06

Location: Manilla, NSW

Owner: The Presbyterian Church of Australia

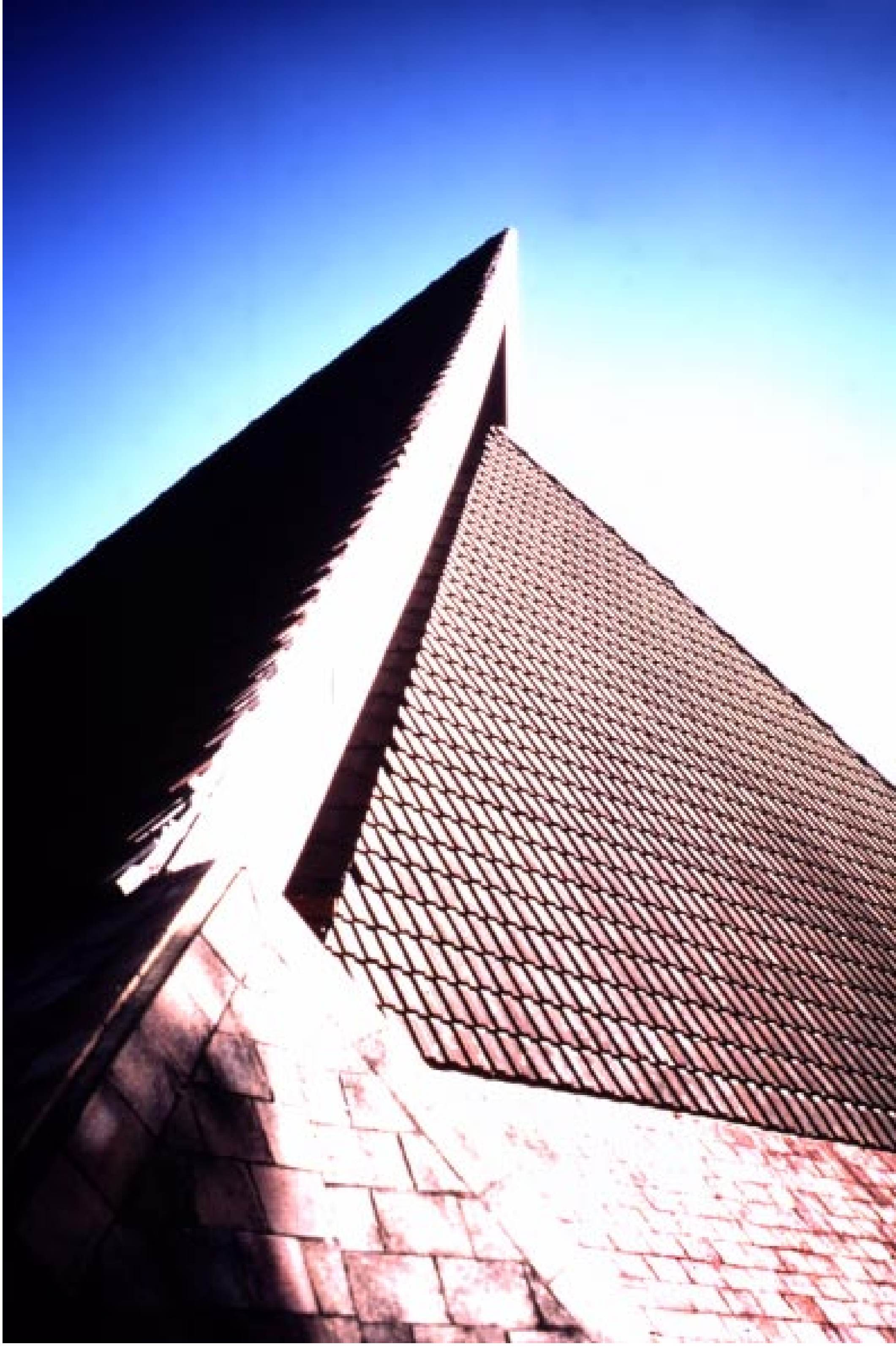
Architect: Ian McKay & Associates
(documentation in association with Phillip Cox)

Engineer: Miller, Milston & Ferris

Builder: Sweeney Constructions Pty Ltd

Constuction Date: 1968

written by: Judith Abell | **with:** Greg Nolan | **design:** Peter Walker



Manilla Presbyterian Church

Manilla - Northern New South Wales

In this small parish church at Manilla, in central northern NSW, architect Ian McKay embraced plywood and exploited its natural finish and structural capacity as a shear skin in the elements of roof design.

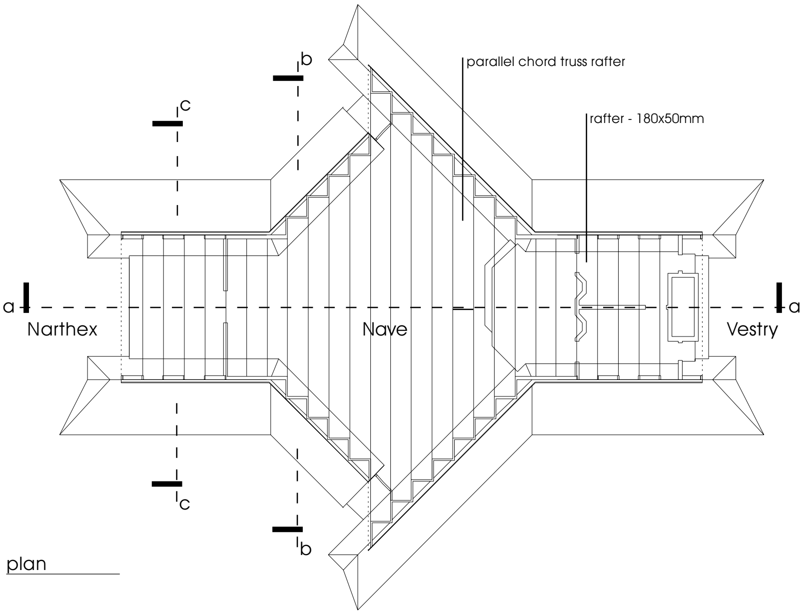
The Congregational Building Committee at Manilla required a church to seat 160. The site was flat but on deep alluvial black soil that has the potential to move as much as 5cm across the building area. An initial design of solid inclined timber rafters set on deep piered footings proved too expensive, so a light, earth integrated solution evolved. The timber rafters were replaced with much lighter plywood clad trusses. Earth filled and concrete encased **berms**, tied through the floor slab, replaced the expensive piered system. This flooring system spread the building load over a wide area and provided a strong but flexible structure, tolerant of building movements. The berms provided stability for the structure and enclosure for the congregation. The trusses, clad as if they were a folded plate of plywood, provide an economic, light and flexible roof, and a naturally finished ceiling that steps down from the crown of the church to focus attention on the centre of worship, the altar.

above:
detail of nave roof taken from north west
all photos - Catherine O'Brien

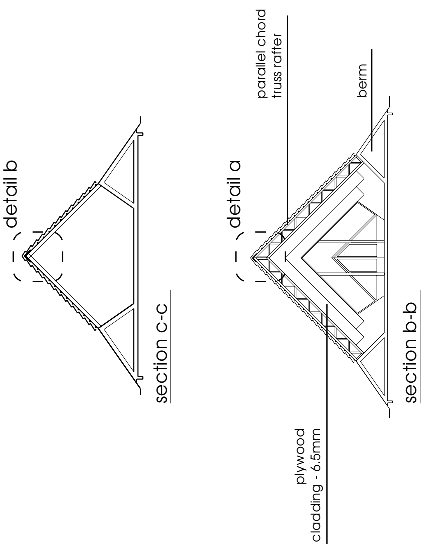
•**Description** - A number of structural principles have been cleverly interwoven in this small parish church, to create a simple, intimate space for worship. The symmetrical space of the church is divided in section into three parts. The Nave forms the building's core with its rising and falling ceiling and skylight creating a lofty worship space. The Narthex, or entry, and the Vestry, the preparation space for services, service the Nave at either end. The walls become the ceiling in each of these spaces as the roof framing springs from the berms and pitches to a ridge, creating an earth integrated A-frame structure.

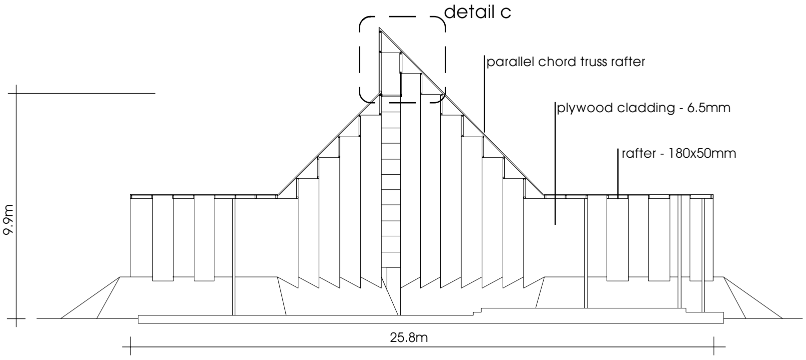
The berms which anchor and support the entire building, are a construction of consolidated earth, encased within reinforced concrete, and finished with a cladding of brick. They are tied across the building by the reinforced concrete of the floor slab. This triangulates the structure of the building. The **lateral forces** from the roof trusses maintain tension in the floor slab, which works to counter some of the effects of soil movement.

The nave framing consists of a series of pitched, parallel chord trusses supported on the berms and spanning across the width of the church. Increasing in span as the supporting berms angle out from the Narthex and Vestry towards the width of the Nave, each truss steps up above its predecessor. As each step is equal to both the depth of the trusses and the spacing between them, a series of regular 90 degree junctions are formed.



plan





section a-a

top left
main entry to the church

top right
skylight and ridge

above left
floor plan of chapel

above right
section c-c | section b-b

bottom left
section a-a

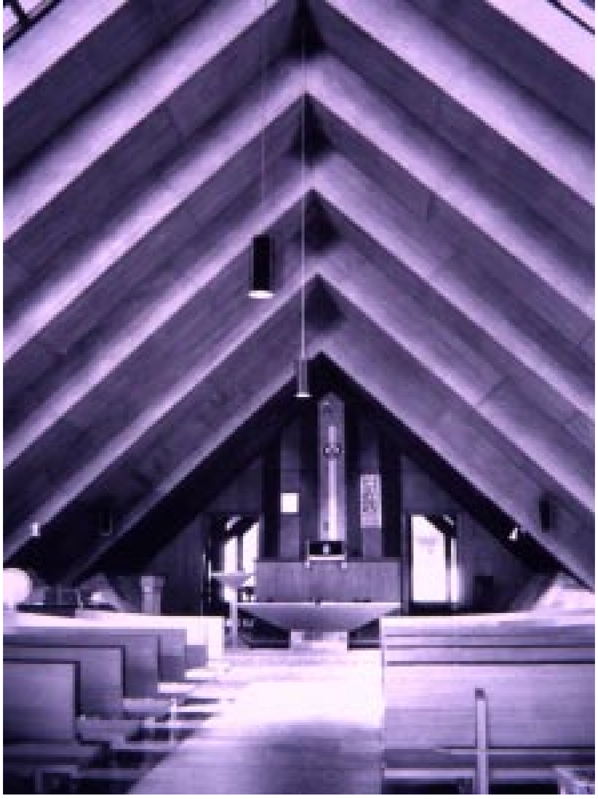
Ladder frames span between each of the stepped Cypress trusses, connecting each top chord to the bottom chord of the higher adjacent truss. Both frames and trusses are clad internally with 6mm plywood, and this creates the impression of a complex folded plate ceiling. Battens, supporting the roofing tiles, are fixed diagonally across the top chords of each of the trusses, providing further **triangulation** of each of the roofing members. Each of these components works efficiently to perform both a structural and, in the case of the ladder frames and stepped trusses, a finishing function.

The narthex and vestry are of simpler construction. Solid timber rafters pitch to the ridge height of the lowest nave frame to create an A-frame hallway at either end of the central space. Ply facing is fixed alternately to the top or bottom edges of pairs of rafters to form an undulating ceiling surface.

A continuous glazed roof-light splits the building across its widest and highest point and accentuates the plywood surface through a play of light and shadow.

A unique space was created through this form of construction, using standard 90 and 45 degree angles for all of the major timber junctions. This allowed for a high degree of detail standardisation that was efficient in construction time and in cost.

While the church is acknowledged as a fine place of worship, the building has several problems. The original plywood fascia to the building faced into the western sun and deteriorated quickly. It was clad with metal sheeting in about 1978 but this too has buckled. Ironically, the stiffness of each of the roof sections has caused stress through movement to be localised in the glazed roof-light. This is the weakest element in the building and has required ongoing repair.



top right
Interior of nave and altar

middle right
narthex and main entry

bottom right
Interior seating, roof light and exposed ceiling

•Shear plywood skins… structure as a surface finish - The properties of plywood allow for the design and construction of single skinned, stiff structures that resist the effects of lateral forces.

Plywood is constructed of a series of **veneers** laminated with the grain direction of adjacent veneers at right angles to each other. To ensure a stable material, free from warping, an odd number of veneers is used. This assembly gives plywood great strength as a lightweight, dimensionally stable cross-bracing sheet material. A single skin of ply of appropriate thickness, fixed to a timber frame, forms a strong, cross-braced structure that resists deformation through the development of shear across the panel. The ply skin can also become the interior or exterior surface, and dependent upon the application may only require clear finishing. Finishing veneers are available with a wide range of colours or characteristics, making ply an excellent natural surface finish.

The design of the parish church combines these two important characteristics of plywood. Plywood is used as a bracing skin as it is fixed to the ladder frames and members of the nave trusses, and between the narthex and vestry rafters. Its aesthetic properties allow it to act as an attractive internal surface finish.

far left
exterior of church entry

near left
strip glazing between the two roofs

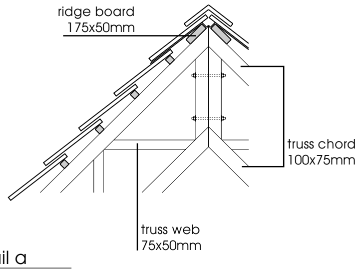
•Lightweight Structures - Due to its high strength to weight ratio, plywood, when combined with a solid timber frame, creates a strong and stiff, lightweight structure. The designer of the church at Manilla used plywood to make a lightweight structure, in order to avoid difficulties with the unstable soil conditions on site. There are various other situations in which this characteristic of plywood would be particularly advantageous:

[1] Constructions that require prefabrication, and transport to site - cost is often reduced in proportion to weight. [2] Building with small construction teams - a sheet of structural ply can be lifted, and machined by two people (a 9mm ply sheet - 2400 x 1200 weighs about 16kg) [3] Constructions on top of existing buildings where additional building loads need to be minimised. [4] Building in remote or inaccessible areas, where lifting equipment is not available.

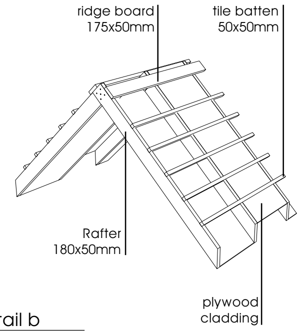
•Standardisation of detail - While the profession of architecture has a reputation for custom designed buildings, fittings, and fixtures, unique structures can be generated through the use of standard details.

This building has an unusual spatial configuration and built form, but it is generated through a simple geometry of 90 and 45 degree junctions. The stepped space of the nave is achieved simply by reducing the height of the same triangular section, and allowing the plan to follow the corresponding reduction in span. Maintaining regular spacing of structural members throughout the building allows for further standardisation. There are numerous advantages to this approach to design:

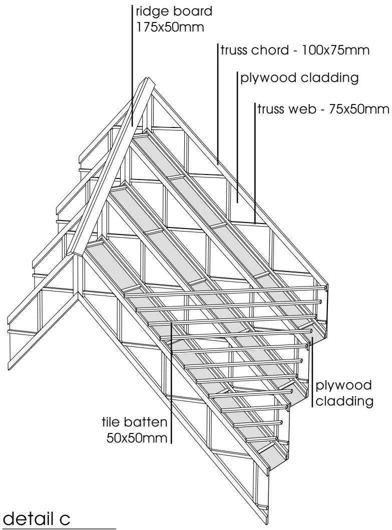
[1] Prefabrication can occur with construction elements, as there is a reduced requirement for components to be fitted and cut on site. [2] A simple range of tools and jigs can be employed for set-out, cutting and erection when standard angles and dimensions are used. This can allow for prefabrication off site, and ease on site construction. [3] There is a reduced potential for material wastage, if a standard set of angles and dimensions are employed for a whole building. For example: short pieces remaining after docking timber at 90 or 45 degrees can be utilised in other junctions in the building.



detail a



detail b



detail c

•references

Architecture in Australia 1970, 'Presbyterian Church Manilla, NSW', Oct, pp. 777-781

Wood World 1970, 'A Unique Structure', vol. 3, no. 3, pp. 9-11

•glossary

berm: an artificial ridge of earth

jig: a custom made, or commercially available device to set a dimension or angle for fabrication: eg a mitre box which acts as a guide for 90 and 45 degree saw cuts

lateral forces: a force applied horizontally to a structure in any direction, such as a force caused by wind or earthquake action. Also called horizontal force

triangulation: joining structural members together so that they form a rigid triangle

veneers: a thin sheet of wood of uniform thickness

•on the internet

download pdf:
http://timber.org.au/education/architecture/

this and other timber projects:
http://oak.arch.utas.edu.au/projects/