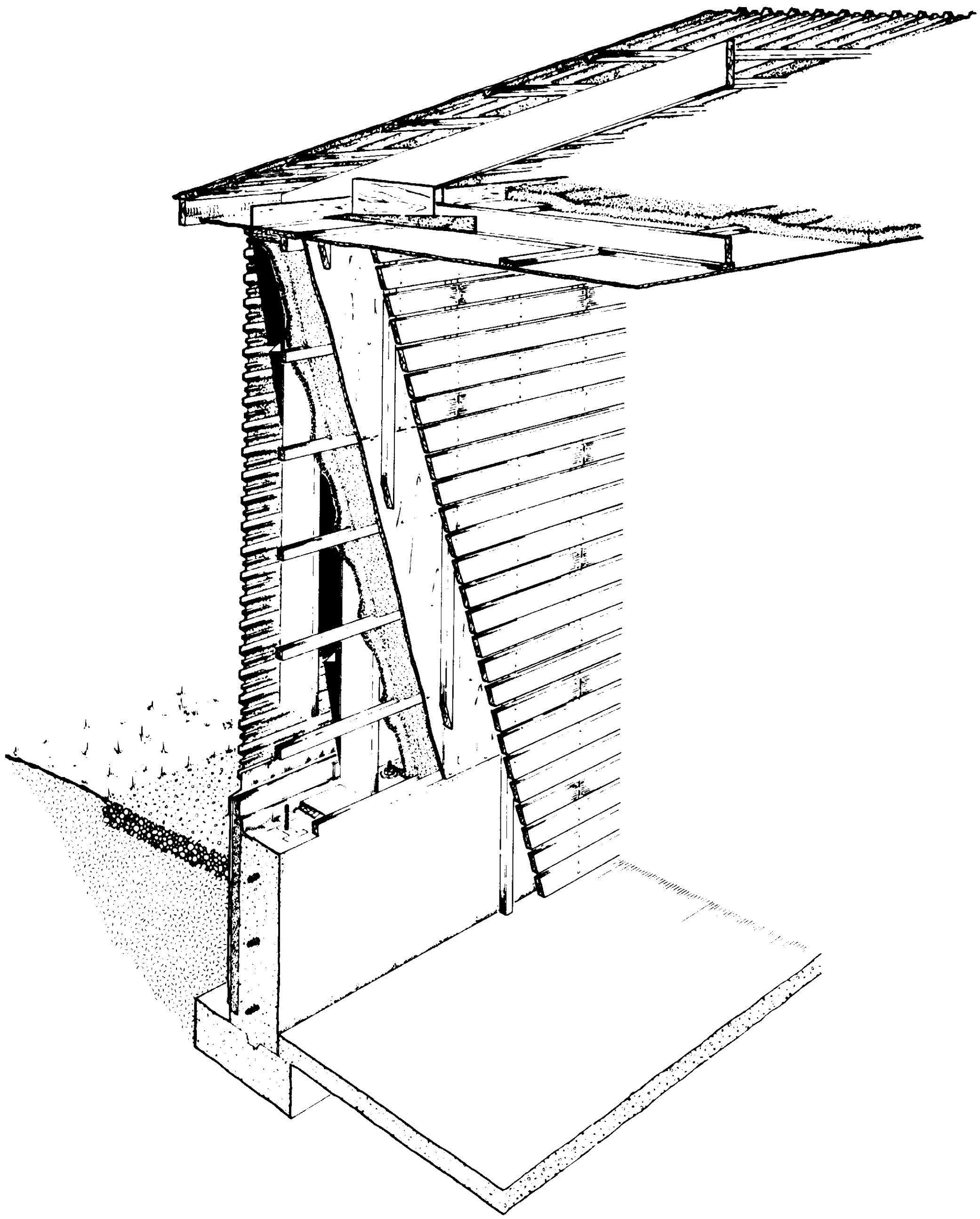
PLAN 6111

# REFRIGERATED BULK VEGETABLE STORAGE WALL



CANADA PLAN SERVICE

The Canada Plan Service prepares detailed plans showing how to construct modern farm buildings, livestock housing systems, storages and equipment for Canadian Agriculture.

This leaflet gives management information and describes one of these detailed plans. To obtain a copy of the Canada Plan Service detailed plan, contact your local provincial agricultural engineer or extension advisor.

## REFRIGERATED BULK VEGETABLE STORAGE WALL

PLAN 6111 REVISED 83:04

This plan is to be used as a component for large commercial bulk fruit and vegetable storages. Whenever refrigeration is used to extend the storage period into warm humid weather, a vapor pressure reversal occurs; this tends to drive atmospheric moisture from outdoors into the wall and ceiling insulation. The ideal solution is the 'inside-out' construction sequence given in this plan, using moisture-resistant foamed-in-place polyurethane.

INSIDE-OUT INSULATED CONSTRUCTION The stud walls are framed in quite conventional fashion, except that the inside (plywood) sheathing is installed first. Then urethane foam insulation is sprayed (in several layers) to the outside face of the inside sheathing (and of course to the adjacent framework). Exterior cladding (such as prepainted galvanized steel) is applied last. This technique has several important advantages:

- urethane foam has enough air tightness and moisture resistance that it seals the entire structure, effectively controlling heat losses and preventing wet wall-spaces;
- inside sheathing (either steel or plywood) provides essential fire protection for the highly-combustible urethane foam (in case of welding sparks or other fire hazards);
- urethane foam adds structural rigidity, effectively 'glueing' the various building parts into a single unit;
- although relatively expensive, urethane foam is one of the most effective insulation materials (3" thickness of urethane is roughly equivalent to 5" of dry fiber-glass insulation).

Inside-out construction, however, has two important limitations. The weather must be warm and dry for the fresh urethane mix to 'foam up' and harden outdoors. Also, any moisture contained in the wood framing at time of foaming can be entrapped indefinitely, causing rapid decay and wood failure. Do not use green wood, and wait long enough after rain for the framework to dry out thoroughly, before going on with the insulating.

FOUNDATION The plan provides for wood stud walls from 10 ft to 18 ft heights above the concrete foundation. Since bulk potatoes and other similar crops exert considerable pressure against the wall, the plan has special engineered details for the foundation, walls, ceiling and their connections.

A special L-shaped foundation of reinforced concrete supports the combined vertical and horizontal forces expected from bulk-stored potatoes. Earth backfill packed against the outside of the foundation helps resist the overturning force from the stored produce, and the mass of potatoes (bearing on the concrete floor slab inside) holds down the 'heel' of the footing. Do not change the dimensions and arrangement of this system without special advice from a consulting engineer.

If the site is well-drained, it may be feasible to place the floor level below natural grade, provided the site has enough slope to put the floor slightly above grade at the end loading doors. On flat or poorly-drained sites, it is better to place the floor entirely above grade; this requires extra backfill around the outside of the foundation to provide frost-protection and lateral support for the wall.

Perimeter insulation is an essential part of the foundation design. The best way to do this is to tack polystyrene insulation board (Dow SM, or equal) to the inside face of the outside forms. Use finishing nails so that they will pull through the insulation when the forms are stripped, leaving the insulation firmly bonded to the hardened concrete.

A special, proven connection is required between the wall studs and the foundation. Heavy steel angle (with special 'toe-holds' welded to it) is bolted into the concrete foundation. This prevents the butt of each stud from 'kicking out' due to storage pressure. Note that the perimeter insulation (mentioned above) extends to the top of this steel angle, to control winter heat loss and sweating from the humid storage inside.

STUD WALLS Moisture often collects at the cool interface between the base of the stud wall and the concrete, providing ideal conditions for the rapid growth of wood-decaying fungus and mold. Wood sills should be pressure-treated with CCA-type wood preservative, and the studs should be butt-soaked in preservative, to prevent decay and early failure. Stud size and spacing tables are given in the detailed plan.

To hold against storage pressures at the top of the wall, each stud is tied to the plate above by a steel 'joist hanger.' The doubled wall plate is, in turn, tied to the roof truss lower chords with galvanized steel strapping and nails. Be sure to advise your truss fabricator, giving him the additional tension force he must consider in designing the truss lower chords and splices. At the end walls, the trusses cannot be used to tie the walls against the potato pressure, therefore a special connection is required from the wall to the diaphragm ceiling; see Plan 9374 for the plywood ceiling diaphragm, or Plan 6131 for the steel ceiling diaphragm.

DIAPHRAGM CEILING FOR WIND BRACING The structural diaphragm ceiling is a superior way to stiffen the top edges of the walls, as well as to provide lateral wind-bracing for the building as a whole. The diaphragm may consist of nailed softwood sheathing plywood (Plan 9374), or screwed prepainted galvanized steel (Plan 6131). Plywood, being absorbent, is less prone to condensation and dripping, but it becomes discolored quickly due to humidity and mold. Steel is easier to install, since it eliminates the extra 'grid' of wood strapping that is needed for four-edge support of the plywood.