Purpose

People credited with this unit standard are able to describe features of pole frame and pole platform construction, and describe the method for constructing pole frame and pole platforms.
POLE FRAMES AND POLE PLATFORMS

References:  
NZS 3604:2011, Timber framed buildings  
NZS 3605:2001, Timber Poles and Piles for use in Buildings  
NSZ 3603:1993, Timber Structures Standard  
NZS 3640:2003, Chemical preservation of round and sawn timber  
Norton, P, (1976) The New Zealand Pole House:  
An introduction to the design and construction of pole frame homes  
A book on the pole house “Poles Apart”  
Mitek New Zealand Limited – Lumberlok, Bowmac, and Gaingnail

For competency assessment you will need to:  
1. Describe the basic principles of pole house design  
2. Describe the selection and installation of the poles, driven and drilled.  
3. Describe the basic principles of bracing and beam joint design, and selection of fastenings.  
4. Explain the reasons for corrosion protection.

INTRODUCTION  
This unit will describe the domestic pole platform and pole frame structures, which essentially consist of a grid of poles supporting the floors, or floors, walls and roof. The poles are generally round and tapered, and embedded in the ground with concrete.

Pole houses are suited to steep slope or bush clad sites. The trends of pole house construction are:  
⇒ Utilise better steep building sites.  
⇒ Economise on foundation costs.  
⇒ Reduce the risk of soil erosion and slipping.  
⇒ Flexible to accommodate movement due to settlement or reactive sites, and even
earthquake forces

However, pole construction can be technically difficult, particularly on very steep sites i.e. setting out profiles.

Each structure, whether a platform or pole frame requires a specific structural engineering design in accordance with the loading code NZS 4203 and NSZ 3603.

The New Zealand Building Code clause B2 requires a durability of 50 years for structure e.g. poles, beams, braces and fixings.

POLE HOUSE DESIGN

Pole Platform is a pole structure which stop at the floor level and support a platform on which a house is built. (Sketch)

Pole Frame is a pole structure where the poles extend to the roof level or beyond; or a combination of both. (Sketch)

POLES SELECTION AND QUALITY

NZS 3605:2001 defines the quality of poles, in terms of:

⇒ strength
⇒ straightness
⇒ minimum number of growth rings
⇒ grading - i.e. permitted defects (cuts, checks, splits, knots, nodal swelling and spiral grain.)
⇒ debarking or peeling methods affects strength.
⇒ preparation and seasoning
⇒ preservative treatment i.e. H5B
⇒ dimensions of poles
⇒ branding
⇒ testing regimes
⇒ precautions for handling
POLE SIZES
Maximum pole length is 12m
Consideration associated with lifting and placing large poles are:

⇒ site access for delivery and lifting equipment
⇒ availability of cranes
⇒ availability of helicopters of sufficient capacity

TIMBER DURABILITY
Is determined by :

⇒ The hazard specification (H5) to prevent decay and insect attack.
⇒ The proven natural durability in ground contact conditions
⇒ In service conditions e.g. timber in ground contact and protected from weather

POLE PRESERVATIVE

⇒ H5 House pole
⇒ H4 Beams, braces, joists subjected to regular wetting or continuously damp condition
⇒ H3 Timbers under the building or enclosed areas protected form wetting
⇒ Exposed Douglas fir beams and floor joists can be treated with creosote or oil based preservatives.

POLE SPECIES

Pole species approved by NZS MP 3640 for treatment:

⇒ Corsican pine
⇒ Radiata pine

\[ \text{service life “in excess of 80 years”} \]

CONSTRUCTION OF POLE PLATFORM

Setting out
Pole houses are likely to be constructed on difficult steep sloped sites, therefore erecting profiles may be difficult. A registered surveyor will be required to set out the profiles.

Each pole must be located by a peg, with further pegs for offset lines, 2 m outside the building boundaries for every line of poles. These offset lines are the only reference after the holes are drilled.

If the building site contains trees that are to be retained, care must be taken to ensure that sight or building lines are not obstructed.
Drilling the holes
The method used will depend on site conditions e.g. access or steepness of the site, and the size of the hole required.

- Drilling methods used are:
  - Truck power mounted augers
  - Tractor mounted boring rigs
  - Tripod mounted air powered augers
  - Hand held motorised augers
  - Spades

- The largest auger bit available is 600 mm in diameter. If the holes need to be enlarged, use a drain-layers spade to enlarge the holes and ensure all loose and disturbed soil be removed from the bottom of the hole.

- The depth of the holes is determined by the engineer at the designed stage.
- Hole diameters should be 100 mm larger than the pole diameter, to allow the pole to be adjusted during erection.
- If rock is struck during the digging, an engineer must be called on, to decide what action is to be taken.
- **Concrete plug (200 mm deep or more)** is poured into the hole base. The concrete should be a dense dry mix, with a strength of 17.5 MPa, and firmly compacted.
- Ensure all holes are covered after the concrete plugs are poured.

Pole Erection

- Ensure poles are not damaged or spoiled during transportation and placement.
- Poles are placed in position by crane, helicopter, or manually by labour force.
- The **butt end** of the pole is place first down in the hole.
- Locate corner poles accurately by using the off set lines.
- Plumb poles by using a spirit level and 3m straight edge with a block at each end or a theodolite. *Note: Poles are tapered, therefore pole must be plumbed at both direction.*
- Brace poles in position with temporary timber braces until the concrete is placed and set.
- Concrete or backfill the holes immediately to secure the poles, and ensure the alignment and position of the poles are maintained.
- Line up and plumb the remainder of the poles at ground and upper levels, using the secured corner pole as a reference point.
- The poured concrete must be left for a minimum of 3 days before lower beams are housed and fixed. Loads should not be applied to the concrete until it is cured for 7 days.
**Fixing Beams**

- Use string lines to establish the beam levels and the positions of *housing* on the poles. This will ensure beams are fixed accurately onto the poles.

- Beams are fixed in pairs (one on each side of the pole) and housed 40 mm maximum into the pole to support the floor joists. Excessive housing may weaken the poles and expose untreated timber. *Note: Temporarily fix beams into position with nails then drill bolt holes)*

- Hot dipped galvanised or stainless steel brackets may be used as an alternative to housing. Hot dipped galvanised brackets and bolts must be protected from CCA treatment in the poles i.e. coat bracket and bolts with grease.

- Beam joints must be bolted with hot dipped galvanised or stainless steel bolts not less than 16 mm diameter with 50 x 50 mm square washers.

*Note: Refer to NZS 3604:1999 Table 4.1, Protection required for steel fixings*
Bracing

Bracing must resist vertical loads i.e. building mass and horizontal loads i.e. winds and earthquakes. To resist vertical and horizontal loads, the depth and size of poles and type of bracing will be determined by the engineer at the design stage.
Methods of resisting horizontal loads are:
- Stepping the floor levels down with the slope, will reduce the unsupported length of poles.
- Cantilevered poles embedded into the ground can act as cantilevers in resisting horizontal loads.
- Using timber or steel bracing’s between the poles.

Common types of braces
- **Steel tension** cross brace consisting of 16 mm or 20 mm diameter rod installed into oversized inclined holes through the top and bottom adjacent poles.
- **Timber** cross braces i.e. 200 x 50 mm Radiata, H4, R/S bolted onto the side of a pair of adjacent poles. **Note:** Careful consideration must be taken to ensure adequate end distance between the bolt hole and the end of the timber brace. To determine the distance, multiply the diameter of the bolt by eight e.g. for a 20 mm bolt $20 \times 8 = 160$ mm minimum.
- **Timber** cross braces, as describe above, but the end connections to the poles incorporates toothed connectors to increase the strength of the brace.
- Pole braces with proprietary metal connectors. *(refer to Bowmac/Lumberlok brochures)*

Pole Brace Bracket BS 145 and B155
- Composite timber tension and compression braces. This consist of two lengths of timber (or shaft) with intermittent spacing blocks between them, can be used to carry both tension and compression.

- Plywood shear walls between poles.

**CORROSION PROTECTION**

Wet *Copper, Chrome, Arsenate* (CCA) treated timber reacts very quickly with zinc coated bolts causing rapid corrosion of the zinc then rusting the steel.

To prevent corrosion, all zinc coated fastenings must be isolated from the treated timber by:

- Coating with grease
- Coating with solvent based bitumen
- Powder coating
- Paint with a recommended primer
- Placing bolts in plastic sleeves.

**NOTES:**

Acknowledgement to Gang Nail / Bowmac (MITek New Zealand)
SUMMARY

General Precautions

- Locate and plumb poles accurately.
- Do not extend poles by splicing – order correct length.
- Limit all checks and housings to 40 mm maximum
- Do not cut, notch, or drill poles within 300 mm of the ground.
- Prime and overcoat all metal fittings for extra protection.
- Where possible, stain all poles (light colour) to slow down the drying process and help prevent unsightly shrinkage cracking.
- Care must be taken during the lifting and placing of poles.
- *Turned poles* are available in a range of diameters and lengths.

WORK SHEET

1. List three requirements NZS 3605 describes for the selection of poles?
   (i) ____________________________________________
   (ii) ___________________________________________
   (iii) __________________________________________

2. Show a clear cross section sketch of a pole platform and a pole framed construction.

3. List two advantages for pole frame construction?
   (i) ___________________________________________
   (ii) __________________________________________

4. List two advantages for pole platforms.
   (i) ___________________________________________
   (ii) __________________________________________
5 Pole house require specific design. Write a list of the main points the engineer will consider.

______________________________________________________________________________
______________________________________________________________________________

6 Describe with the aid of sketches a method of setting out a pole house on a steep slope.

______________________________________________________________________________

7 Show a clear sketch of how **offset lines** are used to position poles.

8 Show a clear cross section sketch of two main beams fixed to the top of a pole.
9. Describe how galvanised bolts are protected from CCA treated poles.

__________________________________________________________________________

10. Outline a method of installing poles to line and level.

__________________________________________________________________________

11. What is the minimum bolt size for fixing beams? _____________________________

12. What is the maximum depth for housing into poles? _____________________________

13. Explain why must all loose and disturbed soil be removed from the bottom of hole?

__________________________________________________________________________

14. What are the main disadvantages for placing exterior walls between poles?

__________________________________________________________________________

15. Describe one bracing system used to resist horizontal loads.

__________________________________________________________________________

Not the perfect choice for a pole!