BUILDING YOUR OWN ROOF TRUSSES

COMPLETE INSTRUCTIONS

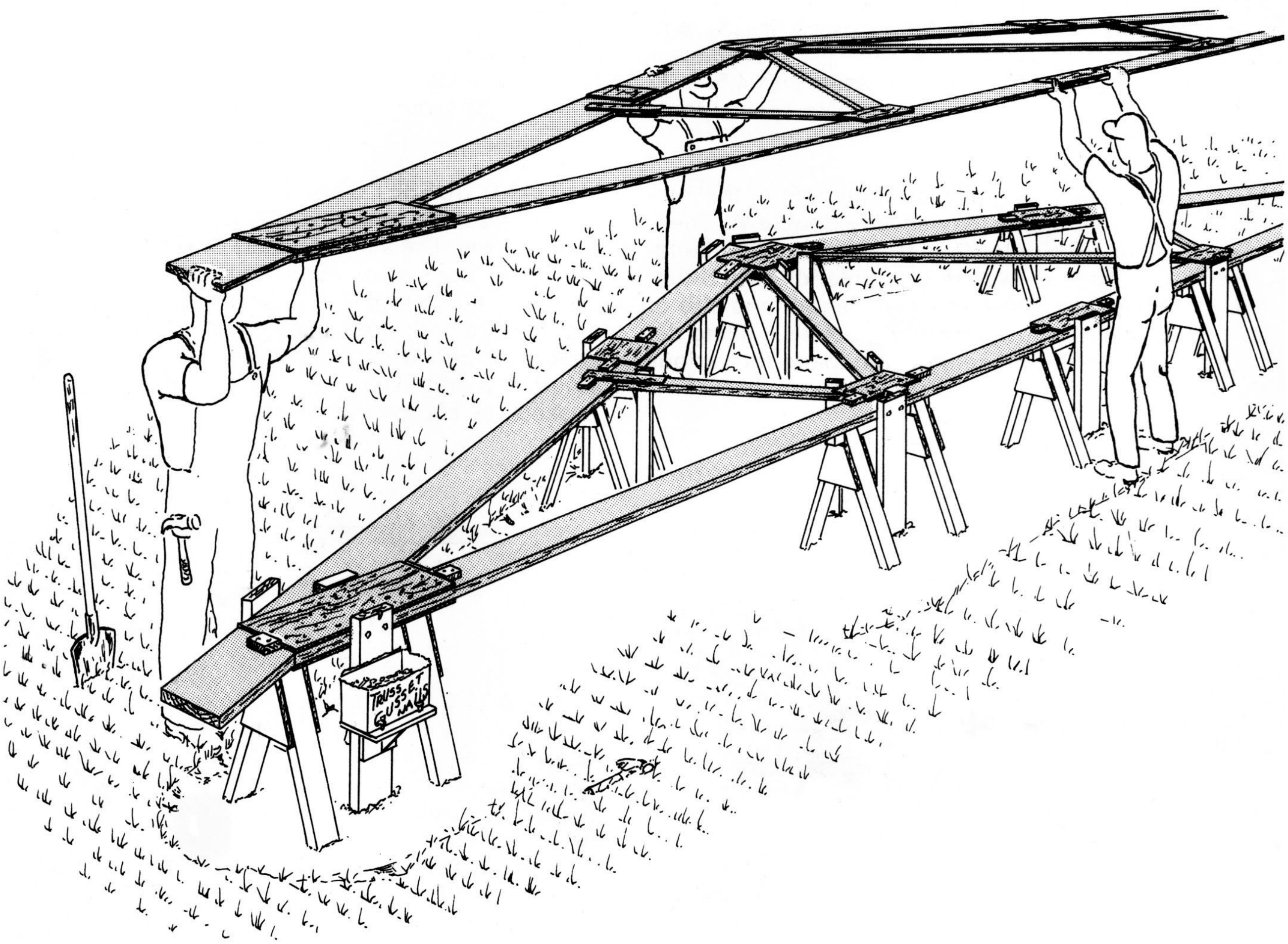

Figure 1

DEVELOPED BY CANADA PLAN SERVICE

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CPS
PLAN M-9101 REVISED: 86:08

PLANS Canada Plan Service supplies roof truss plans for a wide range of farm building spans (see leaflet M-9100). These trusses make economical clear-span roofs that take asphalt shingles on either plywood or aspen waferboard sheathing, or metal roofing on 39 x 89 mm (2 x 4) spaced roof purlins.

All plans are now designed for No. 2 grade S-P-F (spruce) dressed lumber. Recent revisions to the wood design code (CAN3-086.1-M84) indicate that S-P-F (spruce) sawn lumber is at least as strong as D. fir-L (Douglas fir), so there is no longer any advantage in using Douglas fir lumber for farm trusses. Truss members are connected by 18.5 mm (3/4 in.) exterior sheathing Douglas fir plywood gussets and 4.5 x 77 mm (3 in.) hardened concrete nails. No special tools are required.

Most trusses use a single-W arrangement of the interior webs; wider spans may specify double-W. There are also plans for single-slope trusses for wider buildings having one or two rows of interior supporting columns or poles. Plans show the length and size of each truss member, gusset cutting details, nailing details for each joint and safe design loads for various truss spacings.

DESIGN Select your truss plan to suit each building, taking into account roof loading, lumber grade, truss spacing and roofing/ceiling materials. Because of variable material quality, design with wood incorporates a relatively high safety factor. A roof, however, is only as strong as the weakest truss, and any truss is only as strong as the weakest connection or piece of lumber.

LOAD The load specified on a plan is total roof load, in kilonewtons per square metre (kN/m^2). Total roof load consists of building dead load (see table that follows) plus roof snow load. CPS trusses are not designed for heavy ceiling loads such as chain-hoists or suspended poultry cages; these require additional engineering design.

Roof snow load for farm buildings is usually taken as 80% of ground snow (or 1.0 kN/m^2 minimum). For unsheltered, windswept sites where wind is more likely to blow snow off the roof, this may be reduced to 60%. The reduction would not apply to roof valleys, near taller buildings or near tree shelterbelts.

Roofs connected to higher buildings are subject to snow drifting and sliding from the higher building. In these cases the National Building Code of Canada (and its Supplement) give rules for estimating these increased snow loads.

Ground snow load varies considerably from place to place in Canada, being relatively low in the prairies, higher in Ontario and Quebec, and quite variable in B.C. and the Atlantic Provinces. Consult your agricultural engineer for the design ground snow load in your area and the roof snow load for your particular building. Ground snow loads for most communities in Canada are published in the Supplement to the National Building Code of Canada.

Although truss spacings of 600 or 1200 mm (2 or 4 ft) are most common, spacing can be adjusted to meet a variety of loads. Reduce truss spacing on those areas of the roof where unusual snow loads are likely to occur, for example on a roof below an adjacent higher roof, or in valleys over L-shaped or T-shaped buildings.

LUMBER All plans indicate the safe design load. Do not use ungraded rough-sawn lumber. The lumber must be dressed to 38 mm (1 1/2 in.) thickness so that each nail can penetrate both plywood gussets. Lumber can be used to best advantage by selecting the best pieces for the more-critical top and bottom truss members.

NAIL-AND-GUSSET CONNECTIONS All Canada Plan Service truss designs have gusset plates fastened with special nails. The single trusses (M-9111 to M-9190 for example) consist of 38 mm (1 1/2 in.) lumber frame pieces with 18.5 mm (3/4 in.) Douglas fir plywood gussets nailed to both sides. With these, 4.5 x 77 mm (3 in.) special hardened spiral concrete nails are just the right length to penetrate the center frame and both plywood gussets, as shown in Figure 2.

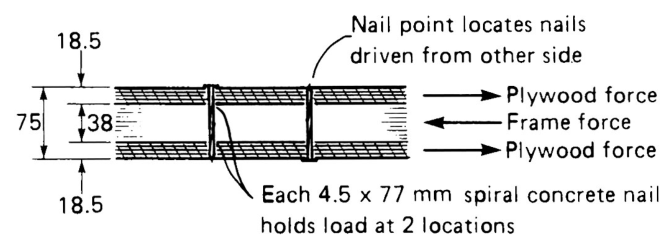

Figure 2

The number of nails is specified in each joint of the truss plan, according to the forces at that joint. The special concrete nails are easily obtained across Canada; do not substitute shorter or thinner nails which would not provide the required double-shear strength. Previous CPS truss designs have used 5-ply, 12.5 mm (1/2 in.) plywood and shorter nails. This 12.5 mm 5-ply plywood is no longer available, therefore the new trusses specify 18.5 mm (3/4 in.) plywood, which may be either 5-ply, 6-ply or 7-ply. Bigger nails make this a stronger joint and reduce the number of nails for each truss.

SPLICES Most spans require splicing of top and bottom chords. Top chord splices are made at the point of lowest bending stress. For bottom chord members, the splice is placed near midspan where forces are smaller. Do not locate the critical lower-chord splice directly below a ridge ventilation slot where frequent wetting by rain and condensation may promote wood rot. Treat the exposed ridge joint with a penetrating wood preservative, preferably while the trusses are being put together.

CONSTRUCTION STEPS

1 Measure and cut material for one truss. Fit all pieces together to make sure that fit and dimensions are true, then use these pieces as patterns to mark and cut remaining members. Take care that all members butt tight and true at connections.

2 Select the best-quality lumber for the top chord and the outer segment of the bottom chord; these are the areas of highest stress.

3 Cut the plywood gussets. Mark out the front (o) and back (x) nailing patterns on one set of pattern gussets using the nail numbers and spacings shown in your truss plan. Be careful to alternate 'back' and 'front' nails so that they do not come together, splitting the frames. Using a pattern is easier and faster than counting the nails each time you make a joint. Use the pattern gussets to connect one side of the last truss.

4 Nail truss connections on a solid, level surface. Note that nails must penetrate all gussets, so gussets must be in place on both sides of the connections.

5 Drive all nails required for one side for each connection, then flip the truss and drive nails from the opposite side. Remember to also flip the pattern gussets.

When you need a number of identical trusses, the jig shown on the front of this leaflet speeds up production. Make and use the jig as follows:

6 Build the first truss as described in steps 1 to 5.

7 Place this truss on firm, levelled supports (saw horses at each joint.

8 Fasten blocking around each gusset to form a "pocket" that will locate the gussets of following trusses (see Fig. 1).

9 Lay out bottom gussets in the pockets.

10 Lay out framing members. It is important that all these members butt tight and align true above the jig truss. Some light toe-nailing helps hold the framing pieces in alignment until the gussets are nailed in place.

11 Lay out top gussets.

12 Drive concrete nails. Lay the pattern gusset (step 3) along each joint as a guide for spacing and counting the nails.

13 Flip truss over; stack on level ground.

14 Flip the pattern gussets and drive the same number of nails into the gussets on this 'back' side. Alternate the nails between the points of the nails previously driven from the 'front' side. Avoid driving nails in straight lines parallel to the grain of the framing members.

ENGINEERING INFORMATION

This series of nailed roof truss designs is based on specified strengths for 18.5 mm Douglas fir exterior sheathing plywood and 38 mm No. 2 (or better) S-P-F dressed sawn lumber, as published in CAN3-086.1-M84 Engineering Design in Wood (Limit States Design). A computer program, PPSA II (Massé, 1986) was used to analyze the truss stresses, to adjust the member sizes for balanced design and to determine the safe roof loads. The number of nails at each joint was based on an ultimate unit lateral resistance N_u = 2.14 kN/nail (Limit States Design method). This corresponds to a Working Stress Design load of 1.25 kN/nail.

REFERENCES

Associate Committee. 1985. National Building Code of Canada. NRCC No. 23174, Nat. Res. Coun. of Can., Ottawa K1A OR6

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Massé, D.I. and J.E. Turnbull. 1986. Canada Plan Service Truss Design. Report I-804, Engineering and Statistical Research Centre, Research Branch, Agriculture Canada, Ottawa K1A OC6

Massé, D.I. 1986. Canadian version of Purdue Plane Structures Analyzer II. Report I-825, Engineering and Statistical Research Centre, Research Branch, Agriculture Canada, Ottawa K1A OC6

Technical Committee. 1984. Engineering design in wood (limit states design). National Std. of Canada CAN3-086.1-M84, Canadian Standards Association, 178 Rexdale Blvd., Rexdale, Ont. M9W 1R3

TYPICAL ROOF DEAD LOADS

Construction	Dead load (kN/m^2, or kPa)
Trusses 1.2 m oc, purlins, metal roofing, no ceiling	0.20
Trusses 1.2 m oc, purlins, metal roofing, plywood ceiling, insulation	0.27
Trusses 1.2 m oc, purlins, plywood decking, asphalt shingles, no ceiling	0.32
Trusses 1.2 m oc, purlins, plywood decking, asphalt shingles, plywood ceiling, insulation	0.39
Trusses 0.6 m oc, add 0.05 kPa to above loads	