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POLE-FRAME FARM BUILDINGS

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Farm Buildings such as hay barns and machinery sheds can be constructed very easily with uprights of round pole timber to which a framework of sawn timber is attached. The advantages of this type of construction over conventional timber construction are:

Construction is simple and can be done by farm labour.

Round poles, suitably treated for durability, are readily available.

Expensive concrete foundation walls are not needed.

The poles are sunk in the ground and firmly rammed; thus rigidity is good and little bracing is required.

As the walls do not support the roof, they can be wholly or partially omitted, or installed later if required.

The building can readily be extended later.

The type of construction described in this bulletin is particularly suited to hay barns, but similar constructions, with shorter poles, could be used for machinery sheds, garages, workshops and other types of storage sheds on farms.

Poles. These should be sound, straight tree trunks, with a minimum small-end diameter of at least five inches, e.g., larch Douglas fir (oregon), Corsican pine, stripped of bark, and treated by a timber-preserving process suitable for timber in contact with the ground, or alternatively poles of timber naturally durable in the ground, e.g. totara.

Erecting the Poles. Poles for high buildings, e.g. hay barns with roofs up to 20 feet above ground, are normally sunk about four feet in the ground, but in soft soils a greater depth, e.g. five feet may be needed. For lower buildings, e.g. roof 12 feet or less above ground, the depth can be 3 ft. 6 inches. In addition to the depth in the ground, when ordering poles an extra two feet of length should be allowed for trimming the tops to correct length after erecting. The post hole should normally be about 16 inches in diameter, to allow space for aligning the poles before ramming and also for providing a footing in the bottom of the hole where needed, i.e. when the soil is not shingle or firm clay. The footing is formed by placing about 12 inches of shingle or six inches of concrete in the bottom of the hole. (Fig. 5). This prevents the pole sinking under the weight of the structure. Extra depth is required for the footing.

A suitable spacing for the poles is 14 feet centre to centre, except that for the outside or endmost rows of poles the spacing is measured to the outside of the poles. This permits the use of uniform roof purlins 14 feet long. Any number of rows of poles can be used depending on the required overall

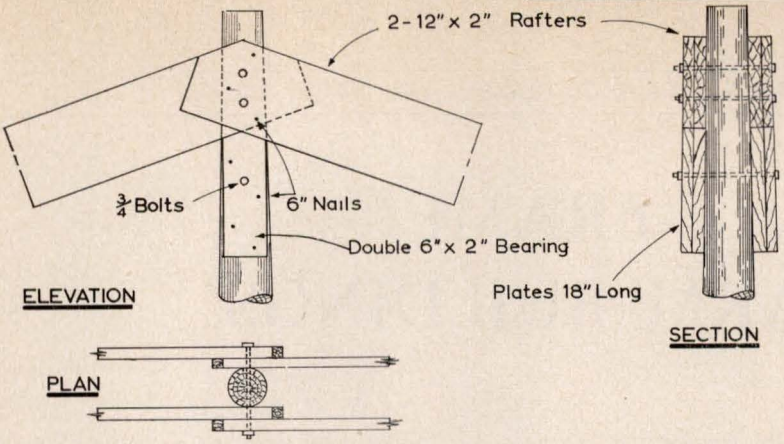


Fig.1 RAFTER ATTACHMENT AT RIDGE (GABLE ROOF)

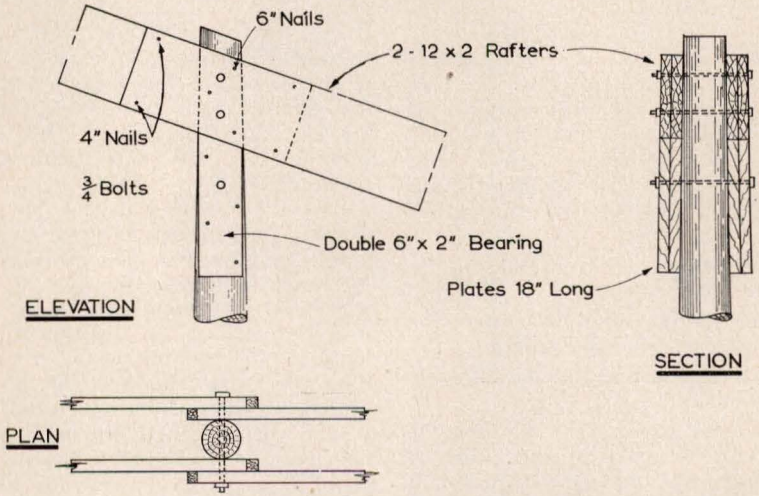


Fig.2 RAFTER ATTACHMENT AT INNER POLE (LEAN-TO ROOF)

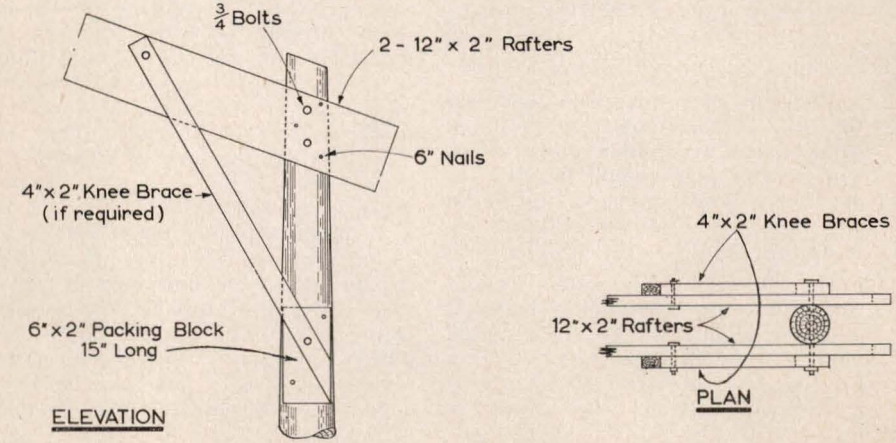


Fig.3 RAFTER ATTACHMENT AT OUTER POLE (SHOWING KNEE BRACE

width of the building, e.g. one row 14 feet wide; two rows 28 feet wide; three rows 42 feet wide. (Fig. 5). The overall length of the building can be any desired multiple of the pole spacing. (Fig. 6).

Before the post holes are dug, batter boards are set up at the corners of the building and string lines stretched between them to mark out the outline of the building, e.g. the dimensions of the outside poles. A 3, 4 to 5 ratio triangle is used to lay out the right angles at the corners, and the diagonals checked to ensure that they are equal. From the string lines the position of the centre of each hole is measured and marked with a peg. The holes are then dug to correct depth and the footing put in the hole if required.

Four good straight poles are selected for the corners and erected with their outside faces vertical, checking with a carpenter's level. A little earth is thrown in to hold the butts of the poles in place, and the poles are then braced upright with temporary timber braces nailed to pegs driven in the ground. The remaining poles are then erected and aligned to correct spacings. A tractor front-end loader is very useful in erecting the poles. The soil is not finally rammed until after the framing is completed and the final alignment of the poles checked.

A height is chosen to represent final ground level, and carried right around all the poles with a carpenter's level and straight edge, line level, or other levelling device. This line is marked on each pole with a nail or sawcut, giving a base line from which heights can be measured for attaching roof and wall timbers to the poles.

Timber for the Frame. The timber for the framing can be of radiata pine or any other suitable building timber. The timbers are of considerable span between supports and therefore only good, sound "sticks" should be used. Suitable preservative treatment is desirable, but is not essential except for wall timbers near the ground.

Roof Framing. The roof can be either of lean-to or gable type, the former being slightly easier to construct. (Fig. 5). For simplicity of construction by unskilled labour, the type of construction recommended is that in which the roof is attached to horizontal roof-timbers called purlins, running along the building, which are themselves supported by heavier timber called rafters running across the building on a slope and supported by the upright poles to which they are bolted. These rafters have a slope corresponding to the pitch or slope of the roof.

For pole spacing of 14 feet the rafter at each crosswise row of poles consists of two 12 in. by 2 in. timbers, one on each side of the poles, except for the outermost row which is one 12 in. by 2 in. timber attached to the inside of the poles. (Fig. 6). The rafters are initially fastened by six-inch nails while being drilled for two $\frac{3}{4}$ inch engineer's bolts which pass right through both rafters and poles, and have large washers under the bolt heads and nuts. Each rafter timber is 16 feet long, and the timbers are lapped at the inner row of poles or ridge as the case may be, (Figs. 1 & 2) and overhang the outer poles about six inches to form an eave. (Fig. 3).

At the inner row of poles, which carry a heavier roof load than the the outer row, double 6 in. by 2 in. timbers about 18 inches long are nailed and bolted with one $\frac{3}{4}$ inch bolt vertically underneath the rafters on both sides of each pole to form bearing plates to help to support them. (Figs. 1 & 2).

The height of the rafters above ground must suit the type of building. For a hay barn, from 14 feet to 18 feet to the underside of the rafters at the eaves is satisfactory. The roof should have a slope of not less than 18 inches in 14 feet for a hay barn, and two feet in 14 feet for storage sheds for machinery.

The purlins, i.e. roof timbers running along the roof to which the roofing iron is nailed, are 6 in. by 2 in. by 14 feet long, standing on edge

on the rafters. They are spaced at not more than 2 ft. 6 in. centre to centre for 26 gauge corrugated galvanised iron roofing and not more than three feet for 24 gauge roofing, but the spacings are modified to suit lengths of roof sheeting employed. The 14-feet purlins are bolted at the ends, the butt joints occurring over each pair of rafters. The purlins are firmly nailed to cleats made of two-inch timber 18 inches long, and cut to a width equal to the space between the rafters. Besides supporting the purlins, these cleats which are firmly nailed between the rafters, serve to fasten the 12 in. by 2 in. rafters firmly together so that they act as a single beam. (Fig. 4). In this type of construction a beam or lintel running along the top of the poles on the outside walls is not required, as the purlins and rafters carry the weight of the roofing material direct on to the poles.

Roofing. Galvanised corrugated iron, 26 gauge or, better still, 24 gauge, is nailed to the purlins with lead-headed nails in the usual manner, with side laps of 1½ corrugations and end laps at least six inches. Laps should be primed before fixing. In an open shed, condensation will not be troublesome, but for a closed shed, bituminous paper supported by wire netting should be provided under the iron. If corrugated aluminium roofing is used, it should be not less than 24 gauge, and should be fixed according to the directions of the suppliers.

Wall Sheathing. The building can be wholly or partially walled in if required. For proper ventilation of a hay barn it is wisest to wall in only the upper half of the wall, or to use 4 in. by 1 in. or 3 in. by 1 in. battens with a half-inch space between battens; otherwise there is danger of fire. Other types of buildings may have solid walls. Instead of the usual vertical studs the most convenient type of wall framing for pole-frame construction consists of horizontal timbers called walings nailed to the outside of the poles. The walings should be 6 in. by 2 in. timber with the six inch direction vertical, or alternatively 4 in. by 2 in. timber with another 4 in. by 2 in. nailed on top of it to form an L-shape. Single 4 in. by 2 in. are not rigid enough to span the 14-feet spacing of the poles. The walings can have staggered spacings so as to overlap at the posts. To these walings can be nailed galvanised iron sheets or vertical boarding as required. To close the gap between wall and ground, a board 8 in. by 2 in. treated with preservative can be fastened to the bottom of the posts and partly buried in the ground.

Bracing. Conventional timber-frame construction requires ample diagonal bracing to make the building rigid enough to withstand the force of wind or earthquake and moderate accidental forces due to pressure of stored material within the building. Pole-frame construction is in itself sufficiently rigid if the poles are set well in firm ground and rammed tight; therefore a minimum amount of diagonal bracing is required. In fact, on a well sheltered site all that is likely to be needed, are short 4 in. by 2 in. knee braces fastened between the post and rafters, to brace the building crosswise. (Fig. 3 shows a knee brace at the eaves joint, but similar braces can be used at the inner joints.) In addition, lengths of 6 in. by 1 in. timber nailed diagonally underneath the purlins between the rafters at the ends of the roof will stiffen the roof structure. Similarly, in a very exposed site 6 in. by 1 in. timber braces nailed diagonally to the inside face of the wall walings between the end and second-to-end posts will help with stiffening the building lengthwise. These should reach from the top of the end post to near the bottom of the second post. Where the barn is not walled in, 6 in. by 2 in. timber braces can be used, bolted to the pole uprights to form an X between the end and second to end posts.

After the framing is completed the post holes can finally be rammed firm

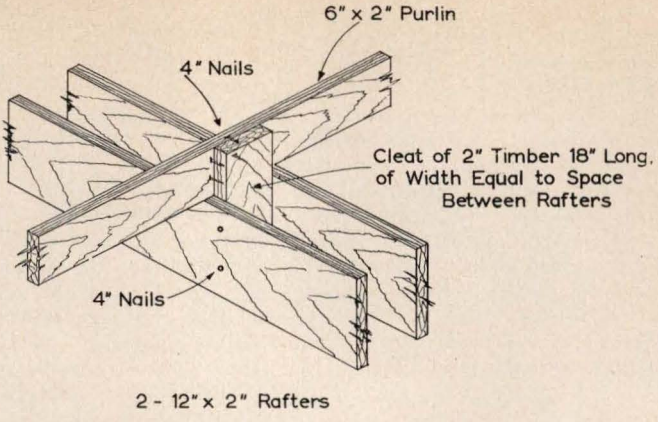
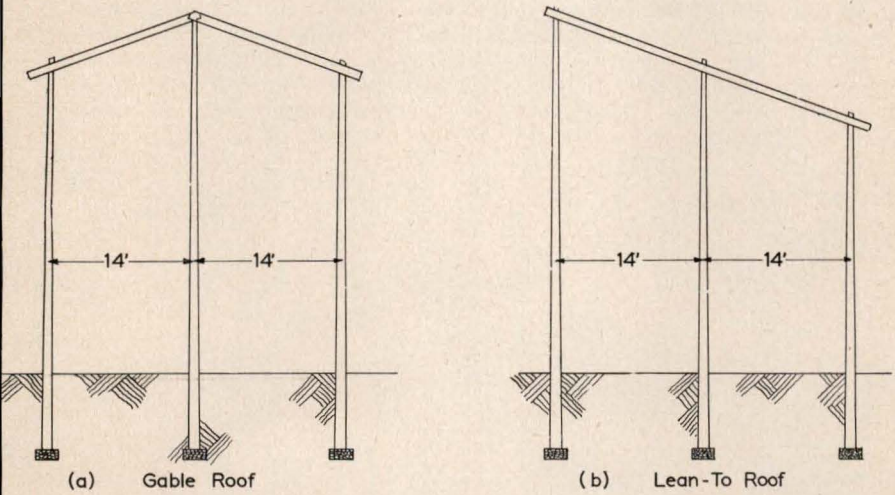
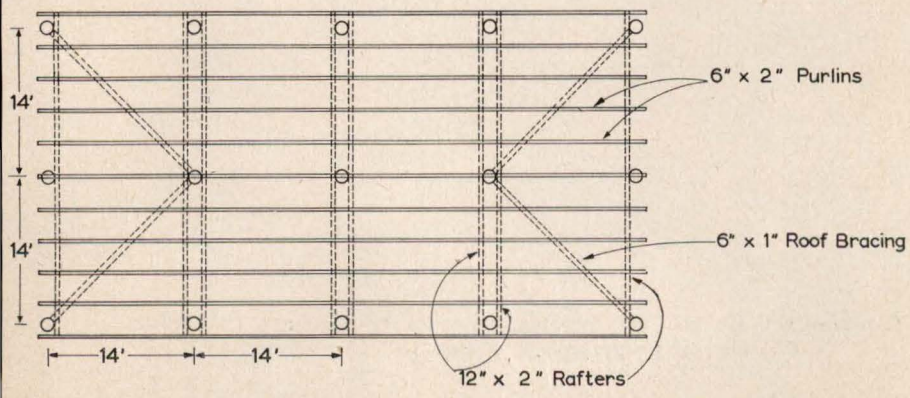


Fig.4 ATTACHMENT OF PURLINS TO RAFTERS



(a) Gable Roof (b) Lean-To Roof

5 TYPICAL CROSS SECTIONS



g.6 TYPICAL PLAN SHOWING POSTS AND ROOF FRAMING

and the poles cut off a few inches above the rafters.

Alternative Construction. If preservative-treated poles or naturally durable poles are not available, old railway sleepers of Australian hardwood may be used as butts for untreated poles. The sleepers are sunk into the ground to the required depth and the untreated poles bolted to them with two $\frac{3}{4}$ inch diameter bolts, so that the bottom of the untreated pole is about six inches above the ground.

If 12 in. by 2 in. timber is not available for the rafters, the spacing of the poles crosswise of the building may be reduced to 12 feet, when 10 in. by 2 in. rafters may be used, or to 10 feet, when 8 in. by 2 in. rafters may be used; but in the latter case the lengthwise spacing of the poles must also be reduced to 12 feet.

The Floor. Hay barns and machinery sheds of pole-frame construction usually need only an earth floor. A good floor may be constructed of shingle mixed with clay, watered and rolled hard.

A concrete floor may be laid inside a pole-frame building if desired.

Building Regulations. Local Authority Building Regulations may require the approval of the plans and specifications and issue of a building permit before building commences. While the method of construction outlined in this Bulletin will give a strong yet economical structure it may not necessaritly comply with the requirements of all local authorities.

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Copies of this Bulletin may be obtained from the Secretary, Canterbury Chamber of Commerce, P.O. Box 187, Christchurch