CANADA PLAN SERVICE

WALK-IN COOLER

6319
NEW 98-03

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PLAN 6319 NEW: 1988-03

A large cooler is excellent for storage of farm produce. For the market gardener, a cooler improves quality and farm operations by:

1. Allowing picking in advance of marketing.
2. Reducing spoilage of returned produce.
3. Cooling produce to remove field heat and extend quality and shelf life.
4. Providing some long-term storage capacity of compatible crops.

Locate the storage on a site that is well drained and easily accessible. If large volumes are anticipated, truck loading ramps and docks should be incorporated into the design. Additional space may be required for receiving, grading, processing. and packing. Plan for expansion in the initial layout.

Refrigerated cold storage can be either a free-standing building or combined with another storage or building, such as a grading and washing facility. Construction options for walk-in coolers varies with the size of cooler and type of building to which it is attached. The cooler can be any practical size. Inside dimensions of the structure should be planned for an exact number of rows of standard 1200x1000 mm (48"x40") pallets or bins, with space along the walls for air circulation.

Provide ceiling space for refrigeration coolers and the pallet height anticipated. The cooler in this plan, 5.4 m x 6.6 m (18 x 22 ft), will hold about 50 m^3 (1800 ft^3) of produce in 40 half-tonne standard pallet bins, totalling 15 - 20 tonnes of produce. About half this amount can be stored if pallets are not stackable.

One of the chief causes of the deterioration of fresh produce is the loss of moisture by evaporation into the surrounding air. Minimum moisture losses are experienced when the humidity in the storage space is high, about 90%. A high level of insulation is therefore required for vegetable storages for cold weather(-35°C) operation to minimize condensation on inside surfaces.

For cold storages in Canada insulation levels should be the following minimum where outdoor design temperature is:

Design T	Ceilings	Walls
- 35° C	RSI 6.3 (R-36)	RSI 5.7 (R-32)
- 25° C	RSI 5.7 (R-32)	RSI 5.0 (R-28)
- 20° C	RSI 5.3 (R-30)	RSI 4.4 (R-25)

For coolers not operating on cold weather, use at least the last insulation value to minimize heat gains in summer. The perimeter concrete foundation should also be insulated with a rigid type of insulation with a protective covering.

Construction Options

Three building types are practical.:

1. Steel frame buildings with spray-on foam insulation.
2. Wood frame structures with appropriate types of insulation.
3. Pre-fabricated "sandwich panel" construction of steel or wood over a rigid foam core.

Steel frame buildings, or frameless steel arch structures, are best insulated with spray-on foam insulation. This is the most practical method of thoroughly and adequately sealing the building. With batt insulation it is difficult to insulate steel purlins and main beams, resulting in condensation and dripping problems. Another option is to attach pre-formed foam core panels to the walls of a larger steel building.

COMPLETE INSTRUCTIONS

Canada Plan Service, a Canadian federal/provincial organization, promotes the transfer of technology through factsheets, design aids, and construction drawings that show how to plan and build modern farm structures and equipment.

For more information, contact your provincial agricultural engineer or extension advisor.

Wood frame storages require special attention to vapour barriers to avoid condensation and wood decay problems. The rule for vapour barriers in buildings is, "they should always be on the warm side".

For refrigerated buildings the warm side is the outside in summer, and the inside in winter. During summer, condensation will accumulate on the cold side vapour barrier of batt-insulated refrigerated storages, causing serious problems. For that reason imperious foam insulation is preferred.

Two construction systems utilizing foam insulation are illustrated on the plan:
(1) Rigid foam insulation panels applied in two lapping layers. The first is nailed and the second glued or nailed. Inside walls should be covered with a protective liner of plywood, metal or plastic laminate that is easy to sanitize.

(2) Spray-on foam is excellent as it both insulates and seals the building. Foam should not be applied to the inside of exterior metal sheathing over a wood frame, because moisture trapped in the foam at the cold steel interface causes serious wood decay. The best method is an "inside out" technique where the foam is applied to the back side of an inside metal liner. Up to one-third of the total R-value can be less expensive batt insulation.

Good quality storage doors, with heavy-duty hardware are desired for trouble-free operation. Door width and height should be sized for forklifts or pallet movers; 1.8 m (6 ft), is minimum width. Concrete floors should be smooth and easy to clean; provide a floor drain for this purpose.

Refrigeration systems

Cooling equipment consists of a compressor and condenser outside the cold room, and evaporator or cooling coils in the coolers, together with appropriate plumbing, controls, and electrical service. Cooling coils operated near freezing require a defrosting mechanism with related controls. Electric defrost and hot gas defrost are most common. Air-cooled condensers are most common for smaller storages. Heat from condenser may be used in the attached room or vented to outdoors.

The size of refrigeration compressor and cooling coils depends both on the size of cold room and how it is managed. A room for cooling quantities of summer produce requires larger cooling capacity than one which simply "holds" produce which is added slowly with some field cooling. The rate of loading has the greatest effect on cooler design; filling at a rate of 5t/day will require 65% of the power that 10t/day requires.

It is important that air circulation off the cooling units moves from "cooler to warmer" produce to avoid rewarming previously cooled crops and the condensation problem when warmer humid air contacts cooler produce. Always use a reliable thermometer or two to confirm room temperatures. It is also desirable to precool the storage two days before it is to be used.

Cooling coils should be designed to operate at a temperature differences of about 4°C to allow the high humidities required for storage of most small fruits and vegetables. The table below is a guide to cooling requirements for cold rooms. It is important that equipment and controls be matched.

Storage Volume [1]		Refrigeration System Capacity [2]			
		Heavy Usage		Medium-light Usage	
m^3	tonnes	kW	T.R. [3]	kW	T.R. [3]
10	3 - 4	7 - 8	2.0 - 2.5	4 - 6	1.5 - 2.0
20	5 - 7	10 - 14	3.0 - 4.0	7 - 9	2.2 - 2.7
40	10 - 15	15 - 20	5.0 - 6.0	10 - 12	3.0 - 4.0

Heavy usage - cooler at 4°C filled with produce every 2-3 days in summer.
Light usage - storage of fall crops, mostly field cooled and partial summer use.

1. About ⅓ to ½ the room volume will be actual produce volume. Most produce will weigh 520 to 650 kg/m^3 (33 - 40 lb/ft^3)
2. 1 kW = 3400 BTU/h; for coolers, 1 kW requires about ½-horsepower compressor.
3. TR = Tons of refrigeration; 1TR = 12,000 BTU/h