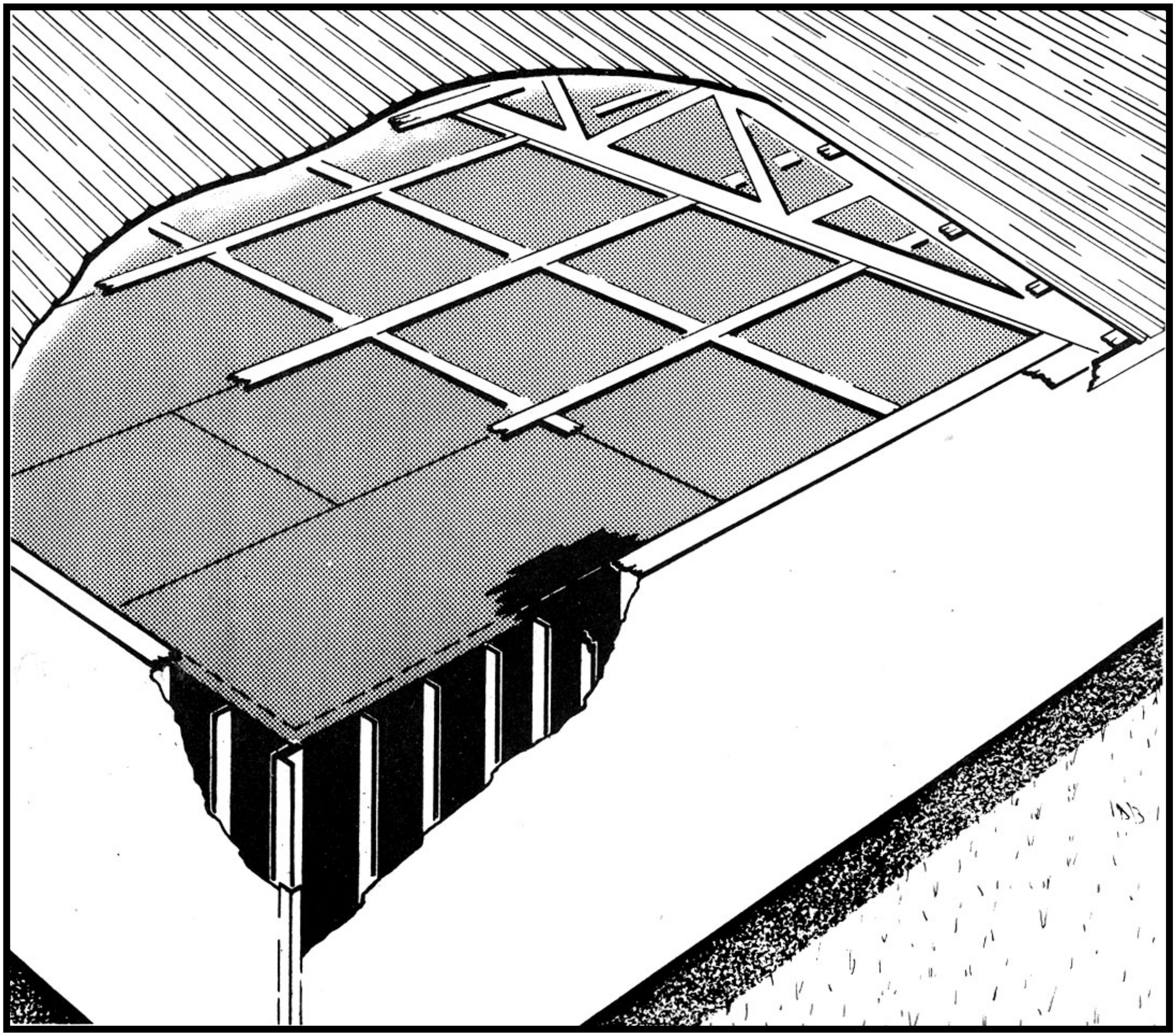
PLYWOOD CEILING DIAPHRAGM



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PLYWOOD CEILING DIAPHRAGM

CPS
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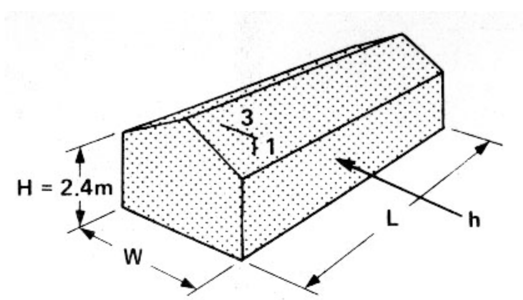
Wind blowing across a typical rectangular, gable-roof farm building produces forces that tend to overturn the walls and lift the roof. The uplift forces on roofs are best resisted by secure attachments of roofing to trusses, trusses to walls, and walls to foundations; the overturning forces acting on the walls must be handled in other ways.

Where buildings are clad inside with wide panel materials such as plywood or galvanized steel, horizontal wind effects can be most economically handled by the 'diaphragm' action of the ceiling working together with the endwall and sidewall cladding. This leaflet and corresponding Plan 305-13 give details of how to use a nailed plywood ceiling to wind-brace a stud-wall farm building.

For effective diaphragm action, each panel of ceiling and wall cladding must be connected on all four edges to adjacent framing and cladding. The plan gives details for all the special connections and framing required to wind-brace a building with diaphragm ceiling.

DESIGN Wind pressures for locations in Canada, and the rules for determining design wind forces applicable to various typical building shapes, are found in the Supplement to the National Building Code of Canada, 1980. For 'low human occupancy' farm buildings as defined in the Canadian Farm Building Code, use the 1/10 hourly wind pressure as tabled in the Supplement.



For rectangular farm buildings with stud walls and gable truss roofs as above, the maximum hourly wind pressure is:

$$h = 2.22 \frac{SW}{HL}$$

where

- h = 1/10 hourly wind pressure, kN/m^2
- S = total ceiling and roof shear, kN/m
- W = ceiling span, m
- L = ceiling (or room) length, m
- H = stud wall height, m

Because plywood is very strong in shear, the ceiling shear strength S will be limited by the fasteners. This design is based on nailing all four edges of each plywood ceiling panel with 3 x 38 mm large-head galvanized roofing nails (the nails ordinarily used for fastening asphalt roofing shingles). Do not substitute smaller nails or other fasteners without adjusting the fastener spacing; see your regional extension engineer for advice on this.

Steel roofing (or plywood roof decking) also contributes some shear strength to the ceiling-roof system; where steel roofing is screwed or nailed to roof purlins not over 600 mm o.c., the combined shear strength S per metre of building span is estimated as follows:

ceiling nail spacing mm	ceiling nails per m span		kN per nail		roofing screws per m span		kN per screw		total S, kN/m
75	(13.3	x	0.21)	+	(1.67	x	0.45)	=	3.54
100	(10.7	x	0.21)	+	(1.67	x	0.45)	=	2.85
150	(6.7	x	0.21)	+	(1.67	x	0.45)	=	2.15
200	(5.0	x	0.21)	+	(1.67	x	0.45)	=	1.80

EXAMPLE PROBLEM For a gable-roofed building 10.8 x 48 m with stud walls 3.0 high, find the diaphragm ceiling nail spacing for London, Ontario (1/10 hourly wind pressure h = 0.36 kN/m^2).

Try nails spaced at 150 mm. The maximum allowable ceiling and roof shear is then S = 2.15 kN/m, and allowable wind load is:

$$h = 2.22 \frac{SW}{HL} = 2.22 \frac{(2.15)(10.8)}{(3.0)(48)} = 0.36$$

which is safe for London.

A table of allowable wind pressures for buildings with 2.4 m stud walls is included on the plan. Use the above formula for cases not covered by the table.

Note also that shear and bending forces developed in the diaphragm ceiling and roof must be carried to the foundation by the side and end walls. The ceiling-to-wall and wall-to-foundation connections as well as the walls themselves must be at least as strong as the ceiling. Walls built according to Plan 305-13, Insulated Stud Frame Walls, would be adequate as long as end-wall door openings do not exceed 1/3 of the building width, W, and the inside and outside wall panels are nailed at least as well as the ceiling.