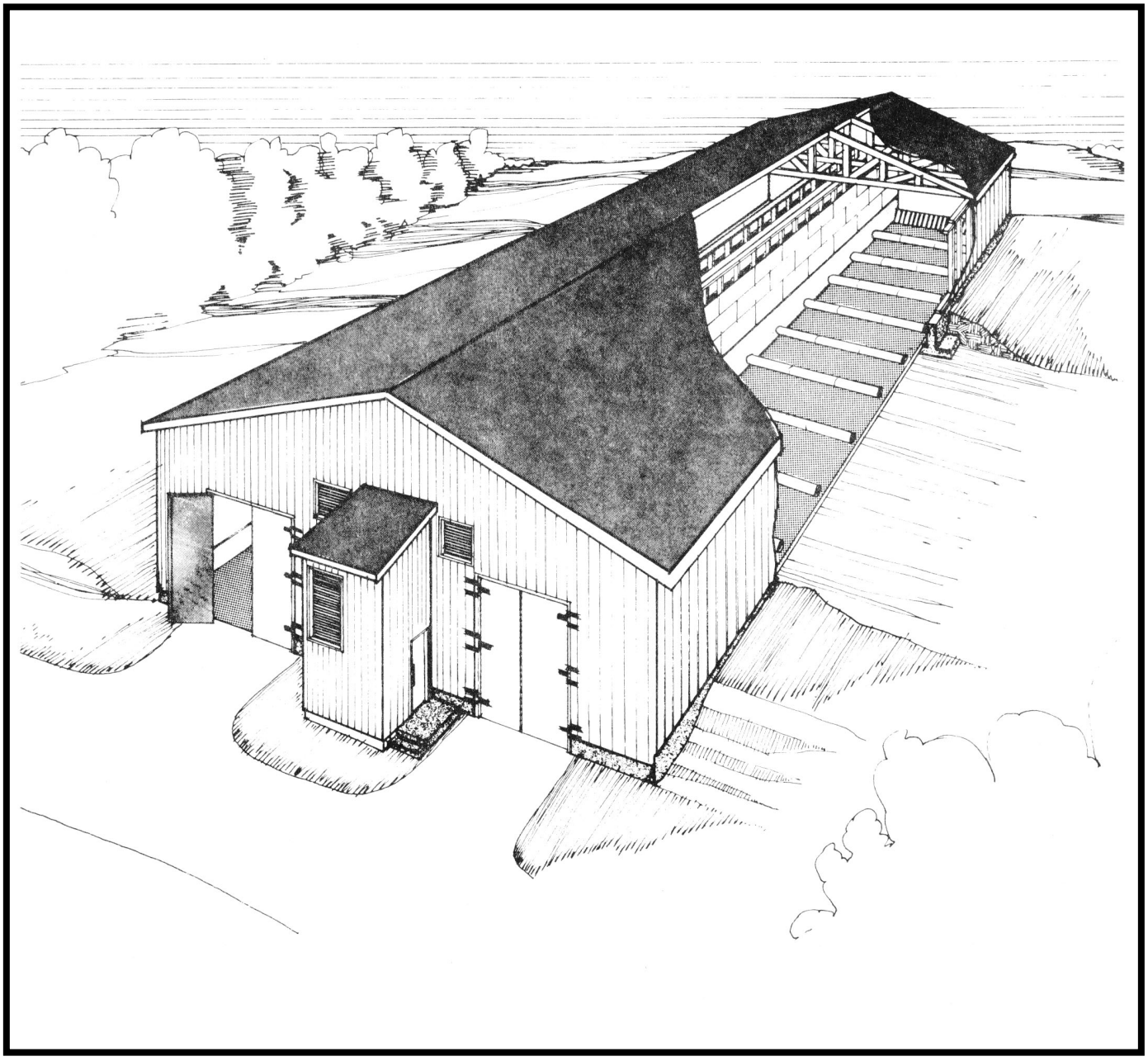
BRITISH COLUMBIA Ministry of Agriculture, Food and Fisheries
Agricultural Building Systems Handbook
PLAN
331-06

TWO BIN BULK POTATO STORAGE



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TWO BIN BULK POTATO STORAGE

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GENERAL FEATURES This large 2-bin storage is 31.6 x 42 m (72 x 140 ft). It will store about 2500 t (2800 tons) of potatoes, at a depth of 4.5 m (15 ft). An optional loading, grading and working area is shown across the front of the storage.

The building is of well-insulated wood frame construction with insulated doors for truck access at one end. A modern ventilation system, with a fan house and control room, forces air along a central plenum and through the pile of potatoes by way of lateral ducts laid across the floor.

The fan room can be located at either end of the storage, inside or outside the main building. Inside, it takes up some storage space, but simplifies exterior trim work. Storage operation is more convenient with the fan and controls at the loading/working end. Locating the fan room outside the storage at the far end allows for easy expansion (doubling) of the storage to a 4-bin unit.

The central air plenum with branch ducts provides excellent control of air flow. The top of the plenum also serves as a convenient walkway for inspecting the stored crop. Lateral ducts laid on the floor at 2.4 m (8 ft) spacing are most common, however they may also be cast in the floor. Duct size or spacing can be adjusted for different ventilation rates.

This building, insulated with batt or loose-fill insulation, is not suited for long-term refrigerated storage. If you plan to add refrigeration, use a rigid foam insulation in the walls and ceiling as shown in plan **330-11**. Other construction details need not be changed.

STRUCTURAL DETAIL All important structural details are shown on the plan. The heavy stud frame construction is designed to withstand the force of piled potatoes. The foundation is designed with an offset footing and extra reinforcing steel to resist overturning due to the large outward wall pressure. Putting the floor below ground protects the footings from frost heave, increases storage capacity and makes efficient use of wood studs for the part of the wall above grade.

It is important to insulate the concrete foundation to reduce condensation and prevent chilling of the adjacent crop. Insulation is most effective applied to the outside of the concrete foundation. Use moisture-resistant foam insulation such as extruded polystyrene. Cover it on the outside with a material such as cement asbestos board or cement plaster on wire lath to protect against mechanical damage or deterioration from sunlight. An excellent construction technique is to tack the rigid insulation to the inside of the foundation forms with finishing nails. The insulation will bond securely to the fresh concrete when the foundation is cast, and the finishing nails will pull easily through the insulation when stripping the forms.

Bulk piled potatoes exert too high a lateral force on the wall for ordinary anchor bolts. A specially designed steel angle wall anchor is detailed on this plan. This must be welded ahead of time and ready to place in the fresh concrete, so be prepared before ordering foundation concrete.

Stud frame walls must be well insulated to maintain the recommended high humidity (90% +) of a potato storage. As a guideline, the following insulation levels are recommended:

	Insulation level	
Outdoor design	**Walls**	**Ceiling**
temperature (^{o}C)	RSI (R)	RSI (R)
-40	5.6 (R32)	7.0 (R40)
-30	5.0 (R28)	5.5 (R32)
-20	4.2 (R24)	5.0 (R28)
-10	3.0 (R18)	4.2 (R24)

Consult leaflet **306-53** for more details on insulation for vegetable storages.

When insulating with bat insulation, it is important that the batts fit snugly into the stud space, flat against the inside wall surface. Be sure there are no bulges or gaps that will allow cold air to touch or move along the wall surface. Wind-barrier building paper under the exterior steel siding is highly recommended. New building wrapping papers, superior to traditional felt paper, are preferred.

A carefully sealed vapor barrier is required on the inside of the wall and ceiling insulation. As added protection against possible decay in critical areas, use CCA-pressure-treated sills and butt-treat studs by dip-soaking their ends in a CCA-compatible wood preservative (not penta or creosote).

The air plenum wall, located in the humid storage environment, and wetted by the humidifier on the inside, is particularly subject to wood decay. The rate of decay increases with the length of storage season and higher temperatures. For greatest durability, use interior wood studs pressure-treated with ACA or CCA preservative. Otherwise use Douglas-fir studs, which are more decay resistant than spruce and dip-soak their butt ends. Keep the treated studs from direct contact with potatoes by using plywood or steel sheathing (see **378.600-3 Wood Preservatives)**.

This plan suggests a stud wall height of 4.8 m (16 ft), for a total inside clear height of about 5.8 m (19 ft). A stud selection table on the plan allows for design of other wall heights. Considering the space required for

insulation, it is desirable to select studs of greater depth and at wider spacings than necessary for structural strength.

Ventilation of the pile, and more uniform temperature, is aided by lining the exterior walls with boards (cedar is longest lasting) spaced 38 mm (1.5 in.) out from the wall by vertical nailer strips.

Roof trusses, in addition to the design snow load, must also hold the outward pressure of the potato pile that is carried to the top of the walls. Be sure to increase the truss lower chords strength for this extra tension force. This wall force is shown on the plan. A special metal strap anchor is used to attach the truss to the side wall plate.

The ceiling is an important structural component in a bulk storage. When filled, the ceiling ties the end walls to the long walls of the building; when empty, it braces the entire building to resist wind forces. Follow the ceiling construction details in the plan carefully.

Ceilings for potato storage may be either galvanized steel or plywood. Details for a plywood ceiling are shown. For a ceiling of steel roof sheathing, see plan 9371. The steel ceiling is longer lasting but because of its shinier surface, it is slightly more subject to condensation than plywood. Staining or painting a plywood ceiling a dark color provides better control of condensation and improved durability.

The air plenum and concrete floor are designed as a complete drainage system, for hosing out and disinfecting the storage. The 125 mm (5 in.) concrete floor rests on the footings opposite the air plenum, and slopes about 75 mm (3 in.) toward the plenum. The plenum floor is set below the storage floor so water can drain through the air duct openings. Install a sump in the plenum that can be drained or pumped for disposal.

In addition to storage cleaning, high capacity humidification often generates excess moisture which drains out of the air plenum. It helps to have the far end of the building about 150 mm (6 in.) higher than the fan end, but this requires more precise work in setting forms and footings to make the building “off-level”. It is easier to slope the floor, foundation and ceiling uniformly towards the fan end, but keep all the studs and endwalls vertical. Sidewall claddings may show a little ‘off-square’ when fastening in place, but this will disappear when trim and flashings are added.

VENTILATION The modern, fully automatic ventilation system controls temperature and circulates air through the potato pile. Air is forced down the main air plenum, outwards and up through the pile by lateral ducts. It is beneficial to have a bypass vent at the end of the main plenum to provide partial recirculation of air to help control condensation in coldest weather.

The ventilation system for this storage is designed to provide 8 L/s per tonne (15 cfm/ton). Some storage situations, such as processing potatoes and wet harvest conditions, may require greater air flow. Where this is desired, adjust fan size, controls and duct design as required and according to sound engineering principles. Other storage applications, such as seed potatoes, may require less air than specified in this plan.

Temperature of ventilating air is controlled by two sets of proportioning dampers which blend cold outside air with return air from inside the storage. Commercial control systems are available for this application. It is important to understand the operation of the particular system chosen.

These systems usually consist of the following components:

(1) Ventilating fan, to circulate the correct amount of air. Select fans to operate at 250-300 Pa (1.0 -1.25 in. water) static pressure.

(2) Motorized dampers on fresh air and return air, usually controlled by separate damper motors.

(3) Air plenum thermostat, a modulating type that controls the damper motors to provide the precise temperature desired.

(4) Low-limit “safety” thermostat in the air plenum, to shut down the ventilation system if air temperature is too low for any reason.

(5) A differential thermostat that does not allow the system to operate when outside air is not cool enough to provide cooling. This control can also start and operate the ventilation system when outside air is cool enough (during the night for example).

(6) A 24-hour clock for regulating operating time.

(7) A high-capacity humidification system. Humidifier capacity should be about 30-40 L/h (7 gal/h) per 1000 tonnes of potatoes.

Ventilation controls, with motorized dampers to blend ventilating air at the fan room, may have problems with freezing of the fresh air dampers in cold weather. This plan illustrates an effective method of minimizing this problem. Cold-air dampers are separated from the humid inside air by an insulated door which can be closed for cold weather. A smaller opening in this door, covered with a blanket or plywood, swings open for temperature control. This feature is not needed for locations where winter temperature is seldom colder than –20^{o}C.