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ABSTRACT
        A school construction guide offers key personnel in school
development projects information on the complex task of master planning and
construction of schools in Australia. This chapter of the guide provides
advice on school building design issues, such as the fundamentals of good
design and designs that accommodate change, issues affecting building
arrangement and arrangement variations, recycled buildings, relocatable
buildings, energy considerations, building services, and security issues.
Specific topics include the factors that promote building durability; school
design that addresses curriculum and enrollment patterns; building
arrangements that accommodate terrain, climate, security, and the disabled;
design considerations that reflect staffing needs; and design considerations
that take advantage of various forms of heating, such as solar and water
heating, and maximize the use of shade. Heating and lighting topics also
cover design issues involving windows, insulation, lighting, and ventilation.
(GR)

School Buildings

Planning, Design and Construction

John H. Odell FRAIA ASTC
in association with the
Association of Independent Schools of NSW Ltd

PRINCIPLES OF GOOD SCHOOL BUILDING DESIGN 3

School Buildings, Planning Design and Construction is presented
in a ring binder with 8 booklets. The document is available only as
a complete set

A Guide Document

for School Councils, Boards and Committees, School Principals and Staff and Construction Professionals

Author - John H Odell FRAIA ASTC

Introduction to

School Buildings – Planning, Design and Construction

Good school buildings do not just happen. Thought and consideration must be given to the needs of the users of the building and to the available resources. The persons responsible for building the school should have considerable experience or draw on the advice of those who have.

For a building to be satisfying and successful it must provide shelter, have durable construction and finishes, be aesthetically pleasing and appropriate to its use. A well-planned school will incorporate the following points:

- buildings and grounds will satisfy and support both short and long-term requirements
- curriculum demands including requirements for registration by authorities will be met
- site development will not be haphazard and each project will pave the way for the next
- building design will be flexible to cater for as yet unknown future requirements
- building will be cost effective - and in the long term the school will avoid unnecessary expensive recovery action
- good building design will encourage a high quality educational environment
- pre-planning of maintenance requirements will assist in reducing operating costs

This guide is designed to assist key personnel in school development projects with the complex task of master planning and construction of schools.

Individual chapters in this guide may be distributed to relevant key personnel as appropriate to their specific interest and responsibility.

Each chapter is a separate booklet with chapters 7 and 8 bound together in one booklet and chapter 9 in booklet 8.

The chapters:

1   Developing a Master Plan for Your School

2   Making the Most of Your School Site

3   Principles of Good School Building Design

4   Purpose Designed Facilities

5   Construction Methods and Materials

6   Managing the Construction Process

7   Technology and Educational Buildings

8   Managing School Buildings

9   Appendices

This Guide aims to:
- demonstrate the necessity for school communities to produce comprehensive master plans for the development of their school
- encourage school staff and boards to be involved in the development of school facilities and to draw on the wider experience of the community during that process
- outline planning processes and techniques that will lead to greater creativity in school design with greater efficiencies and productivity in the construction process
- help school staff and board members in their dealings with professionals in the building industry, and vice versa
- encourage excellence in school facilities
- maximise potential of limited resources to achieve desirable outcomes
- provide advice on how to determine whether a particular facility is vital to a school
- provide examples of excellence in school building and planning
- provide a comprehensive list of contacts, resources and references.

Who should read this Guide:
- All school council/board members
- Principals, bursars and other key staff members
- All members of school building and planning committees
- Administrators in control of school building projects
- Construction industry professionals, especially school architects

Contents of Booklet 3

3. Principles of Good School Building Design

3

Principles of Good School Building Design

3. Principles of Good School Building Design

The master planning team will set the broad parameters for the design of the school building. The professional consultants, such as architects and engineers, will develop the design in terms of the brief, the environment, legislation and codes.

Although the planning team will not be involved in the detailed design of the buildings, they must be able to participate intelligently in the following design activities:

- supply the necessary information to the designers
- understand the responses of the design team
- evaluate the design presented in the light of the brief.

The aspects of school building design covered in this chapter are:

- fundamentals of good design (3.1)
- designing to accommodate change (3.2)
- issues affecting building arrangement (3.3)
- building arrangement variations (3.4)
- recycled buildings (3.5)
- relocatable buildings (3.6)
- energy considerations (3.7)
- building services (3.8)
- Security, buildings, personnel and property (3.9)

> *Achieve significant savings by focusing on real needs*

3.1. Fundamentals of good design

A common plea is that excellence equates to higher-than-necessary costs. The irony is often the reverse – the "it-will-do" philosophy

often leads to greater costs through wastefulness of building area, rooms, and the use of materials which are not quite suitable.

Significant savings can be achieved if careful thought is given to planning at the very early stages, focusing on real needs rather than desires and dreams alone. Major factors to be addressed are as follows:

- The needs of the users (3.1.1)
- The significance of educational decision making (3.1.2)
- Space standards that reflect educational requirements (3.1.3)
- A building designed to last (3.1.4)
- Incorporating flexibility without sacrificing appropriateness (3.1.5.)
- The building as a healthy and safe environment (3.1.6)

3.1.1. The needs of the users expressed in design brief

It is important to prepare a sufficiently precise design brief. The brief is crucial, as it guides the designer regarding space and equipment requirements and their relative priorities. If the design brief is not accurate the outcome will not satisfy the users.

A building exists primarily to achieve an objective. A school building is not an end in itself but a means towards the fulfilment of the needs of the users and decision makers. Hence, a brief should include all legitimate points of view early in the design process. Consequently, the users and their needs and aspirations must be identified. The users are:

- students
- teachers
- parents
- members of the community
- other schools.

A clear statement of agreed priorities formulated at the beginning of the project will minimise further compromises later. Possible conflicts in priorities may include:

- teachers want classrooms - parents want a multi-purpose hall
- students want playing fields - staff want a library
- administrators want classrooms - staff want staff rooms

These are all fundamental requirements of a school, but the order of priority has a definite relationship to its viability and excellence. Classrooms, for example, pertain to short-term financial viability, libraries pertain more to educational excellence. Educational excellence pertains to the long-term viability of the school.

3.1.2. The role of educational decision makers

The design must reflect legitimate local educational decision-making and thinking as well as take into account

economic, political and social factors. There are three basic decision-making groups concerned with educational building:

- policy makers at all levels and administrators, both internal and external to the school,
- educational and building professionals and specialists
- staff and users (students and parents).

Each of these groups contributes in different ways to the development of the brief, and each must be successfully integrated into the briefing process.

The politicians and government administrators have an impact on educational building by means of capital funding. Their decisions and policies need to be taken into account in preparing and developing the brief. Likewise the policy makers on the School Council and School administrators.

Education and building professionals and specialists contribute their research on improving environments for education. Those responsible for preparing the brief should ensure that the latest information is being used. Appendix 9.7 lists relevant documents. The OECD documents dealing with the issues of Learning Environment and Technology in Australia (LETA) are of particular relevance.[1][2]

While current research is important, the staff and other users' (students, parents and community) perception of excellence in education must also be considered. There is little point in following the latest international trends if the local staff and community are more strongly committed to another approach. The perceptions and intentions of the users will greatly affect whether the implemented design will, in fact, "work".

3.1.3. Space standards must reflect educational requirements

Broad space standards (for example, expressed as a number of square metres per pupil) are the most convenient way of ensuring that educational requirements are met. They must be applied, however with due consideration to local conditions and requirements.

Space standards give a rational basis for the allocation of resources and provide a common vocabulary for briefing, design and planning. They need not be expressed in great detail, but can be included as recommendations, allowing for flexibility in their application.

The Commonwealth Government has established eligibility standards for capital grants, referred to as the "area standard" or more commonly the "globals". They represent maximum measures. At the time of writing the standards were as follows:

COMMONWEALTH GOVT.
GLOBAL AREA
CALCULATION

	Nos	m^2	m^2
Primary school	100 × 6.13	=	613
Secondary School	200 × 9.75	=	1950
Total area for 300		←	2563

This is the area of all enclosed spaces together with attached external covered areas ÷ 3.

This limitation applies only if a Commonwealth Capital Grant is being applied for.

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[1] *New Technology and its impact on Educational Buildings — Organisation for Economic Co-operation and Development Conference Adelaide - 1994*

[2] *Redefining the Place to Learn - Susan Stuebing OECD - PEB, 1994*

	sq m/pupil
Primary schools	6.13
Secondary schools	9.75
Boarding schools	24.00

This area is exclusive of walls. External covered walkways and areas having a rigid and waterproof cover that are enclosed on up to three sides are included but at one third of the total area.

NSW has an Interest Subsidy scheme that also applies global standards for eligibility, which is discussed in further detail in Appendix 9.9.

In 1980, the Commonwealth Schools Commission published a series of booklets on school planning, among them "Planning School Building Projects".

Incorporated here are some area guidelines for cost study purposes. They are provided here as a rough guide. Current educational thinking may require a modification of the relative sizes of these functional spaces. Indeed NSW, with the recent changes in curriculum, no longer has a subject called "Home Economics".

PRIMARY SCHOOLS

	Area per pupil - sq m	
	min	max
Library Resource area	0.4	0.5
General Learning area	2.6	3.5
Physical Education	0.35	0.45
Administration	0.4	0.7
Pupil Amenities	0.25	0.7
Travel/Engineering	0.6	1.2

SECONDARY SCHOOLS

Library Resource area	0.6	0.7
General Learning area	1.7	2.5
Physical Education	0.7	0.9
Administration	0.7	1.0
Student Amenities	0.45	1.0
Travel/Engineering	1.3	2.0
Science	0.65	0.85
Art	0.25	0.45
Industrial Art*	0.6	0.75

|		
Home Economics*	0.35	0.55
Music	0.15	0.25
Tiered Lecture Theatre	0.7	1.0

*These are now described as Technology and Applied Studies or abbreviated to TAS.

3.1.4. The building must be built to last

"Durability" and "Flexibility" are not terms in conflict. Durability in this context refers to the external elements such as walls, roofs and floor structure, while flexibility refers to the internal configuration of dividing walls and partitions. Flexibility incorporates the capacity of the internal arrangements of the building to adapt to change.

Factors promoting durability are:

- well-constructed foundations which limit damage due to cracking of walls
- enduring materials which resist decay due to rotting (in the case of natural materials such as timber and canvas, fretting of masonry due to water penetration and freezing in cold climates)
- protection from ultraviolet radiation by means of wide eaves or sun shades
- protection from excessive moisture by eaves
- quality external surface finishes where required. Avoid applying a finish that is less durable than the material to which it is being applied unless a decorative finish is necessary. Rather, choose a base material having acceptable natural colour.
- quality window and door construction designed to resist weather penetration, wind damage, heavy and careless use and wilful damage and abuse
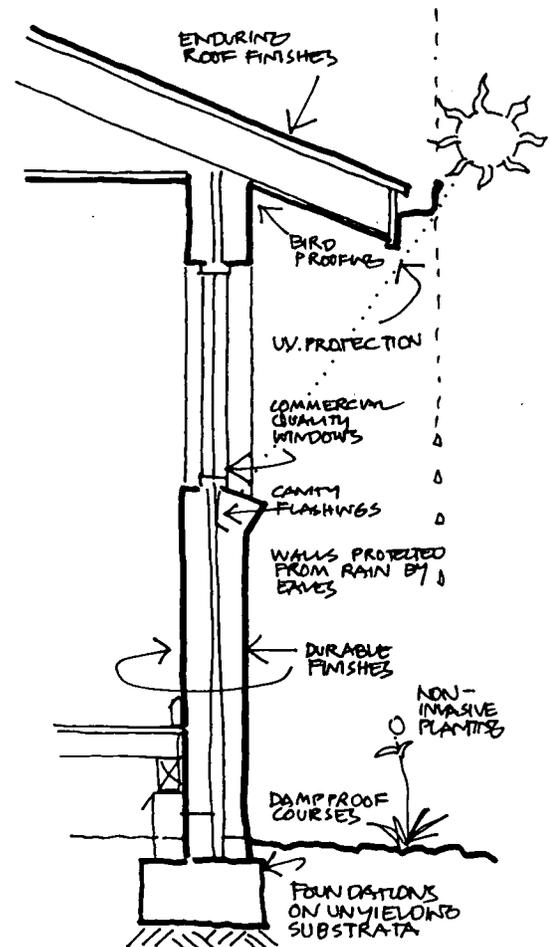
DURABLE EXTERNAL WALLS & ROOFS

3.1.5. Building designed for flexibility without sacrificing appropriateness

A school must be able to cope with short-term changes in group sizes, teaching and learning methods, and educational activities. It should also be able to cope with unforeseen changes required for instruction, new technology or evolving demand. School buildings should be flexible as well as functional. However, flexibility should not overshadow appropriateness. Spaces should be well-defined and suited to their intended use.

A flexible building will permit variations in its use without requiring significant modification to external walls. Internal walls will be able to be removed and/or relocated without affecting the

structure, the roof or external walls, and services such as the power and water distribution systems.

Some examples of where flexibility can be useful:

- General Purpose Learning Areas (GPLA) used initially as Special Purpose Learning Areas (SPLA) for Science and Art until more permanent facilities are available
- GPLA used initially as library or for administration. Equipment can be installed and moved when new facilities are available.
- Science room shared with Art - both require benches, water and drainage facilities. When the school requires science room full time, an Art room can then be provided.
- Open covered area used initially as assembly/multi-purpose hall.
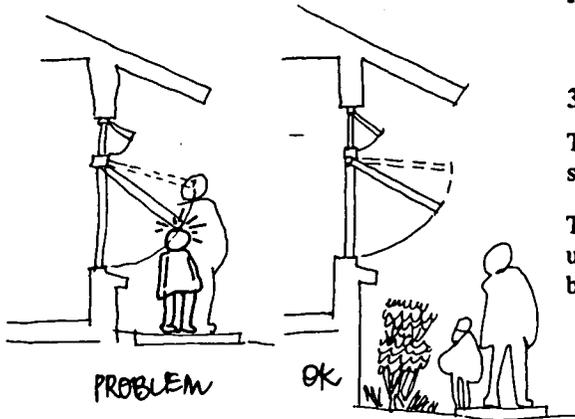
3.1.6. The building as a healthy and safe environment

The building must offer a healthy and safe environment which supports and enhances the teaching and learning environment.

The latest findings on the influences of the indoor environment on users should be incorporated in all new and refurbished school buildings.

PROBLEM   OK

3.2.   Designing to accommodate change

Schools must be able to accommodate changing needs, such as in curriculum, enrolment patterns, community and commercial uses. Therefore, the school building should be flexible in layout and structure to allow for these changes.

3.2.1. Changes in curriculum

Schools need to be flexible in layout and structure to accommodate significant changes in curriculum resulting from changing government requirements, developments in educational practice and new technology. Some examples of changes:

- diminishing demand for language laboratories
- greater demand for technology subjects
- changes in teaching of technology
- smaller class rooms for seminar activities
- increased number of subjects being offered
- changes in way subjects being offered such as links with TAFE, use of correspondence or Open Learning facilities
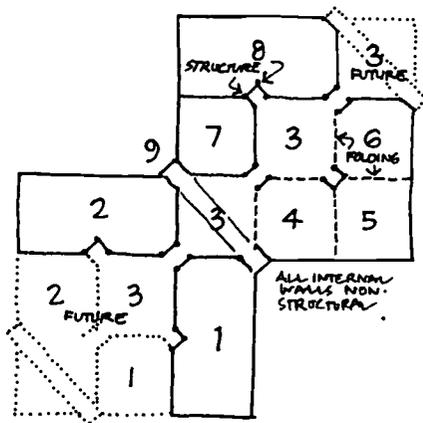
ENTRY	9
SCIENCE LABORATORY	8
STUDENT TOILETS	7
METALWORK	6
WOODWORK	5
ART/CRAFT	4
TRAVEL	3
STAFF FACILITIES	2
ADMINISTRATION	1

A flexible approach to designing a school devised by Paul Archibald P/L Architects - this principle was applied at Plenty Valley Christian School, Vic

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3.2.2. Changes in enrolment patterns

Changes in enrolment, such as an increase in demand for secondary spaces and reduced demand for primary, are not easily catered for unless changes in room sizes, and accessibility to special services and rooms have been allowed for in the initial design. Where such changes can be anticipated, they should be included in the planning process.

If space is provided for the maximum enrolment, there may be significant periods of excess capacity. Therefore, it is in the school's best interest to plan for a combination of flexibility and possible future growth.

Examples of ways changes in needs can be accommodated:

- dual use of rooms, e.g. library in GLA
- plan some of the facilities to be on the periphery of the school site in buildings designed as dwellings but adapted for school use temporarily. See Aberfoyle Park High School in Adelaide (1984).
- a relocatable classroom attached to the permanent facility. Design the building so that the link space becomes a useable space in the long term when the relocatable room has been removed. Refer Chapter 4 in which a school in Woori Yallock, designed by Clarke, Hopkins and Clarke, is illustrated.
- use classrooms for administration or evening classes

Many creative ideas have been developed that allow for flexibility in school buildings. See sections 3.4 and 3.5 for examples.

3.2.3. Uses other than for education

School buildings are very expensive facilities that are often under-utilised. Increasingly schools are beginning to open their facilities to community use, usually on a commercial basis. For example an increasing number of schools are running adult education classes in the evenings.

School facilities that can also be used by the community include:

- gymnasium
- multi-purpose hall
- kitchens - food science areas
- technology rooms
- computer rooms

When designing the school, allowance should be made for these spaces to be used after hours. Consideration needs to be given to: access, parking arrangements, security on a separate circuit, capacity to lock-off areas from public access after hours use, external lighting, access to telephones and toilets.

Part or all of the school may be planned for an eventual conversion to a tertiary facility or other use. A number of schools in Adelaide are planned in buildings designed eventually to revert to houses. [1]

WOORI YALLOCK PRIMARY SCHOOL
VICTORIA
CLARKE, HOPKINS & CLARKE, ARCHITECTS

LEGEND
1 GENERAL PURPOSE LEARNING AREA
2 WITHDRAWAL ROOM
3 STAFF PREPARATION
4 W.C.
5 BAG STORAGE
6 PRACTICAL ACTIVITY
7 STORE

LEGEND
8 KITCHEN
9 LIVING ROOM
10 DINING
11 BATHROOM
12 LAUNDRY
13 BEDROOM
14 GARAGE

MODULE AS CLASSROOM UNIT

MODULE AS HOUSING

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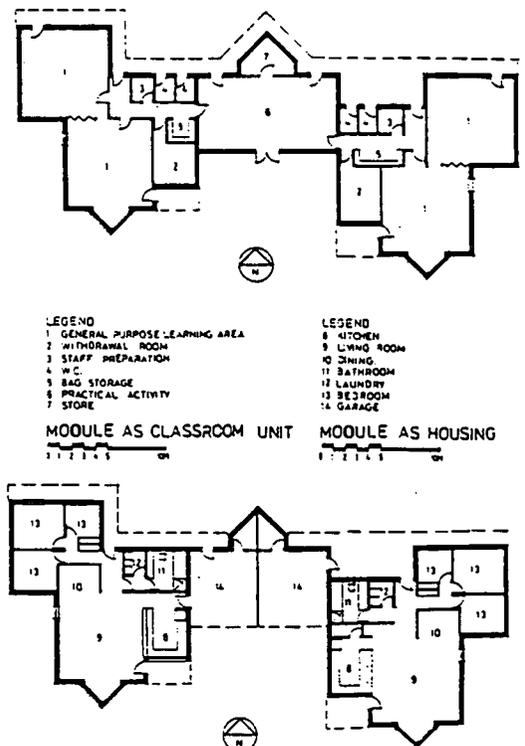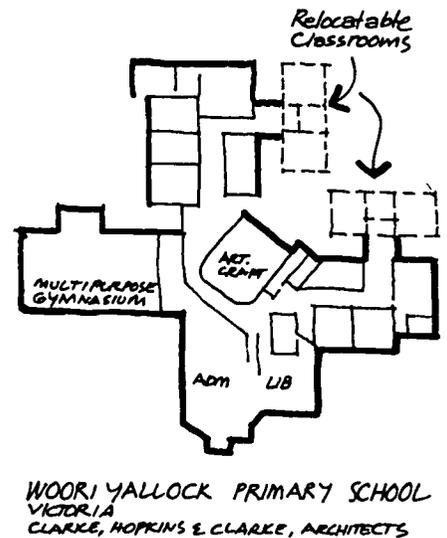
[1]   PEB Exchange October 1992 (OECD Publication)

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TYPICAL WORKSHEET FOR FORECASTING ROOM REQUIREMENTS

Grade	'93 Class	Nos	Total	'94 Class	Nos	Total	'95 Class	Nos	Total	'96 Class	Nos	Total
kinder	2	25	50	2	25	50	2	25	50	2	25	50
1	2	30	60	2	30	60	2	30	60	2	25	50
2	2	30	60	2	30	60	2	30	60	2	30	60
3	1	30	30	1	30	30	2	30	60	2	30	60
4	1	30	30	1	30	30	1	30	30	2	30	60
5	1	30	30	1	30	30	1	30	30	1	30	30
6	1	30	30	1	30	30	1	30	30	1	30	30
7	2	32	64	2	32	64	1	32	32	1	30	30
8	2	32	64	2	32	64	2	32	64	1	30	30
9	1	32	32	2	32	64	2	32	64	2	32	64
10	1	32	32	1	32	32	2	32	64	2	32	64
11	1	25	25	1	30	30	1	32	32	2	25	50
12	1	20	20	1	24	24	1	28	28	1	30	30
Prim	9		290	10		290	11		320	12		340
Sec	8		237	9		278	9		284	9		268
total			527			568			604			608

Anticipated Room Requirements in 1996

From the above tabulated forecast figures of enrolment the following calculations can be made. The formulae are similar to those used in assessing room requirements by Block Grant Authorities.

Primary   12 classrooms (1 per class)

Secondary   9 x 1.4   =   12.7 say 13

(The formula anticipates about 70% usage – 1.4 approximates the inverse of 0.7)

Of these GPLA (9 x 0.7) =   7

SPLA (Special purpose rooms)   6

BEST COPY AVAILABLE

3.3. Issues affecting building arrangement

The school structure, the terrain, the climate, security and consideration for the disabled will affect the building arrangement. This section will cover various building arrangements to accommodate these factors.

3.3.1. The school structure

There are various ways a school can be organised or structured and the school should have made a decision concerning this at the outset of planning. Some of the alternatives are:

Age or grade groupings

Infants, Primary, Secondary

This is the traditional grouping.

Junior, Middle, Senior

This in an emerging pattern where the changes from primary to secondary are made less dramatic for children. Whereas in primary the children spend most of their time with one teacher and in secondary with a variety of teachers, in "Middle School" there is a compromise. In planning for such a structure the following issues need to be addressed:

- access to special learning areas like science
- classroom size (or an increase or decrease in the number of students per class, as younger children need more space than secondary students)
- arrangement of staff rooms
- toilet accommodation to separate very young children from older children

Family groupings

This form of school arrangement, though not common involves classes of mixed grades, where students in each class may range from Kinder to Year 6. Such will be more relevant in a small school, but may be deliberately chosen for educational reasons. The planning implications are minimal, more related to furniture sizes.

Subject diversity

This is more relevant in secondary than in primary school. Where, apart from basic or core curriculum a group of students pursue a particular course of study, for example Humanities, Sciences, Languages, Human Society, Physical Education. Where this concept applies classrooms may be established in such an arrangement to suit the particular course or range of courses. The benefits include reducing time for travel between classes and movement of resources for teaching. Displays relevant to the course are more accessible and related.
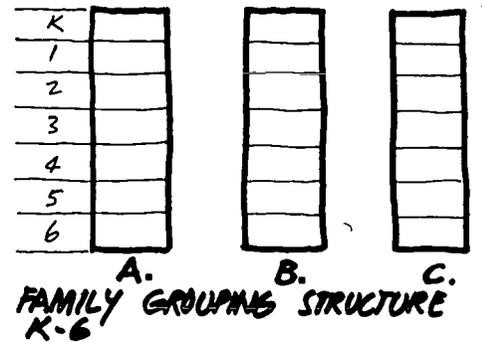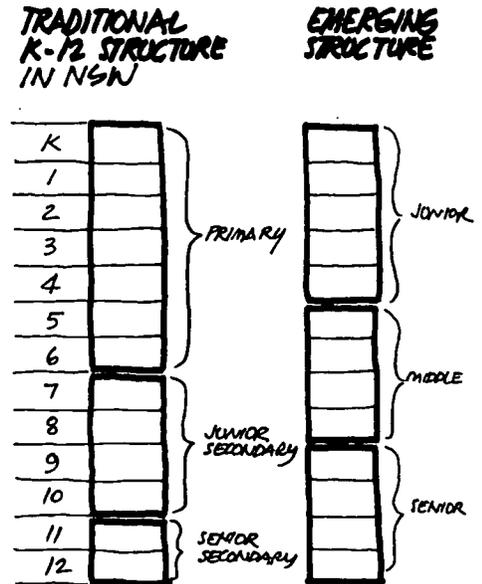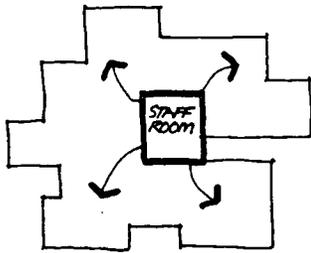
CENTRALISED STAFF ROOM
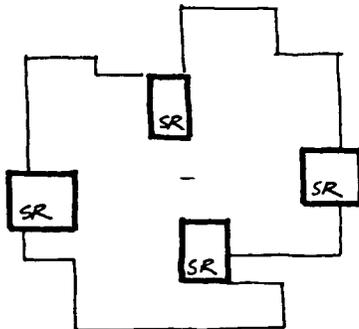
DISPERSED STAFF ROOMS

SUBJECT GROUPED STAFF ROOMS

Staffing arrangement

School design will be influenced considerably by the educational staff. Thus, it is important to have the senior educational staff involved in the planning team at the earliest possible stage. There are various ways a school staff may be accommodated.

- **Centralised**

All staff accommodated together in one staff room or adjacent rooms for staff studies, common room and amenities

Advantages: Communication, staff morale, efficiency in space allocation
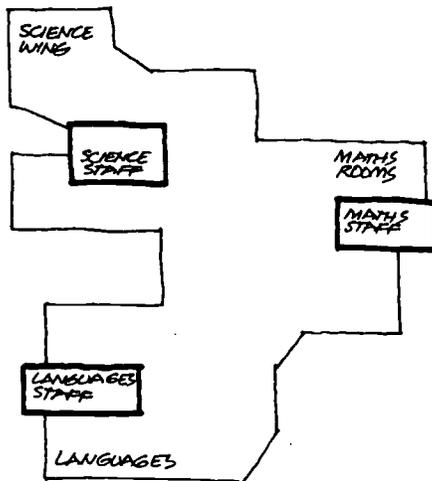
Disadvantages: Remoteness from some class areas, travel distance for staff to classes, subject preparation in specialised areas, supervision in breaks

- **Dispersed**

Staff dispersed around the campus in small studies close to class rooms.

Advantages: Time saved in getting to classes and carrying teaching aids, close proximity to students for maintaining discipline.

Disadvantages: Decrease in communication among staff.

- **Grouped according to Subject**

Staff located together according to subject emphasis.

Advantages: Time saved in getting to classes and carrying teaching aids provided classrooms are similarly grouped; proximity to staff for sharing concerns and problems.

Disadvantages: Decrease in communication among staff members across subjects.

Timetabling - expanding the day, reducing space needs

Because of increasing constraints on capital resources, some schools are seeking ways to stretch limited funds. Two strategies are described below:

- operate, in effect, two schools on the same site, with one group of students attending a morning session and the second group attending an afternoon session, with some overlap. Having two overlapping timetables has significant planning implications. Staff rooms will have to provide for increased staff storage as well as desk space. The cost will be offset considerably by much more efficient use of class facilities, particularly specialised ones such as science and technology where the set-up and equipment cost is high. Another advantage of the split timetable is that students are given wider options.
- operate two schools on adjacent sites, sharing facilities. Trinity College, Gawler SA operates two schools in this fashion. Senior secondary facilities are, to some extent, shared by both schools thus maximising the use of the specialist facilities. Each school has a timetable of six 50 minute periods, one school's program commencing earlier than the other. There is

an "alignment" of most periods allowing provision and sharing of facilities by both schools.

- Rotating timetable. A theoretical study outlined in "Time for Change" [1], demonstrates that by extending the school day an hour for every three classes, space needs will be reduced to two rooms. Planning considerations are minimal, except that the number of rooms required can be reduced significantly. Minor issues have to be addressed, such as signs at the gate to indicate timetable "day". The rotating timetable is illustrated in the sample day program shown here.

Other ways of maximising the use of school spaces:
- evening, weekend or holiday use
- double-shift work
- multi-track year round - several "schools" in effect operation on the one site each operating for different periods of the year - no holidays for the school building

3.3.2. The terrain

The degree of slope, undulation, aspect of slope, relation to prevailing winds – all have planning implications for the arrangement of the building . It is wise for Master Planning Teams to have the advice of specialist building designers at the time of choosing a site if possible. Not all the planning implications of the terrain are obvious. Section 2 of this Guide Document deals specifically with site considerations. This section deals more with planning issues.

All Saints, Mudgereeba Qld is an example of the use of a comparatively small segment of the total parcel of land, the only portion suitable for building being used very creatively. Refer also to Section 3.4.6.

A steeply sloping site

Some of the benefits of a sloping site for buildings are greater exposure to prevailing cooling breezes, to winter sun and to views in scenic areas. A sloping site allows interesting and useful spaces to be created between buildings, for example amphitheatres.

Some aspects requiring careful attention are:

- surface drainage in areas for pedestrian traffic near the bottom of hills
- access to sewerage from buildings requiring sewerage drainage
- reasonable slope on access pathways - max 1:8 (1:10 for wheelchairs)

FOR EACH 3 CLASSES . 3 CLASSROOMS ARE REQUIRED →

ALL CLASSES	
0850	1
0940	2
1030	3
1120	4
1210	BREAK
1340	5
1430	6
1520	END OF DAY

FOR EACH 3 CLASSES 2 CLASSROOMS ARE REQUIRED

STAGGERED DAY		
	A	B	C
0830	1	1	
0920	2	BREAK	1
1010	BREAK	2	2
1100	3	3	BREAK
1150	4	BREAK	3
1240	BREAK	4	4
1330	5	5	BREAK
1420	6	BREAK	5
1510	END OF DAY	6	6
1600		END OF DAY	END OF DAY

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[1] *Time for Change - Conclusions of a seminar in Ouranoupole, Greece October 1987*

TALL "SEE THROUGH" TREES, DEFINE SPACE & FRAME VIEWS.
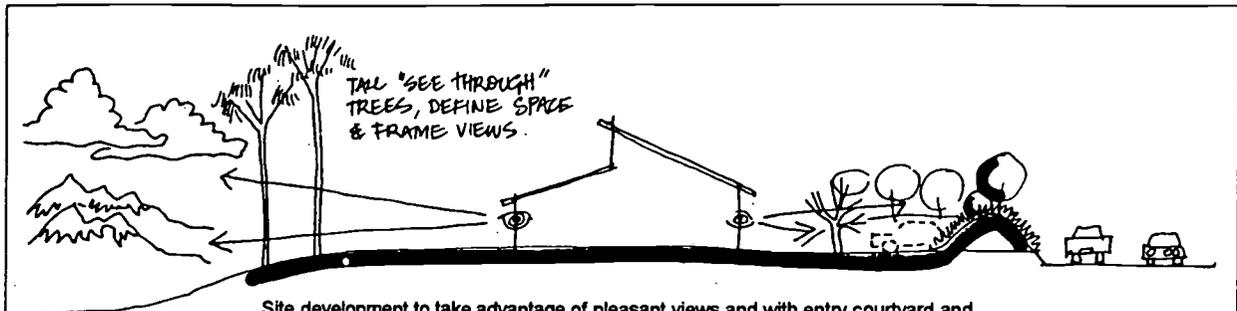
Site development to take advantage of pleasant views and with entry courtyard and mounded screening to visually distracting road and car parking.

BANK PLANTED WITH GROUND COVER

SHRUBS PROVIDING VISUAL CUT OFF.
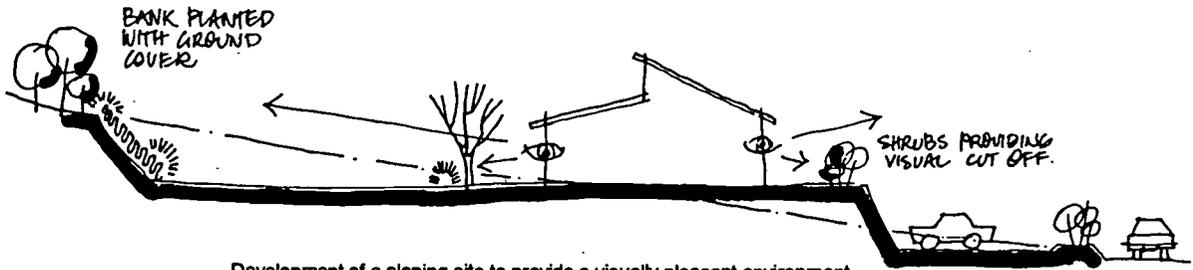
Development of a sloping site to provide a visually pleasant environment.
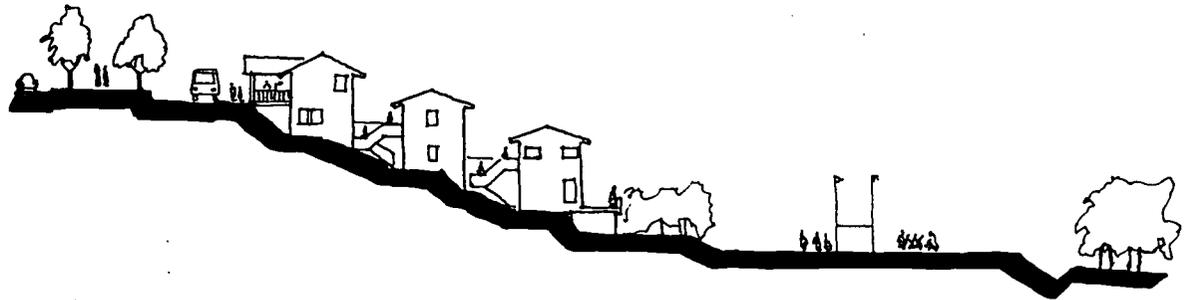
Even very steep sites can be used with creativity and care, provided access to services and vehicles for construction permit.

A   B

C
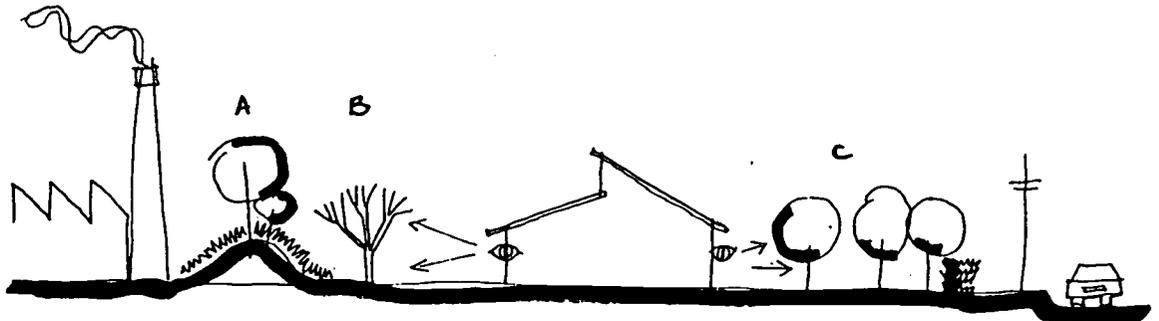
A school with visual problems which will cause distractions and identity problems.

Some ways of improving the school by site development:

A   mound with ground cover and trees at boundary
B   deciduous trees near windows
C   entry courtyard and screening plants

Most of the above sketches are from "Schools, Design and Use" Commonwealth Schools Commission 1982
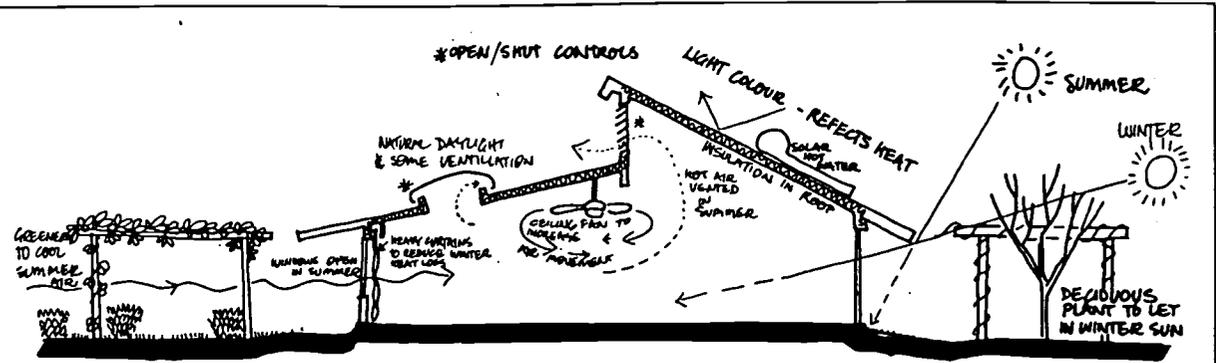
Various ways to promote cooling, to induce ventilation, to provide shade in Summer and warmth from the sun in Winter.
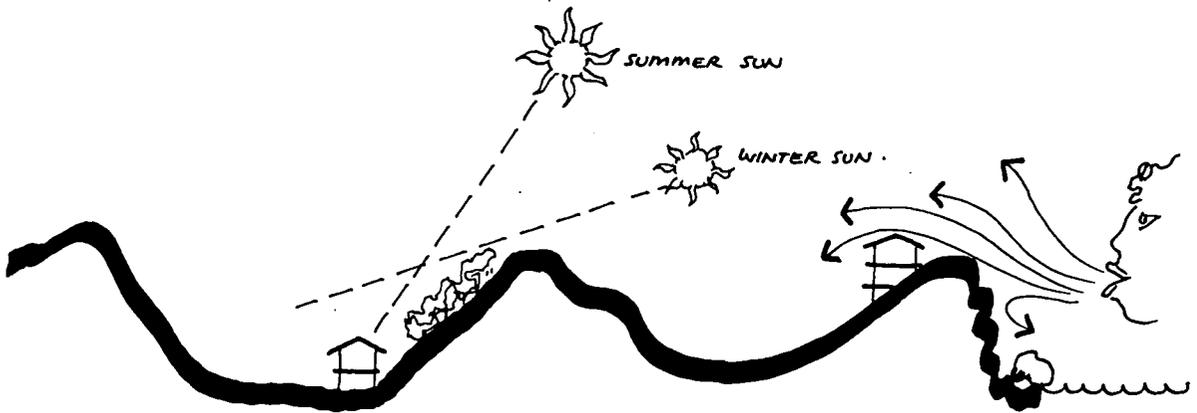
Avoid the lee side of hills if there is need for winter sun.

Avoid exposure to strong winds, particularly if in a sea side area.
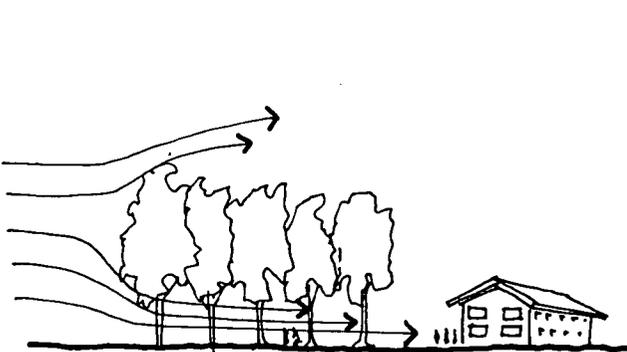
Tall trees can be used to induce a breeze at ground level.
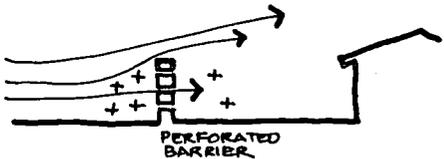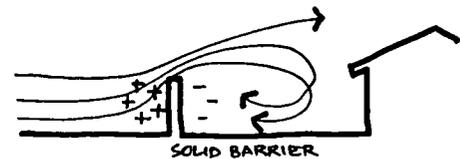
Perforated barriers provide better protection than solid walls as they allow some balancing of pressure behind the barrier.

DESIGN FOR CLIMATE

Most of the above sketches are from "Schools, Design and Use" Commonwealth Schools Commission 1982

EXISTING GROUND LEVEL BEFORE CHANGE

REASONABLE CUT E FILL 1~2m.

EMBANKMENTS TOO STEEP E LARGE

PLAYING FIELDS ON STEEP SLOPES ARE IMPRACTICAL E UNECONOMIC

- steep slopes on south sides of hills limiting sun penetration in winter
- steep slopes toward prevailing breezes may induce unacceptably high wind currents around buildings
- steep slopes away from prevailing breezes may limit cooling breezes
- additional cost to foundations of buildings on sloping land
- hazard in bush-fire prone areas as fires rush quickly up hills

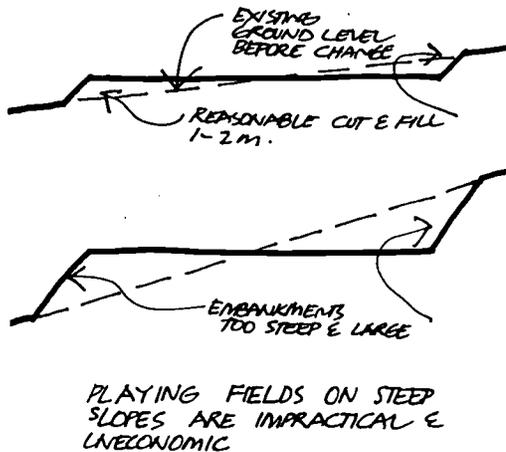Screens and screen planting can be used to modify terrain. Careful configuration of buildings can minimise "wind-tunnel" effect.

Playing fields are a problem on steeply sloped sites. To a certain extent, retaining walls can provide level areas, but for large areas this is possible only on minimum slopes.

A flat site

A flat site allows maximum flexibility in planning but is not without problems. Among the problems of a flat site are:

- deep trenches may be required to provide adequate falls for drainage
- lack of scenic interest
- shielding from prevailing cooling breezes
- potential to flooding particularly if the site is near a water course

Generally, if cost is a major factor a gently sloping or relatively flat site is preferable to a steeply sloping site.

Planning for natural hazards

Bush Fires

- Maintain clearances from build-up of undergrowth and debris
- Good access for fire-vehicles
- Clearly defined escape routes to safe areas
- Lower fire risk by carefully choosing external wall material

Flooding

- Floors above flood level (design for 100 year flood - obtain information from local Council)
- Escape routes clearly defined for both pedestrians and vehicles
- Continued use of services in times of flood.

Rescue-refuge areas

Schools often serve as a shelter and refuge for local residents in times of disaster.

In high risk areas planners should provide suitable facilities such as rooms insulated against heat, above flood levels, with protected

access to toilets and showers as well as cooking facilities (school canteen).

3.3.3. The Climate

After educational factors, climate is next in importance in building design. Different climates will dictate specific design choices:

Hot and dry

Requires good ventilation and insulation together with air-conditioning in extreme circumstances, in this instance evaporative cooling will be the most economical - refer section 5.3.4.

Brick or concrete block walls and concrete floors are useful as heat absorbers. It may be helpful to provide means of limiting ventilation if the hot air only contributes more heat and no relief.

External shading is helpful in providing shelter to students out of class as well as cooling the air coming in to the buildings.

Hot and humid

A hot and humid climate requires good ventilation and insulation with air-conditioning (in this case with de-humidifying capability). Reverse cycle air-conditioning is useful if both heating and cooling are required.

This kind of climate requires plenty of openings in walls with space around buildings to promote free flow of air (except where there is total reliance on air-conditioning).

Temperate

No special requirements apart from ventilation and insulation to conserve energy.

Cold climates - dry or wet

Buildings should be well insulated, in extreme climates even to the extent of double or triple glazing of exterior glass areas.

Facilities should be constructed with limited external openings and should rely on internal corridors for access between classrooms.

A cold site

A site may be particularly cold for a number of reasons:

*   on the lee of a hill not exposed to winter sun
*   exposed to prevailing cold winds
*   protected over much from morning sun by, for example tall buildings or a large bank of trees on an adjacent site

In such circumstances the designer should locate buildings where they will receive sufficient direct sunlight but wind will be controlled adequately. Sun and wind need consideration in playing areas as well. It may be more efficient to provide warmth artificially within buildings in order to maximise benefits of sun and wind protection for external areas.

TYPICAL ATMOSPHERIC CRITERIA
(Low Physical Activity Area)

	Ranges		Desirable	Tolerance
Temperature	Outside temp.	32°C 0°C	26° 22°	±2°
Relative Humidity	Outside temp.	32°C 0°C	50% 30%	±5%
Outside Air	litres/second per person		7→14	3.7
Air Changes/hr.			6→8	5
Air Movement metres/second			7.6→12	±3

NOTE: Summer temperature comfort is acceptable at 25-27°C if R.H. > 60% .Winter 18.5°C is OK if adequate clothing is worn

EFFECT OF CLOTHING ON COMFORT

Type of clothing	Comfortable temp for person sitting
Nude	28.5°C
Shorts & T-shirt	25
Slacks & Pullover	22
Lounge Suit	18
Overcoat & Gloves	14.5

outside temperature

A = area (m²) of either lower or higher openings (smaller)

Inside temperature

h

t^0

t^i
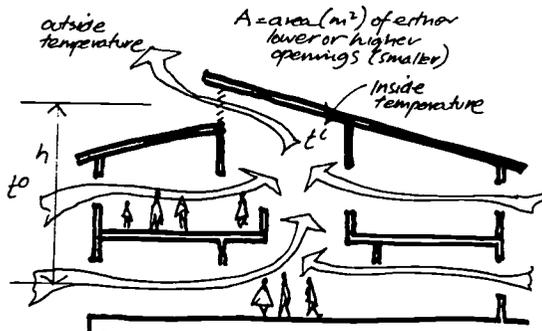
'STACK EFFECT' USED TO INDUCE AIR · FLOW

V = volume of air flow (m³/sec)
= $0.121 \times A \times H \times (t^i - t^0)$

IN AREAS OF LITTLE AIR MOVEMENT CREATE CLEAR PATHS FOR AIR TO FLOW

A windy site

When designing for windy sites avoid:

- creating wind tunnels between buildings
- creating turbulence with roof forms and fences
- trapping more wind by high barriers, including fences and buildings, which can funnel air to openings between buildings. Channel air to where it will have the least impact on people.

Wind can be controlled best aerodynamically, taking positive and negative pressures into account and maintaining the correct balance:

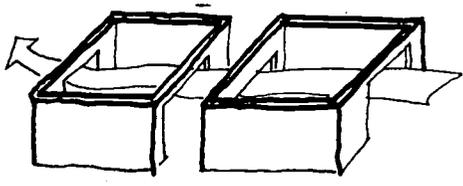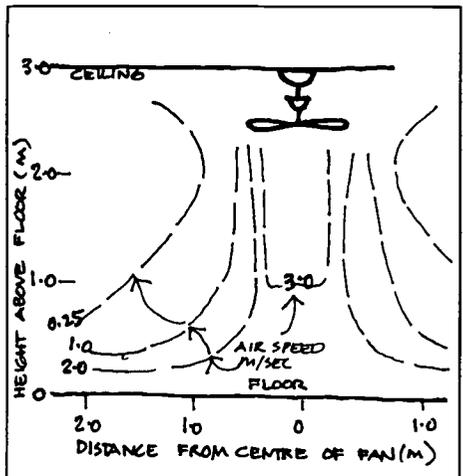- Trees can assist in modulating wind but can also create other problems. Trees with dense foliage and in rows can increase air flow at ground level. Conversely trees with sparse foliage can help modulate air flow.
- Fences, if solid, will create eddies behind them. Fences with a degree of perforation will allow some air through and offset the negative pressure behind them, thus allowing the wind to be deflected up over the fence.
- Sloping roofs facing the wind deflect it but, without balance from air moving around and through the building, they can create eddies similar to the case of unperforated fences.

These effects can be predicted by experienced consultants. Master Planners should seek professional advice if the school is to be located in areas of extreme winds.

HEIGHT ABOVE FLOOR (M)

3·0 CEILING

2·0

1·0

0·25

1·0

2·0

0 FLOOR

3·0

AIR SPEED M/SEC

2·0   1·0   0   1·0
DISTANCE FROM CENTRE OF FAN (M)

Circulating Fans for Air Movement

Ceiling fans assist cooling where there is little natural air movement by mixing air in contact with the structural mass of the building cooled the previous night.

Ceiling fans cover a greater area than vertically mounted fans and at more comfortable air speeds.

Ceiling fans must be mounted not less than 2.2m above floor level. This means that ceilings should be not less than 3m, less than this and the ceiling will be too close for effective air movement.

A site with little air movement

Measures deleterious in a windy site can be turned to advantage in one with limited air movement. For example:

- banks of trees with dense foliage can be planted to trap air and bring it to ground
- roof forms can be chosen to deflect any air currents and create movement where required
- interior layout of buildings can be arranged to create a stack effect. This is the application of the principle that air tends to move from higher to lower pressure areas – the lower pressures are usually at higher levels. A building with tall spaces with ventilation both at the top and the bottom will produce an air flow.
- arranging for openings in walls that are exposed to prevailing breezes. This is well illustrated in chapter 5 of the Building Energy Manual.[1]
- ceiling fans can be installed within the building to promote circulation

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[1] *Building Energy Manual as published by State Projects NSW Public Works.*

3.3.4. Students and Staff with physical disabilities

For people with limited independent movement

Current legislation in NSW requires that public buildings provide access for people with disabilities at least to the ground floor of buildings. Schools would be so categorised and should therefore provide for access for students and staff who have difficulty with walking, or indeed confined to wheelchairs[1]. The design of the school will need to provide for:

- wheel chair access to all spaces
- additional space in classrooms for manoeuvring wheel chairs
- protection for walls from wheel chair impact
- doorways of standard width are generally adequate for wheel chairs but may need additional protection at floor level
- toilet designed for wheel chair access
- ramps and/or lifts in multi-storey buildings
- additional handrails in corridors for ambulant but disabled students

For students or staff with sight or hearing limitations

People with sight and hearing disabilities require only limited design modifications:

- tactile signs
- changes in floor textures to assist in identifying changes in level (stairs and ramps)
- hearing loops and microphones in classrooms may be required although many students capable of being integrated can rely on lip reading

3.3.5. Security - vandalism aspects

Security design considerations are covered in this section. The level of need for security will vary with the locality. Schools in some localities may require a major commitment to providing protection.

Where security and vandalism are an issue the following should be given planning consideration:

- a means of controlling the periphery of the building site - this may mean a fence or the external envelope of the building being continuous, with gaps between buildings protected by gates
- all external openings having secure doors and windows
- maintaining free egress (escape) at the same time as controlling ingress (entry).

Security systems and vandalism are also covered in sections 2.6.2, 3.9 and 5.3.6.

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[1]   *Disability Discrimination Act No 135, 1992 clauses 22 and 23*

3.3.6. Limitation of site area

Where schools sites have severely limited space, school planners should:

- seek permission to use nearby public play spaces such as a local park or playing field. This scenario may not be a feasible long-term solution; (councils and neighbours do change)
- consider transporting students to local playing fields
- consider construction of multi-storey school with play spaces under or on top of building
- incorporate play spaces within the building as roof terraces

The lack of play spaces may be less relevant in Secondary schools, (particularly Senior Secondary schools) than in Infants and Primary schools.
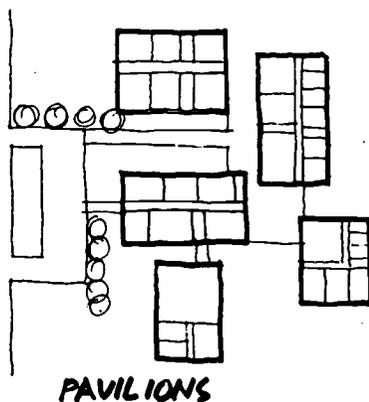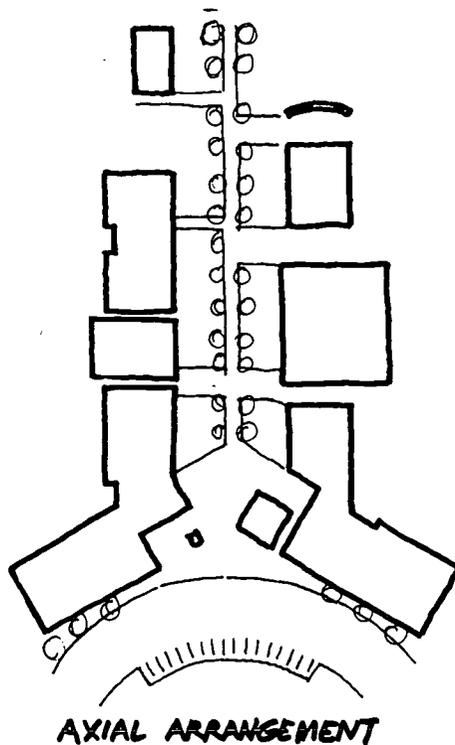
3.4. Variations of building arrangement

There are almost as many varieties of ways to arrange a school plan as there are schools.

This section of the Guide refers only to the basic and broad planning concepts, not the detailed planning of those buildings or rooms.

The purpose in defining these is to illustrate some basic concepts - most schools will be a derivative on one or more of these basic concepts.

3.4.1. Axial

An axial arrangement means the groups of rooms are centred about one or more axes - either in parallel or angled.

The outcome is usually a fairly formal arrangement. This arrangement can usually only be used where land is in plentiful supply. Landscaping is sometimes used to enhance or emphasise the axis or axes.

3.4.2. Pavilions

Where groups of rooms are enclosed in a building and several buildings form the school complex these may be referred to as pavilions.

They may be arranged formally or informally. They may be linked by covered ways or totally isolated from each other.

The principle advantage is that for a developing school each stage of the project can be a finished building.

AXIAL ARRANGEMENT

PAVILIONS

One disadvantage is that the potential for adaption to other uses may be limited, except where these may be foreseen and planned for.

Another disadvantage of this form of building arrangement is that as the size of the pavilion decreases the proportion of external surface (wall and roof) increases with subsequent increased initial costs and running costs (due to greater potential heat loss or gain in areas of temperature extremes).

This arrangement is ideal on steeply sloping sites where the pavilions can be built running parallel to the contours and stepped down the site with the covered links over ramped or stepped access.

3.4.3. Single Shell

The single shell is where all the facilities of a school are housed in a single building.

A disadvantage is that it is more difficult to build in stages.

It allows much greater flexibility in modification and adaption to other uses.

The fundamental concept for construction could be likened to a shopping centre with a large roof supported by beams and steel columns with roof lights providing light and ventilation to the inner parts of the building. All of the interior walls are lightweight construction, steel framing and plasterboard. These can be removed without endangering the main structure allowing maximum flexibility for change of use as needs change.

An example of this form of construction is Pacific Hills Christian School at Dural, NSW and to a lesser degree Plenty Valley Christian School in Victoria.
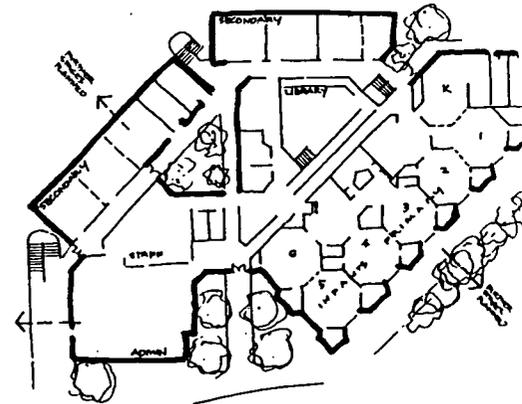
PACIFIC HILLS CHRISTIAN SCHOOL STAGES Is
ARCHITECTS NOELGELL-RIDLEY SMITH . STAGE /
A.K. WERRY   STAGE 2

3.4.4. Rooms around a series of courtyards

There are various ways courtyards can be used in school planning. They can be closed courtyards or open courtyards. The former is where access is only through the building. The latter where the buildings are arranged around an open area.

It is a compromise between the pavilion concept and the axial concept. It allows a degree of flexibility and adaption. Covered access can be provided at lesser cost than in the pavilion concept, the covered access provided by wider than usual roof overhang and being closer to other buildings.

3.4.5. Core-Plus Concept

The core-plus concept, developed by Clarke Hopkins and Clarke Architects, allows change with minimum fuss and impact. It provides a basic core to which a series of classroom blocks is added as required.

The core would comprise the basic administration and staff facilities such as Principal's office, administration. staff rooms, store and students toilets.
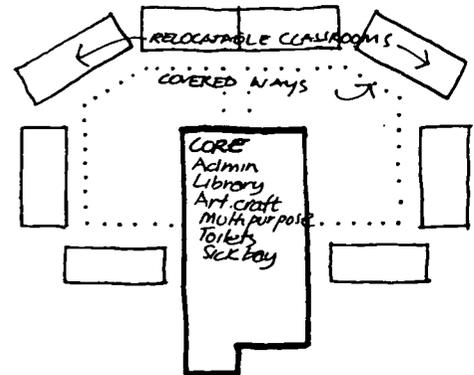
CORE PLUS CONCEPT
Bayswater North Primary- Vic

OVERNEWTON ANGLICAN COLLEGE
KEILOR, VIC
FORWARD, VINEY, WOOLAN; ARCHITECTS

ALL SAINTS ANGLICAN COLLEGE
MERRIMAC (MUDGEERABA) QLD
BURLING, BROWN E PARTNERS, ARCHITECTS

Surrounding the core, depending on terrain, climate and orientation, may be a series of courtyards bounded by walkways to which relocatable or permanent classroom facilities may be added as required.
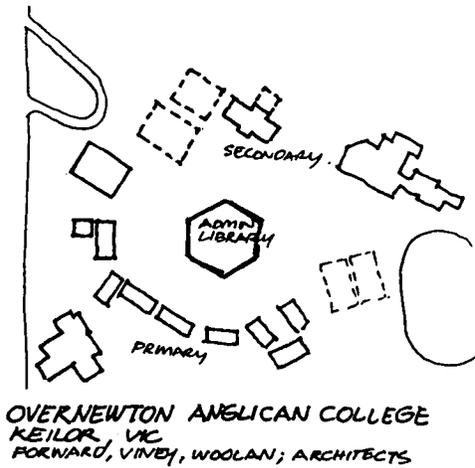
This concept may not be the most appropriate arrangement where numbers are low as the Commonwealth Government "globals" may be exceeded. Even so, the core can be designed to contain spaces which can be used as classrooms for later conversion to other uses:

- a library may serve as one or two classroom spaces
- a staff room may serve as a classroom
- a small space may be used by staff until conversion to its final use, for example, as the general office area.

An example of the Core-plus concept can be seen at the Bayswater North Primary School in Victoria, designed by Clarke, Hopkins and Clarke, architects.
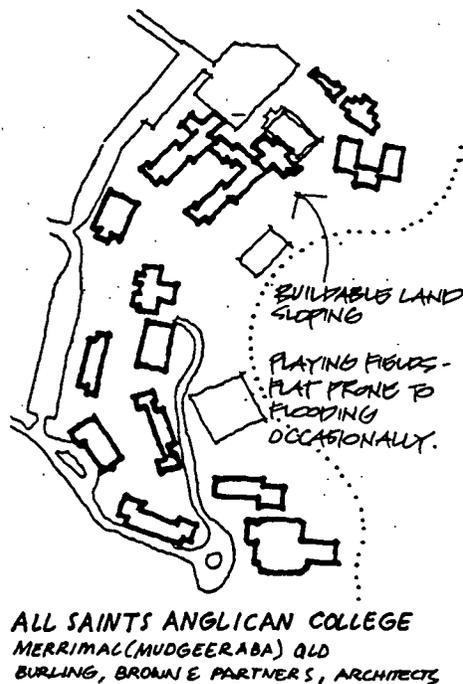
3.4.6. Buildings circling central space

An excellent example of buildings arranged in a circle format is All Saints in Mudgereeba, Qld where the buildings are confined to the sloping and only area available for building – all are facing the playing field which is prone to flooding.

3.5. Recycled Buildings

In the course of this study a number of schools were visited or investigated because they had adapted buildings and site which were originally designed and used for totally different purposes.

These examples below included here by way of encouragement to others. The former uses in some cases are so unlike the current use that it seems to suggest that almost any building might be capable of being adapted with sufficient enterprise and creativity.

Belmont Christian Community School (Belmont NSW)

This school is constructed on the site of the John Darling Colliery. The buildings which have been adapted are the office building and the miners wash house. This latter building was large enough, with a minor addition to house the entire single-stream primary school.

The secondary school, still developing toward full enrolment, is housed in what were the laboratories, drafting offices and mess rooms.

Byron Bay Community School, Byron Bay

The school was established originally in a shop and adjacent residential block. Since then another house has been purchased and converted to another school classroom. Part of the original shop has been demolished and a new facility established at the rear to provide staff amenities and office. A new building comprising two

classrooms has also been constructed on the site, all on three
residential blocks, all carefully master-planned and coordinated.

Temple College in Adelaide

The school has been established in a city environment in a disused
winery warehouse and office complex. Classrooms have been
constructed inside the large warehouse facility. It has been
relatively easy to provide large covered assembly areas in what was
the truck dock area.

Bega Valley Christian Parent-controlled School

This school commenced in 1995 and is housed in buildings
originally designed as an abattoir (but never used for that purpose)
with additions and modifications as required to suit the school's
needs.

Portside Christian School - Adelaide

Portside is a developing area on the northern perimeter of Adelaide.
The primary school, incorporating a preschool, was constructed
originally as a works development site for SACON. The existing
accommodation was adapted for use as classrooms and new,
purpose facilities were developed for the administration, library and
Art facilities.

Two disadvantages in adapting the site to new uses were the
difficulties of access, the site being the "gateway" to Portside, and
the oversized rooms – appreciated by staff but further development
is limited due to Commonwealth Government global area
guidelines. An "exceptional circumstances" case may have to be
argued if capital grants are sought.

Christian College, Highton, Geelong, Victoria

Here a large building built as an orphanage has been adapted for
use as a Primary and Secondary school. The traditional dormitories
were capable of being re-subdivided to provide ideal class sizes in
most cases. The principal disadvantage in the early days was
overcoming the problem of exceeding Commonwealth Guidelines -
this being a completed building and far bigger than the school
could justify in the early days of the schools existence.

Planning changes can sometimes assist to reduce the negative
impact of such superfluous area.

Advantages of recycled buildings

There are a number of obvious advantages in using existing
buildings:

* Time saving

The main part of the building is already in place – no time is
required to lay foundations, minimal time is required to provide
underground services

* Infrastructure in place and can be assessed

The soundness of the construction is immediately evident and the
building is ready for assessment as to suitability to the proposed
use.

- Cost savings

The level of savings will vary with the circumstances. Timing may be the main saving. In the Belmont example there were significant savings in terms of main structure.

- Atmosphere can be stimulating

Recycled buildings often have unique character. Elements of the existing site should be preserved where possible to retain this uniqueness.

Disadvantages of recycled buildings

There are disadvantages, although they can usually be overcome. Some of the disadvantages are:

- compromises are usually required

It would be unusual for a building already constructed to suit the school's needs perfectly, but this need not be a significant constraint.

- tendency to "make do"

Because "it is there" a tendency exists to make do. Provided there is sufficient determination among the master planning team to seek the very best, this difficulty can be minimised.

RELOCATABLES MADE PERMANENT
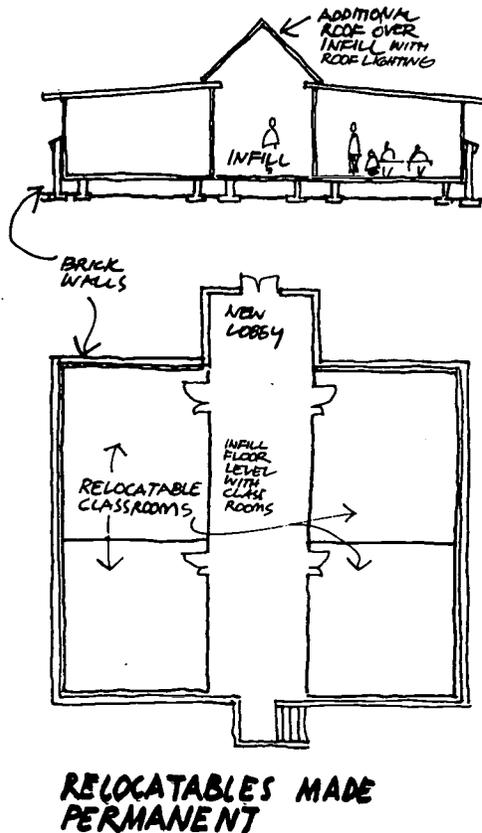
3.6. Relocatable Buildings

Relocatable or transportable buildings have been commonplace in the school scene for many years. They are an ideal response to urgent needs and to "humps" in the demand for accommodation.

The relocatable buildings currently in use comprise steel frames with rolled steel sheeting of varying patterns or aluminium covered plywood panels. Interior finishes are usually plywood panels rather than plasterboard which is more likely to be damaged in transit. Roofs can be flat or sloping - the latter is preferred as it gives an appearance of permanency.

Some schools plan to use relocatables in the long term by arranging them so that a brick skin can be built around them as a permanent finish. An excellent example is the primary section of Beaconhills Christian College at Packenham, Victoria. The class rooms have been arranged either side of a 3-metre-wide walkway built level with the floors. A roof with a continuous roof light was built over the centre walkway and the exterior enclosed in brickwork to match existing buildings on site. An imposing entrance transforms the building into a very satisfactory permanent building.

The needs of basic teaching spaces can be met relatively easily by the above methods primarily because the ancillary services such as plumbing and power and special furniture are fairly simple. These kinds of solutions are not as appropriate for special purpose classrooms.

The construction of relocatable buildings is not really any different to permanent buildings of framed construction, except for internal

finishes, which is not a significant issue as they are often covered by pinboards.

If required, insulation can be specified to provide additional heat resistance/retention if required until permanent cladding is provided.

Advantages of transportable buildings
- Useful for schools during growth periods in which enrolments are not predictable
- An almost immediate response to accommodation needs
- Flexibility in providing accommodation
- Building progress not hindered by inclement weather

Disadvantages of transportable buildings
- Life of building is often limited due to the use of steel components, especially in coastal areas. It is not a significant factor if building is to be clad in more permanent material later, provided the exposed structural elements are galvanised.
- Energy waste. The lightweight nature of the buildings means that they do not insulate easily against heat gain/loss unless special steps are taken to provide additional insulation.
- Acoustics. Because of continuous framing between classrooms and lightweight construction, sound travels easily from one room to the next. This problem is not easily solved using traditional insulation methods.
- Limited opportunity to modify. The configuration designed specifically for transport on trucks limits expansion potential except in a linear formation.

Cost factors

Transportable buildings are not necessarily cheaper to buy or to operate. Their principle justification is flexibility in use and in providing space where needed in times of crisis/peak enrolments. Transportable or demountable buildings have a cost other than the building itself. Costs of infrastructure, (electrical, drainage, footings and water supply) and transportation to site as well as paths and covered ways need to be taken into account.

3.7. Energy Considerations

Schools should take a lead in establishing energy conservation as a way of life. This section covers energy conservation and cost minimisation as pertains to the design phase, and methods that schools can adopt to conserve energy.

An energy efficiency statement should be prepared early in the design phase as a standard for evaluating the design. The statement should include such matters as:

- comfort levels for occupants
- orientation of building
- design of building envelope (will there be additional expense to conserve energy?)

- controls to be available and monitored to conserve energy. Will staff be trained in the use of monitoring and control equipment
- degree of complexity for operation of the controls - sophisticated equipment may be more efficient but will staff be available and motivated to operate the equipment?

The most convincing argument for conserving energy is the guarantee of cost savings, as energy is an ongoing, major, non-capital expenditure contributing to a high proportion of total life-cycle costs (see section 1.5.8 for a discussion on life-cycle costing). Cost savings may be achieved by:

- efficient energy management of buildings
- applying financial evaluation methods to select the best design
- reviewing of supply authorities tariff structures to select the most appropriate method

Some methods for conserving energy are:

- solar heating (3.7.1)
- reducing the area of the external envelopes of buildings (3.7.2)
- shading for summer months (3.7.3)
- careful attention to glazing - double glazing to minimise heat gain in summer and loss in winter (3.7.4)
- landscaping - keeping the ground cool around buildings will cool the external air coming into buildings (3.7.5)
- insulation (3.7.6)
- lighting design, to minimise heat gain in summer (3.7.7)
- selecting fuel types with stable costs (3.7.8)
- heat reclaim - reverse cycle air-conditioning (3.7.9)
- natural ventilation to reduce requirement for air-conditioning (3.7.10)
- off-peak electric storage (3.7.11)
- energy conserving tips (3.7.12)

3.7.1. Solar heating

Solar heating can be used where sufficient sunlight warrants the installation of the necessary equipment.

The school can obtain data from meteorological bureaus as to number of sunny days per year. This information can be evaluated by an engineer to compare the possible use of solar energy with the more usual means such as gas, electricity or other fuels. The higher cost of equipment and the amortisation, weighed against savings in energy may prove to be less cost effective than other methods..

Space heating

Solar energy for space heating is best where sunlight penetrates most rooms, such as site sloping to the north. A site in the shadow of tall buildings, hills or trees for the major part of the day in winter would not be suitable for solar heating.

References for further reading on solar heating can be found in Appendix 9.7.

SITES SLOPING TO NORTH
ASSIST IN TRAPPING SOLAR ENERGY

31
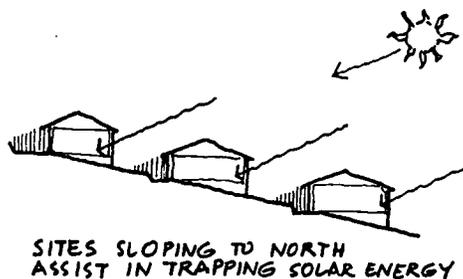
Water heating

Solar energy for water heating is best where sloped roofs face due north (in the southern hemisphere) and are not shaded for the major part of the day. Panels can be located on frames remote from the buildings to achieve such exposure, but the heat lost in long runs of piping and the additional support structure costs may make the effort too costly. Before a decision is taken to rely on solar heating for water, a consultant should prepare a detailed study to determine the long-term cost effectiveness (life cycle cost).

3.7.2. Minimising the area of the building envelope

Minimising the contact area of the building envelope to external air (the envelope comprises the roof, walls and, where buildings are elevated, the floor as well) can reduce heat loss/gain and make temperature control easier.

Doing so can produce other design problems however such as limiting natural light and air flow through the building. Pacific Hills Christian School at Dural, Sydney have overcome these limitations with the use of roof lights with shade provided to control summer sun. They provide good natural light, good cross ventilation, sun in winter and, by virtue of careful design, summer sun does not penetrate the rooms.
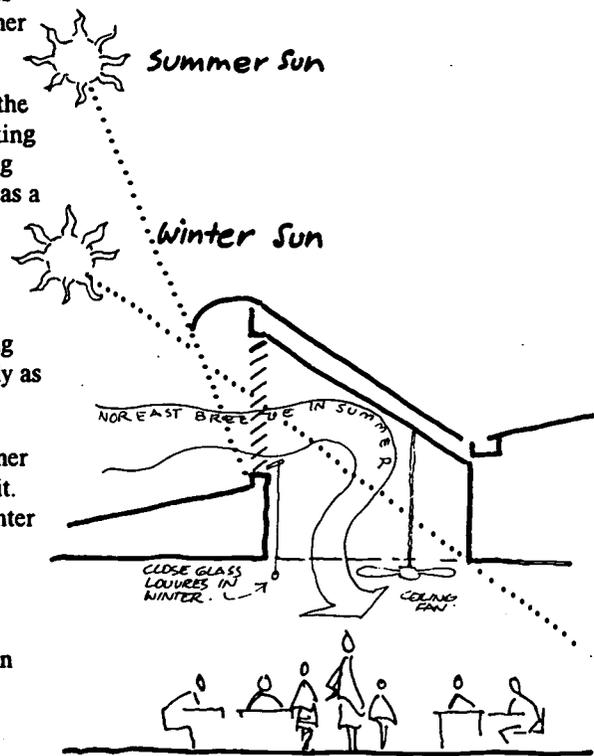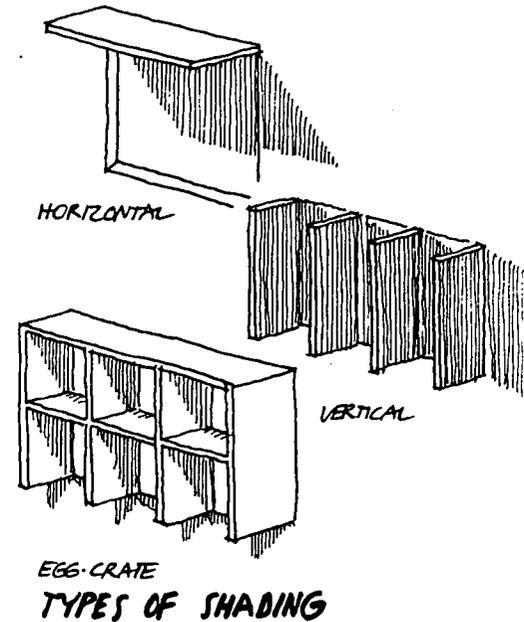
Sometimes access problems result from minimising the area of the building envelope, but they can usually be overcome. Incorporating internal corridors for access to class rooms can assist in reducing the ingress of air where extremes of heat or cold are likely, and as a result help to retain energy efficiency.

3.7.3. Shading

Shading of windows in summer is important, as energy radiating from internal elements does not flow out through glass as readily as solar radiation comes in. Hence heat builds up in rooms.

Shade structures need to be carefully designed to shade in summer and allow sun penetration in winter to achieve maximum benefit. Sun angles vary according to latitude and season: the sun in winter is lower in the sky than in summer. Therefore it is possible to design for sun penetration in winter while blocking it out in summer.

Tables and diagrams are available to accurately calculate the sun angles for any location in Australia. They may be found in "Sunshine and Shade in Australia"[1]. General principles of designing for the sun may also be found in "Solar Energy and Building"[2].

HORIZONTAL

VERTICAL

EGG-CRATE

TYPES OF SHADING

Summer Sun

Winter Sun

NOR EAST BREEZE IN SUMMER

CLOSE GLASS LOUVRES IN WINTER.

COOLING FAN

Pacific Hills Christian School Dural NSW.

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[1] *Sunshine and Shade in Australia - Experimental Building Station publication*

[2] *Solar energy in Building by S V Szokolay Edwards Arnold (Aust) P/L Melbourne*

AMOUNT OF HEAT REFLECTED DEPENDS ON CHARACTERISTICS OF GLASS INSTALLED

MOISTURE SEAL
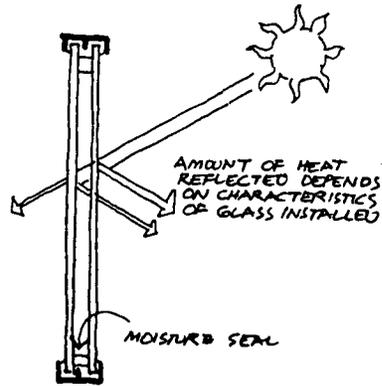
INSULATION ACHIEVED BY DOUBLE GLAZING

SUMMER SUN.

WINTER SUN

DECIDUOUS TREES ALLOW PENETRATION OF SUN IN WINTER & SHADE GROUND IN SUMMER

INSULATING MATERIAL
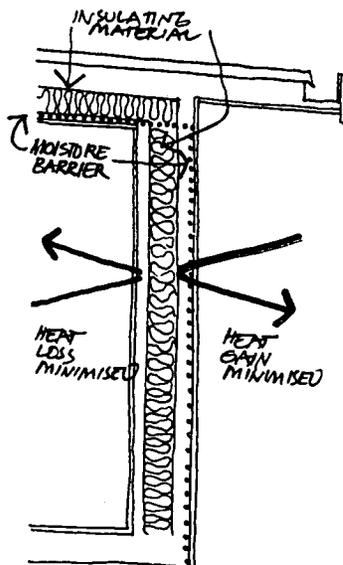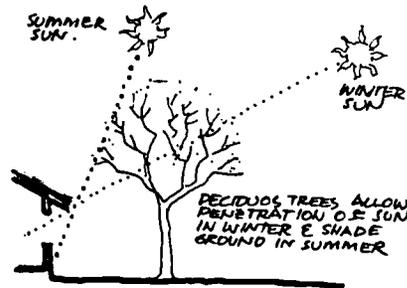
MOISTURE BARRIER

HEAT LOSS MINIMISED

HEAT GAIN MINIMISED

IMPORTANCE OF INSULATION

Other methods of shading include:

- deciduous vines or trees
- adjustable shade structures such as blinds, awnings and louvres

3.7.4. Double Glazing

Double-glazed windows utilise two panes of glass separated by a sealed air gap for insulation. The sealing must be carefully done as moisture trapped in the gap can condense, clouding the glass and damaging the frame.

Double glazing is required only where extremes in temperature occur or where noise levels are high. In very extreme weather conditions triple glazing is used, for example, in the Australian Alps.

3.7.5. Landscaping

The use of plants and trees around a building can be useful in controlling the internal environment. Deciduous trees and shrubs can provide shade in summer and allow sun to penetrate in winter. The landscaping should be designed so that plants do not impede air movement into a building.

In country areas, peppercorn trees (*botanical name Schinus Areia*) surrounding farm residences are a familiar sight. Their purpose is to keep the surrounding ground cool by shading. As air flows across the shaded area the ground acts as a "heat sink" absorbing the heat from it and providing cooler air to flow on through the rooms of the building.

3.7.6. Insulation

Insulation for energy conservation involves using material which, by its nature, forms "cells" of air which resist the flow of heat. Different materials have differing resistance to heat flow. Increasing the thickness of the material also increases its capacity to resist heat flow. Fibreglass filament – (concern about the use of fibreglass fibre has led to specifications calling for it to be wrapped in polyethylene film) in the form of batts or blankets, slag wool, dacron blankets, treated mulched paper, natural wool or similar material all provide insulation. Another form of insulation used in ceilings is loose fill of cellulosic fibre.

Careful analysis of all surfaces of the building exposed to external air mass, including the floors, should be done to determine the need for insulation.

3.7.7. Lighting design

Another way of limiting energy use is through good design of lighting. Maximising use of natural light, reduces the power used by artificial light and the resulting heat load.

Some classrooms in secondary schools are vacant for long periods of time. In such rooms ways of saving lighting energy should be explored. Possibilities include:

- movement sensors which switch lights off after a pre-determined period
- timers - providing lighting for a period slightly in excess of usual teaching period
- a "switch-off" signal through the light circuitry after school hours

While switching lights on and off in large areas decreases lamp life, it is still economical to do so.

Seek advice of professional consultants before selecting any of the aforementioned methods. Refer also 5.2.13 Light Reflectance and Glare Factors.

3.7.8. Fuel types with stable prices

Fuels likely to fluctuate in price should be avoided, as a sharp increase in such fuels, and hence energy costs, can lead to an administrative push for a change of equipment, meaning additional capital costs.

3.7.9. Heat reclaim and reverse-cycle air-conditioning

In climates where extremes in temperature do not occur, reverse cycle air-conditioning is a viable method of both cooling and heating. Reverse cycle air-conditioning provides cooling in summer and heating in winter and is regarded as an economical way of providing comfortable conditions in humid environments. Reverse cycle systems are more efficient in terms of energy use than other forms of air-conditioning. More about air-conditioning can be found in section 5.3.4.

3.7.10. Natural ventilation to reduce requirement for air-conditioning

This form of cooling is cheapest but works well only where air flow is sufficient in the building (for cooling by evaporation of perspiration) or where the air is sufficiently cooled through natural means (by flowing across a cool surface e.g. shaded ground).

3.7.11. Off-peak electric storage

A very efficient form of off-peak space heating is referred to as "heat banks". These comprise ingots of steel or masonry blocks containing radiant electric cables that are switched on during off-peak periods. The blocks are housed in an insulated cabinet with vents at the bottom and top, with a fan switched on by a time clock and controlled by a thermostat during school hours. They are best in climates that are cold for sustained periods.

3.7.12. Energy conservation tips

A conclusion of the OECD Conference on Managing Energy in Schools [1] was that energy costs can be reduced by occupants being willing to accept organisational change and to take care of the

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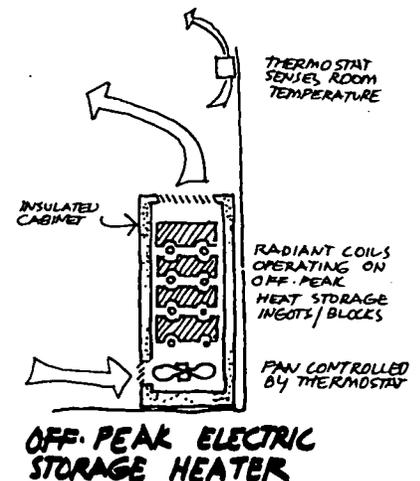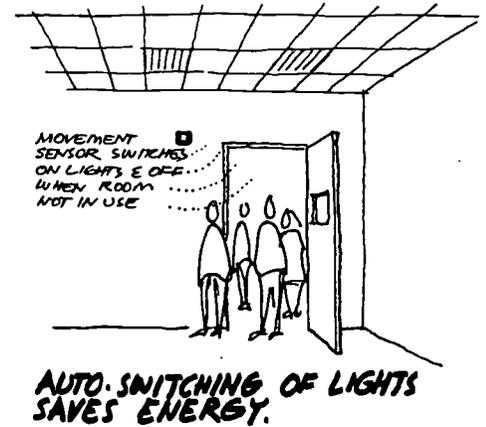
[1]   *The Will to Manage Energy in Schools – Conclusions of an OECD seminar in Vienna May 1984*

AUTO·SWITCHING OF LIGHTS SAVES ENERGY.

OFF·PEAK ELECTRIC STORAGE HEATER

school environment. Practices that can reduce use of energy include:

- keeping doors closed
- adjusting thermostats to moderate conditions (should be done with care by maintenance staff)
- wearing suitable clothing
- switching off lighting when daylight is adequate or when rooms are not in use
- zoning of areas for after hours use to minimise heating/cooling and lighting.

3.8. Building Services

In this section, building services are covered as pertains to master planning and design issues. The degree to which schools rely on building services (water supply, drainage, gas, power, data and transport) can determine the way a school should be constructed and arranged on a particular site. For example, a school built on a significant slope with restricted access to a sewer (e.g. where only part of the site has the potential of gravity falls to a sewer) is limited in where it can locate the buildings that require sewerage facilities; buildings requiring access to heavy vehicles for delivery of equipment and materials (agriculture or technics for example) should be located to avoid having to cross roads used heavily by students or other pedestrians.

Relevant and qualified consultants will provide necessary expertise to ensure that required facilities will be provided.

3.8.1. Water supply reticulation

Buildings and site must be planned to ensure that sufficient pressure and delivery capacity is available to support drinking and washing needs, toilets and fire fighting.

For further information regarding reticulation within the buildings refer section 5.3.2

3.8.2. Sewerage systems

Health regulations require either connection to a sewer or the installation of a satisfactory on-site sewerage system, such as:

- septic tank with effluent drained into absorption trenches
- a packaged sewage treatment system with disposal by settling tanks, evaporation beds or spray disposal on playing fields or a combination of the above
- a pump-out system where sewage is drained to a tank and macerated for pumping via a pressure line to a town sewerage system. This applies where a site does not have potential of gravity fall to a sewer
- in certain cases, absorption by special grasses planted in settling ponds. Such a facility has been installed at the Cape Byron Bay Steiner School, Byron Bay, NSW. (Refer Appendix 9.10)

■ sewerage system drained to a tank and pumped out by a tanker, which is unsatisfactory unless the tank is large enough for several days load.

3.8.3. Electrical light and power

Local supply authorities should be approached to determine whether there is adequate power supply on the local grid and if not how to provide it (see 5.3.1 for more detailed coverage).

Switch rooms and conduits should be sufficiently large to cater for maximum power requirements with scope for further growth. Ideally, switch rooms should be:

■ as close as possible to the power source, as cabling is expensive

■ centrally located to minimise runs to sub-boards

■ accessible for meter readers and urgent maintenance

■ positioned to enable vehicle access for transport of major components such as new or replacement switchboards

■ readily accessible to the fire brigade to switch off power in the event of a fire

For more information refer to 2.2.3 and 5.3.1.

3.8.4. Communications

There is an increasing need for schools to be aware of technology, to incorporate it in the teaching process and to directly include it in the curriculum.

Schools should obtain the very latest and best advice available on communications equipment and networks. Among the important communications services are:

TV and Video

A variety of suitable networks are available for distributing signals around the school buildings, including remote control of those signals. Audio visual equipment is usually centred in the library where the video tape may be placed in the machine by the librarian or technician. From that point on control is in the hands of the teacher in the classroom.

Satellite

In the future, schools may be required to include satellite dishes to pick up broadcasts of lectures for students in TAFE courses as part of their senior studies.

Telephone

Given the relative value of staff time it is probably best to provide ready access to phones. The disadvantage of ready access to phones is abuse by students (e.g. using phones to signal a false alarm of an emergency situation). A safeguard against abuse is to provide a public phone for student use, but locate it in a place open to view by staff.

Intercom

Intercommunication for staff can probably be best provided by means of the PABX telephone system.

Computer networking

With current advances both in technology and educational priorities a sophisticated computer network throughout the school is becoming a priority. Consideration should be given to networking:

- classrooms
- staff or senior student studies
- staff/student homes (via modem)
- international data-bases

Schools cannot afford to downplay the significance of developments in this area. On the other hand: *Computers and video may be the hottest topic among educators, but . . . 'We don't want to repeat the mistake we made with language labs . . . creating large spaces that aren't really needed.' Rather than setting up computer labs . . . the new technology (should be integrated) within traditional classrooms'*[1].

The debate among educators continues on this issue, particularly at the primary school level.

3.8.5. Fire Safety

Fire safety regulations

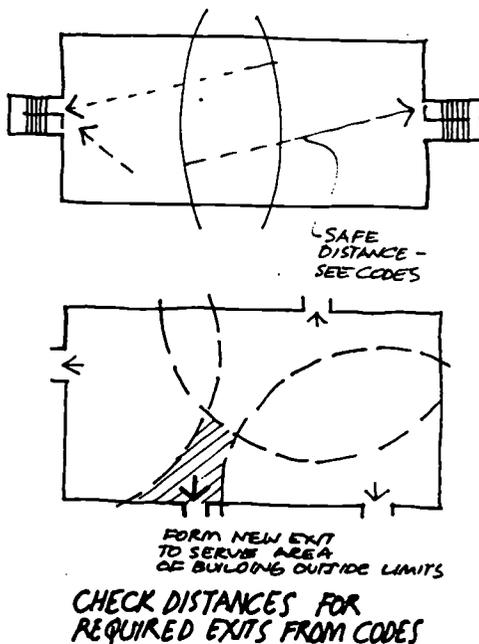In designing for fire safety, regulations govern construction methods on such matters as:

- distances to safe exits
- size of passages and stairs
- location, size and type of fire fighting equipment
- choice of materials
- means of isolating and stabilising fire.

The Building Code of Australia requires that locks on all doors to rooms and passages forming part of required escape routes (as defined in the regulations) to be such that doors can be opened by a single-handed action. Secondary locks are forbidden.

These regulations are written for professionals in the construction industry - seek advice from architects for their interpretation.

Management and training for fire safety

Buildings designed to be safe from fires remain so only when management monitors the environment, maintains equipment and fire services, and trains staff and students in safe behaviour in the event of disaster. Consider making fire safety procedures part of the overall training for staff and students.

└ SAFE
DISTANCE -
SEE CODES

FORM NEW EXIT
TO SERVE AREA
OF BUILDING OUTSIDE LIMITS

CHECK DISTANCES FOR
REQUIRED EXITS FROM CODES

---

[1] *Clifford A Pearson in Architectural Record January 1991*

Evacuation plans – design

At a very early stage in the planning process the broad parameters of fire safe practices and designs for schools must be understood. Before the building is occupied an exit plan should be prepared and available to staff. Evacuations of the building should be rehearsed frequently.

Evacuation from buildings may be required for dangers other than fire. The evacuation process for fire may differ from that of other potential hazards or threats.

Evacuation systems

There are various means of ensuring people escape from the building in emergency:

* an alarm bell
* public address system. Some public address systems have a range of warning buzzers and bells as part of the standard mechanism. Staff and students need to be trained in the system and use.
* escape routes need to be identified

Bush Fires

In areas threatened by bush fires the safety procedures need very careful thought in consultation with the local authorities. The school may well be the community haven in event of bush fires.

Fire suppression systems

Fire suppression systems comprise:

* fire blankets. They should be available on walls in high risk areas such as kitchen, science and technology areas
* sprinkler systems. Sprinkler systems would usually only be applicable to schools in multi-storey buildings.
* shut-down mechanisms on ventilation systems. These are required in areas where mechanical ventilation exists and where the systems need to be shut down automatically to minimise the spread of fire.

Fire warning systems

* smoke detectors. These are the most common form of alarm or warning system. They should be connected to an alarm in an area likely to be staffed while ever the school is occupied. The staff need to be trained in quick detection of false alarms what to do in case of a real fire. Detectors should be tested regularly.
* heat detectors. These detect heat rather than smoke. They are useful in areas where flammable material is likely to produce more heat than smoke (e.g. flammable liquids) and where a very early warning sign is important.
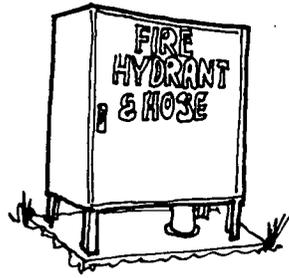
Fire fighting systems

* fire extinguishers. Different types of extinguishers are used for different types of fires. Professional advice should be obtained from the local fire brigade.
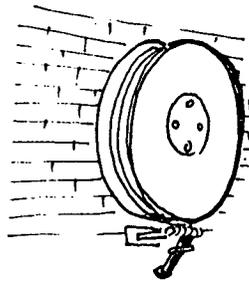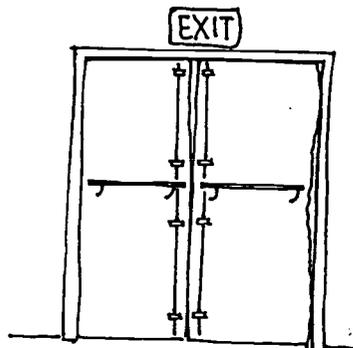
FIRE HOSE REEL

FIRE HYDRANT & HOSE
IN CABINET

BATTERY POWERED EXIT
SIGN WITH SIGNAL LIGHT
INDICATING SERVICEABILITY
OF RECHARGING SYSTEM

- fire hose reels. They are generally required by the fire safety authorities - their location recommended as part of the building approval process. They are capable of being managed by school staff. Staff should be required to become familiar with and trained in their use and location.

- fire hoses. They are used generally by trained fire fighters only, as the quantity of water carried by these larger hoses is generally unmanageable by untrained staff. They are required where brigades are not readily able to bring vehicles onto the site.

- fire hydrants. These are large pipes with valves connected to the town water supply and suitable for connection to fire brigade hoses and fire pumps to boost the available water pressure. Building codes govern their installation. Ensure that staff are advised of their use and location.

- fire brigade. They should be invited to participate in preparing the escape plans for the school. The fire brigade should also be able to offer advice on:

  - fire fighting systems

  - alarm systems

  - keys to be used in emergencies

  - location of the electrical switch room

Exit and other signs

Important parts of the fire safety design of the school are the exit signs and emergency lighting systems. They are efficient only if they are maintained in working order.

Older style of emergency and exit lighting systems were powered by a central battery system, the wiring being in fire-isolated environments, conduits or sheather cable (MIMS = Mineral insulated metal sheathed).

The current trend is to provide each unit with an internal battery and a trickle charge system connected to mains power. When the mains power is cut the internal batteries provide sufficient power for exit signs and lights.

These units have a signal light which indicates that they are operating. They must be checked on a regular basis - a certificate is usually required, issued by a recognised authority, indicating that the equipment is serviceable.

3.9. Security – Buildings, Personnel and Property

With the increasingly sophisticated and expensive equipment in schools, security is an important issue. A secure building arrangement and systems for monitoring and sounding alarms are therefore necessary. School planners should ensure that:

- entrances are well lit and resistant to forced entry

- windows that open should be fitted with strong locks
- external building material should not easily be damaged
- fences and gates should be lockable to vehicular traffic (except for emergency access by fire trucks and police vehicles - supply keys to local brigade and the police)
- surveillance is easy for patrolling security staff
- all entrances are highly visible to staff during school hours to monitor who is coming in to or out of the building
- staff and students are provided with safe and secure storage for personal property

Security, Alarm and monitoring systems

There are a variety of systems available for consideration including:

- alarms which are activated by sound, heat sensors, movement, glass breakage, magnetic switches on doors and windows which detect the opening of windows and doors
- surveillance cameras including video recording of all movement activity at critical points of the building
- master key systems
- security key systems - programmable keys which record when used
- programmable cypher pads to control access including the time access is permitted
- security firms who supply personnel and/or systems
- links to police or security firms

For more detailed information and recommendations refer to "Safety and Security in Educational Buildings"[1]

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[1]   *Safety and Security in Educational Buildings - OECD Seminar May 1987*

AiS
of NSW
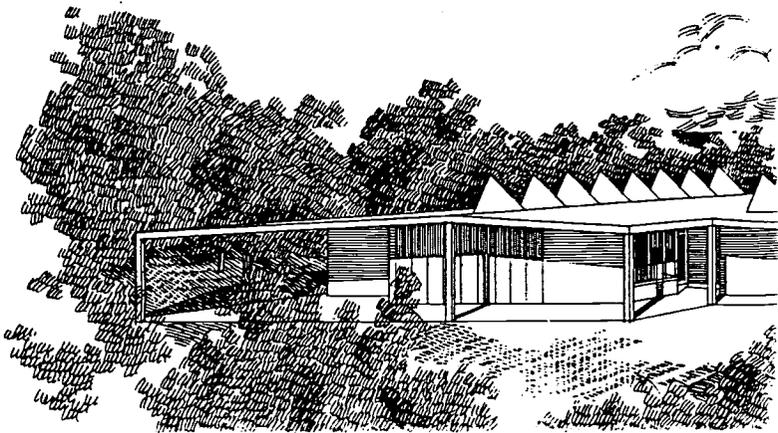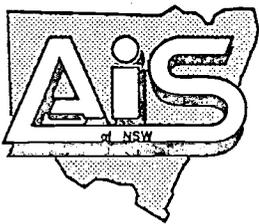
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