4.6 SCHEDULE OF TYPICAL CONSTRUCTION TYPES

Attached hereafter is a schedule of typical types of construction for the countries listed.

- i Sri Lanka.
- ii The Philippines.
- iii. Vietnam.
- iv China.
- v. Bangladesh
- vi. Caribbean.
- vii Australia
- viii Tonga.
- ix. Mauritius.

It is recognised that, in each of the countries above, there are a number of construction types not shown. The list is indicative of selected current or traditional methods.

4.7 SKETCHES OF TYPICAL SCHOOL DESIGNS

Sketches of selected traditional or current designs of schools from the countries listed in 4.6. above are attached hereafter, together with notes of the construction materials used.

Later chapters offer comments on methods and ideas that may be applied to the existing constructions to mitigate damage.

This visual portfolio shows the variety of building types responding to different cultural and climatic environments.

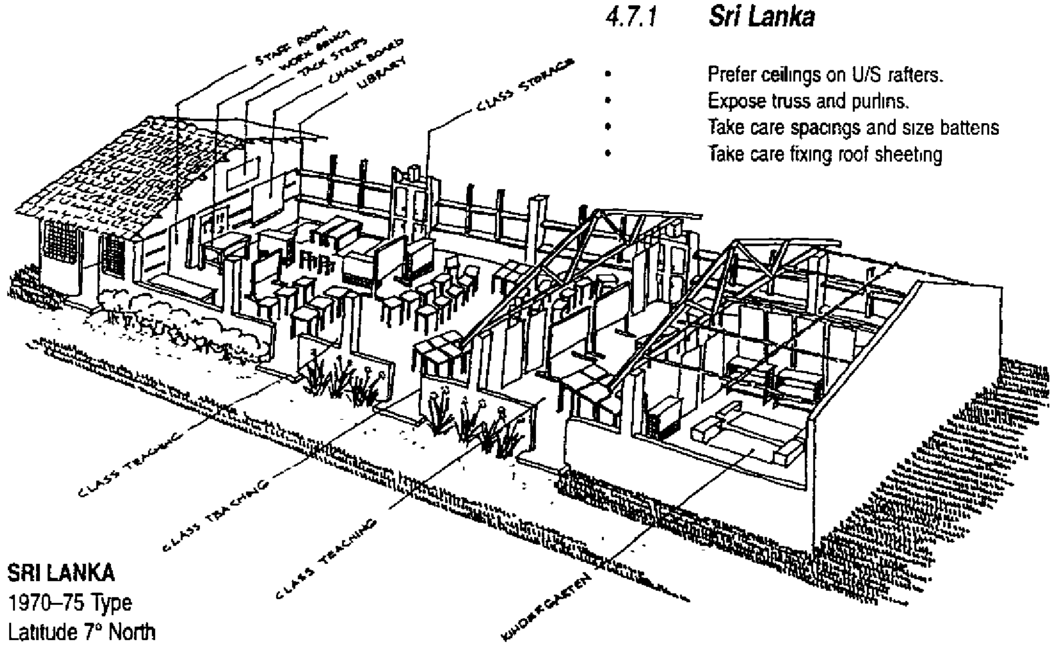
TABLE 4
SCHEDULE OF TYPICAL CONSTRUCTION TYPES

COUNTRY	*FLOORS*	*WALLS*	*ROOF FRAME*	*ROOFING*
i Philippines	R C Slab	a. 230 brick, or, b. Concrete masonry block reinforced. c. Portal frame.	a/b. Purlins on beams, or, a/b. Rafters on beams, or, trusses, beams. c. Purlins.	CGI fixed to purlins or, CGI on battens.
ii. Vietnam	a R C Slab b Render on brick or aggregate	Load bearing. 230 thick solid brick rendered.	a Steel truss Purlins. Rafters. b Concrete slab.	a. CGI on battens. Tiles on battens. b. Brick piers supporting slate tiles.
iii China	R C Slab	Concrete frame. 230 solid brick infill. Cement render both sides infill	a Concrete slab. b Timber truss, timber purlins c. Timber truss, timber purlins	a. Membrane & render. b. Tiles or battens c. CGI on battens.
iv. Caribbean (various styles)	R C Slab	230 brick load bearing.	Trusses, rafters and purlins.	CGI on battens.
v Sri Lanka	R C Slab or render on crushed aggregate or brick.	230 solid brick walls to 1.0 m height (open over), thence brick piers to support trusses	Timber roof, trusses, purlins and rafters.	Tiles and battens. CFC or CGI roofing.
vi. Bangladesh	R C Slab	130-230 brick with piers	a Concrete & tiles. b. Truss, purlin, rafter.	a. Tiles or concrete. b. CGI on battens
vii Mauritius	R C Slab	230 solid brick	R C slab or trusses & purlins & rafters.	Tiles on concrete or CGI on battens.
viii Tonga	R C Slab or timber on bearers and joists on stumps.	Prefabricated timber panels.	Prefabricated roof trusses	CGI on battens.
ix. Australia	R C Slab	Timber frame & cladding	Steel portal, plus purlins	CGI or pan type steel roof.

LEGEND:
CGI = Corrugated galvanised iron,
CFC = Corrugated fibre cement,
RC = Reinforced concrete.

4.7.1 *Sri Lanka*

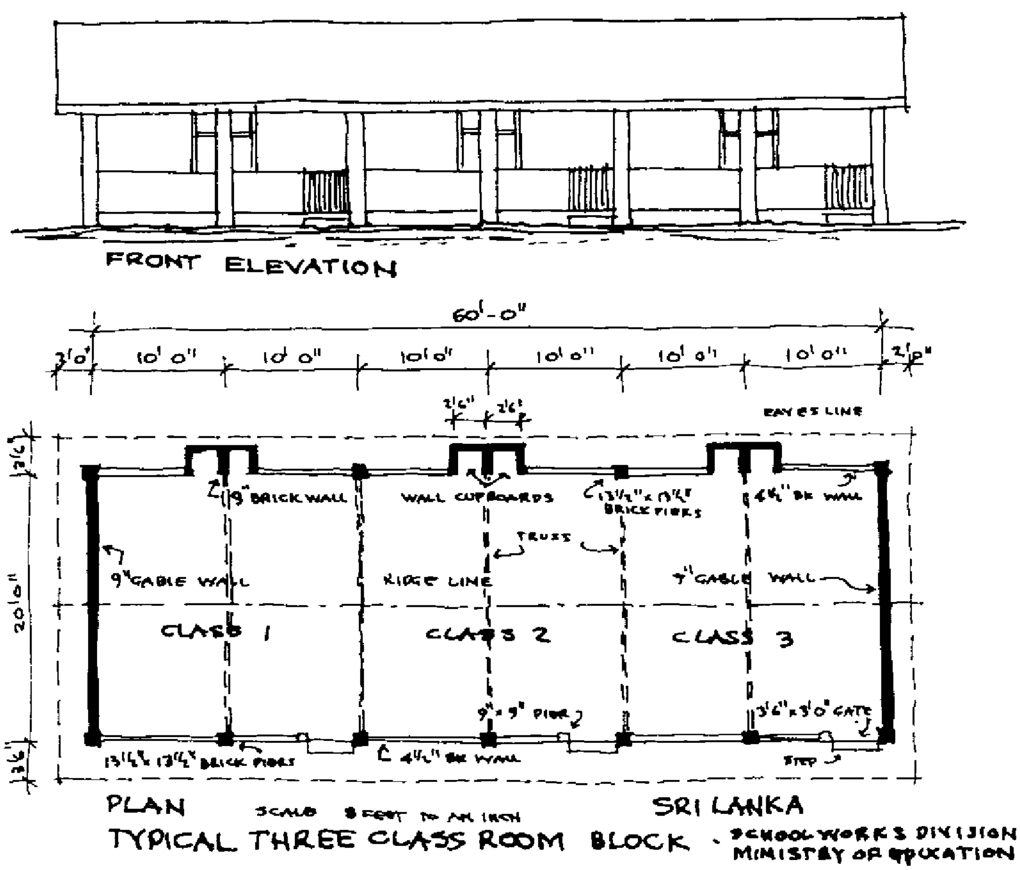
- Prefer ceilings on U/S rafters.
- Expose truss and purlins.
- Take care spacings and size battens
- Take care fixing roof sheeting



SRI LANKA
1970–75 Type
Latitude 7° North

- Columns need to be reinforced concrete in lieu of brick
- Roof needs to be braced in roof plane
- Bracing needed in wall planes
- Note building sides are open so wind loads are lower than in a fully enclosed building.
- Good quality timber trusses
- Good brickwork and rendering
- Prefer extra truss at gable walls
- Roof normally tiles on battens on purlins on rafters supported by roof trusses
- Prefer sheet cladding to roof

(Diagram Source: UNESCO 1982: Educational Buildings: Occasional Paper No.1)



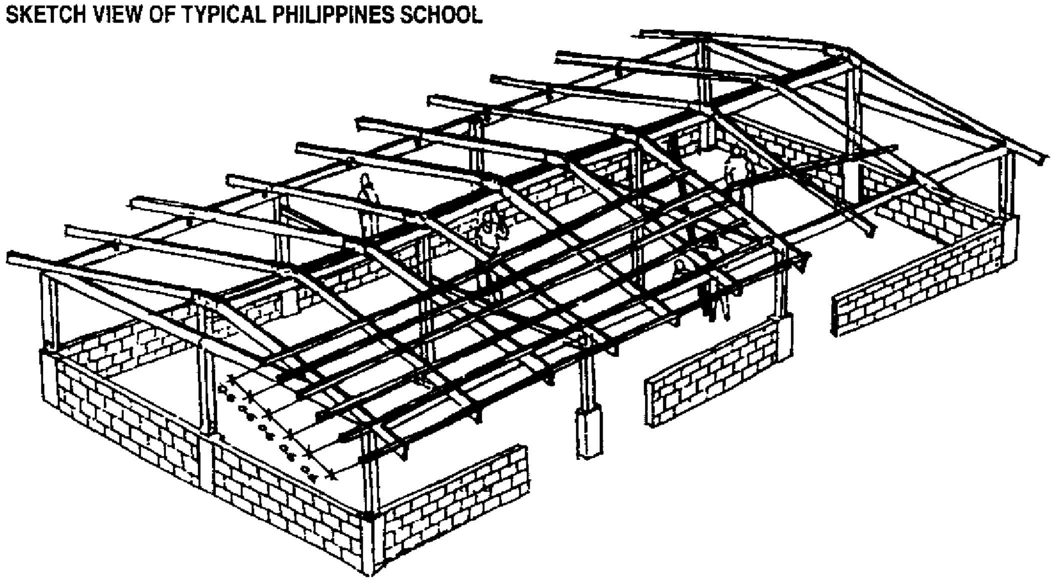
4.7.2 *Philippines*

- Portal frames of posts and beams.
- Tie beams at ridge and external wall.
- Purlins fixed to rafters via timber cleats.
- CGI roof sheeting
- Masonry block spandrel walls
- Window and door infill
- Bracing to underside of purlins
- Design, documentation and details by government are generally high quality (good example to others).
- Roof and window fixings shown on drawings.

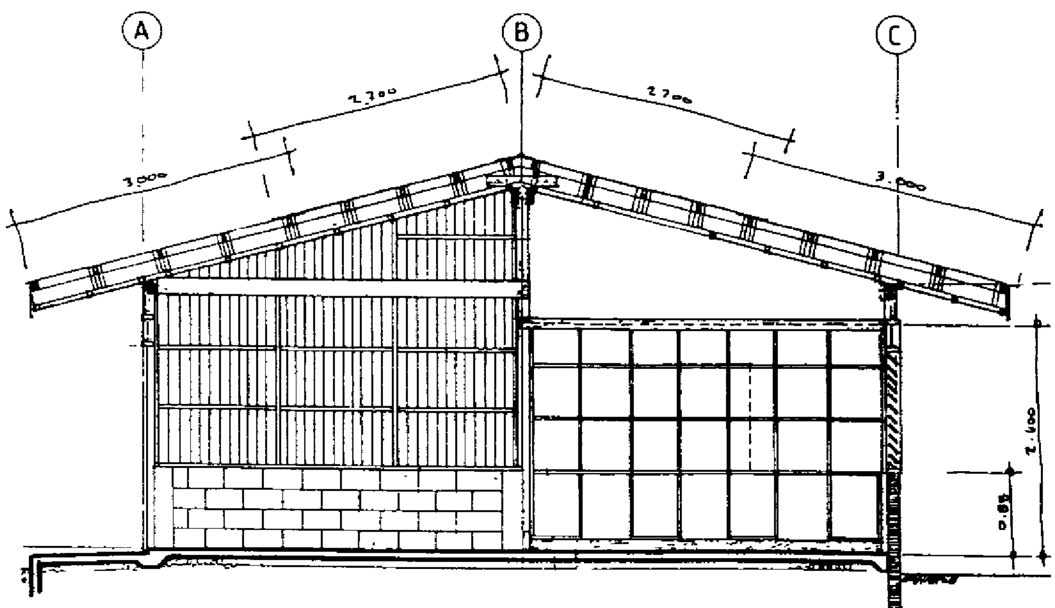
Comments

- Check alternate roof materials
- Check diaphragm action of ceiling and their fixings
- Check variety of purlin fixing details.
- Control reinforced masonry construction.
- Check bracing of walls, roofs.

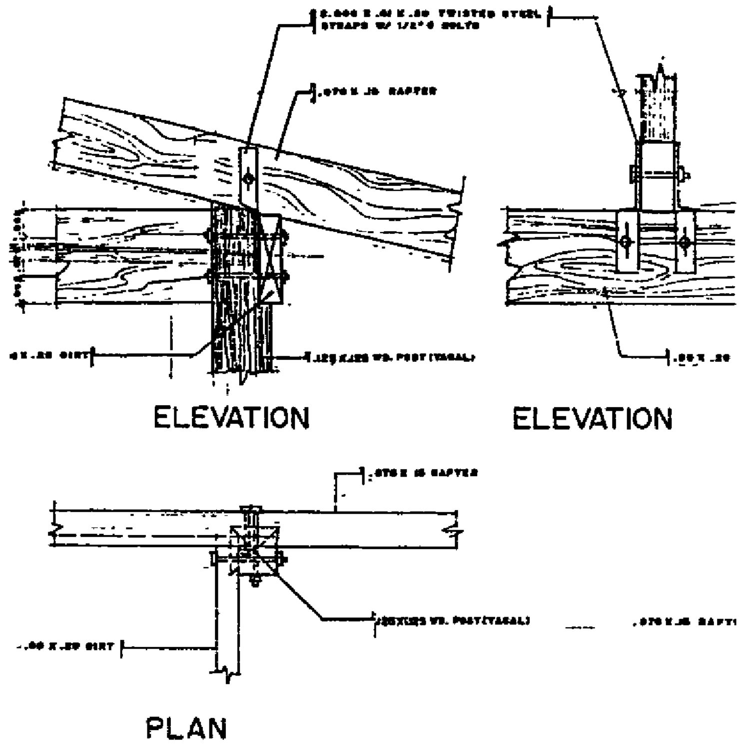
SKETCH VIEW OF TYPICAL PHILIPPINES SCHOOL



DETAIL CROSS-SECTION

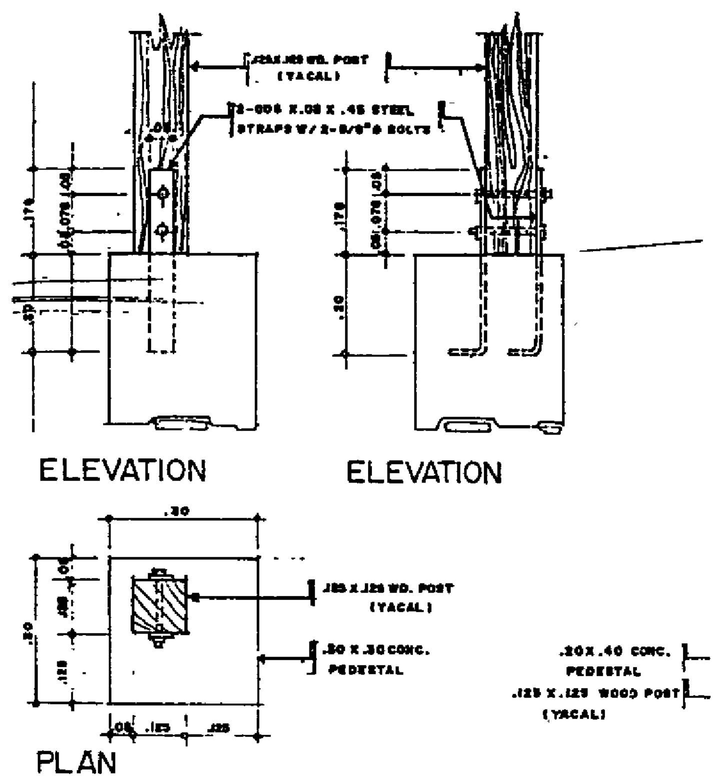


TYPICAL STRUCTURAL DETAILS – TYPICAL PHILIPPINES SCHOOL



I/S-8 DET. OF RAFTER CONNECTION

SCALE: 1:10 MTS.

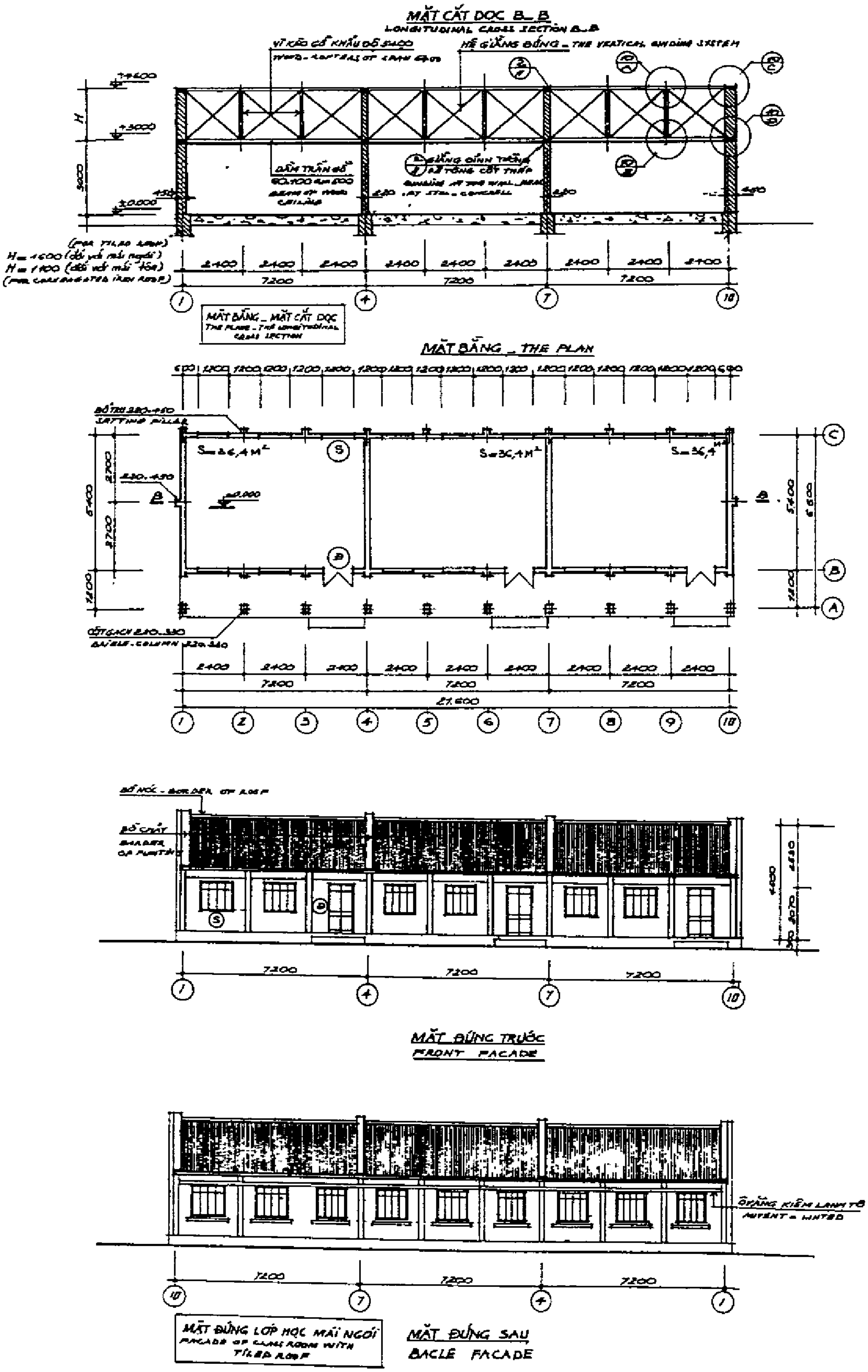


I/S-5 DET. OF POST SUPPORT @ CORNERS

SCALE: 1:10 MTS.

4.7.3 Vietnam

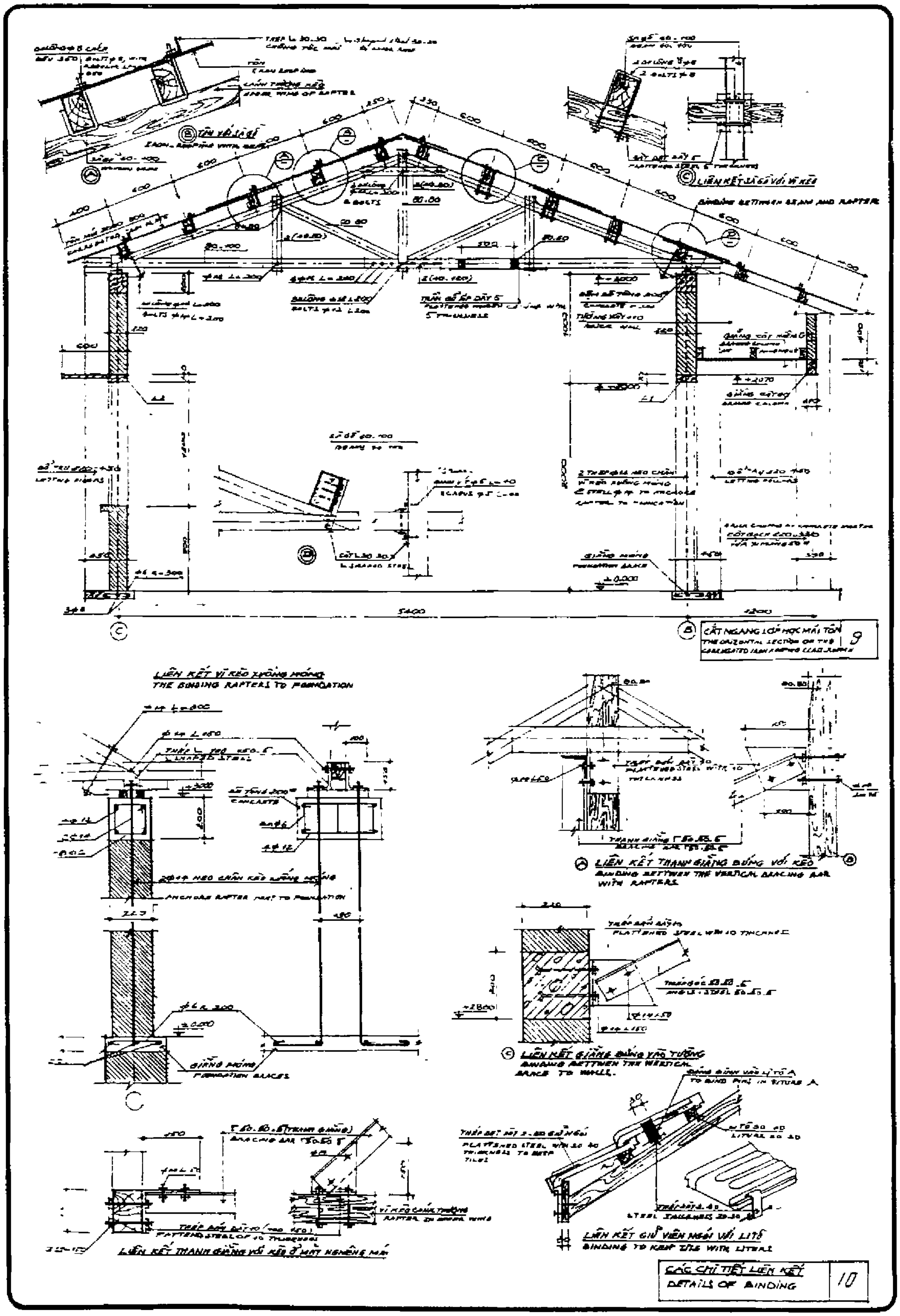
PLANS, SECTIONS AND ELEVATIONS OF TYPICAL SCHOOL BUILDING – VIETNAM



TYPICAL CROSS-SECTION AND STRUCTURAL DETAILS – VIETNAM

Comment

Need to review design and construction details to add variety and options to existing technology.

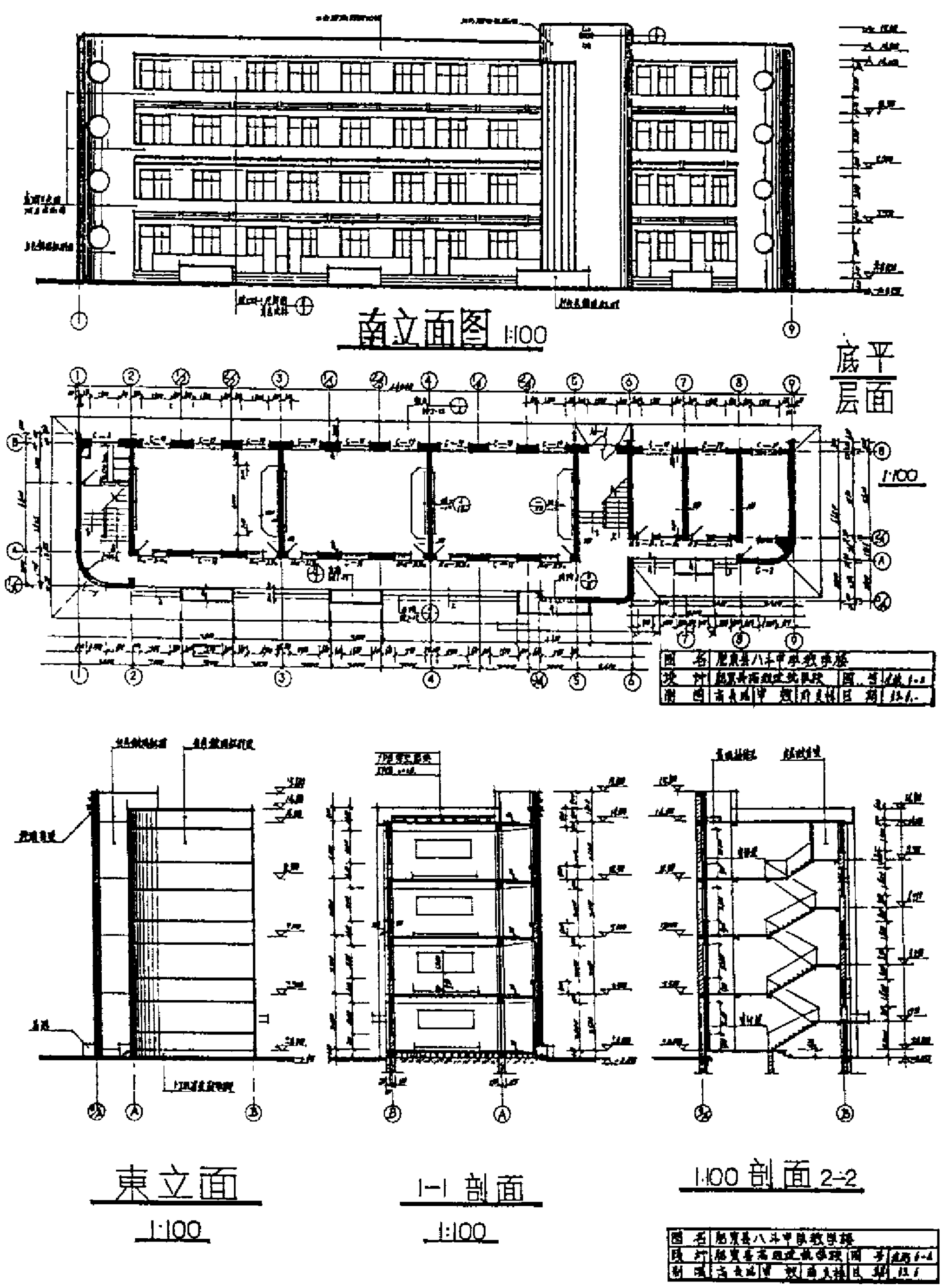


4.7.4 China

Comments:

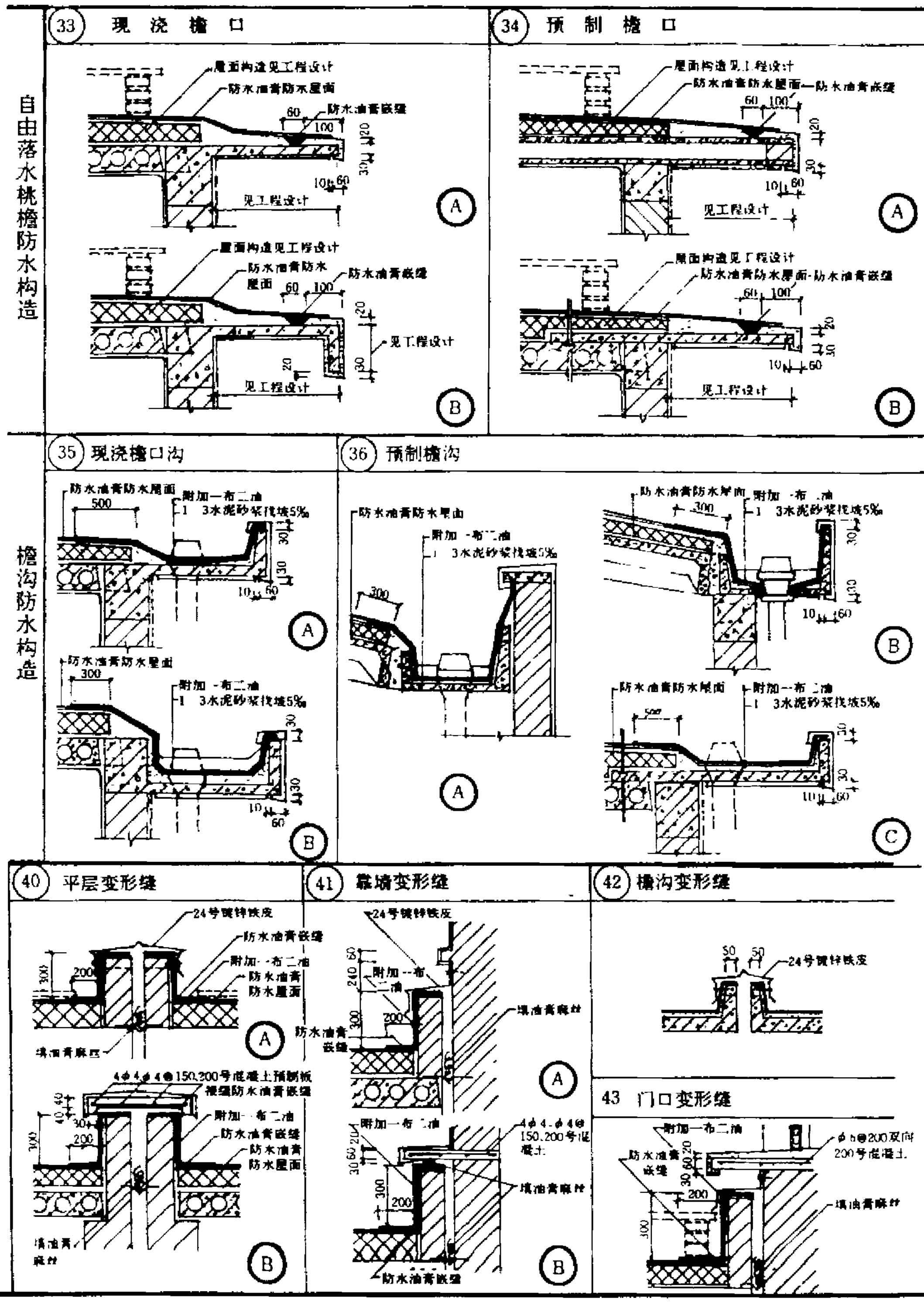
- Generally good construction techniques and details.
- Need to review waterproofing techniques at roofs and walls are installed as detailed.
- Maintain quality construction superintendance.

FLOOR PLAN, ELEVATIONS AND SECTIONS OF A TYPICAL CHINESE SCHOOL BUILDING



Typical roof details: The following details are extracts from the publications of the China Building Technology and Development Centre (CBTDC), Beijing.

TYPICAL CONSTRUCTION DETAILS FOR CHINESE SCHOOLS



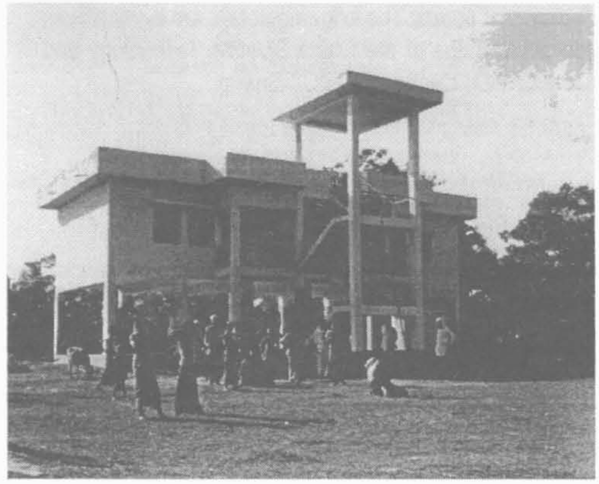
4.7.5 *Bangladesh*

(a) *Pucca Construction*

- Concrete frame.
- Brick infill.
- Concrete roof slabs or pre-cast.
- Concrete roof tiles, (or quarry tiles). (Prefer insulated blocks).

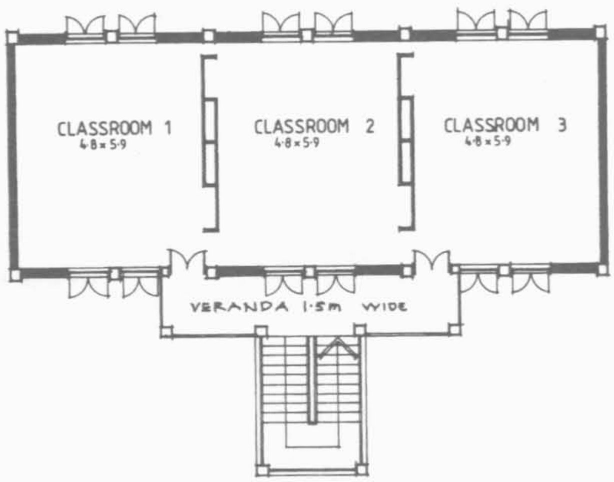
Notes:

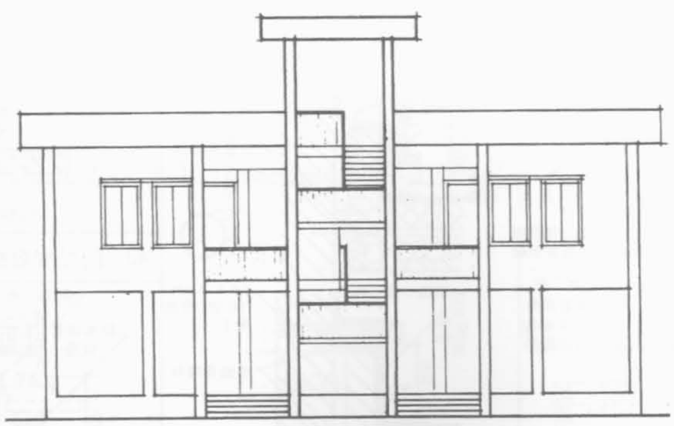
- Lack of insulation in roof structure.
- Transfer of radiant heat to interior.
- Cost.
- Watch that adequate cross ventilation is provided.



TYPICAL BANGLADESH 'PUCCA' SCHOOL BUILDING

FLOOR PLAN AND CROSS–SECTION THROUGH TYPICAL BANGLADESH 'PUCCA' SCHOOL BUILDING

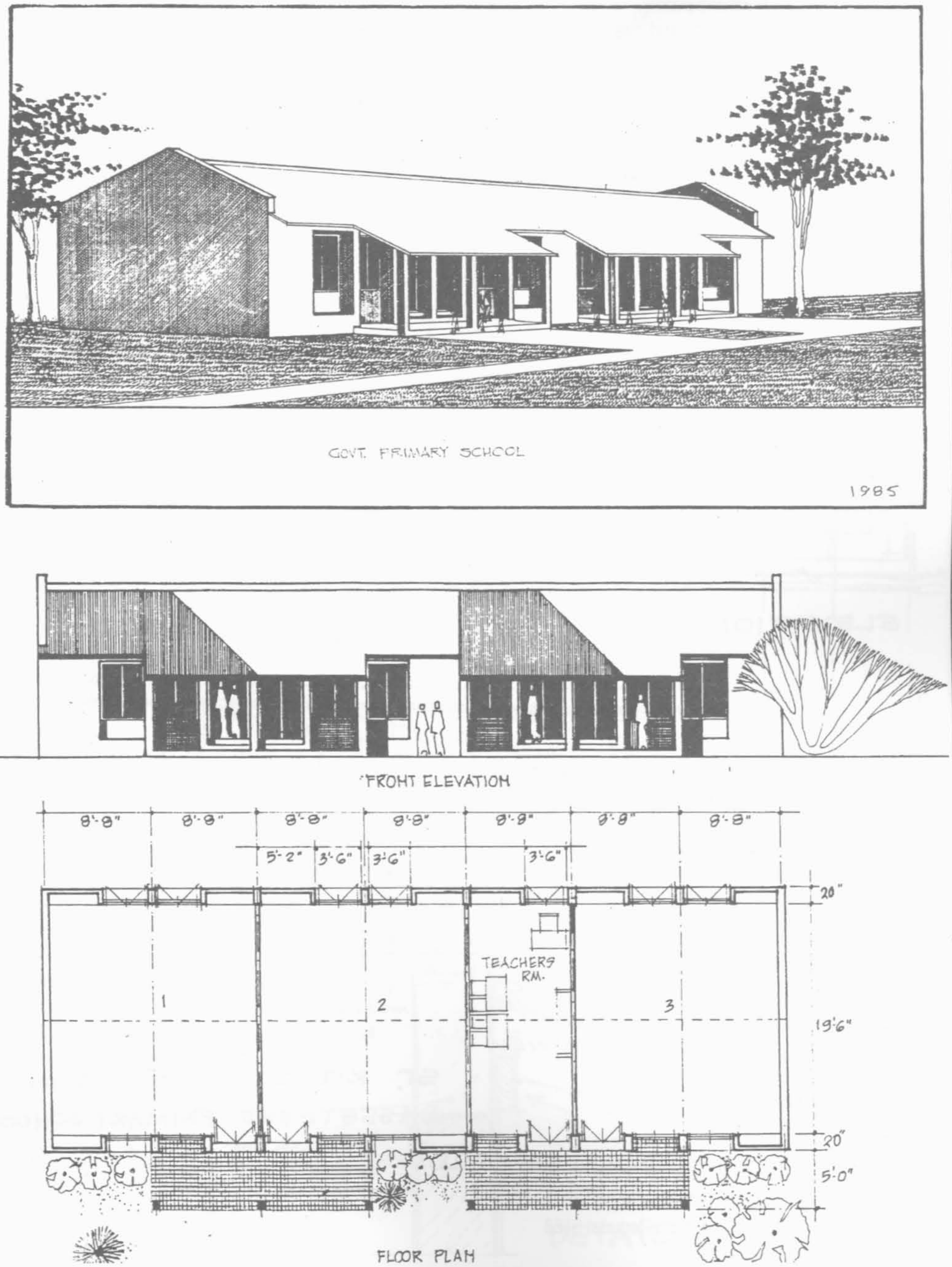




(b) Semi-Pucca Construction

- Need for extra truss at end brick walls.
- Brace roof framing in roof plane.
- Provide lateral support between trusses.
- Check spacing of purlins: Reduce if possible.

SKETCH VIEW, ELEVATION AND FLOOR PLAN OF TYPICAL BANGLADESH "SEMI-PUCCA" SCHOOL BUILDING

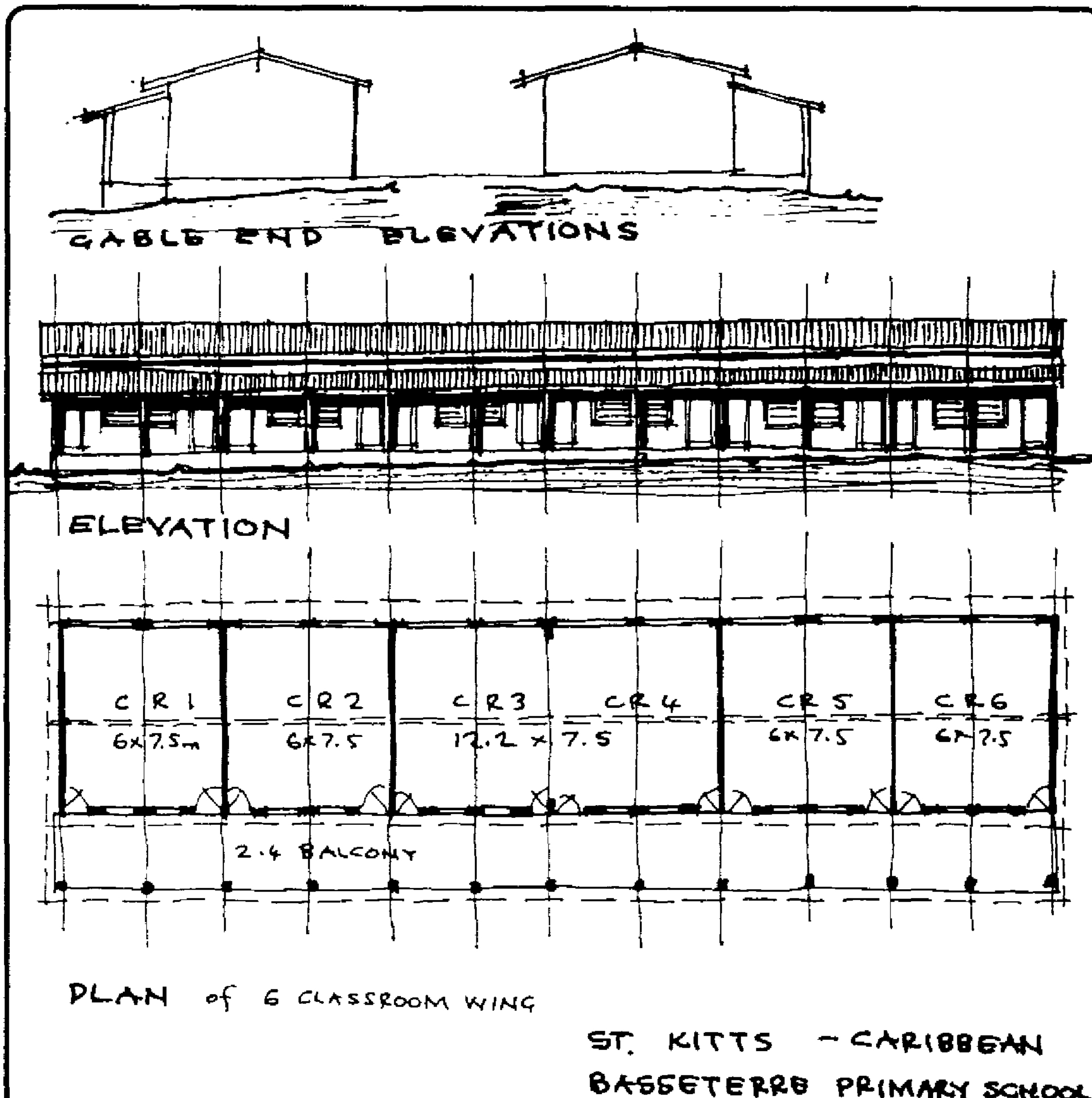


4.7.6 Caribbean

- Load bearing.
- Brick walls
- Timber roof trusses.
- Purlin beams
- Rafters and tiles on battens or sheet roofing on purlins.

Decide:

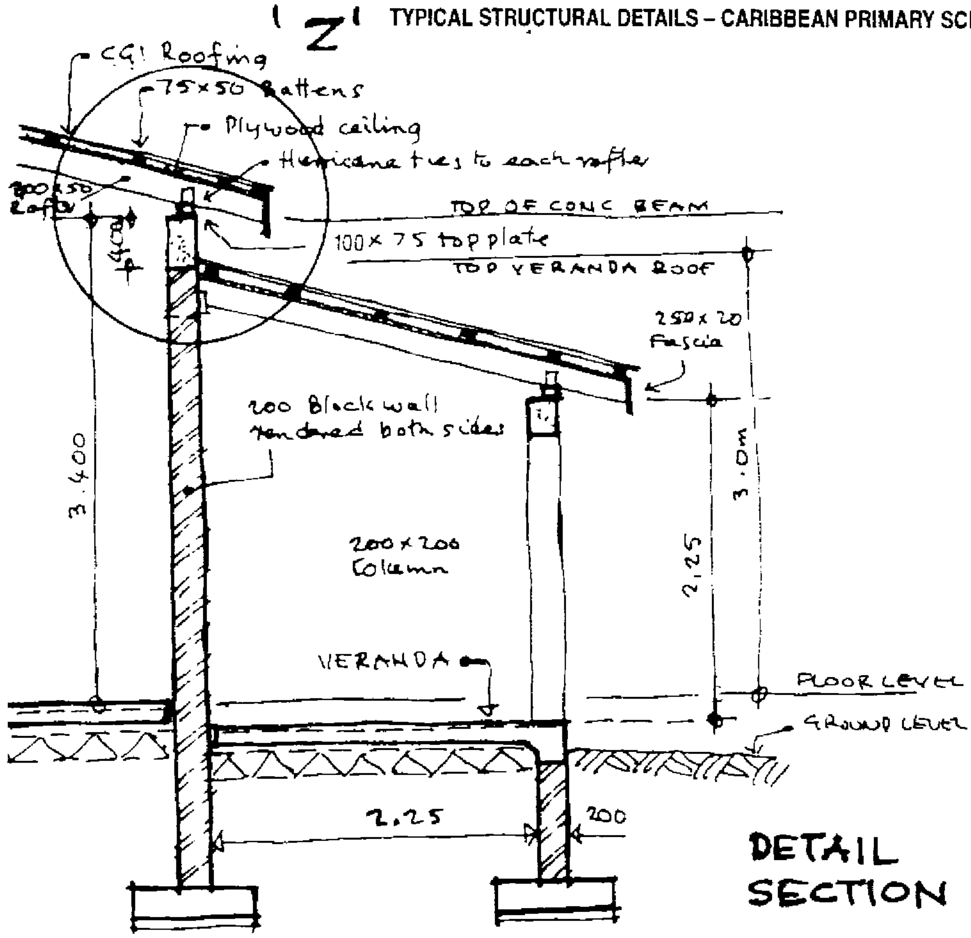
- Prefer ceilings on underside of rafters.
- Expose truss and purlins.
- Take care spacings and size of battens.
- Take care fixing roof sheeting



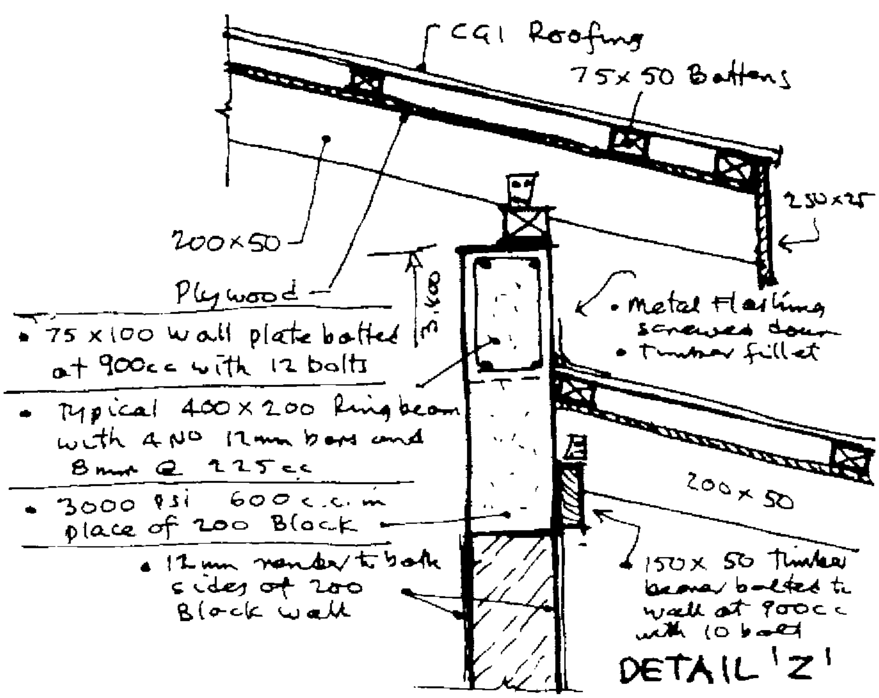
TYPICAL CARIBBEAN PRIMARY SCHOOL – PLAN AND ELEVATIONS

Plan adapted from UNESCO Mission Report on Caribbean Sub-Region on Program Request 5168 November 1991 by James Lewis.

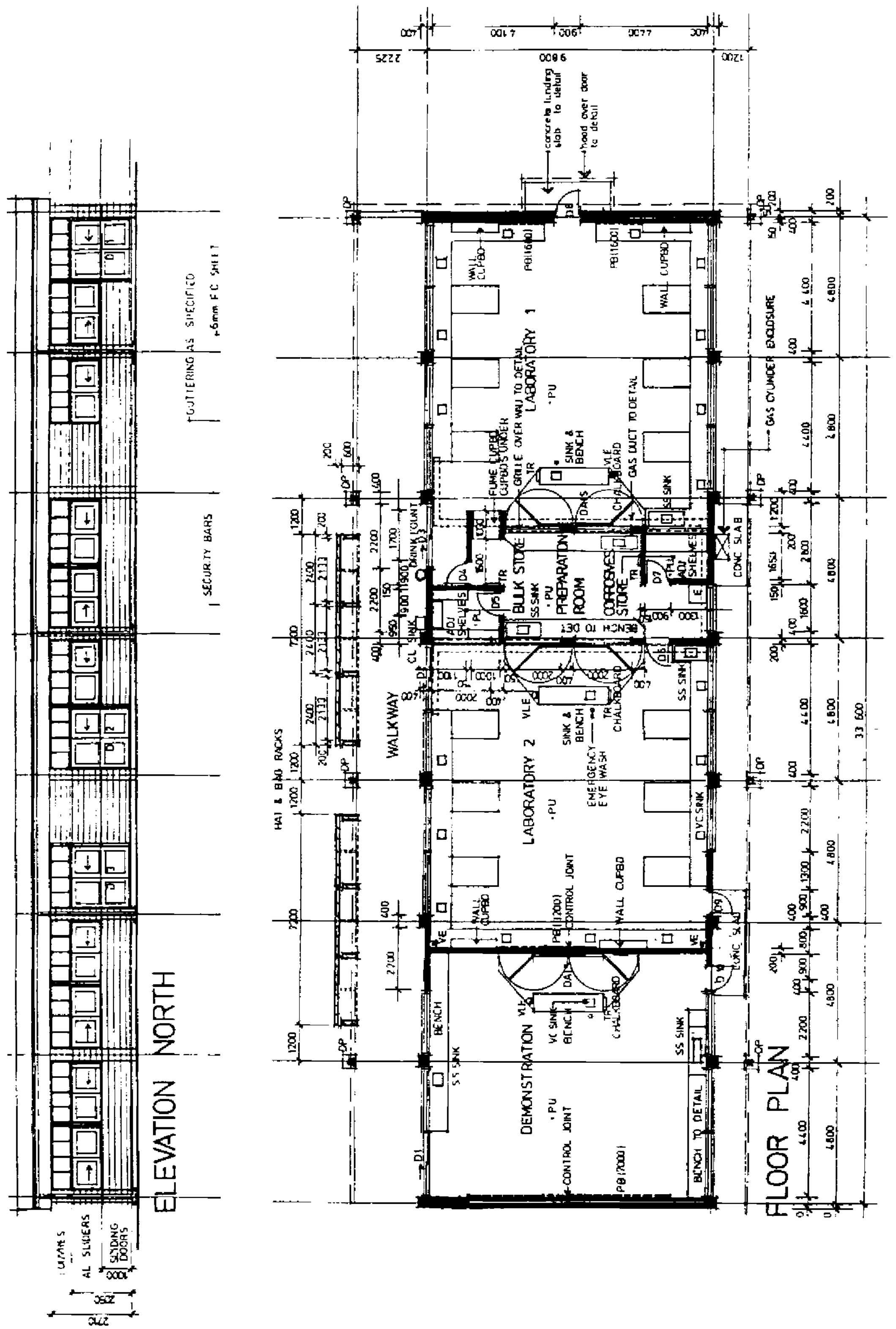
TYPICAL STRUCTURAL DETAILS – CARIBBEAN PRIMARY SCHOOL



ST. KITTS – CARIBBEAN
BASSETERRE PRIMARY SCHOOL



4.7.7 Australia

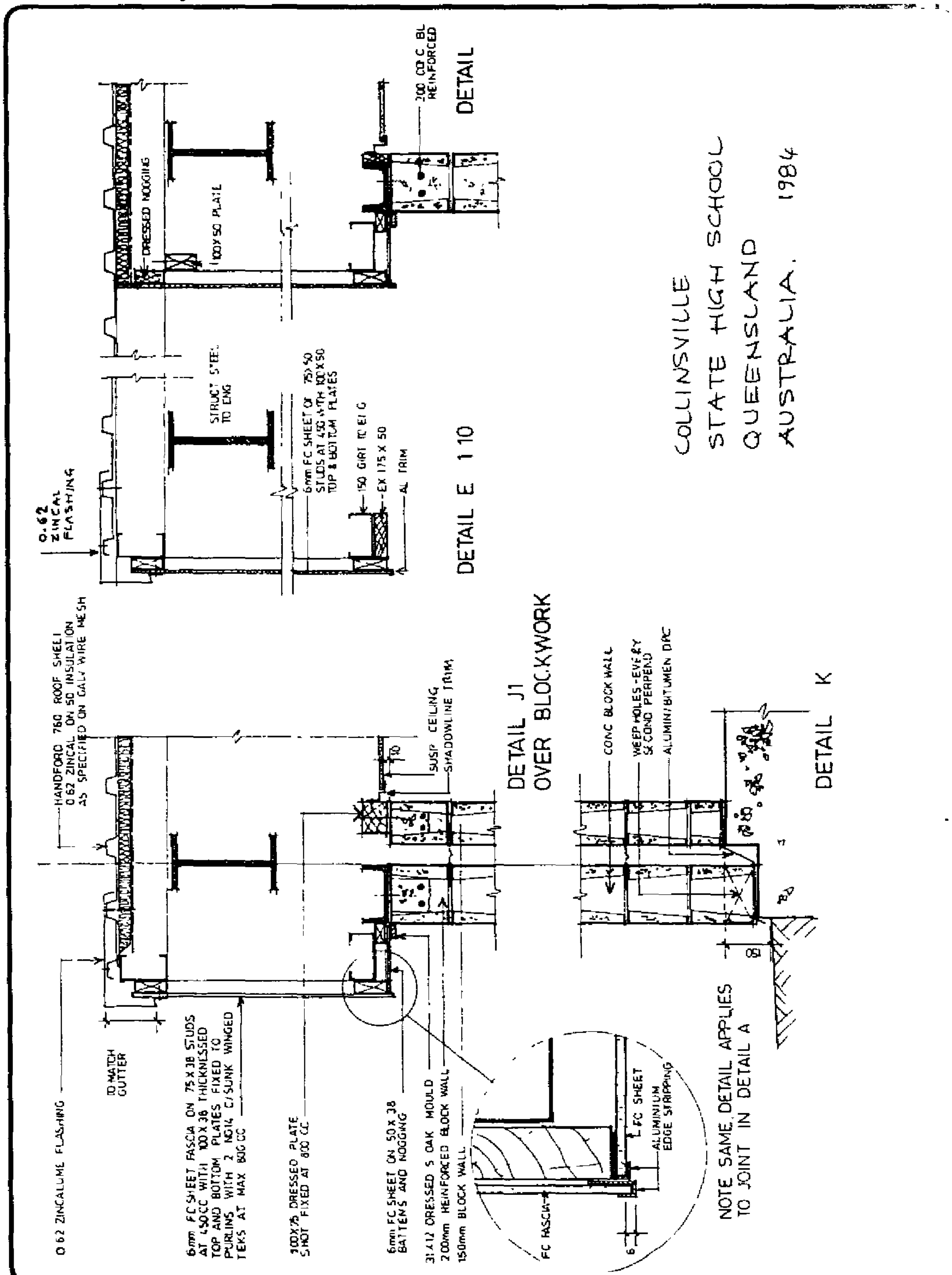


School buildings are built in different styles

- Roof pitch 5° to 15°.
- Concrete foundations.
- Concrete floor slab.
- Steel portal frames at 30 c c on pad foundations.
- Timber roof purlins, 150 x 50 @ 600 c c 170.
- Corrugated or pan type galv. steel roof sheeting.

Notes

- Foundation sizes to be adequate.
- Brace roof framing in plane of purlins.
- Fix steel ties between portals.
- Purlins (steel or timber).
- Bracing to portals in each plane.
- Purlin spacing too great
- Fixing of roof sheet to purlin.



4.7.8 *Tonga*

TONGA TYPICAL SCHOOL BUILDING

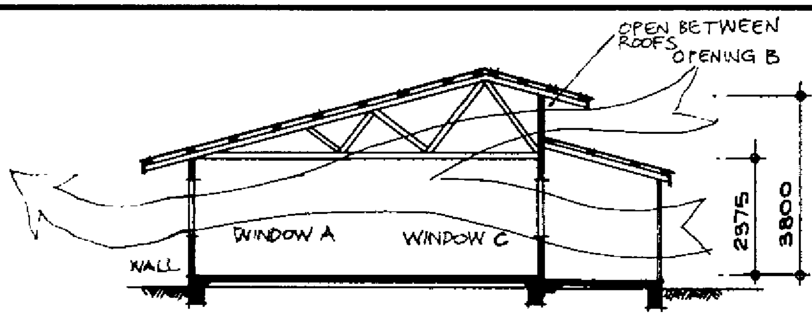
- Concrete floor slab
- Prefab wall frames with plywood wall cladding
- Prefab roof trusses
- Purlin Battens
- CGI roof sheet

- Wall panels 2.4 x 1 2 prefabricated and bolted.
- Roof trusses prefabricated and bolted.
- Factory Produced Components
- Note good cross ventilation.

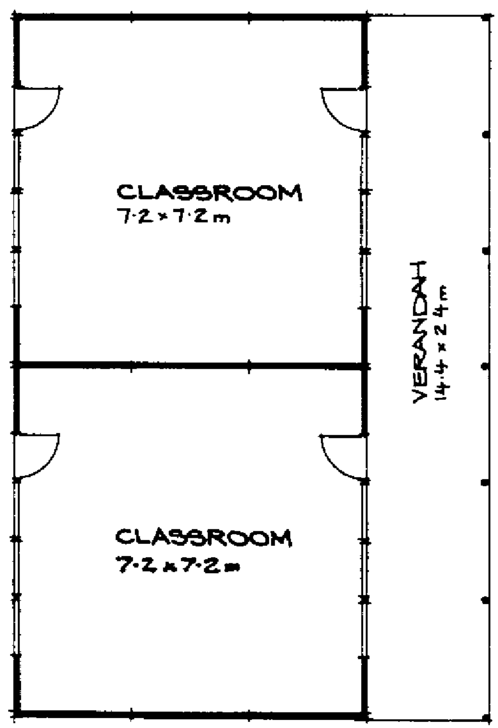
If opening at 'B' is open then internal pressure is sharply reduced.

If opening closed by windows then internal pressure adds to suction force.

- Check size/spacing or roof battens
- Check fixing of roof sheeting
- Check bracing in wall plane
- Check bracing in roof plane

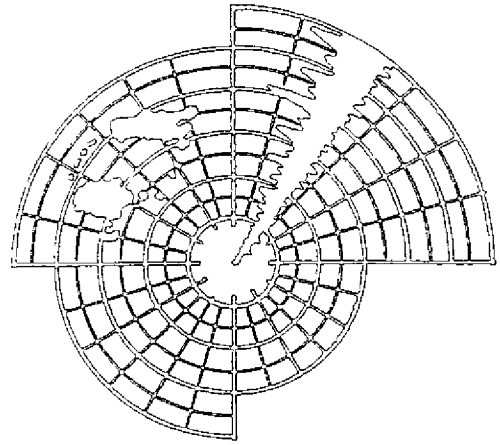


SECTION



PLAN - 2 CLASSROOMS

PREFABRICATED PANEL CONSTRUCTION.
TONGA - MINISTRY OF EDUCATION



5 INTRODUCTION TO WIND LOADS

CONTENTS

5.1 GENERAL COMMENTS

Before looking at details of buildings and how they should be designed and built or rehabilitated in order to withstand cyclonic winds, there must be some understanding of what forces a cyclone is going to apply to buildings as a whole, or to a component of the building, roof, wall, window or even just a barge flashing.

Unless designers have a quantitative estimate of the force on each part of the building it is impossible to even guess the number of screws or nails needed to fix a roof down, what size glass is needed in a window, or to be confident that the building being designed will survive a cyclone.

Cyclonic wind forces on a building act predominantly upwards and horizontal. A building must have a structural system, which will remain intact under these loads and transmit the wind forces to the ground through its structural members, connections and cladding without failure of these elements.

To provide structural adequacy and integrity during cyclonic winds the following properties must be designed and built-in throughout the structure

These properties can be thought of as "The ABC of Cyclone-Resistant Construction".

A **Anchorage**

Every part of the structure **MUST** be anchored back to some secure point which is capable of resisting the applied forces This is generally the foundations

B **Bracing**

Every part of the structure MUST be held rigid so it cannot tilt, slide or rack.

C **Continuity**

Every part of the structure **MUST** be properly connected in a continuous line from roof cladding to the foundations.

If one takes the analogy that a building is a chain with a load applied at one end, then if a single link is missing or of inadequate strength, the chain will not support the load This chain must extend from the point of application of the wind pressure down to the foundations

It is important to remember this ABC of wind resistance, i e , ANCHORAGE, BRACING and CONTINUITY The roof framing should be anchored together, it should also be anchored to the supporting walls. The roofs should be braced to prevent lateral twisting, walls should be braced and stiff enough to resist loads, and continuity of fixings should be maintained from the roof cladding down to the foundation level This will enable all of the building elements to carry out a "load sharing" role in resisting forces.

5 2 WIND LOADS

The selection of design figures for loads due to wind is a fairly involved process, particularly if an accurate figure for the wind load at any instant is required.

It is made complex by the following factors:

i The gustiness of the real wind particularly under storm conditions

Variations in gust speed during the peak 10 minutes of a cyclone can show dramatic changes in direction each few seconds, combined with rapid fluctuations in wind speed from say 20 kph to 200 kph from minute to minute or from second to second

These dynamic effects place great dynamic stresses on the structural cladding especially at the edges and corners of roofs and walls.

ii The load on any building is greatly affected by the shape of the land and the number and shape of any projections from the land, (i.e , trees, ridges, escarpments, other buildings, etc.) on the windward side of the building under consideration and to a far lesser extent the land shape etc on the leeward side

iii. The load on a particular building or part of that building can vary widely with fairly small variations in the shape of the building.

iv. The wind direction that can be expected during a cyclone cannot be predicted with any certainty, the factors will obviously be different on any one building for a different wind direction.

Therefore the problem of accurately predicting the exact maximum likely wind force on any building is extremely difficult and leaves the designer to follow code provisions for these loads and forces.

Codes are formed from the results of research both in the field and in various laboratories

One can be fairly certain that if a building is designed to withstand the maximum forces laid down by the Code it will not suffer serious damage in a cyclone or other wind storm that could reasonably be expected to occur.

Further detailed information on wind forces, pressures and overall wind loads are set out later in this study where tables of likely loads are provided.