is the holding or storage period. In general the higher the storage temperature above 40° F., the shorter the storage period will be without sprouting and excessive shrinkage. Tubers can be kept for only 12 to 15 weeks at a temperature of 50° F. before they begin to sprout. But they can be kept 40 weeks or more at 40° F. without sprouting. If chemical sprout inhibitors are used, the temperature may be slightly higher. The lower the temperature below 38° F., the greater is the conversion of starch to sugar. Therefore, for long-term storage the best compromise is to store the tubers at 39° or 40° . (With about 90% relative humidity.) This temperature is low enough to prevent sprouting and high enough to allow only a minimum conversion from starch to sugar.

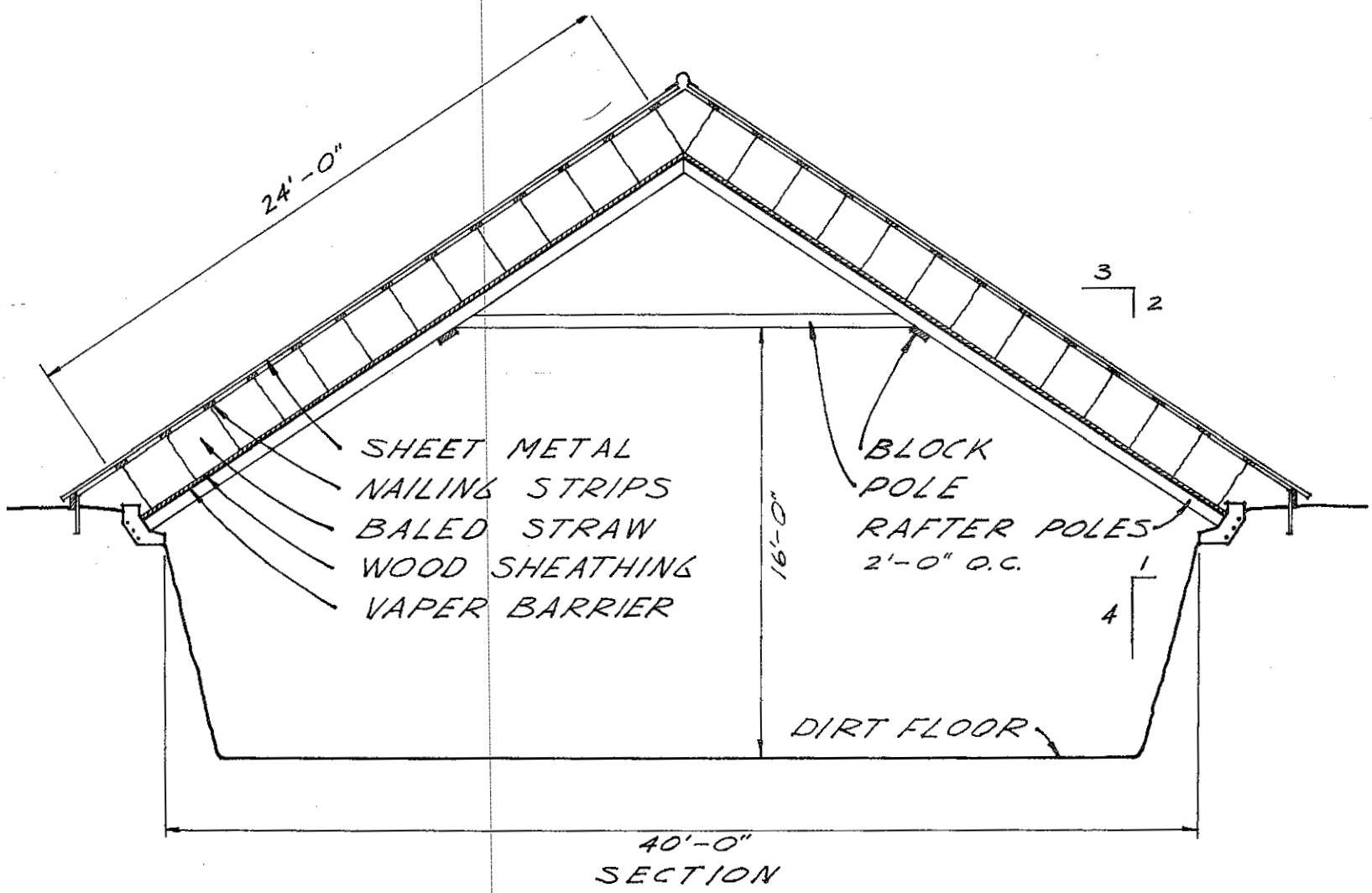
The Removal, or Grading and Packing Period

Cold, brittle potatoes are easily injured. Therefore, it is advisable to warm the tubers to a temperature of 45° or more before removing them from storage. Closing the air vents to prevent cold air from entering the storage is an easy way to raise the temperature. Heat from the respiring tubers will be enough to raise the temperature several degrees in a few days.

In large storages where potatoes are taken out of storage over a period of several months, a warm up period may have to be omitted to prevent sprouting of those tubers remaining in the storage cellar. In all cases, careful handling must be practiced to reduce injury.

To summarize, a potato storage must be well constructed, well insulated and well ventilated. The humidity of the ventilating air must be kept high, about 90% relative humidity. We will go into the details of a ventilating system in a later session.

PARTIALLY BELOW GROUND A-FRAME
TYPE POTATO STORAGE



SECTION

Figure 1

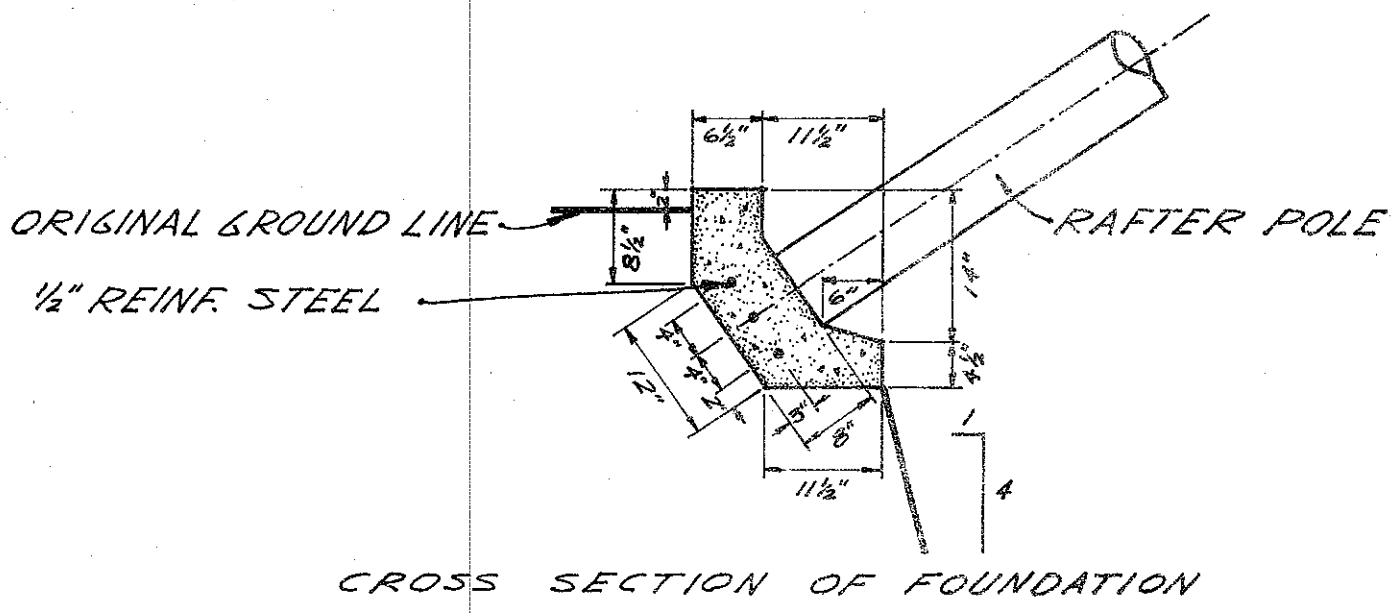


Figure 1 continued

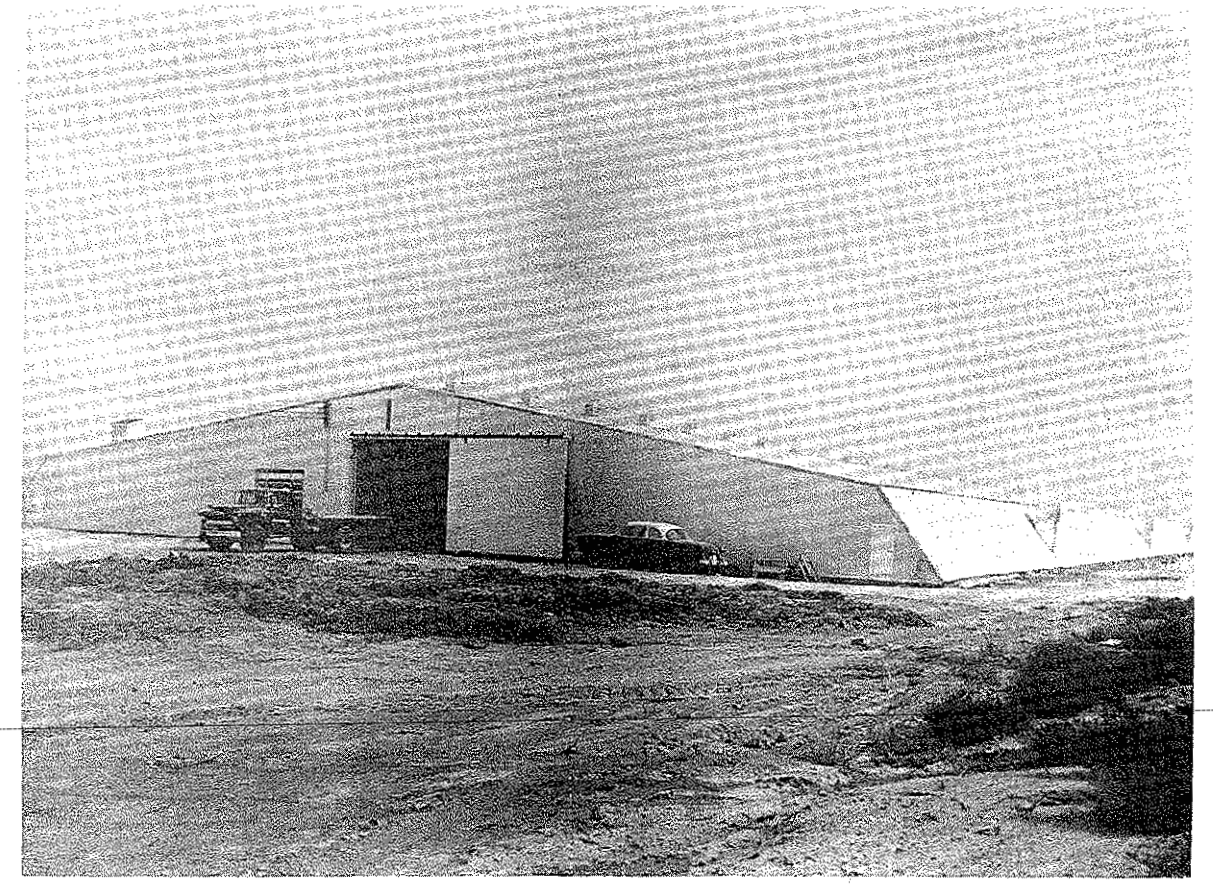


Fig. 2. Steel covered pole-frame structure. Photo courtesy of U. P. Railroad.

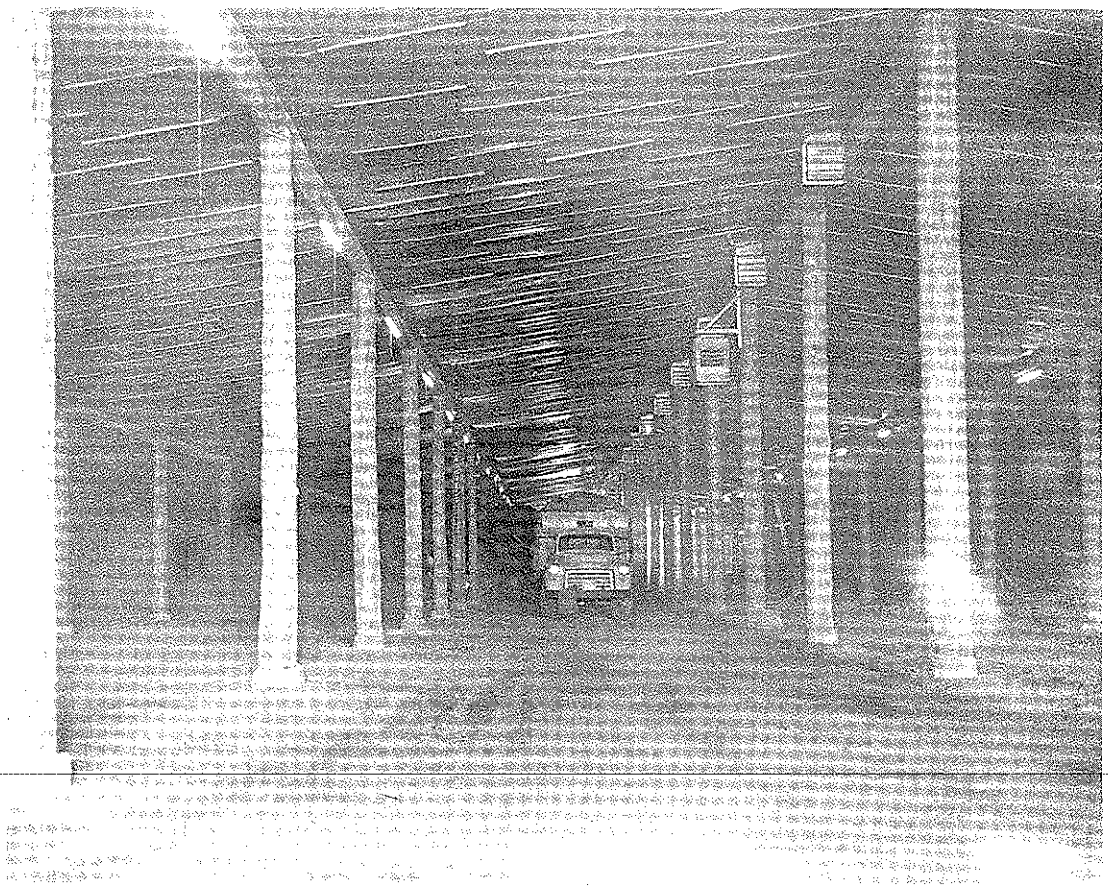


Fig. 3. Inside view of Fig. 2. Note how vapor barrier and chicken wire netting is held up by lath. Photo courtesy of U. P. Railroad.

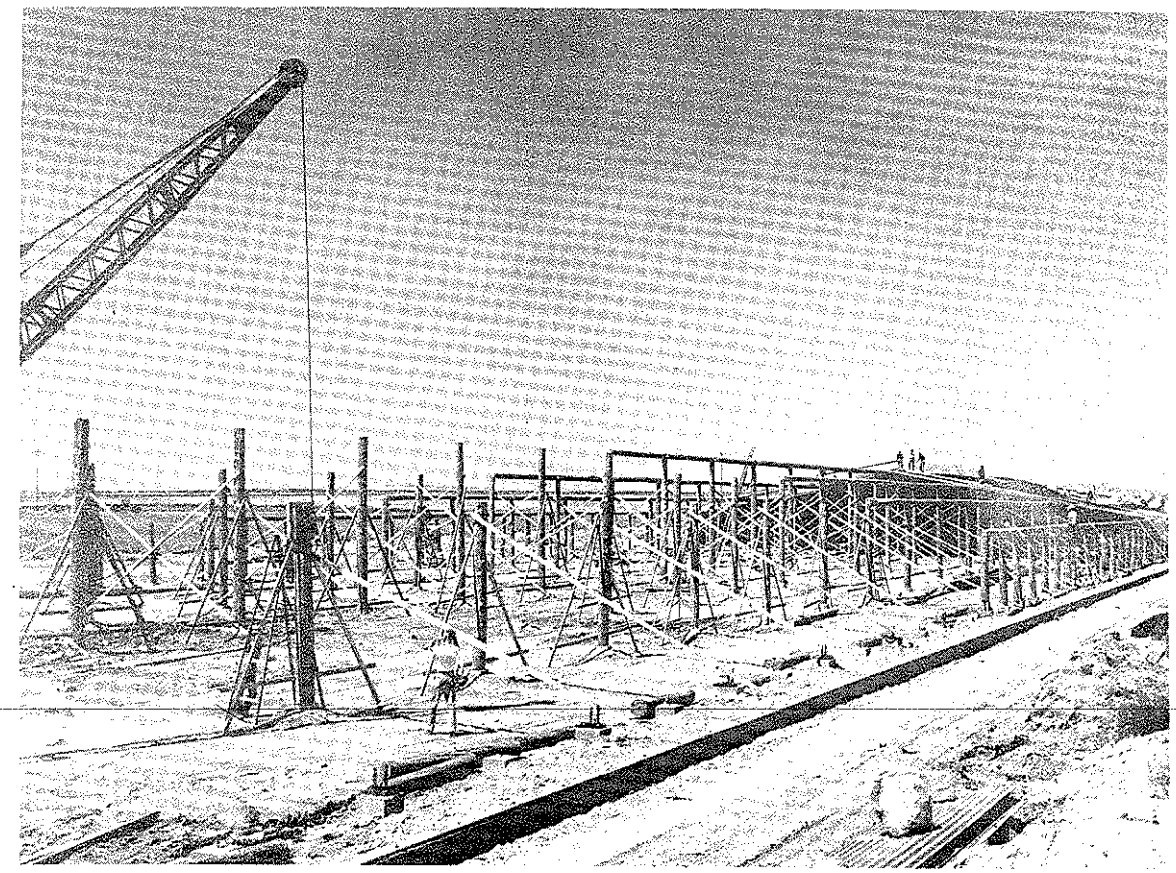


Fig. 4. Construction view of Fig. 2. Courtesy of U. P. Railroad.

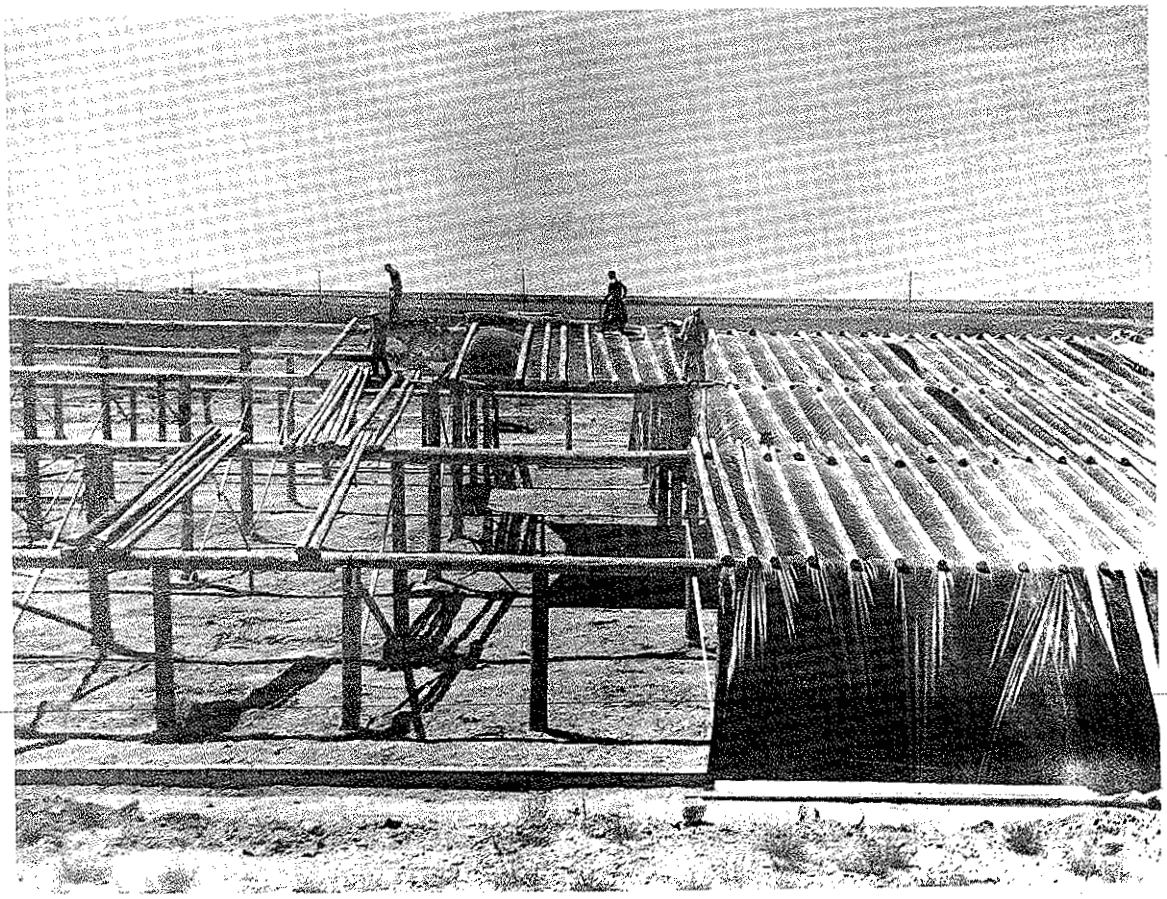


Fig. 5. Construction view of Fig. 2 showing chicken wire and vapor barrier. Courtesy of U. P. Railroad.

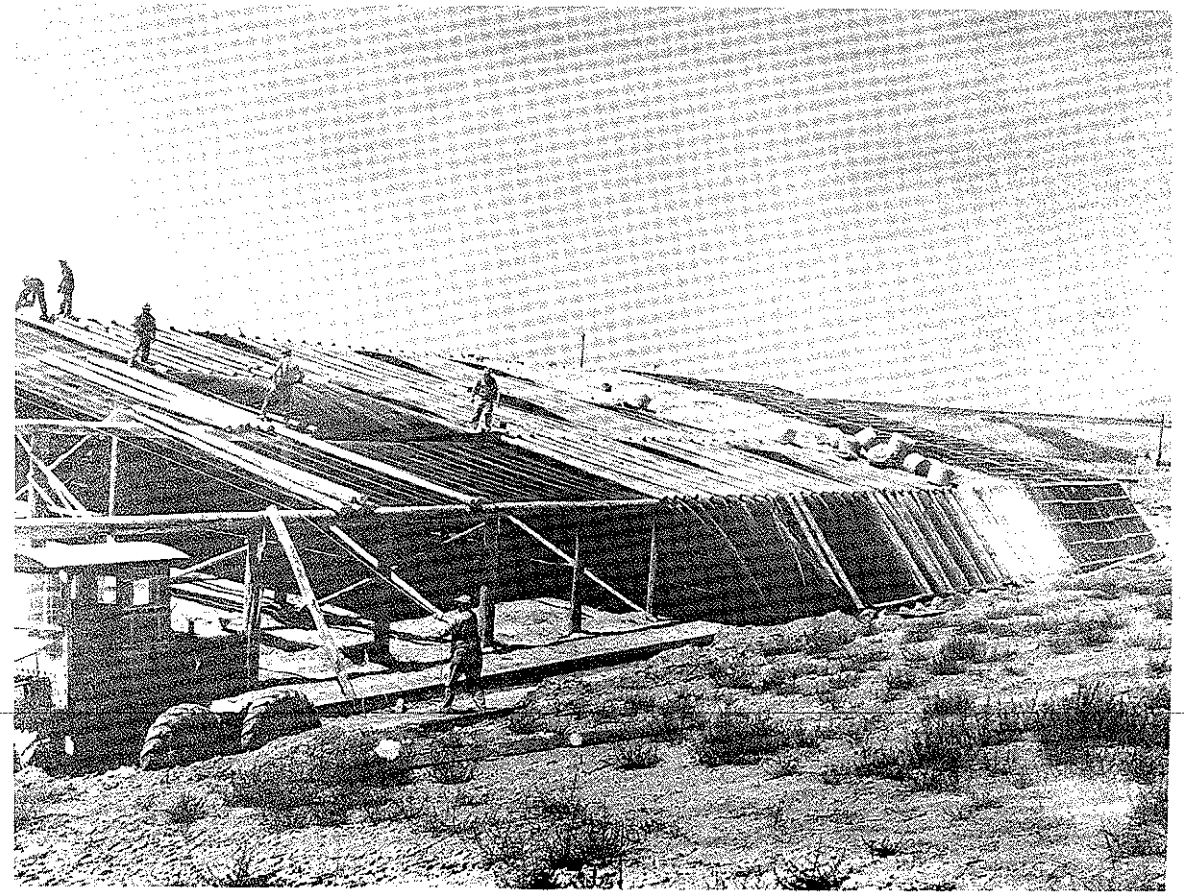


Fig. 6. Construction view of Fig. 2 showing insulation bats and second layer of visqueen. Courtesy of U. P. Railroad.

Fig. 7. Construction view of Fig. 2 showing foundation and footing detail. Courtesy of U. P. Railroad.

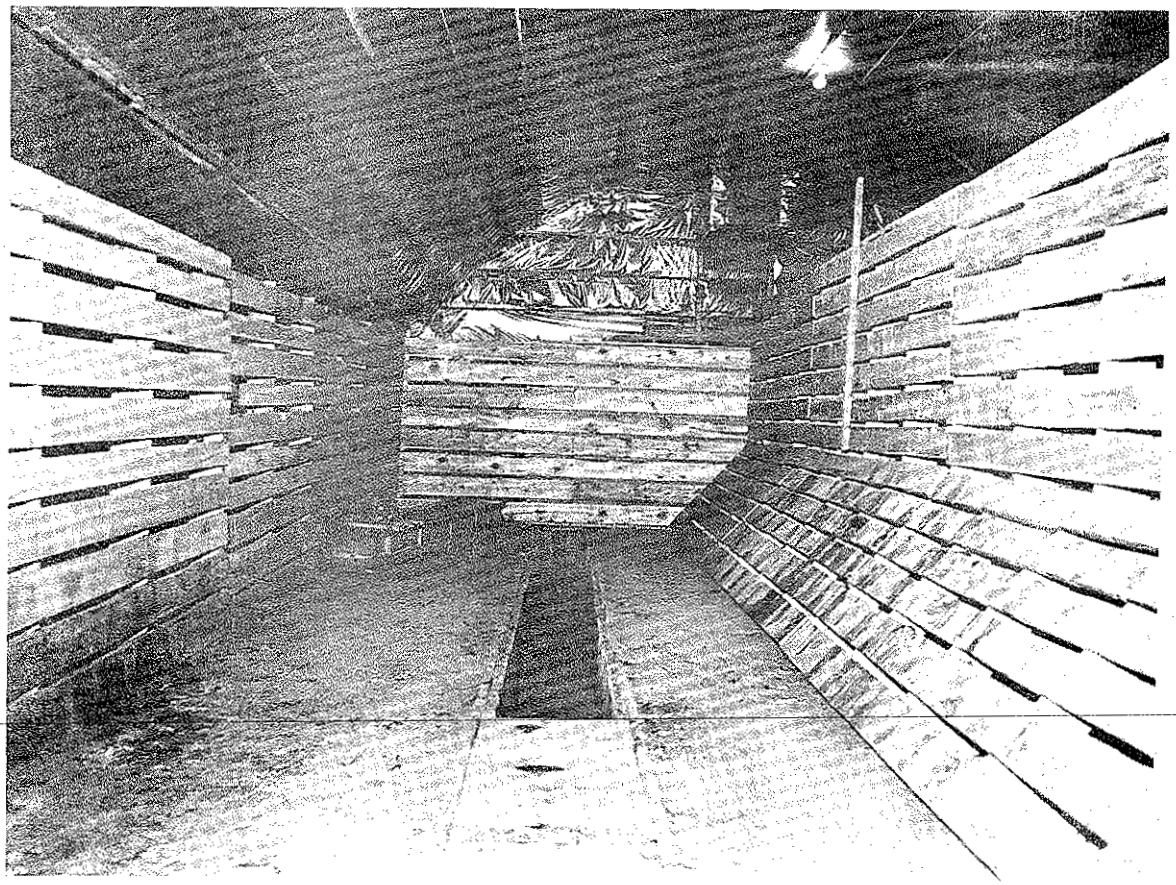


Fig. 8. Inside view of well insulated and ventilated potato bin. Courtesy of U. P. Railroad.