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MICHIGAN STATE COLLEGE

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APPLE STORAGE

Conditions most nearly ideal for the storage of apples are to be found only in well constructed cold storage houses, but the costs of construction and operation are too high for the grower or growers' organization with less than 25,000 bushels of late-fall and winter fruits. Unheated cellars and basements have been used for apple storage with varying success. Those provided with openings for the introduction of large quantities of air from the outdoors and with earth floors have been the most successful. These storages, whether they are partly below or entirely above the ground line, are known as common or air-cooled storages.



Fig. 1.—This frame storage was built in 1922. It is 40 by 60 feet and has a capacity of 10,000 bushels. A grading room extends across the front. The second floor is used as a storage for empty containers. This is one of the few storages in Michigan with a permanent false floor. A two-inch thickness of hair felt in the walls provides excellent insulation. Note the location of air intakes and outlets.

A good air-cooled storage should be designed (1) to obtain cooling of the fruit by the introduction of cooler air into the storage room whenever the outdoor temperatures are lower than those of the fruit, (2) to prevent freezing of the apples during the colder winter weather and (3) to regulate humidity. The construction should be such that the cooler air is taken in through several openings or air intakes built in the walls just above the ground level or near the floor of the structure and leaves the building through ventilators, or air outlets, which extend from the ceiling of the fruit room through the roof of the building. Freezing during periods of extremely cold weather and rising temperatures during periods of warm weather are prevented by insulating the walls, doors and ceiling of storage. Earth floors aid in maintaining humidity at the proper percentage.

Investigations have shown that there should be one cold air intake, 18 inches high by 30 inches long, for each 2,500 cubic feet of storage space and that there should be about two square feet of ventilator or warm air outlet for the same volume of storage. The latter should never be less than two feet square and three by three, three by four or even four by four feet is better. The intakes and outlets should be evenly spaced and should be provided with insulated doors.

When the outdoor air temperatures are lower than those in the storage room or of the fruit, the air inlet doors and those of the outlet flues may be opened permitting the warmer (and lighter) air of the storage room to pass out through the flues and an equal volume of the colder air to enter the room through the openings near the ground level. Whenever the outdoor temperatures are higher than those inside the room, all the openings must be



Fig. 2.—One of the older air-cooled storages of the modern type. The size is 36 by 60 feet, including a nine-foot sorting room across the front, and the capacity is about 8,000 bushels. There is an outer wall of eight-inch glazed tile and an inner one four inches thick and between the two is an insulating quilt. The second floor is used for the storage of empty containers.

tightly closed or warming rather than cooling of the fruit will follow. Good management consists in seeing that the air intakes and outlets are promptly closed or promptly opened when the outdoor temperatures become higher or lower than the storage room temperatures.

Investigations in properly constructed and well managed storage houses in Michigan show (1) that the storage temperatures during the fall months, tend to follow the outdoor mean and minimum temperatures, (2) that a mean storage temperature three to six degrees lower than the average mean daily outdoor temperatures may be contemplated, (3) that storage temperatures not more than five degrees above the average daily minimum may be reasonably expected, (4) that temperatures which will compare favorably with those maintained in cold storage ware-houses cannot be attained in air-cooled storage houses until late November or possibly the first week in December, (5) that the average daily range or fluctuation of temperature should not exceed one-half of one degree after the temperature of a room filled with apples has been reduced to 35° F., and (6) that temperatures of 32 to 35° F. may be safely maintained regardless of outdoor winter weather conditions provided the storage is nearly full of fruit. When these conditions do not obtain, the storage is either poorly constructed or improperly managed.

The cost of an air-cooled storage depends somewhat on the kind of materials used in construction, the size and extent of the building above the storage room. The cost of the better constructed storages has been 35 to 40 cents per bushel of storage capacity and this range is the amount that one should assume in planning to erect a well constructed storage of 8,000 bushels capacity or larger. The cost of operation is very slight. It will not exceed ten cents per crate for the season.



Fig. 3.—The walls of this storage consist of twelve inches of interlocking tile with waterproof plaster on both the inside and outside. It is 33 by 80 feet in size and has a capacity of 12,000 bushels. Hair felt is the principal insulating material of the ceiling. The air intakes are just above the ground line and are well distributed about the building. The air outlets are each 4 by 4½ feet.



Fig. 4.—This 38 by 70 storage is similar in design to the one shown in Fig. 2. There are two eight-inch glazed tile walls with a two-inch air space between them. The height of the storage room is 14 feet, or about two feet higher than those shown in the other figures. The capacity is about 10,000 bushels. Note the large size ventilating cowls.

This bulletin presents in more condensed form the more important points covered in detail in Special Bulletin, No. 146, of the Michigan Agricultural Experiment Station. A copy may be had upon request.