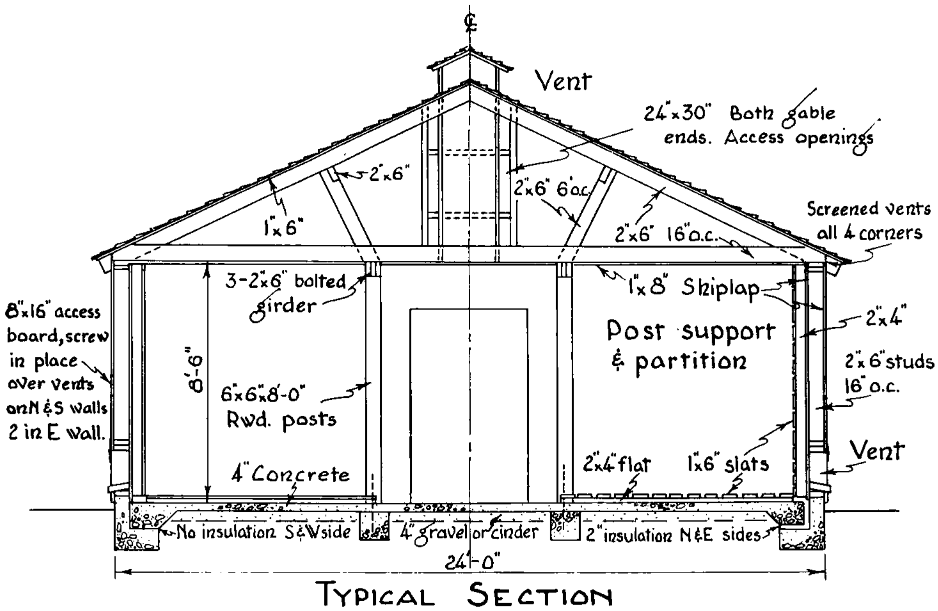
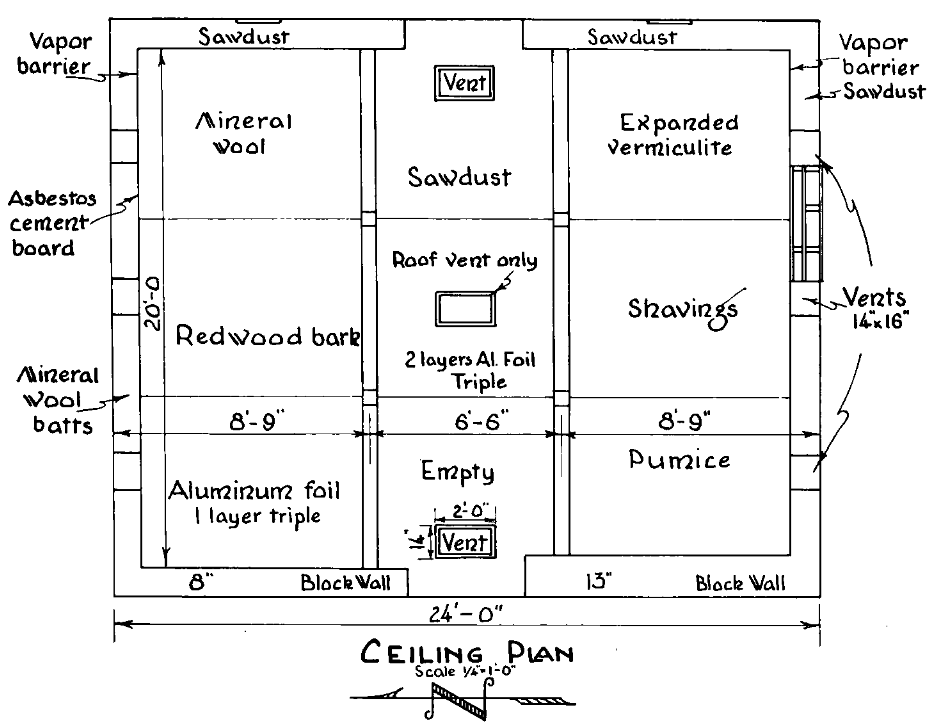
Potato Storage at Tulelake

study of five types of insulated wall construction in one building revealed weakness of a single block masonry wall

L. W. Neubauer and B. J. Hoyle



General layout of the storage building. *Above*—cross section of the shed indicating special construction features; *below*—floor and ceiling plan showing types of wall construction and various insulations in the ceiling.



Tulelake—the largest late potato producing area in the state—holds most of the 8,000 acre crop for three to seven months as about half is seed potatoes for other areas. Tulelake also is the only area in the state that stores the crop in cellars requiring protection from cold as low as −30°F.

For years, earth-covered underground storages were in common use, but lately these are being replaced with modern above-ground storages.

To study types of insulation for the most economic construction for above-ground storage, an experimental and functional cellar was built on the Tulelake Field Station. In addition to five wall types, nine types of ceiling insulation are included. This report, however, is concerned primarily with the efficiency of the walls.

Wall Construction

All masonry blocks used were composed of cement and pumice concrete.

Part of the west wall was constructed of single hollow blocks 8″ thick; another section of the west wall was built of masonry blocks 6″ thick, in double layers with a 1″ air space between making a 13″ cavity wall.

Walls with east and south exposure had sawdust filler between 6″ wood studs, with no vapor barrier, and 1″ boards on either side, but one wall exposed to the south was supplied with a vapor barrier. The wall with the north exposure had 1″ boards on either side and 4″ of rockwool with attached vapor barrier between 6″ studs. This left a 2″ air space.

All walls had an open board barrier on the inside surface which prevented the potatoes in the bins from coming closer than 4″ to the actual wall surface.

During construction, 25 thermocouples were built into the walls at various depths. The wires were brought to a central point and connected to a 25 place switch. The temperatures were read by connecting a potentiometer to the switch.

Temperature studies were commenced in the warm autumn period soon after potatoes were harvested and put into storage. For several days abundant ventilation was required at night to cool the

Concluded on page 18

MITE

Continued from preceding page

per 100 gallons, have generally resulted in satisfactory seasonal control of this mite. Sulfur should not be applied during or immediately preceding periods of hot weather, and treatment should be separated from an oil application by at least 60 days.

Chlorobenzilate applications—at the rate of 10 pounds of a 25% formulation per 100 gallons of spray—may be used to control the citrus flat mite during the times when it is inadvisable to apply sulfur. A thorough distribution type of coverage is necessary for good control.

H. S. Elmer is Assistant Specialist in Entomology, University of California, Riverside.

L. R. Jeppson is Associate Entomologist, University of California, Riverside.

The above progress report is based on Research Project No. 1078.

POTATOES

Continued from page 5

potatoes down to storage conditions, after which the ventilation was reduced to maintain inside temperatures as uniformly as possible. During the mild fall weather, some temperature readings were taken to observe day and night fluctuations and comparative temperatures for individual locations.

To begin with, temperatures recorded by the thermocouples were observed hourly. This frequency was found to be seldom necessary, so in most cases, intervals were extended to an average of about three hours. In mild weather, even this time was expanded or readings discontinued temporarily. When extremely cold weather arrived, the hourly interval was resumed and maintained to obtain complete sets of data. Extra readings were taken at high and low temperature periods, so as to best define the maximum and minimum measurements.

The critical periods are those of lowest temperatures. Intermediate temperatures pose no special problem for this type of potato storage. Lowest temperatures were awaited, as providing the really significant conditions and data. The coldest occurrence in several years proved to be -18°F. At this time the most useful data were collected. Humidity, condensation, and frosted interiors were also studied.

The sawdust and rockwool insulated walls proved satisfactory for small-volume storage. Safe potato temperatures were maintained.

The 13″ concrete block cavity wall also was adequate, being nearly equal to the well-insulated frame walls.

The 8″ concrete block wall proved unsatisfactory because it cooled too much, frost formed on the inside surface, nearby potatoes froze, and some were spoiled.

Temperatures inside the concrete blocks and the insulation materials revealed the progression of changes within the various parts of the walls, at several hours during the day. Outside minimum wall temperature was -18°F. The temperature lag within the wall material was especially apparent with the concrete blocks. The interior was warmed by the heat of respiration of the potatoes together with a small amount of supplementary artificial heat. Although having different characteristics, the cavity wall was about as effective as the insulated frame walls.

In contrast, the 8″ block wall remained too cold on the interior surface all day long, ranging from 19°F to 28°F—dangerous temperatures for the safe storage of potaotes. Frost was seen only on this one wall section.

Additional temperature recordings in the concrete walls showed an obvious relationship between the 8″ and the 13″ walls. The superiority of the cavity wall was clear. The cold interior surface of the single 8″ wall was the feature which caused potato damage.

L. W. Neubauer is Associate Agricultural Engineer, University of California, Davis.

B. J. Hoyle is Superintendent of Tulelake Field Station, University of California.

The experimental cellar is a co-operative project and part of Agricultural Engineering Project 400-D.

PACKING HOUSE

Continued from page 2

ferent methods showed that relative costs with different methods also are affected by plant capacity and proportion of cull fruit.

In general, the nonmechanized methods were found to be the most economical with short season operation—250 hours per season—low cull proportions, and low rates of packer output. On the other hand, the highly mechanized equipment was found to be most economical with long-season operation—750 hours per season—a high proportion of culls, and high rates of packer output. Between these extremes in operating conditions, a rather broad range was found in which the cost differences between the mechanized and nonmechanized methods are relatively small.

The effect of variation in the factors affecting the costs of the packer-supply operations can be illustrated by reference to several specific results of the cost comparisons. For example, with a given length of season and proportion of culls, the costs of the packer-supply operations decrease as the size of the plant increases. Thus with 250 hours operation per season, a packer output rate of five lugs per hour, and 30% culls, costs with efficient operation are about 5¢ per lug in a small plant, 4¼¢ per lug in an average-size plant, and 4¢ per lug in a large plant. A similar, although smaller, effect is evident with long-season operation.

When output rates of five and 30 lugs per packer hour are compared, the effect of the high output rate is to reduce costs by about 1¢ per lug when the length of season is 250 hours and ¼¢ to ¾¢ per lug—depending on the proportion of culls—when the season length is 750 hours.

When output rates of five and 30 lugs costs rise about 1¢ per lug as culls increase from 10% to 30%; and there is an additional 1½¢ increase as culls rise from 30% to 50%. With 750 hours' operation per season, the variation in costs as the proportion of culls changes is less regular but approximates ½¢ per lug as culls increase from 10% to 30% and an additional 1¢ per lug as culls rise from 30% to 50%.

Comparing the most efficient methods at a culling rate of 30%, costs with short season operation—250 hours per season— are about 1¾¢ per lug higher than with long-season operation of 750 hours. At 10% culls, this difference is 1½¢ and at 50% culls it is about 2¢ per lug.

While substantial differences in costs are associated with the wide range in operating conditions, these costs differences do not necessarily indicate savings potentials. In general, only limited adjustment in the factors affecting the costs of the packer-supply operations is possible for individual shippers. Some adjustment in proportion of cull fruit might be attained through changes in cultural, picking, or marketing practices. Increased packer output rates might be achieved in some plants through adoption of an incentive wage plan. In some areas, size of plant and hours of operation per season might be increased through consolidation of small plants. Such changes, however, would ordinarily involve shifts through only a part of the range in operating conditions and frequently would be economical only as existing plants are worn out.

Some of the changes involved in reducing the costs of the packer-supply operations would affect the costs of other operations. The costs of packer labor would be affected by any change in packer wage plan; changes in practice necessary to reduce the proportion of packing house culls probably would affect picking, hauling, and cultural costs.

L. L. Sammet is Specialist in the Experiment Station, University of California, Berkeley, and Co-operative Agent of the Agricultural Marketing Service, U. S. Department of Agriculture.