THE PROVISION OF SCHOOL BUILDINGS IN SAUDI ARABIA WITH PARTICULAR REFERENCE TO JEDDAH.

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The degree of Ph.D.

SYNOPSIS.

This thesis studies the provision of school buildings in Saudi Arabia with particular reference to the city of Jeddah. It attempts to provide general design guidance and criteria, which incorporate suitable educational, environmental, social, religious and economic factors in the country.

Early investigation of population statistics and the result of the survey held in the city of Jeddah indicated that: intermediate schools should be given priority in this study. The second point was that most of the existing schools which are provided by the authorities are educationally, environmentally and economically inadequate.

The study emphasizes and interlinks three major subject areas: education, environment and architectural design. Reference is made to the development of education and consequent implications for school buildings in developed countries. An attempt is made to define environmental requirements for hot arid regions such as Saudi Arabia. Traditional Islamic architecture and school building (Madares) is examined. The outcome of this study indicated that: two major issues should be considered in the formation of the final brief. First, the relationship of the existing educational situation and its future. The western educational model is the origin, yet Islamic education can not be disregarded and any development in the existing system will initially be religiously oriented. The architectural response should on the one hand be localized and related to the traditional Islamic values. On the other hand, it should be modern and up to date with future needs borne in mind. The second major decision is that, for many reasons, internal environment should be of a high standard. This should be generated by a natural process of ventilation and lighting.

For educational demands layouts have been suggested and developed to meet existing and future needs with a minimum of physical alterations. These layouts respond to environment by blending traditional elements in such a way as to provide cross-ventilation by the controlled movement of cool air. This is assisted by an original use of the stack-effect in building in a way which reflects traditional architecture, yet provides modern standards of light and thermal control.

To my parents, my wife
and to my children,
with love ....

ACKNOWLEDGEMENT.

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INTRODUCTION.

A: PREFACE.

Although the first schools in history were recorded in the ancient civilizations of Babylon, Egypt and China between 2,000 and 3,000 B.C.,(1) basic formal education was usually restricted to a few, especially to those whom society required to be educated for functional reasons. It was not until the beginning of the 19th century that such attitudes began to be challenged by new ideas, which led eventually to mass elementary education. Since that time and till the beginning of the 20th century, the value of education in terms of 'general education' had been transformed in advanced countries, where it was realised that an industrialized society required a high proportion of people educated to an elementary level. Thus compulsory systems were developed. This played an important part in the processes of development and progress in Western Europe and North America.

After the Second World War, which set in train social changes and which witnessed the independence of many underdeveloped countries in Asia and Africa, the value of the provision of general education became clearer than ever. It is now generally recognised as a logical requirement for continuous development and the future survival of both developed and developing countries. This has led to the launching of many development plans and programmes in underdeveloped countries. As a result of the lack of alternatives and due to the preparedness of many developed countries to give economic co-operation and support, there has been a tendency to import Western and North American modes of development. Naturally the formal schooling system was included in these programmes. (It is the general acceptance of the provision of general education that has brought the issue to the international level). On the other hand, despite recent criticism of educational planning reforms, compulsory education for at least the first nine years of what is generally thought to be the 'school age', has become inevitable for any kind of successful contemporary development (i.e., the economic growth and social equality development approaches).[2] Of the available alternatives, whether to suffer illiteracy and poverty or to pay in advance the full market price for what may become an uncertain future, most developing countries have gone searching for their future!

Moving from such an obvious point of demand to the areas of 'what and how', the situation gets more involved. The provision of general education (the system, teaching methods and school buildings) in developing countries, started as a prerequisite for their social and economic progress. This, despite the long experience of the developed countries in such a field, has become, in less than two decades, a cause of great concern. This was not, of course, because general education was discovered to be unnecessary, but because the models which were imported by the developing coutries, especially following decolonization, have become not only difficult to fit into changing circumstances but also, in many cases, obsolete. Some reasons for this situation are:-

(1) The values of contemporary Western civilization, which, it should be remembered, have had up to 200 years to develop since the Industrial Revolution, have been injected into underdeveloped countries in a very short span of time in the hope that they could catch up with the developed countries. The statement which says "start where others have finished" is no more than a kind of romantic political justification. In reality we in developing countries have to start where we are at present, especially if we do not have the basic foundation upon which we can build, otherwise we will face a future not of our own choosing.

In other words, the short cut approach, which has been used to try to overcome the handicap of time, has brought most developing countries face to face with the same kind of modern social problems which face developed countries today. At the same time, the basic requirements of any human civilization such as political justice, administrative flexibility, social consciousness and equality, technological innovation and progress have in general not yet matured. Moreover, remaining aspects of the traditional 'civilization' and values are rapidly being submerged in newer social forms.

(2) Where a particular internal climate prevails; where rigid centralization, lack of support, are present and patience and sometimes even freedom are lacking, the innovational processes which are required to balance the quantitative and qualitative needs of the development of education have

become exposed to inevitable political manipulation and administrative bureaucracy.

(3) Simple imitation of models suitable for other societies have not proved successful.

(4) A wide gap between the quantitative and qualitative responses has been created. Imported educational models (the system, curriculums, teaching methods and school buildings) are becoming unsuitable and out of date for the needs of a society which can never develop exactly as that of the original model.

Such an educational dilemma, as described by John Simmons, has always attracted the attention of politicians, planners, educationalists, economists and sometimes even architects in developing countries. They have usually dealt with it mainly from its horizontal dimension comprising planning policies, reforms, administrative requirements, teacher training, enrolment and distribution of educational facilities, etc. The vertical dimension - the architecture of school buildings - has been left to the 'ingenuity' and artistry of architects. It has been assumed that he will perform the necessary miracles to give an ultimate solution to the problem of supplying the necessary building quickly and cheaply. The effect of this has been quite negative. For speed of erection, standardized plans have been developed. This technique also fitted in with conventional views about economies of scale and use of industrialized systems. School design has not really moved on since the pioneering work of the fifties. The importance of buildings to an expanding educational programme can be shown by the fact that school buildings are the second most costly component of an education system after teachers' salaries. It is clear that in developing countries the conventional architectural practise of individual building design does not work. School building is a complex architectural problem. It needs research, development, implementation and feedback procedures - a continuous process of innovation - if there is to be a true merging of the educational and building processes.

Saudi Arabia is one of the developing countries affected by the problem, despite being an apparently rich and wealthy country it is subject to the dilemma described above. Dr. Tarik M. Al-Soliman described the existing situation in Saudi Arabia as follows:

> *"Saudi Arabia carries many of the hampering problems found elsewhere in developing countries with the exception of being caught up with more capital flow than it can actually invest within its absorption capacity. This has resulted in a fierce competition and consequently shortages in the country's meagre resources of manpower and materials. Eventually, less schools end up being built than were originally planned for. The ones that are built are often of a compromised quality. Poor forecasting and assessment of needs result in an unbalanced distribution of new school facilities which are either overloaded or underloaded. The planning and design processes for newly built schools are by-products of the bureaucracy, rigidity and inefficiency that characterize most of the development plans undertaken by the government. This led to the adoption of poorly designed standardized architectural plans for all locations.*[3]

B: AIMS OF THE STUDY.

In the light of the foregoing analyses the aim of this study is to propose a general set of requirements in the form of an 'architects brief', to help in the updating of the architectural response to the existing and future educational needs in intermediate schools in Saudi Arabia. For this the study will attempt to investigate and assess the following major subject areas:-

(1) The contemporary philosophies, theories and practise of education which influence the provision of general education in developed countries. It is expected that some aspects of the existing models may be of use in Saudi Arabia.

(2) The existing practise of general education in Saudi Arabia: the models; philosophy, theories and teaching methods and their application with regard to school buildings and their design concepts.

(3) The development of trends in school building - the architectural response to the educational, economical and environmental conditions in developed countries since the last century.

(4) The environmental standards and requirements of schools in Saudi Arabia - a general review of environmental standards and requirements for school buildings with reference to a hot, arid climate. It is proposed to limit the climatic response to that found in Jeddah.

(5) The main characteristics of Islamic traditional architecture and school buildings in Saudi Arbaia and other parts of the Islamic world. Designs will be analysed and evaluated in relation to functional, social and environmental conditions found in their localities.

C: STRUCTURE OF THE THESIS.

This thesis comprises seven chapters in addition to the general introduction. Each chapter has a brief preliminary statement, a summary and a conclusion.

Chapter One is a study of the background to the educational, administrative and construction programme in Saudi Arabia to determine the scale of the existing and possible future demands for the provision of school buildings.

Chapter Two illustrates briefly some of the most important contemporary international educational trends and their basic theoretical assumptions, beliefs and teaching approaches. This chapter also describes the present educational practise in Saudi Arabia, its philosophy, aims and teaching methods. A comparison can then be made between the two areas.

Chapter Three covers briefly the development of school building design as an architectural response to the changing demands of education. The study examines the major innovational issues and trends in the design of school buildings internationally.

Chapter Four is concerned with environmental requirements in school building. This includes thermal comfort, natural and artificial lighting and ventilation, acoustics, pollution, etc. The study also suggests a general set of environmental requirements for schools in Saudi Arabia which can form the basis of a design brief.

Chapter Five examines traditional Islamic architecture, with emphasis on the climatic solutions and techniques used in the regions of Saudi Arabia and other similar countries in the Middle East. The second part of the chapter is devoted to a brief study of traditional Islamic school buildings.

Chapter Six is a case study, which deals with the experiment of the provision of school buildings in Saudi Arabia and examines the particular needs and requirements of intermediate schools in cities such as Jeddah.

Chapter Seven is the final chapter, which is presented in the form of an architectural brief.

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(1) Shipman, M. D., 'The Sociology of the School', 2nd. ed., London: Longman Sociology of Education, 1975, p.8.

(2) Simmons, John, 'The Education Dilemma', London: Pergamon Press, 1980, pp. 2-3.

(3) Dr. Al-Soliman, Tarik M., 'School Building for Boys' General Education in Saudi Arabia', Ph.D. Thesis, University of Michigan, 1981, p.4.

CHAPTER ONE.

THE BACKGROUND AND DIMENSIONS OF GENERAL EDUCATION AND SCHOOL BUILDING IN SAUDI ARABIA.

PRELIMINARY STATEMENT.

This chapter is a general background for the study. The first section describes briefly the conditions found in Saudi Arabia. This includes geography, population, topography and climate. The second section is devoted to determining the scale of the problem of school building provision in Saudi Arabia; relating it to the existing situation and predictable future demands.

GEOGRAPHY AND NATURAL CONDITIONS.

LOCATION AND POPULATION.

The Arabian peninsula, of which Saudi Arabia is part, covers well over 3,000,000 square kilometres. Saudi Arabia itself comprises about 2,300,000 square kilometres - nearly 900,000 square miles.

The Kingdom of Saudi Arabia extends from the Arabian Gulf in the East to the Red Sea in the West, and it borders Kuwait, Iraq and Jordan to the North, Quatar, the United Arab Emirates and Oman to the East, Yemen and the Republic of South Yemen to the South. Saudi Arabia lies between latitudes 32° and 16° North and between longitudes 35° and 56° East.[1]

The latest population census of 1974 showed that Saudi Arabia's population stood at 7,012,624.[2] In recent years, there has occurred a considerable movement of population into the main cities as a result of large development plans. The population of the city of Jeddah, for instance, stood at 60,000 in 1947, quadrupled to 250,000 in 1966, then more than doubled again to 595,900 in 1974. It again expanded and redoubled to 915,800 in 1978 (see Table 1-1). Other cities, such as Riyadh, Dammam and Makkah have also witnessed significant population increases.

GEOGRAPHICAL PROVINCES.

Saudi Arabia is divided into six geographical provinces, each province being headed by a governor or Amir. The six provinces are as follows:

(1) **Western Province.** Main cities: Jeddah, foremost sea port, commercial capital of the country; Makkah and Madina, the holiest cities of the Islamic World; Taif, agricultural centre, summer seat of the government.

(2) **Central Province.** Main cities: Riyadh, the capital and the permanent seat of the government.

(3) **Eastern Province (Al-Hasa).** Main cities: Dammam, a major sea port and industrial centre; Al-Khobar, a residential and commercial centre, Dhahran and Jobial, focus of operation of the province's oil and industry.

(4) **Southern Province (Asir).** Main cities: Abha, a tourist resort; Khamis Mushayt.

TABLE 1—1

CHANGES OF THE POPULATION OF JEDDAH IN THE PERIOD BETWEEN 1947 TO 1978.

Year	No. of Population	Change in No. of Population for the period	% Change in in No. of Population for the period	Annual % Change for the period.	Source of Estimation.
1947	60,000	-	-	-	Aerial Photography interpretation.
1961	150,000	90,000	150.0%	10.71%	Wilson Murrow Report.
1966	230,000	100,000	66.7%	13.33%	Wilson Murrow Report.
1971	404,600	154,600	61.8%	12.37%	Social Survey by Robert Matthew and Johnson Marshall, Planners.
1974	595,960	191,300	47.3%	15.76%	Official Census.
1978	915,800	319,900	53.7%	13.42%	Socio-Economic of SCET/Jackson Int/ Saudconsult.

(5) **Northern Province.** Main cities: Tabuk, a city of strategic importance (military base); Al-Jouf, undergoing agricultural development.

(6) **The Desert (Rub-Al-Khale).** This large sand desert occupies much of the South of Saudi Arabia.[3] (See fig. 1.1)

GENERAL TOPOGRAPHY.

Along the Red Sea lies a narrow plain, whose width varies from one place to another. It is 40 miles wide in the south and gradually narrows to 30 miles from Jzan to Al-Laith, to only 10 miles when it reaches Al-Wajh in the north. This coastal plain is called "Tihamah". Immediately to the east of the coastal plain runs a range of high mountains with steep escarpment edges dominating the Tihamah below. The highest mountains are in Asir where peaks rise to over 9,000 feet.

Directly east of this range of mountains lies the Najd plateau with an average height of 4,000 to 6,000 feet. The Najd plateau extends southward to Wadi-Ad-Wawasir, then runs parallel to the Rub-Al-Khali. To the north the plains of Najd extend for nearly 900 miles past Hail until they join the Iraqui and Jordanian borders. While gradually, eastward the plateau diminishes near Hafuf, after which the surface drops to form the low-lying coastal plain of Hasa.[4] (See fig. 1.2).

FIGURE 1.1.

GEOGRAPHICAL PROVINCES IN SAUDI ARABIA.

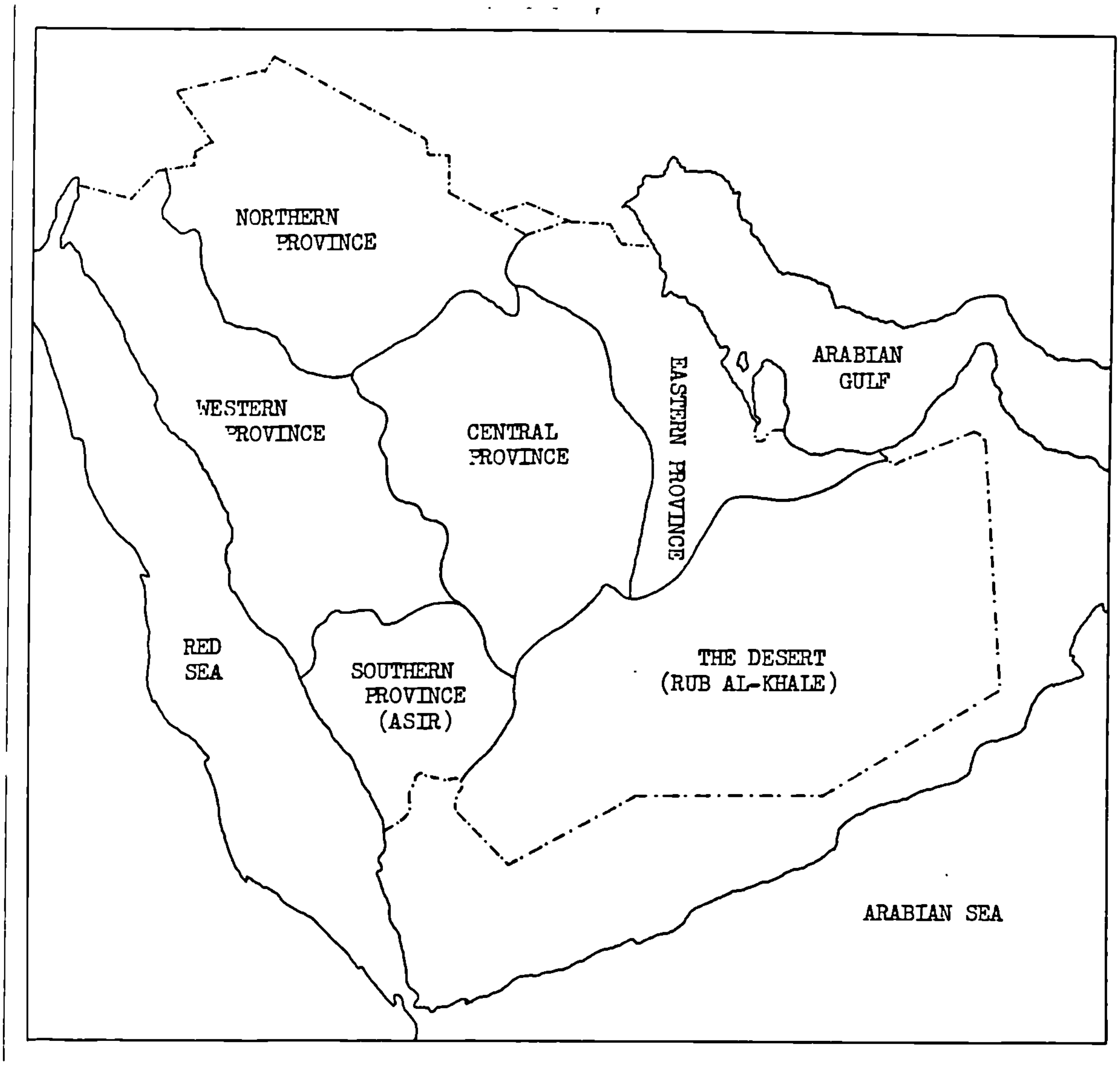
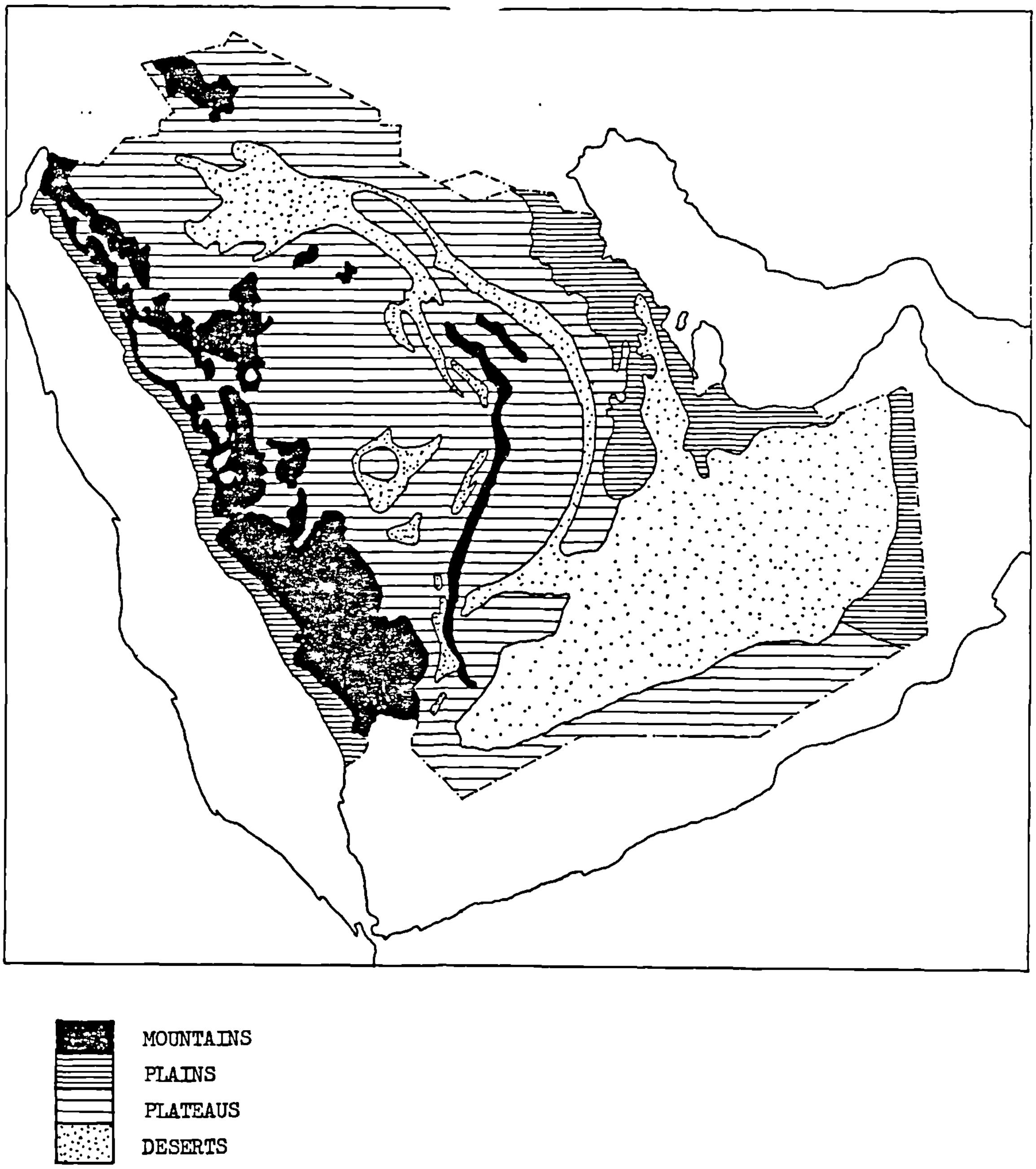


FIGURE 1.2.

TOPOGRAPHY OF SAUDI ARABIA.



Source: Hussain Bundagi, "Atlas of the Kingdom of Saudi Arabia".

CLIMATE.

Saudi Arabia derives its weather mainly from the north and west: climatically it has a similar pattern to the eastern Mediterranean and adjacent lands, in that it has a long, hot and almost dry summer, with a short cool winter season during which a little rain occurs. This is because air masses reaching Arabia have been largely exhausted of their moisture. Although Saudi Arabia is surrounded on three sides by sea, aridity is the dominant feature. With the exception of the mountains of Asir in the south-west, any influences from the southern tropical zones are excluded by the highland rim that runs from Oman through the South and North of Yemen.

Because of the dryness of the air reaching Saudi Arabia, and the consequent lack of cloud, insolation is considerable, producing very high summer temperatures, up to 45° or 50°C, and sometimes even more in the southern deserts. But the cloudlessness also allows heat to escape from the surface at night, especially in winter, so temperatures drop quite markedly both between day and night and between summer and winter. The night coolness, with a 10° to 22°C drop in both seasons, is a boon in summer, but leads to sporadic frost in the interior of the centre and in the north during winter; -7°C has been recorded at Riyadh.

Rainfall is scanty, irregular and unreliable, occurring mostly during the months from October to April. Except along the Red Sea coast and the mountains of Asir, summers are partially rainless, and in the interior of Saudi Arabia several years may continue without rain. Because of the temperature contrasts, winds can be strong, raising dust storms from time to time.[5]

This regime is modified in the coastal strip by the wind passing over the Red Sea. Relative humidity is quite high near to the sea and is a factor to be considered in those urban areas on the coast. The effects however quickly fall off as one penetrates inland. This can be shown by comparing the data for Jeddah and Makkah. The distance between them is about 60 kilometres. (See figs. 1.3 - 1.6).

CHARACTERISTICS AND DEVELOPMENT OF GENERAL EDUCATION IN SAUDI ARABIA.

BRIEF HISTORY.

Education in its contemporary meaning as an educational programme open to the mass of the population was not usual until the unification of the Kingdom of Saudi Arabia. Before that time and in spite of the multiplicity of the provinces in the Kingdom, very few schools were founded in the western holy province. These schools are as follows:

(1) **The Saulatiyya School, founded in the year 1291 A.H. (1873 A.D.), by Al Sayedh Saulat Al-Nisaa.**

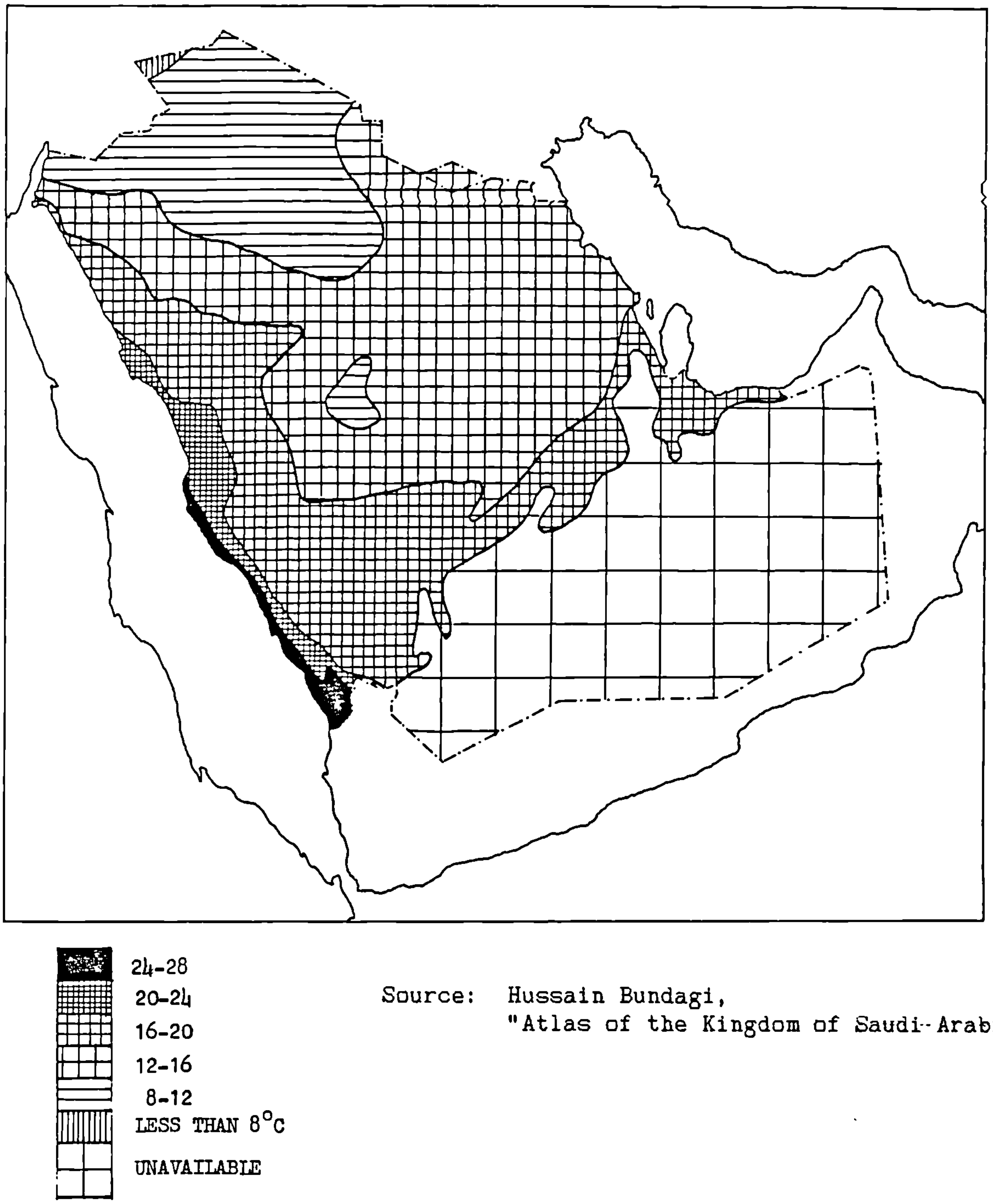
(2) **Al-Fakhriyya School, founded in 1298 A.H. (1880 A.D.).**

(3) **The Islamic School - called Daar-Al-Faaïzeen, founded in 1304 A.H. (1886 A.D.).**

FIGURE 1.3.

AVERAGE TEMPERATURE IN WINTER.

December, January, February.

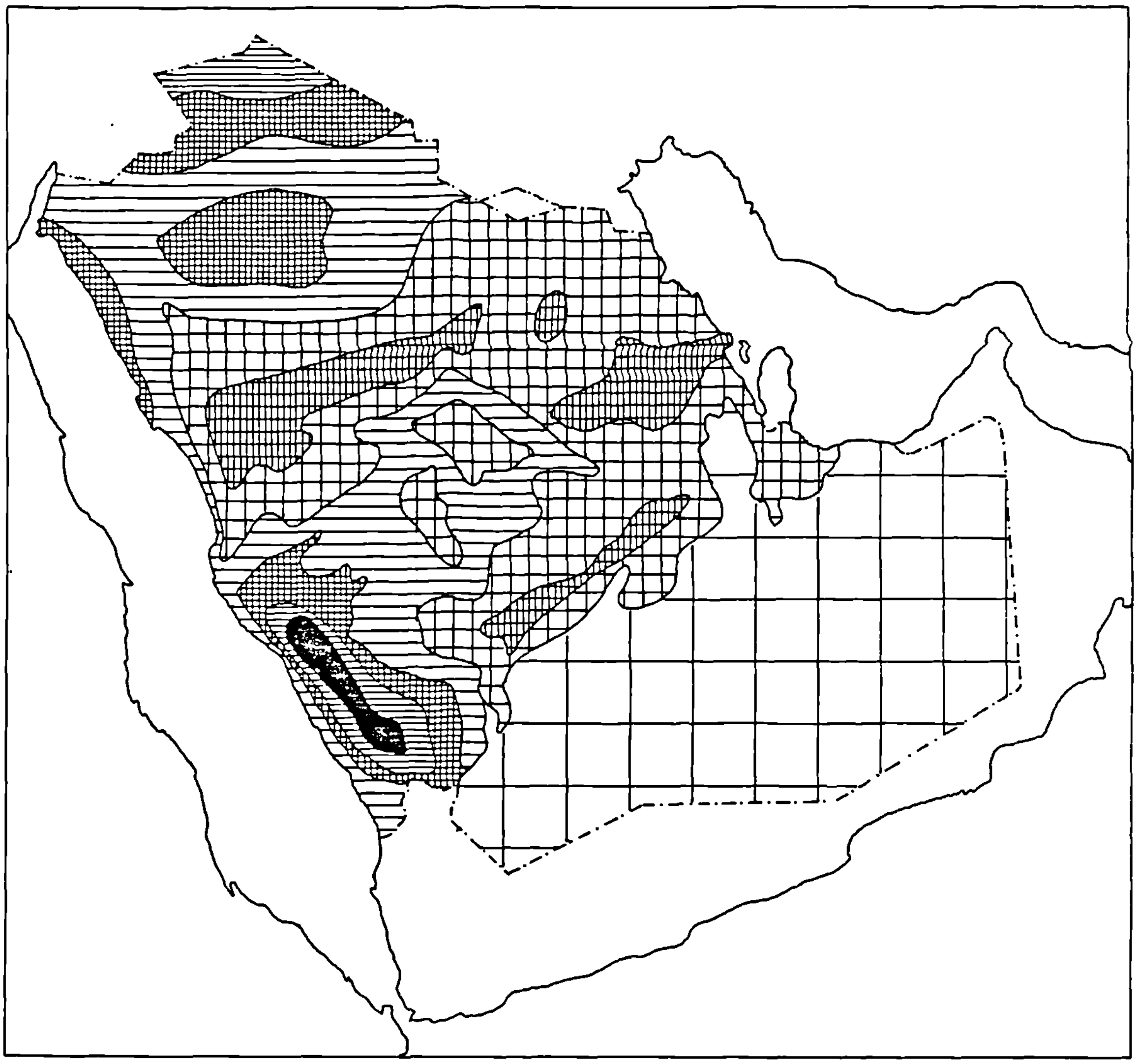


Source: Hussain Bundagi,
"Atlas of the Kingdom of Saudi-Arabia".

FIGURE 1.4.

AVERAGE TEMPERATURE IN SUMMER.

June, July, August.



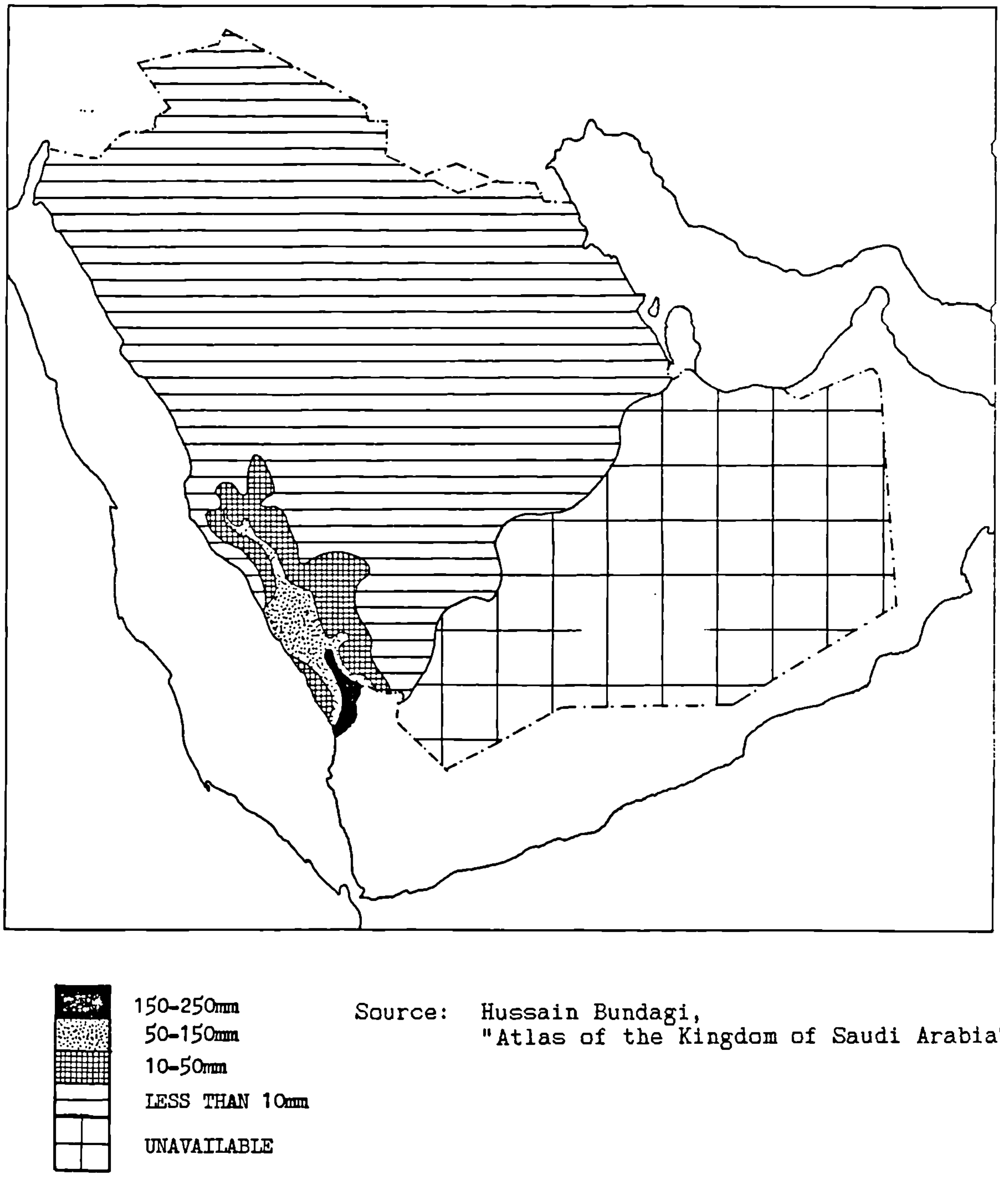
LESS THAN 26°C
26-28
28-30
30-32
32-34
34-36
UNAVAILABLE

Source: Hussain Bundagi, "Atlas of the Kingdom of Saudi Arabia".

FIGURE 1.5.

AVERAGE RAINFALL IN SUMMER.

June, July, August.

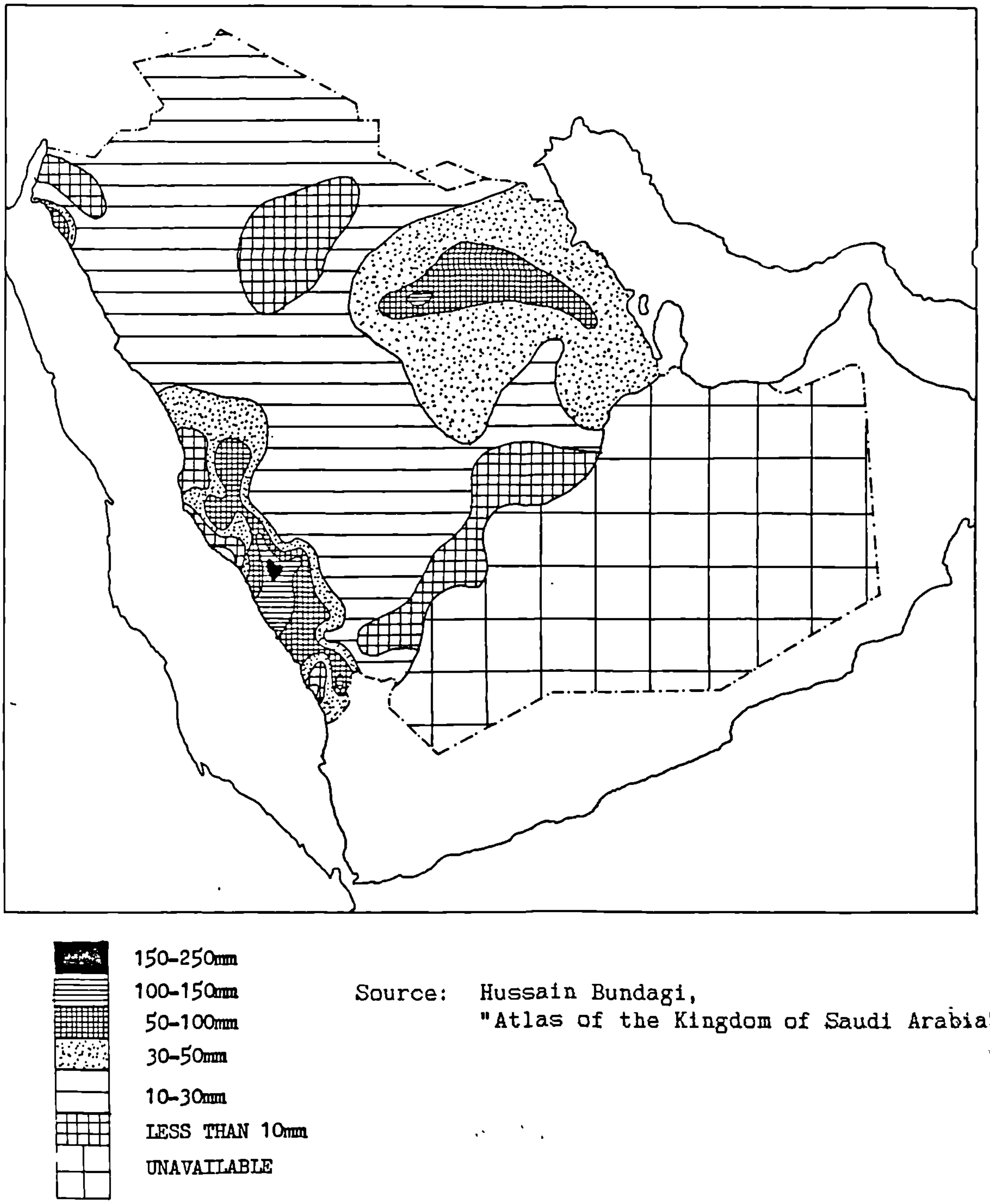


Source: Hussain Bundagi, "Atlas of the Kingdom of Saudi Arabia".

FIGURE 1.6.

AVERAGE RAINFALL IN WINTER.

December, January, February.



Source: Hussain Bundagi,
"Atlas of the Kingdom of Saudi Arabia".

(4) **Al-Falah School in Jeddah, founded in 1330 A.H. (1912 A.D.).**

(5) Al-Falah School in Makkah, founded in 1337 A.H. (1919 A.D.).

These schools had been established through private initiatives and as a service by some of the early emigrants to the holy lands.[6] But other than that, there were a few 'kuttabs' or one teacher schools, where students learned the rudiments of religion, reading and writing.

This situation remained until the first government grants for education were made in 1925 A.D. through the establishment of the General Department of Education which was considered to be a precursor to other educational organizations such as: the Saudi Scientific Institute, founded in 1925 A.D; and the Basic School for Foreign Scholarships (Madrasat Tahdeer Al-Ba'thaat) founded in 1936 A.D.

The major step which was taken by the government to spread general education was the establishment of the Ministry of Education in 1952 to supervise the educational affairs of boys throughout the Kingdom of Saudi Arabia.

The task of the Ministry of Education was not easy, where just two years prior to its establishment, the total number of elementary schools in the Kingdom was only 196, with 942 teachers responsible for 23,835 students. Under the Ministry of Education the number of elementary schools rose to a total of 1,197. There were 18,380 teachers with 364,651 students by 1974.[7] The difference shows the tremendous effort that has been made to accelerate the development of education in the Kingdom.

The other important step which has been taken by the government was the establishment of the Presidency of Girls' Education in 1970 A.D., to supervise the education of girls throughout the Kingdom at all levels. Before that time, girls' education was limited to some private institutions in a few cities.

PHILOSOPHY OF EDUCATION IN SAUDI ARABIA.

Education in Saudi Arabia is one aspect of a total and comprehensive philosophy about life, based on the fundamentals of Islam. The concept of Muslim scholars at the First World Conference on Muslim Education held in Makkah in 1977, is:

> *"... the creation of the 'good and righteous man' who worships Allah in the true sense of the term, builds up the structure of his earthly life according to the Shari'ah (law) and employs it to subserve his faith.*
>
> *The meaning of worship in Islam is both extensive and comprehensive; it is not restricted to the physical performance of religious rituals only but embraces all aspects of activities: faith, thought, feeling and work .... Therefore, the foundation of civilization on this earth, the exploitation of the wealth, resources and energies that Allah has hidden in its bowels, the search for sustenance, the measures by which man can rise to full recognition of the ways of Allah in the Universe,... all these are considered forms of worship by which scholars and God-seekers come into closer contact with Allah."*(8)

AIMS AND POLICIES OF EDUCATION.

The official document of educational policy in the Kingdom, which was issued in 1968, comprises over 200 sections, covering general and higher education, technical education, teachers' training programme, anti-illiteracy and adult education, etc. But the most important feature that characterizes the policy is the strong emphasis on Islam, where Islamic studies are basic to all levels of elementary, intermediate and secondary education. Islamic culture is a basic subject in all higher education years.

SYSTEM OF GENERAL EDUCATION IN SAUDI ARABIA.

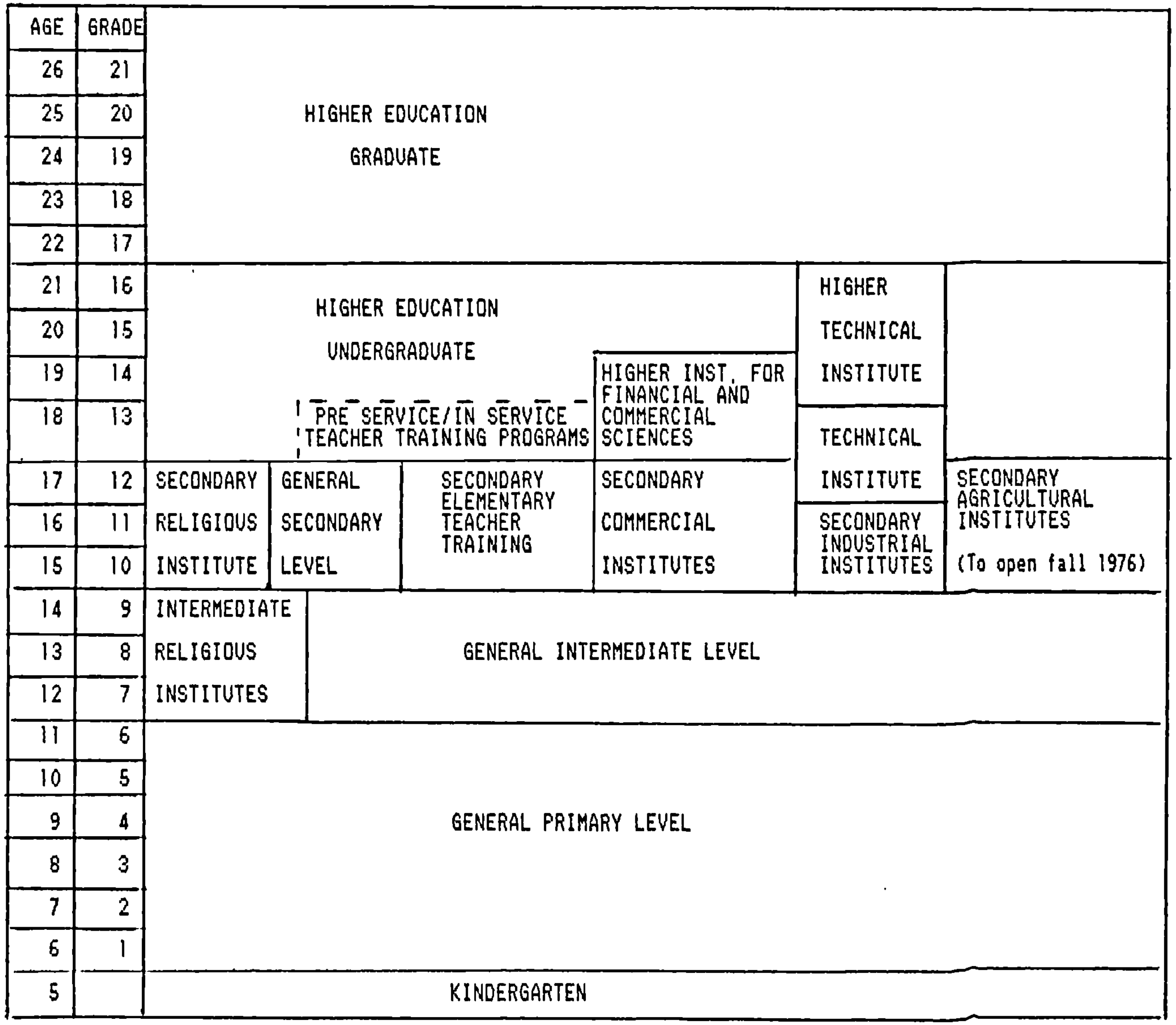
The pattern of the general educational system in Saudi Arabia comprises four levels: 2 years of kindergarten, 6 years of elementary schooling, 3 years at intermediate level, then 3 years at secondary school, leading to higher education. (See fig. 1.7).

This system is well known and is being applied in other Arab and Muslim countries, but the most important feature that characterizes the Saudi's system is the complete separation of male and female education. This covers administrative facilities and instruction throughout the elementary, intermediate, secondary and higher education periods.

CURRICULUM AND TEACHING METHODS.

Although male and female education is separated, curriculum and textbooks, prescribed by the central authorities at all levels for both sexes, are almost uniform throught the Kingdom

FIGURE 1.7


AGE
GRADE
26 21
25 20
24 19
23 18
22 17
21 16
20 15
19 14
18 13
17 12
16 11
15 10
14 9
13 8
12 7
11 6
10 5
9 4
8 3
7 2
6 1
5
HIGHER EDUCATION
GRADUATE
HIGHER EDUCATION
UNDERGRADUATE
PRE SERVICE/IN SERVICE TEACHER TRAINING PROGRAMS
HIGHER INST. FOR FINANCIAL AND COMMERCIAL SCIENCES
HIGHER TECHNICAL INSTITUTE
TECHNICAL INSTITUTE
SECONDARY RELIGIOUS INSTITUTE
GENERAL SECONDARY LEVEL
SECONDARY ELEMENTARY TEACHER TRAINING
SECONDARY COMMERCIAL INSTITUTES
SECONDARY INDUSTRIAL INSTITUTES
SECONDARY AGRICULTURAL INSTITUTES
(To open fall 1976)
INTERMEDIATE RELIGIOUS INSTITUTES
GENERAL INTERMEDIATE LEVEL
GENERAL PRIMARY LEVEL
KINDERGARTEN

with some minor adaptation in girls' textbooks to suit their particular needs.

Teaching methods and curriculum are based on a class group organization, where all students are split up by age groups and each age group is divided into classes of 30-40 students. This is similar to the traditional pattern found in other countries. On the other hand, the teaching week contains 35 periods at elementary level and 36 in intermediate and secondary levels. The length of each period is 45 minutes.

ENROLMENT AND CONSTRUCTION OF SCHOOL BUILDINGS PROGRAMME.

There have been a number of development plans. The first two need not be studied as they have been overtaken by the third.

According to the Third Development Plan 1980-1985, education has been given special attention in the short and long terms. The major educational goal of the new plan is the continued expansion of facilities at all levels.

ELEMENTARY LEVEL.

Enrolment of boys in elementary schools is expected to climb from 527,769 to 696,335. To shelter this increased enrolment, 848 new elementary school buildings should be constructed during the five years of the plan. (See Tables 1.2 - 1.5).

The enrolment of girls during the same period will increase from 308,092 to 439,213. To permit this increased enrolment by 1985, more than 2,000 school buildings should be provided over the country.

TABLE 1.2.

MINISTRY OF EDUCATION: PROJECTED ENROLMENTS.

(Number)

Category.	1399/1400	1404/05	Percentage Increase
Elementary(1)	527,769	696,335	31.9
Intermediate(1)	126,215	188,844	49.0
Secondary(1)	50,489	79,625	57.7
Teacher Training	9,594	17,335	80.7
Adult Education	75,700	137,650	81.8
Other(2)	8.624	17,275	100.0

(1) Data includes Islamic education.
(2) Other includes special education and technical education.

TABLE 1.3.

MINISTRY OF EDUCATION: CONSTRUCTION PROGRAMME
(Number)

Category	Classrooms	Schools
Primary	10,461	848
Intermediate	4,161	270
Secondary	1,593	105
Intermediate/Colleges	-	6
Special Education	-	5
Koranic Schools	-	60
Polytechnic Institutes	-	1

Source: Ministry of Planning,
Third Development Plan, 1980-85.

TABLE 1.4.

PRESIDENCY FOR GIRLS' EDUCATION: CONSTRUCTION PROGRAMME

(Number of Class Rooms)

Type of School	1400/01	1401/02	1402/03	1403/04	1404/05	Third Plan
350 New schools of 6 classes (elementary rural schools)	210	441	483	483	483	2,100
50 New schools of 9 classes (elementary and intermediate levels)	-	-	140	121	189	450
45 New schools of 15 classes (intermediate and secondary levels)	-	-	60	250	365	675
40 New schools of 27 classes (educational compounds)	-	-	227	540	313	1,080
	210	441	910	1,394	1,350	4,305

TABLE 1.5.

PRESIDENCY FOR GIRLS' EDUCATION: PROJECTED ENROLMENTS.

Category	Enrolments (Number) 1399/1400	1404/05	Percentage Increase
Elementary	308,092	439,213	42.6
Intermediate	72,033	103,655	43.9
Secondary	26,542	43,560	64.1
Teacher Training	12,996	24,370	87.5
Adult Education	36,485	49,404	35.4
Other(1)	4,520	15,552	244.1

(1) Includes nursery, kindergarten and technical education. Koranic programmes are included under "elementary".

Source: Ministry of Planning,
Third Development Plan, 1980-85.

INTERMEDIATE LEVEL.

Enrolment at the intermediate level for boys is projected to increase from 126,215 to 188,844. It is estimated that the number of new schools needed to deal with that increase is 270. Enrolment of girls will increase from 72,033 to 103,655 with a commensurate demand for new buildings.

SECONDARY LEVEL.

Planned enrolment at the secondary level for boys is expected to climb from 50,489 to 79,625 giving a percentage increase of 57.7%. To accommodate this increased enrolment, 105 new schools are to be provided during the five years plan.

Enrolment of girls will increase from 26,542 to 43,560 with a percentage increase of 64.1%.

THE ADMINISTRATIVE SYSTEM IN SAUDI ARABIA.

GOVERNMENT.

The Council of Ministers, headed by the King, possess the legislative and executive power in Saudi Arabia. The Council exercises authority and supervision over all internal regional government agencies, as well as being responsible for dealing with all international matters. The whole executive action of the government machine is carried out by the Council. However, all drafts and decrees must be submitted by it to the King for signature, who may return them for further consideration. The first Deputy Prime Minister has wide powers of supervision and control over the ministries and departments. He is responsible for directing the policy of the state.(9)

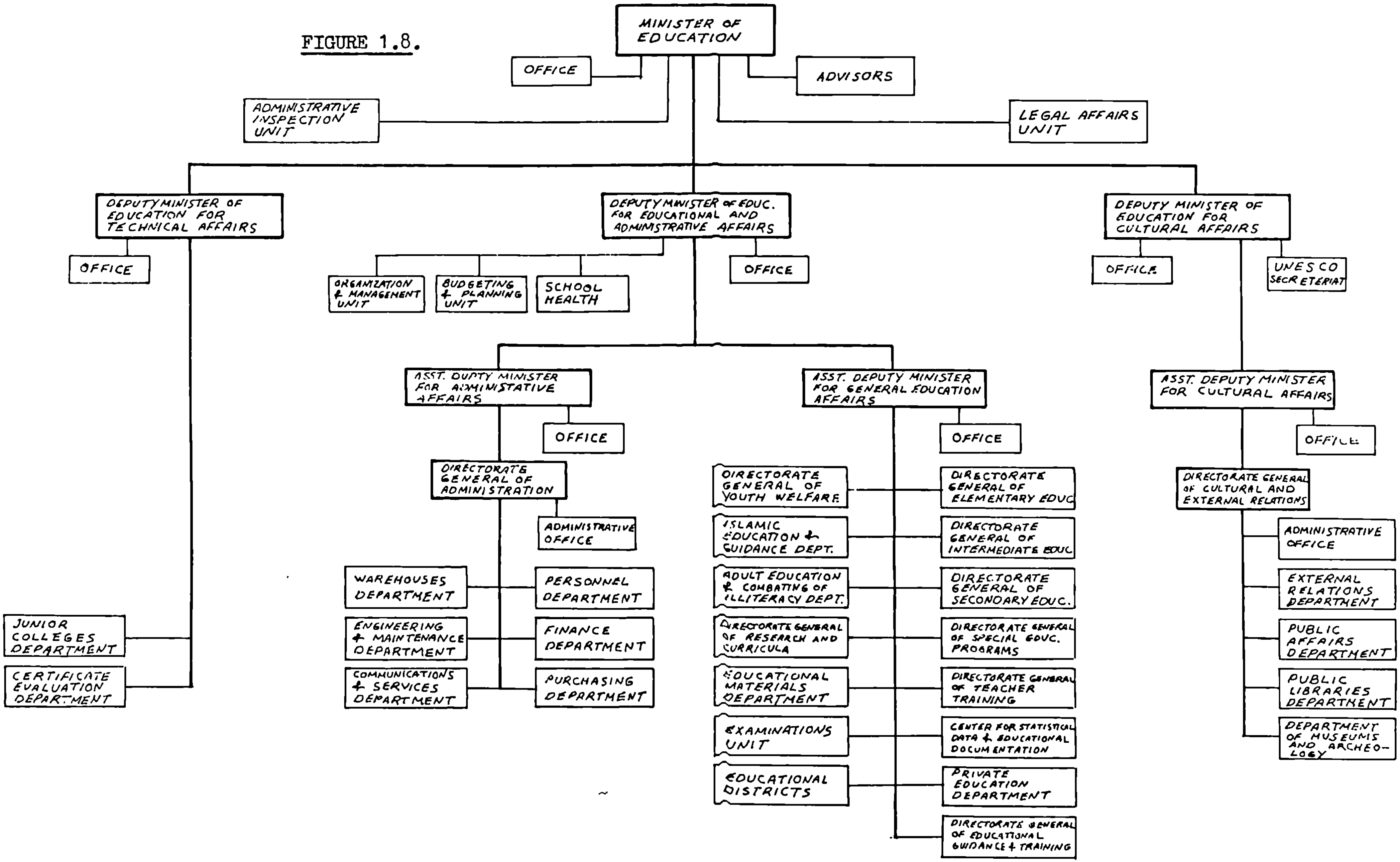
As a result of having a centralized form of government, a coordinating body is required between the various Ministries and departments. This is especially important to deal with the availability of natural resources and for the purposes of the annual budget. The first Planning Board, which was responsible for planning and drawing up the policy of economic and social development amongst the various Ministries and following up their execution, was established in 1961. With the need to control the public sector and to influence the private sectors as well, another advisory body was established in 1967 which was called the Central Planning Organisation. It was not until the early seventies that the Central Planning Board was elevated to Ministerial level. The responsibilities of the new Ministry of Planning have been to set up and execute the national Five Year Development Plans (1970-75; 1975-80 and 1980-85), as well as to review and follow up the progress submitted by executive Ministries and to coordinate and prepare the annual budgets of capital expenditure in the implementation phase.[10]

CENTRAL GOVERNMENT AND LOCAL DISTRICTS - THE COMMUNICATION PATTERN.

Figure 1.8 shows the organization chart of the Ministry of Education in 1981, where the general education affairs are headed by a separate Assistant Deputy Ministry. The 15 departments, which are supervised by this Assistant Deputy Ministry, represent the core work of the Ministry. This is because of the load and magnitude of responsibility and delegated authority covers and affects every school in the country.[10]

ORGANIZATION PLAN OF THE MINISTRY OF EDUCATION 1981

FIGURE 1.8.



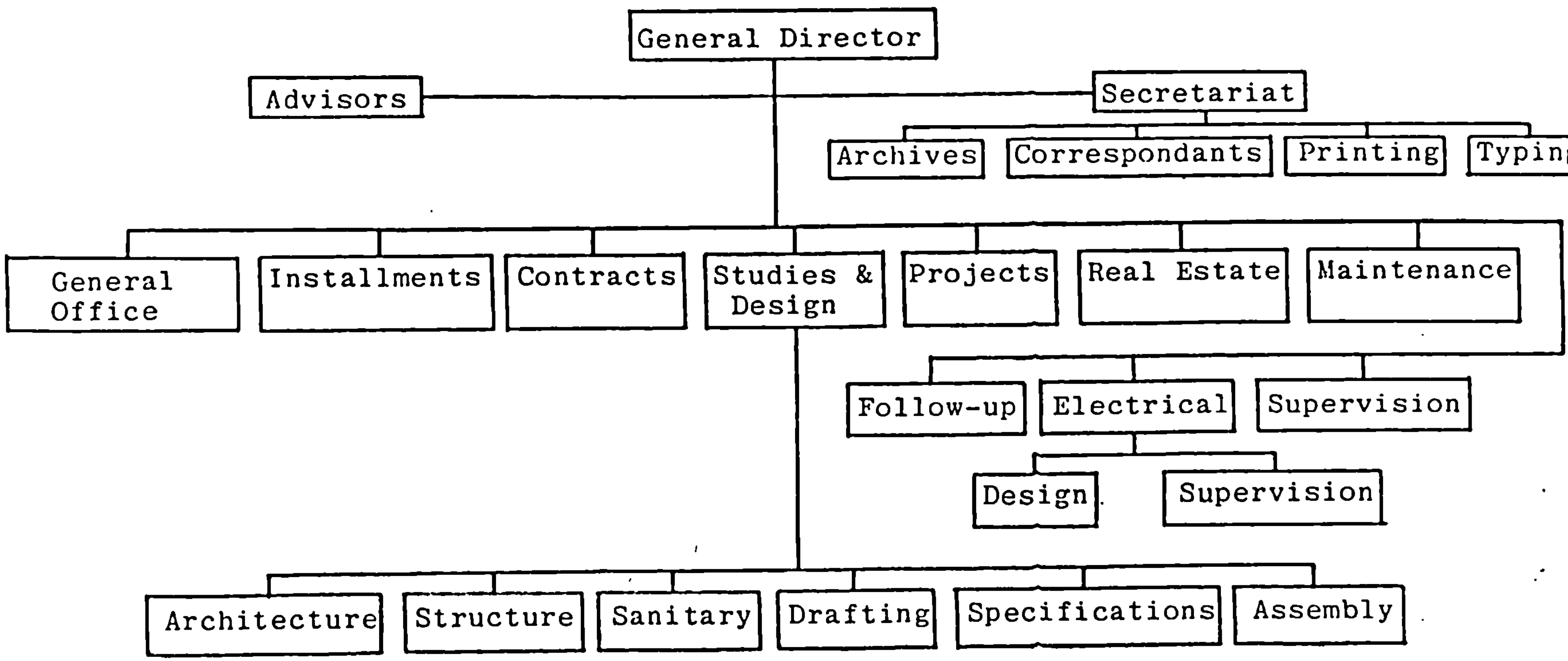
The organization chart (figure 1.9) shows that all matters of school building are the responsibility of the Department of Engineering and Maintenance, which is headed by the Assistant Deputy Minister for Administrative Affairs. The responsibility of the Engineering and Maintenance Department (ED) is to handle all affairs related to school building, both in public ownership and leased, throughout the country. This includes acquiring sites, preparing drawings for tenders and construction, supervising the construction, receiving executed buildings and maintaining the buildings after occupancy. The responsibility of the Department also includes other facilities built by the Ministry, such as Educational District Office buildings, public libraries, special schools and maintaining leased school buildings.(11)

Moving to the regional level, 25 Educational Districts are directly responsible for the daily affairs of every school in the country. (See figure 1.10) Each district is headed by a director who reports directly to the Assistant Deputy Minister for General Education Affairs. The main function of the Educational District is to represent the Ministry of Education, rather than representing the local communities. This is why these district offices are called officially "Eductional Districts", rather than "Local Educational Authorities".

As a result of this lack of any local representation, the school unit comes at the bottom, having a sense of isolation and lacking any political power. This isolation brings many problems but in the field of school building and design there is little

FIGURE 1.9.

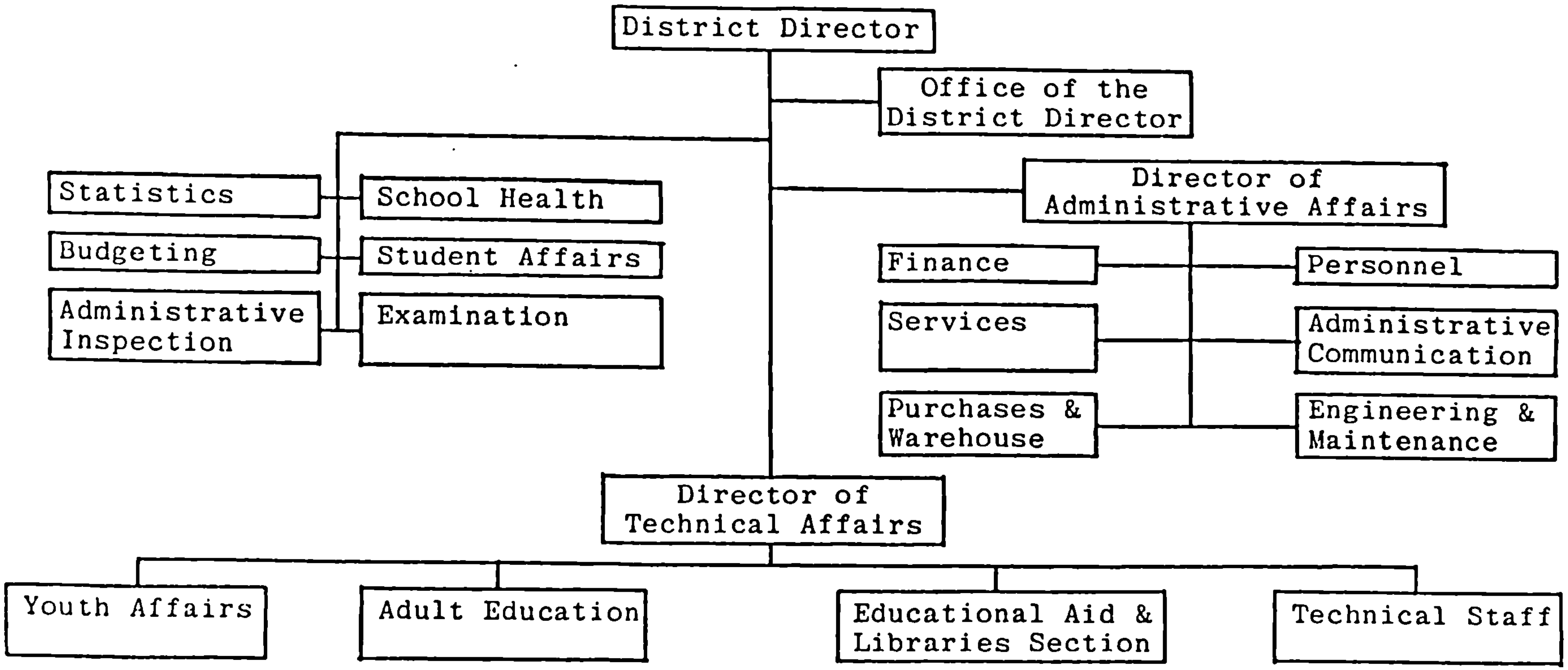
The Organizational Chart of the Engineering and Maintenance Department of the Ministry of Education



Source: The Engineering and Maintenance Department, Ministry of Education, Riyadh.

FIGURE 1.10

Organizational Chart of the Educational District



Source: Center for Statistical Data, Educational Statistics 1973-74, Ministry of Education, Riyadh, knowledge of shortcomings in design and little feedback into the design and educational processes.

EXISTING SITUATION AND FEATURES OF THE PROBLEM.

The statistical data relating to general education in the Kingdom during the past ten years, 1971-72 to 1980-81, shows a considerable annual percentage increase of enrolment (7.5% in elementary, 13.2% in intermediate and 17.6% in secondary) and an annual rate of school buildings provision of 11.5% in elementary, 13.7% in intermediate and 15.6% in secondary. (See Appendix A) But despite this considerable increase, two main features can be recorded. The first is a phenomena of drop-out and repeating years by students, the second is a shortage of adequate school buildings.

DROP-OUT AND REPEATING.

Following three cohorts of children enrolled from grade 1 to 7 from the periods 1972-73, 1973-74 and 1974-75 respectively indicates the following results:

(1) The first cohort enrolled in 1972-73 with a figure of 41,115 students, of whom 23,150 managed to enroll in grade 7 in 1978-79. While the number of students who dropped-out and repeated is 17,965, or 44% of the total.

(2) In the second cohort who enrolled in 1973-74, the percentage was negatively increased to 56%.

(3) While the third one, who enrolled in 1974-75, had suffered a percentage of drop-out and repeating of 80%.
(See figs. 1.11 - 1.13).

Unfortunately the available time-series is not long enough to follow complete cohorts through from grades 1 to 13. Therefore, other cohorts have been followed through from grades 7 to 10 and 10 to 13, which represent intermediate and secondary levels respectively.

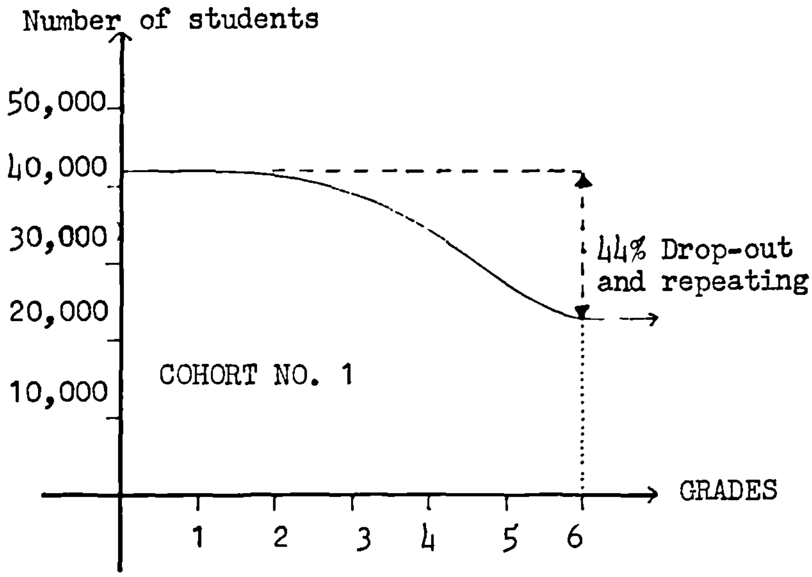
In the intermediate level, 12 cohorts have been followed through from 1972 to 1981, where six of them were boys and the rest were girls. Four of the boys' cohorts had suffered badly from drop-out and 'repeating'. The percentages of drop-out and repeating for the 6 cohorts have been recorded as follows: -55%; +1.7%; -39%; +10%; -64% and -88%. The negative sign (-) means that the number of students has been decreased or a drop-out to this percentage, while the positive sign (+) means an increase in the percentage of graduate students. (See figs. 1.14 - 1.19).

The Situation in the other six girls' cohorts is rather worse, where the six cohorts had suffered a high drop-out and 'repeating'. The results are as follows: -62%; -48%; -68%; -55%; -43%; -40%. (See figs. 1.20 - 1.25).

In secondary level, the average percentage of drop-out and repeating is 60% for both boys and girls. But the situation in secondary education is different, because dropped-out students

ELEMENTARY LEVEL
PHENOMENA OF DROP-OUT
AND REPEATING IN BOYS'
AND GIRLS' SCHOOLS

FIGURE 1.11



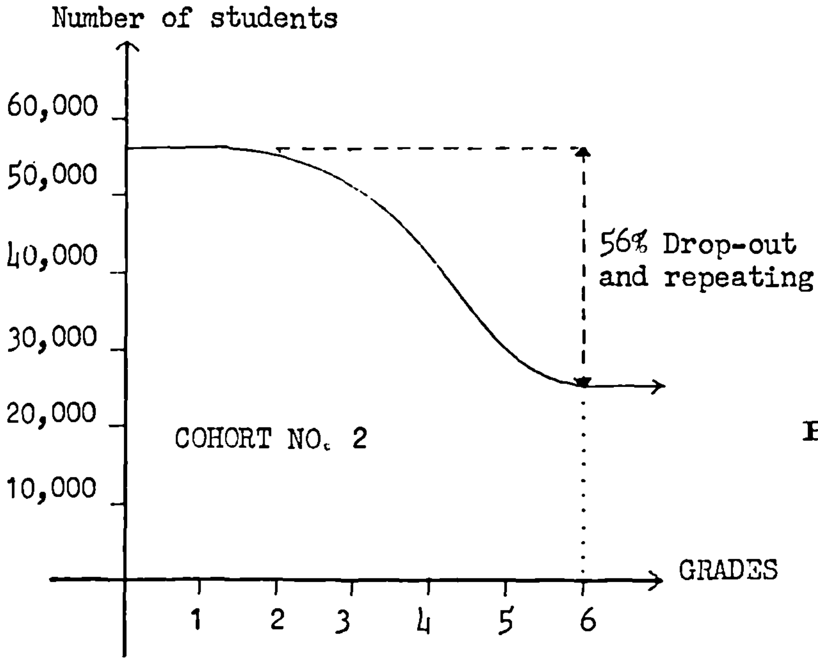
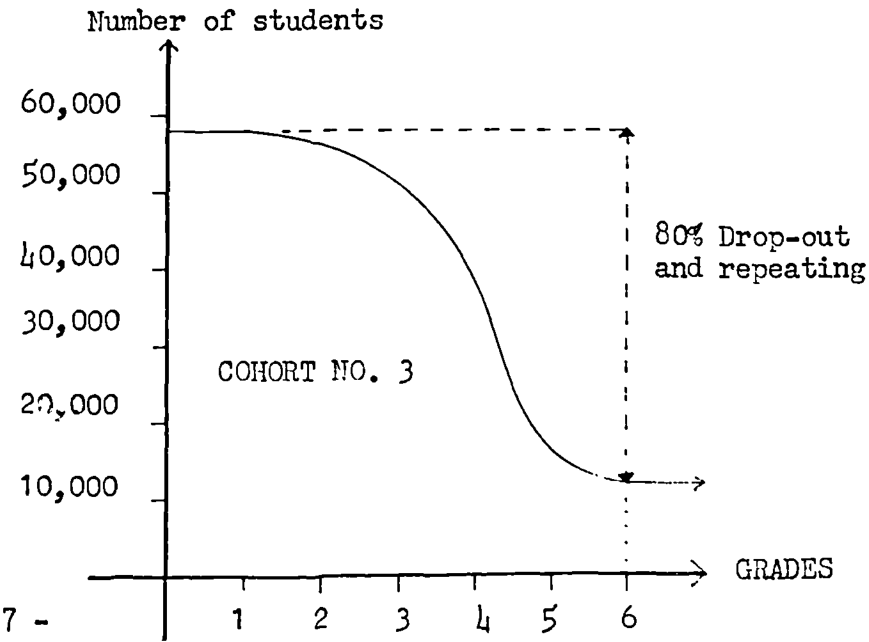


FIGURE 1.12

FIGURE 1.13



INTERMEDIATE LEVEL

PHENOMENA OF DROP-OUT AND REPEATING YEARS IN

BOYS' SCHOOLS

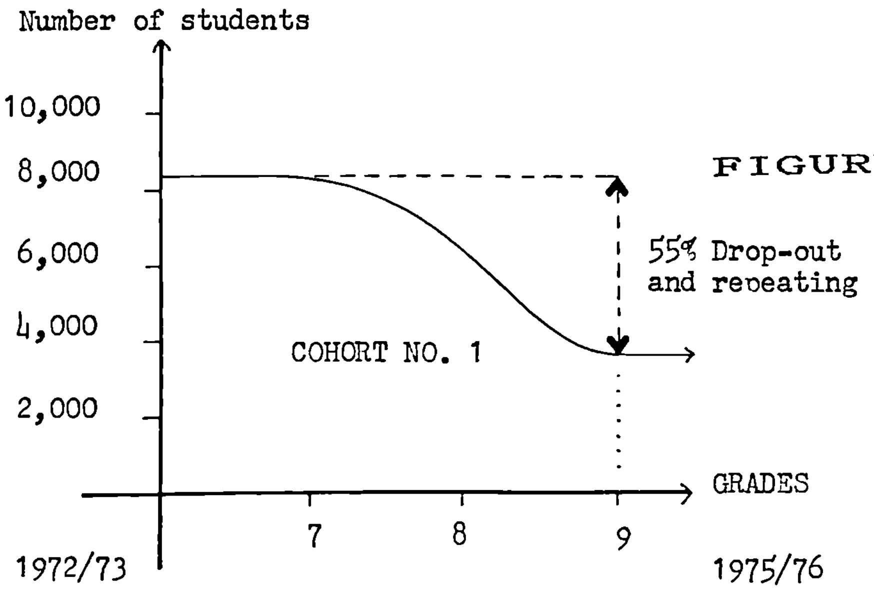


FIGURE 1.14

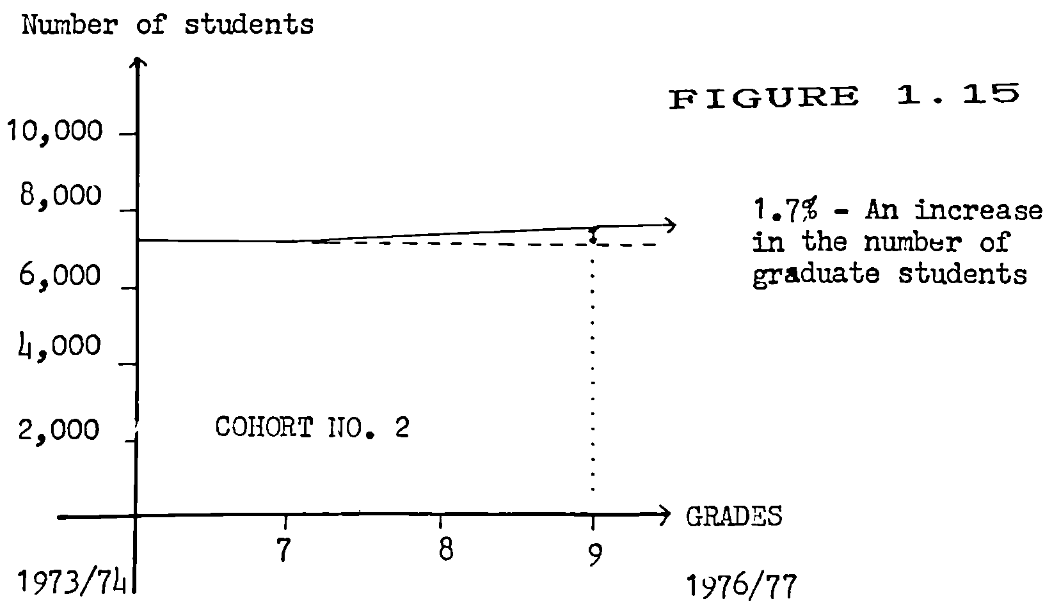


FIGURE 1.15

INTERMEDIATE LEVEL

PHENOMENA OF DROP-OUT AND REPEATING IN BOYS' SCHOOLS

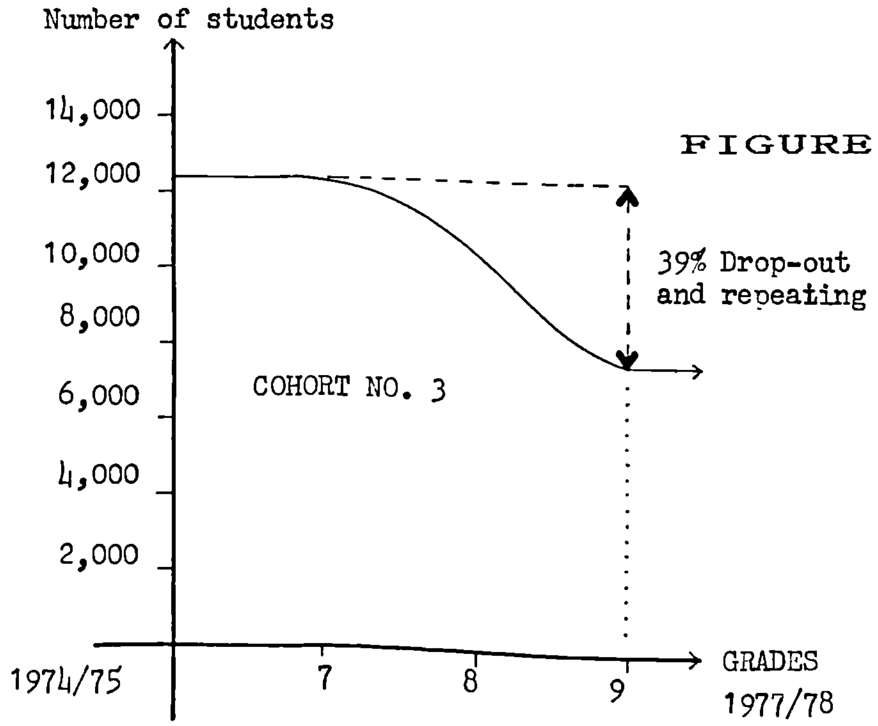


FIGURE 1.16

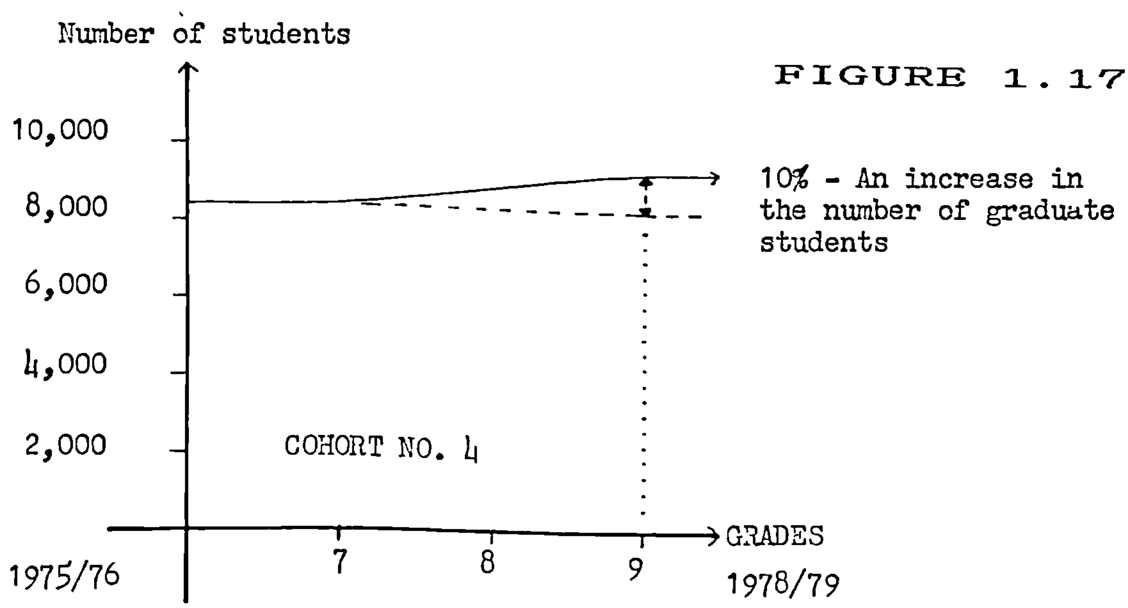


FIGURE 1.17.

INTERMEDIATE LEVEL

PHENOMENA OF DROP-OUT AND REPEATING IN BOYS' SCHOOLS

FIGURE 1.18

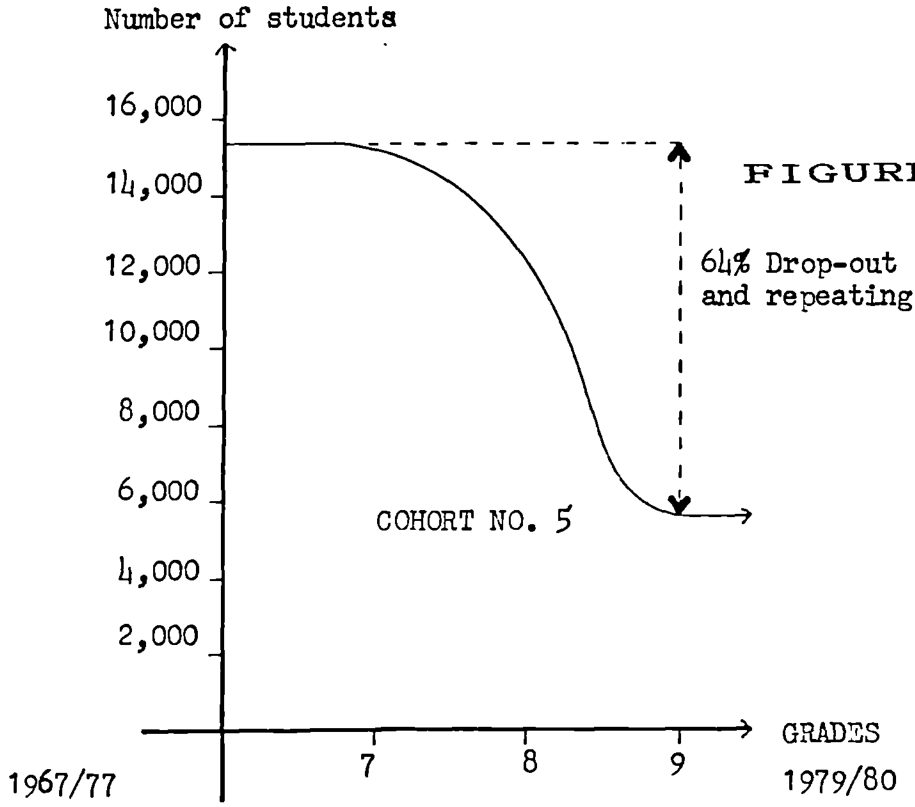
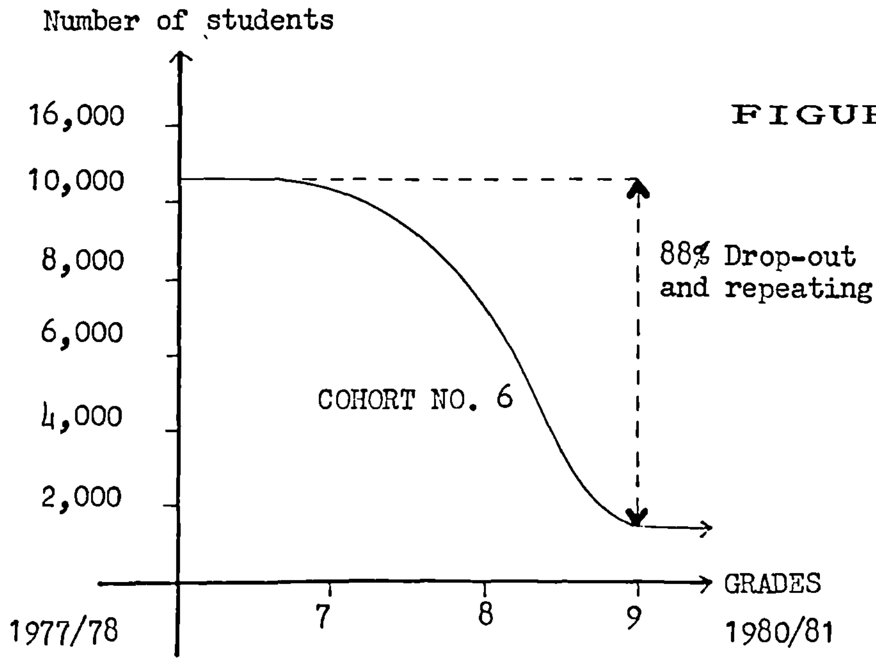
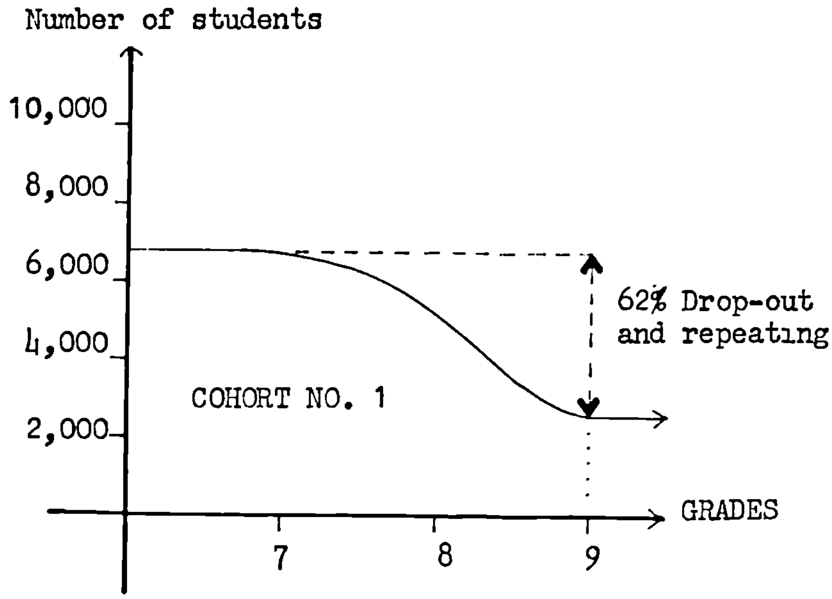


FIGURE 1.19.



INTERMEDIATE LEVEL
PHENOMENA OF DROP-OUT AND
REPEATING IN GIRLS' SCHOOLS

FIGURE 1.20.



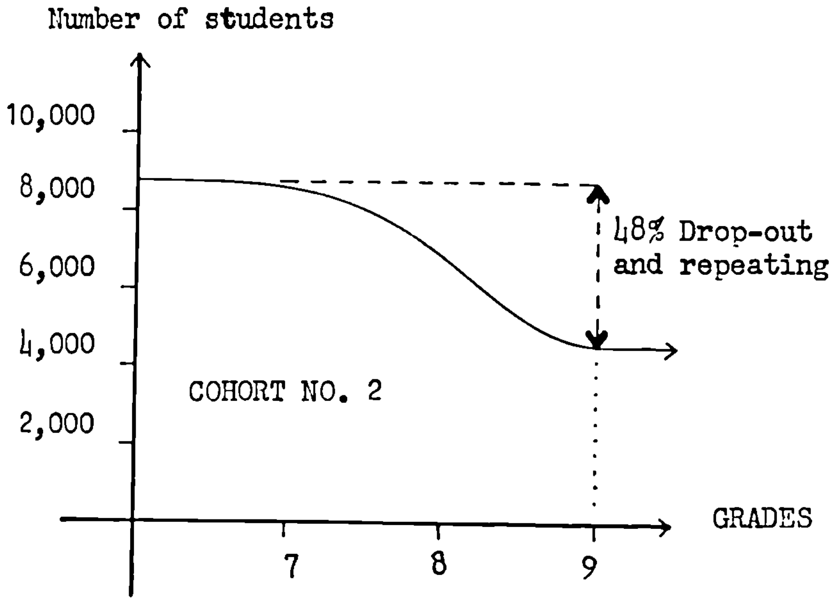
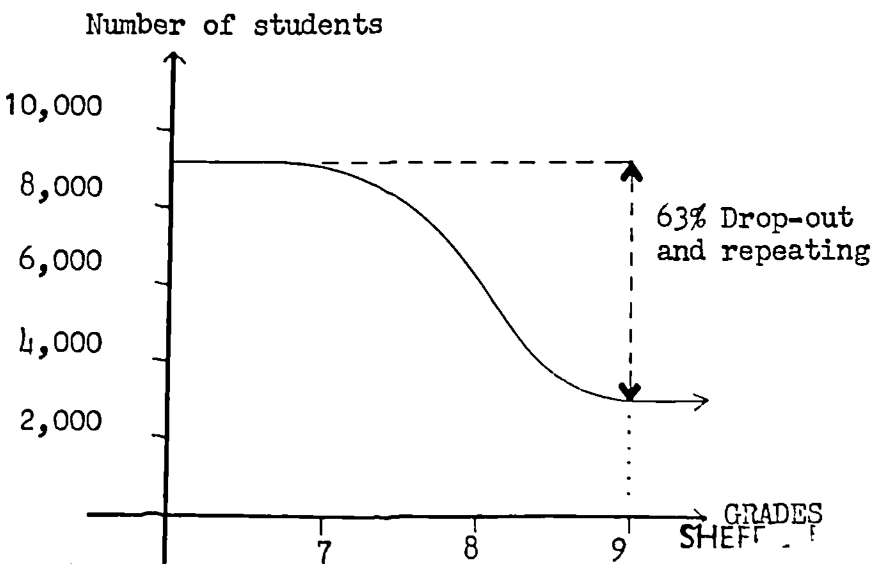


FIGURE 1.21.

FIGURE 1.22.



INTERMEDIATE LEVEL

PHENOMENA OF DROP-OUT

AND REPEATING IN GIRLS' SCHOOLS

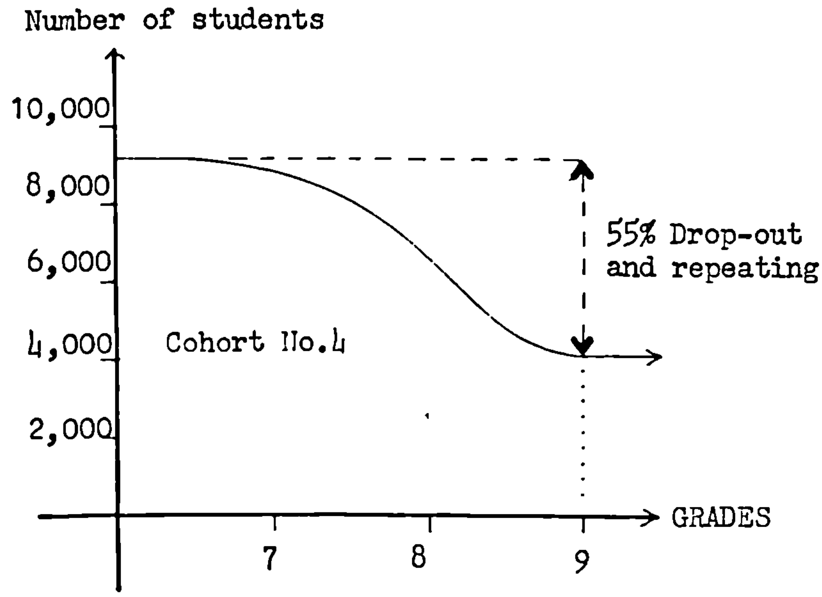


FIGURE 1.23.

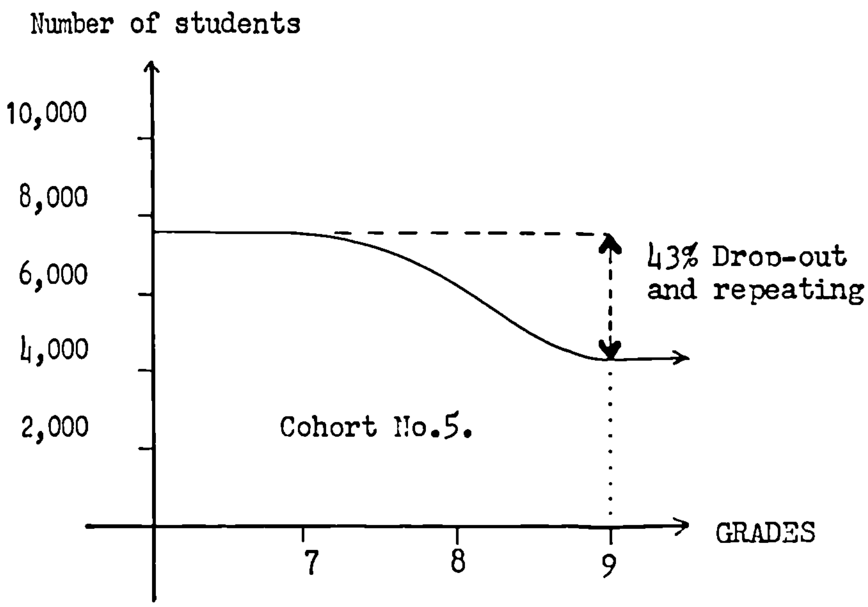
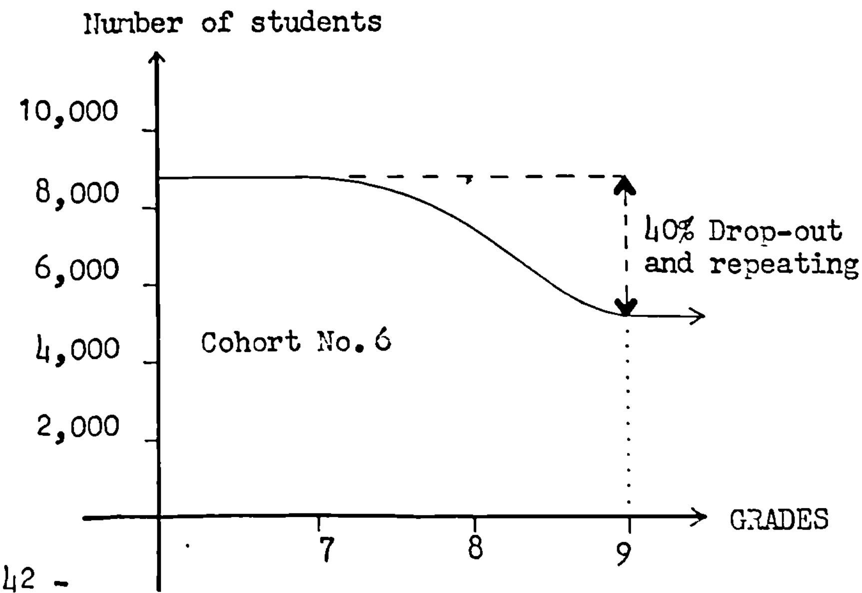


FIGURE 1.24.

FIGURE 1.25.



can be positively absorbed in the Saudi's educational system, where they can be channelled into other institutions such as agricultural studies, commercial institutions, etc

SHORTAGE OF ADEQUATE SCHOOL BUILDINGS.

During the period between 1971 to 1981, the number of elementary, intermediate and secondary school buildings (both owned and rented) for boys and girls was increased from 1,784 to 7,796 buildings. Such a huge expansion has forced the government to locate most of these schools in buildings rented for the purpose. The available data shows that until 1977 only 27% of all general education schools were housed in government owned buildings, while 73% were housed in rented buildings.[13]

> *"Those rented buildings lack all the basic requirements for school function if not the original function for which they were designed and built.*[14]

The above figures are considered to be unsatisfactory. At a later stage it will be shown that many of these buildings are quite unsuitable for this purpose.

THE SCALE AND DIMENSIONS OF THE PROBLEM.

The problem of the provision of school buildings can be classified broadly into four dimensions:

(1) A horizontal dimension representing the planning of school buildings which covers educational expansion strategy, planning numbers and location of school buildings, followed by aspects of financing and control, procurement and procedures, contracting, implementation and feedback.

(2) A vertical dimension which represents the physical facilities. This covers: designing, the spatial standards of the school building, the function and layout of the educational activities, structure and construction methods, materials, cost, etc.

(3) The third dimension relates to education and society. Education includes the administrative system, teaching methods, organization, curriculum, etc., while society is represented by students, staff, the community, the whole society and its response, attitude and experience as part of the educational investment.

(4) The fourth and the hidden dimension is the political and economical situation. The activating mechanism of this dimension is repsonsible for the progress of the other three dimensions. It may accelerate, balance or delay the whole process of education.

When reviewing the situation as it is in Saudi Arabia today the four dimensions identified previously can be used in analysis as follows:

(A) The political situation is positively stable, and the economical system is based on the principles of free economy. The country can be considered to be the world's largest oil exporter and the third largest producer of oil (afer the Soviet Union and the United States), nevertheless a major constraint in the country's development plan is the limitation of its manpower in terms of both numbers and skills.[15] Other constraints have also been described by a group of researchers as follows:

> *"Having too much money may sound like an enviable problem, but, for Saudi Arabia, it is a real one with political and economic consequences. The country's immense oil revenues make it possible, in a way which is perhaps historically unique, for the government to plan virtually any developments, including a total transformation of economic and industrial base, without financial constraint. Theoretically, this can be done at once. But in practice, everything can not be done at once. Pumping huge sums of money into a relatively undeveloped economy causes inflation, social upheaval and innumerable bottlenecks.*
>
> *Opposite political pressures quickly arise, as they have in Saudi Arabia. On the one hand, there are impatient young Saudis who complain that the government is moving too slowly. On the other hand, older people and more cautious people are now asking for a slow-down, for a system of priorities and for greater care in protecting a social structure which is inevitably being shaken by the speed of change.*
>
> *Very rapid development continues to be the government's declared aim, entailing - in principle - the expenditure of its entire revenue".*[16]

(B) The phenomena of drop-out in both elementary and intermediate levels cannot be considered only as a result of the social situation, though that is very important in a country like Saudi Arabia, where the average percentage of illiteracy is 64%.[17] The phenomena should be related to the whole situation and constraints that are facing the country. Therefore several problematic factors can be assumed to be underlying this phenomena:

(B-1) The social situation with its high rate of illiteracy and the unstable demographic conditions may in one way or another affect the official age of entry to elementary school. In virtually every country there is usually an official age of entry to elementary school. There is also some small under-aged entry and usually, a considerable late entry at ages a year or so above the official age.[18] Saudi Arabia is not an exception; late entry to elementary school is one factor that *encourages the phenomena of drop-out.*

(B-2) The other factor that affects drop-out is the location of school buildings. The location of schools with regard to population and residential areas in urban areas can be kept more or less under control by sound physical planning.

In rural areas in a large country such as Saudi Arabia, with thousands of small undeveloped villages and with a relatively high percentage of nomadism (over 25%),[19] the situation is seen to be very different. The difficulties arise not only in terms of location, transportation or school's size, but also in terms of encouraging qualified teachers and staff to teach in rural areas.

(B-3) The last factor which affects the phenomena of drop-out is the total environment and atmosphere of school building and its social and learning roles. The conflict is between the total environment of the school, which could be inadequate and between the external life which gives more in terms of work, prospects, money, etc. This conflict may tempt an over-aged student in intermediate level or even at elementary level to leave the school to seek employment or a change in life style.

(C) The other major phenomenon that has been viewed in the existing situation is the shortage of adequate school buildings. This phenomenon is usually related to the economic and financial situation in many developing as well as developed countries. But that is not the case in Saudi Arabia where, as it has been previously explained, there are other preceding factors which affect the whole construction programme. These factors are:

(C-1) The unstable demographic situation caused by the effects of ill considered development plans which caused movement of population. This, when coupled with the original problem of nomadism, have made it difficult to build new school buildings, especially in scattered and poorly populated settlements. Consequently, most of the schools in such areas are located in rented or purchased houses. On the other hand, and in contrast to the rural areas, cities became crowded and this in turn led to a shortage of suitable sites in terms of size, price or location. Consequently, it was again necessary to resort to renting buildings for educational use.

(C-2) Designing, contracting and implementation processes have tended to delay the progress of the planned construction programme, and consequently affect the cost and budget. This delay can be related to the system of communication, co-ordination and control within the administrative boards. Experience indicates that it could also be related to the shortage of skilled architects, engineers, contractors, labour, etc. Dr. Tarik Al-Soliman gives a clear picture of some of the negative aspects in the administrative board:

> *"(1) The ED (Education and Maintenance Department) is actually overloaded, not necessarily by design work for new schools but by getting involved too much in operational work, routine maintenance and reach-out supervision duties for schools under construction.*
>
> *(2) The previous pressure led to the adoption and the extensive use of standardized architectural plans which would be built anywhere in the country. In addition to being poorly designed and functionally rigid, they carry the same specifications for materials and construction methods which further restrict any changes or modifications and to more delays in construction.*
>
> *(3) The centralization in decision-making results in a definite delay in communication, progress-payments, and modification permits.*
>
> *(4) Understaffing at the district level by architects, engineers and technical assistants results in work delay and, most importantly, to the acceptance of below-standard buildings.*
>
> *(5) By being too much involved in routine daily work, the ED prospects for research and improvement in the quality of design are minimum. Unlike other building facilities, school projects are not to be assigned, in what seems to be a policy matter, to private architects either in each district's region or in Riyadh itself.*
>
> *(6) In general, the ED is acting almost separately from other related agencies and groups, not only outside the Ministry but also within the Ministry itself. It was surprising that departments such as texts and programs, audio-visuals and teacher training, which are rapidly expanding and changing, are*

totally isolated from what takes place in the ED although they occupy the same building. The apparent result of such isolation is the common practice of transforming classrooms into new activities assigned and required by texts and programs and/or audio-visual departments."[20]

Finally, the whole situation has been summarized in the **Third Development Plan as the following:**

"Although the Second Development Plan has witnessed a very considerable expansion of physical facilities of the education and training system, there are problems in location of facilities, their delivery and equipment and their maintenance. Designs are often costly and ill adapted to the educational purposes. Rapid expansion of primary, intermediate and secondary schools in response to the expressed needs of local communities has occurred without the benefit of adequate planning and control. The consequences are:

(1) Widespread inter - and - intra district inequalities;

(2) A large number of the schools declared 'unfit' with most of them in rented premises;

(3) Large scale overcrowding in some schools and under-utilization of space and teachers in others, with an especially large number of small incomplete schools.

In these circumstances, where rapid expansion appears to continue, and demographic conditions are in a state of flux, it is clear that there is a need for a complete national and regional school inventory and for more effective implemenation procedures generally."[21]

SUMMARY OF FINDINGS AND CONCLUSIONS.

(1) The provision of school buildings in Saudi Arabia is affected mainly by the rapidity of development programmes and by administrative and architectural factors, rather than by economical or political ones.

(2) As a result of the demographic movement in rural areas, the policy to locate schools in rented or purchased buildings is effective, providing that these buildings are suitable or flexible enough for adaptation. This is often doubtful.

(3) With the rapid growth of cities, expansion of adequate facilities such as education becomes difficult, especially under a rigid and overloaded central administration.

(4) The result of the study which investigated the drop-out rate and of those pupils who repeated years points to a serious situation, espeically at intermediate levels.

As a result of points 3 and 4 above, the architectural study in this thesis will be devoted particularly to the provision of intermediate schools. This reflects the urgent nature of school provision at this level. However the study in general has implications for elementary, intermediate and secondary levels.

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(6) Al-Zaid, Dr. Abdullah Mohammed, "Education in Saudi Arabia, A Model with Difference", 2nd. ed., Jeddah: Tihama, 1982, p.15.

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(10) Al-Soliman, Tarik, M. A., "School Buildings for Boys' General Education in Saudi Arabia: Present Functioning, Future Demands, and Proposed Alternatives Under Conditions of Social Change", Ph.D. Thesis, University of Michigan, 1981, pp. 74-75.

(11) Ibid., p.79.

(12) Ibid., p.86.

(13) Ibid., p.67.

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(16) Ibid.

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(19) Bundadji, op. cit., p.5.

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CHAPTER TWO.

DEVELOPMENT OF EDUCATION.

PRELIMINARY STATEMENT.

The concept of education for the purpose of this thesis is synonymous with schooling and brings to mind the whole range of activities that take place in kindergartens, schools, colleges and universities. It is also possible *to speak about life itself* as an education. Life in the wider social environment outside the school has a 'hidden' curriculum of knowledge. And indeed to make a distinction here it is possible to refer to the process of schooling as 'formal' education, and to that in the wider community as 'informal'.[1]

In societies at pre-industrial stages of development, the stress on schooling is on moral education and social training rather than preparation for an occupation or vocation, which can be learned informally by knowing and practising all the necessary technical and social skills to enable each man to approach self-sufficiency with his family.[2]

On the other hand, industrialization, and the consequent movement into towns that accompanied it, created demands for widespread education. The new urban, industrial family was outside the close social control exerted in the older village life. Under these conditions, parents or kin can no longer prepare the next generation for their occupations because they will be doing different jobs, using different skills, in different places. Schools and colleges take over this preparation.[3] The demand on formal education then, has dominated the twentieth century, where education has become the main avenue to high level opportunities.

This importance of formal education necessitates a general investigation into some of the contemporary beliefs, theories and practices approaches of education. This chapter will try to deal with this investigation. It will also deal with the effect of these attitudes on the educational approach of Saudi Arabia and look forward to the changing pattern of the future.

THEORIES OF EDUCATION.

GENERAL DEFINITION.

Distinction has been made between educational and scientific theory. The latter is basically descriptive and explanatory, while the former is practical. The difference can be expressed briefly as follows: a valid scientific theory gives an adequate explanation of what happens in the world, based on established evidence, while a valid educational theory would be one which gave adequate recommendations for practice, based again on adequate and appropriate evidence.[4]

The structure and contents of an educational theory have been defined by Moore as follows:

> *"Educational theory is a species of practical theory, an argument whose conclusion consists of recommendation for practice. Its structure contains certain assumptions about the desirability of ends, about the nature of men and of children, and about knowledge and*

pedagogical methods, and it is on the basis of these assumptions that its practical recommendation are made."[5]

THE ROLE OF EDUCATIONAL THEORY.

In any educational model, there are usually three major interrelated sets of activities going on at different levels. At the lower level there are various educational activities such as: teaching, learning, training, demonstrating, or any sort of activities to be found in classrooms anywhere. At the next higher level, there is educational theory, which may be understood as a body of connected principles, counsels and recommendations, aimed at influencing what goes on at the lower level. At the third level still there is a philosophy of education, which has for its main tasks the clarification of the concepts used at lower levels, such as educating and teaching, and an examination of theories which operate there. These being tested for consistency and validity. The differences in level are to be understood as 'logical' differences, which means that each higher stage arises out of, and depends on, the stage below. Educational theory, for instance, presupposes educational activities and depends upon them for its point. Philosophy of education presupposes both educational activities and educational theories. Therefore, and since educational theory operates on related activities which operate at a lower level, it has been described as a higher order enterprise, which aims at guiding those engaged in educational activities, in schools and elsewhere.[6]

SYNOPSIS OF CONTEMPORARY EDUCATIONAL TRENDS.

There are many diverse and conflicting philosophies and theories of education, which may be classified according to various degrees of traditionalism and progressive polarity. The purpose of this study is not to present a systematic and exhaustive treatment of each one, but rather to choose some which appear to be important in the approach to school design and to illustrate briefly some of their basic theoretical assumptions and beliefs.

A - THE TRADITIONAL 'CONSERVATIVE' VISION.

The traditionalists believe that the basic task of education is to conserve the best of our past and that consequently the present will be adequately dealt with. They also see the curriculum as being concentrated on the cultural inheritance - 'the tried, the tested and the true'. Efforts to build or reconstruct the curriculum so as to up-date it to include contemporary problems or to the interest of the learner detract education from its only truly legitimate mission - cultivation of the intellect.[7]

A-1 - PERENNIALISM.

The perennialists believe that man is uniquely gifted with rational faculty, and because of that, education must be: first, aimed at the cultivation of his intellectual virtues; second, it must follow the perennial truths and not be misdirected toward meeting contemporary needs that are only temporal.

The cultivation of the intellectual virtues can be achieved only through the 'permanent' studies that constitute the intellectual inheritance. These virtues are embodied in the Great Books of the western world which cover all knowledge, such as: liberal arts of ancient, medieval and modern times, tradition of culture, classical and modern languages. Vocational, practical and physical studies have no place in the school curriculum, whereas such studies are temporal.[8]

A-2 - ESSENTIALISM.

The esstentialists share the views of the perennialists about the mental discipline and the irrelevance of pupil interests and the conception of the child's mind as a vessel or container. They also agree that the student does not really know what he wants, and for that, they should be forced to study. Both the perennialist and the essentialist see the role of the elementary school is to provide mastery of the basic skills and facts that are necessary preliminary to subsequent learning.[9]

On the contrary to the perennialist, the essentialist sees that the curriculum should be directed at modern needs through languages (grammar, literature and composition), mathematics, science, history and modern foreign languages. These subjects are essential to the development of mental capacities. The other subjects such as fine arts, vocational and physical studies are regarded as secondary subjects.[10]

A-3 - NEW CONSERVATISM
(Basic - Education Theory)

Some of the most important beliefs recognized by the proponents of the basic - education theory are stated by Clifton Fadiman as follows:

> *"1 - Men desire to know and to transmit various matters.*
>
> *2 - This choice of matters have been organized into a hierarchy of subjects.*
>
> *3 - They have selected certain areas of knowledge that can and should be taught to the exclusion of others.*
>
> *4 - There are two kinds of subjects - those that have generative power and those that do not.*
>
> *5 - The subjects with generative power consist of those matters which, when once learned, enabled the student to learn all matters of all kinds.*
>
> *6 - These generative subjects constitute the content of basic education.*
>
> *7 - Among them are those subjects that deal with language, whether or not one's own; forms, figures and numbers; the laws of nature, the past, and the shape and behaviour of the earth.*
>
> *8 - A knowledge of the fundamental aspects of these subjects enables one to learn their more specialized aspects and also the minor, self-terminating subjects."*(11)

The new conservatives recognize the importance of two kinds of educational values or aims - general personality traits and subject matter aims. The criteria of personality traits to be cultivated are to be found in the classical and Christian virtues of western civilization. The 'subject matters' objectives are to be found in those basic subjects which have been classified into two groups - the required and the elective. The required subjects are citizenship, American history, European and world history, geography, composition, literature, classical languages, modern languages, mathematics, biology, chemistry, and physics. The illustrative elective subjects are art, music, philosophy and speech.[12]

While the new conservatives have their own educational beliefs, like proponents of other theories of education, they also have their own objections about the application of other theories. These objections are related to all features of school practice. With respect to the curriculum development, they reject the idea of the comprehensive secondary school, which for them disables and hinders rather than promotes the concentration of students on the basic subjects. They are opposed to the elective system at any educational level. They think students are not qualified to decide what subjects to study or how they should be studied. They object to the practice of spending school time on sports and extra curricular activities. They condemn the 'great book' idea as developed by the perennialists.[13]

B - THE PROGRESSIVE VISION.

The progressive sees that man is essentially an active, problem-solving creature. Ideally, he is developing, growing and socially conscious. To produce this ideal type the child must be involved in tasks which develop his intelligence, his capacity to live adequately, and this must be done in a way that makes him a co-operative social being. This necessitates an education of the 'progressive', child-centred type, making use of man's social resources to encourage individual growth.[14] During the twentieth century the progressive vision has been defracted into several images. the most systematic and consistent progressive educational theory is one based upon experimentalism.

B-1 - EXPERIMENTALISM.

The experimentalists, pioneered by John Dewey, believe that the task of education is not the making of an aristocratic ruler, or a scholar, or even a middle class man, but modern, urban democratic man. They assume that man is an active, social, problem-solving animal, for whom success in life is the continual mastery of his environment; the solution of problems about the provision of food, shelter, clothing, as well as those about social and political organization.(15)

Their assumptions about children follow from their view of man in general. Essentially children are active, exploring, problem-defining creatures. They divide the child's life roughly into three stages of development; a 'play' period characterized by spontaneous activity of a fairly uncritical kind; a 'techniques' period, in which the child learns to distinguish means and ends, and to follow simple procedures, and lastly, a period of 'reflective attention' in which a more critical approach to problem-solving is possible. The emphasis throughout is on activity, which becomes more differentiated and purposeful as the child grows older.(16)

The experimentalists believe that the most effective educational methods are those which involve direct, first-hand experience and practical activity by the pupils, activity in which the need for knowledge and skill and the exercise of intelligence will make itself felt. Their criticism of schools was that the emphasis was always on the subject matter to be learned, on the text book, or the teacher's words, whereas they thought it should be on the participatory activity of the pupil. So the methods recommended by experimentalists involved the children in working on topics which interested them, which presented real problems to them, which linked their activities to the life of the world outside the school. Children should be encouraged to work together, as adults do, collaborating in various activities, making things, cooking, writing magazines, and so on. The teacher's role is to be that of providing an environment in which children could work on their own, the teacher co-operating with them when necessary, helping them, advising them, but not imposing his views on them.[17]

C - THE ROMANTIC VISION.

Since experimentation is an open rather than a closed system, it can be indefinitely developed through the use of new assumptions and beliefs, and can constantly be applied to any new features of practice that emerge as cultural conditions change.(18) Some of the second generation of progressivists are impatient with the open-mindedness of the experimentalist vision. They see the need for the school to play a more direct function in reconstructing society for a democratic social order. But the later generation of progressivists seem to have avoided entirely the social message of the progressive approach by adapting only the humanitarian priinciple of child-centredness. In doing that, they have tended to romanticize the nature of the learner with the result that their version is more romantic than progressive.[19]

C-1: **ROMANTIC NATURALISM.**

In rejecting the authoritarian methods of traditional education and their concept of child as a miniature adult, the romantic progressivists embraced their own concept, which has been briefly explained by Daniel and Tannen as follows:

> *"... the romantic progressivists embraced the notion of the child as a flower to unfold naturally into fruition. This unfolding and fruition could best be realized by capitalizing on the natural propensities of the child. The pervasive idea of the child's natural development led to the notion that the school must be an environment in which the child's spontaneity, felt needs, and activity are seen as positive energies for effective learning."*[20]

The famous leaders of this radical educational reform are A. S. Neill, Paul Goodman, John Holt and Ivan Illich, who all believe in freedom and open society. Neill believes that a child is good, wise and realistic, not an evil being, and for that, the school should be a place for utilizing play, the child's own interests and creativity, his capacity to work and live with his peers in co-operative arrangement by enabling him to develop his own rules and regulations.

> *"Well, we set out to make a school in which we should allow children to be themselves. In order to do this, we had to renounce all discipline, all direction, all suggestion, all moral training ... All it required was what we had - a complete belief in the child as a good, not an evil being. For almost forty years, this belief in the goodness of the child has never wavered; it rather has become a final faith. My view is that a child is innately wise and realistic. If left to himself without adult suggestions of*

any kind, he will develop as far as he is capable of developing.[21]

Neill rejects the school's basic subjects, homework, exams and grading. He stated:

> *"It is time that we were challenging the school's notion of work. It is taken for granted that every child should learn mathematics, history, geography, some science, a little art, and certainly literature. It is time we realized that the average young child is not much interested in any of these ... I am not decrying learning. But learning should come after play."*[22]

Although Neill belonged to an earlier generation of romantic progressivist ideology, the new wave of romanticists carried the same message and more by denying the idea of curriculum on the grounds that knowledge is so subject to change, it is senseless to plan in advance what it is that the child should be taught. According to John Holt:

> *"The notion of curriculum, as an essential body of knowledge, would be absurd even if children remembered everything we 'taught' them. We don't and can't agree on what knowledge is essential ... the idea of the curriculum would not be valid even if we could agree on what ought to be in it. For knowledge changes. Much of what a child will learn in school will be found, or thought, before many years, to be untrue ... since we can't know what knowledge will be most needed in the future, it is senseless to try to teach it in advance."*[23]

The contemporary romanticists go so far as to say that the natural capacity of the child for education is destroyed by the schools. Paul Goodman declared:

> *"The purpose of elementary pedagogy, through age twelve, should be to delay socialization, to protect children's free growth, we must*

drastically cut back formal schooling because the present extended tutelage is against nature and arrests growth".[24]

Ivan Illich goes so far as to advocate that all schools should be abolished, and he romanticizes the society and the growing information technology as capable of fulfiling the educational needs of children and youth.[25] This view is not universally accepted.

EDUCATIONAL APPROACH IN SAUDI ARABIA.

Education in Saudi Arabia has got to be seen within the general framework of education in a staunchly Muslim country. It has many features which are found in other Muslim areas and which reflect the intensely religious nature of the state.

The philosophical concept of education in Saudi Arabia has been mentioned in Chapter One, where the creation of a good and righteous man is the major aim of an education that must achieve two things: first, it must enable man to understand his Lord so that he worships Him in full conviction of His Oneness. Secondly, it must enable him to understand the way of Allah in the universe, explore the earth, and use all that Allah has created to protect faith and reinforce His religion in the light of what Allah has said in the Quran.[26]

The sources of knowledge of Islamic education have been classified into two categories:

(1) Divine revelation where Allah teaches that man cannot, by himself, be rightly guided to the Divine truth and that life

cannot be regulated in the proper manner in the absence of stable and unchangeable injunctions inspired by Allah.

(2) The human intellect and its tools which are in constant interaction with the physical universe on the levels of observation, contemplation, experimentation and application.[27]

Because of the lack of a systematic formula of Islamic or Saudi educational theory, it is necessary to read some of the important terms of the Saudi Arabia educational policy. The chosen terms will give some idea about the beliefs and principles of the Saudi educational approach. These guiding principles may be classified as metaphysical, knowledgeable, sociological and psychological.

METAPHYSICAL PRINCIPLES.

(1) Believing in God as a Lord, Islam as a way of life and Mohammed (May peace be upon him), as a prophet and a Messenger of God.

(2) A complete Islamic conception of the universe, man and life with the entire creation subject to the laws set by Almighty God so that every creature will perform his duties without any flaws or disturbance.

(3) Life in this world is but a phase for the process of creativity and work, during which a Muslim will utilize his

capacities, out of faith and right guidance, for the eternal life in the Hereafter...

(4) The message of Mohammed (May peace be upon him) is the noblest and most comprehensive course for a very proper and good life, achieving happiness for human beings and saving mankind from the corruption and suffering into which it has fallen.[28]

KNOWLEDGEABLE PRINCIPLES.

(1) Islamic studies are basic in all elementary, intermediate and secondary school years ...

(2) Directing the various types of science and knowledge and their related materials, whether in the setting of programmes or in the composition or writings or in teaching according to Islamic methods. Handling thereby their problems and passing judgement on their theories and the means of their utilization, so as to let them be in harmony with the appropriate Islamic thinking.

(3) Benefiting from all types of useful human knowledge, in the light of Islam, so as to promote the country and raise its living standards.

(4) Harmonious co-ordination with science and technology, since these two are the most important means for cultural, social, economic and health development, so as to raise the level of our nation and our country and share in international cultural progress.

(5) Basically, the Arabic language is the meduim of education in all the materials used and stages covered, unless it is necessary to teach in another language.[29]

SOCIOLOGICAL PRINCIPLES.

(1) Complete faith in the dynamics of the oneness of the Muslim nation and in being the best way for mankind to evolve. Having faith in its unity despite the difference of its races, colours, creed and territories.

(2) A common social responisbility by the individual of a society in a co-operative, loving and fraternal manner, giving preference to the general good over private interests.

(3) Developing a feeling of responsibility among students towards the cultural, economic and social problems of their society, and preparing them to contribute to the solution of such problems.[30]

PSYCHOLOGICAL PRINCIPLES.

(1) To be closely related to the nature of the psychological growth of the students at every stage, and to assist them to develop in a proper manner spiritually, intellectually, emotionally and socially, affirming the Islamic spiritual aspect and letting it be the prime guide to the private and public conduct of the individual and society.

(2) Learning about the individual differences among the students as a preliminary to giving them the proper guidance and assistance to advance themselves according to their abilities, readiness and inclinations.

(3) Encouraging and developing the spirit of intellectual curiosity and thinking among the students, and strengthening their ability to perceive, gather information and reflect on the wonders of God in the universe.[31]

CURRICULUM AND TEACHING METHODS.

Having examined the general education approach in Saudi Arabia we can see how it is applied. The curriculum of general education is based on defining specific subjects. The contents and scope of the curriculum cover these general fields:

(1) Islamic studies, such as: the Holy Quran, Prophet's Sayings, Commentaries, Islamic Fundamentals, Elementary, Jurisprudence.

(2) Language studies, which cover Arabic and English languages.

(3) Natural sciences, such as Physics, Chemistry, Mathematics, Hygiene, etc.

(4) Social Sciences, which cover History and Geography.

(5) Fine Arts and Athletics.[32]

The methods of teaching in schools as they have been observed during the survey, indicate that teachers are combining several methods of teaching such as: lectures, a questioning mode, text book training and demonstration methods. Application of these methods depends upon the circumstances and the capacity of the teacher.

ANALYTIC REVIEW AND CONCLUSION.

(1) The foregoing discussion pointed out that, although there are many diverse and conflicting philosophies and theories of education, it is still possible to distinguish two major practical models of education: the traditional, and the progressive models.

The concept of the traditional approach depends on the assumption that children are more or less ambivalent towards education, and that means of teaching them is a matter of direction, compulsion and restraint, and it is the responsibility of the teacher to bring this about. Emphasis is usually made on 'what is to be learned', assuming that education involves the student in acquiring important knowledge skills. This knowledge is usually seen as comprising a number of distinct areas of understanding - science, mathematics, history, etc. - all of which need to be taught and learned as distinct disciplines. T. W. Moore comments on that:

> *"Education is thus represented as a sort of transaction between a full and an empty vessel. The teacher is a full man, a repository of socially important knowledge and skills and attitudes, whereas the pupil is empty and needs to be filled up. Since the pupil is usually naughty as well as empty the transaction often needs to be accompanied by the exercise of authority and force. The typical methods will be those of instruction and demonstration by the teacher, with passive reception and imitation by the pupil. As the only source of educational advantage*

to the pupil will be the teacher, attention to him is required at all times, co-operation between the pupil and another being on the whole discouraged".[33]

On the other hand, the concept of the progressive or 'child-centred' approach, rests upon a different set of assumptions. Children are usually assumed to have a positive reaction to education, with a natural instinct of curiosity, energy and interest. It is assumed, too, that knowledge and skills are important because they help in developing the internal potentialities and growth of children. Education here is not considered as a one-way transaction between teacher and pupil, but as a co-operative enterprise in which the pupil is encouraged to take the initiative, to explore his environment, to find things out for himself, the teacher providing the help needed to ensure that the child gets the necessary intellectual stimulation and opportunities for development. Teaching and instruction methods and the internal layout of classroom are all based on concepts of free-ranging enquiry, while discovery methods and exploratory activity by pupils are encouraged. So is co-operation in learning between one pupil and another. The concept is not differentiated into rigid compartments called 'mathematics', 'science' and the like, so too 'knowledge' is not a matter of rigidly separated disciplines. Progressive educationalists tend to avoid traditional subject divisions and a compartmentalised curriculum and think rather in terms of 'integrated' activities.[35]

(2) Despite the philosophy of Islamic education on the head of the hierarchical order of the Saudi's educational model, the

rest of the educational pyramid is not yet purely Islamized. What is happening in Saudi Arabia and in other Islamic countries, is that the traditional western systems of General Education have been adopted in one way or another to suit each country's situation. In Saudi Arabia, for example, intensive courses of Islamic studies have been integrated in the system to overcome the lack of any applicable Islamic system of education. Dr. Sayed Ali Ashraf comments:-

> *"The American concept of General Education has invaded Muslim countries and attempts are being made to fit religious education into this pattern and formulate a desirable curriculum from the Muslim point of view."*(36)

Because of the above, it is possible to notice some conflicts between the theoretical parts of the educational principles and their application. For example, although the principles of the eductional policy encourage the spirit of scientific research and thinking among students, and admit the individual differences among them, teaching methods in schools are responding to that by following the traditional approach.

Finally, in the near future the educational approach in Saudi Arabia can not accommodate a radical change toward new Islamic or even a western progressive approach. The reasons behind this statement are that there are many other and important priorities which take precedence, such as urgent national issues; for example, illiteracy, compulsory education, etc.

This philosophy is clearly going to impinge upon the building requirements for the immediate future. A statistical study of the population at school age in the area was brought forward in Chapter One which established the objective nature of the buildings needed for the educational policies as outlined above to have suitable buildings.

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CHAPTER THREE

DEVELOPMENT OF SCHOOL BUILDING DESIGN.

PRELIMINARY STATEMENT.

In the preceding chapter, emphasis was placed on the development of education in advanced countries in terms of its philosophies and theories as well as on teaching methods approaches.

This chapter tries to trace the development of school building design as an architectural response to the general educational, economical and technical needs in developed and some developing countries. The choice of material has been made primarily on the significance of the design work. The range of materials has been drawn from sources available in Sheffield. This chapter and its results help in making comparisons between different countries and serves as a reference for the following chapters.

THE EARLY ARCHITECTURAL RESPONSE.

Although general mass education in terms of its philosophies, theories and teaching methods has been positively developing and changing since the last century, the architecture of school buildings and its response to educational changes always tended to lag behind educational ideas. The reasons behind this unbalanced and slow response were lack of consciousness of public education as a social obligation,[1] and the lack of a positive interrelationship between educators and architects. Consequently, both education and school building architecture tended to develop in different and isolated lines.

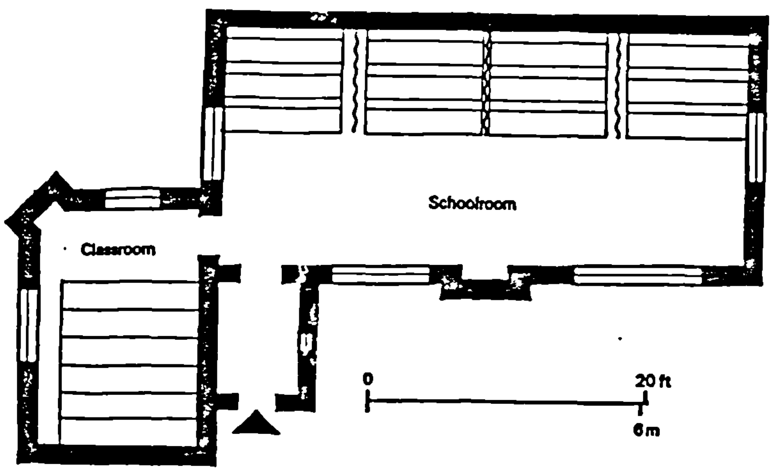
Education in Europe up to the eighteenth century was a matter for private initiative or left to certain circles which were particularly interested in educational matters, e.g., the churches. In general, only the children of the upper classes had access to such schools. The architectural response at that time was the medieval convent school.[2] Some enlightened patrons from the successful merchant classes founded grammar schools and there were several charitable enterprises which led to schools being formed.

When the problem of mass elementary education was first faced in the early nineteenth century, the type of building used at that time as a model was the schoolroom of the later Middle Ages.[3] (See Fig. 3.1). This English schoolroom, which was also used in North America,[4] consisted simply of one very large room in which a number of forms were taught at the same time, usually by one master and several assistants.[5]

During the second half of the nineteenth century, and while education was moving forward slowly but firmly towards the compulsory system, architecture in general, and school buildings in particular, were in a situation of standstill. Alfred Roth explained the situation as follows:

> *"During the second half of the nineteenth century, the decline of architectural conception and creative thought was rapidly approaching the lowest possible level, characteristic of a deeply uprooted and contradictory epoch. ... The immediate effects of the conceptions of that period can be summarized as follows:*

FIGURE 3.1.



Plan of school showing layout suggested in 1851 by the Committee of Council on Education. This building was to accommodate seventy-two children in four classes, and variations on this plan were widely adopted in the second half of the nineteenth century.

Source: Seaborne "Primary School Design".

- *Out-sized buildings;*

- *Unfunctional and undifferentiated space organization;*

- *Unfunctional and non-creative design.*

It is significant that this unfunctional and schematic design actually ignores not only all pedagogic requirements, but even the simplest conditions of hygiene, and above all, the physical and psychic necessities of the child. Form and details of all styles were regardlessly borrowed here and there and put together in some new shape wherever the architect's imagination failed him, either in respect to the details or the general form of the building. Accordingly, schools were either castles or palaces and their architectural style either gothic, renaissance or baroque, or a combination of all styles".[6] (See Figs. 3.2 and 3.3).

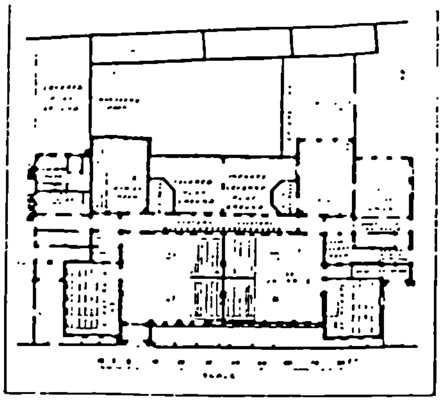
By the end of the nineteenth century and till the outbreak of the First World War, new educational ideas began to spread out all over Europe and North America. The American, John Dewey, published his book "The School and Society" in 1899. His ideas of the 'child centred' approach were popularized in England in J. J. Findlay's "The Child and the Curriculum" in 1906.[7] Fundamental importance is attributed to play (Forebel), to manual activities (Maria Montessori), and also to gymnastics, music and rhythmics (Dalcroze).[8] This change in attitude toward children was supported by psychologists such as: Sigmund Freud (Psycho-Analysis), Adler (Psychology of the Individual) and Jung (Analytical Psychology), etc.[9]

On the other hand, and during the same time, there were striking developments and changes in architecture. Henry Van den Velde, one of the Belgian pioneers of the modern movement in Europe, asked for a "rational and pure form" and for "rational

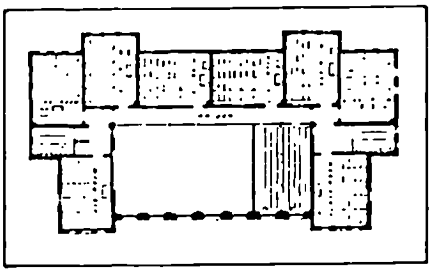
FIGURE 3.2.

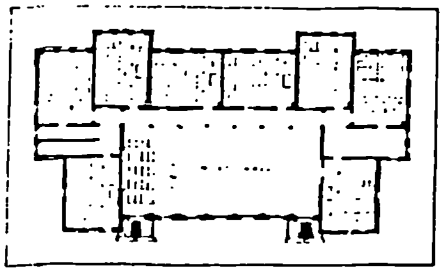
Johnson Street School,

1872, London.



Source: Ron Ringshall, "The Urban School".





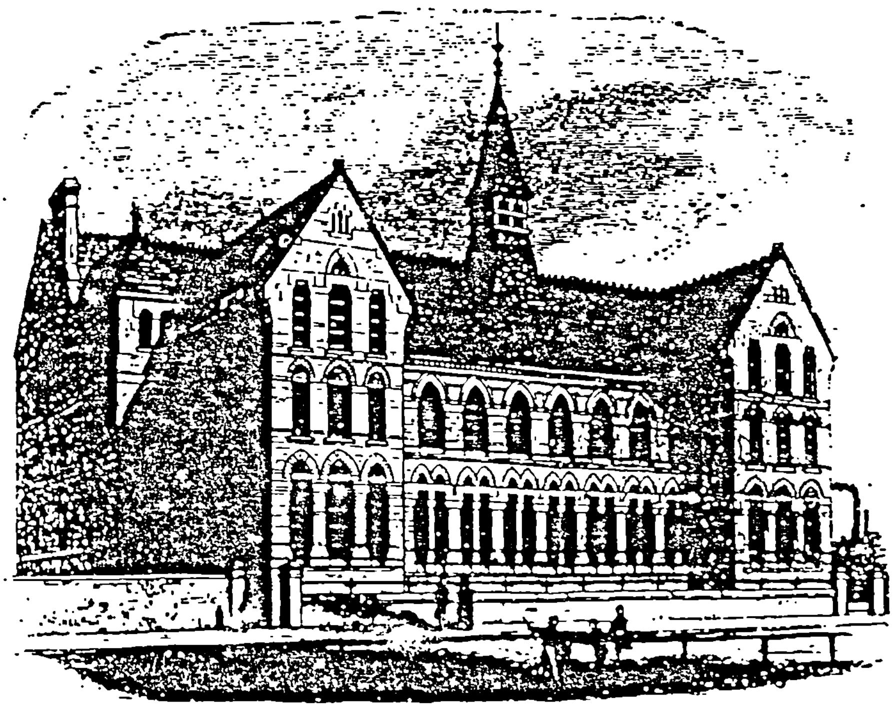
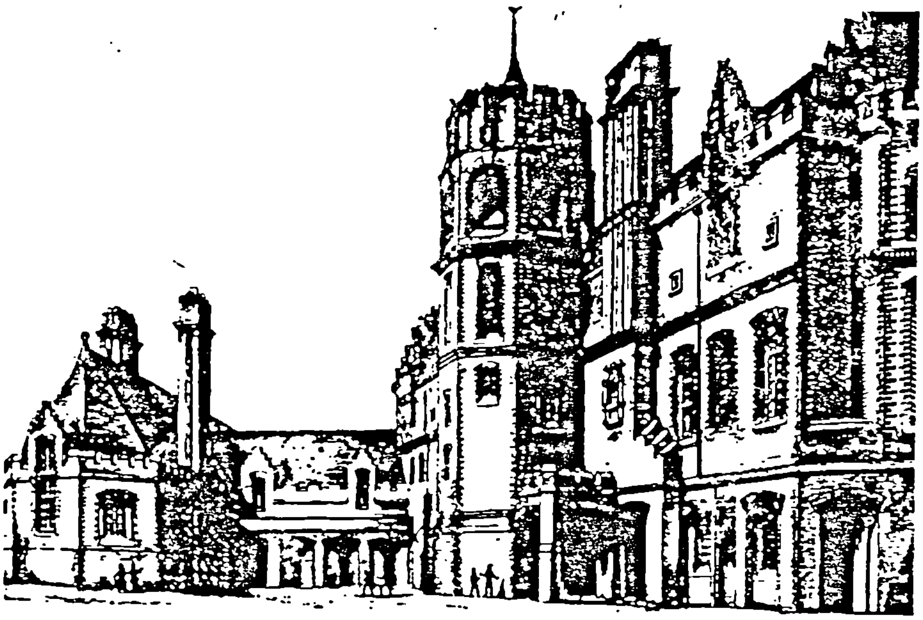


FIGURE 3.3.



Winstanly Road School, 1874.

"A school having a castled character"

Source: Ron Ringshal "The Urban School".

beauty".[10] Other designers greatly modified or discarded decoration for form, such as: Otto Wagner and Adolf Loos.[11] Later in the century, in 1928, leading architects met at the Congrès Internationeaux d'Architecture Modern (CIAM), to reach certain consistencies, such as: no ornamentation, flat roofs, rectangular outlines, white walls, large windows, etc.[12]

In America, Louis H. Sullivan wrote in 1986:

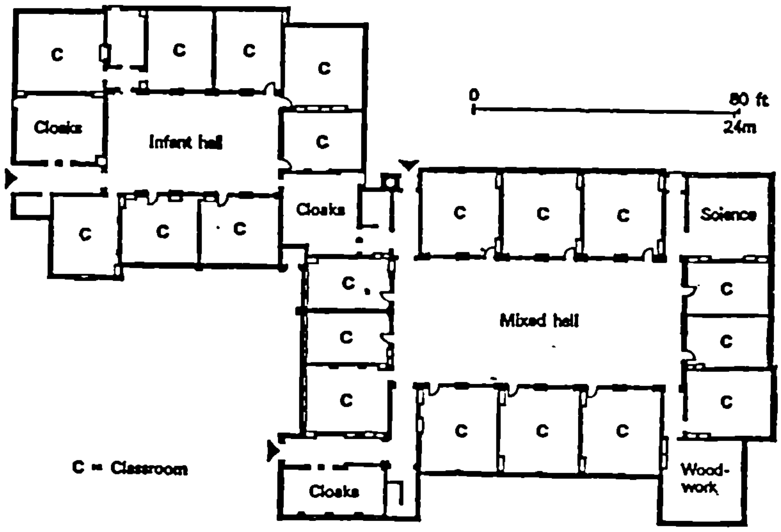
> *"... form ever follows function and this is the law. Where function does not change, form does not change."*[14]

With the availability of steel frames and reinforced concrete, the traditional solidity of architecture could now be replaced by transparency, together with a visual release from gravity by using thin columns and cantilevers.[14]

In the early period of modern architecture, (and specifically until the outbreak of the First World War), school buildings were apparently not considered as a vehicle for architectural experiment. The important architectural buildings for education were colleges and universities.[15] In England, as a result of the problem of providing for elementary compulsory education at the end of the century, the tendency was to increase the number of classrooms along the sides of a central corridor, which gradually widened to become a hall used for general assemblies and for teaching two or more of the classes. This in turn developed into what is known as the 'central hall plan'.[16] (See Fig. 3.4.).

FIGURE 3.4.

Infant and Juniior Schools, built 1894-9.



The Central Hall Plan.

Source: Seaborne "Primary School Design"

In America the one-room as well as the multi-storey central-hall school continued unchanged for some time. The only notable exception to these monumental buildings with their impressive entrances, halls and their depressing rooms were Frank Lloyd Wright's Hillsdale Home School (1902), which can be considered to be half a century ahead of its time, and Dwight Perkins, Carl Schurz High School in Chicago (1910). Both examples pointed the way towards more open planning, a scale appropriate to children, and a freedom from the dictates of historical electicism.(17) (See Fig. 3.5.)

It was not until the period before and immediately after the Second World War, that the development of school buildings began for the first time to accelerate and respond more comprehensibly to educational, architectural and environmental needs.

The educational conditions which permitted and accelerated the development of school buildings were summarized by Alfred Roth as follows:

(1) The child is the subject and not the object of education and consequently of school building (scale of the child).

(2) The object of education is to gain a grasp of the whole human being, the psychic and intellectual life. This can only be achieved by a flexible system of many different activities (cheerful, differentiated planning of rooms, greatest possible convertability).

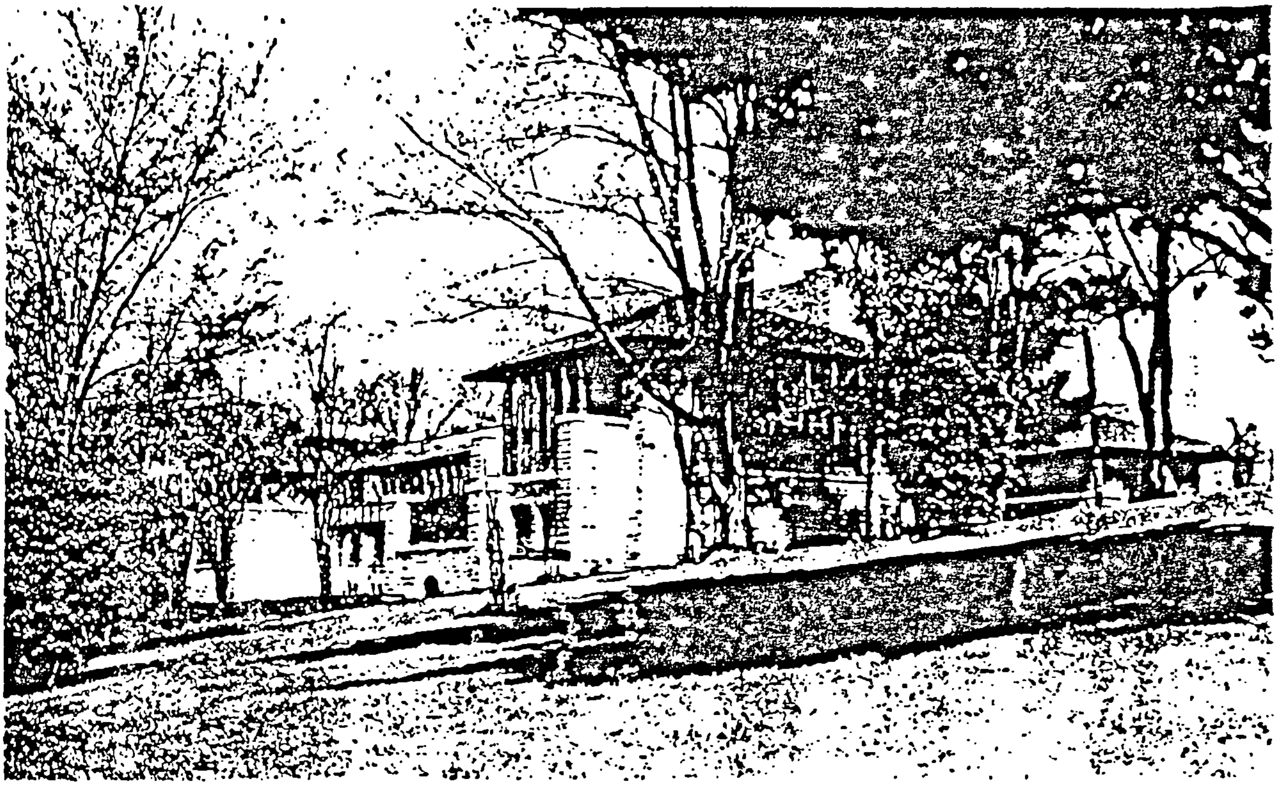
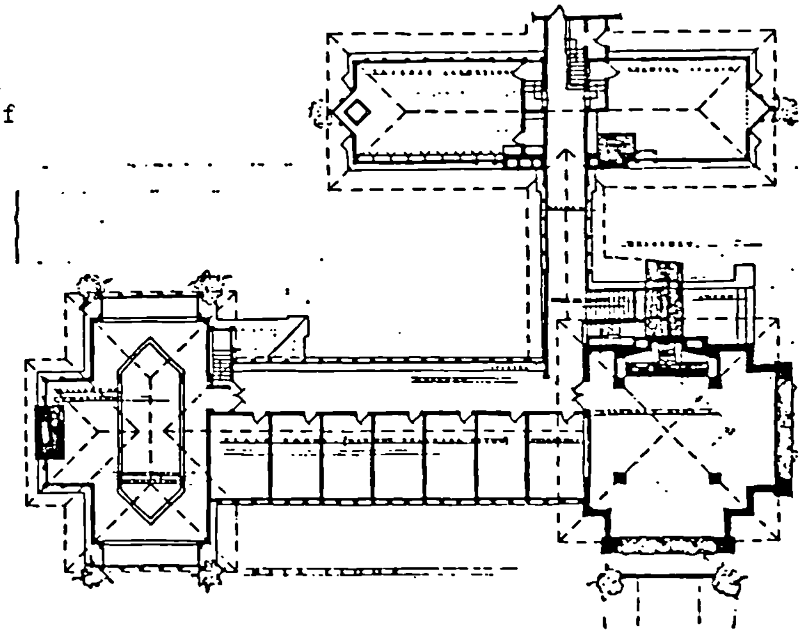


FIGURE 3.5.

Frank Lloyd Wright's

Hillside Home School, Spring Green, Wisconsin - a school building half a century ahead of its time - 1902.



Source: Educational Facilities Labortories, "The Cost of Schoolhouse".

(3) Teaching methods must be adapted to the childs age and talents (individual instruction, groupwork, friendly rooms).

(4) Education at school must be considered as the continuation of family influence. Therefore the closest possible affinity between school and home with respect to rooms and atmosphere must be attained (living-room education...).

(5) The entire environment in which the child lives and is educated is an integral part of education (unity of fundamental architectural conception, close affinity with nature).

(6) The child is gifted by nature with creative imagination and loves all that is true and alive (lively architectural design, exclusion of all that is not genuine, schematic or artificial).[18]

The teaching programme as it was generally understood in most countries during this period, can be seen in Table 3.1.

On the other hand the influence of the 'international style' has geared up the architecture of school buildings to a new level, where form should be a creative expression of purposes, materials and construction. New materials allow for new construction, and new construction for new spacial conceptions.[19] While as late as 1925, the typical questions asked by a school board were: how many classrooms should the schools have?, and in what mode or style can they decorate it?

TABLE 3.1.

TYPE OF ACTIVITIES	PLACE OF ACTIVITIES
Reading, Writing, Arithmetic Languages, Geography, etc.	Classroom.
Natural History, Chemistry, Physics, Arts, etc.	Special rooms.
Manual Work: housecraft (needle work, cooking, house-keeping), Woodwork, Metalwork.	Special rooms and practical rooms.
Singing, Music, Rhythmics, etc.	Special rooms.
Research Work.	Library, School-Collections
Physcial Training, Recreation, Gymnastics, Sports, Games, Swimming.	Covered Play-Ground, Gymnasium, Physical Training Ground. Playground Playing Fields.
Collective Activities: Music, Conferences, Play-acting, Cinema, Meals, etc.	Assembly Hall, Dining Room.

In the 1940's the same board had to examine not only new teaching methods and programmes, but also a great variety of architectural solutions involving materials, esthetics, function, ventilation, lighting, furniture and equipment, etc.[20]

In general the main characteristics of the school buildings during this period were the provison of good lighting and ventilation, and the use of sites with spacious surroundings. This strong emphasis on good lighting and ventilation has resulted in what is called the "corridor-plan". Many of the schools built before and immediately after the war were lavish, not so much in terms of the teaching facilities provided, but in terms of corridors - space, cloakrooms, playgrounds and playing fields. The corridor-plan at its most extreme point of development resulted in what is called the "finger-plan" school[21] because of the resemblance of the plan to a hand, with the hall and administrative rooms forming the 'palm' and the rows of classrooms the 'fingers'.[22] (See Figs. 3.6-3.10).

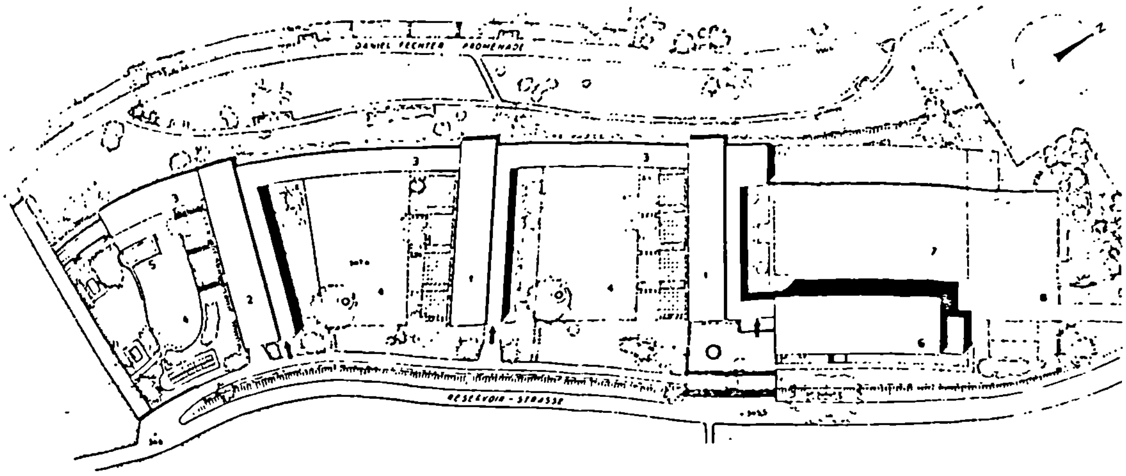
SCHOOL BUILDING TRENDS DURING THE POST SECOND WORLD WAR PERIOD.

Although "finger plan" schools can be considered as a revolutionary solution in comparison with the early twentieth century schools, it has been considered lavish when seen against the standards of the late post-war period. The reason for this statement is clear when the economic situation after the war is considered. The shortage of skilled labour, materials and high

FIGURE 3.6.

Bruderholz School, Basel, Switzerland. 1938-39.

Source: Alfred Roth: "The New School".



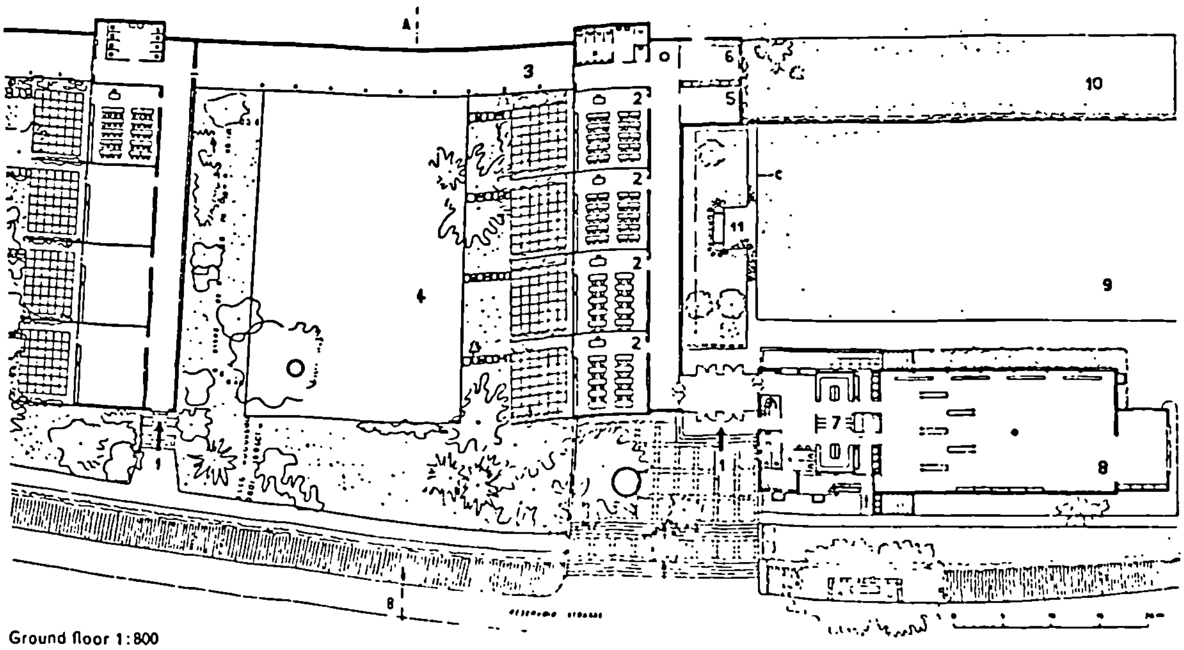
Site 1:1700

1 Classrooms
2 Kindergarten
3 Covered passage
4 Play ground
5 Splash basin
6 Gymnasium
7 Sports ground
8 Out-door gymnasium

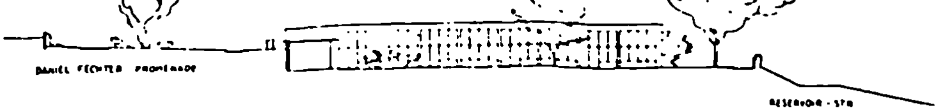
Ground floor:

1 Entrance
2 Classroom
3 Covered passage
4 Play ground
5 Teachers' room
6 School collection
7 Dressing rooms
8 Gymnasium
9 Sports ground
10 Long and high jump
11 Showers

FIGURE 3.7.



Ground floor 1:800

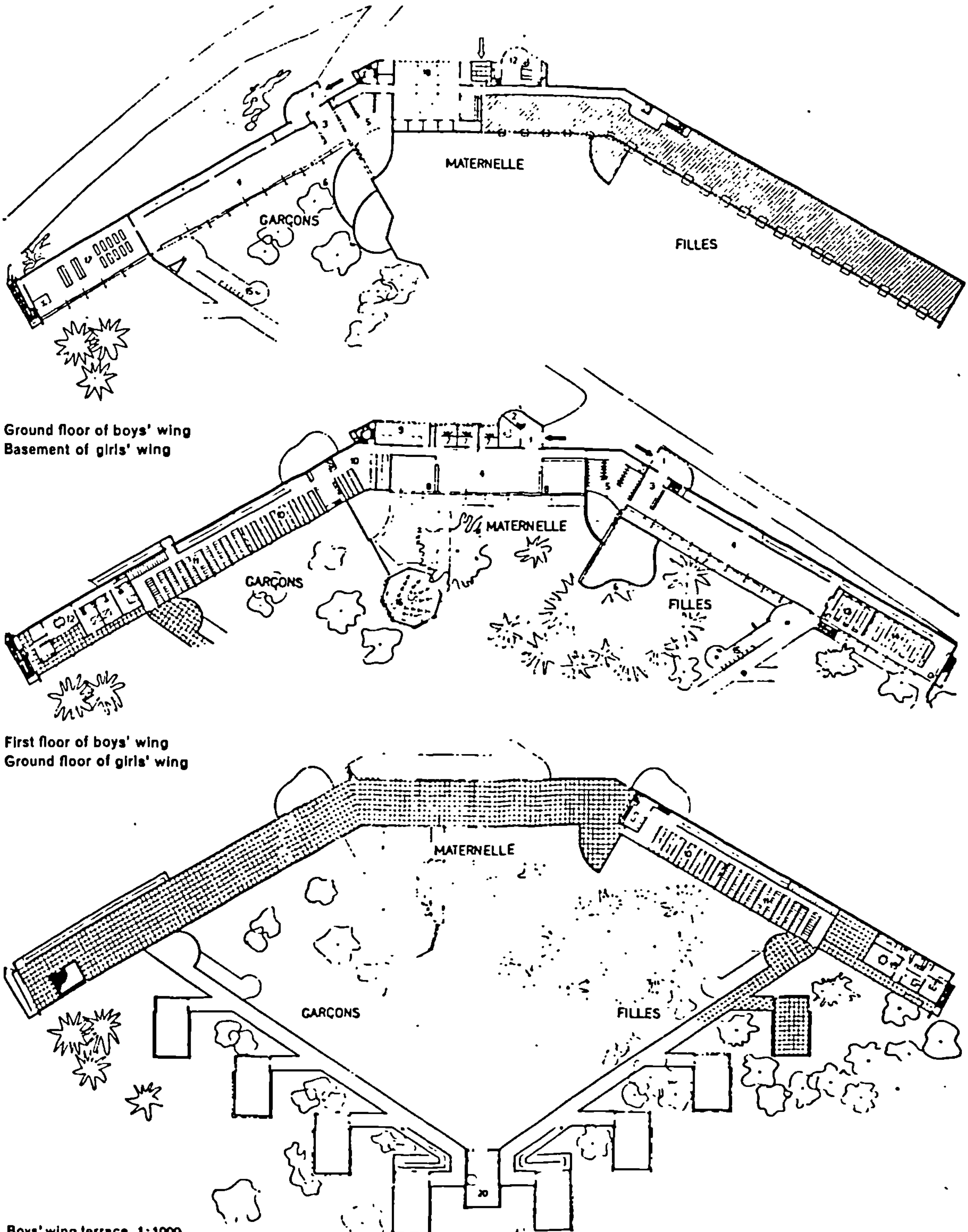


Cross Section A-B through covered passage and playground.

FIGURE 3.8.

Open air-school in Suresnes, Paris, France. 1935-36

Source: Alfred Roth: "The New School".



Ground floor of boys' wing
Basement of girls' wing

First floor of boys' wing
Ground floor of girls' wing

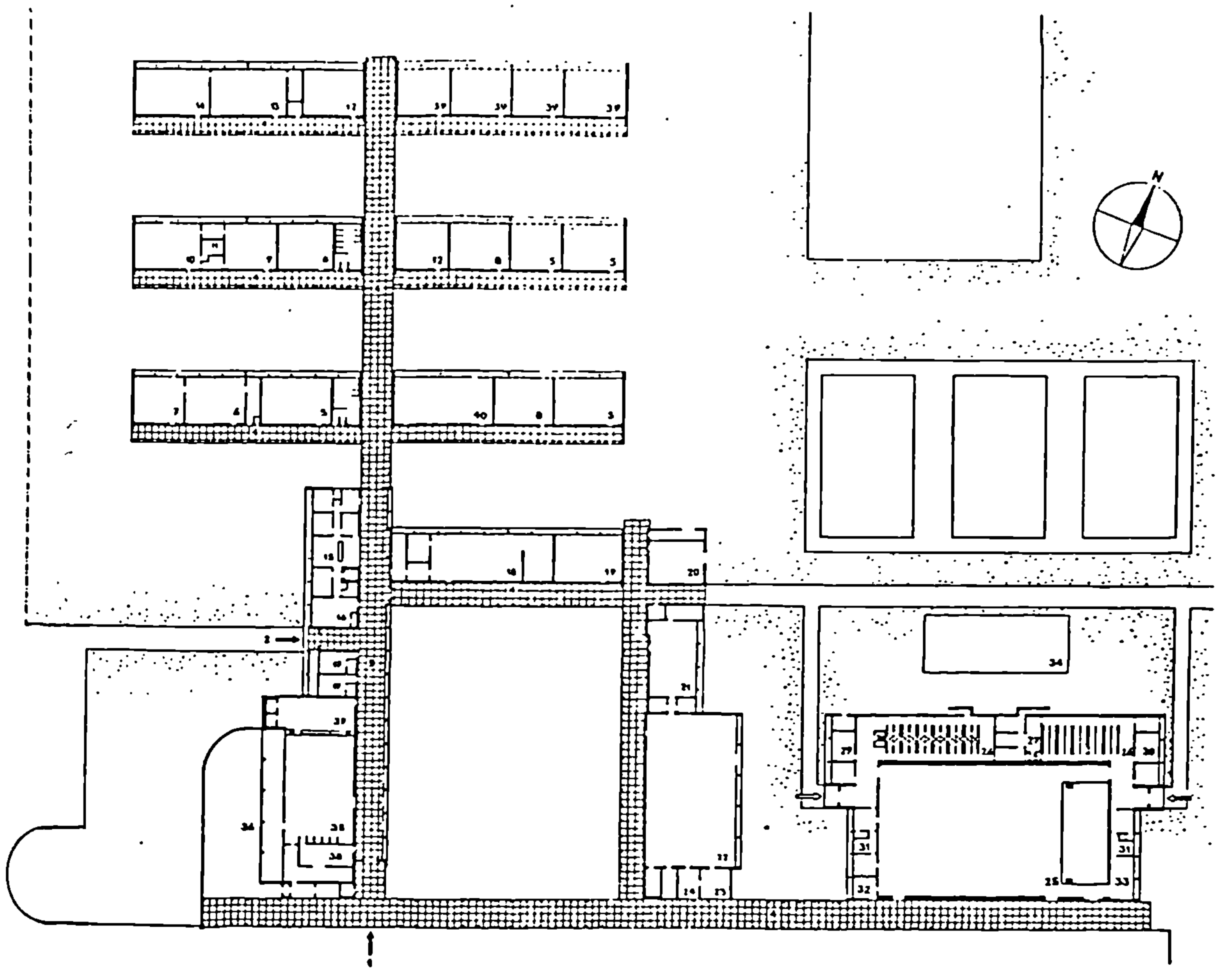
Boys' wing terrace 1:1000
First floor of girls' wing

1 Entrance
2 Caretaker's box
3 Wash basins
4 Recreation hall
5 In-door splash basin
6 Out-door splash basin
7 Wash and dressing room
8 Kindergarten
9 Therapy
10 Dining room
11 Rest room
12 Staff quarters
13 Domestic science
14 Needlework
15 Lavatories
16 Pavilion for special teaching
17 Manual work for boys
18 School kitchen
19 Matron's quarters
20 Medical service pavilion

FIGURE 3.9.

Acalares School, Lafayette, California, U.S.A. 1940-50.

Source: Alfred Roth, "The New School".

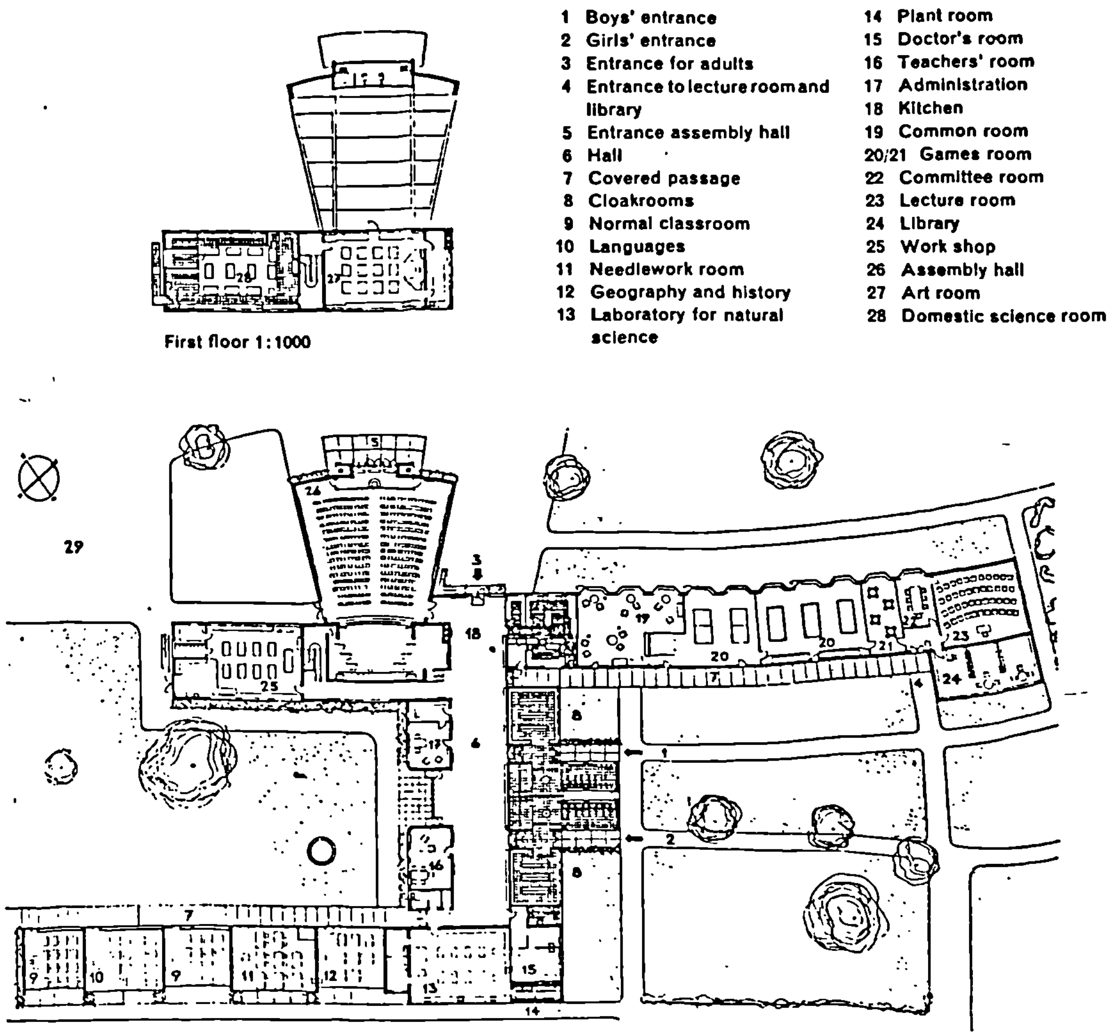


Groundfloor 1 : 1250 first and second stage

1, 2 Main entrances
3 Corridor
4 Covered passage
5 Social studies
6 Typing room
7 Commercial room
8 English room
9 Languages
10 Science room
11 Darkroom and storage room
12 Mathematic room
13 Needlework
14 Domestic science
15 Administration
16 Board room
17 Teacher's lavatories
18 Library
19 Social studies
20 Boiler room
21 Technical drawing
22 Workshop
23 Painting
24 Tool storage
25 Stage
26 Dressing room
27 Showers and dry room
28 Towel room
29 Girls' rest room
30 Boys' team room
31 First aid room
32 Kitchen
33 Storage
34 Swimming pool
35 Cafeteria
36 Terrace
37 Stage
38 Kitchen
39 General classrooms
40 Study hall and projection room

FIGURE 3.10

Impington School, Camrbidgeshire. 1939.



Source: Alfred Roth: "The New School".

demand for new school buildings, made "corridor" and "finger plan" schools far too costly in land, materials and time consuming construction. In particular, the amount of circulation space for corridors, etc., was found to be uneconomic.

But, while the pressure of the economic sitution led to the general phasing out of "finger-plan" schools, on the other hand it encouraged new trends in the development of school building design. These mainly led towards rationalization of plan layout and response to a detailed anaylsis of functional requirements. The latter often being based on statements of educational philosophy.

A - THE USE OF INDUSTRIALIZED BUILDING SYSTEMS.

The simple equation of the development of school buildings in the 1930's and 1940's, which aimed to balance only educational, architectural and environmental needs, had become more complicated. New variable factors had emerged as a result of the economical, social and political situation of the post-war period. The new equation endeavoured to achieve a balance between cost, quantity, urgency of provision and the limits of available resources. These clearly influenced educational, environmental and architectural factors.

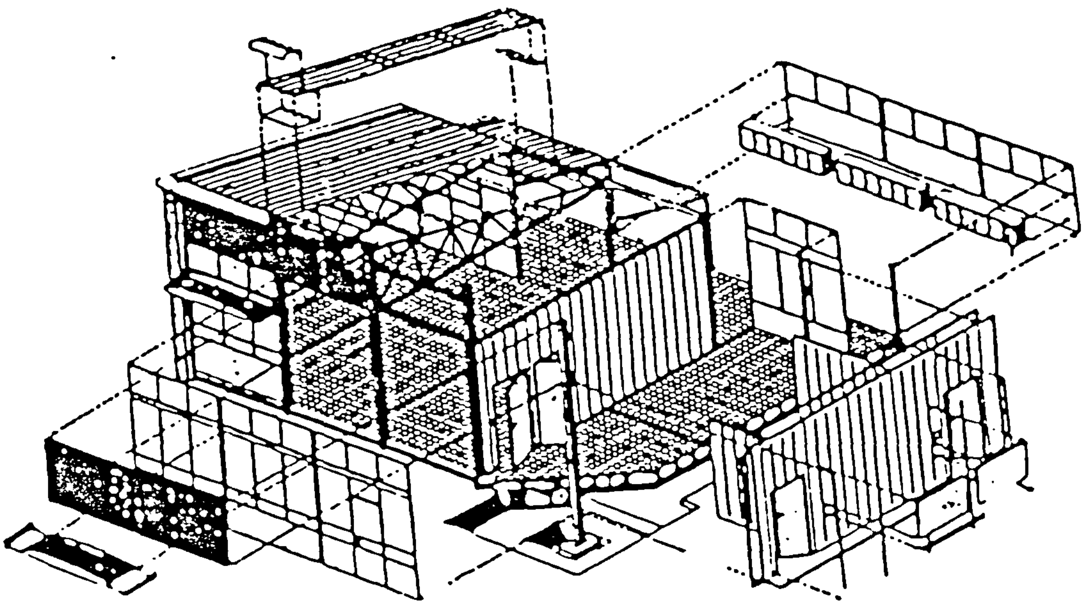
One of the early attempts to balance this equation came from England. In the years 1945-46 the Department of Hertfordshire County Council carried out a research programme into standardization of structural systems, dimensional control and surveys of daylighting and heating provision. The aims of the research were to overcome the problems of the shortage of skilled labour and materials, and to reduce construction time by using steel and concrete [23] elements, often prefabricated on site.

The importance of this research came from, first: the use of a grid system in which the column and beam components were designed to form spaces of incremental spans and heights from a single point. Thus with the standard components, room sizes of different spans and heights were possible and they could be connected at right-angles at different levels. The main principle of the grid system was to standardize the components made in the factory, not on the school site.[24] (See Fig. 3.11). Secondly: the Hertfordshire development programme encouraged the idea of architecture as a team activity rather than the expression of a single artist-designer. Thirdly: it was the first time that educational ideas were related to, and indeed were often behind, technical innovation.[25] This process was helped by co-operation with a high quality research team in the Ministry of Education.

During the 1950's and 1960's, the logic of Hertfordshire's experiment spread, not only in the United Kingdom, but also all over the world. Several hundred modular systems of construction have been proposed and marketed during the last few decades, each with a particular characteristic.[26]

In France, due to the educational reform and increase of school population in the 1960's, which traditional building methods could not satisfy, the Ministry of Education instituted

FIGURE 3.11.



Axonometric cross-section showing structural elements.

Source: Alfred Roth: "The New School".

its 'Concourse design/build competitions' to encourage builders to collaborate with architects and engineers to develop alternative constructional methods. The COIGNET and BALLOT systems were two of many which resulted from the Concourse.

The COIGNET system is a heavy concrete construction, with a planning module of 1.80m and a normal span of 7.20m between load-bearing internal walls, but with a maximum span of 9.00m. Floors, roofs and external walls are all of reinforced concrete. The BALLOT system is also of heavy reinforced concrete, but with a structural frame of columns at 7.20m in both directions. External walls can be used as prefabricated timber panels or concrete.(27)

In Denmark, the Municipal of County Education Authorities on the island of Fyn were encouraged by the Ministry of Education to use industrialized buildings in order to overcome the failure of traditional construction methods, and to meet the demand for more school accommodation. The result was the FXNSPLAN system, designed by a group of private architectural and engineering firms. The system of a heavy pre-cast concrete frame on a module of 3.60m spanning up to 10.80m. Upper floors and roofs (either flat or pitched) are of pre-cast concrete slabs. Several alternatives may be used for external walls, as in the BALLOT system.(28)

In the United Kingdom, as a result of a direct influence of the Hertfordshire experiment, many other County Councils followed this approach to develop their own systems. The first system was CLASP (Consortium of Local Authorities Special Programme). This consortium was formed in 1957 to exploit the potential for attracting the co-operation of component manufacturers, and for obtaining more favourable prices by means of bulk purchase which was offered by the industrialized building system designed by Nottinghamshire County Council.[29] The main feature of the system lay in its unique advantages in overcoming problems of mining subsidence. In general the system is based on the use of lightweight materials with a cold-rolled steel frame. Pre-cast concrete panels can be used for external walls. Columns may be located anywhere on a 0.90 x 0.90m grid with a maximum span of 18.00m for roofs and 9.00m for upper floors.[30] By 1966, 58 Local Education Authorities in England and Wales had become full members of eight consortia.[31]

In Switzerland another system was developed by a group of private architects and engineers to meet the school buildings requirements of the local authority in Lausanne. The system CROCS (Center de Réalisation et d'Organisation des Construction Scolaires) has a steel-framed structure dimensioned in bays of 7.80m x 7.80m, 7.80m x 5.40m and 5.40m x 5.40m. Pre-cast concrete slabs are used for upper floors and corrugated steel panels for roofs, while pre-cast concrete panels form external walls. Internal partitions are of lightweight materials.[32] These were only some examples of the industrialized systems in some developed countries.

In the developing countries, although there is a huge demand for housing and other facilities, such as school buildings, caused by both population growth rate and population movement, industrialized construction does not account for a significant percentage of either housing or school buildings.[33] Very few developing countries have attempted the use of industrialized building systems for school buildings. Those who have ventured into the field, such as: Mexico, Morocco, etc., have used systems of light skeletal frame structures, designed for rural schools by the Ministry of Education in each country. External and internal walls in both systems are optional in accordance with local requirements.[34] (See Fig. 3.12). The use of industrialized building systems for school building in Saudi Arabia will be discussed in Chapter 6.

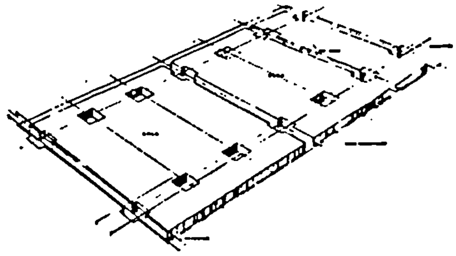
MOTIVATION AND LIMITS OF THE USE OF INDUSTRIALIZED BUILDING SYSTEMS FOR SCHOOL BUILDINGS.

In 1975, almost thirty years after the Hertfordshire experiment was begun, a report by Guy Oddie on the use of industrialized building for schools in the OECD countries[35] outlined new facts. According to the report, the assumptions that the use of industrialized building systems for school buildings is cheaper and quicker than the use of conventional methods can not be confirmed. But, on the other hand, the major benefits are the consistency of product and the saving in decision time.

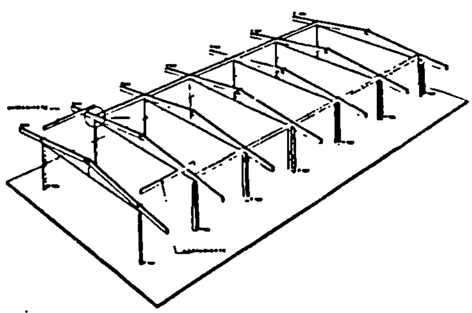
1 - ECONOMICS.

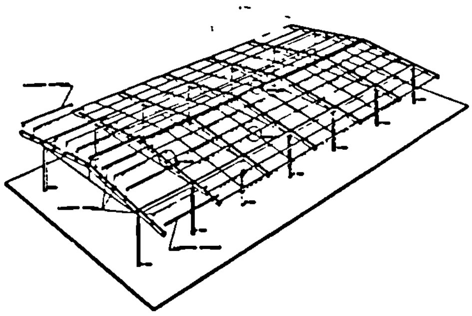
Although industrialization in general is always identified with cost reduction, the prospect of such a benefit has not been convincing enough for industrialized building systems to displace all alternative methods. Even in England and France, where industrialized building systems can be discerned as at all

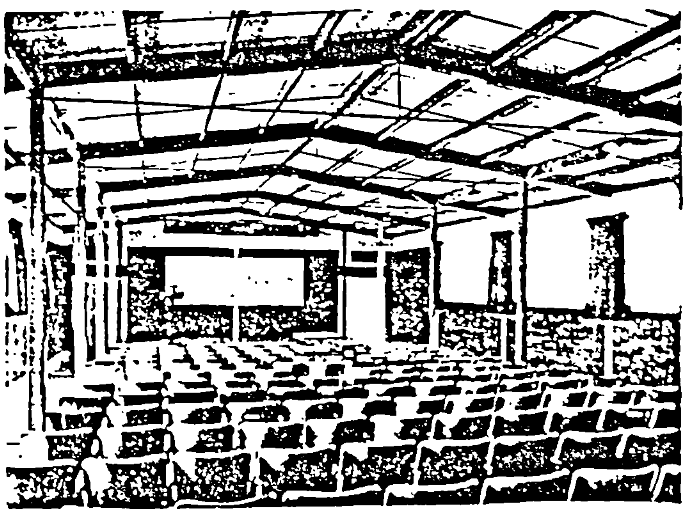
FIGURE 3.12.



Industrialized building systems for school building in a rural area in Morocco.







dominant in school construction, they have done so less as a substitute for conventional building than as an addition to the potential of the building industry.[36] The reasons behind this have been summarised in Oddie's report as follows:

(a) The attempt to save scarce labour on site leads naturally to the use of standard components which are large, bulky, difficult to store and which, by comparison with bricks and tiles, are needed in much more limited quantities. For this reason industrialized building components can benefit much less from mass production or stockpiling as a means of sustaining production in a period of slack demand than can so many products of industrialization in general.

(b) Since systems depend for their effect on the mutual compatability of prefabricated components, mainly assembled by dry techniques, the components must be made to finer tolerances than usual in the industry to ensure a proper fit; and higher dimensional accuracy can cost more.

(c) ... because the range of components which are mutually compatible is inevitably less than the range where compatibility does not need to be considered, conventional building enjoys greater freedom to substitute one component for another to meet variations in cost and availability.

(d) ... In practice systems which are currently 'successful' differ considerably from their original form and their continued success demands continuous development to meet changing circumstances. The opportunity for this is absent in most sectors of building. Housing is the exception...

the absence of opportunity for sustained development in all other sectors is probably the main reason why industrialized systems have not yet become the dominant mode throughout building as a whole.

2 - TIME.

The major factors that always handicap the speed of construction time are:

(a) Those industrialized components which cost more than non-industrialized methods may yet not save time. According to Oddie's report many cases have been found where traditional block work was significantly cheaper for internal partitions than any of the industrialized alternatives, but where the extra time needed for its construction was not. The block work construction could be timed to coincide with other operations, and it was these other operations, not the blockwork itself, which were critical in the total completion time. Therefore the real savings in time are not dependent on the use of industrialized systems, but they are also dependent on how the industrialized system affects the critical path through the whole opertional network.[38]

(b) Because of the natural tendency for every building to be unique, there is no opportunity, except in the case of repetitive housing, for site operatives to become familiar with assembly operations. In this respect building systems do, in fact, offer an advantage over other conventional methods, but it can not be seized unless the same assembly contractor can build a number of buildings using the same system.[39]

3 - SAVINGS IN DECISION TIME.

During the period between the initial decision to build and the date on which construction starts, many decisions have to be taken, including design decisions, approval of the design by the school building agency and by other responsible authorities. Following these approvals, tenders for construction have to be sought. The successful bidder must ascertain possible sources of labour, materials, etc. All these decisions and many others take time. With conventional methods every one of them has to be taken on each occasion that an individual building is constructed. But by using industrialized building systems many of these decisions need to be taken only once, no matter how many buildings are produced by the system.[40]

4 - CONSISTENCY AND QUALITY OF PRODUCT.

As well as the saving in decision time, quality and cost control is easier to assure with the knowledge that for a given expenditure, the quality of product will remain constant wherever the system is used. With conventional building, quality is more subject to the greater variability of site supervision. Therefore the advantages from industrialized building systems in this respect form one of the major benefits which consumers in general enjoy, not only because the building elements are of consistent and reliable quality, but can be programmed to meet supply dates. A major advantage is that the product can be sampled and evaluated before being purchased.[41]

B - DESIGN INNOVATION.

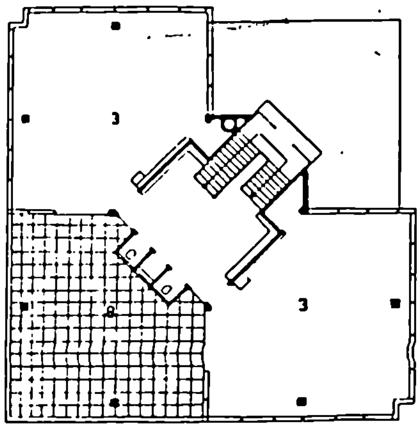
The movement towards the use of industrialized systems for school building has overlapped with another developing concern of the post-war situation - the rationalization of building design. What is meant by rationalization is the balanced response to educational, economical, environmental and social needs, whereby flexibility, efficiency and adequacy are key words in the design process.

Before going farther into this, it is important to show some examples of early signs of rationalization during the period before the Second World War. The open air school in Amsterdam, built in 1930, showed for the first time how the problems of long corridors could be tackled, at the same time assuring very high levels of daylight and natural ventilation. (See Fig. 3.13.) The second example is the Crow Island School in the United States of America, built in 1940. In this school priority was given over to educational needs rather than to space for circulation. The solution showed for the first time a new type of classroom, the 'self-contained teaching space', with alcoves and work places and its own sanitary arrangements, suitable for a great many activities.[42] (See Fig. 3.14). (It must be considered that the general arrangement shows a long corridor giving access to the classrooms).

FIGURE 3.13.

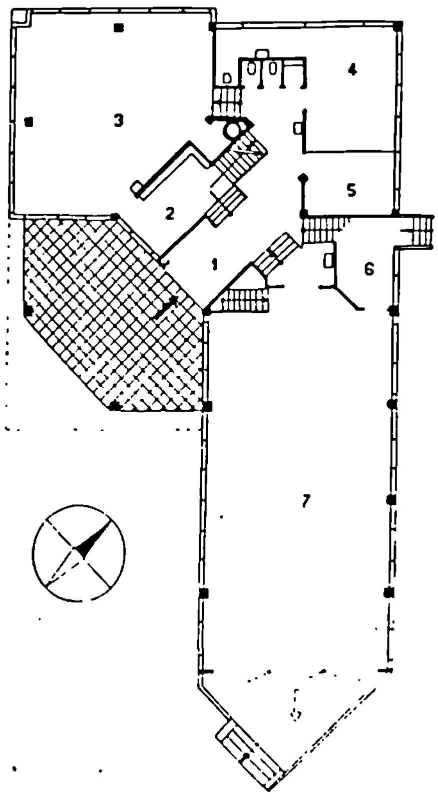
Open Air School (1930)
Architect: J. Duiker.

Source: Information Centre for school building (ICS). "Third Netherlands-Hungarian Seminar on School Building. 1982.

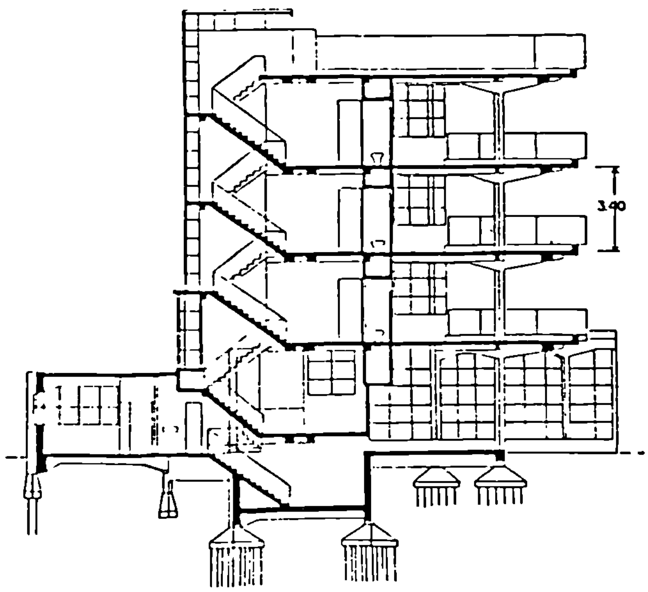


First floor 1 : 300 ' Obergeschoß

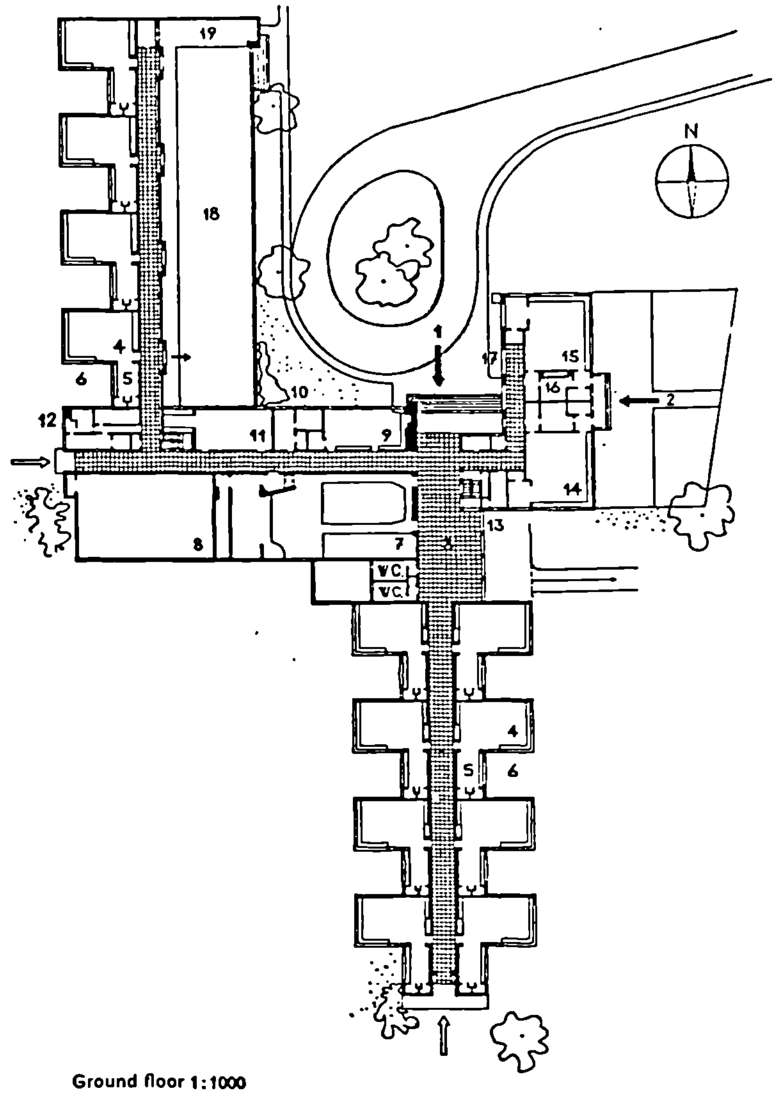
1 Entrance hall
2 Cloakroom
3 Classroom
4 Teacher's room
5 Headmaster's room
6 Dressing room
7 Playing hall
8 Open-air class



Ground floor 1 : 300



Cross section 1 : 300



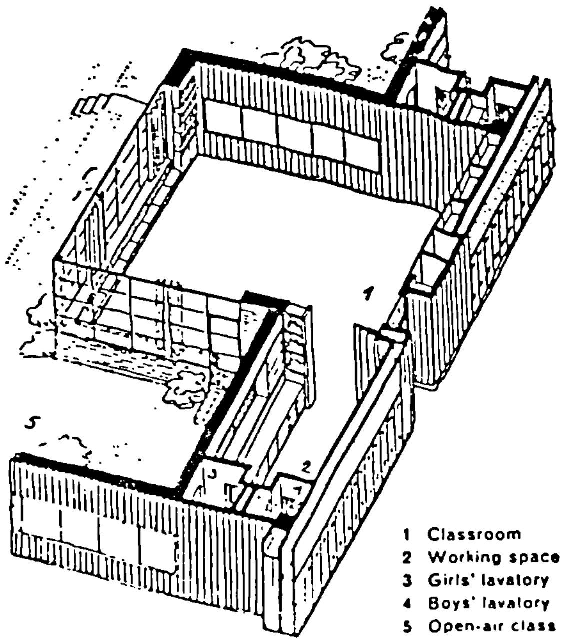
Ground floor 1:1000

FIGURE 3.14.

Crow Island School,

Winnetka (Illinois), 1940.

Source: Alfred Roth, "The New School".



Classroom unit

Although the total solution in each school is more or less typical of that period, it is also true that their particular solutions have added new idioms to the vocabulary of school building architecture, i.e: the compact plan and the multi-purpose classroom.

By the end of the Second World War it was clear that neither architects, educationalists nor administrators could alone deal with innovation and rationalization of school buildings. The first response to this fact came, again, from England. The Amersham school built in 1956 can be considered as a turning point in the development of school building design, not because it has a unique solution, but because it offered a new general approach that could be developed to meet the ever changing educational, architectural and environmental needs. The Amersham solution came from a close co-operation between educators and architects who concluded that the requirements of primary education need to be met by more subtle arrangement of spaces than by a series of classrooms.[43]

The educational practice in this school was based on the individual and group works typical of the progressive approach. As a result of that, the school had eight classes which were arranged in two self-contained groups and in such a way as to allow access from one room to another without the use of corridors. Two of the classrooms also shared a practical working area, with two others having large bays used for practical work of all kinds by the whole school. Furniture and equipment were designed specifically for the kind of activities the school was built to accommodate, and flexibility became the keyword and corner stone of the school.[44] The assembly hall was planned without the traditional stage axis and could be used for music and meals activities. The courtyard was also designed not only for looking at, but also as a social amenity, and a place to be used for work and play.[45] (See Fig. 3.15).

In general the main features of the school were:

- the beginning of the use of a 'semi-open plan' concept;

- the multi-use of spaces and corridors;

- and the combined use of traditional and industrialized construction methods to allow for cost reduction.

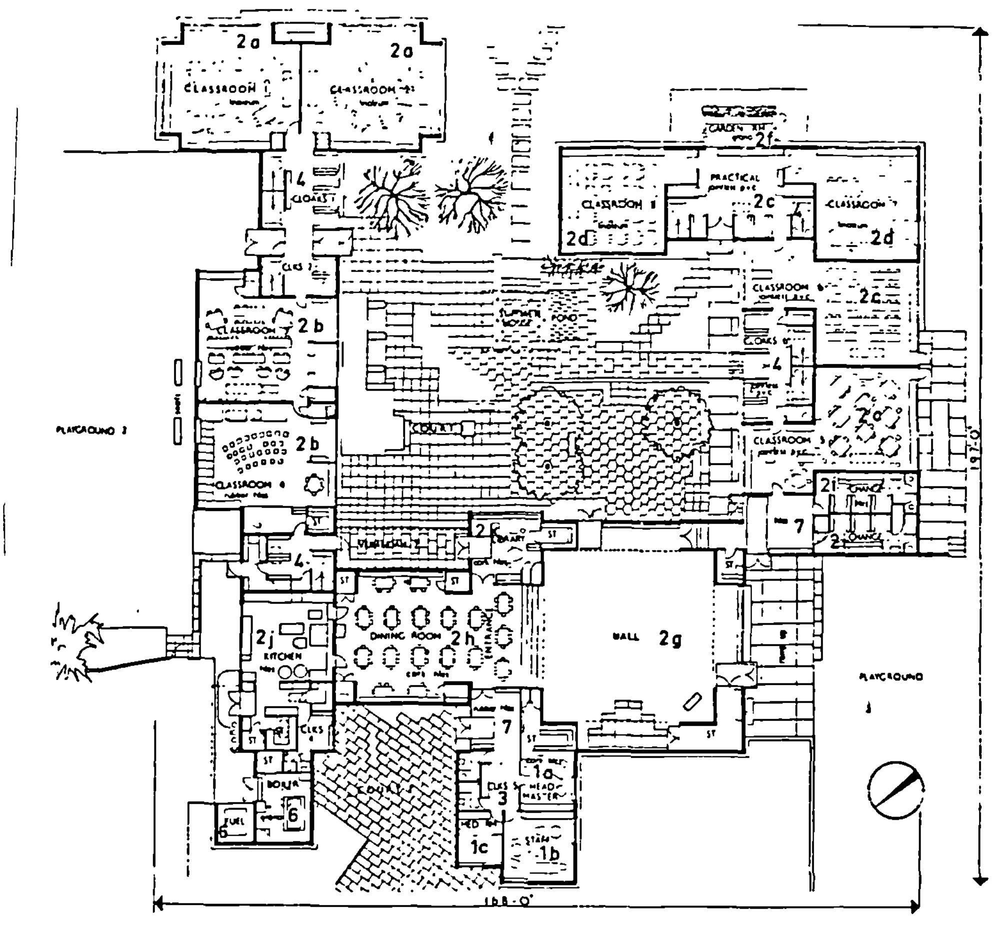
A great many other schools have been designed following the Amersham approach, such as Finmmer, Eveline Low, etc. (See Fig. 3.16).

On the other hand this innovation and rationalization of school buildings design in the United Kingdom and in the period after 1950 resulted in the reduction of area space per child (on average from about 6.50sq.m. to 3.71sq.m.).[46] This was achieved by reduction in circulation and by the dual use of spaces.

Although the use of 'self-contained' classrooms in the United States started as early as 1940, it was not until 1960 when architects and educators endeavoured to balance the equation of rationalization. The need to accommodate progressive educational approaches, reduce cost and time, optimize the internal environmental conditions, as well as allowing for

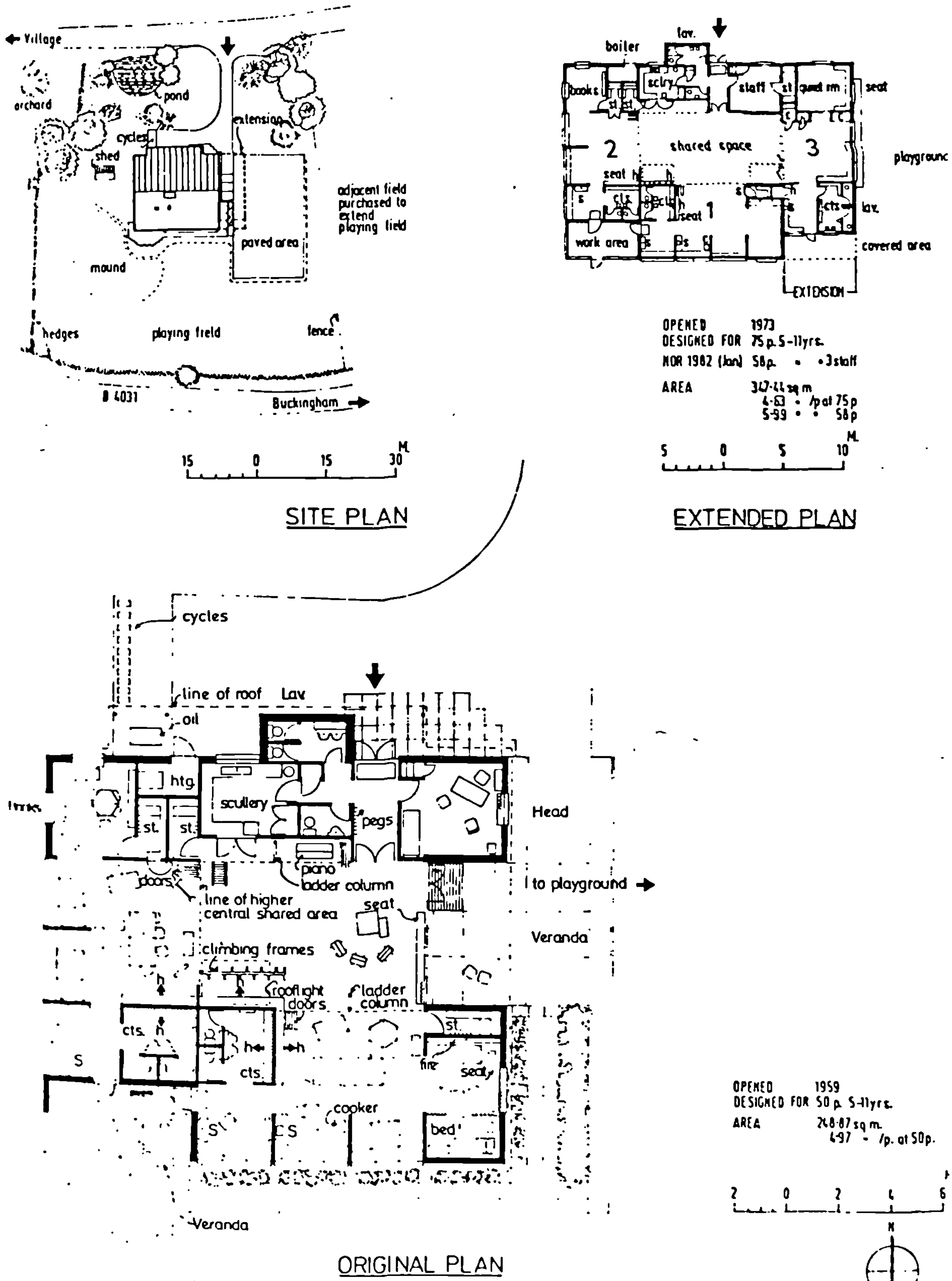
FIGURE 3.15.

School in Amersham, United Kingdom, (1956).



Source: Information Centre for School Building (ICS).
"Third Netherlands-Hungarian Seminar on School Building, 1982".

FIGURE 3.16.



Source: Stuart Maclure: "Educational Development and School Building".

flexibility and adaptability, were factors that had to be taken into account, as had happened in the British experience.

The example which can be considered as a further landmark in the development of school building in the United States is the Barrington Middle School, built in 1965. The school was the first American school to be built with modular, pre-fabricated components, developed by the SCSD (School Construction System Development). The educational programme was non-graded, with a completely flexible arrangement of spaces to employ a team teaching approach.[47] (The open-classroom layout and the construction method can be seen in Fig. 3.17).

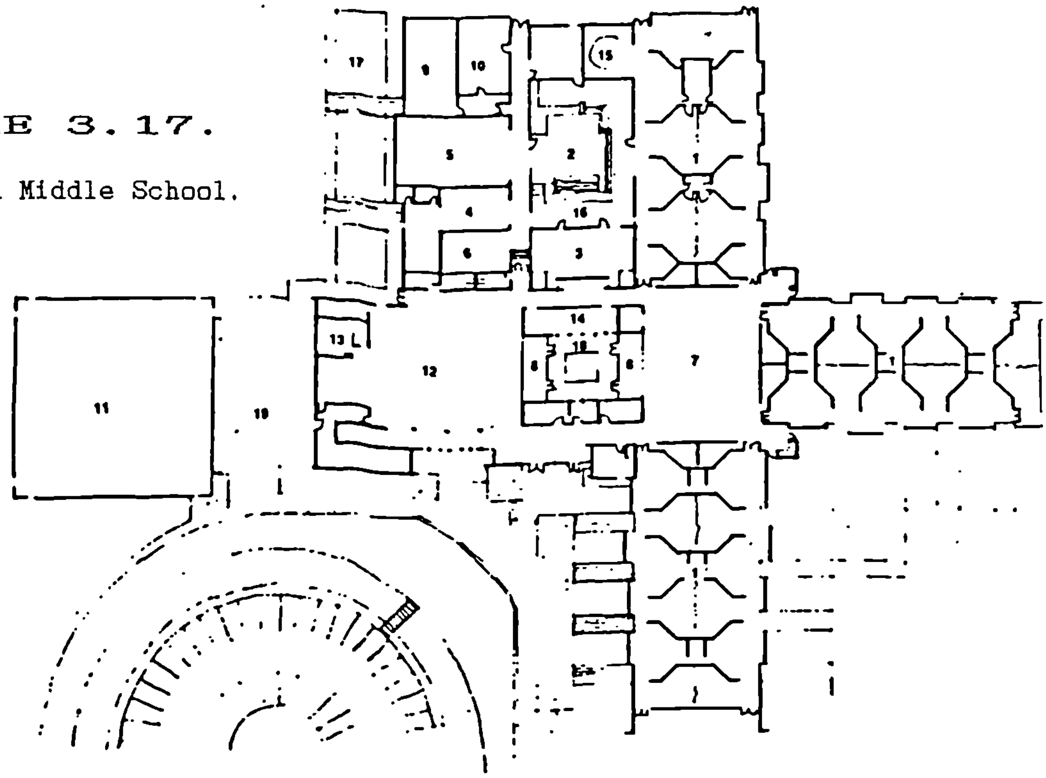
In the continent of Europe (France, Germany, Switzerland, Netherlands, Scandinavia and others), the trends of school buildings during the 1950's and middle 1960's were dominated by 'single-function' rooms; where classrooms were designed for general subjects, with additional special rooms equipped for one subject only.[48]

One of the striking examples of the development of school buildings in Europe is the Netherlands experiment. The PC-School 'Schonenburg' built in Houten and which was developed by the ICS (Information Centre for School-building), showed the compactness of the plan, the multi-use of the classroom and corridors and the adequacy of the internal environment.[49] (See Fig. 3.18).

In Sweden, the Ortgard school built in 1971[50] was designed to accommodate progressive approaches, and as a result of that, a compact and semi-open plan were necessary to support the variety of the educational activities needed. (See Fig. 3.19).

FIGURE 3.17.

Barrington Middle School.

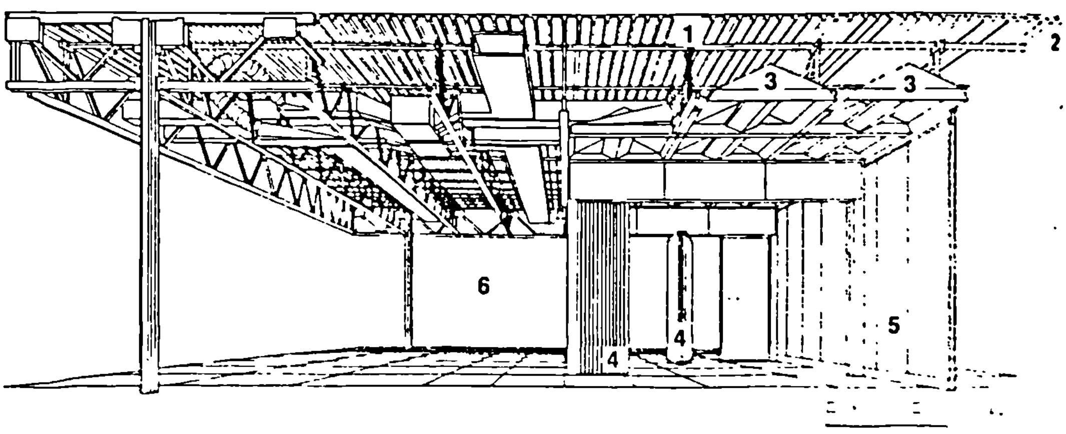


First floor plan:

1 Classroom unit
2 Science study court
3 Art
4 Shop
5 Home economics
6 Drafting
7 Learning center
8 Stage
9 Band
10 Vocal
11 Physical education
12 Dining and creative programing
13 Kitchen
14 Faculty
15 Planetarium
16 Art terrace
17 Band terrace
18 Study court
19 Service court

The first American school building to be built with modular pre-fabricated components.

Source: James J. Morriseau, "Design and Planning The New School".

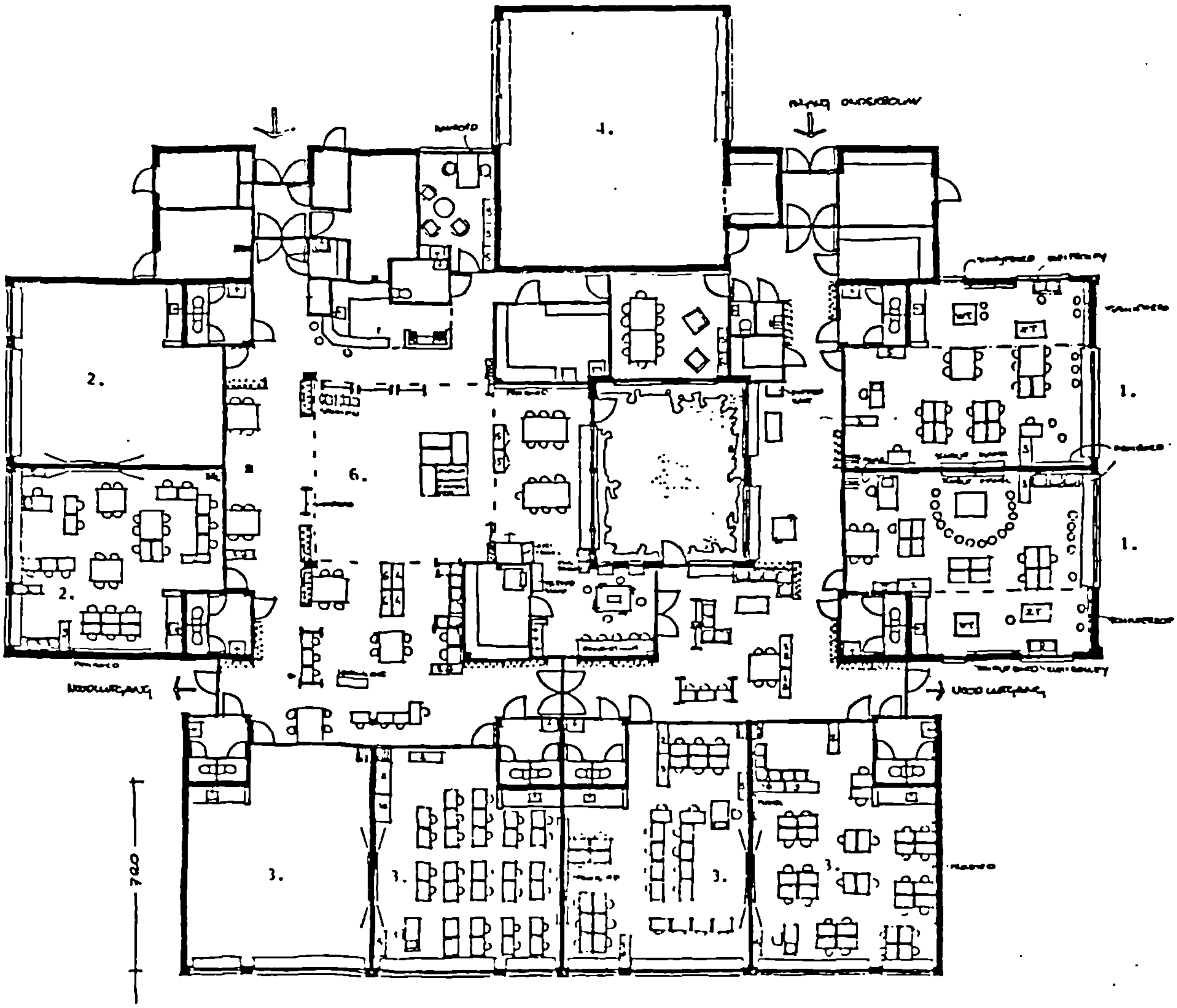


SCSD system component:

1 Truss-deck system
2 Integrated sandwich
3 Ceiling-lighting coffer
4 Operable partition
5 Demountable partition
6 Clear span

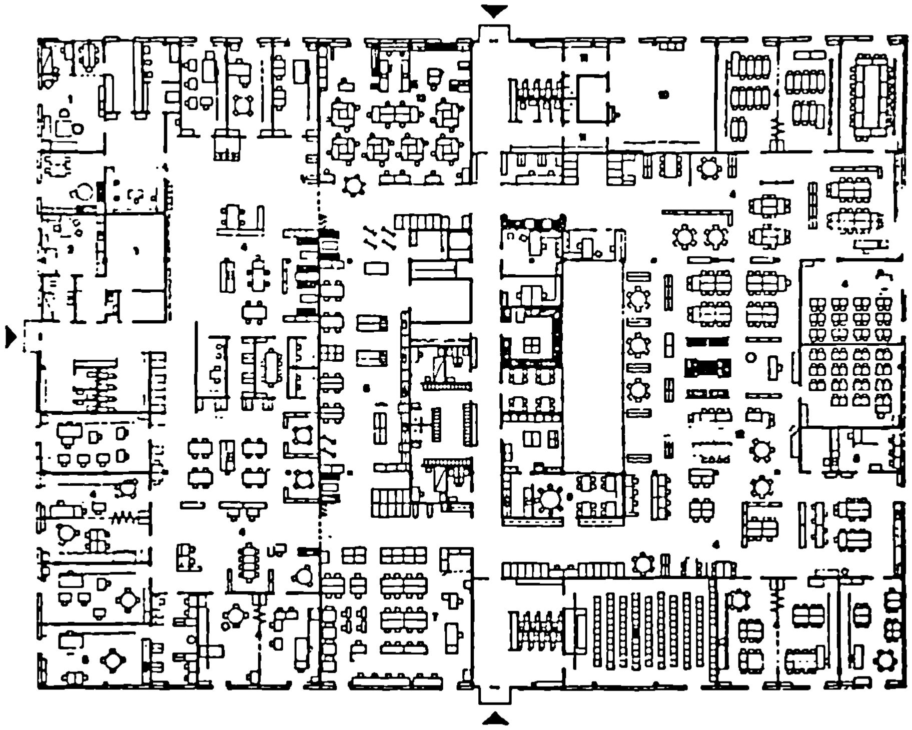
FIGURE 3.18.

PC-School 'Schonenburg', Houten.



Source: Information Centre for School Building (ICS).
"Third Netherlands-Hungarian Seminar on School Building, 1982.

FIGURE 3.19.



Layout.
A Retarded Children's school
B Common area
C Normal Children's school
1 Apartment
2 Physician
3 Remedial gymnastics
4 Class-rooms
5 Clinic
6 Atelier
7 Textile workshop
8 Conference room
9 Teachers
10 Rhythmics
11 Dressing-room
12 Mediothec
13 Wood and metal workshop

open and semi-open plan.

The Ortgard School Sweden, 1971.

Source: Carlo Testa: "New Educational Facilities".

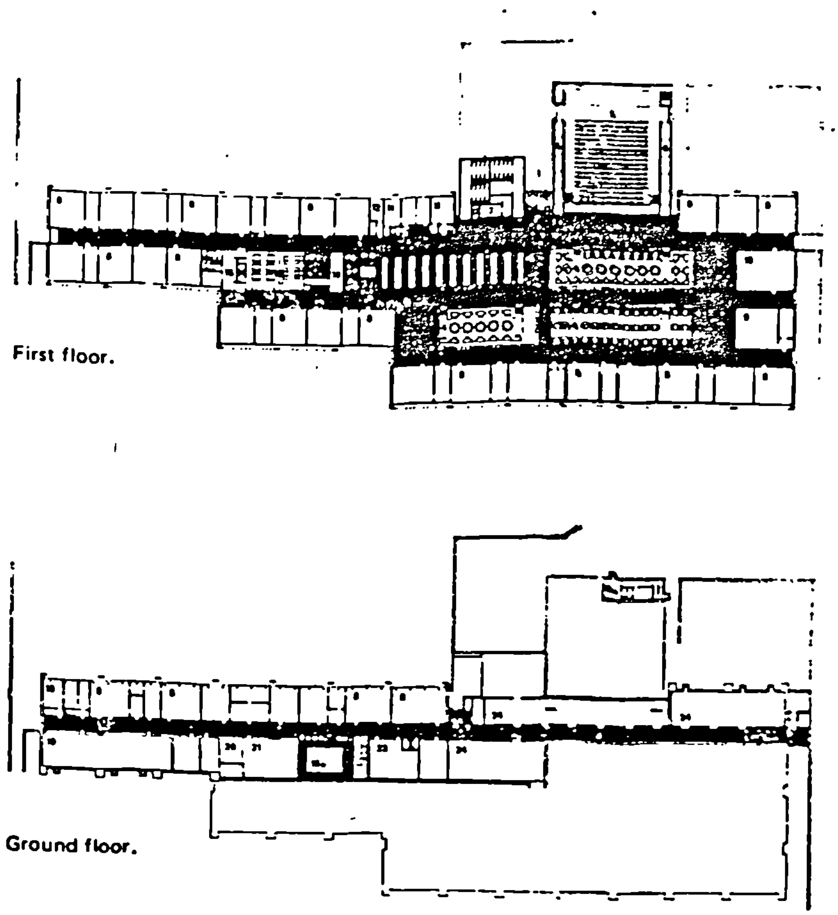
In Denmark, rationalization has been achieved even with the traditional 'Corridor plan'. The Amstsgymnasiet i Risskov school built in 1969 showed how circulation areas can be designed so as to become attractive zones for social intercourse and individual or group work. The dining hall, situated in the centre of the building is used both during breaks for informal meetings, and for individual and group work during the day.[51] (See Fig. 3.20).

NEW TRENDS.

During the 1970's and the beginning of the 1980's, it became clear that the result of the post-war rationalization approaches were positive, not because economical savings and educational needs had been achieved, it was held that further rationalization and consequent innovation were still needed.

Several major factors have affected the planning and designing of school buildings during this period in most developing countries. These include: the general economic recession following the oil price crises of 1974 and 1979, the falling birth rate, population movement. At the same time the success of the progressive educational approach has resulted in demand for modernising older schools. The pressure of all these factors has encouraged the development of two main approaches: the community school and open-plan school.

FIGURE 3.20.



39

1 Main entrance
2 Central concourse
3 Central cloak-room
4 Terrace
5 Assembly hall
5a Changing-rooms
6 Chairs magazine
7 Kitchen with servery
8 Class-room
9 Music and singing
10 Library
11 Offices
12 Tutor
13 Masters' room
14 Kitchen
15 Cloak-room
16 Balcony above low-level atrium
16a Atrium with pool
17 Lift
18 Medical officer and nurse
19 Shelter, table tennis
20 Stage
21 Humanistic auditorium, film and theatre room
23 Book stores
24 Bicycles and motorcycles

The Amstsgymnasiet i Risskov School, Denmark, 1969.

Source: Carlo Testa: "New Educational Facilities".

1 - COMMUNITY SCHOOL.

The term community school has been defined in many different ways. To some people, community school means the use of the premises during non-school hours for recreation, adult education, public gatherings or just summer school. To others, it means extended use of the school building for fine arts, vocational training, social and pre-school services.(52) In their report "Community/School: Sharing the Space and the Action", the EFL (Educational Facilities Laboratories), defines community school as "a place planned and operated cooperatively by schools and other agencies for the delivery of social services, including education, to the entire community".(33)

The plurality of definition may indicate that the term 'community school' has not yet been educationally identified in a theoretical form as a part of the traditional or the progressive educational approaches. In other words the definitions of 'community school' have been directly influenced by social and economical factors and needs, rather than educational needs. Nevertheless, the application of the community school concept can still be considered as an example of educational innovation, not because the standard of general education has been improved, but because it is the first time that informal education can be controlled, organized and developed.

The community school in its widest meaning necessitates a co-operation between the school and other institutions. The potentials of this co-operation have been summarized by the EFL reports as follows:

- Save money or make it go further.

- Avoid duplication of effort.

- Make better use of resources (staff, finances and facilities).

- Aggregate diverse expertise and experience for the benefit of a large contingency.

- Offer many options to faculty and students.

- Provide contacts between persons of different ages and ethnic backgrounds.

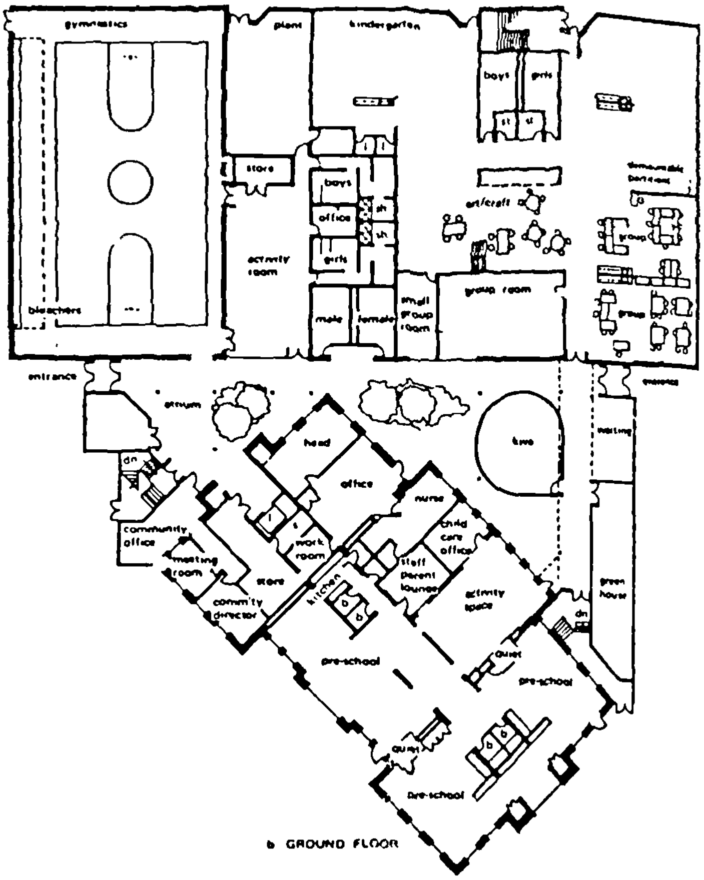
- Coordinate educational and recreational activities with health and social welfare agencies to help citizens identify and use the services available in a community.

- Serve new kinds of people and thereby broaden public support for education.[54]

The oldest and most widely known community school concept originated in the United States. The Flint community school founded in 1930 based its community programme on recreational and partially on educational concepts. The school and its playgrounds could be used by the community for adult education, summer programme and sport.[55] (See Fig. 3.21). But it was not until the late 1960's and during the 1970's when the economical, social and educational values of the community school concepts have been realized and heeded. Several other examples can be seen in Figures 3.22 and 3.23.

FIGURE 3.21.

Doyle Community School,
Flint, Michigan.



Source: Department of Education and
Science Architects and Building
Group.

"Educational Planning in North America".

Design Note 31.

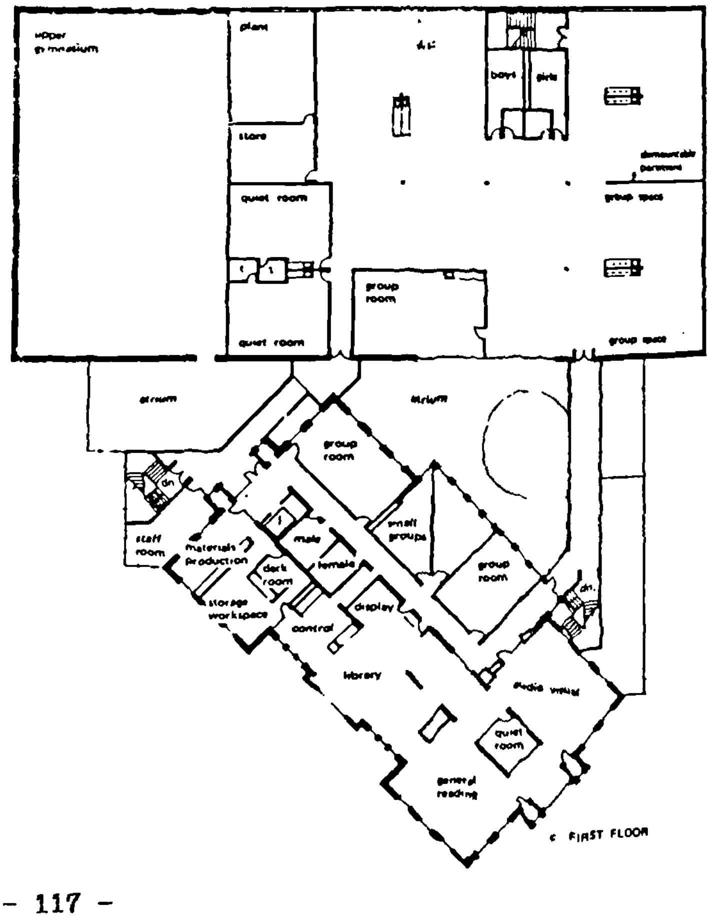
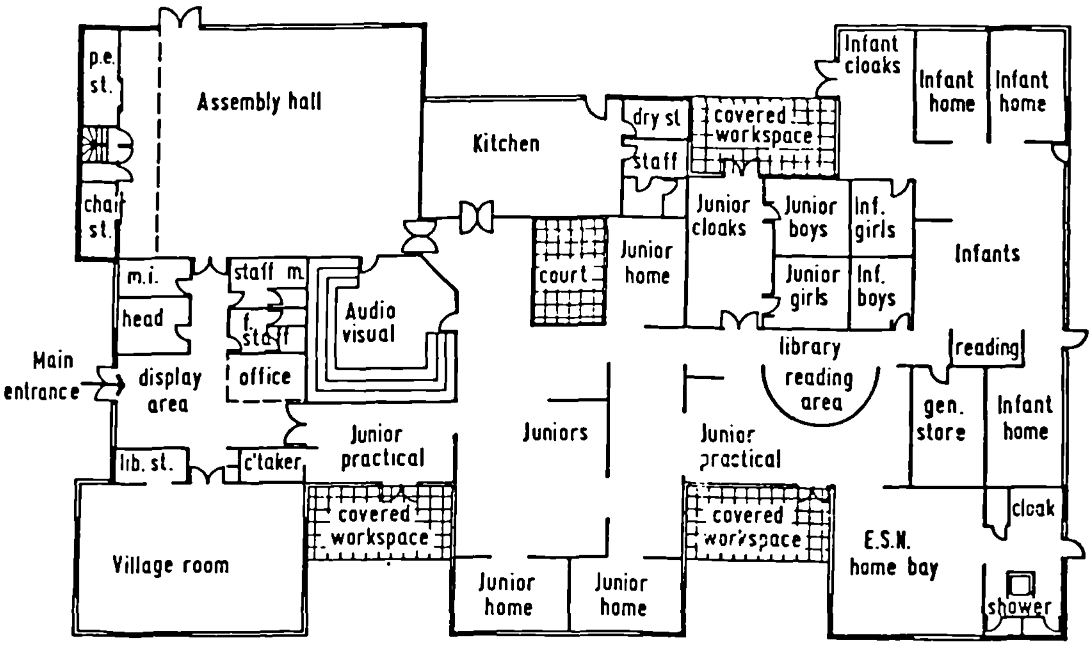


FIGURE 3.22.



The Park Primary School, Tattenhall

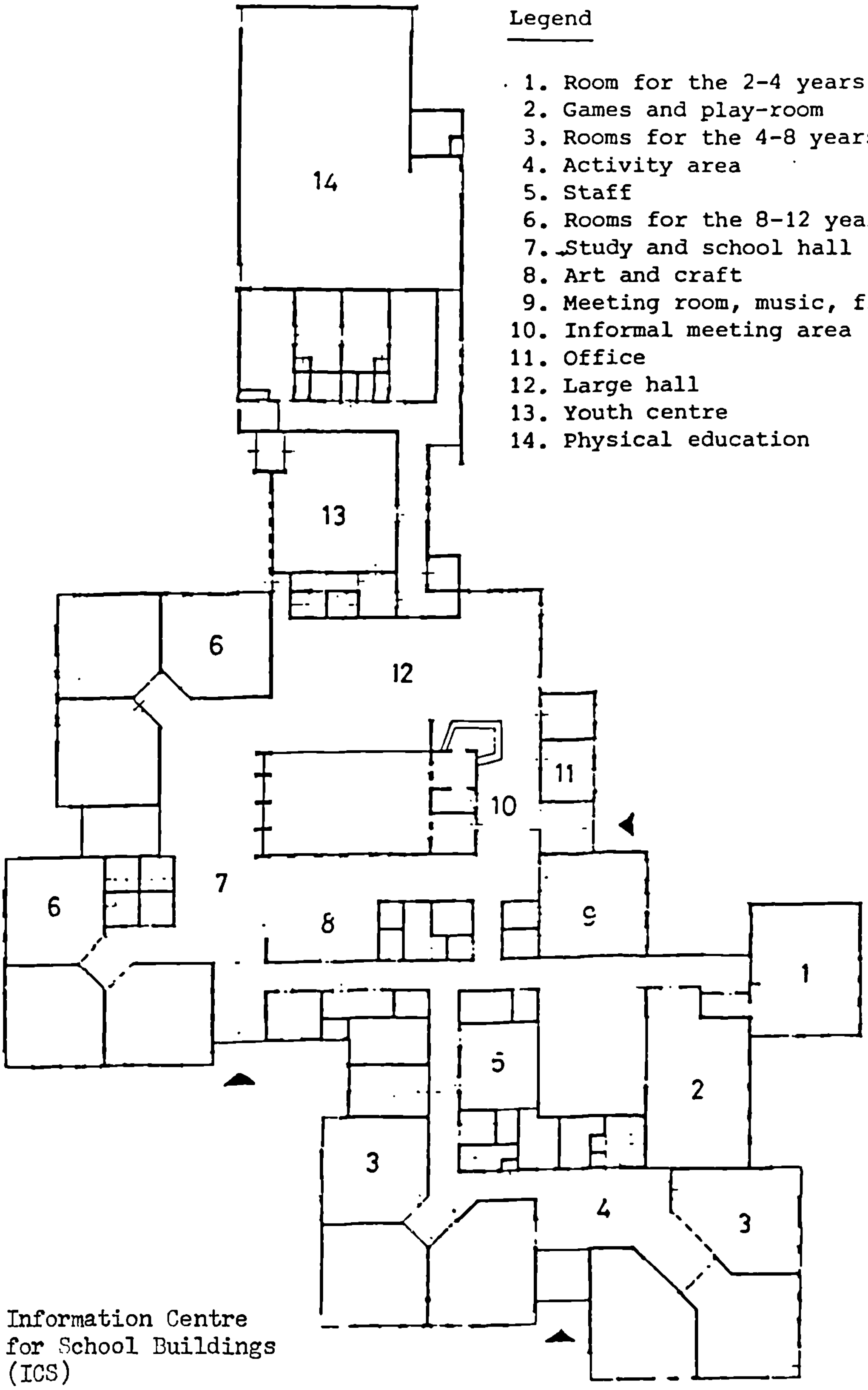
Source: Department of Education and Science
Architects and Building group.

"The School and the Community".

Design Note 5.

FIGURE 3.23.

Multifunctional project in Devente



Legend

1. Room for the 2-4 years old
2. Games and play-room
3. Rooms for the 4-8 years old
4. Activity area
5. Staff
6. Rooms for the 8-12 years old
7. Study and school hall
8. Art and craft
9. Meeting room, music, film
10. Informal meeting area
11. Office
12. Large hall
13. Youth centre
14. Physical education

Source: Information Centre for School Buildings (ICS) "Third Netnerlands-Hungarian Seminar on School Buildings".

2 - OPEN PLAN SCHOOL. (SCHOOL-WITHOUT-WALLS).

The acceleration of the development of school buildings architecture during the post-war period was so fast that the usual long time-lag between educational innovtion and architectural response has been diminished. Many reasons lie behind this achievement, but the most important one was the high level and close co-operation between educationalists, planners and architects. But, although this achievement of reducing the long time-lag can be considered as an innovation in itself, the continuation of that process during the 1970's and the beginning of the 1980's has indirectly forced the development of school buildings to reach the point of 'diminishing return'. What is meant by this phrase is the recognition of the sitution where new ideas may not produce or give any more innovative results. The reason behind this is because innovation depends on a continuous interacton between research, development and implementation with suitable feedback to influence further development. This process of interaction needs an optimum time, which if it is increased or decreased to a certain point will give either obsolete or immature results.

Nevertheless, by the end of the 1960's and during the 1970's, the tendency towards greater flexibility, openness, elimination or reduction of circulation areas as well as the pressure of progressive teaching methods, have made the use of open-plan spaces for school activities theoretically logical. The logic is due to the fact that open-plan space is conceptually related to multi-functional activities. Thus it differs from the 'multi-purpose' space and the 'semi-open' space. These mainly serve one major function, with the possibilities for this function to be performed in different ways and settings. If open-plan space can be used for office activities, factories and supermarkets, why not schools?

Although many open-plan schools have been built in western Europe and Canada (see Fig.3.24), it was in the United States where the approach originated. The American enthusiasm towards open-plan schools can be felt in this statement by James Morriseau:

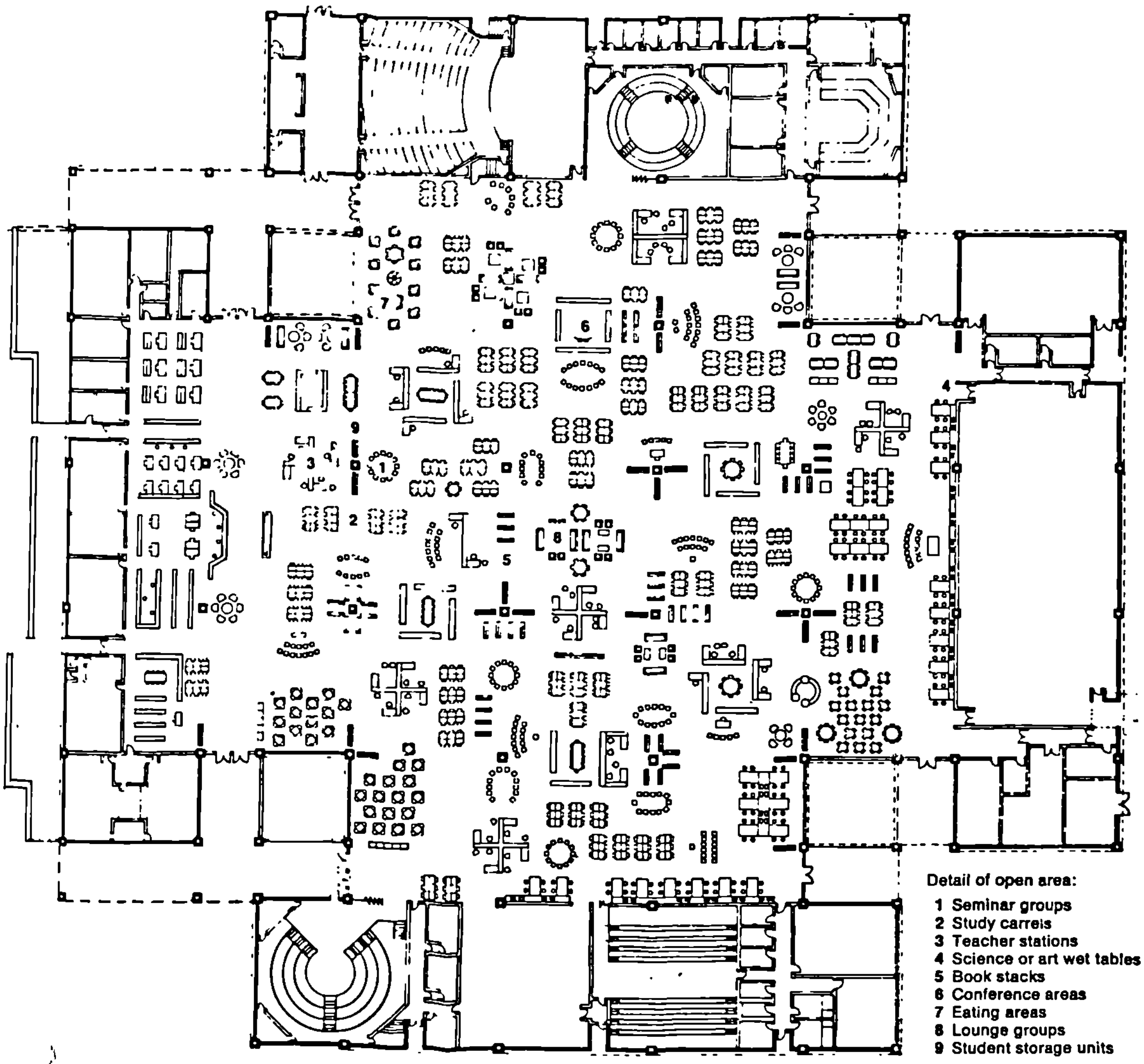
> *"Schools-without-walls are the most dramatic evidence of the trend toward adapting the schoolhouse to educational change... the classroom has given way to large, totally open zones of space accommodating as many as 200 or more pupils and their teachers. There are no partitions; movable furniture and/or screens provide visual privacy where desired. Acoustically absorbent ceilings and floor - that is, carpeted floor - ambient noise, and distance between groups provide acoustical privacy. These open spaces lend themselves to a wide variety of instructional grouping - from independent study to groups of 100 or more for lectures - and to instant and unobtrusive rearrangement of the groupings. Schools-without-walls are adaptable to virtually any educational approach, traditional, team-teaching, non-graded instruction."*[57]

In the United Kingdom the response to the American approach was not great. So much so that very few schools have been exemplified. Those that have been identified include: the Eastergate Church of England Primary school and the Ilford Jewish Primary school. (See Fig. 3.25) both of which opened in 1970.[58] The reason behind this kind of response was not because the use of open-plan for school activities was not

FIGURE 32.4.

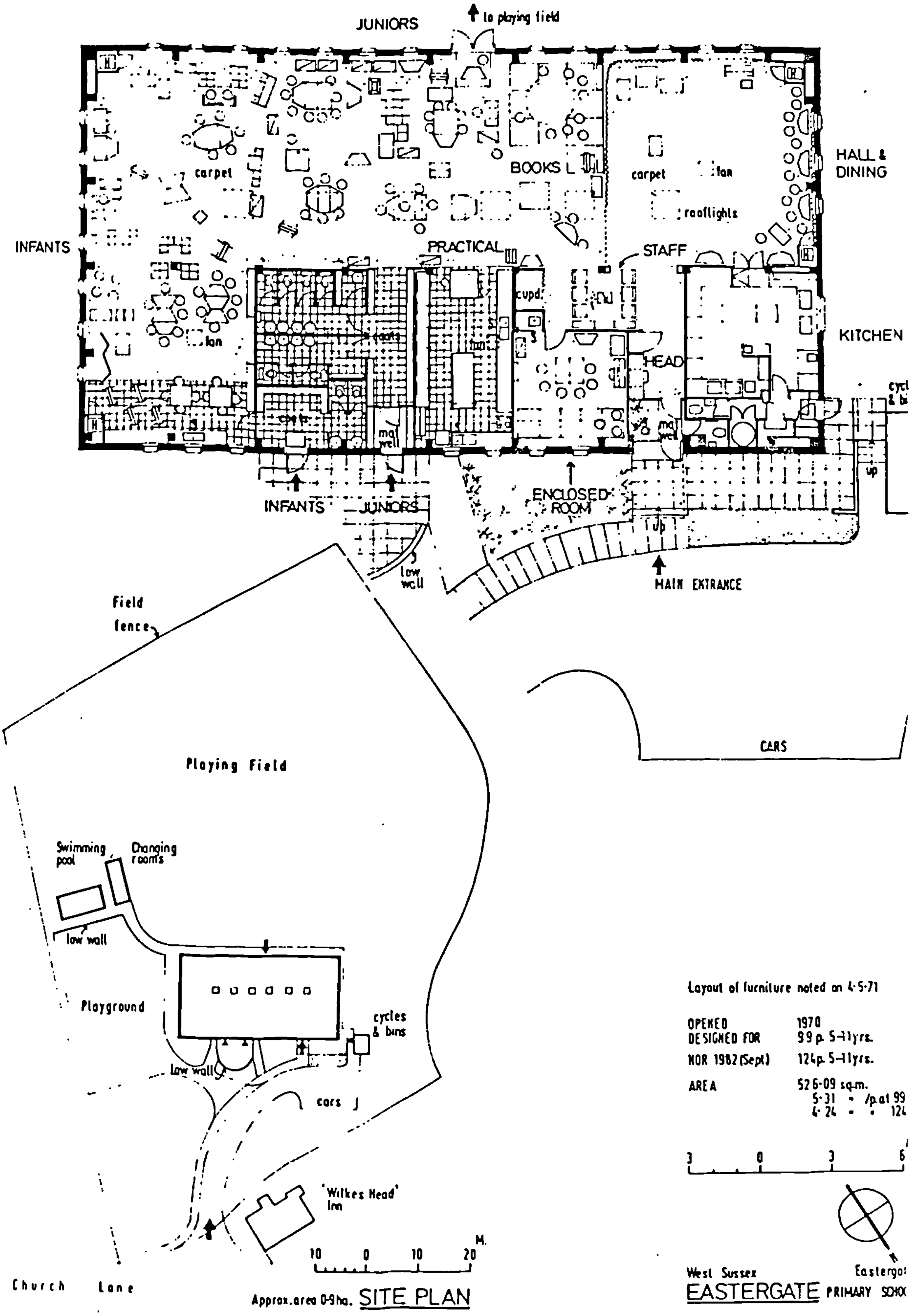
Juanita High School, Washington, U.S.A.

The school-without-walls concept has been implemented in a high school. A huge, square open area, 275ft x 275ft accommodates most of the school's instructional area.



Source: James J. Morisseau, "Design and Planning the New School"

FIGURE 3.25. Eastergate Primary School.



Source: Stuart Maclure: "Educational Development and School Building".

logical, but because it was not yet essential! This accepts that theoretical logic and necessity are to be characteristics of innovation. David Medd, one of the pioneers of the architecture of English schools, expressed his reaction to the American approach as follows:

> *"In my opinion this is not the kind of flexibility that English education is now demanding. It sounds theoretically attractive but it is an abstract conception... I do not want to suggest that it is not important to have partitions that can be moved; it is important for the long-term arrangement of the interior, but at the moment we are in danger of paying too high a price for them in the sacrifice of everyday variety."*[58]

He went farther to say:

> *"School without walls did not have people and education at the starting point"*[59]

The argument about open-plan schools or 'schools-without-walls' is not decisive, not because of the lack of strong evidence, but because the use of open-plan space for school activities has made it doubtful to know whether the school building is responding to its educational activities (form follows function), or vice versa.

ANALYTIC REVIEW AND CONCLUSION.

The provision of school buildings in most developed countries during the last forty years has achieved a significant balance between quantitative and qualitative needs. This balanced achievement can be felt, not only when it is compared with the provision of school buildings during the 19th century and the beginning of the 20th century, but also when it is compared with contemporary provision of school buildings in developing countries. Before going any further into this, it is worthwhile to summarize in general the qualitative and quantative achievements.

QUANTITATIVE ACHIEVEMENTS.

(a) The provision of school buildings in terms of spaces demand in most of western Europe and North America has reached a satisfactory level in primary and intermediate education. Exceptions to this are the southern European countries, such as Italy and Spain.

(b) The costs of school building have been remarkably reduced, not by sacrificing the quality of the building and its internal environment, but on the contrary, the architectural response has been rationalized and improved by means of cutting down the circulation area to the minimum and making space serve more than one purpose. In England, for example, the total area per child in primary and secondary schools has been cut by about 40 percent. However, the amount of teaching space per child within this smaller total area has been maintained or slightly increased.(61) In other European countries such as: Germany, Denmark and Sweden, and in North America, an average of 60 percent of the total area of the school building has been designed to accommdate teaching activities, while an average of only 16 percent to corridors and circulation. (See Table 3.2).

TABLE 3.2.

ACCOMMODATION	HÜMM IMANNSBERS & COMMUNITY SCHOOL, FED. REP. GERMANY %	STAVNSHOLTSKLBY COMPREHENSIVE FARUM DENMARK %	GROBY HIGH SCHOOL LEICESTERSHIRE U.K. %	KROKSBACKSKOLEN COMPREHENSIVE MALMö SWEDEN %	EUGENE V ALESSANDRONI LOWER SCHOOL PENNSYLVANIA %	AVERAGE %
TEACHING	63	64	69	58	64	63
CIRCULATION	22	13	8	18	12	15
ADMINISTRATION	7	12	7	8	6	8
DINING	2	7	11	6	6	7
OTHER FACILITIES	6	4	5	10	12	7

COMPARATIVE ANALYSIS; DISTRIBUTION OF AREAS INDICATED BY PERCENTAGE OF THE TOTAL AREA.

Source; Educational Development - Some Practical Issues,
Educational Financing - Occasional Paper No. 2,
UNESCO 1976, pp.27-47.

QUALITATIVE ACHIEVEMENTS.

The standards of the quality of school building have been highly improved, hand in hand with the standard of education. Flexibility and adaptability have been tried in every possible way, using semi-open and open spaces, operable partitions of the folding, sliding or accordion types, and movable furniture. The internal environment of school, such as: natural and artificial ventilation and lighting, energy consumption, noise, materials, colours, safety, etc., have been challenged and put under control.

Underlying this balanced quantitative and qualitative achievement is a hidden power - the administrative system. The interrelationship between central government and local education authorities is flexible, even within highly centralized governments (i.e. France). This flexibility has given each local authority the opportunity to set up its own research programme to develop a suitable building approach within the general frame of the national standards and regulations. (62) This means that each local authority should have in some way or another its own working team which normally consists of: educationalists, architects, administrators, builders and consultants. The working team will be responsible for research, development, implementation and feed-back processes. Figure 3.26 gives an idea of the communication patterns between the members of the team during a project time.

With the kind of flexibility and heavy responsibility that local authorities enjoy, and the use of industrialized building systems as well as the traditional rationalized methods, the huge

FIGURE 3.26.

An example of organisation of the design and implementation of a project

Specialist →

○ specialist in the team

● specialist takes a leading role

Stage	Administrator	Educationist	Architect	Builder	Consultants
(1) Initiation	●				
(2) Basic programme	●	○			○
(3) Programme	○	●	○		●
(4) Design		○	●	○	○
(5) Building			○	●	○
(6) *Feed-back*	○	○	○	○	●

Source: The Educational Aspects of School Building, Council of Europe, Strasbourg, 1971.

demand of the post war situation has been satisfied and the quality of school building has been improved.

In developing countries where centralization is at its most rigid, the free interplay of educationalists, architects, administrators and other consultants at the local authorities level is completely eliminated.[63] The consequence is the use of standard layouts, designed by the central government and implemented under the supervision of the local authority. The experience of the application of the standard layout approach in most developing countries has proved to be educationally, architecturally and economically unsatisfactory,[64] not because quantitative or qualitative needs have not been achieved, but because of the lack of the process of innovation that could power the mechanism necessary for the updating of the school buildings development.

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CHAPTER FOUR.

ENVIRONMENTAL REQUIREMENTS FOR SCHOOL BUILDINGS.

PRELIMINARY STATEMENT.

The creation of a suitable internal environment is common to all buildings. In this chapter the specific requirements for school buildings in a developing country with a particular climate are considered. As a first step existing standards and requirements are considered. It is clear that the use of a great amount of data on the effect of climate on building must be taken into account.

The differences between standards, norms and guidelines have been noted. They are generally of a purely legal nature: standards or norms are compulsory, while guidelines normally have a purely advisory nature. Standardization in general has found its way into almost every subject in our lives: food, chemicals, transportation, engineering, buildings, education, etc., and can be seen in operation at international, national and regional levels. The reasons for this are not only because it is claimed that standardization has achieved economic success, better use of resources, simplification of a growing number of products, etc., but also because of its achievements in the protection of consumers, community interests and safety and health in general by improving the quality of human life.[1]

The word 'requirement' can be used in architectural design to suggest a level which lies between a standard and the rather more vague guideline; it is thus available to describe both compulsory and advisory values. It may be used by an individual client and become part of the design brief, or it may find its way into regulations provided by official authorities. One of the definitions of the term 'requirement' is the verbal, graphic or numerical statement of a condition which needs to be satisfied in order to produce a sub-optimum condition.[2]

Dealing with environmental requirements necessitates the reliance on performance requirements rather than descriptive ones, not because the latter is not efficient, but because performance requirements provide deisgners and builders with a continuous objective opportunity for innovation and experiment.

The importance of environmental requirements in building design arises from two major points:

A - Although basic environmental requirements usually enjoy a relatively long life span without being changed, in practise the methods of achieving the requirements have on the contrary a shorter life span. This is due to the fact that improvement is almost always needed, either in terms of cost or quality, greater expectations and the practical need to renew services in a shorter time than the life of the building. The process of improvement depends on research, which in turn should aim to respond to and satisfy the requirements of the time.

B - The direct aim of controlling the internal environment of building is efficiency of the quality and quantity of many factors, such as: natural and artificial lighting, and ventilation, solar radiation, and air pollution, etc. The balance of these factors in supporting the functional requirement, which must be achieved at all times, can lead indirectly to a positive and economical energy control.

GENERAL ENVIRONMENTAL REQUIREMENTS.

It is axiomatic that the internal environment must respond to the human activities within the building which is being designed. The variety of activities that a school building should accommodate, makes it a unique building, especially when compared with single activity buildings, such as offices, factories, etc. In school building there are areas which correspond to a factory or a workshop atmosphere, as in the woodwork and metal working classrooms. Similarly, the educational areas for sport, dining and religious activities are reflected in restaurants and mosques. Many other examples can be found if the building type is examined. The schools' activities can be classified in another way, as follows:

TYPE OF ACTIVITY.	TYPE OF ACCOMMODATION.
Sedentary and normal movement.	Activities normally occur in classrooms, studying rooms, dining hall, administrative room, library, lecture rooms, laboratories, corridors, assembly hall, mosque, arts and craftrooms.
Active Movement.	Activities normally occur in sports hall, assembly hall, corridors, stairs, and playing fields.

These various activities need to be satisfied, not only with suitable functional requirements, but also must interact with other physical requirements, such as: thermal balance, lighting, and acoustics.

1 - THERMAL FACTORS.

The thermal performance of a building depends on the balance of the heat losses and gains through two major factors: the users of the building and the materials of which its external enveloped is constructed.

A - USERS, ACTIVITIES AND CLOTHING.

The amount of heat gain from occupants depends on their type of activities and on their clothing. Peter Burberry comments that:

> *"For thermal comfort to be maintained the human body must lose amounts of heat proportional to the amount of physical activities. This heat can be lost in a number of ways and to a limited degree the balance between the various ways can be varied, such as by choice of clothing. Though not a part of building, clothing is a factor which cannot be ignored when considering the thermal design of the building".*[3]

The American scale of units, called 'clo-values' (see Table 4.1) gives a general picture of the relationship between clothing, activities and temperature. Although the type of clothing in the American scale is based on western style, (i.e. trousers, shirts and where appropriate business suits), it is still applicable for other clothing styles. Generally speaking, in hot climates, light and loose clothing is preferable to allow easy air circulation for body cooling, freshness and removal of odours caused by sweat.

TABLE 4.1.

clo value	Thermal effect of clothing	Sedentary and resting max. comfort temp. °C
0. clo	Nude	28.5°
0.5 clo	Short underwear. Light cotton trousers. Short-sleeved open-necked shirt.	25.0°
1.0 clo	Short underwear. Typical business suit, including waistcoat.	22.0°
1.5 clo	Long underwear. Heavy tweed business suit and waistcoat. Woollen socks.	18.0°
2.0 clo	Long underwear. Heavy tweed suit and waistcoat. Woollen socks, heavy shoes. Heavy woollen overcoat. Gloves, hat.	14.5°

Table (1) shows a typical range of combinations of clothing together with their appropriate clo-value, and typical temperatures at which sedentary subjects would be thermally comfortable.

In Saudi Arabia, although the style of clothing is basically different from the one suggested by the American scale, it is still light in colour (white or beige) and of light-weight material (i.e., cotton or cotton and polyester), with a loose and long style. The clo-value for Saudi clothing for most times of the year is 0.5 clo, and it may be increased in some places in the cool season to 1.0 clo. These values are suggested as basic data for reviewing performance.

B - THERMAL CHARACTERISTICS AND BEHAVIOUR OF MATERIALS

The thermal characteristics of material depends on two factors; first: the insulation value of the material itself, usually measured by a (U) factor (overall heat transfer coefficient expressed in W/hr/m^2). The lower the 'U' value, the better the insulation effect. Second: the heat storage value of the material. The larger the heat storage capacity, the slower the temperature change and consequent spread through the material. This delay is referred to as the 'time lag' of the construction. This gives an opportunity to store peak heat loads and release them at low temperature periods.[4] In general, materials which enclose, trap or contain thin films of clinging air have low heat transfer characteristics. These are light in weight. Conversely, materials with long time lags are generally heavy in weight.

C - THERMAL BEHAVIOUR OF LIGHT AND HEAVY WEIGHT MATERIALS.

There is a consensus about the use of materials with relation to climate. A heavy-weight structure will be suitable for hot, arid conditions, while a light-weight structure is thermally desirable for warm, humid climates. Under hot, arid conditions, massive buildings will be relatively cool during the day and relatively warm during the night. While in climates where daily outdoor air temperature variations are small, but solar radiation intensities are high, such as in warm, humid climates, heavy-weight construction can be a distinct disadvantage. The reason behind this statement is that such structures cannot cool down sufficiently during the night to allow reasonably comfortable sleeping or working conditions, and therefore a light-weight structure can be more desirable thermally in these conditions.[5]

Victor Olgyay concluded from experiments that were made for a housing development in Baghdad, that the light-weight buildings heat up during the hot daytime hours (from 7a.m. till 7p.m.), transmitting approximately 143 $W/hr/m^2$ through the differently oriented unit surfaces, while the heavy-weight building transmits only 125 $W/hr/m^2$ during the same period. Here the heavy-weight structures are markedly advantageous in the daytime heat balance.[6]

If the building is going to be used in the evening, the practical solution is to have different time lags for the different exposures. The 'shift in phase' effect of capacity insulation provides a method of delay in the impact of heating periods to cooler time phases, and to transmit the night time low temperature to the daytime heat-peak. This means that facades with an east exposures should have a low time lag, so as to let the impact be felt on the inside while daytime temperatures are still low. The south sides could have a desirable shift of a minimum of 7 hours and optimum of 10 hours. The west side, which receives the heaviest load, should have an optimum shift of 10 hours. The north wall has the least importance with regard to lag characteristics, however a 5 to 10 hour delay helps the daily heat distribution. The heaviest load falls on the roof and this necessitates a shift of 11 to 12 hours.(7) Although the above figures were a result of an experiment made by Olgyay in Phoenix, it is still applicable for hot, arid climates like Saudi Arabia. The use of different time lag exposures could result in a daily thermal balance.

2 - ORIENTATION.

The orientation of a building is determined by many factors, such as solar radiation and wind, local topography, privacy, pleasures of view and noise as well as functional problems of contours, access and drainage.

In hot climate areas protection from solar radiation is important during times of excessive heat, when there can be a difference of as much as 3°C in air temperature in a building between the worst and best orientation. A compromise must be made between all the above factors to determine the optimum orientation which could reduce radiation to a minimum in an overheated period, and allowing some radiation during cooler months.(8)

OPTIMUM SHAPE.

The theoretical concept of optimum shape in hot, arid climates is that which has the minimum heat gain in summer and the minimum heat loss in winter. From his radiation calculations for different climatical areas, Olgyay concluded that the widely believed concept that a square building has the best characteristics of preserving the heat in winter and remaining cool in summer, is a fallacy under the contemporary tendency towards large openings. The old concept which is based on the fact that a square building combines the largest practical volume with the smallest outside surfaces, may be valid for older types of buildings where, because of relatively small window openings, the radiation effect is negligible.(9)

In a hot, arid climate and under winter conditions, the most satisfactory shape is the one which is elongated in an east-west direction. In summer and under periods of severe heat stress, all external walls should be kept as short as possible, especially east and west facing walls. As a result of these factors, the optimum compromised shape is a short rectangle with a ratio of 1:1.3.(10) To improve the performance of this shape, windows should be reduced to a minimum consistent with lighting. Natural lighting and ventilation may be obtained through courtyards which can be cooled down by an evaporative cooling effect using lawns, trees, pools, fountains, etc.

3 - SHADE.

The impact of solar radiation on buildings in hot, arid climates should be reduced not only by effective materials and orientation, but also by adequate shading methods.

A - VEGETATION.

The contribution of trees, shrubs and vegetation to the immediate physical environment is generous and invaluable not only because of the natural aesthetic enjoyment they offer, or because they reduce air-borne sounds or secure visual privacy, but because of their thermal performance. In winter evergreen windbreaks can stabilize thermal conditions in buildings and reduce the effects of dust. In summer the surfaces of grass and leaves absorb radiation, and their evaporation processes can cool air temperatures. Above all, they provide generous shade during the right seasons. In selecting trees, vines or shrubs, two things have to be considered: the shape and performance of the tree itself during the changing seasons, and the shape and quantity of shadow as a natural shading device.(11)

B - EXTERNAL SHADING DEVICES.

External shading devices are the most effective way to reduce solar heat gain through fenestration. If they are properly designed so as to completely shade the glass and allow air movement over the glass surface, they offer each exposure the approximate thermal characteristics of northern light. In other words they will reduce the total heat gain by approximately 80% for sunlit exposures.(12)

Horizontal screens are most effective against a high sun and are normally used on the north or south exposures. Vertical screens are useful against low sun on the east and west sides. Combined vertical and horizontal screening - the egg-crate grill - can be used for any orientation depending on its depths and the dimensions of openings. (13)

It is very important to distinguish between two common situations: concealing a mistake and solving a problem. Using glass to envelope the whole or part of the structure of a building in hot, severe climates is a mistake. To conceal and reduce the scale of the mistake, external shading devices are inevitable.

The other situations, and when a limited number of windows are vital for functional and physical environmental requirements, external shading devices can be considered as a solution. To reduce the impact of solar heat radiation, external glass openings should be kept to a minimum, and that will mean external shading devices must be adequate for dealing with sun angles throughout the day.

4 - NATURAL VENTILATION.

Natural ventilation and air movement perform two main functions. First: ventilation is necessary to supply fresh air for health by providing sufficient oxygen for respiration, which also prevents any concentration of harmful bacteria, hazardous gases, especially Co^2, dust, etc. A subsidiary but useful effect is the removal of body and other odours. Secondly: the supply of fresh air aids thermal comfort by the removal of excess heat, cooling of the interior by convection, and cooling of the inhabitants. There is a direct connection between air speed and cooling of the human body.

The mechanism of producing natural ventilation in buildings results from air changes caused by differences in temperature - the so-callled 'stack effect' where warmer and lighter indoor air is displaced by cooler and denser outdoor air - and by air flow produced by pressure differences.[14]

To increase the pressure differences between inside and outside air temperature, spaces in front of the inlet openings can be shaded to reduce the air temperature, while the outlet openings can be sheltered in a glass house to increase the air temperature. Such a method has been applied in a small rural primary school for a workers' settlement near Cacapara, in the state of Sao Paulo, Brazil. In her report "Building School as A Learning Resource for Science and Technology Education", Dr. Margaret Kennedy, who took part in the above school project, describes the ventilation method as follows:

> *"The heating and ventilation of the buildings will be taken care of by natural means such as simple addition of shaded, covered and trellised areas to the south and glasshouses to the north .... The shaded area produces cooler and dryer air which is pulled through the house by the rise and exit of hot air through high level vents in the glasshouse.*[15]

But the problem of ventilation in the summer of a hot, arid climate is not quite so simple. The assumption that the outdoor air is cooler than the indoor is questionable, not because it may not actually be cooler, but because the question is, is it cool enough to provide optimum thermal conditions? Knowledge of the mechanism of producing natural ventilation is the theoretical, and first half of solving the problem. The other half of the problem is how to cool down the outdoor air to the optimum temperature range of 23°C-30°C (98-111°F), when the actual temperature is over 40°C (128°F).

Several methods have traditionally been used for cooling outdoor air in hot climate areas, such as wind catchers and evaporative coolers. These two methods and others will be explained in more detail in the next chapter. The concept of these methods is to trap the outdoor air and to delay its flow into the building, then, by various processes, of cooling, humidifying and cleaning the trapped air, which will take place by using fountains, porous water jugs, tree plantations, shaded cool surfaces, etc.

5 -INSULATION MATERIALS.

The basic characteristics of building insulation materials can be divided into interstitial air space, surface resistance and material density. The purposes of insulation in general can be summarized as follows:

1 - To conserve heat or cold by maintaining temperature differences between indoors and outdoors. This, where appropriate, may result in a reduction in the size and cost of equipment where mechanical means are used to cool buildings.

2 - To minimize the effect of directional radiation, particularly from roof or ceilings under conditions of high intensity of solar radiation.

3 - To shield occupants from radiation from high temperature sources.

4 - To control the thermal movement of structural elements.

5 - To ensure quick response to intermittent heating and/or cooling of heavy-weight structures.

6 - To control visible condensation.[16]

The choice of an insulation material should not only be made on its thermal conductivity value, but also on other properties, such as density, specific heat, coefficient of thermal expansion, resistance to temperature extremes and vapour flow, durability, mechanical strength, affinity for moisture absorption, possibilities of vermin and insect infestation and influence of dust and air movement on its efficiency and appearance.[17]

The choice of balanced insulation is also governed by its thickness and location. In a badly insulated structure the effect of adding a layer of insulation will be dramatic. However the effectiveness of adding further layers will rapidly diminish.[18] An insulating material on the external face of the wall would restrict the rate of heat flow and reduce the amount of heat absorbed by the inner wall during the day. It will also restrict the heat flow in the reverse direction at night.

In considering insulation in building construction, account must be taken of ventilation. This can help to achieve the stabilization of internal temperatures. An important factor is in ventilating the construction at times which will aid in preventing radiation and convectional heat transfer and enable structures to lose heat when the direct sun is off the facade or roof. This is particularly important to prevent the structure retaining heat at night.[19]

NATURAL AND ARTIFICIAL LIGHTING.

The essential quality of light, whether it is natural or artificial, comes from the simple fact that without light, nothing can be seen. The human visual sense has a certain natural limit depending on two basic factors: distance and amount of light. This natural limit led to the discovery of fire, not for the purposes of cooking or heating, but logically for lighting first. Therefore light should be considered not only as much a 'material' for building design, as the stones, bricks and other components, but also as a medium for the use and development of visual sense.

Much thought has been given to the total enclosure of buildings in tropical zones to exclude all sun and sky light. This was to avoid what was thought to be inevitable heat gain, which was associated with the admission of external natural light. The use of relatively cheap artificial lighting was assumed to be beneficial, especially if the heat output from fittings could be ducted out of the buildings. The arguments are renewed as follows:

The argument about the advantages and disadvantages of artificial lighting over natural lighting is not decisive. The availability of cheap artificial lighting in the form of fluorescent tubes has allowed the provision of artificial lighting to the disadvantage of natural lighting. But the total exclusion of natural lighting could not manage to be the ideal alternative, not because it could not satisfy economical or functional requirements, but because it cannot satisfy the instinctive psychological need for view. Recent economic pressures for a reduction in terms of energy consumption have meant that natural lighting must be considered as the primary means of lighting school buildings which are mainly used during daytime.

In their book "The Lighting of Buildings", Hopkinson and Kay place emphasis on the necessity of view to provide an amenity and experience as follows:

> *"... the real advantages of daylight, however, are to be sought not so much in the spectral composition of the light, though that is important, nor in the variability, though that may well be important too, but more in the fact that daylight is provided by windows and windows have the dual function not only of admitting light, but also enabling us to see the outside world during the working day. Teaching staff often say that the pleasure of working in a post-war school is not only that the light is good and adequate all over the classroom, but also that the children are continually aware of the changing pattern of the world outside. They can see that clouds move, that the moon can be seen in the blue sky during the day, that the rain comes from heavy billowing groups of clouds... There seems to be a real human need for variety and change, and windows offer the physical and psychological relaxation of being able to gaze out..."*[20]

Excluding the psychological effect of natural daylight, how much can a windowless environment offer? Research by the Greater London Council about the problems of a windowless environment reveals another fact. According to the research: although a purpose-built windowless school can reduce and eliminate the solar heat gain and loss, sky glare, external noise, pollution and the load of the air conditioning plant, there is one aspect which must be considered - this is fire. A case of fire in the building may become a disaster if openings cannot be used for escape and smoke reduction.

> *"Confinement of heat and smoke in a burning building helps to spread the fire within the building and interferes with access to the building. It is for these reasons that ventilation is one of the first steps to be taken by fire fighters on arrival at a burning building. The more heat that is ventilated from a burning building, the less water is required in the form of hose streams to complete extinguishment of the fire. Windows are the primary means of ventilating buildings of heat and smoke. They offer the quickest and most efficient method of ventilating where automatic ventilating facilities are not provided.*[21]

Therefore, not only the lack of the psychological effect of daylight which prevented the spread-out of windowless buildings, but also safety.

Since both artificial and natural lighting are indispensible to each other for most types of buildings, a compromise is required to satisfy economical, functional and environmental needs. The concept of this compromise is that daylight should be provided in high quality rather than in maximum quantity, while artificial lighting should be used to supplement daylight in those areas where the daylight level is insufficient.[22] This permanent supplementary artificial lighting approach permits greater planning freedom. The proportions of the room are no longer necessarily linked to the requirement of daylight penetration. Windows will be reduced in size and they are no longer required to serve as the only illuminant for the working areas of the room, and by using suitable window screens, glare and solar radiation can be reduced.[23] The interaction between light and heat in tropical buildings is, of course, critical. The problem is to admit light without raising the temperature by admitting direct sunlight. The use of windows for ventilation is a further factor. The high values of light intensity and very high sky factors are tools which can be used.

GENERAL REQUIREMENTS FOR ARTIFICIAL AND INTEGRATED LIGHTING.

The importance and advantages of the use of permanent supplementary artificial lighting which was discussed above indicate that daylight should be provided in quality rather than quantity. Light in a sunny climate penetrates to the interior of a building in three major ways: direct sunlight, the light reflected from the ground and light reflected from the vertical facades of other buildings and surfaces. To reduce the quantity of daylight, direct sunlight should be avoided. The minimum quantity of daylight needed can be obtained from the reflected light on the ground and vertical external facades. Obtaining and controlling external reflected light depends on the following factors:

1 - Windows and their shading devices should be designed to reflect external light into the interior of the building. This can be achieved by the position of shading devices and their colouring. The minimum side window size for safety and view in installations where artificial light supplements natural light is of the order of one-sixteenth of the floor

area. A window of less than this area has little more significance than a hole in the wall.[24]

2 - The colour of the internal walls and ceiling should be light. The lighter the colour, the greater the proportion of internally reflected light. But a very high level of illumination could cause visual discomfort and glare, therefore reflective values should never exceed 70%.[25]

3 - The interior illumination needed can be in the order of 300 LUX (30Lm/ft^2) rising to 1,000 LUX (100Lm/ft^2), depending on the type of activities and working requirements.[26] In the intensively lit areas heat gain from fittings should be considered.

CHOICE OF SUPPLEMENTARY ARTIFICIAL LIGHTING.

For the choice of artificial light, consideration has to be given to the colour of lamps, which should blend well with the daylight, and at the same time should be acceptable at the illumination level which will be needed when daylight fails.

The 'cold' quality fluorescent light is the only economical light source available at present. The problem of colour rendering may be avoided by selecting a reflectance of the order of 50% to 70% for walls, while the ceiling colour could be higher.

For the choice of an artificial lighting system, three alternative methods can be applied:

1 - A simple inset daylight system can be used if the night time lighting is of secondary importance. The inset system can be supplied by conventional fittings uniformly distributed about the room.

2 - The second system also consists of inset lighting distributed uniformly over the whole ceiling. During the daytime selected units should be used to act as the permanent supplement, while at night the whole installation could be operated.

3 - The third system consists of three parts (A, B, C), of which one part will be maintained permanently in operation. During the daytime units A and B will provide the optimum level of supplementary lighting. At night, system A is switched off and system C is brought into operation, B and C together will provide a uniform level of lighting over the room.

To avoid the loss of light through the windows at night time, blinds of a high reflection factor should be provided. For reasons of economy and efficiency, switching arrangements should be controlled by the school staff.[28] The decision of choosing one of these systems depends mostly on its cost, and cost must be calculated in terms of its payback period, owing to the reduction in operating cost and in terms of its overall comfort to the users.

The choice of system for shcool buildings in Saudi Arabia will tend towards No. 1.

ACOUSTICS AND NOISE.

Consideration of acoustics and noise control in school buildings is necessary, not only for the reduction of external noise or the isolation of noisy activities from quiet ones, but consideration also has to be given to the school building so that it is not a source of noise for its immediate neighbours.

In general the sources of noise can be classified into two groups. First: interior noises originating from people, equipment and machinery within the building. Second: outdoor noises originating from traffic, transportation, industry, exposed mechanical equipment in buildings, construction sites, road repairs, sports, etc.[29] The principles of noise control are either by modifying the noise source, blocking or reducing the noise along the path from the source to the receiver, or by isolating the sound from the receiver by means of barriers.

The methods of controlling external or outdoor noises can be achieved in two ways. First: planning or selecting the right location for school buildings, not only by considering the convenience of transportation, but also avoiding the neighbouring permanent noise sources. Second: the better the building is designed to resist the flow of external heat in general, the better the reduction of external noise.

Internal acoustics and noise control can be achieved not by isolating noisy activities and possibly adding to the cost and inconvenience of additional circulation, but by a compromise decision between isolation and insulation. Using suitable sound-insulating construction for noisy activities will reduce the effect of noise not only on the user, but also on the neighbours.

The effect of noise on working efficiency and production has been put under experiment. Production drops and workers make more errors when exposed for a sustained period to a high noise level above about 80db. However this does not mean that people work most efficiently in a soundproof room. On the contrary it has been observed that when the acoustical environment of a work room is too quiet, production drops and workers make more mistakes. It is not silence which is needed, but quiet; the absence of distraction, not the utter lack of sound. It is clear that academic and scholastic work will benefit from reasonably quiet conditions.

AIR POLLUTION.

Although air pollution has been considered as a major environmental problem in most developed countries as a result of the huge scale of the industrially released wastes, air pollution in unindustrialized (developing) countries is already present, especially in highly populated areas, as a result of other common primary sources of pollution, such as transportation, fuel combustion in stationary sources, solid waste disposal, etc.

The scale of the problem in Saudi Arabia can be felt by reading the results of the report produced by the General Directorate of Meteorology in Saudi Arabia. According to the results of the report, significant pollution levels are already present in many areas. The downtown areas of major cities exhibit CO levels which average 10 to 20ppm. (parts per million) with peaks higher than 50ppm. during periods of traffic congestion. (The U.S.A. air quality standard for CO is 9ppm.)[30]. O_3 peak values as high as 0.55ppm. were found (U.S.A. standard is 0.08ppm.). T.S.P. (The Total Suspended Particulates) levels were also high, the highest recorded was 967ug/m^3, (U.S.A. standard is 150-260ug/m^3), and most of the particulate is in the form of wind-blown dust and sand.[31] The effect of air pollution and dust on health and environment cannot be totally avoided. Protective measures have to be considered in natural ventilation and outdoor spaces in the school.

ENERGY CONSUMPTION.

Rationalization of energy consumption is a national and international aim. On the national level and under a situation where huge demand for buildings is required, priorities are likely to be given to quantitative needs rather than to qualitative ones. One of the qualitative needs which could easily be underestimated is the economical thermal behaviour of the buildings. In developing countries and in the case of the provision of school buildings, and as a result of the standard layout policy, the mistake will be repeated in thousands of school buildings. As a result more energy will be needed to improve the internal environment of these buildings. Consequently costly maintenance will increase under the pressure of the over-utilization of the energy sources in these schools. On a lower level and where local educational authorities or architects made design decisions, the control of energy consumption is not only their aim, but it should also be one of the results of their work.

The problem of controlling energy consumption should be indirectly approached. The process of improving the thermal performance of the school by using suitable and adequate materials, insulation, ventilation, lighting, layout, structure, etc., may increase the cost. Although a comparison of cost and quality between two different things is difficult, the cost of improving the thermal performance of the building is more than offset by a lower cost for adequate heating or air conditioning facilities and their maintenance.(32)

SUGGESTED ENVIRONMENTAL REQUIREMENTS FOR SAUDI ARABIA.

GENERAL INTERNAL COMFORT REQUIREMENTS.

In a wealthy developing country like Saudi Arabia, development programmes since 1970 have changed the face of the country, pushing it to overcome the delay of many years of underdeveloped life. Improvements in health, education, transportation, communications, housing, etc. have been achieved quickly.

The initial impact changed in many ways the use of buildings and the lifestyle of those who used them. The effects on design were immediately noticeable. Perhaps as important was the change in expectation in the community generally. The installation of mechanical systems in buildings became the norm and created a climate of opinion about buildings, their use and appearance, which still persists. This is an important factor which has had to be taken into account in this thesis.

As a result of a free economic policy, imported technology has invaded the country under the necessity and needs of the development plans. Imported technology can be adopted, copied and reproduced depending on two main factors: the existing technological standard level within the country and the level of financial support. The lack of technological expertise means that imported products become essential and are consumed on a large scale. For example, the consumption of imported foods, cars, clothes, etc. One of these imported products is air conditioning equipment. The general improvement of the living standards, the increase of the average income, the availability and cheapness of both electricity and imported air conditioning equipment have caused the use of air conditioning to become considered as such a basic social need that architects and energy consultants find it difficult to suggest a radical change.

Under these circumstances and this social pressure, school buildings in most urban areas have been provided with air conditioning units or central plants. The reliance on mechanical aids have covered not only schools but also all types of accommodation: offices, houses, shops, etc., and even cars. The consequences of this were painful. Traditional architecture and its optimum solutions for coping with severe heat and natural ventilation in economical ways has been ignored.

The preceding statement has other implications in that architects able to design using traditional materials and forms have virtually disappeared.

It was not until 1983 that the meaning of the word "rationalization" was discovered and began to be used in official statements. The economic recession, a result of the decrease in demand and price of oil, has led the government for the first time to cut their subsidization, and to increase the prices of energy and services, (electricity, gas, water, etc.). The aims of these cuts were to rationalize the ever increasing demands on energy, especially electricity, and to cope with the huge scale of maintenance needed, knowing that both parts and the necessary labour would have to be imported. This seems to be a major aspect which must be considered in conceptual terms.

On the one hand there is the expectation of a much higher standard of thermal environment, coupled with the functional requirement of modern education, which points to rejection of standards found in both traditional and many recent school buildings. On the other hand, there is the realization that the sudden increase of energy costs and the high initial and recurrent cost of imported mechanical systems, exacerbated by the shortage of technical labour, means it might be unwise and uneconomic to provide buildings which rely wholly on these methods of providing a suitable internal environment. These conflicting aspects are perhaps the crux of the argument and resolution must be made before proceeding further.

This background statement was necessary to suggest that, first: while mechanical ventilation systems are economically unsound under these circumstances, students and their teachers still desire more and better internal comfort conditions as a result of experience in their homes and other buildings. Second: The rationalization measures taken by the government should be supported not only by choosing more economical and efficient mechanical systems, or even by restricting the use of the system for a certain time, but also by improving the thermal characteristics of school buildings. Third: examination of the problem shows that absolute solutions are probably not the answer. The conflicting tendencies outlined above may be resolved, at this conceptual stage, by accepting that the requirements in built form for buildings which are fully air conditioned as well as those which rely on natural means for *thermal control, are not too distant* as to offer a possible way forward. It must be emphasized that this statement recognizes that Saudi Arabia is fundamentally a hot, arid climate regime. The same statement would not be possible, for example, in a warm, humid climatic area such as Singapore or West Africa. Fourth: the comfort zone of the tropical areas defined by G. T. Trewartha in his book "An Introduction to Weather and Climate", is between 23° and 30°C (74° and 85°F), with relative humidity between 30% and 70%. Although the upper limit of 30°C is high, it is necessary to mention that this general comfort zone covers various sub tropical areas, which need to have different upper limits, depending on the location, altitude and time of the year. In inland cities like Riyadh, for example, the external daytime temperature during school time in May and June usually exceeds

40°C, rising to over 45°C on most days. It is here that the upper limit of 30°C can be felt to be reasonably comfortable under natural ventilation processes. In winter the situation is different. The maximum temperature in January is only between 20°C and 25°C. Similar to that is the lower limit of relative humidity - 30% - which can be considered relatively comfortable when outdoor relative humidity is below 20%. The upper limit of temperature and lower limit of relative humidity, therefore, can vary from one area to another, and from summer to winter. Fifth: Knowing that the school buildings are normally closed during the summer period when the temperature can exceed 40°C makes the use of natural ventilation to achieve the above comfort conditions more applicable. Sixth: the hypothesis put forward is that school buildings will be designed for 'natural' thermal control as a norm, but that the use of mechanical systems will not be totally excluded in situations and circumstances where they could be used with advantage to allow efficient and economic use of the building in a total educational sense. (See Figs. 4.1 - 4.3).

The extent to which these aids may be introduced is dealt with in a later section of the thesis. However, the situations and circumstances where mechanical aids can be justifiable are, first: areas with high environmental pollution levels, such as dust and continuous sand storms, permanent sources of high levels of noise, industrial chemical air pollution and downtown traffic fumes, etc. Second: internal specific areas such as audio-visual rooms, laboratories and their stores and activities with a very high level of noise (i.e. music). The justification to use mechanical systems in these areas should be achieved under two

FIGURE 4.1.

ANNUAL MEAN TEMPERATURE AND RELATIVE HUMIDITY IN JEDDAH.

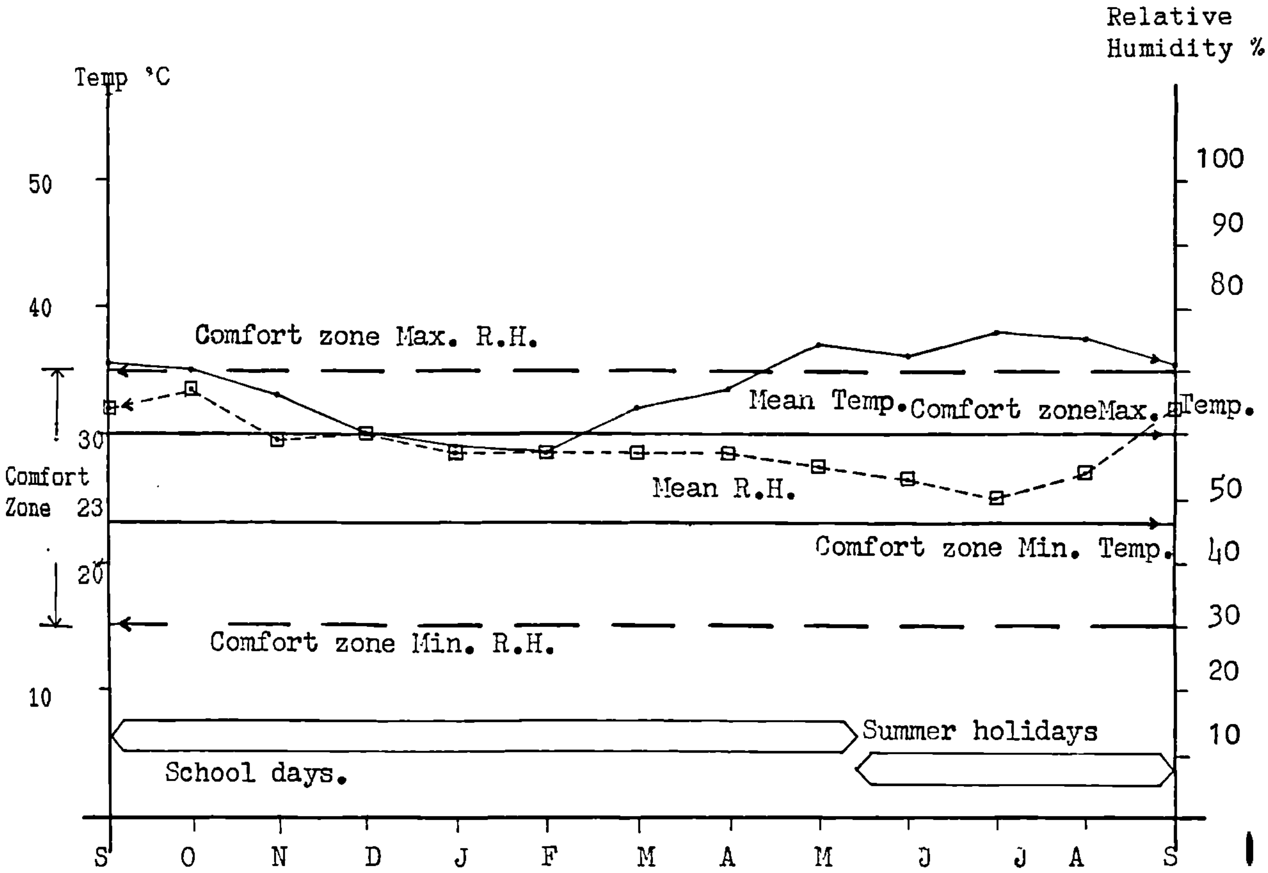


FIGURE 4.2.

ANNUAL MEAN TEMPERATURE AND RELATIVE HUMIDITY IN RIYADH.

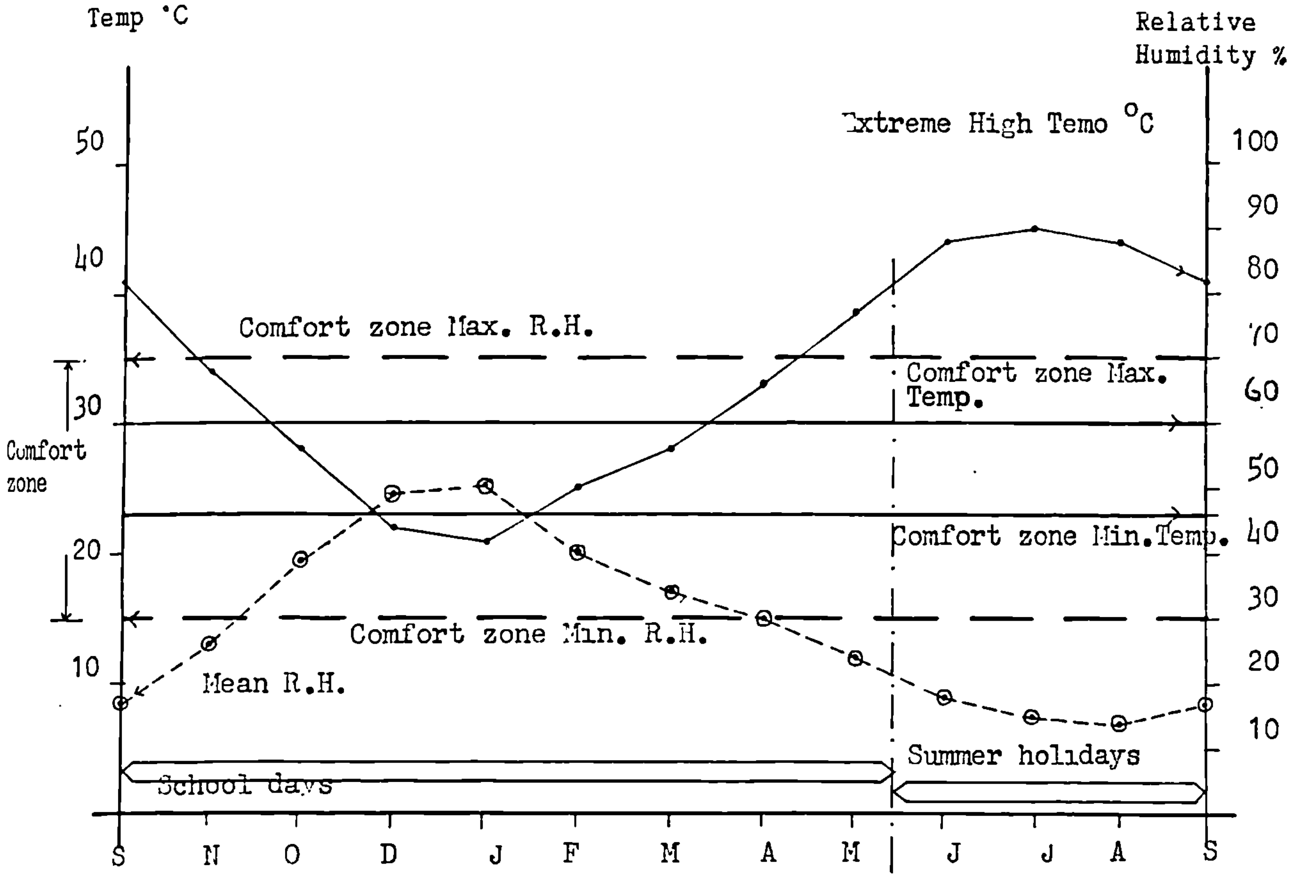
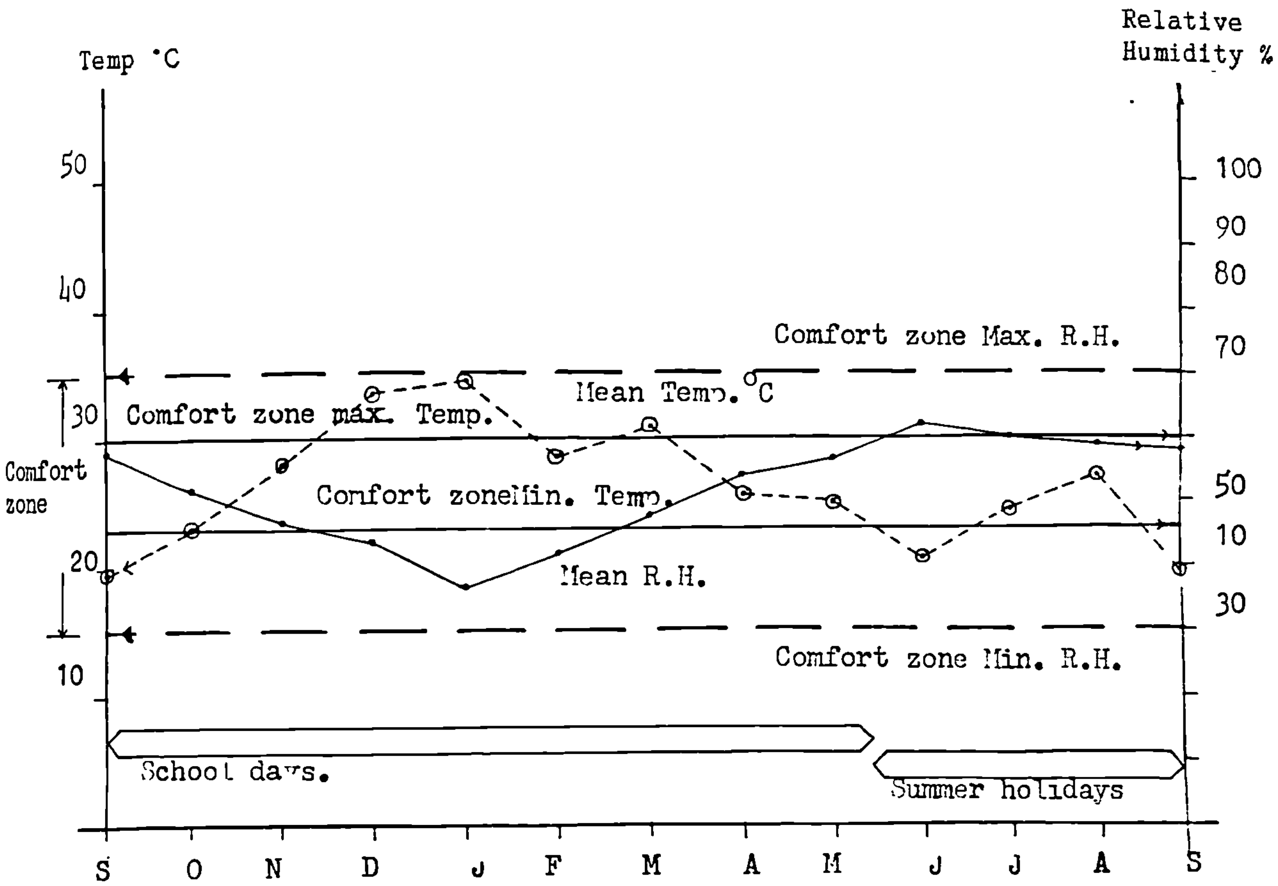


FIGURE 4.3.

ANNUAL MEAN TEMPERATURE AND RELATIVE HUMIDITY IN KHAMIS-MUSHAIT.



main conditions: when planning requirements cannot be avoided, (i.e. location of school building in polluted areas) and when natural ventilation solutions can be defeated, causing health and safety hazards and/or educational disturbance.

Finally, the attitude towards a total conservation of energy without sacrificing the quality of the internal physical and functional requirements should include lighting. Similar to the ventilaton argument, lighting conflicts can be resolved in the same conceptual approach. It is necessary to indicate that permanent supplementary artificial lighting should not be supplied and put into use for all parts of the school building unless strong justification is found. Experience shows that it is more efficient and economical to use daylight, artificial lighting and integrated lighting, wherever they are essentially needed. The choice of each system depends on the space layout and its function, thermal effect and cost. Generally speaking, non-teaching areas can be naturally lit, while in teaching areas it is possible to use the three different systems.

ENVIRONMENTAL DESIGN PARAMETERS.

The requirements for comfort are summarized as follows. These will set the boundaries for future design work. Assumptions are made, as indicated, about clothing which will be worn by pupils and staff.

THERMAL COMFORT.

1 - TEMPERATURE:	Lies between 22°C and 30°C.
2 - RELATIVE HUMIDITY:	between 30% and 70%
3 - CLOTHING:	Clo-value between 0.5 clo and 1.5 clo.

VENTILATION.

1 - NATURAL METHODS: Direct cross ventilation should be avoided in hot summer.

Indirect ventilation, using the stack effect or combination of cross-ventilation and stack effect method.

Outside air should be cooled down before entering the rooms.

2 - INTERNAL AIR MOVEMENT: Between o.15m/s and o.3m/s.

3 - MINIMIUM FRESH AIR SUPPLY:

Accommodation. (Classrooms, labs, Libs., Practical room, etc.)		Rate of fresh air supply.
$2.8m^3$ per person	-	$42m^3$ per hour per person.
$5.6m^3$ " "	-	$28m^3$ " " "
$8.5m^3$ " "	-	$20.5m^3$ " " "
$11.2m^3$ " "	-	$18.5m^3$ " " "
$14.\ m^3$ " "	-	$12m^3$ " " "
Cloakrooms	-	3 air changes per hour.
Corridors, w/cs., and lavatories	-	2 " " " "

4 - MECHANICAL AIDS:

FANS: To increase the pressure difference a simple extract only fan, or supply only fan can be used depending on ventilation methods.

Consideration must be given to size and location of fans. Weathered louvres or cowl and wire mesh should be used to protect the external side of fans.

AIR CONDITIONING: Used in highly polluted areas or where price and size of land are expensive and small. Building should be compact with very high thermal resistance. If air conditioning units are to be used, noise should be examined.

LIGHTING.

1 - SYSTEM: Daylight, Artificial and Supplementary Artificial Lighting.

2 - LIGHTING LEVEL:

Classrooms and: Assembly Hall :	min. 10 lm/ft^2 (100 LUX) average 30 lm/ft^2 (300 LUX)(34)
Arts rooms and: Workshop :	min. 30 lm/ft^2 (330 LUX). average 50 lm/ft^2 (500 LUX).
Local Lighting: if required :	up to 150 lm/ft^2 (1500 LUX)(35)
Staff room and: common rooms :	average 10 lm/ft^2 (100 LUX)(36)

3 - SOURCE OF ARTIFICIAL LIGHTING: 'Cold' quality fluorescent types.

4 - SOURCE OF NATURAL LIGHTING: Windows (side lighting, top lighting). Direct sunlight should be excluded. Reflected light only permitted.

* Window Size: Minimum 1/16 of the floor area.

* Shading Devices: External, movable or fixed. Horizontal for north and south. Vertical for east and west. They should give full shade and reflect light to the interior.

5 - INTERNAL COLOURS: Walls: light colour (50% to 70% reflectances). Ceiling: 70% or higher.

6 - GLARE: White coloured walls should be avoided. External shading devices should be used to eliminate or reduce glare.

ACOUSTICS.

1 - EXTERNAL NOISE: Noise level in schoolrooms should not exceed 50 dBA, otherwise special sound insulation measures should take place, such as obstacles - earth bank, wall, sound absorbent screen, trees, etc., and sound insulation materials.

2 - INTERNAL ACOUSTICS AND NOISES:	Shoolrooms with rectangular shapes, level floors and floor areas of less than 93 sq.m. do not need any acoustical treatment. Multipurpose Halls and auditoriums should be treated to achieve adequate loudness, distribution of sound. Acoustical defects such as echoes, noise and vibration should be excluded. Noisy activities should be either isolated or insulated with suitable materials. General background of fully occupied space should be between 40 - 50db.
DUST.	All external openings should be covered with fine wire mesh to reduce dust and prevent flies, insects, etc. Outside spaces within the school should be paved with suitable materials or plantation.

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(24) Ibid., p.163.

(25) Ibid., p.290.

(26) Ibid., p.188.

(27) Hopkinson, R.G., Petherbridge, P., and others, "Daylighting", London: William Heineman Ltd., 1966, p.522.

(28) Hopkinson and Kay, op. cit., pp.161-162.

(29) Doelle, Leslie L., "Environmental Acoustics", New York: McGraw-Hill Book. Co. Ltd., 1972, p.140.

(30) Ibid., p.138.

(31) Ministry of Defence and Aviation, General Directorate of Meteorology, "Surface Climatological Report", 1983, p.91.

(32) Rogers, op. cit., p.2.

(33) Olgyay, op. cit., p.17.

(34) Hopkinson, R.G., "Architectural Physics - Lighting", London: Her Majesty's Stationery Office, 1963, p.27.

(35) Hopkinson and Kay, op. cit., p.230.

(36) Ibid.,

(37) Grandjean, E., Gilgen, A., "Environmental Factors in Urban Planning", London: Taylor and Frances Ltd., 1976, p.54.

CHAPTER FIVE.

TRADITIONAL ARCHITECTURE: DESIGN CONCEPT AND FORMS.

PRELIMINARY STATEMENT.

There are two major influences upon architecture and urban forms which are universal. The first can be seen as a static group and includes such major generators as physiography and climate. These are enduring and continuous; they are therefore easier to define and identify. The second group is more subjective and consists of social considerations and functional requirements as well as metaphysical (religious) concepts. Arising out of the latter group, there is found a changing scene, involving spatial conceptualization, invention and identity. Both static and dynamic factors work together in determining the form and the location of different elements in architecture and urbanization, therefore producing a pattern particular to a group of people or settlement.(1) The word "culture" is used to summarize the end product of these static and dynamic factors.

There are areas where circumstances ensure that one factor becomes dominant. In the static group, for example, physiography dictates the general characteristics of climate. In the dynamic group, the dominant factor or factors are variable, depending on the rate and scale of change and the interrelationship with other factors in the same group. The slower the rate of the periodical change, the more dominant and influential the factor will be.

In western countries, and as a result of the industrial revolution, the relatively stable traditional equation of the dynamic group found in the 18th and 19th centuries, for example, became rapidly moving at the beginning of th 20th century. During this time, the periodical change of the main factors of the dynamic group was moving much faster than previously. Therefore, as a result of the rapid and drastic change in social, metaphysical, symbolic and technological conditions, the influence and the dominant behavioural value of each one was devalued in the totality of the situation. What was left were those functional factors, which have a relatively slower rhythm of change. These therefore came to be the dominant influences. Consequently, those factors based on function began to take a significant role. This produced, finally, not only the international style of modern architecture, but also produced an international urban pattern. Indeed, the word "Functionalism" was used to illustrate this movement in aesthetics.

When the focus is moved from the wider picture to the view encompassed by the Arab and Muslim world, it can be shown that the position outlined in the previous paragraph is applicable. Moreover the geographical position of the countries under scrutiny meant that there were two dominant factors at work. The physiographical element of climate was one of these, but was matched by an equally prominent element in the social structure of the region in the form of the Islamic religion. When we consider these two factors we find that a hierarchy of influences has been established which gave a distinctive cultural pattern. This was long lasting because, as has been pointed out earlier, the dynamic rate of any situation is important. The countries of the Middle East were politically dominated by a succession of colonial powers. This tended to speed up the rate of change. Thus the hierarchical system of cultural influences was only slightly disturbed during the Turkish Empire, especially in Turkey itself, and in Egypt during the 19th century.(2) Otherwise it was kept and conserved in most Islamic-Arab settlements. During the colonization period in the beginning of the 20th century, the typical model of western urbanization was applied to cities in the Arab world, followed later on by the new 'functionalism' model. By the end of the colonization period, the traditional Islamic-Arab urbanization and building models were badly affected. Not only were the hierarchical order linkages weakened, but the hierarchical order itself appeared to be inapplicable and out of date. Since that time and until now, the influential urban factors of the Islamic-Arab urban and rural settlements have been dominated almost solely by the 'functional' aspect of decision making. The application of the European 'Functional' model of urbanization to Muslim societies could have been successful, if it had not been blindl imitation, causing serious conflicts, not only between religious and functional factors but equally between social and environmental requirements and functionalism. The most severe dichotomy was between functional aesthetics and climaticological requirements. The reason underlying these conflicts is that Islamic religion as a force within the dynamic range and urbanization is still strong, affecting every aspect of social life, especially in Saudi Arabia.

Under the above circumstances, nostalgia and romantic visions are appreciated, but they do not work. The existence and the future of the pattern of Islamic-Arab cities and towns have already been documented in 'Master Plans', commanded by 'technocratic zoning laws and regulations'. The only thing which has been left for architects are individual urban elements. Each building has to cope individually with climatic, social and functional factors in the design brief.

This chapter highlights briefly and in a general conceptual form, first: the traditional interrelationship between some of the major static and dynamic urban factors. These major factors, which include climatic, social religious and cultural aspects, have an effect on urban patterns. They can also have a deterministic effect on the form and appearance of individual buildings. Attention is drawn to the way in which functionalism as an aesthetic system has overshadowed some of the other generators to the disadvantage of the quality of the buildings. The next part of this chapter will be devoted to a brief study of traditional Islamic school building architecture and comment made on its main characteristics. Reference to Saudi Arabia will be made where applicable in the chapter.

THE EARLY MESSAGE.

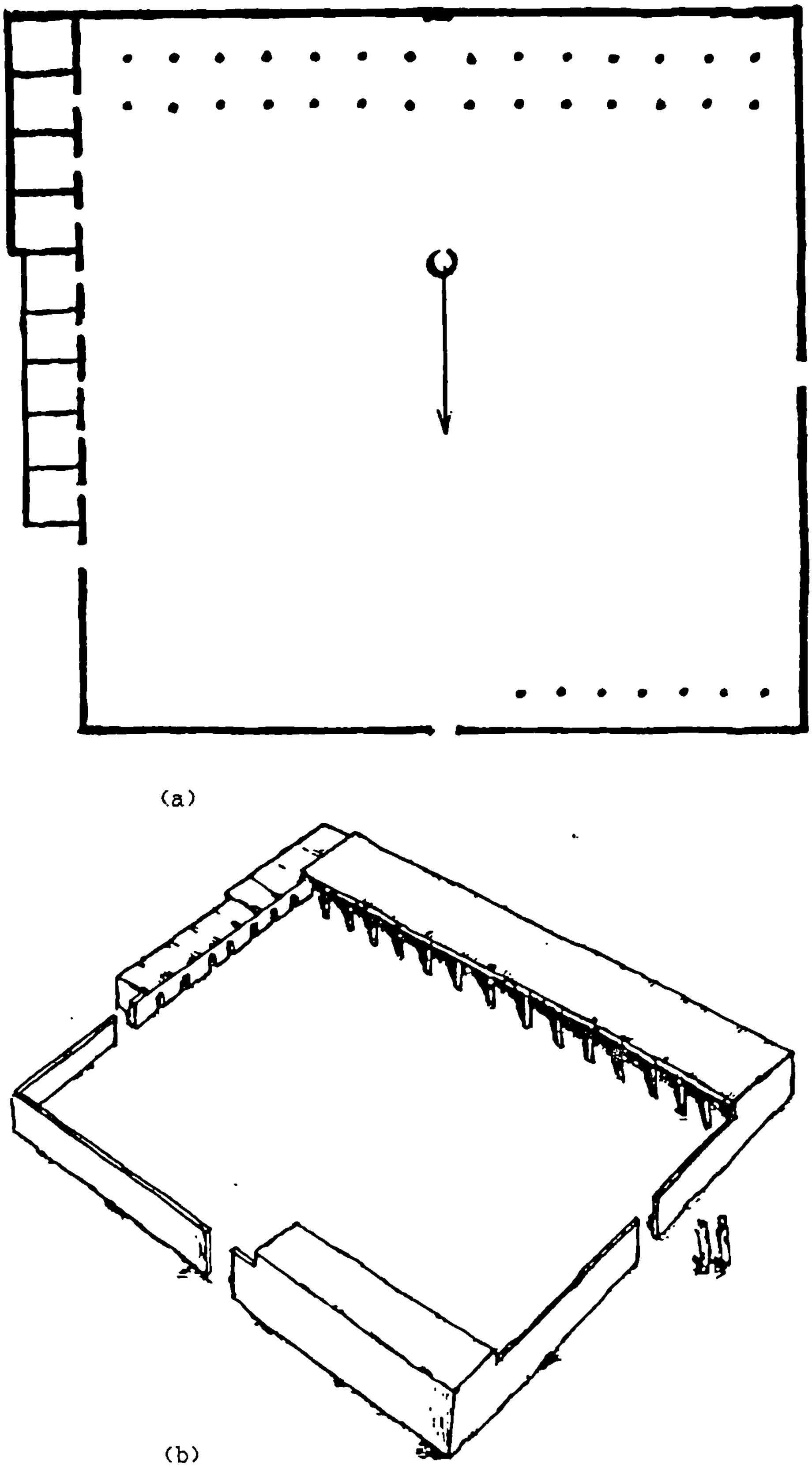
Historically, Muslim architecture of the first years of the Islamic calendar (622 A.D.), shows one of the first important buildings - the Prophet's mosque and house in Al-Madena Al-Monwara. The architect and the client were the Prophet himself; the result must be considered as an architectural message.

The mosque of the prophet had been built with an area of 100 x 100 cubits with three entrances. A flat roof of compacted mud, palm branches (stripped of their leaves) and palm-stems, was supported on palm trunk pillars. Outside the east side of the court (with doors opening into the mosque) was a series of rooms for the Prophet and his family.[3] (See Figs. 5.1. and 5.2). Although it was financially feasible for the prophet to build a monumental structure, the mosque and the house were, on the contrary, built in a very modest way.

The functional concept of the mosque was unique. It was not a Temple nor a Church, nor even a restricted Muslim religious place. In fact it was a centre with a life of its own where prayer, discussion, meetings, learning and teaching, etc., all together combined to care for the body, mind and spirit of the people; young and adult, men and women.[4]

The design concept of the mosque as an architectural response to the multi faceted requirements at that time can be considered remarkable. It is not only because of the use of the courtyard as an environmental and social element, or the use of aisles as semi-open shaded areas, nor even because of the modesty of the building which resulted from the use of local materials, human scale and welcoming, natural atmosphere; that the design concept can be considered unqiue. Most important was the avoidance of any specialized functional spaces for rational or economic reasons. The terms "multi-purpose" and "open space", which are 20th century architectural vocabulary, have been in use for more than 1,300 years.

FIGURE 5.1.

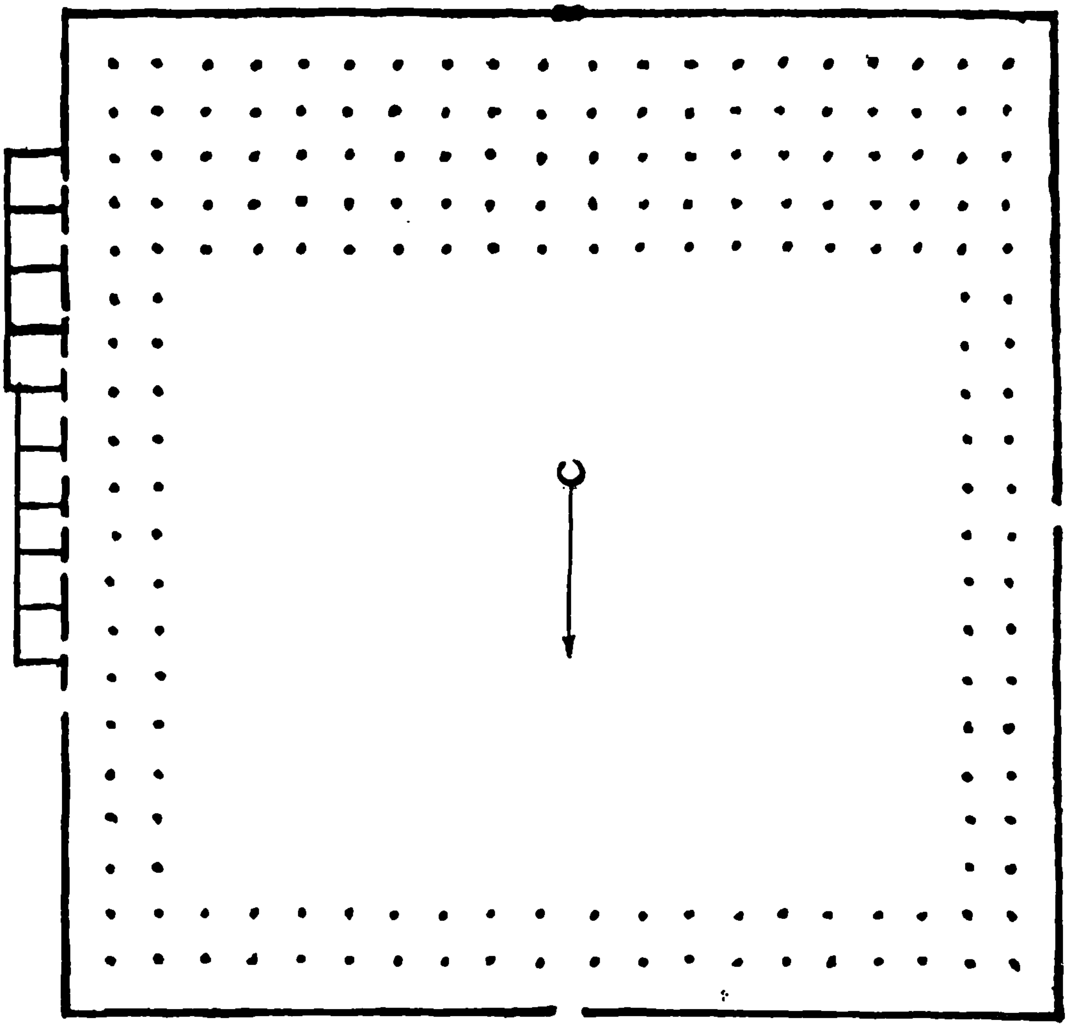


The Prophet's Mosque and house at Al Madena Al-Monawra.

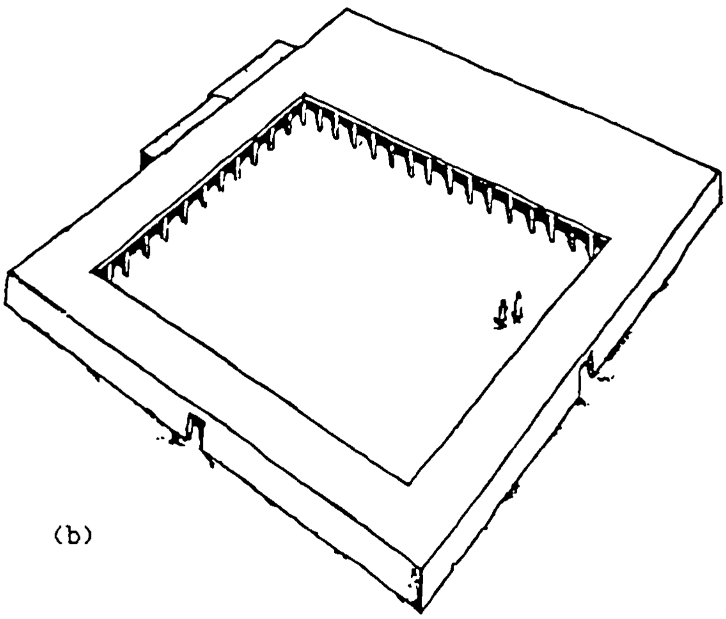
Plan (a) and isometric (b).

Source: Dr. Fareed Shaf'i,
"Islamic-Arab Architecture".

FIGURE 5.2.



(a)



(b)

The Prophet's Mosque and house during Hhalifa Uthman Bin Affan.

Plan (a) and isometric (b).

Source: Dr. Fareed Shaf'i, "Islamic-Arab Architecture".

Following the erection of the Prophet's mosque, a new wave of architecture began to grow, slowly but firmly interpreting the early message into a real architecture, with its own characteristics and behaviour. These are briefly outlined in the following sections.

1 - INWARD PLAN: THE COURTYARD BUILDING.

A - THE CLIMATIC FACTOR.

Although courtyard buildings had been used in the pre-Islamic period, specific application of it in the Prophet's mosque and house, as it was shown earlier in this chapter, has given the courtyard plan special meaning. Even in regions with relatively high humidity, such as in Jeddah and Suakin in Sudan, courtyard spaces have been created either as an external courtyard, enclosed by several buildings, or by the use of the roofs with parapets up to two metres high to give the necessary enclosure.

The climatic function of the courtyard in hot, arid regions works in three cycles:(5) during the night cool air is deposited at gound level in layers within the courtyard, and flows into the rooms surrounding it, cooling the walls, roofs, ceilings and furniture. The courtyard during that time loses heat by irradiation to the sky. During the second cycle, around noon and as the sun strikes the courtyard floor, cool air gets warmer, causing convection currents in the rooms. The 'stack effect' makes the courtyard act as a wide chimney, which in turn affords further comfort. During the third cycle and by sunset, the outside temperature falls rapidly; the courtyard begins to irradiate to the sky, and cooler air begins to flow from the courtyard into the surrounding rooms, causing another pleasant reversed 'stack effect' action.

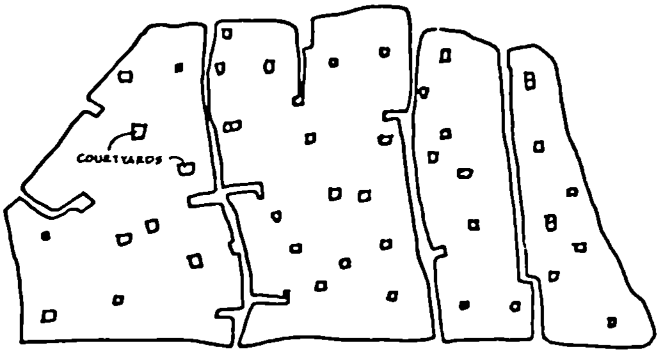
Although the natural mechanism of the courtyard cooling system is theoretically acceptable, it is in reality far more complicated if a high level of comfort is required. In the summer days, when the temperature exceeds 40°C, the second cycle of the courtyard cooling system will fail within an hour or so in the early afternoon period. The pleasant 'stack effect' process started in the morning will not be like that found in the afternoon. The very warm, dry air in the courtyard will replace the relatively cooler air in the rooms. As the time goes on, heat will penetrate to the inside of the rooms through the courtyard and the external walls, causing a very high level of discomfort.

Going back again to traditional architecture shows how the second cycle of the courtyard had been treated, not only by design concepts, but also by 'urban planning' approach. To reduce the heat impact on external walls of the courtyard house in hot, arid regions, thick insulating walls of mud or stones, with an average time-lag of as much as twelve hours were needed. Although this could be economically achieved in ground floor walls, upper walls would cause structural difficulty and uneconomical construction, if the long time-lag was obtained. On the other hand, and at the same time, the environmental care and protection which is thought to be given to people inside their buildings, should be continued, even outside their building: in streets, roads, shopping areas, etc., protecting them from heat, wind and sand-storms.

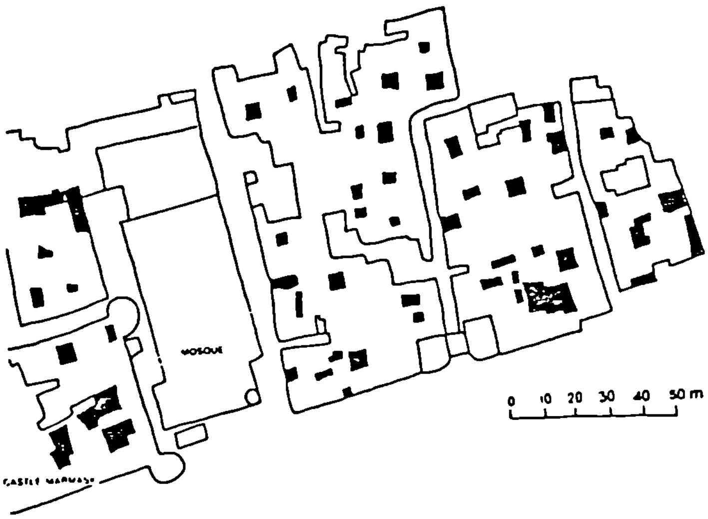
Putting the above points together, the traditional compact, irregular pattern of urban and *rural settings*, can now be understood. The consciousness of the heat impact on external walls had led structures to be built sharing as many as three walls, with narow winding streets and small external courtyards to shade each other and allow pedestrians to walk in shaded alleys. This also prevented penetration of strong winds and sand-storms (See fig. 5.3). Buildings on the setlement periphery were normally protected and shaded all around by thick growths of palm trees.[6] It is important here to remark that the above compactness can be applied in the Prophet's house, which shared the eastern mosque walls, instead of being built as a separate entity.

Thus, as well as the contribution of urban planning to reduce the heat impact on external walls by the use of compact layouts and shaded wall structures, traditional design methods were used to improve the internal environment in the courtyard during the second cycle in the afternoon. The form and the dimensions of the courtyard were always designed to reduce the quantity of heat gained during the day, either by providing internal covered terraces on two or three sides of the courtyard and/or making the height of the court usually greater than any of its dimensions on plan. By doing this, there would always be adequate shading, even when the summer sun is almost directly overhead. The use of plants and water would cool the air temperature and raise the humidity in the courtyard.

FIGURE 5.3.



Two traditional housing patterns in historic areas in hot-dry Riyadh.



Source: Kaizer Talib, "Shelter in Saudi Arabia".

(See fig. 5.4). In addition to those basic climatic measures, a new cooling system was introduced, using wind catchers (malkafs). The concept of the wind catcher, or wind-tower is to deflect unobstructed higher level breezes or air-flow into the building to create an artificial ventilation system. (See figs. 5.5. and 5.6). The difference between the wind catcher and the wind-tower is that the latter is multi-directional and usually used to ventilate the interiors of the building (rooms), while the former is unidirectional and used for internal and external spaces in the building. One of the striking examples of the application of wind catchers in a courtyard building can be in fig. 5.7. In this courtyard house in Iraq, a series of wind catchers on the roof provide indirect ventilation for a basement room where the residents normally take their summer afternoon siesta. Each catcher is connected to the basement by a duct contained between two party walls which are cooled during the night by natural through-ventilation. Because the duct does not receive any direct solar radiation, and because of its thickness, the internal surfaces remain cooler than the rest of the interior throughout the day. The incoming air is cooled by conduction when it contacts the cold inner surfaces of the duct walls and its relative humidity is increased by evaporation as it passes over porous water jugs just before being discharged into the basement. After passing through the basement, the air flows into the courtyard,[7] keeping it cool during the critical second cycle.

FIGURE 5.4.

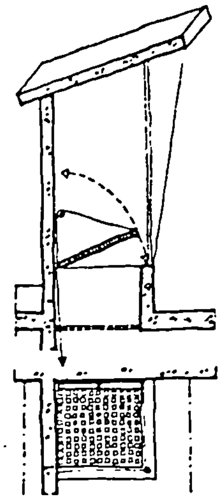
A sheltered courtyard with pools, trees, outdoor furniture and a shady iwan.

Source: George Mitchell, "Architecture of the Islamic World".

FIGURE 5.5.

The inlet to the wind catcher can usually be closed to keep out dust or cold air-screens are often provided to keep out insects and birds.

Source: Allan Konya, "Design Primer for Hot Climates.

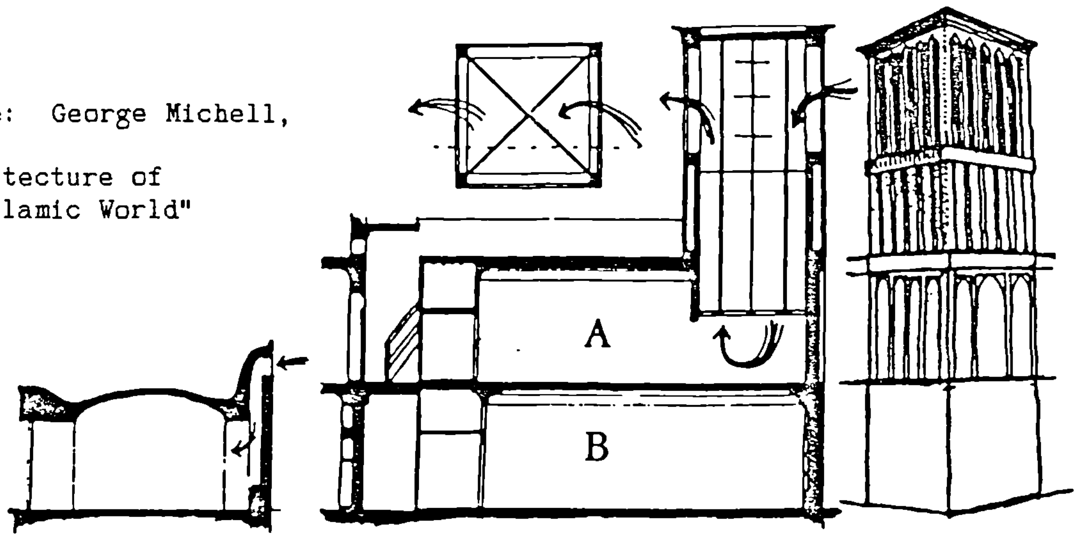


WIND CATCHERS

FIGURE 5.6.

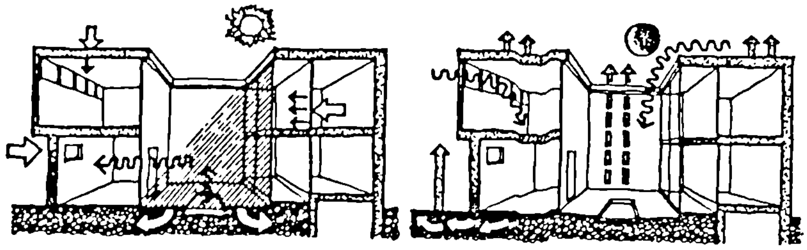
Source: George Michell,

"Architecture of the Islamic World"



A common form of wind-tower, consists of a tall structure with vertical openings in all directions and with internal walls arranged diagonally (see plan to the left of the tower; the section is taken along the dotted line), so that any breeze entering it is forced downwards and up again before it can escape. This creates a circulation of air in room A, which is used in summer. Room B is used in winter. The section on the left shows a simple form of wind-scoop ventilating ground-floor at Hear, Afghanistan.

FIGURE 5.7.



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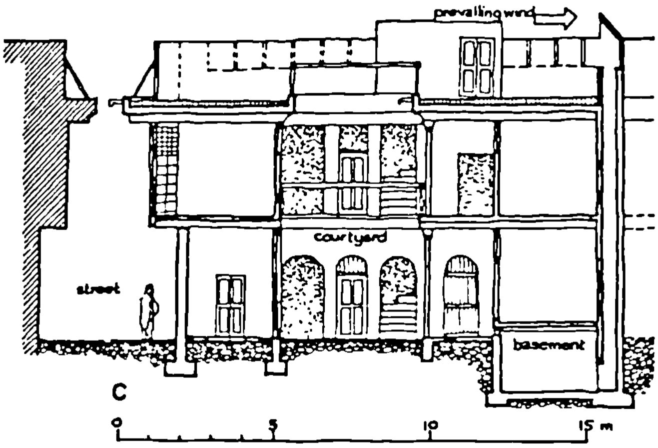

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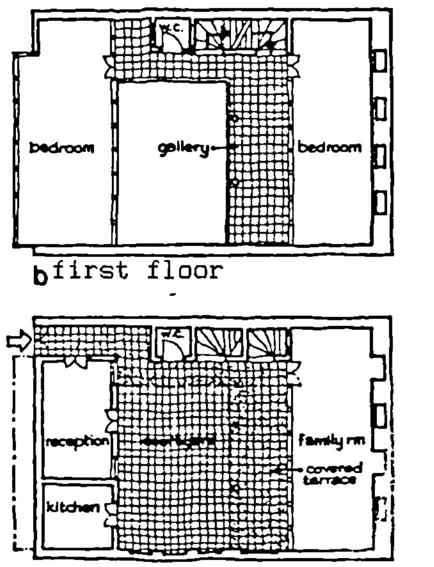
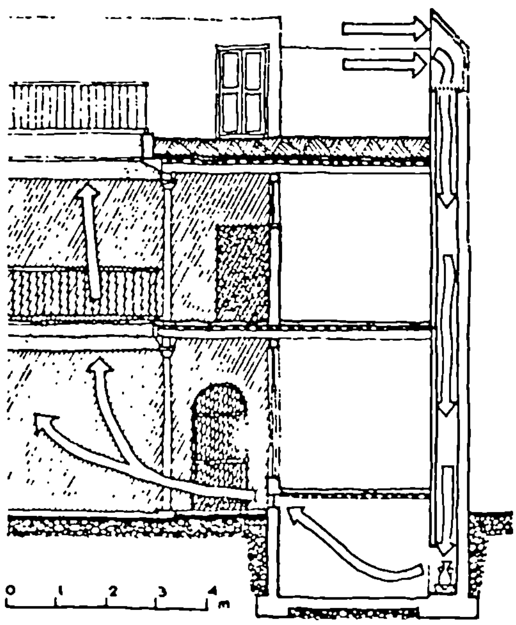


b first floor

a ground floor

Typical oriental courtyard building in Iraq. Ground floor plan (a), First floor plan (b) and section (c). The diagrammatic sections (d and e) illustrate the thermal system of this type of building showing how shaded courtyards provide a source of cool air during the daytime. Section (f) shows the technique of using wind catcher and porous water jugs.

Source: Allan Konya, "Design Primer for Hot Climates".



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B - THE SOCIO-RELIGIOUS FACTOR.

As the climatic behaviour of courtyard buildings and their urban setting gave many useful clues, similarly, their socio-religious response can be analysed.

THE URBAN SETTING.

Although the compact climatic pattern of the traditional urban setting may seem to be in conflict with the strong requirement for privacy of the individual social unit, it can, on the contrary, suggest a very collective social life too. It is very difficult to separate or distinguish between the effect of climate and social factors on the growth of the traditional settlement. This indigenous balance between climate and social needs may be explained by the following: first, the contemporary academic separation between architecture, town and urban planning and other divisions, were not existent at that time. The unity of traditional settlement suggests that designer, planner and engineer were all represented in the one - the architect. Hassan Fathy commented as follows:

> *"The form of any Arab city which was not built in a single operation arose by continuous growth from within. Problems of planning were solved as they occurred, on the spot and by a process of accretion ... By the combining of architectural design and town-planning into a single process of creation, town-planning was raised to the level of city design, which the modern architect attempts. The time devoted to planning was spread over the whole period of the construction of the city allowing successive generations of architects and master-builders to attend properly and individually to the separate problems.*[3]

Second, the strong collective social family life and its way of growth may explain the compactess and irregularity of the traditional settlement, and may explain also why problems of planning were solved as they occurred, on the spot. The strong emphasis in the Qur'an on the relationship between parents and their sons and daughters and next relatives was reflected in the small neighbourhood unit. With new settlers *such as young* couples starting to establish a new household, two or three rooms might be built around a small courtyard on the ground level. At a later stage, rooms may be added as required, over a period of several years as the children grow or sons get married, and the extended family develops. Married sons who stay with this nuclear family might build an extension around another courtyard of their own if extra land is available. So, as time goes on, two or more houses might be interconnected by internal passages or doors,[9] expressing the collective and co-operative life they live. It is for this unpredictable way of family growth, as well as the problems of external privacy, that fixed and geometrical urban patterns in traditional settlements were also unpredictable. At the same time the efficiency of climatic protection measures and the support and security of the growth of any social unit within the settlement pattern cannot be a result of haphazard planning. In his book "Shelter in Saudi Arabia", professor Kaizer Talib confirms that predictable planning existed within the informal growth:

> *"Construction of the nuclear house is carried out in such a way that future extension is possible. For example, the limber members in the roof are left uncut and extended through the wall to the outside so that when a room is constructed adjacent to it, the new beams can be connected to the old to form a*

continuous structure. Similarly, the ground floor is built with walls much thicker than necessary for a single storey structure, thus making it possible to add a second storey in the future.[10]

Finally, the social growth and the social collectivity approach can again be seen in the Prophet's house. The house started originally with two rooms only, extended later on to be four, then nine rooms. All rooms opened directly into the mosque's courtyard instead of opening into their own courtyard or corridor. This avoidance of segregation was no doubt intentional, and it suggests that the Prophet's family (wives) were participating in the activities of the mosque, either educating other women and children or listening and learning from the discussions and lessons held in the courtyard and joining in the prayers from their own rooms.

C - THE FUNCTIONAL FACTOR.

In the Prophet's house, only one room was devoted to each wife for everyday domestic life, dining and sleeping. Although this simplicity was pre-Islamic, normally seen in nomadic sheltered life, the emphasis of it in the Prophet's house was enough to allow the principles of such a way of life to spread and was conserved from that time until now, in small or large houses. Guy T. Petheridge describes the use of the traditional interior spaces in houses:

"While rooms in European houses are usually allotted to a specific activity, such as bedroom or dining room, the significant divisions in Muslim houses are those of social accessibility, both public and private. In the harem most interior spaces are functionally polyvalent and non-specific; rooms can be used interchangeably for eating, sleeping, recreation and domestic tasks.

This flexible use of living space is reflected in the absence of the cumbersome furniture (cupboards, tables and chairs)..." [11]

As well as the Prophet's house, his mosque with its multi-functional activities, was designed, as mentioned earlier in this chapter, in a simple and brave way, avoiding any kind of specialized spaces or partitions and giving it a timeless touch of flexibility. The above design principles were carried out and developed to a degree that multi-functional buildings were considered as a major characteristic of Islamic architecture. The courtyard building, at its best as a four-iwan building, was an advanced interpretation of the philosophy and design principles of the Prophet's mosque and house. In his book "Architecture of the Islamic World", Ernst. J. Grube emphasizes the multi-functional Islamic approach as follows:

"There are very few forms in Islamic architecture that can not be adapted for a variety of purposes ... The paramount example of this phenomenon is the four-iwan courtyard structure of central Asia and Iran, which is also found in other parts of the Muslim world. These structures function equally well as palaces, mosques, madrasa, caravanserai, bath or private dwelling; at different times and in different places, in fact, they were built to serve all of these functions. In other words, an Islamic building does not automatically reveal, by its form, the function it serves. It need not be designed to serve a particular purpose, but is, in most cases, an abstract and perfect scheme that can be used for a great variety of functions without any difficulties". [12]

D - TRADITIONAL COURTYARD BUILDINGS IN SAUDI ARABIA.

Although existing vernacular architecture in Saudi Arabia is mostly two to three hundred years old,[13] it is still possible to find older individual buildings scattered in different parts of the country. Many houses and buildings, as late as the 1930's were still being built in traditional forms, using traditional methods. The basic courtyard building was used mostly in the central region in Riyadh, Gassim. These settlements and buildings were following the climatic and functional behaviour discussed earlier in the chapter. (See fig. 5.8).

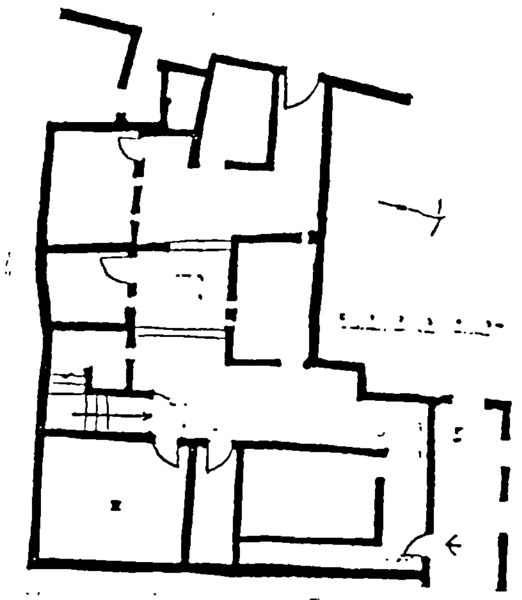
2 - OUTWARD PLAN.

Two sub-climatic zones can be found within the hot, arid zone, first: regions where the climate is hot with relatively high humidity and a low average rate of precipitation, such as in Jeddah and Yanbu in Saudi Arabia and Suakin in Sudan. Second: regions where the climate is less warm to moderate in summer and cold in winter, with a moderate rainfall rate, such as in Southern Yemen, Abha, Khamis Mushait and southern parts of Hejas in Saudi Arabia, etc. Within the above two different climatic conditions, outward looking plans (as opposed to the introspective courtyard plan) were traditionally used, but with different aims and applications.

A - THE ROWSHAN BUILDING.

In the first case where temperature, humidity and solar radiation were high such as coastal areas, three major requirements were needed: cross ventilation (onshore breezes), external facades, shade and privacy. If the courtyard layout

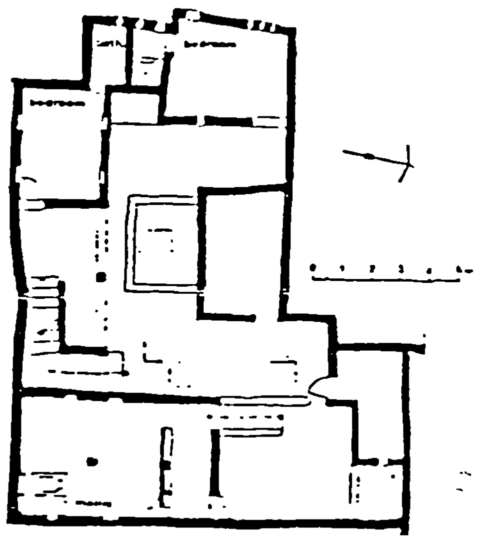
FIGURE 5.8.



a

A typical basic courtyard building in Sadus, central Arabia, Saudi Arabia.

Ground floor plan (a), First floor plan (b) and Section (c)



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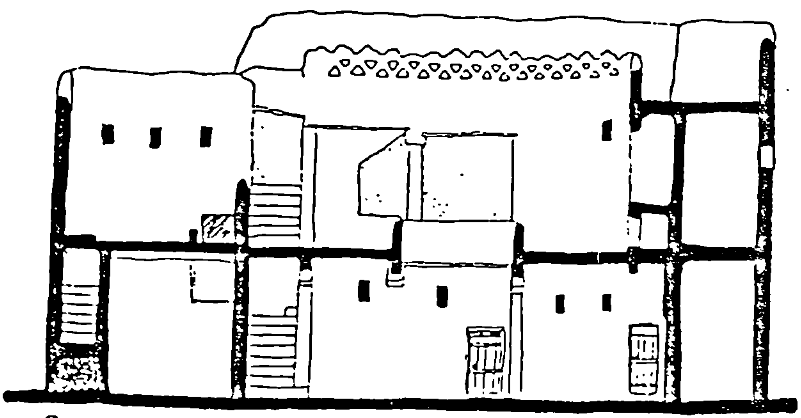


Section AA' c

approach had been applied with their solidity and compactness, shade and privacy would have been achieved, but buildings inside the periphery of the settlement would suffer a lack of effective cross ventilation. If detached courtyard layouts had been alternatively applied, with a horizontal spread on the shore sidefor maximum ventilation, privacy and ventilation would have been achieved, but the impact of heat on buildings and pedestrian activities would be very great. Therefore, neither the typical compact low profiled courtyard layout, nor the detached ones were suitable and advantageous for that climatic situation. The traditional alternative response was as follows: to reduce the heat impact on buildings and pedestrian routes and to provide each individual building with direct cross ventilation, several measures were taken:

(1) Use ofdetached or semi-detached buildings (2-3 free elevations);

(2) compact internal layout, with vertical development (4-6 storeys); to reach upper air streams.

(3) Circulation routes in the form of narrow, winding pedestrian roads and small external squares;

(4) Provision of large shaded window openings;

(5) Use of differential time-lag materials.

The result was remarkable. The detached and semi-detached approach combined with tall buildings and narrow roads gave the opportunity for each building to enjoy cross ventilation and to effectively shade each other to reduce the heat impact and at the same time protect the pedestrian roads from heat, sand storms, etc. (See fig. 5.9).

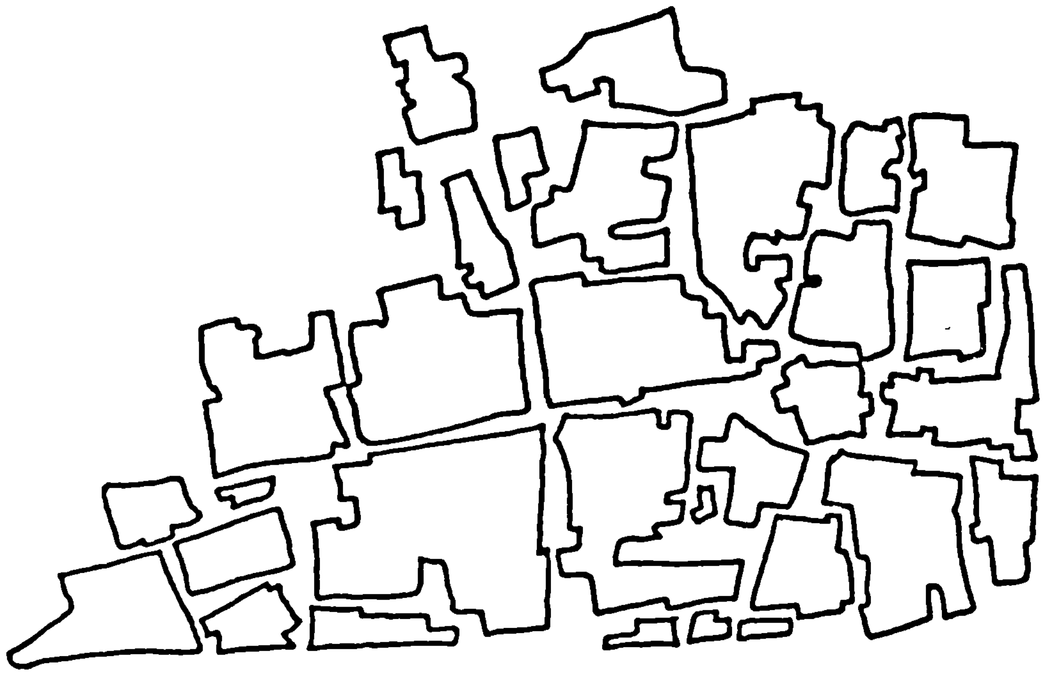
Having built multi-storey buildings with large exposed windows next to each other, privacy, a major social need may break down. An external large shading device was necessary, to provide effective privacy. It also needed to have special flexibility so that it could be easily opened, closed or positioned. It also should be of a light-weight material of high insulation (low U value) to ensure internal heat balance, especially during the summer nights, where the diurnal temperature variations would always be lower than those of inland regions such as Riyadh, Baghdad, etc. The only available local materials at that time were gypsum and lime, but both lacked the flexibility and the structural strength that was needed to build large screen panels. The only material that would do the job was wood, even if it had to be imported. (See fig. 5.10).

Several wooden screens were introduced, such as the rowshan, which can be described as a projected oriel window enclosed by a wooden screen and movable louvres. The mashrabiya may be described as a large window covered either by a fixed decorative screen or by fixed and movable louvres, or any other suitable combination. (See fig. 5.11).

Within the rowshan building, internal privacy and the multi-functional approach of using rooms were similar to those in the courtyard building. Roofs in the rowshan buildings with their high parapets (up to 2 metres) and the surrounding rooms, have given these roofs a courtyard's character.

FIGURE 5.9.

Traditional housing pattern—loose clusters—in hot-humid Jeddah.



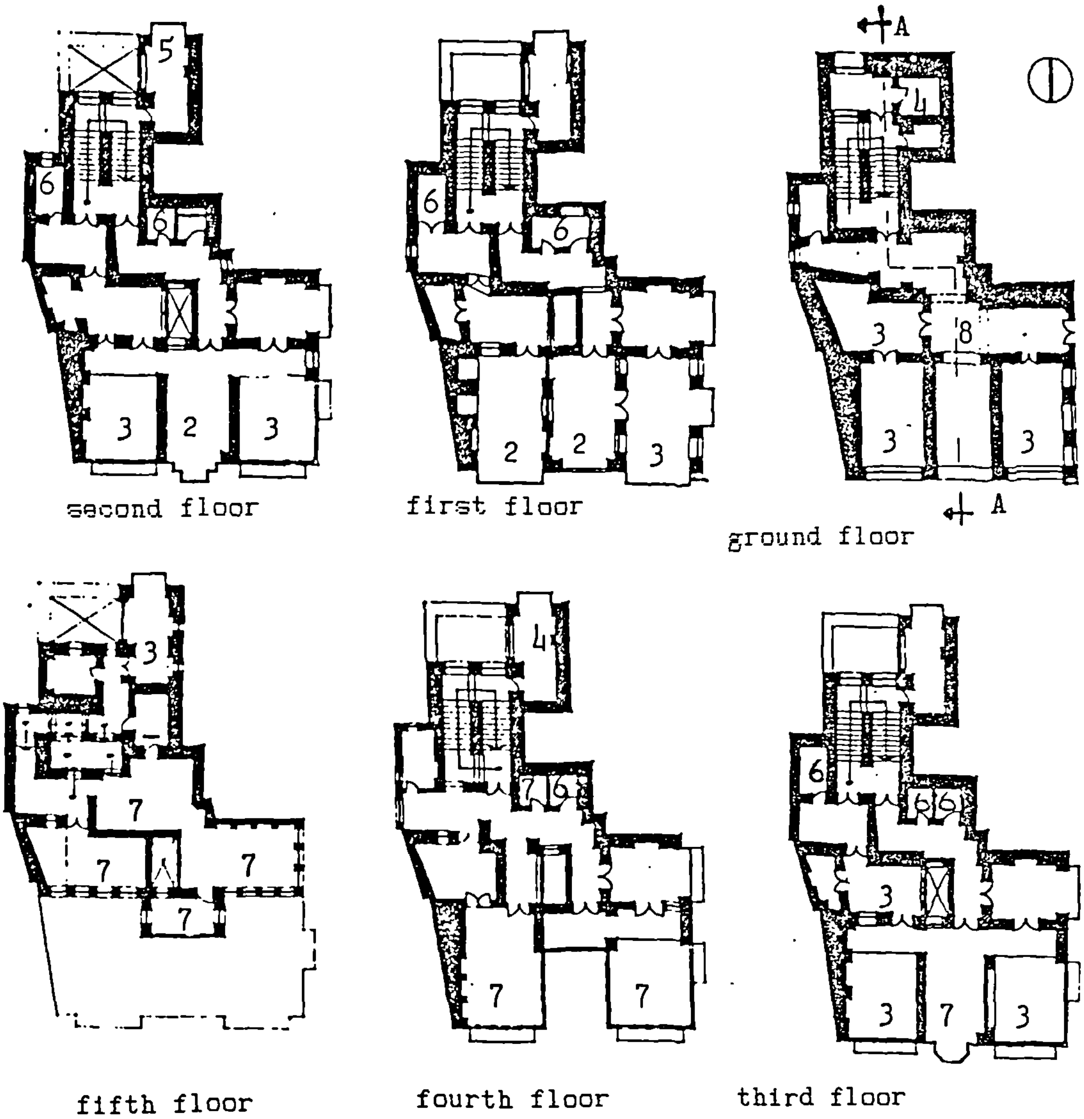
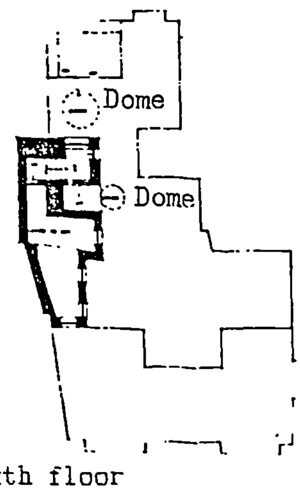
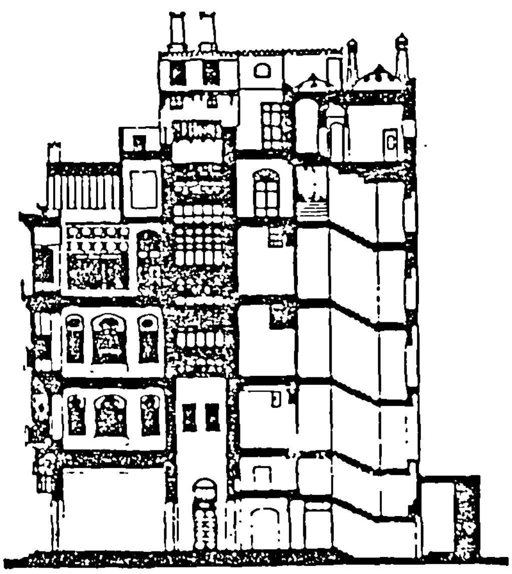
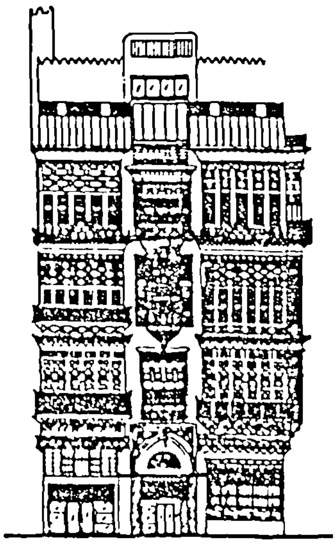


FIGURE 5.10.

A rowshan building in Jeddah. Entrance (1); guests' rooms (2); multi-purpose room (3); storage (4); kitchen (5); lavatory (6); terrace (7) and family entrance (8).





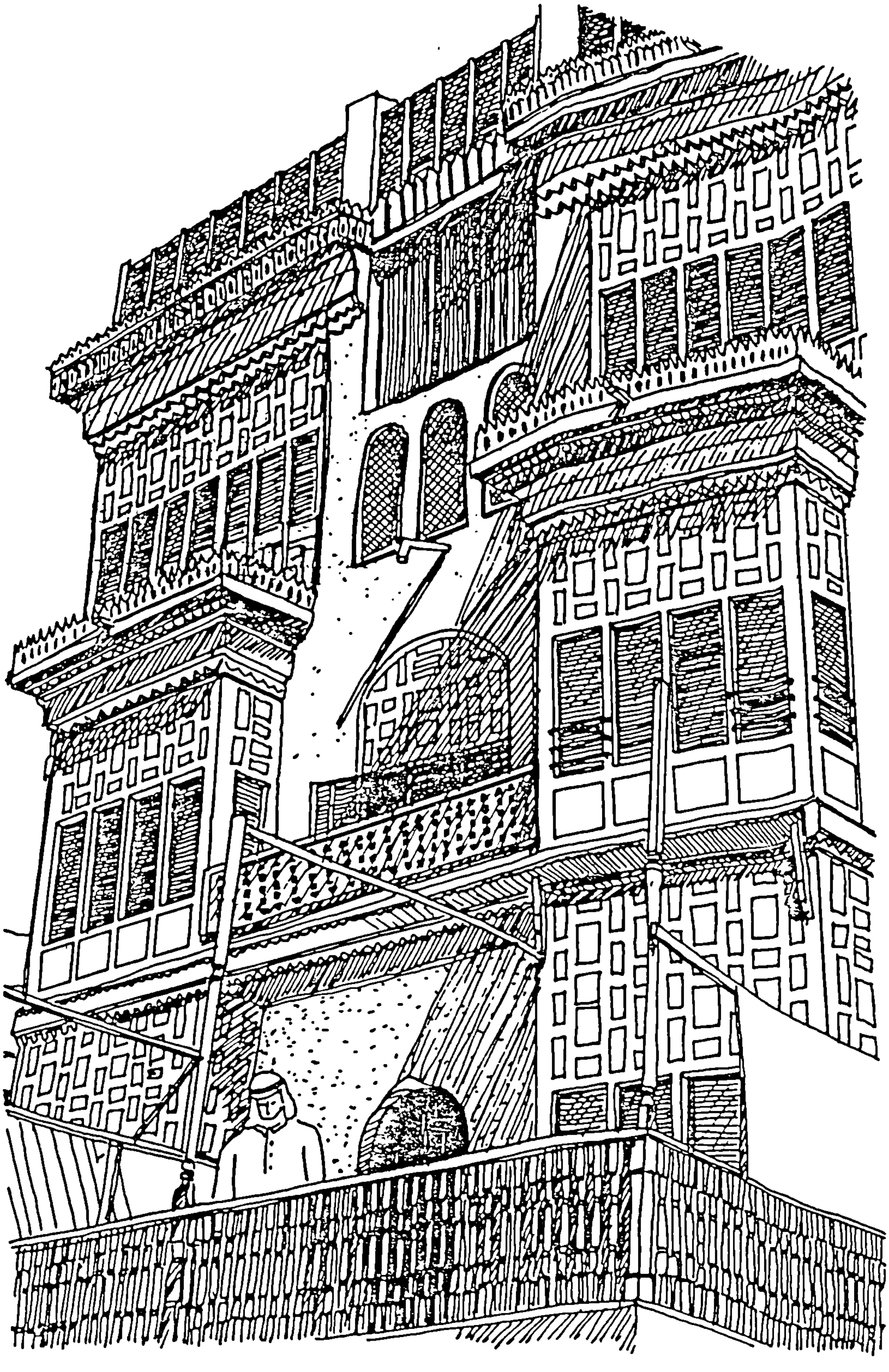


Elevation

Section A.A.

Source: Mohammed Sai'd Farsi, "Architecture and Urban Pattern of the Pilgrimage Cities in Saudi Arabia".

FIGURE 5.11.



Distinctive rowshans and mashrabias of a large building in Jeddah. Almost completely ventilated wooden facade.

Source: Kaizer Talib, "Shelter in Saudi Arabia".

B - THE TOWER BUILDINGS.

In upland regions, where the climate is cool and dry in winter, while in summer enjoying optimum temperature and humidity with a moderate amount of rainfall, two major requirements were needed: solar insolation and privacy. Neither the courtyard nor the rowshan building could work in such an environment, where external activities are limited, especially in winter, and energy conservation is needed. Therefore, a compact internal layout with multi-storey buildings having solid thick walls and small openings, were all combinedto gain and maintain heat during winter and summer nights. Upper floors in these buildings usually have roof courtyards as in the rowshan buildings. (See fig. 5.12).

3 - INWARD AND OUTWARD PLAN. (Composite layout).

In regions with a composite climate fluctuating between hot-arid and hot-humid desert conditions, such as in Dhahran, Quatif, Dammam in Saudi Arabia, Qatar, Bahrain, Cairo, etc., the traditional design response was a composite one too. The settlement layout in those areas was moderately compact for mutual shading and at the same time loose enough to permit cross ventilation.[14] (See fig. 5.13). Narrow streets, small external courtyards (baraha), overpasses and underpasses were still essential.

The design of buildings in those regions is much more complicated than those in hot-arid or hot-humid zones. Cross ventilation is needed in summer, but not in winter. Solar insolation is needed in winter, while shade is essential in

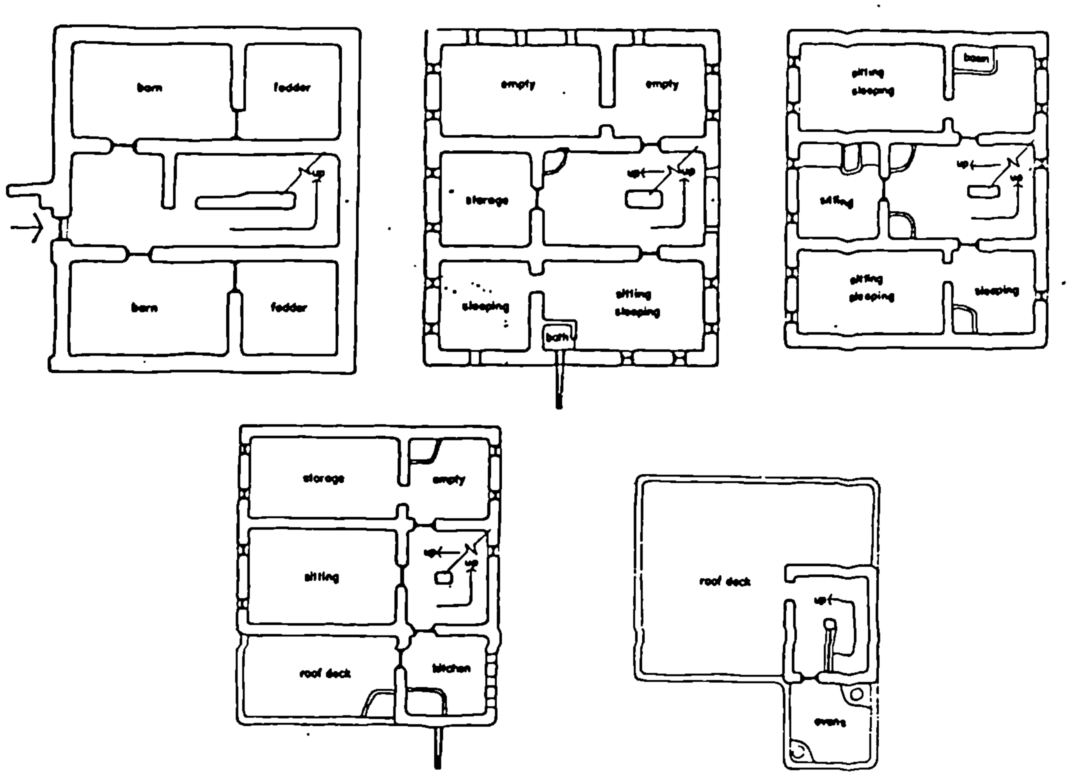
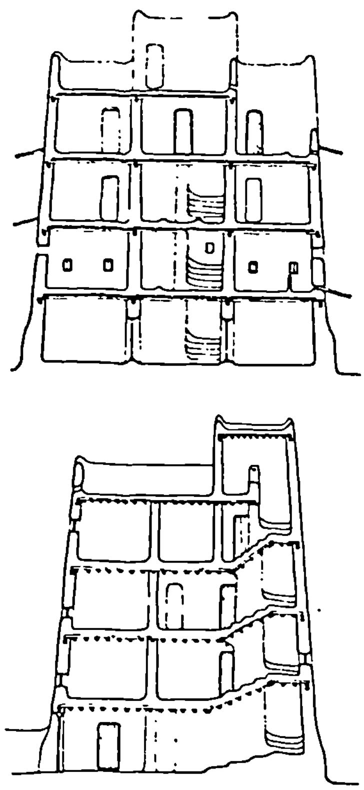
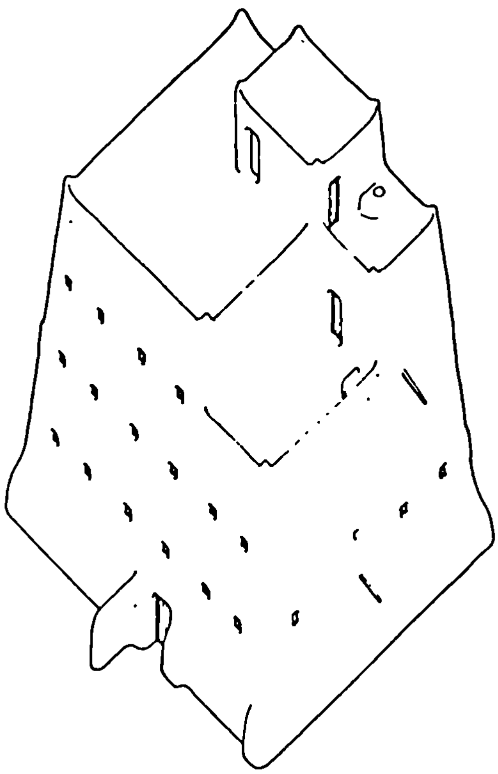


FIGURE 5.12.

Indigenous Architecture of the Asir Highlands - the tower buildings.

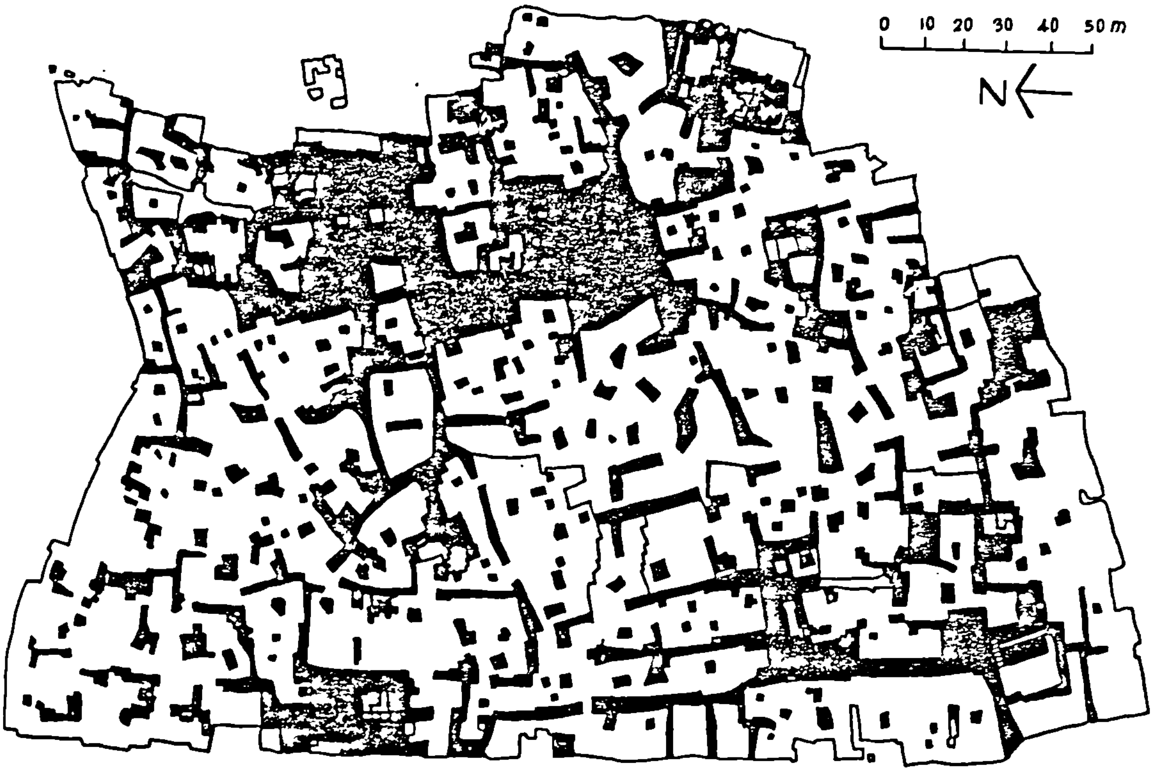
Detached mud bulding: plans, section and isometric.





Source: Kaizer Talib, "Shelter in Saudi Arabia".

FIGURE 5.13.



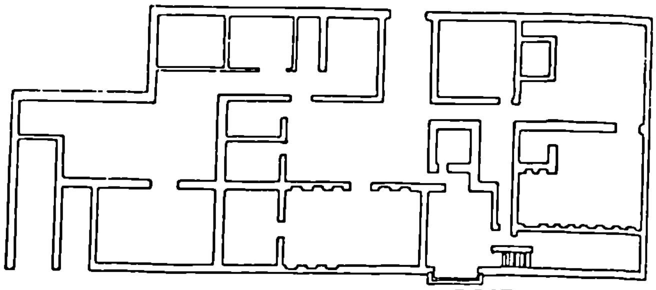
Traditional closely-knit settlement in Al-Qalah, Quatif.

Shaded areas are courtyards and narrow streets.

Source: Kaizer Talib, "Shelter in Saudi Arabia".

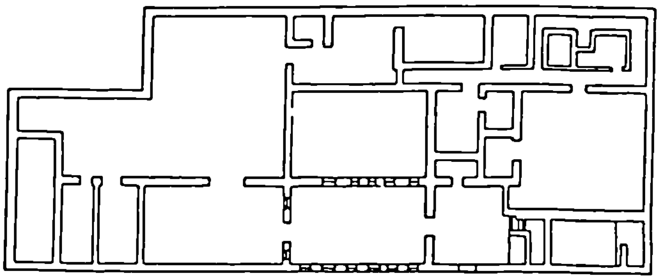
summer. At other times of the year when the temperature averages are optimum and pleasant, external activities increase and open spaces may be needed. Therefore, a combination of the courtyard and the rowshan concepts became essential for well ordered design. In a typical house in those regions, some rooms were always built with materials with high thermal capacity to be used during the hot-dry and cold-dry periods, while others were built partially with low thermal capacity materials so that they could cool faster on warmer nights. The use of gypsum panels, large mashrabias and rowshan inside the courtyards were not for ventilation only, or even for privacy and decoration, but also to achieve the thermal balance needed. This combination between heavy and light-weight materials helps the courtyard temperature to cool down more quickly than if they were constructed of high thermal capacity materials only. (See figs. 5.14.-5.17). This understanding of the thermal behaviour of materials and their applications led to the idea of shading the courtyard in summer with a permanent light-weight structure for better thermal balance. As wood was the only light-weight material that could be used at that time, it was necessary to reduce the courtyard size to a dimension that could be structurally covered by wood. By doing that the typical open courtyard house with its iwans had been developed to become a small covered courtyard called the "dorqa'a house".[15] Although a wooden lantern provides light, shade and cools the spaces below, it may reduce ventilation. Thus to avoid that, a wind catcher was introduced to improve the ventilation system. (See fig. 5.18.).

FIGURE 5.14.

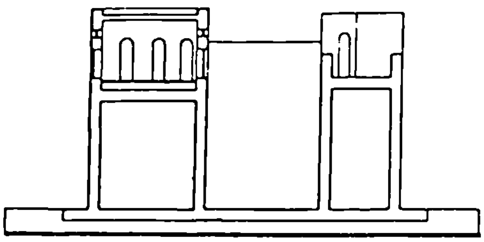


FIRST FLOOR PLAN

Drawings of composite layout
building in Hofuf, Eastern
Province in Saudi Arabia.

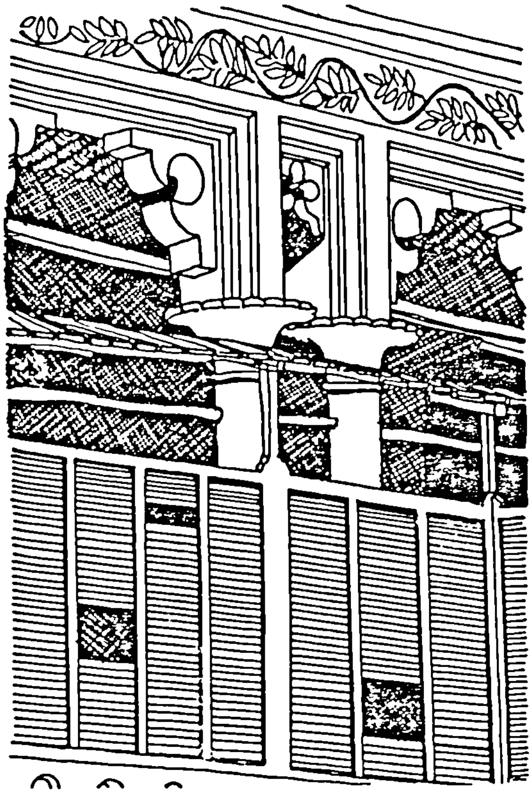


SECOND FLOOR PLAN



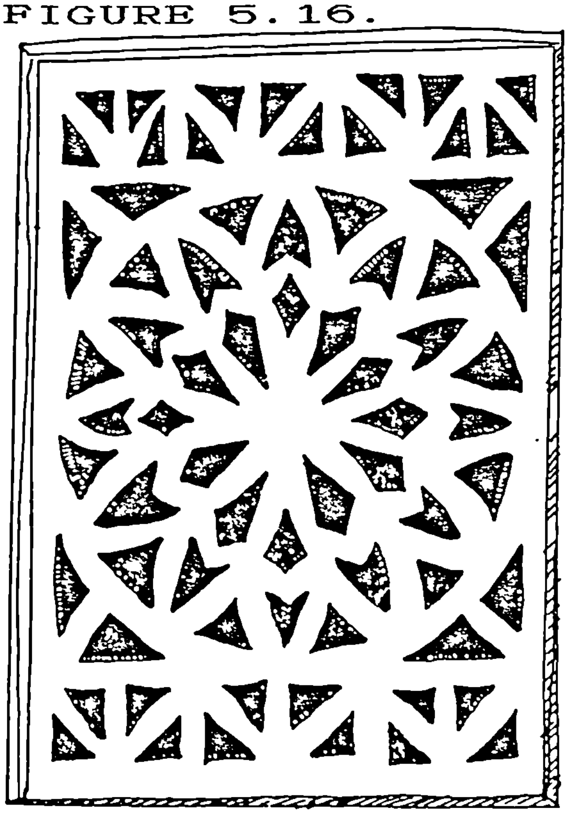
SECTION

FIGURE 5.15



Detail from *Qasariya*, a mixed-use building in Qatif—Eastern Province.

FIGURE 5.16.



Gypsum ventilation panel—Eastern Province.

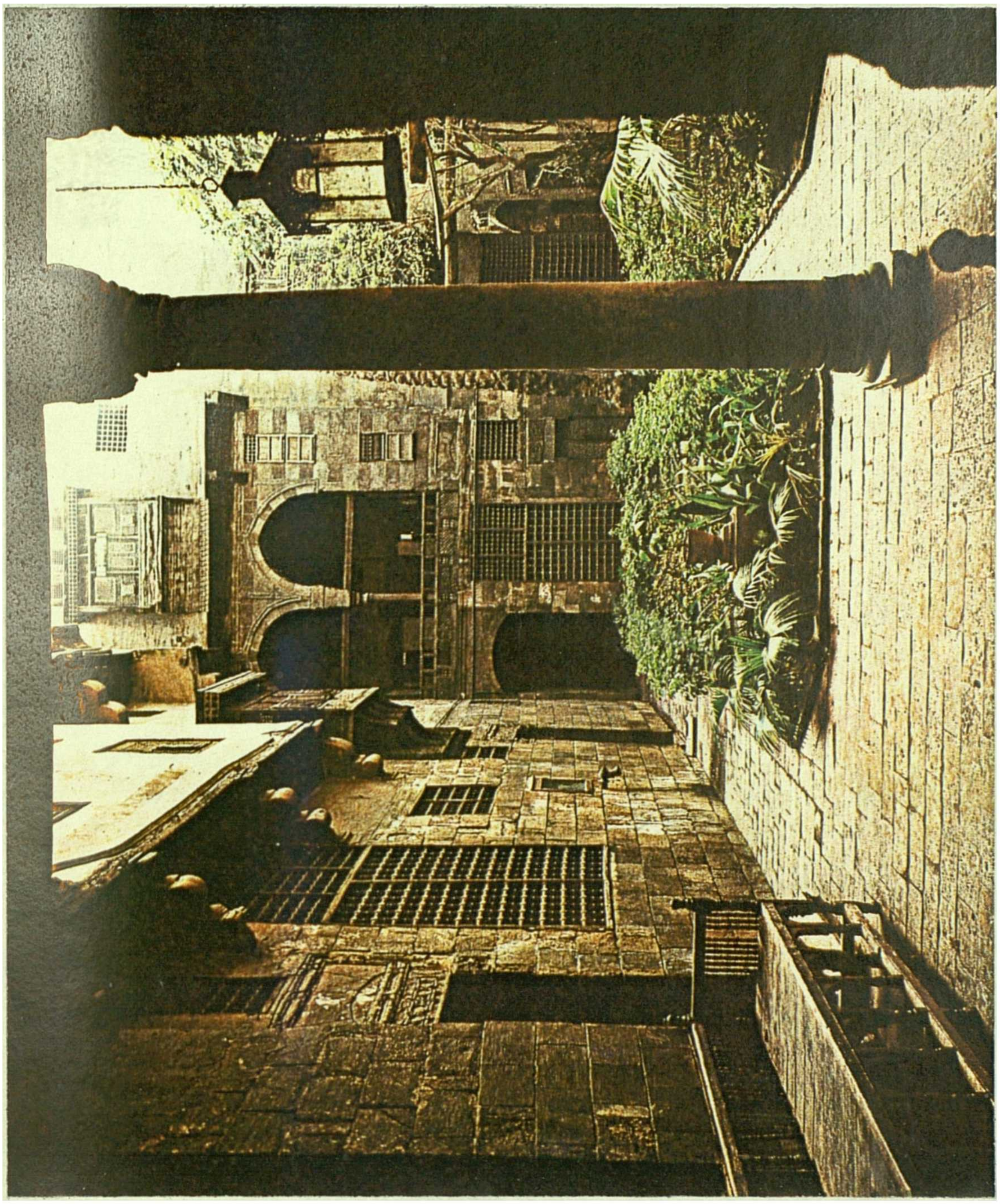
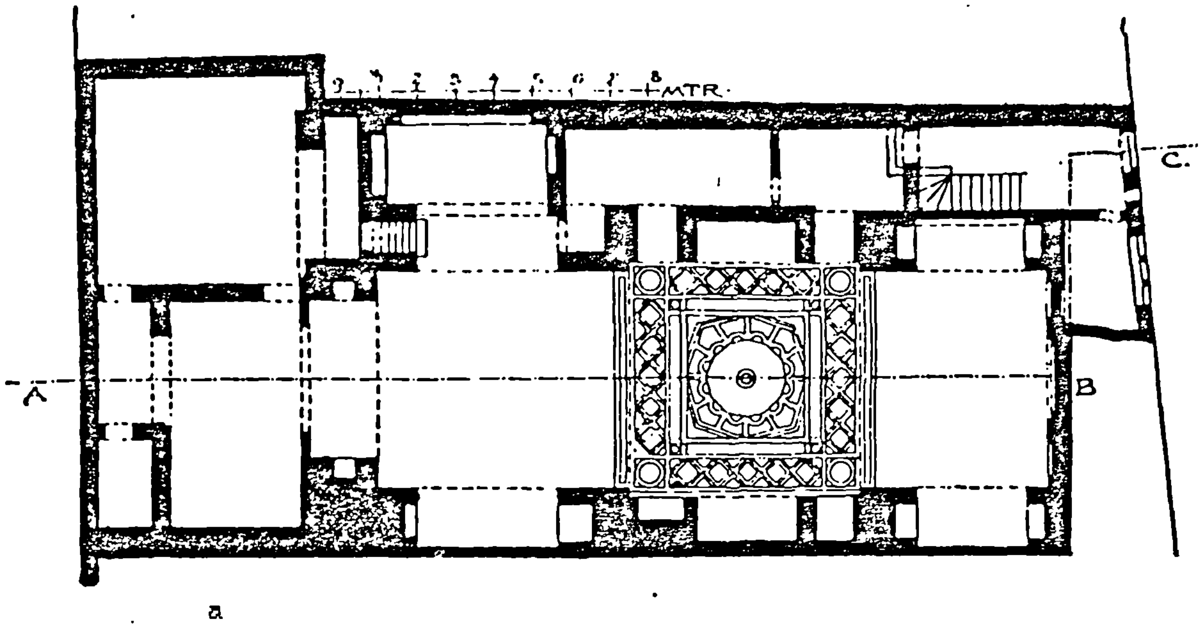


FIGURE 5.17.

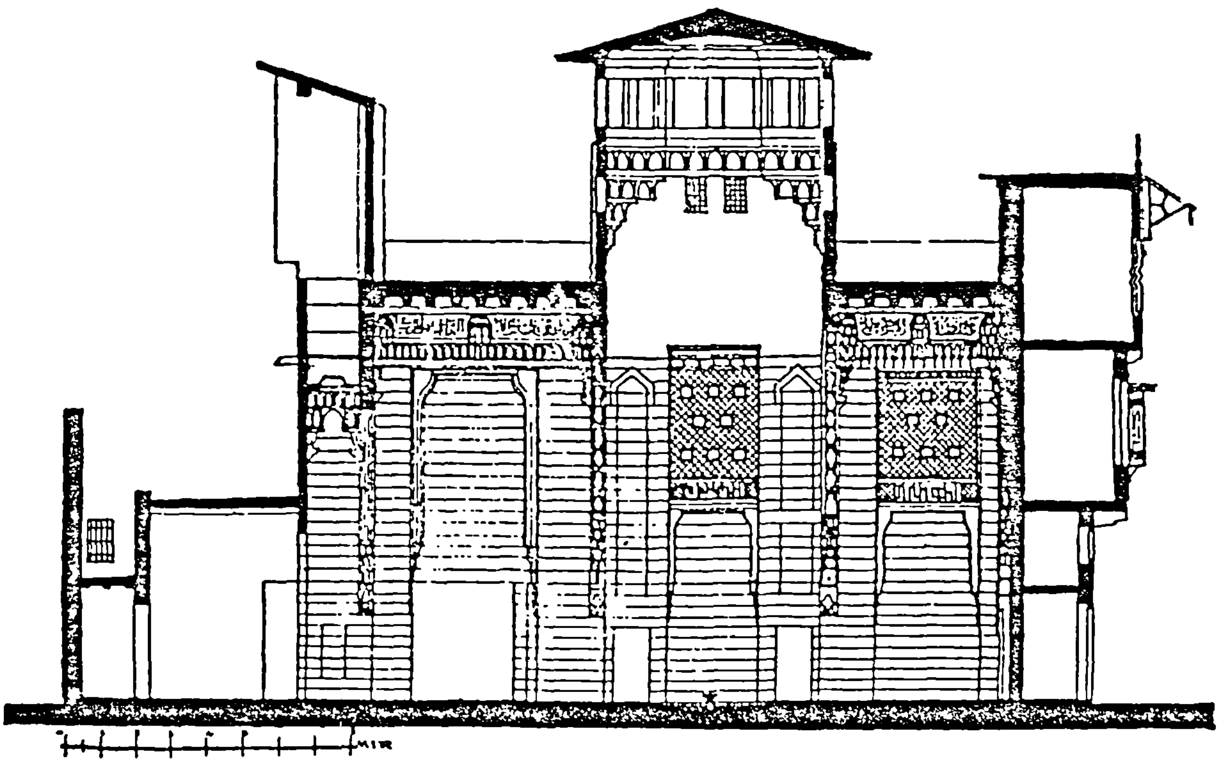
The shady courtyard of the fine Mamluk building in Cairo.

The combination of heavy-weight and light-weight materials helps the thermal balance of the structure.

FIGURE 5.18.



The dorqa'a house in Cairo. First floor plan (a) and section A-C (b).



Source: Dr. Fareed Shaf'i, "Islamic-Arab Architecture".

SUMMARY OF FINDINGS.

Within the different sub-climatic zones of the hot, arid climate, either in Saudi Arabia or in other Middle Eastern countries, the three possible layouts of buildings: inward, outward and composite layouts had been applied with reference to climate, social, religious and functional local factors. In each of those sub-climatic zones a typical layout was used, but with different technical solutions.

1 - THE INWARD PLAN.

Used in severe, hot, very dry areas such as in Central Arabia and Iraq. In Iraq the court, wind catchers, basement rooms, and covered terraces for shade, were all used together with porous water jugs to assist in cooling by evaporation. These devices assisted the natural cooling and ventilation system. The central arabian courtyard was basic. The wind catcher cooling system did not apply due to frequent dust and sand storms. Plants and water only were usually used as a palliative.

- THE OUTWARD PLAN.
A - THE ROWSHAN BUILDING.

Used in most hot and relatively humid areas, such as in Jeddah and Suakin. Due to the high relative humidity during summer afternoons and nights, the temperature does not fall as much as in central Arabia, and therefore the structure temperature must cool down. Light-weight screens made of wood were used (rowshan and mashrabia), not only to achieve thermal balance but also for privacy and as a simple cooling-ventilating system.

B - THE TOWER BUILDING.

In upland areas where the climate is cold in winter and summer nights, compact, solid, multi-storey buildings were used to gain solar insolation and conserve heat. Tower buildings can be seen in southern parts of Saudi Arabia.

3 - THE COMPOSITE PLAN.

In regions where the climate fluctuates between hot-arid and hot-humid or warm-arid, such as in the Gulf areas - Makkah, Maddena, Cairo, etc., a composite layout was used, combining courtyards and light-weight materials (mashrabia, rowshan, gypsum). The two types of buildings can be seen, first; the open court composite layout such as in Dammam, Makkah. Second, the covered court layout (the dorqa'a house) as used in Cairo.

These six different solutions had been influenced directly by climate requirements and socio-religious factors, which in turn affected the spatial concepts and led to the particular identity of building in each region or town. The internal function had no major effect on form or layout, it only affected the internal routine or the organization of activities. The buildings were flexible and virtually interchangeable. A Rowshan building in Jeddah, for example, could be used for housing as well as administrative work,(16) or the four iwan building could be used as a house, mosque, madrasa, palace, etc. The multi-functional concept, which originated from the Prophet's mosque and house had been applied in all buildings. This is a fundamental concept in Islamic architecture and will be brought forward again in future chapters. There are however limitations on scale which must be considered.

TRADITIONAL SCHOOL BUILDINGS.

TRADITIONAL EDUCATION.

The Qur'an must be understood, learned and memorized to be read in everyday prayers by every Muslim; young and adult, men and women. An organized process of transmitting and instilling Islamic knowledge and experience is essential. Islamic knowledge and experience which depend on the Qur'an should be put in action through worship. The meaning of worship is not restricted to the physical performance of religious rituals only, but embraces all aspects of life: activities, faith, thought, feeling and work. As a result of the above facts, Islamic religion becomes a way of life, and thus the aim of the process of transmitting and instilling (education) is to enable individuals to live the Islamic way of life. Organization, on the other hand, depends on how, when and where that could be achieved. During the early Islamic period, a primary educational form was organized. Children until the age of puberty should be taught religious sciences, Arabic language, reading and writing and arithmetic. The next stage was informal. Youngsters had to work, either half or full-time as assistants in shops, specialized sugs or pazaares until they could achieve their independence. Other students could have more lectures for several years, which enabled them to pursue the career of preacher (Khatib), leader of daily prayers (imam) and judge (quadi). All those educational activities were held in mosques and in the teachers' houses (Kuttab).

THE EVOLUTION OF THE ISLAMIC SCHOOL (MADRASA).

While primary education continued to be taught in mosques and private houses, a result of the increased number of scholarship students and the need to accommodate them, as well as the need for more specialized subjects, higher education began to require a new spatial organization. Although this might be seen to be revolutionary, it should rather be seen as evolutionary. The building type and indeed the function were new, however. The design concept had deep roots and was almost four hundred years old. The simple combination of a typical domestic house and a mosque for educational use which was called "Al madrasa", was another advanced interpretation to the design philosophy of the Prophet's mosque and house. James Dickie (Yagub Zaki) describes the concept of the madrasa:

> *"The Prophet's house, or more accurately its courtyard, had supplied the model for jami (mosque), and now it was another domestic courtyard that was adopted for the need of the madrasa. The typical Khurasanian house was cruciform, with four arched openings, known as iwans, off a central courtyard ... The typical Khurasan madrasa consisted of two tires or cells, or hujras, preceded by diminutive iwans running around a courtyard, each side of which was punctuated in the middle by an iwan rising the full height of the facade or projecting in a frame above the line of the roof. The quibla iwan was given more prominence than the other three so it would serve as an oratory qibliyya."*(17)

Lectures, seminars, discussions and prayers were usually held in iwans and courtyards. Students sat on the floor forming an informal semi-circle around their teacher. (See figs. 5.19-5.20).

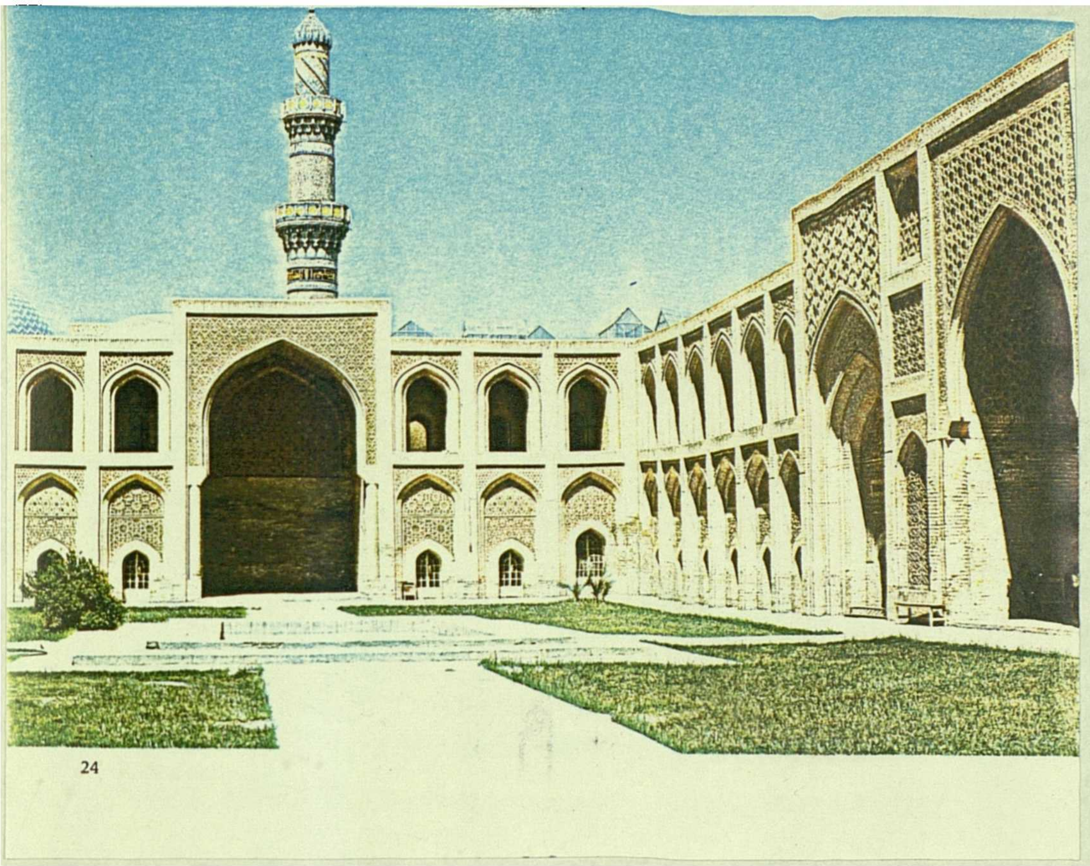


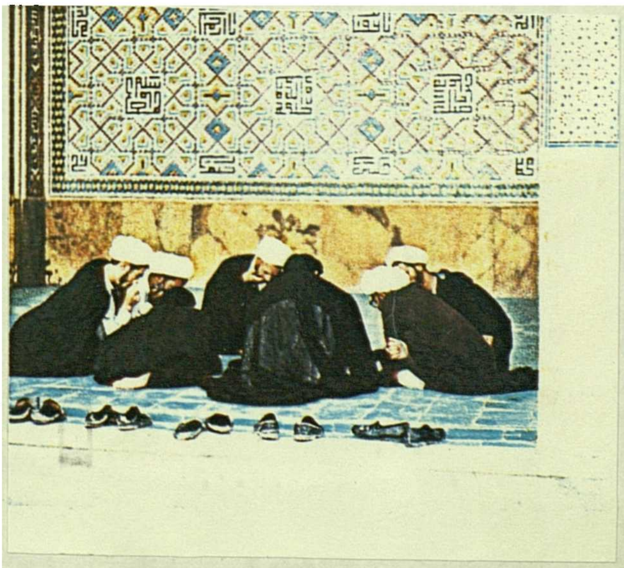
FIGURE 5.19.

The restored Mustansiriyya madrasa in Baghdad: a rectangular courtyard with four iwans in the centre of each side. Teaching takes place in the iwans.

FIGURE 5.20.

Students studying in the iwan. They have removed their shoes and squat in a circle.

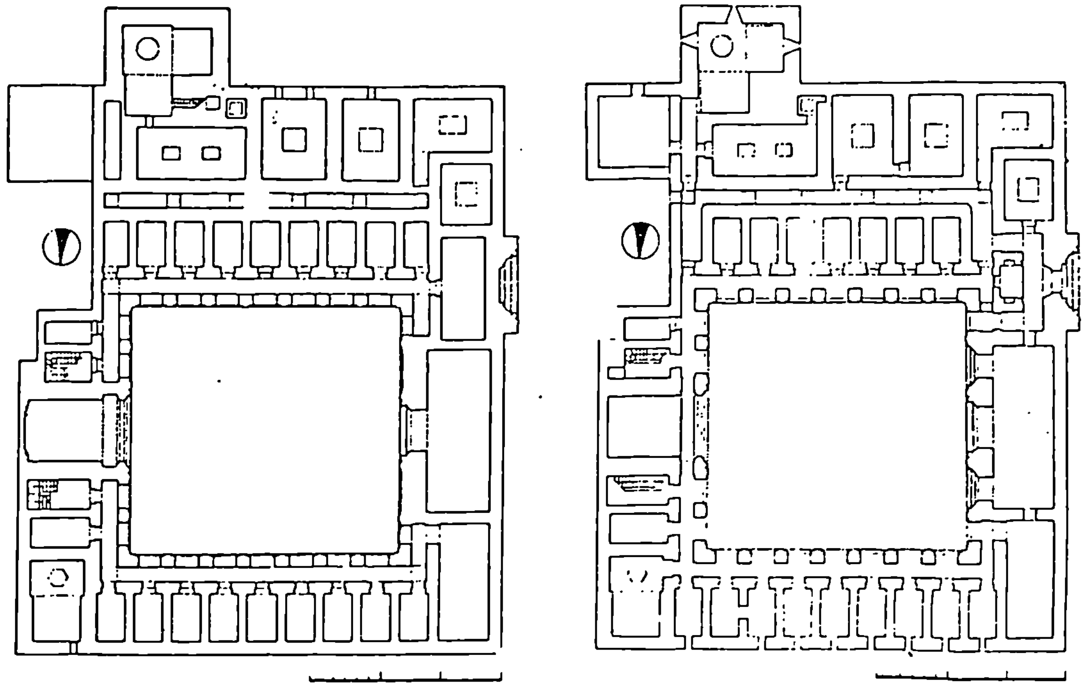
Source: George Mitchell, "Architecture in the Islamic World".



The earliest known madrasa was at Nishapur in Khurasan in 947 and although several other madrasas were built after that, the movement of school building remained essentially local in the form of independent institutes. It was not until the Seljuk Prime Minister Nizam Al-Mulk came into power that the madrasa as an institution came of age. The famous Nizamiya madrasa founded at Baghdad in 1065-7, comprises of iwans (classrooms), halls, library and residence, with bazaars and caravanserais forming its endowments. Staff and students had free board. Teachers had to have an official diploma, while students could obtain a certificate conferring a rank of Doctor of Law and Tradition, which enabled them to become either a preacher, leader of daily prayers (imam), judge (qadi), professor (muderris), and for the chosen few, the leadership of the Alem (mufti).[18] Since that time the construction of madrasa buildings spread all over the Islamic world. In Baghdad, and by the year 1260, there were as many as 44 madrasa, providing religious, literature, liberal arts, public administration, mathematics and medicine courses.[19] The remainder of Baghdad madrasas are no more than three: Al-Mustansiriyyah, which is considered the biggest Islamic madrasa, built in 631 A.H. (1233 A.D.). (See fig. 5.21.), the Abbaside Palace Madrasa, which is smaller, but similar to Al-Mustansiriyyah, (see fig. 5.22), the last one is Al-Murjaniyyah which is more similar to madrasas in Syria.[20] (See fig. 5.23.).

Three major elements are common in all traditional madrasas: the iwan, (the main study area), courtyard and students and teachers residences. The treatment of each one may differ from one region to another, depending, for example, on climate or the

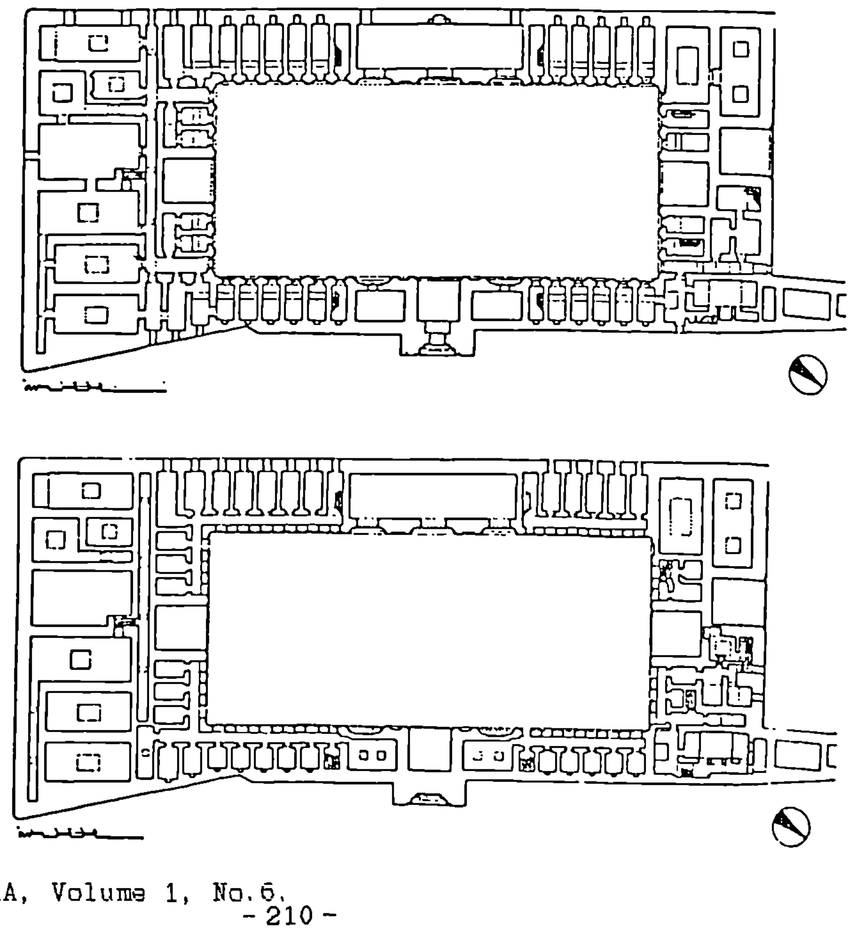
FIGURE 5.22.



Abbaside madrasa.

FIGURE 5.21.

Al-Mustansiriyyah
madrasa built
in 631 A.H.,
(1233 A.D.).

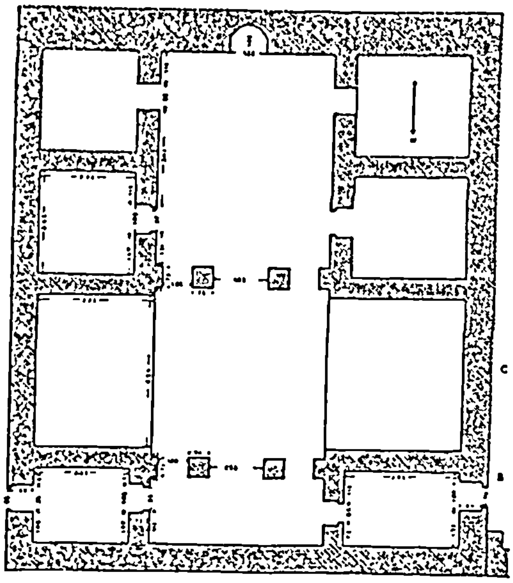


Source: ALBENAA, Volume 1, No.6.

local architectural dialect, etc. The Syrian madrasas, for example, normally have two iwans, exceptional to that is the madrasa of Abu Mansur Kamushlakin at Bosra, founded in 530 A.D. (1136 A.D.) which has three iwans. (See fig. 5.24). The quibliyya iwan (masgid) in Syrian madrasa always took a special form, a central formed bay with extensions, usually tunnel-vaulted to right and left.[21] The number of iwans varies and depends on the number of rites in the madrasa. The qibliyya iwan in other madrasas, either in Car, Isfahan, Samarkand or Baghdad, etc., have not been emphasized by special treatment, as in Syrian madrasas. In Iran iwans could have wind catchers, such as in the Ghiyathiya madrasa at Khargird, founded in 1445 A.D. (See fig. 5.25)

The teachers and students residences are almost typical in all madrasas around the Islamic world. Tiers of multi-purpose rooms (hujrat), opening into the courtyard can be found either on one, two or even on four sides of the madrasa, depending on the madrasa's size. Exceptions to that can be found, as in Cairo and Morocco. The Sultan Hassan's madrasa in Cairo, founded in 1356-59 A.D., consists of four compacted iwans. The space between each adjoining iwan is provided with a residential unit for both teachers and students. This residential unit is actually a one iwan dorqa'a house which was discussed earlier in this chapter. (See fig. 5.26). In Morocco, the Ben Youssouf madrasa has only one iwan, while on the other two sides of the courtyard there are seven residential units. Each unit is a typical basic courtyard house (see fig. 5.27). The iwan in this madrasa is exceptionally covered by a dome and thus resembles the Syrian madrasas.[22]

FIGURE 5.24.



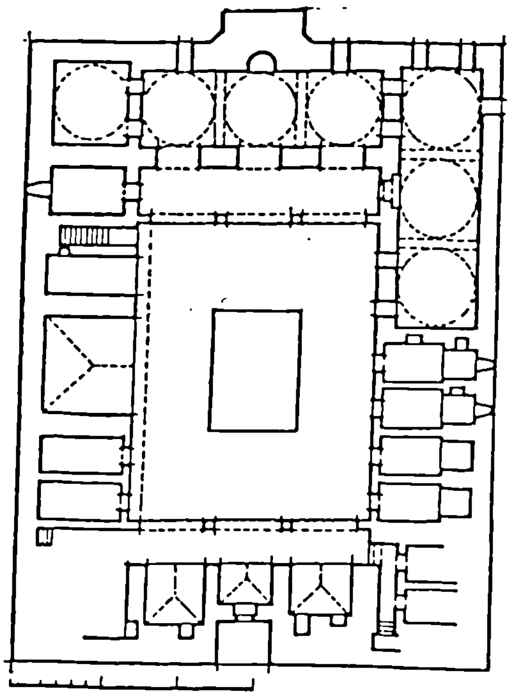
Abu Mansur Kumushlakin madrasa in Syria, founded in 1136 A.D.

A Syrian madrasa with exceptional three iwans.

Source: K. A. C. Cresswell.

FIGURE 5.23.

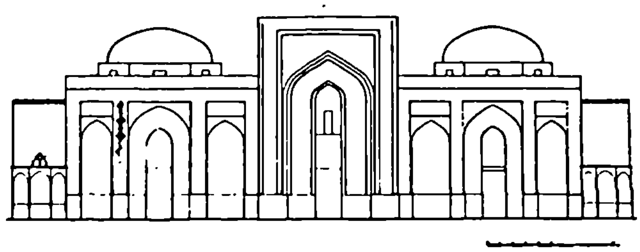
Al-Murjaniyyah madrasa.



F

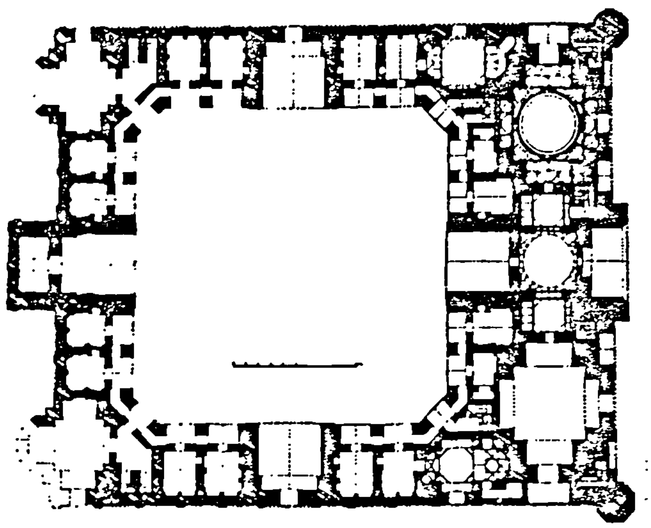
Source: ALBENAA, Volume 1, No.6.

FIGURE 5.25.



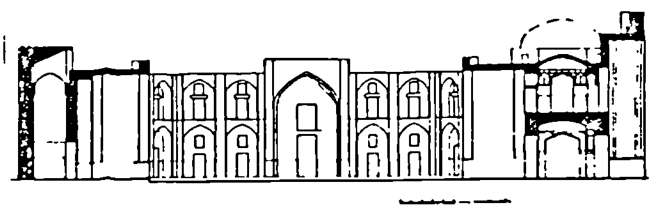
The Shiyathiya madrasa at Khargird, founded in 1445 A.D.

(b) second-floor plan



Section (c) shows the wind catcher behind the iwan.

(c) section



Source: The Aga Khan Program for Islamic Architecture "Higher Education Facilities".

(d) library-vault plan

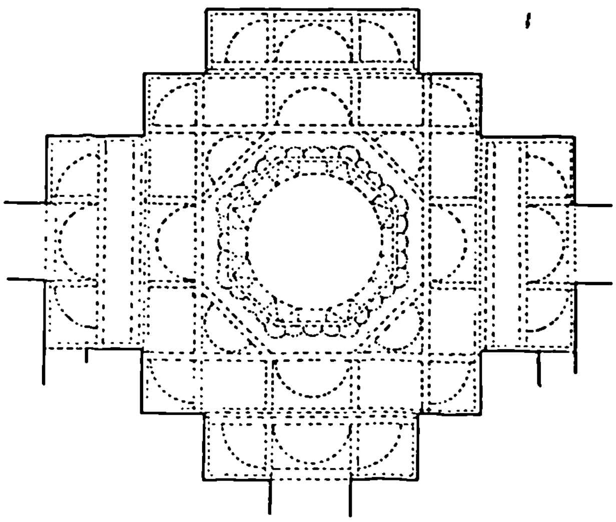
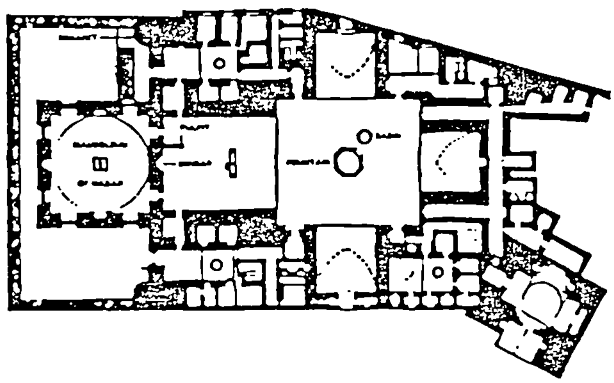
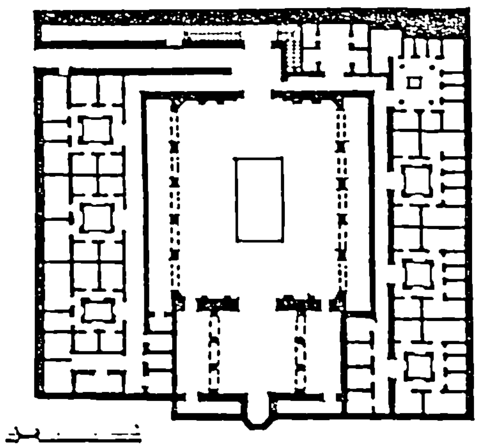


FIGURE 5.26.



The Sultan Hassan's madrasa in Cairo, founded in 1356-59 A.D. Each residential unit was designed as a one iwan dorqa'a house.

FIGURE 5.27.



The Ben Youssouf madrasa in Morocco. The one iwan school is surrounded by seven residential units. Each one is designed as a typical basic courtyard house.

Source: ALBENAA, Volume 1, No.6.

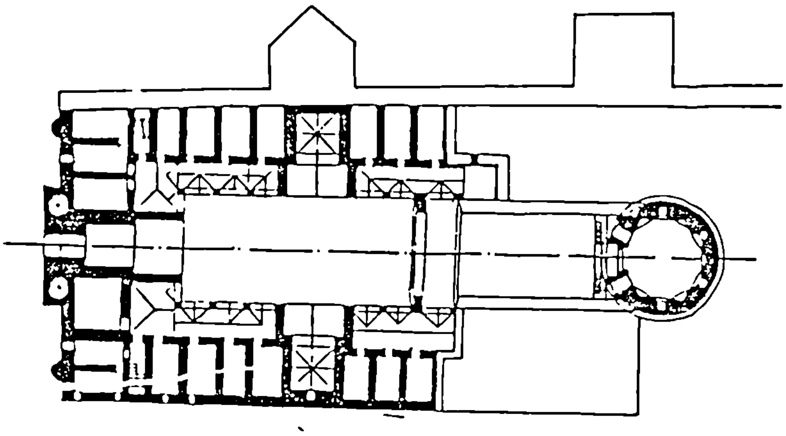
In all traditional madrasas without exception, a courtyard was a basic element which was usually provided with a water basin. In areas where the climate is cold and has more rainfall, the courtyard can be seen covered by a large dome, such as in Turkey. (See figs. 5.28-5.29).

Elements such as libraries, studying halls (other than iwans), sepulchres and minarets can not be generalised. Sepulchres and minarets are mostly found in Cairo and Turkey for example. Studying halls can be found in almost all madrasas with different sizes, shapes and locations. Libraries were definitely founded in many schools, such as in the Nizamiya Mustansiriya and Ghiyathiya madrasas. However, central libraries were founded in major cities such as Dar Al-I'Lm (House of Learning) in Baghdad, Dar-Al-I'Lm in Musel. As well as having the nominal function of housing books and biographies, they were also considered to be specialized schools in 'ancient sciences'. These comprised of foreign and pre-Islamic originated sciences inherited from antiquity, such as mathematics, astronomy, geodesy, physics, medicine, grammar, philosophy, etc.[23]

ANALYTIC REVIEW AND CONCLUSION.

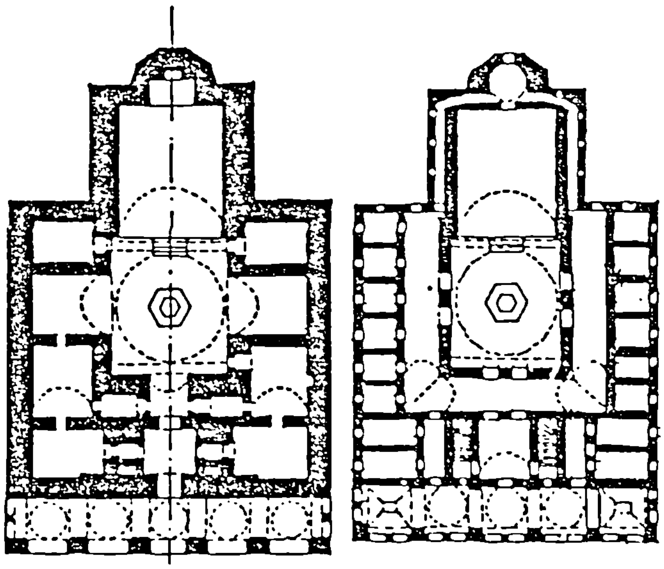
Earlier in this chapter it was found convenient to accept two forces which historically can be identified in aesthetic progression. The two major groups - the static and dynamic -have an influential role on architecture and urban forms. This was followed by a brief study of the three building types found in Islamic work. These were the 'inward', 'outward' and 'composite'. In order to focus down from the general to the particular topic of this thesis, there was also a study of

FIGURE 5.28.



Ground floor plan of the two Minarets madrasa in Ardrom, Turkey.

FIGURE 5.29.



Ground and first floor plans of the Mural 1st madras in Bursa, Turkey.

traditional Islamic school buildings. To conclude this section the general pattern of the major interactions between the static and dynamic factors in the old Islamic architecture and the contemporary western one as well as the existing situation in Saudi Arabia will be examined.

The interaction between the static and dynamic factors can be seen in turn to be generated by two other forces: the 'direct'and 'indirect'.

The 'direct' force results from the amalgamation of the following factors: physiogaphy and climate, social factors, spatial conceptualization, building technology and economics, and function (the uses of the building). The interaction between those factors usually tends to satisfy the 'present' needs as perceived by an architectural era. With such a tendency, the outcome of the interaction will have a progressive potentiality towards the future rather than the past. By using the contemporary terminology the outcome of this direct interaction would be called "modernism".

The second force - the 'indirect' one - results from the amalgamation of the remaining factors. These are more difficult to identify and describe, as they have abstract qualities. The words best used in this context are "metaphysical" and "identification". These serve to describe ways in which people see aesthetics as related to buildings, space and place. As they are based on observation of existing artefacts, they tend to look backward rather than forward. Indeed contrary to the direct force, those two factors not only tend to describe the past, but in many cases they form the past itself. Their effect, especially if their conservative potentiality is active, can produce what is called "traditionalism". The two forces - the direct and indirect - work together - their equilibrium produces a distinctive architecture for a certain group of people, within a certain period of time and, usually within well defined locational terms.

The above statement remains true, especially when there is such an important metaphysical factor in the form of the "Islamic Religion". The interaction of Islam with the other static and dynamic factors has produced a culture with distinctve architectural characteristics. Yet it was not a 'dictatorial international style', similar to those of the ancient Greeks, Romans and Christians, or the contemporary modern one. Its response to people, time and place, is characterized as follows:

(1) A very high level of local architectural unity.

(2) Regional and local architectural solutions within the framework of Islam.

The response to the values of place (physiography and climate) has evolved many different technical architectural solutions. Some of these, (The Iraqi courtyard house; the basic courtyard building in central Arabia; the composite layout; the darq'ua house; the rowshan building and tower buildings) have been analysed earlier in the chapter. The climatic consciousness in those buildings was very strong and evident to such a degree of dominance that electicism could not become a phenomenon. A rowshan building, for example, can not be found in central

Arabia, nor can a tower building be found in Iraq. This means that the major issue which was concerned the 'modern movement' during the Islamic architectural era was the search for a better climatic design response rather than design influenced by functionalism, fashionable stylism, etc.

The unity, which is evident in Islamic architecture, arises from limitation of materials, yet it reflects a strong architectural discipline in the use of structural methods and technology in general. It is difficult to assume that such an architectural discipline was intentional in terms of using mass production systems or rules and regulations. However, one can assume that, theoretically, the stronger the tie between the 'direct' and 'indirect' forces, the longer it will last. In other words, this means that the gap between what is called "traditional" and "modern" is very small or is not large enough to interrupt the natural process of evolution. This explains why it is difficult to make a distinction between various buildings in Muslim cities in terms of "modern" or "traditional, as the forms reflect traditional values yet the buildings are both old and new.

Such a kind of architectural continuity can be seen not only on the external facades of buildings but also inside buildings. Factors such as religion (Islam) and identity play a major role in the process of moulding buildings' layouts and forms.

Every example of the three building types identified and the use of madrasas has deep roots. The image of the mosque, (namely the Prophet's mosque) can always be seen somewhere in a building, indeed, in some it dominates the design. This mass reflection of the spatial elements of the mosque (courtyard, multi-purpose space, iwans, and later on domes, arches, etc.) on the interior of buildings, shows the strong influence of religion (Islam) on the social and spatial conceptualization. Such an influence, which indirectly satisfies the desire for natural social equality, is powerful enough to standardize common internal volumetric spaces into well understood proportions that have been passed from one gneration to another.

Outwardly, the influence of these factors (climate, religion, social, technical) has produced two general distinctive facades: the solid and the semi-transparent. Both can be seen throughout the Islamic world. Solidity is the dominant language of any introspective building (central Arabia) and partially in the outward looking building types such as in southern Arabia (tower buildings). Semi-transparency dominates the composite buildings (eastern Arabia, Cairo) and partially in the outward building types, such as in Jeddah (the rowshan buldings).

The continuity of the application of the above two types of facade has been influenced by a desire for identity in what can be called a "symbolic" way. In the very hot-arid regions, for example, the more solid the external walls of the buildings, the more the building will be appreciated by local people. Solidity, therefore, becomes the architectural quality which symbolises coolness, privacy, security, etc. On the contary, in humid climates (such as that of Jeddah), the more the external walls are semi-transparent, the more the building will be appreciated by local people. Here, semi-transparency in terms of rowshan, mashrabia and wood in general, becomes the symbol which reveals coolness, good ventilation, privacy, wealth and health. As has been mentioned earlier in the chapter, the above balance between the direct and indirect forces continued for a long time and it was not until the beginning of the 20th century, that the wind of change started to blow, in the form of the modern movement in architecture, affecting not only the Islamic architectural model but also the traditional western one.

The western modern movement of architecture of the 20th century can be seen as a unique phenomenon and a turning point in the development of architecture in general. For the first time, the interaction between the direct and indirect forces of the 'present' and 'past', in its traditional sense, could not be seen. This is because the modern western movement is a revolutionary one. It refutes its past on very strong and logical grounds. Whatever the reasons were, the interaction between the direct and indirect forces is one which needs to be realized.

Within such a situation, where uncertainty of the past becomes the norm, metaphysical factors and the search for identity can not generate the traditional equilibrium which is required for the balance of urban factors. On the contrary, any uncertainty in past values can lead to uncertainty at the present time, which in turn leads to the situation where speculative creativity and the search for the truth comes to dominate not only architectural thought and trends but also all aspects of life in general. The general tendency generated by the above two factors has been called "futurism".

On the other hand, the direct force, which influences contemporary western architecture has been dominated by factors such as functions and lately also by innovation (technology in general). Although technology is changeable this very ability to change becomes a permanent and destabilizing feature. This has had a strong influence on contemporary architecture which has negated a sense of identity and relationship with place. The general tendency of the direct force acts in an evolutionary sense to serve and satisfy both present needs as well as those of the future.

The interaction between the direct and indirect forces in contemporary western architecture is strong, active and dynamic, but has not yet reached a steady state. this is because the two forces are working togther, but in one direction: the future. Until contemporary 'modern' architecture forms a new tradition, the equilibrium of western architecture will not be reached.

Moving from the old Islamic architecture and the contemporary western one to the existing situation in the Islamic world, and particularly Saudi Arbia, there is an architectural dilemma. The old Islamic architectural model cannot be fully applied, not because it is climatically unsuccessful, nor is it costly in financial terms, but because of many other reasons. Some of these are:

(1) Most of the countries of the Islamic world, including Saudi Arabia, are undergoing rapid processes of social change. One of the aims, of course, is to produce a modern Islamic society. Although those changes are not radical or

revolutionary, the image and identity of the coming modern Muslim man is not yet clear. However, it is becomng evident that old Islamic local architecture with its characteristics of solidity or semi-transparency does not now have the same symbolic meaning as previously. On the contrary, old buildings are seen to be noisy, inconvenient, uncomfortable and even hazardous. Many other new architectural symbols are taking their place, revealing modernity and progress. Although it is difficult within the existing social structure to account for these new architectural symbols, they are clearly western in origin.

(2) Although central governments and their experts can be seen to be responsible for the introduction and the importation of western civilization, including architecture, into their countries, it is necessary to remember that, first: modernization was, and is, a result of essential development programmes Secondly: due to technical and political factors, the western model was the only one available for imitation.

(3) It is necessary, again, to accept the assumption that neither local traditional builders and architects, nor planners, could have solved the unique problems in architecture and urbanism which were required by the sudden transition from an underdeveloped state to one with great financial resources and an outstanding rise in prosperity. This resembles a sudden transition from the past to the future without passing through a present.

The situation can be summarized as follows:

(1) The continuity of the old Islamic architecture has been stopped in its tracks.

(2) The climatic response of old urabn patterns and forms (narow roads, compactnes, rowshans, etc.) is in conflict with many aspects of modern life, especially modern *transportation* systems.

(3) It is difficult to say that there is an Islamic architectural movement at the present time on which to build. However there are a few signs of individual effort to help to define trends to the future, (i.e. the Aga Kahn award for architecture).

(4) The straightforward application of modern western architecture in Muslim cities is not suitable. It does not adequately respond to the requirements of Islamic society in social and religious terms, and is not always suitable climatically.

For the purpose of this thesis, the following points will be considered for inclusion in an architect's brief for school building in the chapter which follows:

(1) The difference between the dynamic and static factors represented by the old Islamic models and contemporary western ones is radical. The former respects its past, while the latter refutes it. Since the western model appears likely to have a high risk of failing to achieve progress, and since Islam is essentially a dominant factor

which connects the past, present and future in Saudi Arabia, the enthusiasm to imitate the western model can not be the right architectural response.

(2) Having said that, blind imitation of the old Islamic buildings is not wise either. This is simply because an old Islamic building can not climatically work in the modern urban pattern of Muslim cities. In other words, the theoretical part of the old Islamic model is the one which is to be accepted, but not its application. This means that traditional climatical solutions should be modified or developed as a base to suit the new circumstances.

(3) Any new climatic solution should provide an efficient natural environment both externally and internally. This is not only to satisfy social, religious and functional needs, but also to compete with artificial systems which are high in cost and need to be maintained at a high level.

(4) Specialization in functions of buildings are difficult to avoid. However, the reflection of traditional spatial elements (courtyards, iwans, multi-purpose spaces, etc.) on the internal spaces can produce a high level of architectural unity as a framework into which functional differences can be accommodated.

(5) The unity of traditional architecture can not be reproduced by standardization, regulations or imitation. The old architectural unity came from the interaction of the climatic solutions, social needs and from a general coherence in all aspects of Islamic life. There is at

present rapid social change. The aim must be to produce an architecture which satisfies the new needs of society, even though at present these can not be clearly seen. Tradition must act as a basis, and achievement of the sort of unity that has been defined in traditional forms should be the aim of modern Islamic societies.

(6) In school design this problem is of great significance. Traditional teaching methods must pertain at present, simply because there is not a pool of suitably trained teachers. Yet the positive aspects of educational advances must not be overlooked and designs for new schools to accommodate change. We have seen that there is a pressing need for school buildings, so the architectural and educational pressures are joined by the need to build quickly and efficiently to satisfy a demand for school places which, if not met, could lead to extreme problems in the future. It is indeed a daunting task. This thesis is intended to give some lead to architects in the school building process to enable them to pursue their tasks with knowledge and enthusiasm.

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(21) Ghouli, op. cit., p.58.

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(23) Grube, op. cit., p.10.

CHAPTER SIX.

CASE STUDY.

PRELIMINARY STATEMENT.

This chapter will describe the existing situation of urban school buildings in Saudi Arabia. Clearly the whole country cannot be surveyed in this thesis. It is therefore proposed to take a representative area for analysis. The city of Jeddah has been chosen for the following reasons: First, the city is large enough to give a representative sample of school buildings; it is also old enough to have a wide range of buildings. Second, it was already known that the Ministry of Education in Saudi Arabia was applying policies which included standard layouts for school buildings in all cities, and therefore the situation of school buildings built during the period that these policies operated in other cities such as Riyadh, can be assumed to be relatively similar to those in Jeddah.

The method of the survey, which was carried out by the author, was based upon two sections. The first was a physical assessment by observation while the second depended upon interviews with headmasters and teachers. The former is referred to in this chapter as the 'architectural assessment', while the latter is the 'user response'. (See Appedix B).

Out of the twenty schools visited, fifteen were boys' schools, of which three were prefabricated; one courtyard conventional school building, (the only one of its type in Jeddah); seven 'finger plan" conventional school buildings and two rented buildings. The other five, which were all of courtyard type concrete buildings, were girls' schools. A general analytic description of the above school types will be dealt with first. Particular problems of design and users requirements in both boys' and girls' schools will be dealt with in the second part of this chapter.

The main objectives of the investigation are:

(a) To assess the architectural response to the functional and climatic situation. This includes the layout, structure, function, physical environment (natural lighting and ventilation, artificial lighting and ventilation, acoustics, etc.), furniture, finishes and decoration.

(b) To test the reactions and attitudes of the users towards their present school buildings. This in turn will help towards providing a list of educational and architectural priorities in future buildings.

THE EXISTING SITUATION - A GENERAL DESCRIPTION.

GENERAL STATEMENT ON POLICIES.

Since the establishment of the Ministry of Education at the beginning of the 1950's, and as a result of the increased demand for general education during the following ten years, it was becoming clear that the policy of renting various buildings for use as schools was not only unsuitable for educational purposes, but the policy was proving costly too. This policy was started because the traditional building programme could not keep pace with the increased demand for places. The next step taken by the Ministry to overcome the problem was to apply an approach which was based upon a small number of standard layouts which could be erected in any district. The aims were obviously to speed up the construction programme by means of reducing the time taken for design and administrative decision. The responsibility of regional and local authorities in dealing with this particular problem was limited to implementation and supervision. The standard layouts were designed to accommodate elementary, intermediate and secondary education, and to be used all over the Kingdom.

GENERAL DESCRIPTION OF THE ORGANIZATION OF EDUCATION IN SCHOOLS.

In all schools, students should be divided into grades, and each grade may be divided into several class-groups depending on location. In the case of intermediate schools, three grades are the limit, with a minimum of three class-groups for each grade. This can be extended up to 18 or even 27 class-groups; each class-group should be provided with a classroom for teaching general subjects, which include religion, Arabic and English languages, mathematics, social studies and general sciences. Specialized teachers in these subjects move from one classroom to another, while students remain in their classrooms all day. Exceptions to this are science laboratories, arts and crafts studies and physical education, where each class-group should move to these specialized spaces.

Each teaching week (five days) consists of 36 periods, while each teaching day comprises about 7 periods of 40-45 minutes. General non-teaching activities such as the mid-day break and mid-day prayers are normally held by all students and their teachers at the same time. The break is usually taken between the third and fourth periods, the latter between the fifth and sixth period.

The activities observed in one of these schools seemed to be typical of all, and this view was endorsed by staff comment in general.

A typical day in most shcools begins at 7.00a.m., with the morning assembly of the whole school. After this, and since each school has its own fixed timetable, students and teachers move to their usual places (classrooms). During the first few minutes of the first teaching period, each teacher orders the windows to be closed, he then turns on the air conditioning units, closes the door and begins his formal lesson. Silence is demanded of the students by the teachers.

In their classrooms, students sit formally in their chairs, facing and listening to their teacher. As the bell is rung, announcing the end of the period, a sudden mad rush towards the classroom door occurs. In a few seconds all classrooms become empty; the last one who may leave the classroom is the teacher. During each five minute break, corridors become a meeting place for students who talk, play, run, laugh and shout, causing a very high level of noise and disturbance; maybe because they are unconsciously protesting and releasing the psychological pressure of the previous formal 45 minutes. By the end of the third teaching period another rush of movement occurs, but this time all the students run down to the ground floor to queue for their mid-day snacks, which last for 30 minutes. After this they go back to their classrooms for another three periods. By the end of the sixth period, students must go for prayer. In general the movement towards the toilets or ablution area at this time is slower and quieter. Apart from the more serious nature of the activity there is also recognition that waiting and queuing in overcrowded toilets is not a pleasant experience. It is pointed out that ablution is necessary before prayer. By the end of the last period, the time will be 1.30p.m. and everyone leaves the school, which will be closed until the next morning.

EXISTING SITUATION OF SCHOOL BUILDINGS.

The following is a description of the main categories of school buildings that were found in the survey. These are:

First - Boys' schools:

A - Conventional purpose-built school buildings:

A-1 - The old finger-plan type.

B - Prefabricated school buildings:

B-1 - Central corridors layout.

B-2 - Central hall layout.

C - The new conventional purpose-built school buildings:

C-1 - The courtyard layout.

Second - Girls' schools.

Third - Rented buildings.

The term 'conventional purpose-built' is used to describe buildings which are designed for educational purposes. These buildings, which are owned by the educational authorities, are built by using conventional construction methods (in-situ reinforced concrete structures, cement blocks). The term 'prefabricated' is used to describe purpose-built schools which are built by using industrialized building systems. Finally, the term 'rented' is used to describe buildings which were originally designed for residential uses, but have been rented by the authorities to be used for educational purposes.

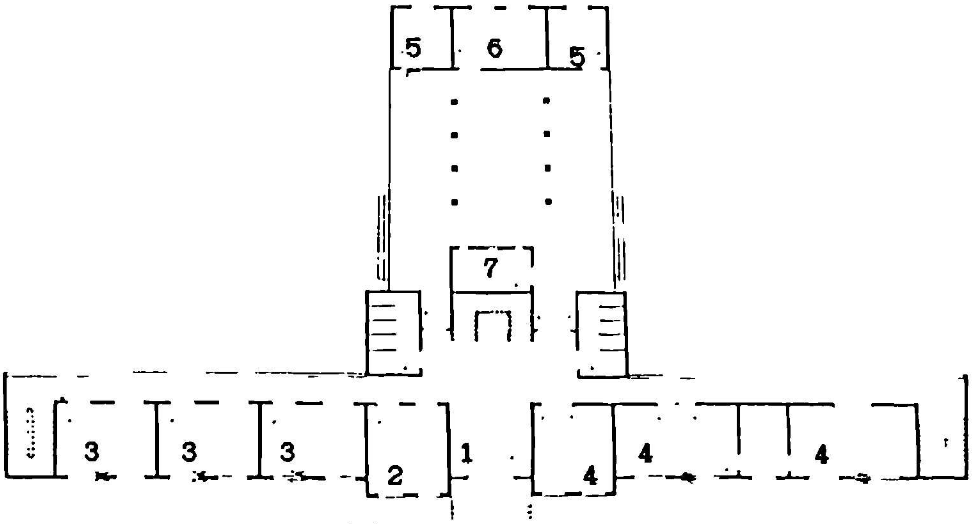
FIRST: BOYS' SCHOOLS.

A - CONVENTIONAL PURPOSE-BUILT SCHOOL BUILDINGS.

A-1 - FINGER PLAN TYPE: LAYOUT, STRUCTURE AND FUNCTION.

The site of this type of school comprises the following: the main building, a mosque, basketball, volleyball and handball grounds. The building is three storeys high and is usually in the form of a 'T' shape. One advantage is that it can be extended to 'F' or even 'E' shapes if that is required. (See fig. 6.1). However, it is difficult to consider this factor as being truly flexible, since a new structure must be built and it means that circulation must extend to the end of each layout. The concept of the finger plan in general is a response to quantitative needs rather than to qualitative ones. A finger plan structure gives more rooms, spaces, and corridors which are naturally lit and ventilated, etc., but this type of plan

FIGURE 6.1.

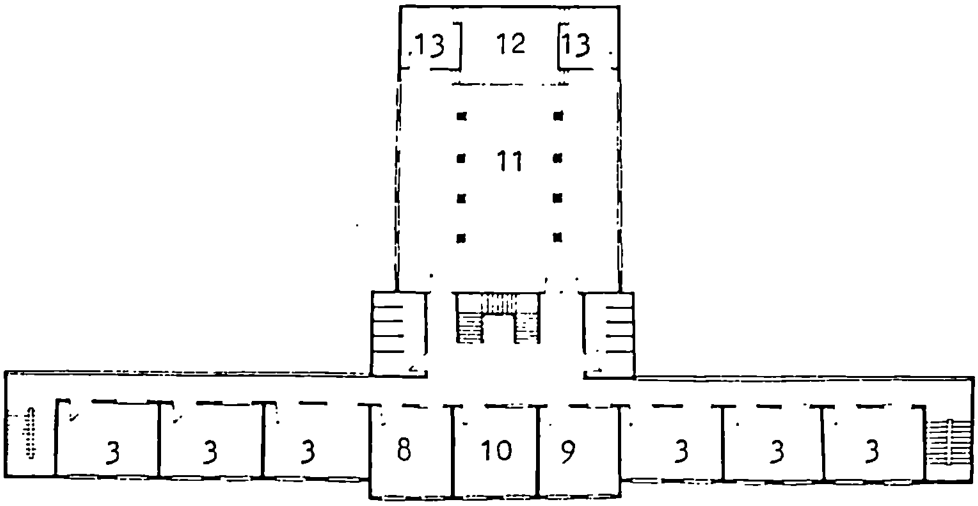


(a)

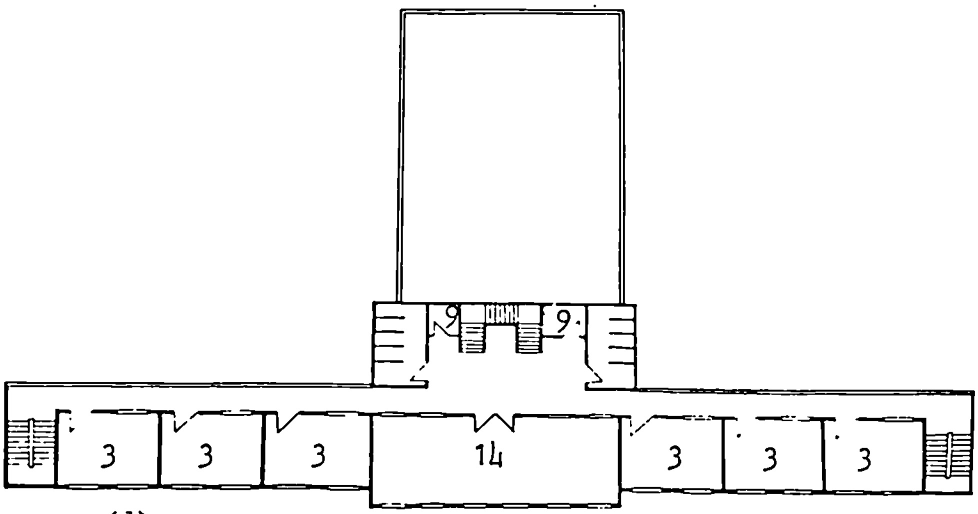
The finger plan school: Ground floor (a), general view of the school (b). On the next page: first floor (c) and second floor (d)

(1) Entrance.
(2) Headmaster.
(3) Classroom.
(4) Laboratory.
(5) Storage.
(6) P.E. - Staff Room.
(7) Buffet.

(b)



(c)



(d)

(3)	Classroom	(11)	Meeting Hall
(8)	Administration	(12)	Stage
(9)	Staff	(18)	Changing Room
(10)	Library	(14)	Arts and Craft

can be expensive and may not satisfy all the environmental requirements.

Although a reinforced concrete framed structure is used, which ostensibly can be said to improve the internal flexibility, the use of solid slabs and vertical beams as well as a rigid modular grid have tended to make the internal dimensions of the spaces too rigid. In other words, the hierarchical functional order of spaces could not be obtained because the internal dimensions of rooms were primarily designed to satisfy the structural modular grid. This explains why the size of classrooms, laboratories, teachers' rooms and administrative rooms all have equal dimensions.

Despite the compactness of circulation and narrow corridors, the total area devoted to circulation is 30% of the total area of the building, leaving 46% for teaching areas and 24% for other facilities including administration.

As a result of the layout and its symmetrical shape, most of the school activities were necessarily to be distributed on a linear line (the flange of the 'T' shape). The intent was that the central part of each floor would act as a focus and meeting point for students and teachers. In reality this did and does not happen. The size of the area devoted to students was too small, in fact there was just enough space for circulation. On the other hand, locating the headmasters room, or teachers' and administrative rooms in these central focal points was enough to cause a certain level of tension in the space. This tends to cause students to behave formally in these areas. Consequently, corridors, which although they are narrow and unfurnished because they are the only other spaces available, become meeting spaces for students. The most successful outdoor space in the school is the open area under the meeting hall. Because it is outside the building, paved and shaded, it has become a multi-purpose space and a focal point for students. It can be used as a dining space during the mid-day break, as a mosque for prayer and for physical education.

All schools of this type which were visited were overcrowded. A classroom with an area of 41 square metres may be accommodated by more than 36 students. Many schools of this type are deficient in specialized areas as well as the more mundane but necessary spaces required for storage, cleansing, kitchens and medical rooms. The latter group was always deficient in the users views. In many cases specialized rooms, for example for arts and crafts, had either not been provided or had been taken over for general teaching, due to the pressure of numbers.

ENVIRONMENTAL CONDITIONS:

DAYLIGHTING AND NATURAL VENTILATION.

One of the advantages of the linear distribution of spaces in these 'finger plan' schools was the case of controlling the orientation of the building. All classrooms and other rooms are planned to face to the north, where good quality daylight and natural ventilation can be easily obtained.

In each classroom there are three windows. Two of them are large and facing north, their functions are to provide daylight and admit air ventilation. The other is located on the opposite wall overlooking the corridor. Its main function is to allow cross-ventilation; therefore it is smaller and higher in level than the other two. (See fig. 6.2). The percentage of the glassed area to the floor area is about 20%.

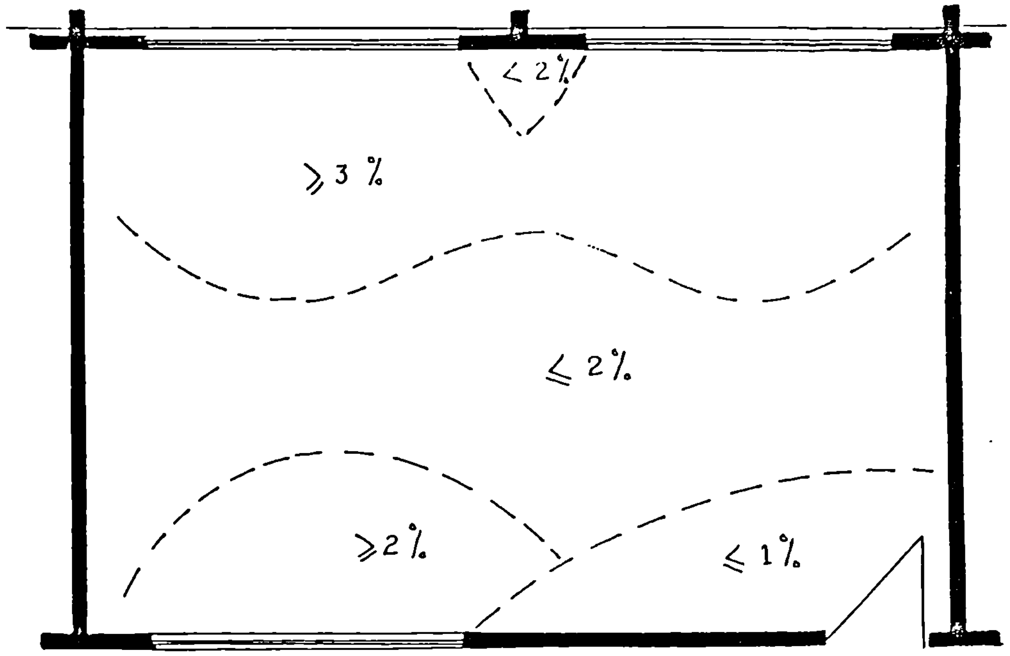
Using a light meter to measure the daylight factor in classrooms showed that the area near the main windows was enjoying very good light, while the area near the opposite wall was suffering from poor light. The factor which was apparently causing this rapid fall off of lighting values was the use of translucent glass in the north windows. This was noticed when the measurement was taken in another classroom with broken glass. The daylight in this classroom was much better. (See fig. 6.3.).

During the 'warm' days of the winter, direct cross-ventilation can be enjoyed. On very warm and hot days in later winter and summer, direct cross-ventilation is not practical at all. This is because the outside air temperature is very hot, and because all of the schools visited lacked any means of naturally cooling the outside air before it passed into the building. Plants and trees found on all school sites were used for aesthetic effect rather than for cooling or shading.

THERMAL CONDITIONS.

As a result of the failure of natural ventilation, windows tended to be kept closed. By doing that, the temperature builds up slowly and students begin to sweat, causing unfavourable smells and odours. An early solution to improve the internal thermal conditions was the use of mechanical ceiling fans. By

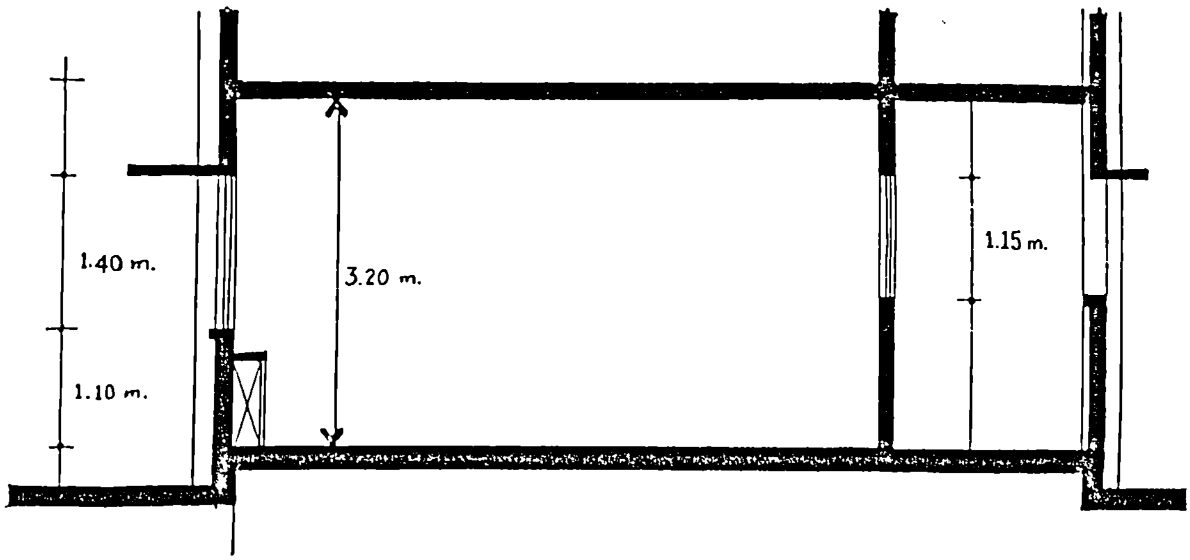
FIGURE 6.3.



The daylight factor distribution.

FIGURE 6.2.

A Section in a classroom.



opening the internal small windows which overlook the corridor, ceiling fans work as ventilators and coolers. The use of ceiling fans in school remained as the best available solution for a long time. It was not until the mid-seventies that the Ministry of Education made a decision to provide all schools with air conditioning units. Since many schools built before this decision were not designed thermally to cope properly with the climate of Saudi Arabia, air conditioning units were over utilized to keep temperatures down. This was because windows were not properly sealed and because of the impact of heat gain through the external uninsulated walls and roofs. Consequently, not only was the system inefficient and uneconomical, but there were frequent breakdowns as maintenance was not properly organized. Indeed requests for maintenance took top place on the list of priorities for the needs of the schools.

ARTIFICIAL LIGHTING.

As a result of the poor provision of daylight, artificial lighting is heavily used, even in corridors. In many schools of this type, fluorescent tubes have been installed instead of the old tungsten lamps. This is obviously because of their economy and good quality. Tungsten lights were also known to give out heat.

ACOUSTIC CONDITIONS.

In all schools visited, external noise was not a problem that headmasters and teachers ever complained about. This was so even in schools which were situated near to a main traffic road. This is because the noise generated by the air conditioning units makes a background cover, not only over external noises, but also over internal noises which might be generated occasionally from noisy areas in the school, such as craft rooms, or when other class groups passed by in the corridors.

Although the hall is surrounded by noisy activities such as the playgrounds and the cafeteria, which are located under the hall, the interior of the hall has not been provided with any acoustic treatment. Since the three main areas (the theatre hall, playgrounds and cafeteria) can be in use at the same time, especially during the mid-day break, and because the hall is not provided with air conditioning units, which can work as a background cover, the internal activities inside the hall are always disturbed and disrupted to the point that it is not used for any facility or group work requiring concentration.

FURNITURE AND EQUIPMENT.

All schools are provided with the basic furniture, such as chairs, desks and tables, all within the standard. The lack of specialized furniture and equipment for arts and light craft and physical education is a common problem in all schools of this type.

MATERIALS, FINISHES AND COLOURS.

The use of white plaster on the external facades of the schools is a climatic response, which can be appreciated despite the poor standard of finishes. Inside the schools, all interior surfaces are plastered and painted. The use of the colour blue on classroom walls has reduced their reflection factor, while the cream colour used in corridors, entrance halls and stairs has caused a monotony. Finishes are generally poor, especially in classrooms and toilets. The low standard of details and joints; causing cracks, as well as the lack of proper maintenance could easily be seen.

TYPE B - PREFABRICATED SCHOOL BUILDINGS.

As a result of the mid seventies economic boom, there was a huge population movement from rural to urban areas. There were also shortages of basic building materials, skilled labour and many other facilities and services. This in turn affected not only the school construction programme, but also the whole building construction sector in the country. The response of the Ministry of Education was immediate. It took the view that the only approach left to speed up the construction programme was the use of industrialized building systems, and since this kind of industrialization was not available in this country, it seemed theoretically logical to import schools. Money was available to pay the cost of these imported systems.

Many schools with different light-weight building systems were built all over the country. Two different types were used in Jeddah, which the author visited. It proved difficult to obtain detailed information on these schools from official sources. Some design drawings were obtained from the technical department of the Educational Authority of the Western Province. This information was augmented by observation during visits to the schools.

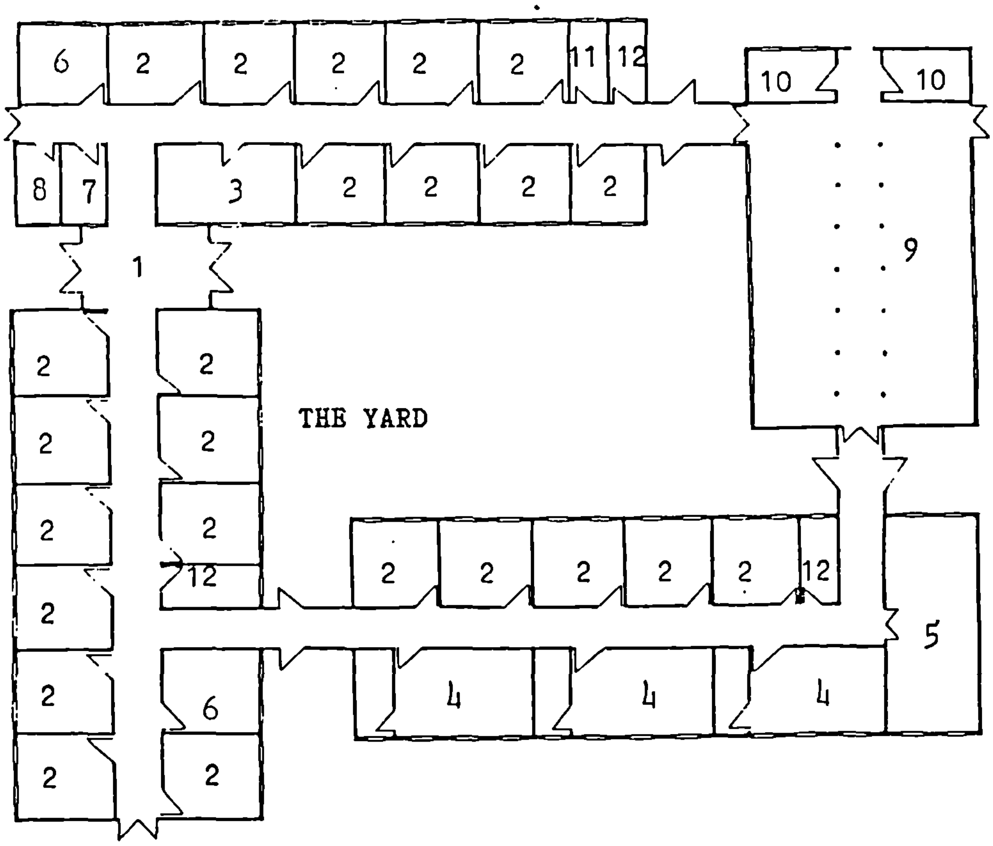
B-1 - CENTRAL CORRIDOR LAYOUT - LAYOUT, STRUCTURE AND FUNCTION.

Two schools of this type (Okas and Honian intermediate schools) were visited. Each one contained 24 classrooms, three laboratories, dining hall, library and administrative rooms, all of which were on one floor. Classrooms and other facilities are arranged in three groups, connected with each other by centrally planned corridors. These three groups of classrooms and the dining hall are arranged to enclose an open courtyard. (See fig. 6.4).

Although the layout is segmented into four parts, it cannot be considered as an example of compact design since each segment is not self-sufficient. On the other hand, although the use of rooms on each side of the corridors successfully reduced the percentage of circulation to about 16% of the total area of the building, the circulation pattern was still similar to a finger plan one. This is because of the rigidity of the circulation which does not allow any flexible movement across the plan, and because of the lack of a hierarchy of traffic capacity. There is always a disadvantage in natural lighting and cross-ventilation.

The floors and ceiling of the building are supported by a skeleton steel frame. External walls and internal partitions are of timber sandwich panels. The use of standard one way truss frames, suported by four columns has two effects on the plan dimensions of the space. First, the flexibility of increasing or decreasing the internal dimensions of spaces can be achieved in one directional way only, which is the dimension between any two trusses. Second, the length of the truss span and the ceiling limit make it difficult to provide a suitable space for rooms requiring either smaller or larger than usual areas. This can be seen, for example, in the headmasters room, which has dimensions of 3.5m x 7.00m x 2.4m. The dining hall dimensions are out of

FIGURE 6.4.



The central corridor school (Light-weight Prefabricated Building).

(1) Main Entrance	(5) Arts and Craft	(9) Dining Hall
(2) Classrooms	(6) Staff	(10) Buffet and Service
(3) Library	(7) Administration	(11) Storage
(4) Laboratory	(8) Headmaster	

proportion too (17.2m x 27.50m x 2.4m). Not only that, but also it has 14 free-standing columns.

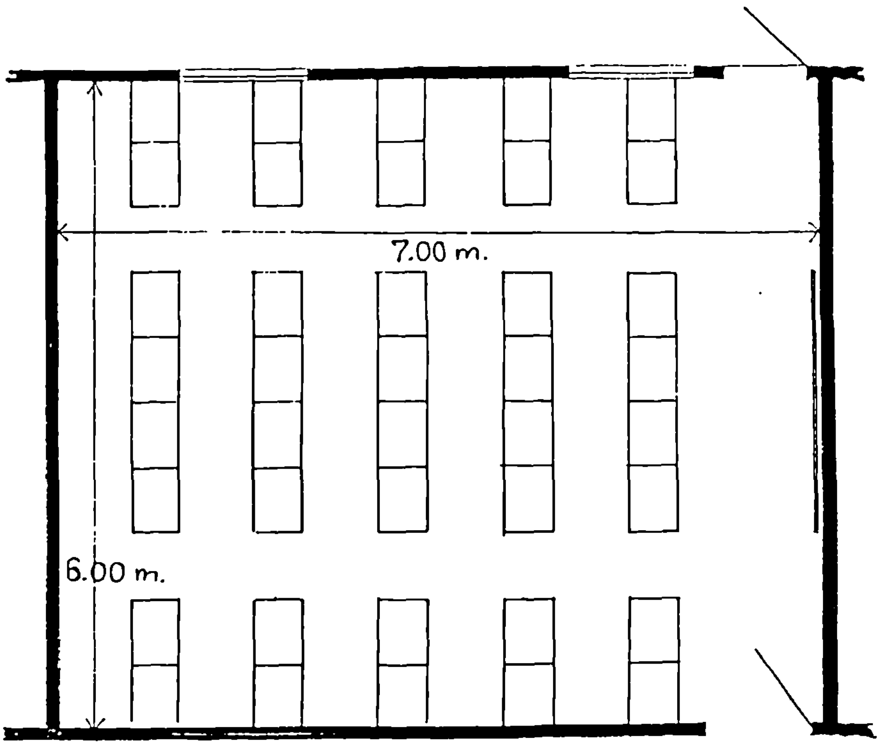
The rectangular layout of the school created a large open space in the middle. If the surrounding spaces could be opened directly into this central open space, the central area may be called a courtyard. If, on the other hand, the surrounding spaces open directly into other spaces, such as corridors, which is the case in this school layout, the central area becomes merely a yard. A courtyard is an organic part of the building form and activities; the yard is part of the building form only. This explains why the central areas (the yards) in these schools are almost deserted and unused. As there is no shade over a short-cut, circulation movement is not apparent. There is certainly no use for recreational activities such as the mid-day break when an outdoor space would normally be crowded with pupils.

This misunderstanding of the true function of a courtyard has badly affected the distribution of the functional activities and their interrelationship. The circular distribution of the activities becomes scattered and incomprehensible. The circulation movement through the school becomes a linear one, dictated by the corridors.

ENVIRONMENTAL CONDITIONS -
LIGHTING AND VENTILATION (NATURAL AND ARTIFICIAL).

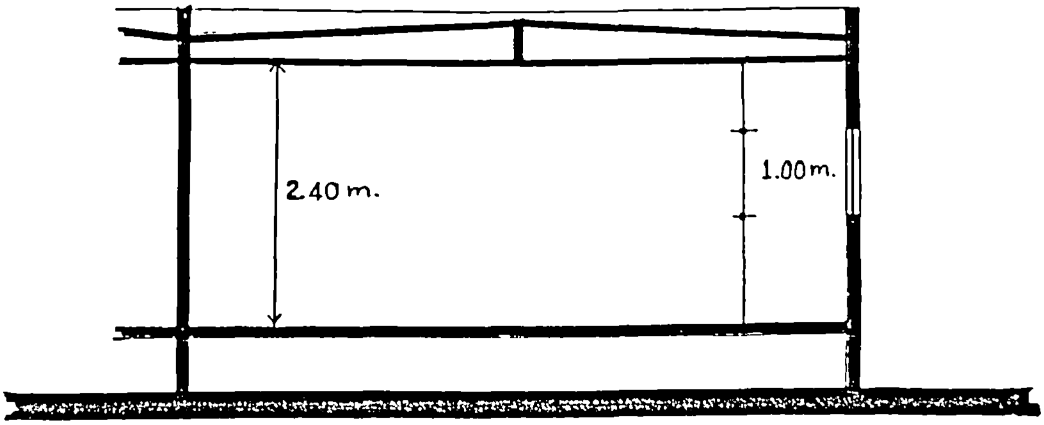
To improve the thermal performance of the external timber sandwich walls, windows were kept as small as 6% of the total area of any room. (See fig. 6.5). This is not to provide

FIGURE 6.5.



(a)

The internal layout of classrooms in the cental corridor school. (Notice the overcrowded situation - 40 students in an area of 40 sq. metres) (a); section of the classroom showing the height and size of the windows (b).



(b)

resistance to the gain from external heat, since timber materials providing a light-weight system are not the best way to prevent heat build-up. It is rather to reduce the cooling load as these schools have an internal environment provided by means of air conditioning. Since air conditioning is to be used, a compact sealed layout is advantageous. The provision of small windows and sealed plan meant that neither daylight nor cross-ventilation had been a major factor in the design.

Artificial lighting, which is provided by fluorescent tubes, is very good in quality and quantity. Despite the noise it causes and the maintenance it needs, air conditioning in such a building is an advantage. It has been considered by the headmasters and teachers to be as essential as blackboards, chairs, desks, books and chalks - without them no work can be done.

ACOUSTIC CONDITIONS.

Although sounds and noise can easily transfer through the internal timber partitions, the air conditioning units generate enough noise to create a background of continuous noise which covers other sounds.

FURNITURE AND EQUIPMENT.

Furniture and equipment are generally within the standard specified and in very good condition. The only problem observed about furniture was the size of students' seats, which have dimensions of 30cm x 30cm x 38cm. Such seats cannot even be used in elementary schools. The only explanation to this is that the smaller the seat and table, the more the classroom can contain.

This is a clue to a possible overemphasis upon the provision of a compact plan and a reduction in spatial standards to save money on the building and to reduce the cost of air conditioning.

MATERIALS, FINISHES AND COLOURS.

Externally, the use of light-weight materials is not climatically suitable. (See fig. 6.6). Internally, surfaces are badly damaged and marked, suspended ceilings are subject to collapse and floor tiles are loose. This situation could be seen as a maintenance problem. Although that is true while these materials and the standard of their finishes remain difficult to clean and repair, the problem can best be understood as being a poor choice of materials for the use intended, combined with the low standard of finishes, predominantly due to cost limitations.

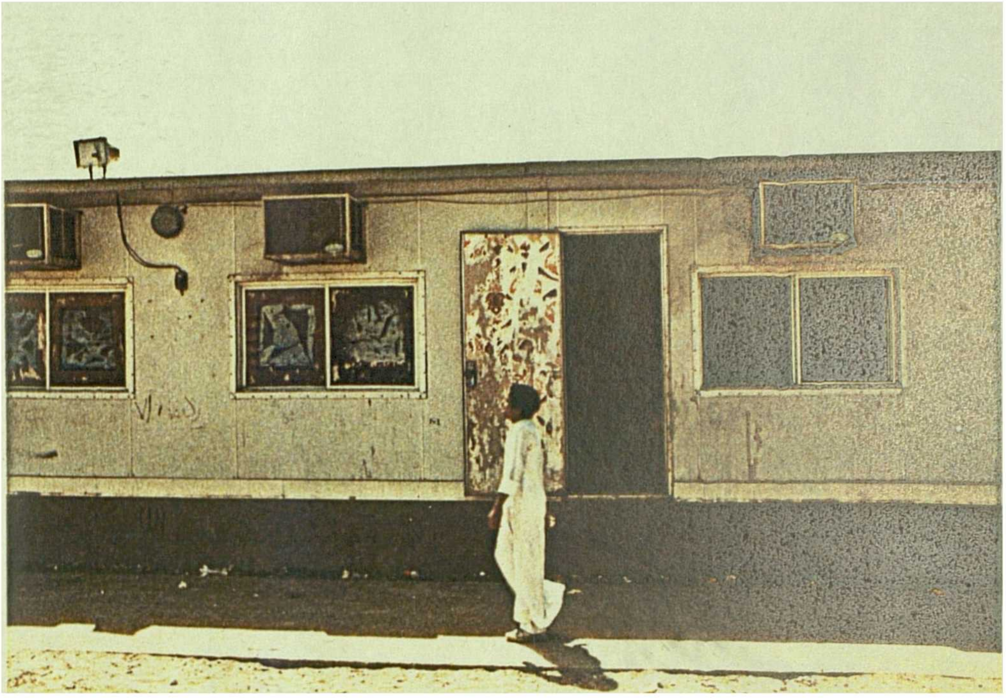
The use of white paint on external walls is the only climatic response in this building. Internally, colours have not been emphasized - all surfaces are painted white.

B-2 - THE CENTRAL HALL PLAN.

LAYOUT, STRUCTURE AND FUNCTION.

This light-weight prefabricated two storey school differs from the other prefabricated type which was discussed previously. It differs not only in materials and system components, but also in design concept and layout. It also provides a multi-purpose shaded playground. (See fig. 6.7).

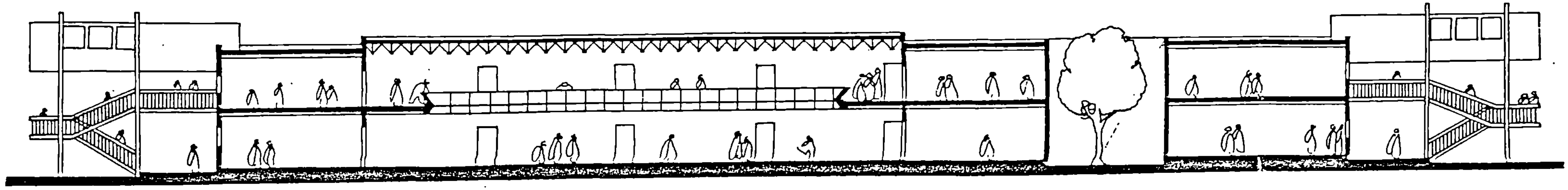
FIGURE 6.6.



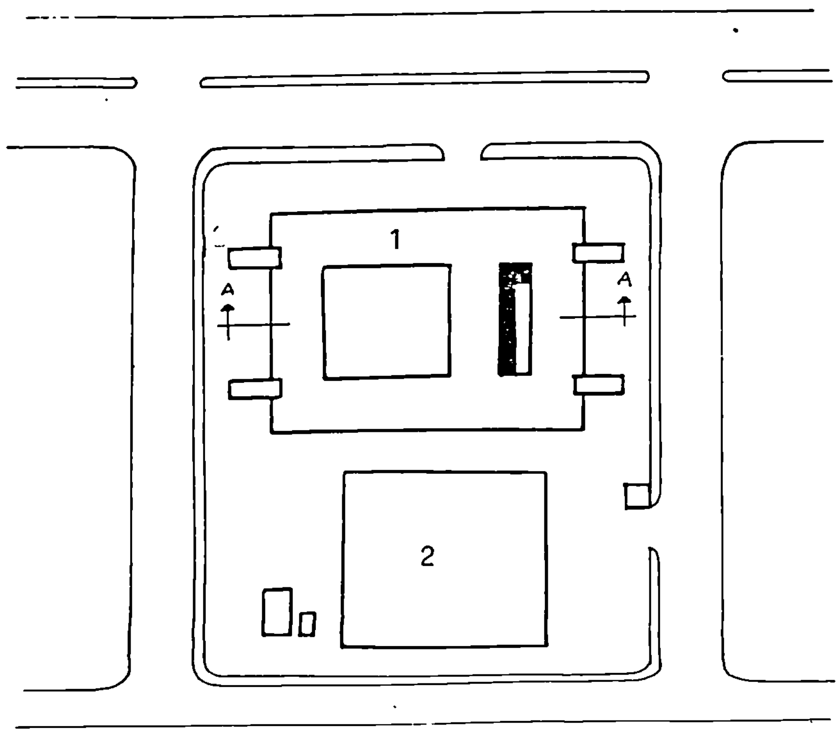
(a)

General external view of the central corridor prefabricated school, (a and b).

(b)



(b)



(a)

FIGURE 6.7.

Site plan of a central hall school (a),
Section A-A (b)

(1) The main building

(2) Covered playground

Although the central hall design concept had been in use in Western Europe and North America since the last century, it was not until a hundred years later that the central hall concept was first introduced in Saudi Arabia. This reflects the influence of modern educational theory on a traditional system. As might be expected, the introduction of this feature was in modern shape and form. (See fig. 6.8). The central hall, which is surrounded by classrooms and other facilities, took the economical and fashionable squarish shape. It was designed to be the school's focus, and to be the centre for multi-purpose activities. This was not only because it provided a stage on one side and a cafeteria on the other, but also because of the ingenious location of entrances and stairs. The entrances were located to open indirectly into the open air for safety measures. As a result of that, the central hall cannot be considered any more as a large entrance hall or overcrowded circulation area liable to meet all the problems of over use. This circulation system which reduced the unnecessary movement between the two floors has improved the image of the central hall and given it a sense of privacy and respect.

The space of the form was designed to emphasize and to support the functions of the shape. Since the physical movement between the two floors, which intentionally reduced it to its minimium, can be considered as an unfavourable segregative solution, a visual contact between the two floors was necessary. This led to the double space central opening, leaving the first floor with an elegant cantilever balcony. (See figs. 6.7(a), and 6.9).

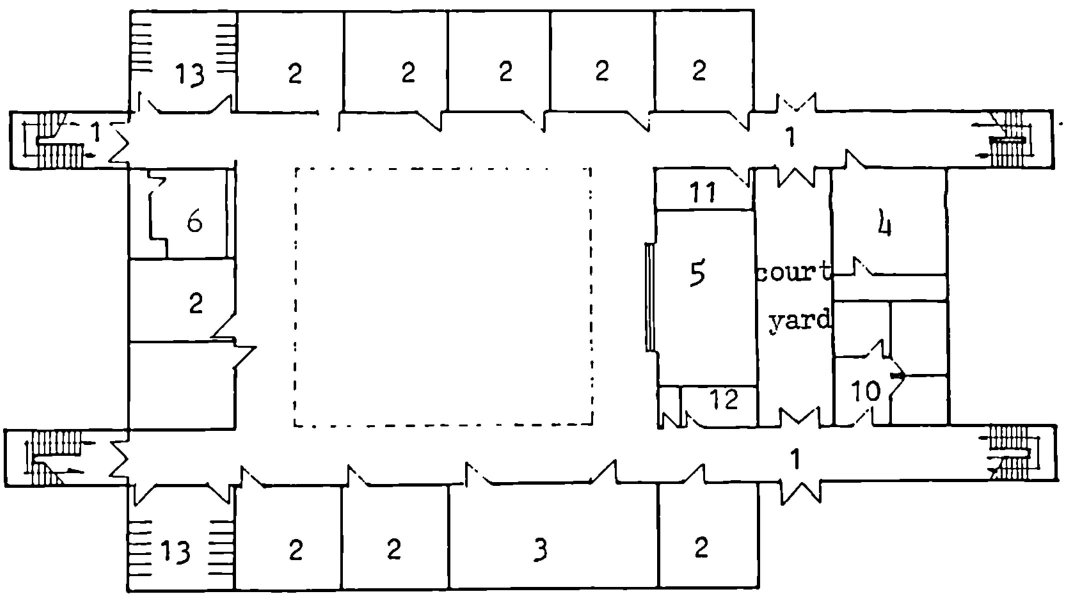
FIGURE 6.8.

(a)

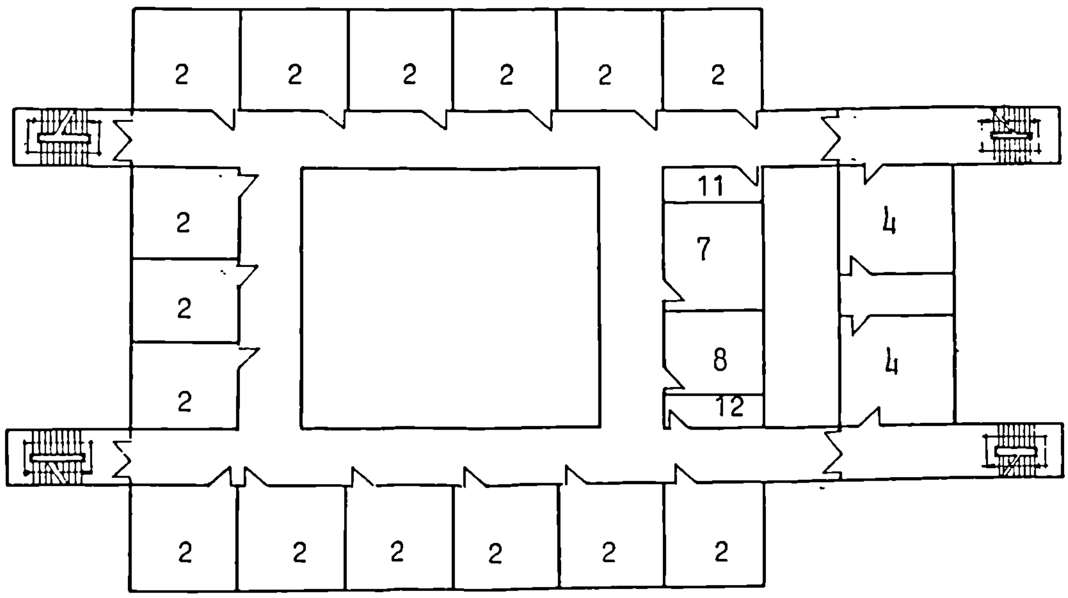
The central hall school; the main entrance (a), and a general view of the southern facade (b).

(b)

FIGURE 6.9.



The Central Hall School (Lightweight prefabricated building).



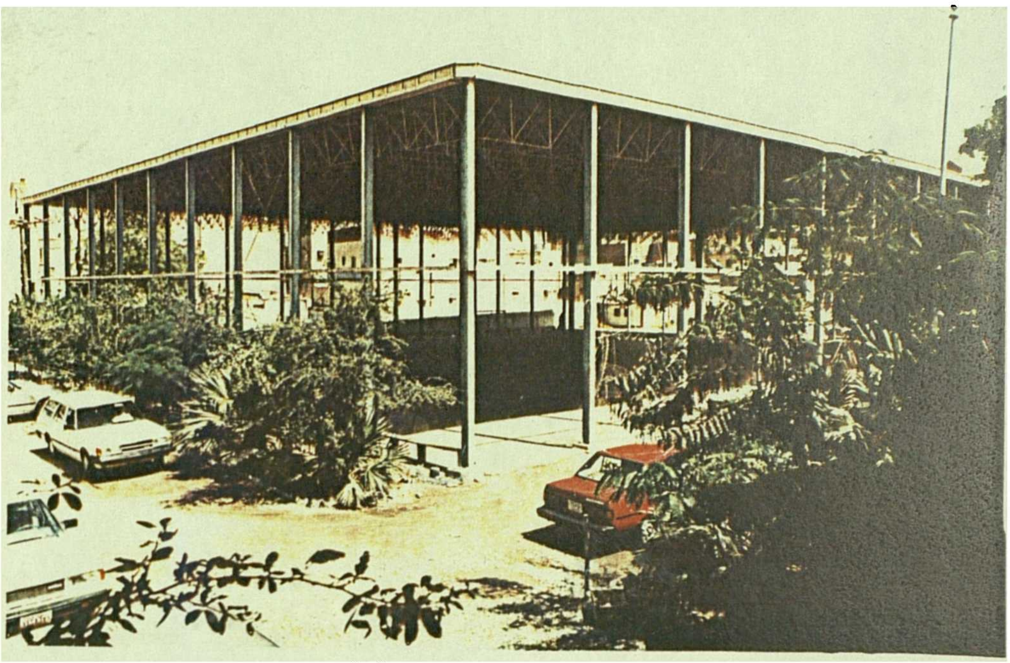
(1) Entrance
(2) Classroom
(3) Library
(4) Laboratory
(5) Arts and Crafts (Originally the Stage).
(6) Staff (Originally Buffet)
(7) Staff (Originally Classroom)
(8) Headmaster
(9) Deputy and administration
(10) Deserted Rooms (Originally administration)
(11) Storage
(12) Power Room.
(13) W.C.

The structural system used in the school shows more flexibility in controlling the dimensions of small or large rooms. This is due to the use of a skeleton steel structure. The large spans of the central hall and the outside playground are formed by three dimensional space steel trusses. The external walls are of metal sandwich panels, while the internal partitions are of timber panels.

The distribution and provision of facilities and teaching spaces were not satisfactory from the point of view of both the architectural assessment and the users response. All toilets are located on the ground floor, despite the fact that there are more students on the first floor than on the lower level. The school is not provided with teachers' rooms, arts and crafts rooms or enough storage spaces. Consequently, the stage on the ground floor has been badly adopted for arts and crafts activities, while the cafeteria on the ground floor and a classroom on the first floor are used as teachers' rooms. The administration department was deserted and closed, and this is because its location was thought to be isolated from the activities of the school. Again, another two classrooms are used as a result of that for the headmaster and his staff.

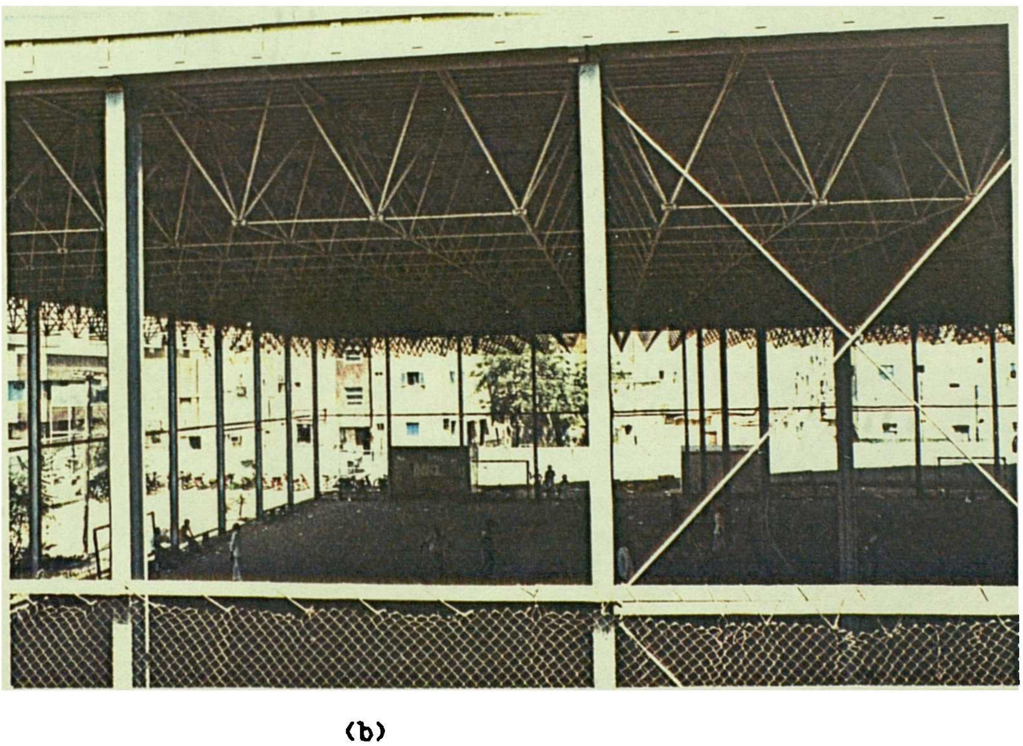
Outside the school building, two adjoining multi-purpose sport areas were provided. Each one is about 20m x 18m., and can be used for volleyball, handballl and basketball. Both are shaded with an impressive space truss structure. They have also been used for the morning assembly and mid-day break. (See. fig. 6.10).

FIGURE 6.10.



(a)

The covered playground; general view of the model (a), and the large space-truss roof (b).



(b)

ENVIRONMENTAL CONDITIONS:

LIGHTING AND VENTILATION (NAUTRAL AND ARTIFICIAL).

The internal environment of the school is fully controlled by artificial lighting and ventilation systems. The use of fluorescent tubes has provided a very good quality and qunatity of light. Movable blinds placed in between the double glazed windows are used to reduce glare and provide shade.

The school is fully air conditioned by a central system, which is appreciated by the staff and students. In the case of any electrical fault or when the central air conditioning breaks down, all internal activities stop too. This is simply because the provision of natural ventilation and daylight is not intended to allow for periods of non air conditioning. The cafeteria and the provision of meals in the central hall were abandoned because the food smells were distributed all over the school by the air conditioning system.

ACOUSTIC CONDITIONS.

External noise is unnoticeable. This is because the location of the school is quiet, and because the school building is properly sealed.

Internal acoustical conditions are poor. Noise and sounds transfer easily between classrooms through the timber panels. Any activities held in the central hall during the teaching periods will become a source of noise for all classrooms, and for this reason they were abandoned.

FURNITURE AND EQUIPMENT.

The school is provided with the basic furniture needed in classrooms, library and laboratories. Suitable furniture and special equipment for arts and light craft activities are lacked. The central hall, which was supposed to be a multi-purpose space, has not been provided with any movable furniture or equipment suitable for use in a flexible way.

MATERIALS, FINISHES AND COLOURS.

Although the use of the beige coloured paint for external panels has reduced the odd expression of the steel and metal image in the surrounding residential area, steel and metal still have their own permanent problem of rust, especially in humid areas. Periodical maintenance and repainting is necessary and costly. The internal partitions are acoustically poor and lack durability. External and internal finishes and colours are generally satisfactory.

C - THE NEW CONVENTIONAL PURPOSE-BUILT SCHOOL BUILDINGS.

GENERAL STATEMENT.

Although the use of industrialized building systems for school buildings in Europe and North America during the 1950's and 1960's was a favoured step in innovation, in a developing country like Saudi Arabia it was a very brave experiment. The experiment was, on the one hand, pretty useful in providing school places for thousands of students in a very short span of time, but on the other hand, it was known that importing building systems was an adventure with unpredictable consequences. The reasons behind this statement can be explained as follows:

(a) The pressure caused by the need to speed up the construction programme, depending only on the availability of funds rather than on the availability of local technical resources as well, had forced the school building authorities to consider any system readily available in adequate quantity on the market; urgency of provision was seen as a more important factor than any constraints such as the initial cost and the quality of the system itself in terms of closed or open types.

(b) The quality and performance of the imported systems were underestimated, especially in relation to liability for future maintenance, levels of thermal control, noise control, and functional efficiency.

As a result of the experience, by the end of the 1970's another, wiser decision had been made by the Ministry to freeze the experiment of using imported building systems in its construction programme. During that period, the Ministry managed to produce its own new standard layout model, using traditional construction methods and local contractors for implementation. This was, and is, based on the use of a courtyard type plan with the buildings arranged around the central space.

C-1 - THE COURTYARD LAYOUT.

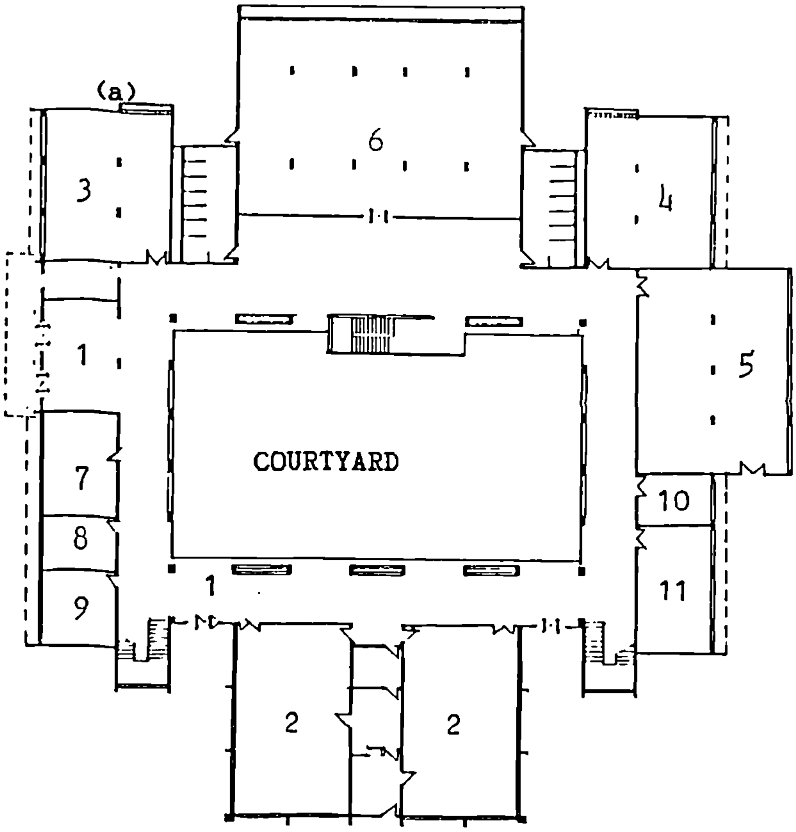
This standard layout courtyard school has been used for elementary, intermediate and secondary education. It can be built with 9, 18 and 27 classrooms, with two or three floors, depending on what level of education it is intended for. The school is provided with a wider range of facilities than other shcools which were discussed earlier in this section. It is provided with arts and craft rooms, dining hall, teachers' rooms and a medical room. (See fig. 6.11).

The school does, however, have some resemblance to the finger-plan schools of the 1930's and 1940's of Western Europe and North America, not in shape or form, but partially in its extravagant use of circulation space. Surprisingly, like the revolutionary finger plans of the 1930's and 1940's, which were considered a step forward in improving the internal environment despite the high cost, this school can be considered neither revolutionary nor even evolutionary in its present form. School design is at a standstill, if not indeed in a retrogressive phase.

The early standard finger layout, which was discussed previously in the chapter, showed that 30% of the built area in the building was devoted to circulation, 46% to teaching and 24% to other purposes. In the new standard layout, 40% of the plan is used for circulation, 30% devoted to teaching areas including the multi-purpose hall, and another 30% for the rest of the facilities.

The schools are lavish in terms of spatial provision. This might be accepted if this was balanced by other qualities. However, the architectural assessment and the user response indicates that the internal environment, including natural lighting and ventilation, artificial lighting and ventilation and air conditioning where used, acoustic quality and the

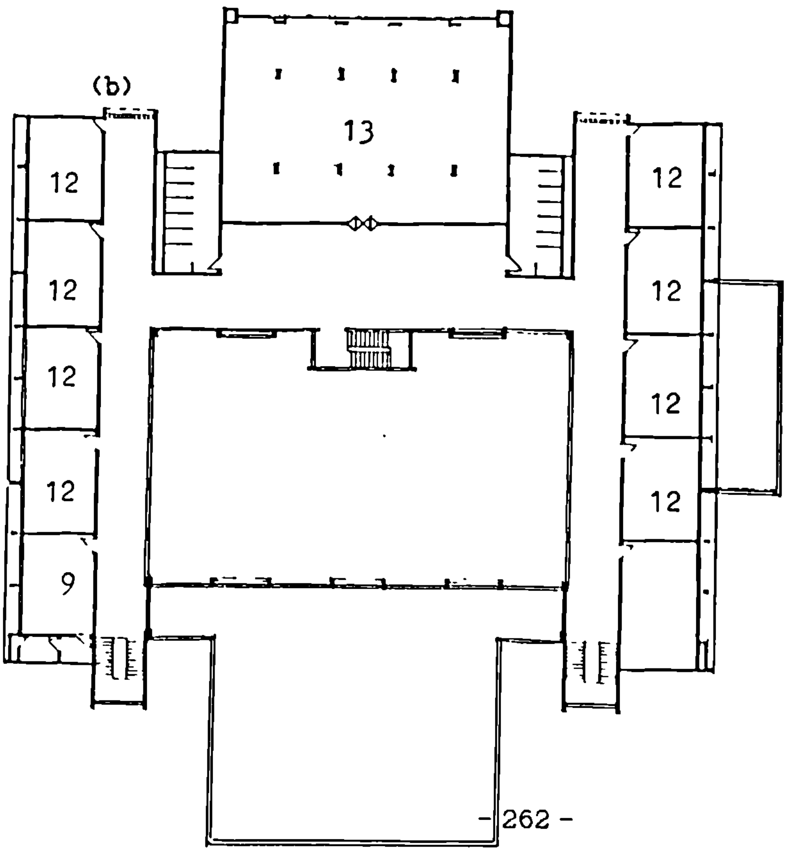
FIGURE 6.11.



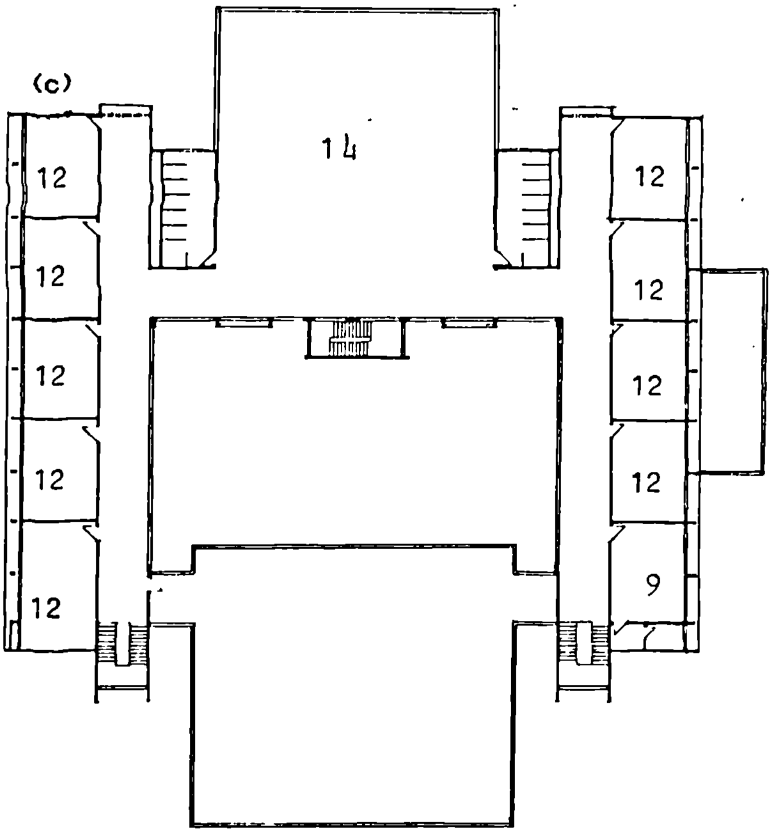
(1) Entrance
(2) Laboratory
(3) Arts and Crafts
(4) Library
(5) Reception Hall
(Originally Mosque)
(6) Dining Hall
(7) Headmaster
(8) Lavatory
(9) Staff
(10) Medical Room
(11) Storage
(12) Classroom
(13) Meeting Hall

The Courtyard School (conventional building);

Ground floor (a), first floor (b). On the next page: Second floor (c) and site plan (d).

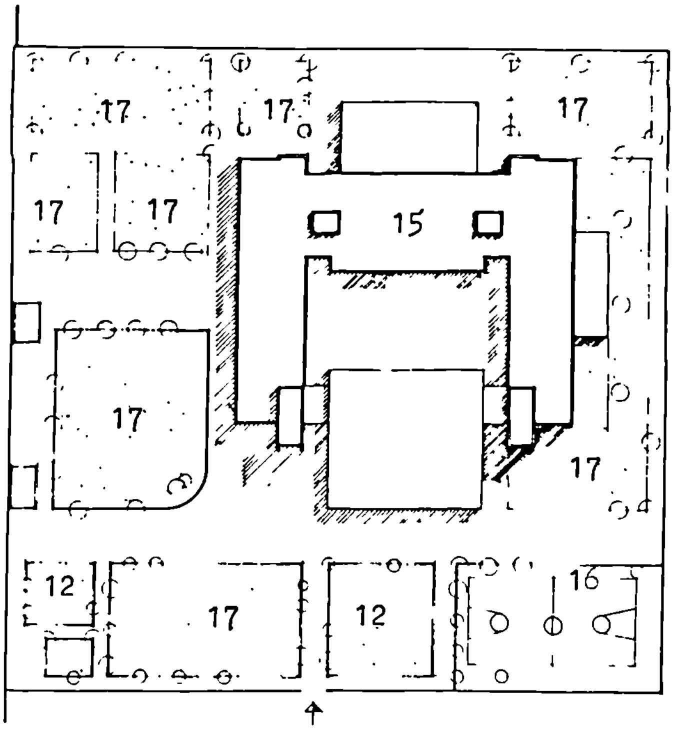


(c)



(9) Staff
(12) Classrooms
(14) Terrace
(used for prayers)

(d)



(15) The Main Building
(16) Hard surfaced area for gymnastics and games
(17) Green area

standard of finishes are almost the same in their poor standards of quality as other schools.

The purpose-built dining hall which can not be used for other activities is an out of date concept. The theatre hall on the first floor, which contains 14 columns is of an irresponsible design. The arts and craft room has an interior layout exactly the same as the library, mosque or a classroom. It is not provided with storage areas suitable for furniture and equipment.

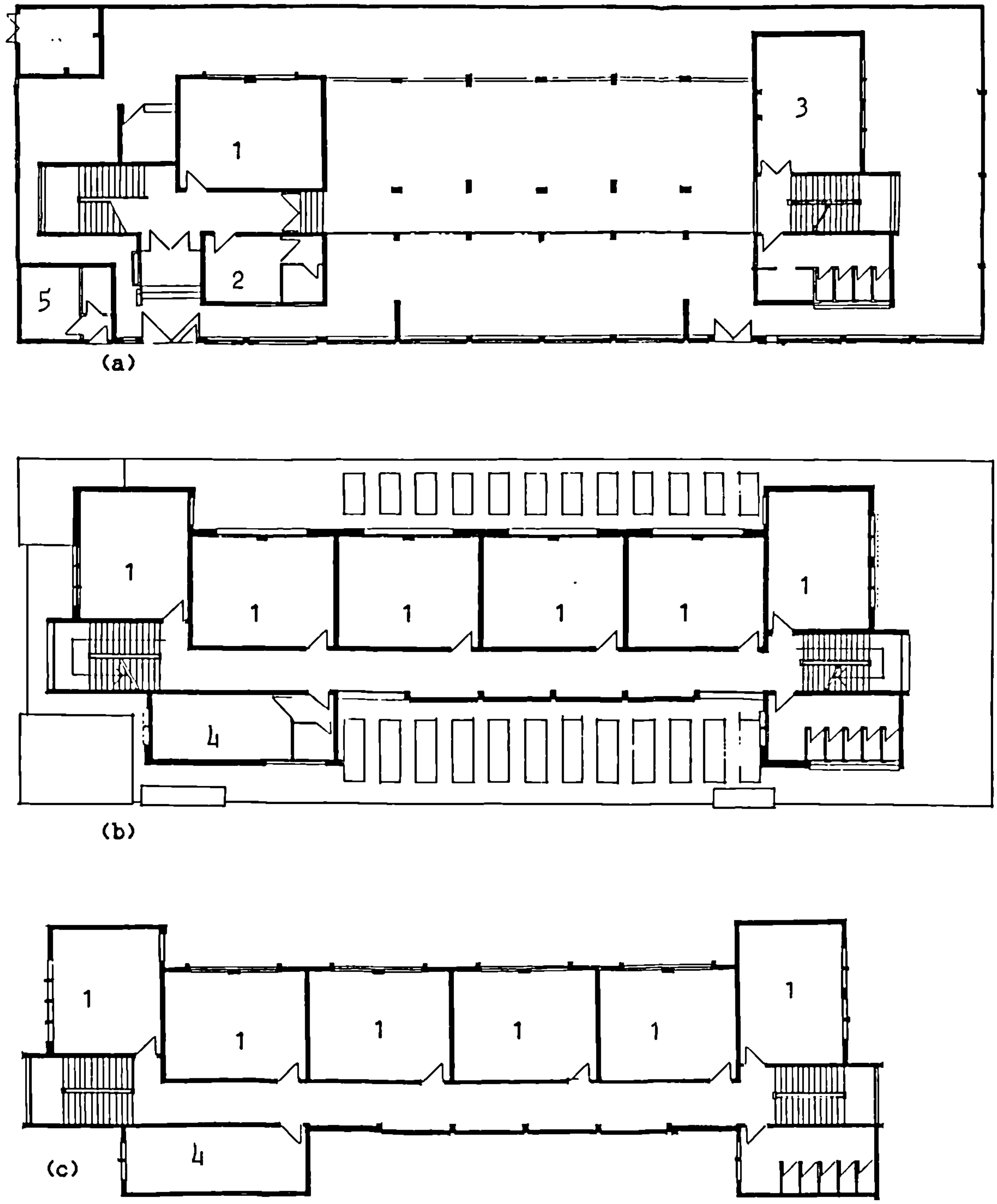
The schools focus - *the courtyard* - has been badly affected by *misuse of materials*, colours and design details. The use of grey cement tiles to pave the courtyard and the use of brown and green colours on the surrounding walls have made the courtyard spaces hard and uninteresting. In general, this rectangular space "courtyard" has no design or furniture to help motivation of activities inside it. (See fig. 6.12).

SECOND - GIRLS' SCHOOLS.

Since the establishment of the Presidency of Girls' Education as late as 1970, the problems of the provision of girls' school buildings have been on a very large scale. This is not only because of the traditional under-emphasis of feminine activity in the Saudi social structure, but is exacerbated by other factors. In particular, there is a shortage of qualified female teachers. There is also a general resistance to girl students, female teachers and administrators participating in the educational activities remote from their places of residence. From the planning point of view, the location of girls' schools can not be dealt with in the same way as boys' schools, since male pupils can travel more easily on their own. As a result, the number of girls' schools has had to be increased more than is usual in other countries. There has to be distribution on the basis of local density rather than balancing the regional needs only. To overcome the problems of unbalanced utilization of spaces in some schools, and the possibly overcrowded situation in others as a result of this dynamic disruption of schools, a secure transportation system has been provided for female students, teachers and staff. This has alleviated the problems of providing a large number of small schemes with the consequent problems of over provision of resources.

Starting almost from a zero position, the provision of girls' school buildings has had to rely almost totally on rented premises. Because of the high expense of renting as well as the unsuitability of these buildings, it was necessary for the Presidency of Girls' Education to develop its own schools, applying the standard layout approach, which has already been used by the Ministry of Education for boys' schools. Several standard layouts were introduced, some of them for rural areas, others intended for urban use. The early layout used in urban areas was a three storey, single corridor building. Schools of this type have not been visited during the survey although the plans have been examined. (See fig. 6.13). Another type of building which was introduced for girls' schools and which was surveyed is a courtyard type building with 29 classrooms. Finally, it is worth noting that although the Presidency of Girls' Education was under pressure to speed up its construction

FIGURE 6.13.



The Single Corridor Girls' School: Ground floor (a), first floor (b), second and third floors (c).

(1) Classroom	(4) Staff
(2) Headmaster	(5) Caretakers Room
(3) Mosque	(6) Power Room

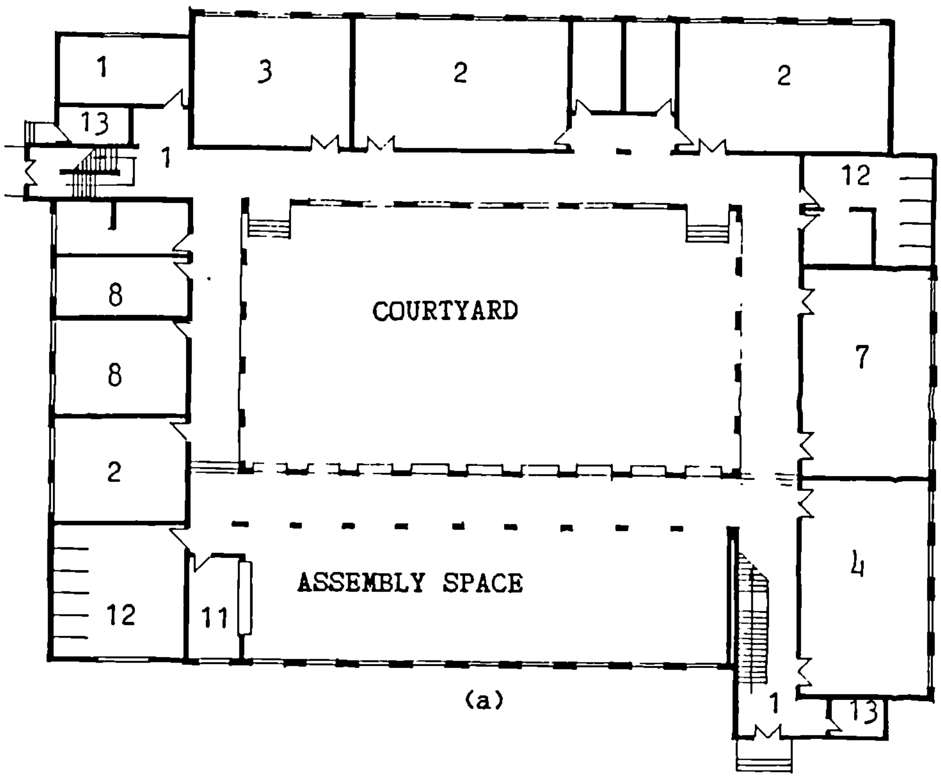
programme, industrialized building systems have not been used at all. This points to the realization at an early point in the overall programme that the experiment of using industrialized systems had not been successful. It also can be said to reflect differing approaches in respect of the provision of boys' and girls' education.

THE COURTYARD SCHOOL.

LAYOUT, STRUCTURE AND FUNCTION.

The internal organization of girls' schools, including subjects, teaching methods, timetable and the typical teaching day, are almost similar to those in boys' schools. The exception is that female students have home economics subjects instead of physical education. With such similarity in functions, a radical design difference between boys' and girls' schools can not be expected. Although privacy for girls as a socio-religious factor might be thought to have made a substantial difference in arrangements, provision of privacy has not been integrated within the total design solution to take full advantage of the layout and its form. The courtyard provides excellent levels of privacy for female students during their morning assembly and the mid-day break. During the formal teaching periods in classrooms and other teaching areas, the courtyard is totally neglected. This is because all teaching and non-teaching rooms have been planned to face the exterior of the school. This leads to loss of privacy which has led to the provision of translucent glass in large areas. (See figs. 6.14- 6.16).

FIGURE 6.14.



(1) Entrance
(2) Laboratory
(3) Home Economics
(4) Meeting Room
(5) Classroom
(6) Nursery Department
(7) Mosque
(8) Headmaster
(9) Medical Room
(10) Staff
(11) Buffet
(12) V.C.
(13) Power Room

(a)

The Courtyard School (Girls' School):

Ground floor (a), first floor (b)

(b)

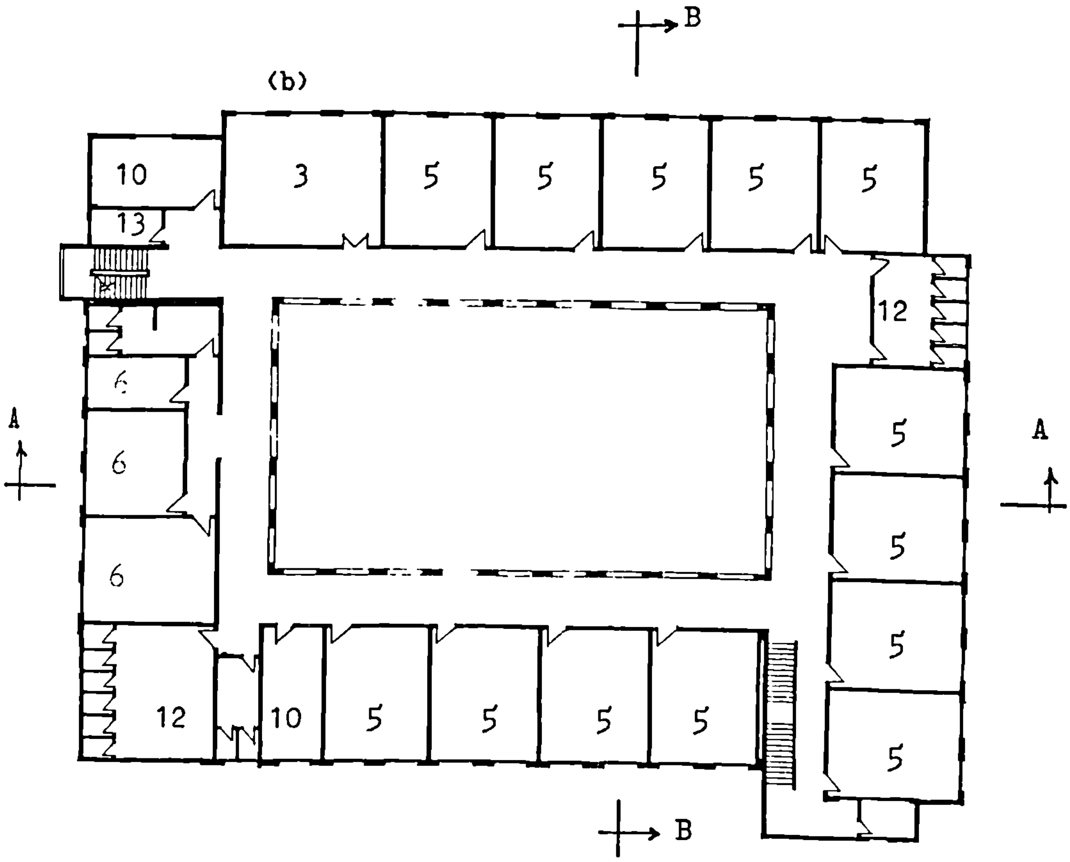
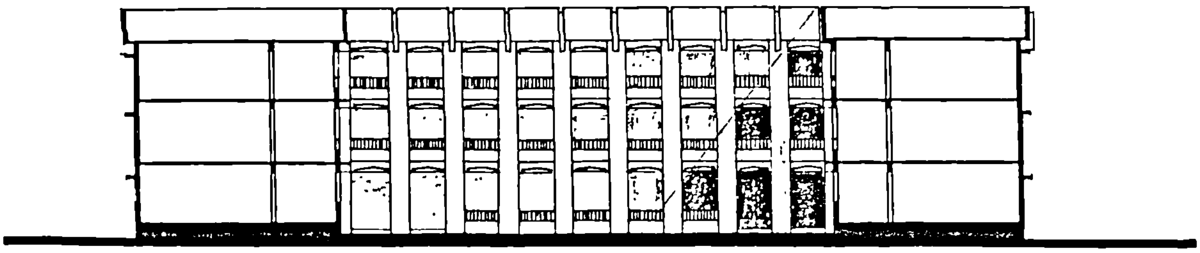
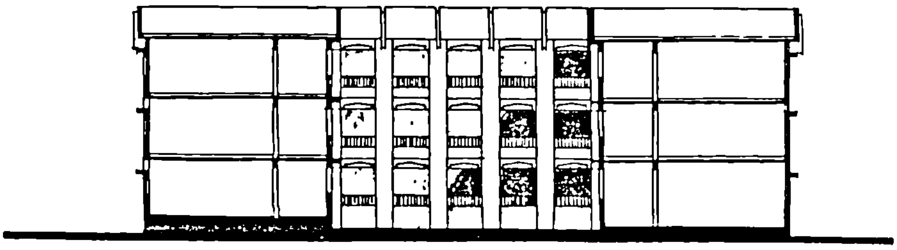


FIGURE 6.15.



SECTION A-A

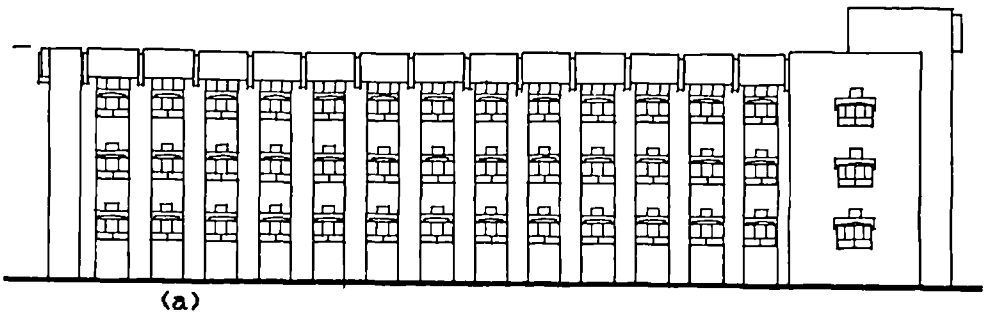
(a)



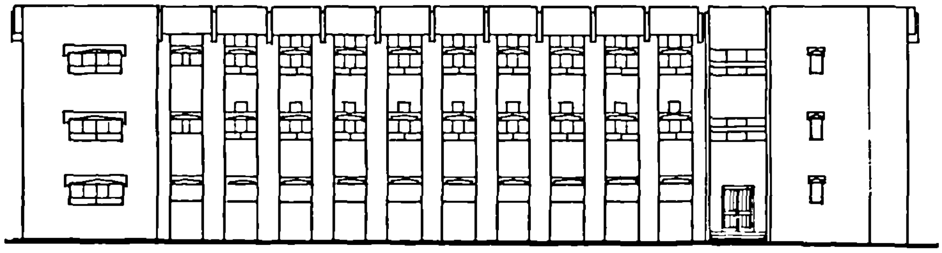
(b) SECTION B-B

The Courtyard School (Girls' Schools):
vertical sections (a) and (b)

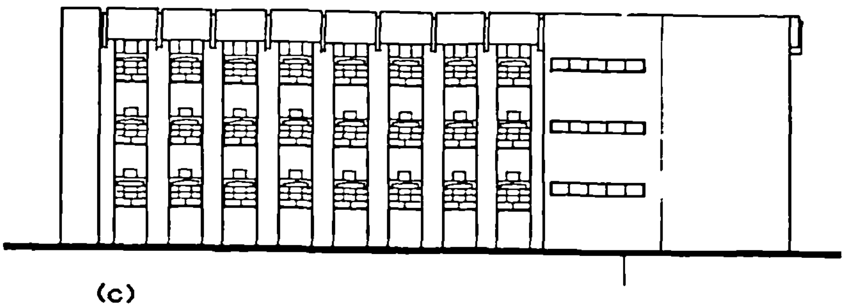
FIGURE 6.16.



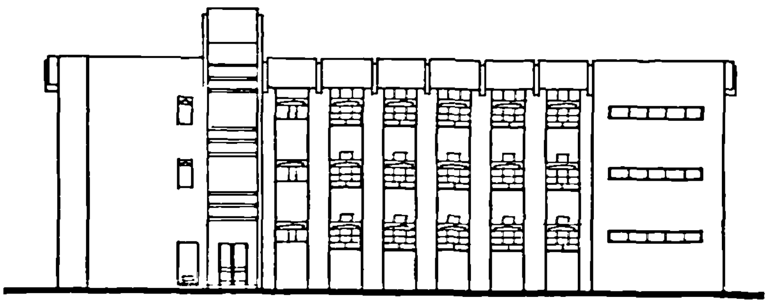
(a)



(b)



(c)



(d)

The Courtyard School (Girls' Schools):
four side elevations (a), (b), (c) and (d).

The structural system used in the building is a reinforced concrete skeleton. Here again, the use of solid slabs and vertical beams as well as the rigid modular grid has made it difficult to provide suitable proportions. This situation applies to both small and large rooms.

The distribution of accommodation shows that only 40% of the total built area is devoted to teaching spaces, 37% for circulation and 23% for other purposes, although the latter does include a nursery department. Despite the high percentage of circulation, entrances of the school are small in size and this leads to overcrowding in use.

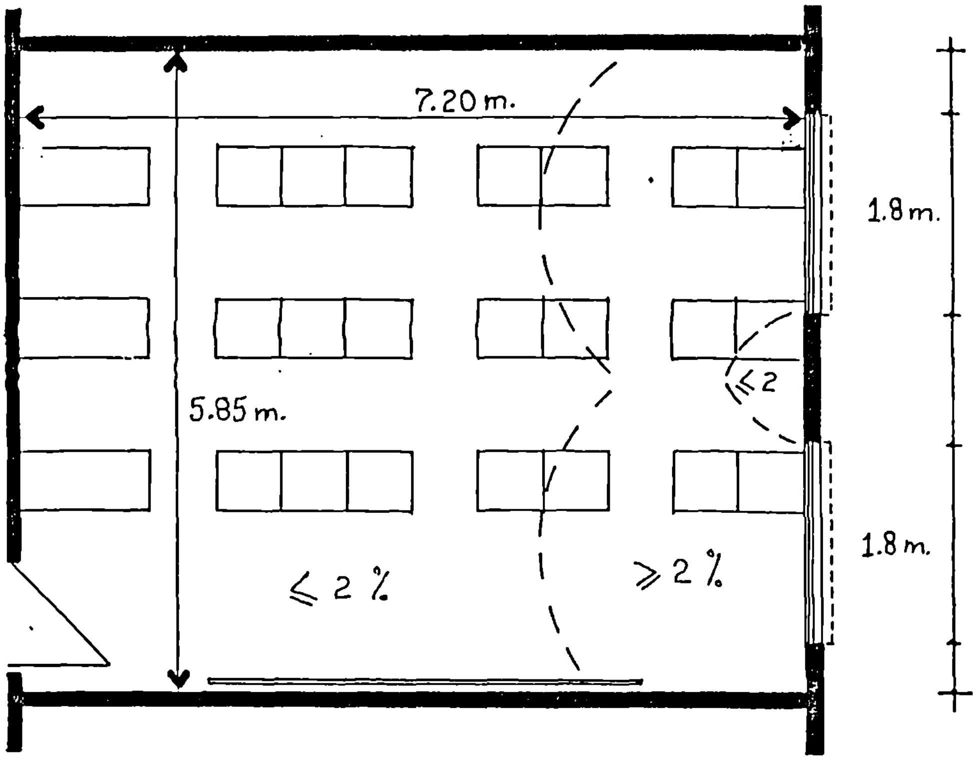
ENVIRONMENTAL CONDITIONS.

NATURAL AND ARTIFICIAL LIGHTING AND VENTILATION.

The use of translucent glass in classrooms and other rooms for the purpose of privacy has badly affected natural lighting. As a result, artificial lighting is used continually in the school. The design of windows, in responding to privacy and security needs, has made it impossible to fully open windows for cross-ventilation in good weather. Consequently ceiling fans and air conditioning units are in constant demand to overcome the problem of overheating. (See fig. 6.17).

ACOUSTIC CONDITIONS.

Air conditioning units cause a very high level of noise. The curious advantage has been previously mentioned - that a background sound cover is created which masks occasional external or internal noises.



(a)

(b)

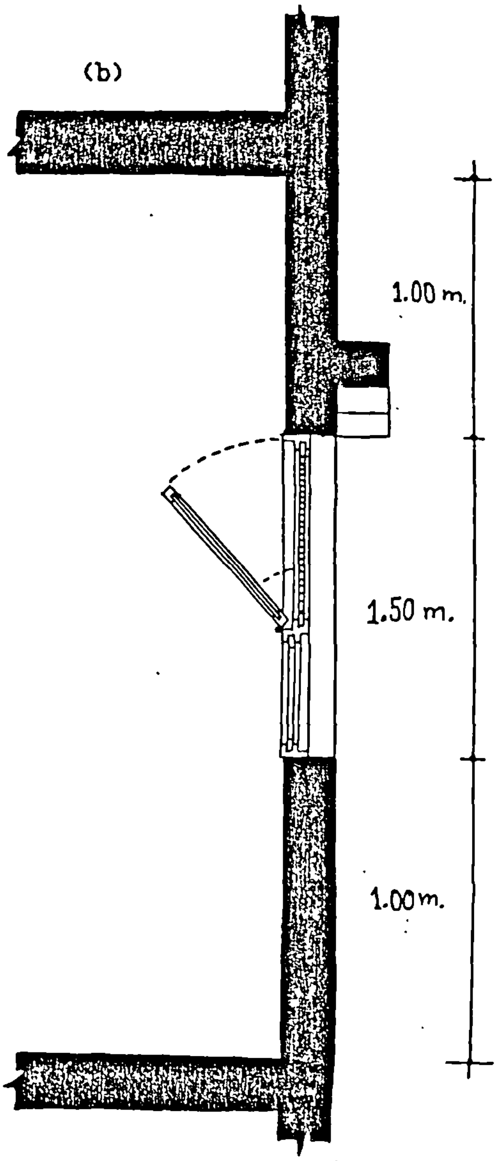


FIGURE 6.17.

The Courtyard School (Girls' School): the daylight factor distribution in a classroom (a), and a section in a classroom showing the design of the window (b)

FURNITURE AND EQUIPMENT.

All schools are provided with basic furniture and equipment for classrooms, laboratories, home economics and staff rooms. The layout and equipment in home economics rooms need more space, a more flexible layout and movable furniture. The courtyard and the shaded area beside it need suitable landscaping and outdoor furniture.

MATERIALS, FINISHES AND COLOURS.

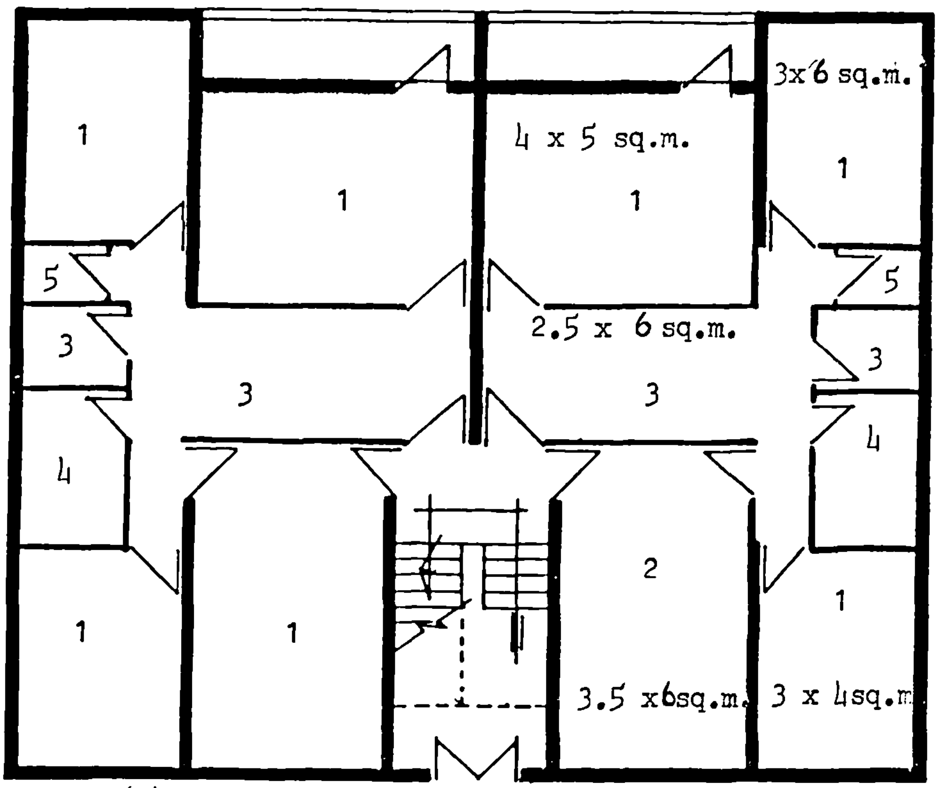
External and internal walls are of cement blocks. The use of light coloured plaster on the facades helps to reflect heat while the use of dark coloured plaster (blue) for internal surfaces has reduced the quantity of reflected light. Finishes in general are of a low standard.

THIRD - RENTED SCHOOL BUILDINGS.

In general there are two types of building which are normally rented. First: buildings which were originally designed for low-rise (2-4 floors) residential accommodation. The second type are detached large houses or small palaces. Two rented schools have been chosen for the survey so that a comparison of provision which covers the range could be made.

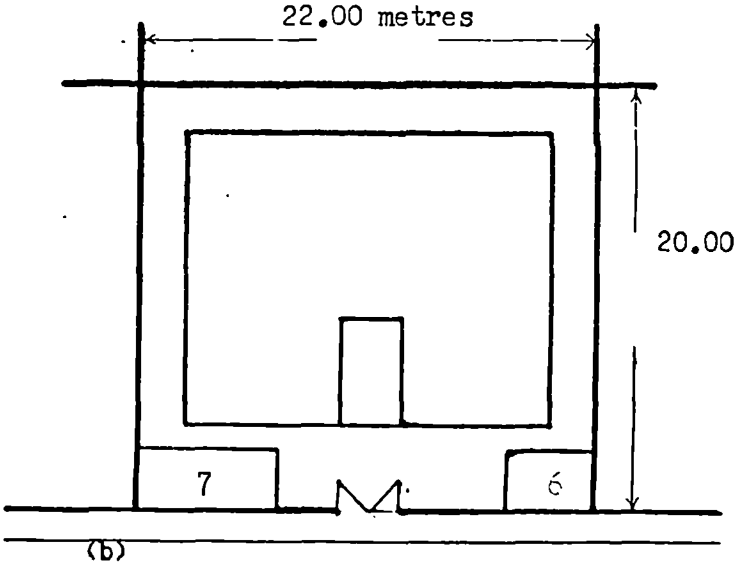
The designs of the two schools are totally different from each other. The first one is a two storey domestic building. Each floor comprises two flats, while each flat consists of a reception hall, four living rooms, kitchen, bathroom and toilets. (See fig. 6.18). Eleven rooms in total are used as classrooms. The one remaining is used as the headmaster's office. Bathrooms and kitchens are adapted to be used for storage or administrative

FIGURE 6.18.



(a)

Rented Building (two storey residential building): the typical floor layout (a), and the site plan (b).



(b)

(1) Classroom
(2) Headmaster
(3) Staff
(4) Staff and administration
(5) Storage
(6) Buffet
(7) W.C.s

needs. Reception halls are used as teachers' rooms. Since the site is very small, morning assembly and physical education lessons take place in the street.

The other school building examined, which is a two storey palace, consists of 16 different sized rooms, an extension of another 6 small rooms which are located behind the main building, 5 bathrooms and a large outside space.

Little needs to be said about this aspect of provision for education in Saudi Arabia. The buildings are ill adapted to educational purposes. The planning and internal environment give very poor conditions for teaching. There is no provision at all of specialized rooms usually found in schools. Finally the buildings are expensive to rent and extremely costly in terms of running costs as the density of use requires continual use of mechanical aids to give ventilation and reduce heat. All concerned agree that this sort of accommodation should be replaced as soon as possible. This adds point to the purpose of this thesis, which is to recommend ways in which the shortage of school places can be alleviated.

SOME PARTICULAR PROBLEMS OF BOYS' EDUCATION.

Comment has been made about the influence of modern education in other parts of the world. There are some particular aspects of the Saudi Arabian educational system which have to be included in any school building. These aspects are discussed in the following section.

PRAYER.

The holy Prophet, upon whom may there be peace, said:

> *"Should a human being's prayers be marked as perfect, all his other deeds will win the satisfaction of the Merciful Lord".*

The importance of the position of prayer in the Islamic religion is very prominent and is not paralleled in any other worship. This is because it is the first duty imposed by God upon Muslims after belief in the oneness of God.

CONDITIONS OF PRAYER AND PLACE.

There must be general cleanliness of the body by ablution just before prayer. Cleanliness of the garments worn and the place of prayer are all essential conditions for the Muslim. Ablution should be carried out by washing each of the following: the palm of the hand, mouth, nose (inside and out three times), arms (from wrist to elbow) three times; rinsing and rubbing the head with water (with both hands) from front to back and vice versa once; ears (with both index fingers inside the ear and with both thumbs outside) three times; and lastly the feet to the ankles three times. This sequence should be followed thoroughly, whereby no organ is washed before the other, and no intermittent ablution is permissible where some organ may be dry before the procedure is completed.

Prayer can be performed in any place. The only essential condition that must be observed is cleanliness. Once the place is clean and dry it can be used for prayers whether it is indoors or outside, even if it is used for show purposes, providing that they are clean and legitimate activities.

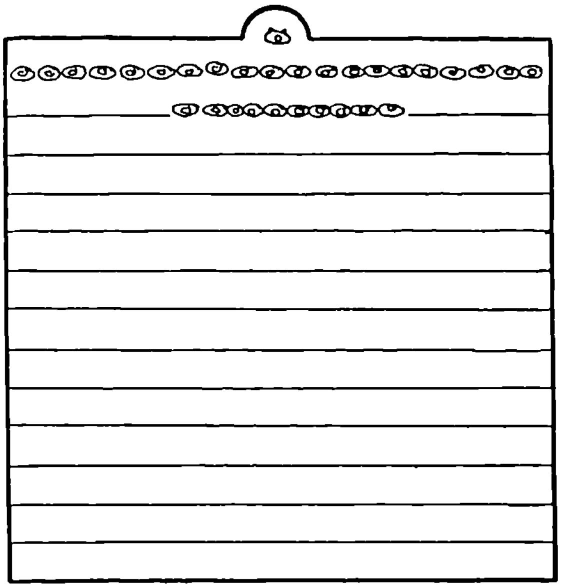
METHOD OF PRAYER.

Five obligatory prayers are to be performed at certain times of the day. These are: the morning prayer (Subh) with 2 bows; the noon prayer (Zuher) with 4 bows; the afternoon prayer (Asr) with 4 bows; the sunset prayer (Maghrib) with 3 bows and the evening prayer (Isha) with 4 bows.

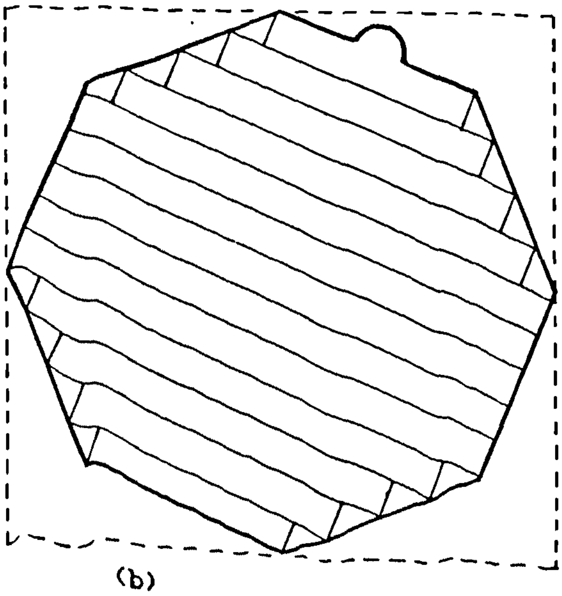
The method of prayer can be briefly described as follows: the worshipper must complete his ablutions, he then faces the Qibla, proclaims the call to prayer (Allahu Akber), recites the opening chapter of the Quran, kneels down easily to his best satisfaction, with ample time to mention at least once or thrice the praises and glory of God (Subhan Allah), then he stands upright to show that he has become straight again. Later he prostrates himself slowly with enough time to repeat the declaration of the praises and glory of God once or thrice. The whole act (without the ablutions) is called a bow, which should be repeated several times depending on the prayer and its appropriate number of bows.

THE PHYSCIAL PATTERN OF PRAYER.

In any prescribed group prayer, all worshippers must line up in united ranks side by side, without intermittent space between them. At the front of these ranks is the Imam, whom they should follow during the prayer. (See fig. 6.19).



(a)



(b)

FIGURE 6.19.

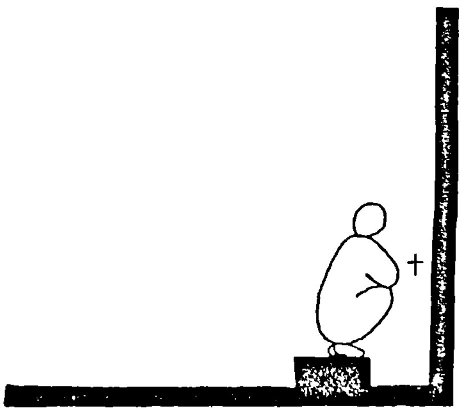
Typical layout of a mosque.

All worshippers must line up in united ranks. In front of these ranks is the Iman (a).

Uneconimical layout (b).

FIGURE 6.20.

Traditional way of ablution.



THE PROVISION OF SPACE AND ABLUTION FACILITIES IN SCHOOLS.

The total time given to students and teachers, who should pray together in one group, is 15 to 20 minutes, while the act of prayer itself is around 5 minutes. The rest of the time is usually spent on queuing in lavatories and travelling between classrooms, lavatory, prayer space and back again to classrooms.

This limitation of time has many effects on the distribution of spaces such as classrooms, mosque and lavatories and their capacity and layout. Most of the schools visited are suffering from defects in this respect. In some schools, mosques are small and located without any consideration to the time limit. While in others the design and layout of lavatories are not suitable for mass ablution. This is because lavatories are designed on western concepts with taps and high basins rather than on the traditional ablution concept with the provision of a large number of taps and a good drainage system. (See fig. 6.20).

In dealing with the provision of prayer spaces in schools, the idea of providing each school with a purpose-built mosque to accommodate all students and their teachers for only 10 minutes a day is not realistic, since cost and utilization are totally unbalanced. Using public mosques as an alternative can not be considered either. This is because the location and size of public mosques can not be guaranteed for each school. On the other hand there will be difficulties in organizing and controlling the movement of a large number of students within the time limit for prayer.

GAMES AND PLAY AREAS.

The most favourite sport games played in Jeddah schools are football, handball, basketball, volleyball and table-tennis. The handball playgrounds are inevitably used for football matches. This is because most school sites are not large enough to accommodate a football pitch; it is also because of the informality of the physcial education lesson, where students are normally divided into small groups to play their favourite games. It is not clear if this is the intention or if a more structured system would be used if facilities were provided.

In the case of the school league matches, it is possible for students to practice their sports during the afternoon in outlying sports centres. The technique of transporting classes to outlying sports centres during the teaching daytime is difficult to achieve within the time limit devoted to physical education lessons. However thought must be given to the provision of expensive sport facilities such as football pitches, swimming pools, etc., to be located near to schools. This would allow more efficient use of the time devoted to physical education.

Although multi-purpose gymnastic halls and covered playgrounds are not common in schools, maybe because of expense, their provision within the layout concept should be considered in the long term as a facility which has been proved to be beneficial in other countries. There are obvious cost implications and the climatic constraints on physical exercise should be taken into account.

MORNING ASSEMBLY.

In all schools students should be gathered into three grade groups. In each group students queue in several straight lines representing their classes. During this time teachers may check attendance and students clothes and appearance. This is followed later on by a collective singing of the national anthem. In some schools a morning programme may be broadcast by a group of students from the school broadcasting room.

The morning assembly may take place in any suitably sized space. This could indeed be outside the school building, possibly in a courtyard or in the central hall, if it was large enough.

The use of loudspeakers causes a very high level of external noise to neighbouring buildings. Internally, acoustical measures should be considered if mechanical means are used.

PROVISION OF EATING FACILITIES.

The type of meal services in all schools is a self-service one. Students have to queue under the supervision of teachers to get their snacks, sandwiches and drinks.

Because most schools lack the provision of purpose-built kitchens, small, light-weight prefabricated rooms have appeared in some schools. These are usually inadequately equipped, and tend to be placed outside the main building somewhere on the school's site. In one school a small purpose-built kitchen which is located inside the building has been closed, and instead its space has been adapted to be used as a teachers room. This was reported to be because it was a source of noise and unpleasant smells. In this case a prefabricated shed is again provided outside the school building.

In these schools where meals are provided outside the building, two interrelated problems have been noticed - seating and cleaning. During the mid-day break students look for any clean and shaded areas to enjoy their meals. Consequently they spread into all parts of the school site. By the end of the break period, and in most cases, they go back to their classes without bothering about what they may have left behind.

In the courtyard school, these problems of seating and cleaning have been controlled. Here, students can have their meals either in the dining hall, which is provided with suitable seating arrangements, or in the adjacent corridors and courtyard. Since these places are clean and cool, students prefer to stay inside rather than going outside where it is warmer. On the other hand, and despite all students eating inside the building, cleanliness is noticeable. Although this can be claimed to be a result of direct supervision by the staff, it is also true that the design of space in terms of privacy has had its effect on the behaviour of the users in terms of proprietorship values toward the space itself. The more the space is private, the more its proprietorship defensive values increase. This explains why the level of cleanliness inside the school (private space) is higher than that outside the building (semi-private). Even inside the building itself there is still a hierarchy of privacies. Corridors in front of classrooms are kept clean and tidy by students more than areas in front of the dining hall or even the dining hall itself or side entances and toilets. The way in which supervision of eating areas can take place seems to be important.

ADMINISTRATIVE CONTROL OF SCHOOLS.

The style of organization in all schools is formal. This formality which is based on Islamic morals and disciplines affects all school activities, whether these activities are formal or informal. In the case of the formal activities in classrooms or laboratories, teachers normally use their authority to maintain proper behaviour and discipline. This is done either through the materials they teach or by a system of rewards and punishments.

The situation is different in the case of informal activities such as playing, eating, etc. Discipline and control becomes a hard task for teachers.

In common spaces such as corridors, staircases, halls, etc., teachers want a peaceful atmosphere and no damage to furniture, walls, paint, etc. The relationship between these spaces and the behaviour of the students towards them, is a result of repression due to long periods in the formal spaces (classrooms, labs., etc.). There are always high spirits and misbehaviour when constraints are lifted. The balance between freedom and discipline is a difficult one to achieve, but carefully supervised spaces can prevent disorder and vandalism.

This problem in a school with one double or single corridor is usually tackled by teachers taking direct control in these spaces. This becomes a diffcult task in a school where there are several corridors and hidden dark spaces. In the central hall school, the internal design has succeeded in releasing some of the pressure and tensions between students and teachers. Because all classrooms and corridors open directly onto the central hall, a hidden or indirectly controlled atmosphere has been achieved throughout the internal space, and everyone knows that everything can be seen and heard. There is a sense of direction in this school which could be emulated in new designs.

PARTICULAR PROBLEMS OF GIRLS' EDUCATION.

Although the structure, methods and contents of both girls' and boys' education are similar, school buildings are strictly separated. The reason for this separation is a natural and conscious response to the religious and social climate of society. In Saudi Arabia separation between the sexes is always maintained. This segregation is found in all public buildings as well as semi-public and private buildings.

In public spaces such as shopping centres, streets, etc., and where separation is difficult, women normally veil themselves. In semi-public buildings such as houses, hospitals, etc., partial physical separation is obtained in terms of planning for internal and external systems of privacy, while in particular building types such as schools, banks, etc., a complete physical separation is normally obtained together with a high level of external privacy such as separate entrances, etc. These levels of separation and privacy are considered as quite normal behaviour and reflect attitudes towards women in the Saudi society.

Therefore, in girls' schools, privacy should be considered as a major factor. It is automatically expected that separate buildings will be provided for girls. The problem then is to safeguard privacy from external sources. The conflicts between the concurrent needs for privacy, daylight and ventilation should not only be answered by physical/technical solutions. (For example the use of translucent glass and partially secure windows in existing schools), consideration has to be given to the humane effects of the solution itself on the users. It is necessary to avoid solutions that emphasize segregation and a prison-like effect. If female pupils should not be seen from outside the school because of socio-religious requirements, this does not mean that they can not see and enjoy views to the outside too.

SPORTS, GAMES AND HOME ECONOMICS.

Under the concept of privacy in schools, one area which is often a joyful part of the school activities in open parts of the world - the sports and games - has been completely eliminated. Not only that, but indoor sports and games have not been considered as an alternative. Physical education lessons have been abolished. They are substituted by lessons in home economics, where students practice cooking, knitting and sewing.

It seems that the abolition of games is not official, it does not appear anywhere in the policy statements in the educational programme. It is rather a reflection of the lack of means of providing games areas which are private and not overlooked from the exterior of the school. If suitable sports/games areas can be considered without conflict with the requirements for privacy then they would be used.

The other problems (prayers, eating, morning assembly and administrative supervision) which were previously discussed in the section about boys' schools are almost the same in girls' schools and could be treated in the same way.

THE DUAL USE OF SCHOOL FACILITIES.

Having two institutions, the Ministry of Education and the Presidency of Girls' Education to share one educational task is a duality in itself. Although this can not be avoided as a result of the socio-religious and administrative systems in the country, the duality of the educational facilities they provide can still be rationalized. Expensive facilities which are usually associated with a low rate of utilization such as laboratories, libraries, art and crafts rooms. Home economics demonstration rooms, halls and sports halls, could be organized to be shared between two or more schools. Although this may need a very high level of co-operation between the Ministry of Education and the Presidency of Girls' Education and other Ministries, it is economically, functionally and architecturally possible and positively sound. The advantages which can be expected from such co-operation and sharing of facilities can be summarized as follows:

- a reduction in the number of spaces provided for expensive facilities.
- efficient rate of utilization comparable with other countries.
- more efficient servicing and ease of maintenance.
- convenient transportation.
- an overall reduction in cost across the building programme.

This sharing of facilities could be applicable to groupings of boys'/boys', girls'/girls' or even boys'/girls' schools to give more econmic and efficient use of resources.

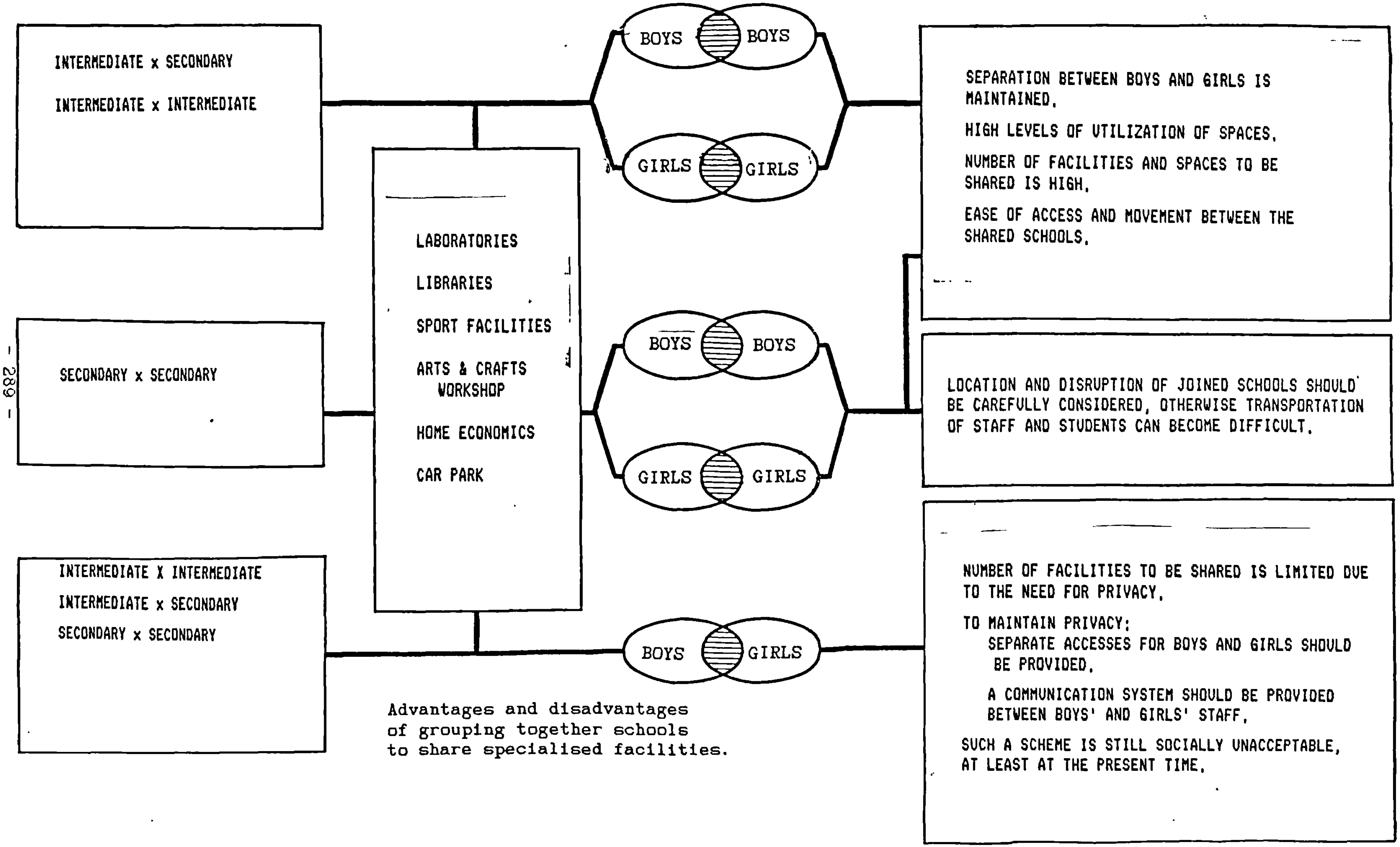
The analysis in figure 6.21 indicates that grouping together boys'/boys' or girls'/girls' schools is more advantageous than boys'/girls' schools in terms of privacy, accessibility and the number of shared facilities.

The application of such a programme will not affect the distribution of the existing schools, but it should influence the zoning of new areas and districts. In figure 6.22, the schematic diagram which was proposed by the Deputy Ministry of Town Planning, shows a typical zoning concept but without the consideration of the shared facilities concept, while figure 6.23 shows how the concept of sharing schools facilities can be rearranged within the district centre, assuming that the same zoning pattern was to be conserved. The zoning of district centres can be radically changed to support not only the sharing of school facilities, but also the sharing of other facilities such as the sports stadium, parks, playgrounds and car parks, as illustrated in figure 6.24.

BROAD AREAS OF PRINCIPLE FOR INTERMEIDATE SCHOOL DESIGN.

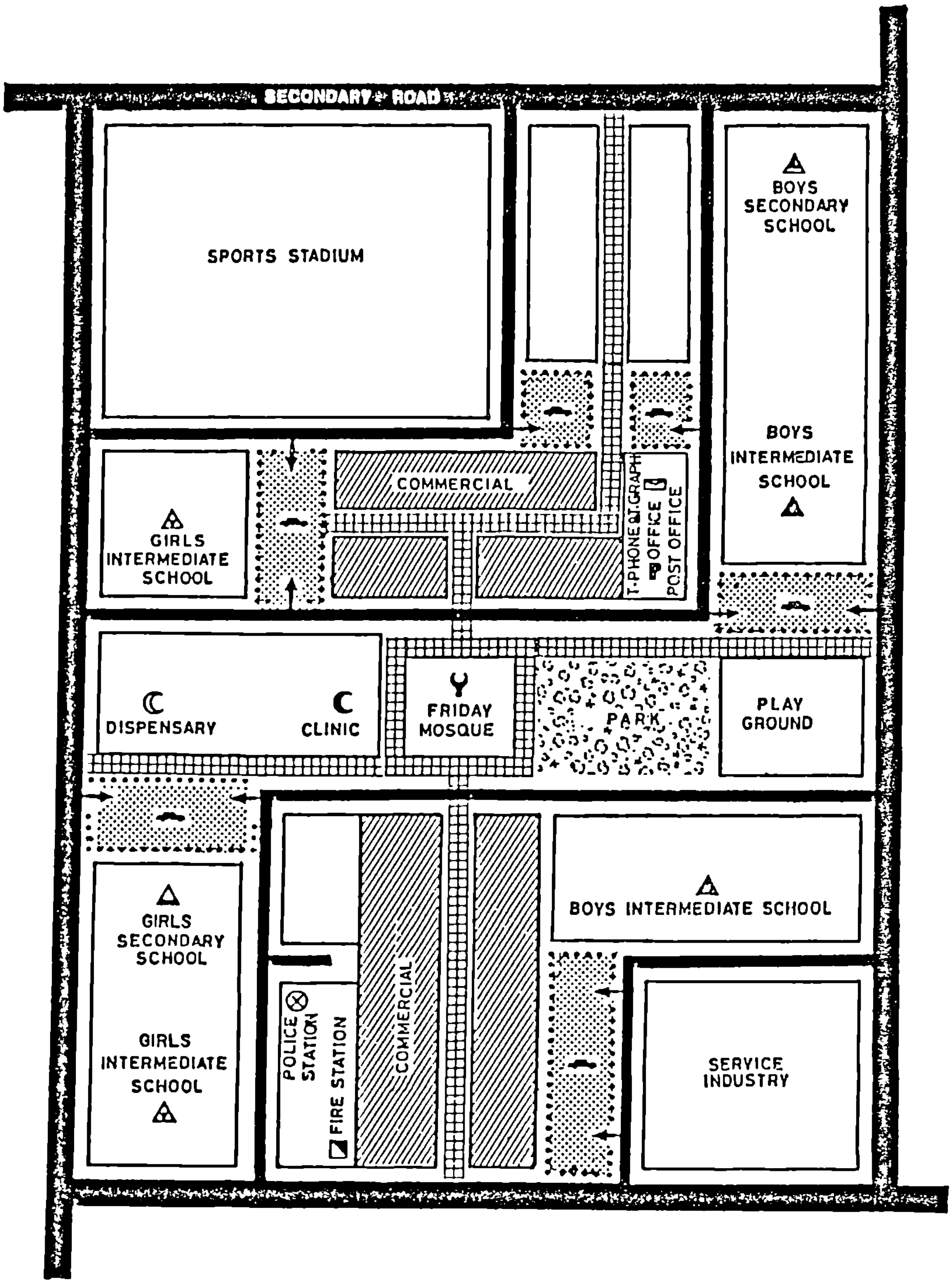
(1) The urgent need for intermediate schools has been shown. However this need cannot be seen in isolation. In particular, the consideration of secondary schools and intermediate schools on one site with shared facilities is one which should be considered.

FIGURE 6.21.



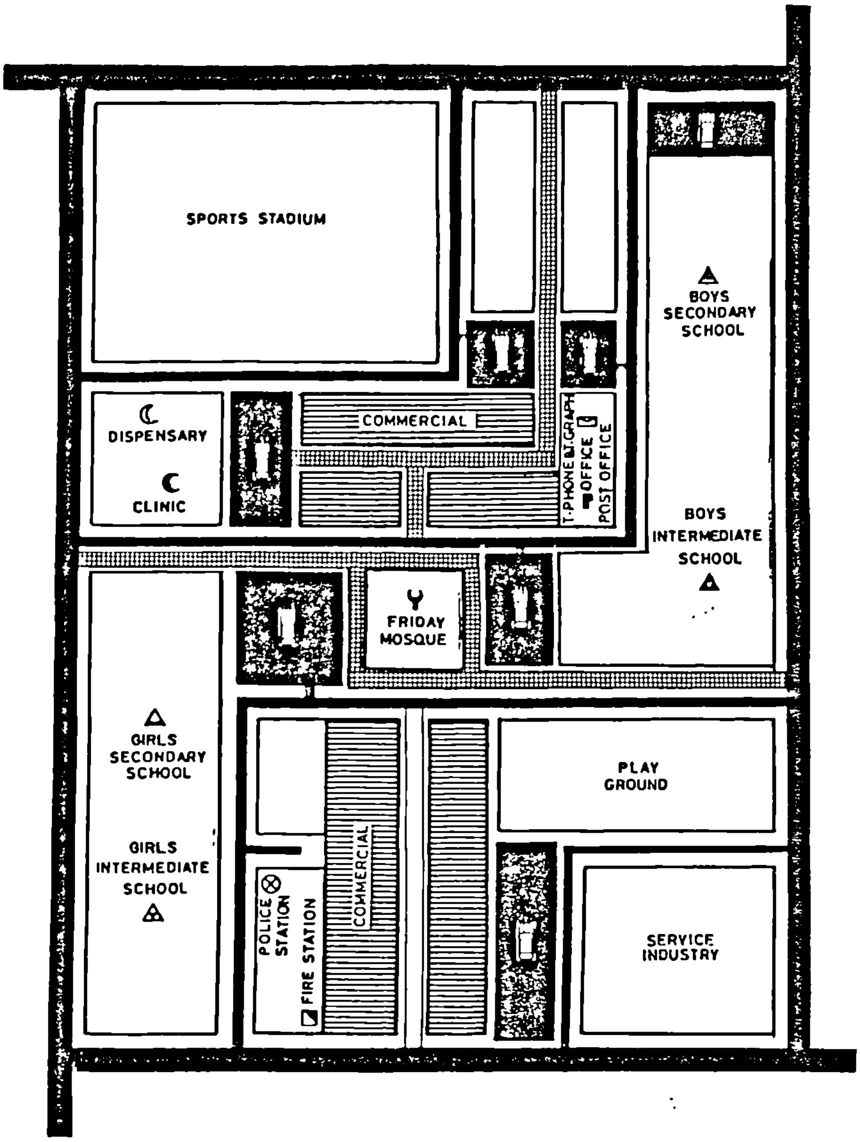
Advantages and disadvantages of grouping together schools to share specialised facilities.

FIGURE 6.22.



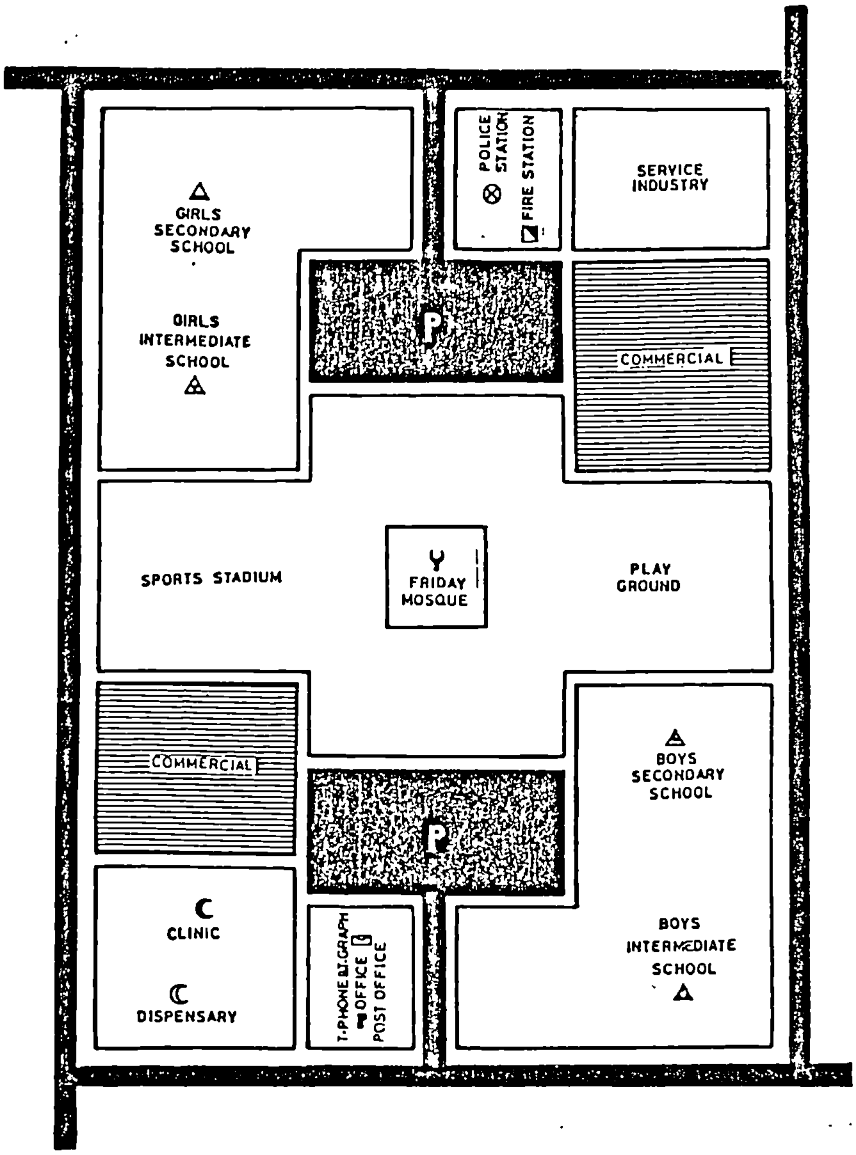
Typical zoning concept of district centre which was proposed by the Deputy Ministry of Town Planning in Saudi Arabia.

FIGURE 6.23.



The concept of sharing schools' facilities can be rearranged within the district centre, assuming that the same zoning pattern has to be conserved.

FIGURE 6.24.



Different layout of the district centre - can support not only the sharing of school facilities but also many other facilities such as the recreational area.

(2) The provision of school buildings for an Islamic society brings with it requirements for prayer and other religious considerations which must be observed. This is of primary importance in the Saudi Arabian educational system and is a major factor in generating the form of the buildings.

(3) The education of girls brings specific problems in Islamic culture. These must be understood and catered for.

(4) The provision of suitable buildings for what might be called the 'standard' educational requirements should be adequate in spatial and environmental terms and should also be efficient in use and economical in both inital and future cost.

(5) There is a social content to the education of young people which sould be recognized in the arrangements for building.

(6) Physical education is important as well as mental well being. Schools for both sexes should be designed to allow for development and maturity of the body.

(7) There is a growing realization that there must be an aesthetic component which reflects both traditional and future aspirations of Islamic and Saudi Arabian culture.

(8) The school building can be considered as a resource available to the community as a whole. This is to some extent a secondary factor but one which is of growing importance in some countries and should not be neglected in the planning and organization of school buildings.

SUMMARY OF FINDINGS.

The existing architectural response to the provision of school buildings in Saudi Arabia is in many ways similar to that found in Europe and North America during the beginning of the 20th century. In a sense, this is understandable as the educational system, curriculum, contents and methods are close to those prevailing in these countries at the time. However, when new educational areas, particularly the sciences, are taught, and some very modern techniques are used, the buildings lack sensitivity and flexibility. This is exacerbated when some western modern architecture with deterministic form is used. Very often the interrelationship ideas behind the buildings do not reflect the efficient qualitative and quantitative response to the educational system which is required. This is, as it was indicated in Chapter 3, mainly due to the centralization of the administrative system and to the unthinking application of the standard layout and repetitive buildings unrelated to differing conditions. The situation in general can be described as follows:

(1) Under the pressure of shortages of purpose-built schools, the hierarchy of the priorities of school needs is always seen by headmasters and teachers only from an educational point of view. This no doubt also reflects a shortage of specialized teaching rooms and other facilities. Architectural matters such as the quality of spaces, flexibility, adaptability, finishes, materials, natural lighting, natural ventilation, acoustical conditions, etc., were discussed with teachers, headmasters and even some

members of the local authority, but did not reveal any enthusiasm for anything other than short term improvements. This lack of architectural consciousness and experience in the authors view resulted from isolation from any system analysis feedback contributed to during the design making process. It is seen that headmaster and local authorities reports and complaints only dealt with educational problems, maintenance and shortages of spaces and furniture.

(2) The failure of industrialized systems. This is not a failure of standardization or prefabrication as such, but insufficient research into those closed and imported systems which were chosen. In addition, there was a lack of understanding of the quality and performance of the systems. This does not mean that industrialized systems are not needed or useful any more. On the contary, rationalization of traditional construction methods and locally developed industrialized systems are still needed as alternatives to other methods, not only to speed up the construction programmes, but also to balance the cost and quality in an economical way.

(3) Environmental conditions in all school buildings examined were generally poor. Air conditioning and artificial lighting are used in a lavish and irresponsible manner. This is due to the failure to properly define the climate solution necessary for a reasonable environment in the building.

(4) Spatial environment as a response to functional requirements is primitive. The hierarchy of spaces and their layouts are usually dictated by the modular grid and structure rather than by their functions.

(5) Utilization of specialized areas such as laboratories, libraries and halls is very low. This is because spaces such as libraries and halls are only occasionally used as a result of the rigid teaching methods. The latter have often developed simply because proper spaces were not available. The under utilization of laboratories is due paradoxically in some schools to over provision rather than poor teaching methods. All purpose-built intermediate schools are provided with 2 to 3 general laboratories despite the fact that the actual functional need would be satisfied by only one laboratory given proper timetabling and suitable access.

(6) The high proportion of the total built area which is devoted to circulation and entrances reflects the lack of awareness of the financial implications of planning and appointment of space in school building.

CHAPTER SEVEN.

DESIGN REQUIREMENTS.

PRELIMINARY STATEMENT.

The use of standard designs has been criticised earlier in this thesis. Successful school buildings in other countries show that broad areas can be defined and advice given on these areas that can be used by designers as a base for architectural design. This chapter endeavours to do this.

Setting up an architect's brief for school building is a task which implies appreciation of necessary influences and consideration of many interactive factors such as educational requirements, the administrative structure of the education service as well as the usual architectural and technical constraints. The process of presenting the brief could vary from one situation to another. Within a local or central authority, a consultant team of professional members in education, architecture and other technical matters will usually deal with the brief. As this is not possible in the case of personal research, some assumptions have to be made. The author has consulted with models of other disciplines and has accepted the findings of educationalists in other countries. Therefore in this thesis and throughout the previous chapters a background has been built up to provide the author with what he has selected to define the necessary educational, architectural and technical inputs.

The purpose of this chapter is to clarify the essential issues necessary in designing intermediate schools in Jeddah. These will be applicable to other cities where there are similar prevailing conditions. A performance requirement approach will be followed rather than a descriptive one. This will help to reduce the static image often associated with briefs. At the same time it gives the brief possibilities of an evolutionary function which should be a characteristic of documents of this type.

It is accepted that although the brief reflects the existing practice in Saudi Arabia, it may be in some respects ahead of the current national thinking. The position of women in society and education is an example. In some cases educational attitudes which have been identified in developed countries will not be applicable in Saudi Arabia because of the social and religious background of the country.

GENERAL CONSIDERATIONS.

BACKGROUND.

The existing situation relating to the school buildings programme is a result of several factors:

(1) The commitment of the government to provide free education without compulsion in a relatively short span of time for a society with a very high level of illiteracy. This, in a large country where the basic infrastructure has not yet been completed, has put the quantitative needs in front of the qualitative ones.

(2) The rushed development plans of 1975-80 and 1980-85 created a dynamic demographic movement from rural to urban areas. This has made the planning of educational facilities a complicated and unpredictable task. This in turn has affected the allocation of these facilities on a regional scale, leading to under-utilization in rural areas and overcrowding in the towns and cities of the country. Indeed these have become an acceptable phenomenon.

(3) The rigid and overloaded central administrative approach has eliminated the effective participation of local authorities in architectural decision making. On the other hand the introduction of standardized schools has tended to obstruct the possibility of innovational process.

(4) Since local demands were not visible and specific, the central supply responses were inevitably equivalent. This interpretation of the supply and demand relationship has, on the whole, seriously affected educational development.

PLANNING AND ARCHITECTURAL PRIORITIES.

When considering the above points, neither the planning procedures, the activities of the central administration, nor the political enthusiasm behind them can be suggested to be radically changed, since that is out of the scope of this thesis. However, general architectural implications and priorities need to be clarified within the existing framework.

The assumption that a standardized design approach can be built in any place, at any time, throughout the country is invalid, functionally, economically and environmentally.

The reasons for this statement are as follows:

(A) There are regional differences in climatic zones, each having different traditional architectural solutions;

(B) It is difficult to obtain regular plots of the right size, in the right place and time at a reasonable price. There must be flexibility in design to be able to use irregular or densely developed sites.

(C) The application of a standard layout on a nationwide scale means delaying, if not freezing the progress of general education and the required architectural response.

On the other hand the implications of abolishing the standard layout approach can be summarized as follows:

(A) It will be a major breakthrough for the rigid central administration. The whole attitude and understanding of the architecture of school buildings will be expected to be more progressive and have a flexible approach. This is simply because the load and the administrative pattern of professional responsibilities will be distributed over the whole country.

(B) Consequently, local authorities will share part of central responsibilities. This means more involvement and contribution to architectural and technical issues.

(C) Since many local authorities are severely understaffed, lacking experienced architects, engineers and other technicians, private architectural and engineering firms will be called upon to assist in designing school projects in close co-operation with local authorities.

(D) The local authorities work will be under the general framework of nationally accepted standards, regulations and cost limits provided by the central authority.

The urgent need to speed up the provision of school buildings can be obstructed by many factors. These can be grouped into financial, administrative and architectural. On the architectural side, the type of construction plays a major role in controlling the speed of erection and affects the cost. Thus construction is of great importance. Construction methods should be considered under the following headings:

(A) Local industrialized building systems are not yet available in the country.

(B) Indirect industrialization, which refers to the industrialization of some parts or components of the building, but not the total building, is available in large cities such as Jeddah, Riyadh, etc.

(C) Some of the indirect industrialized factories depend on local materials (cement, steel, etc.) to produce usually heavy-weight components. Other manufacturers, who deal with light-weight structures, depend on imported components.

(D) Since the former have no reference to any international building systems or to any modular systems, and because the latter depend on imported components, and since both produce high quality components within a low market demand, their products are relatively costly.

(E) Conventional construction methods which depend on in-situ reinforced concrete skeleton and framed structures with concrete block or brick-work filling and plastering, are commonly used.

(F) Although the quality of materials and finishes of the conventional method can be guaranteed, the time needed for construction is rather long.

Considering the above circumstances, several measures can be suggested as follows:

(1) It must be accepted that industrialized building systems for school buildings can not be applied to speed up the construction programme at the mean time, since such systems are not locally produced.

(2) Conventional construction methods should be rationalized as an alternative, not only by improving site management procedures and construction work, but also by the 'indirect industrialization' of building components, such as structural components, slabs, stairs, cladding, etc. This should be considered during the design process.

(3) This 'combination approach' requires the introduction of a general set of standards and, where appropriate, modular and dimensional co-ordination. This in turn necessitates close co-operation between designers of various kinds, manufacturers, surveyors and contractors.

EDUCATIONAL PRIORITIES.

THE ORGANIZATION OF EDUCATION IN INTERMEDIATE SCHOOLS AND THE ARCHITECTURAL IMPLICATIONS.

Two major models of education have been shown in Chapter Two - the traditional and the progressive models. It is also indicated that the traditional model has been applied in Saudi Arabia.

The application of the traditional approach, which can be considered to be a straightforward process of transferring knowledge and information, and which needs less effort from teachers and students, has been necessitated by the pressures of illiteracy, a shortage of qualified teachers and the lack of adequate educational facilities.

Under such a situation, teachers and text books will become the main learning resources in schools. Other resources such as libraries, laboratories, audio-visual aids, etc., can hardly be used, even if they are provided and fully equipped. This is simply because:

(1) Within the traditional teaching methods, libraries, laboratories and audio-visual aids are usually called "specialized teaching areas", but not "learning resources"

since teachers and text books are the only recognized learning resources.

(2) The function of the specialized areas is in helping the teacher to illustrate some of the contents of text books. In the case of the library, and since at present there is no tradition of teaching by projects, topical work or academic research, students usually read books only for the sake of it. This, of course is to be encouraged, but guidelines and development of suitable skills are necessary.

(3) Since traditional teaching methods are tested by setting written examinations of the contents of the text books, but not on what has been read in the library or what has been seen in the laboratory, specialized teaching areas have apparently become less important.

(4) The investigation of the survey in intermediate schools in Jeddah confirms the above facts. The maximum rate of laboratory utilization is 50% rather than 75%. Knowing that each intermediate school has two laboratories instead of one makes the utilization rate even lower. Libraries and audio-visual aids are only occasionally visited or used.

Attention has been drawn in a previous chapter to the stage that education in Saudi Arabia has reached. It is likely that there will be an assessment of the results of educational development in other countries. The more positive ideas will be incorporated into the Saudi system. It does seem clear that the shortage of skilled teachers, for example, will require the positive use of audio-visual aids based on texts in the short term. School planning must allow for this. The history of educational development in schools is one where there must be a closer relationship between function and form. Educational progress must be anticipated in the guidance which is given to architects.

Considering the above paragraph, the question which can be put forward is: if learning resources such as libraries, laboratories, audio-visual aids, etc. are vital for students to develop their abilities to discover, create, experiment, etc., how will these learning resources be integrated positively during the natural process of the general educational reforms? Although the question is couched in educational terms, the answer will outline the expected form of the internal organization to react to steps in setting up the brief and design concepts.

Four main successive stages can be classified as follows:

(1) THE CLASS GROUP ORGANIZATION.

Within the class group organization, students are divided into several grades. Each grade consists of several fixed class groups of students. Each group will be accommodated in a permanent space, usually called a "classroom". The teaching method generally applied is traditional, where teachers and text books are the main learning resources. Students, under such organization and methods, can continue to be taught without the need for specialized teaching facilities such as libraries, laboratories, audio-visual aids, etc. If these specialized facilities are to be provided, they could still be in small and basic scale. Teachers within this kind of organization have to move from one class to another to give their lessons.

(2) THE SUBJECT AREA ORGANIZATION.

The subject area concept still lies within the traditional model. The school is divided into several subject areas or zones, such as science zone, social zone, etc. All subject areas will share a central library and workshop resources. Each zone should be provided with a suitable learning resources centre, usually small in scale. This may contain: a private study, library, laboratory, private audio-visual area, practical work area, etc. The use of these centres will still be under the direct supervision of teachers in class groups as each subject zone contains several classrooms. Within this kind of organization, students have to move from one zone to another to attend their classes. The points that are significant in this concept are:

(a) Utilization of classrooms will be high. This is because students move to subject bases.

(b) The decentralization of the learning resources gives teachers in each subject zone the opportunity to control and utilize their private learning resources. This is likely to be the way in which the traditional methods will become less rigid in format.

(3) THE YEAR GROUP ORGANIZATION.

The year group organization is a stage in the departure from traditional methods to more progressive ones. It recognizes the individuality of students. The school is divided into several centres, depending on the number of grades. Each centre is provided with a multi-purpose practical area which can be used by students for either theoretical or small practical experimental work. Since the concept of this kind of organization depends on specific subjects as well as some optional activities in its working methods, it accepts that working group sizes will not necessarily be regular and equal. This means spaces in each centre should vary in size and equipment. The school is also provided with a learning resource centre which allows for different kinds of work. These will include drawing, painting, clay modelling, wood and metal work, as well as a library. The learning resource centre is there to supplement the resources of equipment and skills available in local practical areas in each year group centre.

(4) THE ACTIVITIES GROUPS ORGANIZATION.

The concept based on activities groups is an advanced version of the year group organization. It aims for more individuality and a greater number of options in each student's work. Although the year group still exists, the whole educational programme depends on a large set of activities. These may be classified as: receptive activities (listen, observe and read), reciprocal activities (discuss, converse, memorise, etc.), creative activities (model, draw, paint, act, dance, etc.), reporting activities (relate, present, demonstrate, act, play), etc. The type of activity that the student needs will determine the subjects as well as the learning resources and aids required.

Teachers are no longer the only source of knowledge; other resources (libraries, labs., audio-visual aids, etc.) will be under intensive use within the general application of educational techniques, such as learning by doing, investigative and project work. This allows for both self-learning and for a mixed ability co-operative approach. Within such approaches, students in each year group need not be provided with specific classroom spaces or centres to work in. The school will become a series of learning resources such as theoretical resources (library, reading and study spaces), practical resources (workshops, art studios, etc) and technical resources (laboratories, workshops, etc.).

Finally, although centralization of resources is a major feature in such organization, the distribution of these resources is not necessarily central too.

SUGGESTED ORGANIZATIONAL FORM OF EDUCATION IN INTERMEDIATE SCHOOLS.

The existing organizational form of education in intermediate schools in Jeddah is based on the class group concept. Despite the rigidity of this organization, which has been shown previously and which cannot be avoided, the class group concept will still be the main departure point of the architect's brief and design in the near future. However, the principles of the subject area and the year group organizations will be considered as likely future educational demands. These are:

- The decentralization of learning resources;

- Formation of year group centres.

Thus the architectural brief must allow for a movement towards these principles and be flexible enough to incorporate them. The spaces and layouts of the year group accommodation are expected to be architecturally achieved without any conflicts with the class group organization and within a reasonable time for the utilization of their principles. On the other hand, providing each year group centre or subject area with additional practical areas will initially be costly and most important, at present they will not be used. This is simply because teachers are not qualified to integrate such a facility into their teaching methods as yet.

However, and under such economical and functional constraints, the future demand as identified above can be approached as follows:

(1) The numbers and the uniformed layouts of classrooms which are needed for the class group organization will not be adequate for the year group ones. This is because the latter is less dependent on formal teaching methods. It also depends on different working group sizes, which in turn require different sizes and layouts of teaching rooms. Therefore, classrooms should be designed to accommodate the simple formal teaching layouts. At the same time and without any kind of physical structural alteration, each classroom should have the possibility of division into two zones - practical and non-practical zones which are essential for non-formal teaching methods. Examples showing how such layouts can be established will be illustrated later in the chapter.

(2) Circulation areas should either be designed to complement the adaptability required, or alternatively be able to be adapted for other uses.

(3) It is possible to provide each year group centre with a small space for private theoretical work such as reading and studying. If such space is provided within the total floor area of the school, it will make the task of future adaptation much easier.

THE COMMUNITY USE OF EDUCATIONAL FACILITIES AND THEIR ARCHITECTURAL IMPLICATIONS.

The importance of community educational facilities has been shown in the previous chapters. Although such schemes are always viewed from economical and maybe educational motivation, their success or failure depends on the local social needs and the administrative commitment. The design side, on the other hand, should be accepted as an architectural response to the situation rather than a generative process.

The concept of community use of schools is becoming a major issue in most developed countries. It is discussed and placed in a hierarchy of their educational, social and economic needs. In a developing country like Saudi Arabia, the hierarchy of priorities is different, and the community use of schools can be expected to have different weight and value in such a hierarchy. This is simply because:

(1) If community use should be applied in its wider sense, school buildings must be built first. With the huge shortage of school buildings, the talk about community use (in the terms of the western model) is no more than emotional enthusiasm.

(2) Within a centralized administration, a community school approach is a matter of a policy that, if it will exist, should be applied on a national scale. Because of the shortage of qualified teachers as well as funds, added to a shortage of school buildings, a policy to encourage community use of schools will take time to be put forward and must inevitably have a low priority.

(3) As illiteracy is a major problem in society, available educational facilities, including buildings, staff, teachers and equipment, will be expected to be devoted to the literacy programmes for adults rather than to recreational and leisure use. This sort of use may take a high priority. Therefore architectural measures should be taken in expectation of future demands. These are:

(a) Many schools will continue to be used for literacy education for male and female adults during the evening time. This necessitates the adequate provision of artificial lighting and natural ventilation as well as environmental conditions in respect of thermal gain.

(b) Location and accessibility of facilities such as outdoor playgrounds, indoor sports/games, cafeterias, etc., which will be targets for future community use, should be considered during the design process.

ENVIRONMENTAL REQUIREMENTS.

In Chapters three and five, climatic requirements and traditional solutions have been investigated in general terms. The following theoretical solutions have been proposed for consideration for the city of Jeddah:

- use of cross-ventilation systems during early morning and night.

- use of natural convection in stack effect systems, particularly during the very hot periods of afternoon and evening.

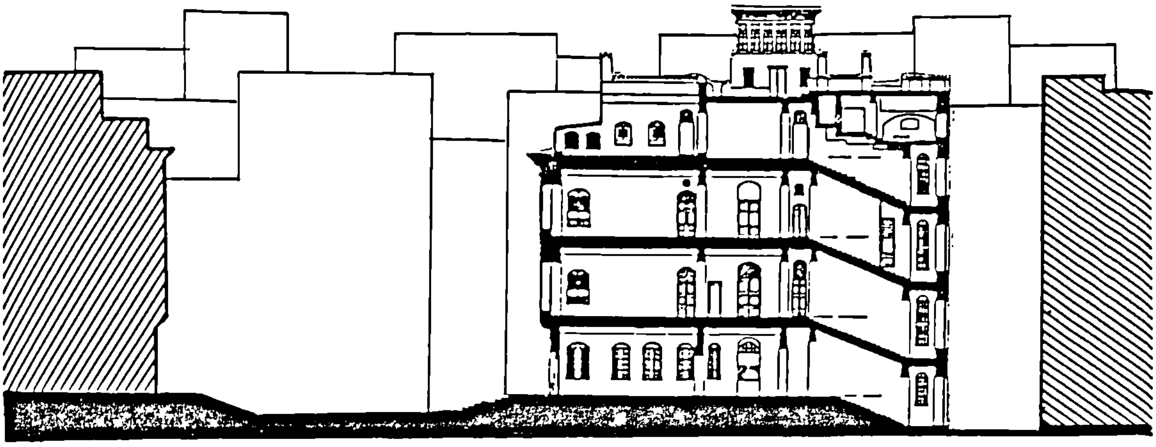
use of differential thermal capacity materials to give suitable time-lag if building will be used all day.

- ability to take advantage of cool air "pools" in detached or semi-detached buildings with 2-3 free elevations.

planning to give shaded areas, especially for external circulation.

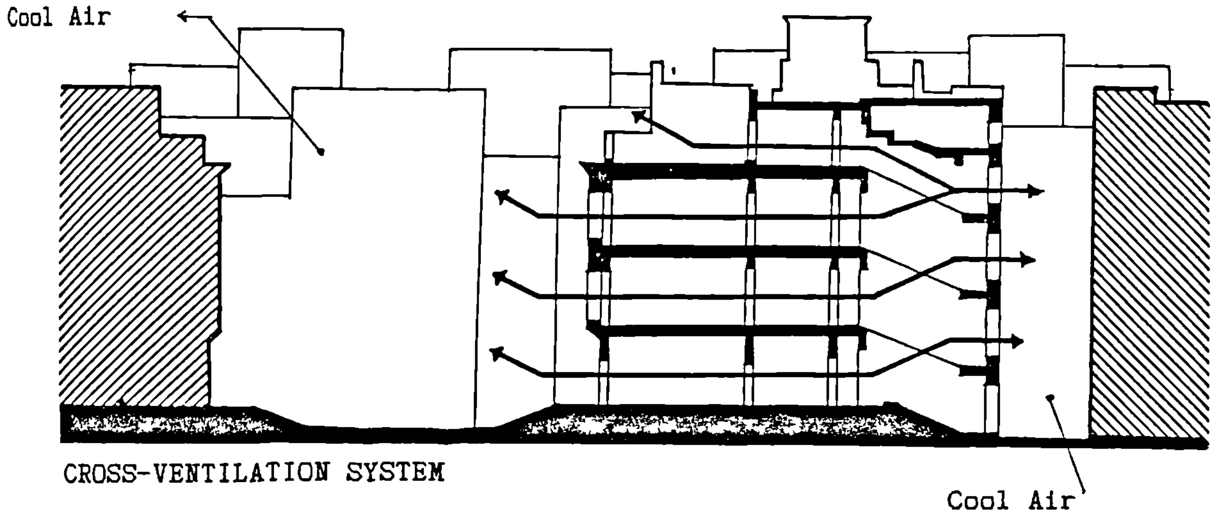
Figures 7.1-7.3 show the 'stack effect' and cross-ventilation systems in a traditional building in Jeddah.

FIGURE 7.1.



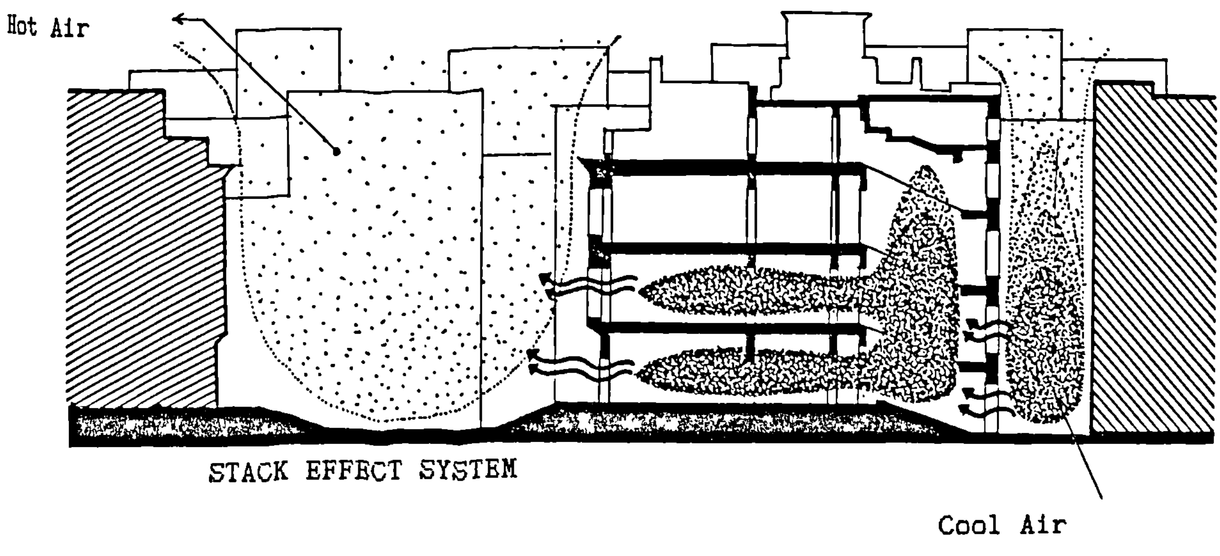
SECTION - A TYPICAL BUILDING IN THE OLD PART OF JEDDAH

FIGURE 7.2.



CROSS-VENTILATION SYSTEM

FIGURE 7.3.



STACK EFFECT SYSTEM

When applying these concepts to school building design in the contemporary urban pattern, there are constraints. It is likely that the school building elements themselves may be designed in a similar way to the traditional urban pattern. For this, the following design measures should be considered:

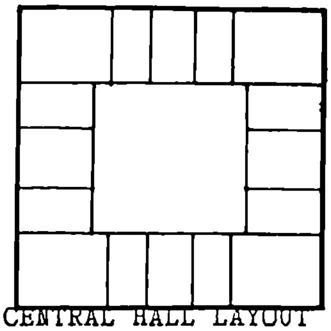
(1) Building layouts such as closed central hall and double banked corridors and finger plans should be avoided. This is because:

(a) both the cross-ventilation and 'stack effect' systems are difficult to achieve in these plans with a central hall and blocks having an internal corridor

(b) although a finger plan layout is perfect for direct cross-ventilation, it is not, however, an ideal solution for efficient 'stack effect' ventilation. This is because such a layout does not usually form areas where the outside air temperature is cooled.

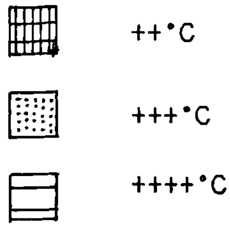
(2) Complementing the functional requirement defined earlier, layouts such as cluster courtyards, buildings arranged as in city streets, should be incorporated in the design. The reason for this is that such layouts could help to increase and keep a significant difference between the inside and outside air temperature, thus causing sufficient pressure differences required for pleasant air movement. This factor can then be used to create a suitable internal environment and moreover can be considered as a suitable generator for architectural form. Figures 7.4, 7.5, 7.6 and 7.7 show, theoretically, the hierarchy of air temperatures between

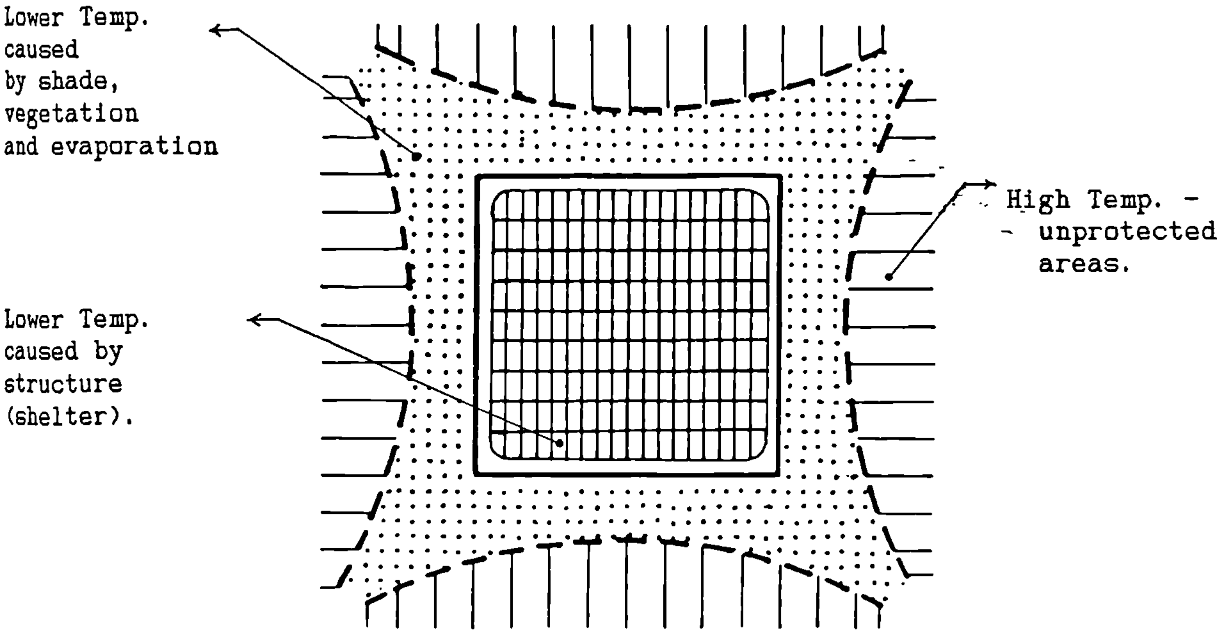
FIGURE 7.4



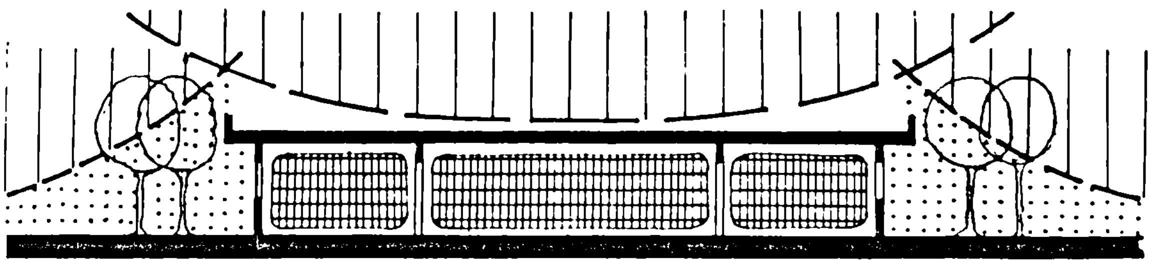
CENTRAL HALL LAYOUT

Central Hall Plan: Poor Cross and Stack Effect ventilation.



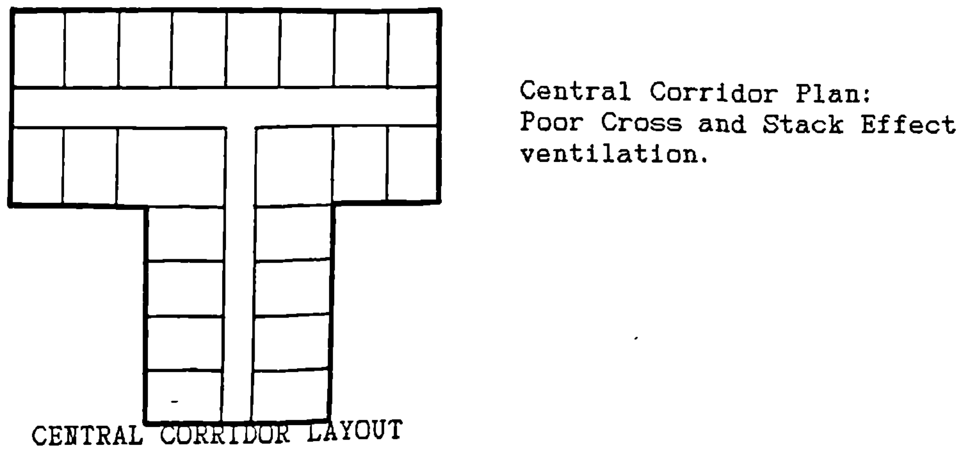


HIERARCHY OF TEMPERATURE

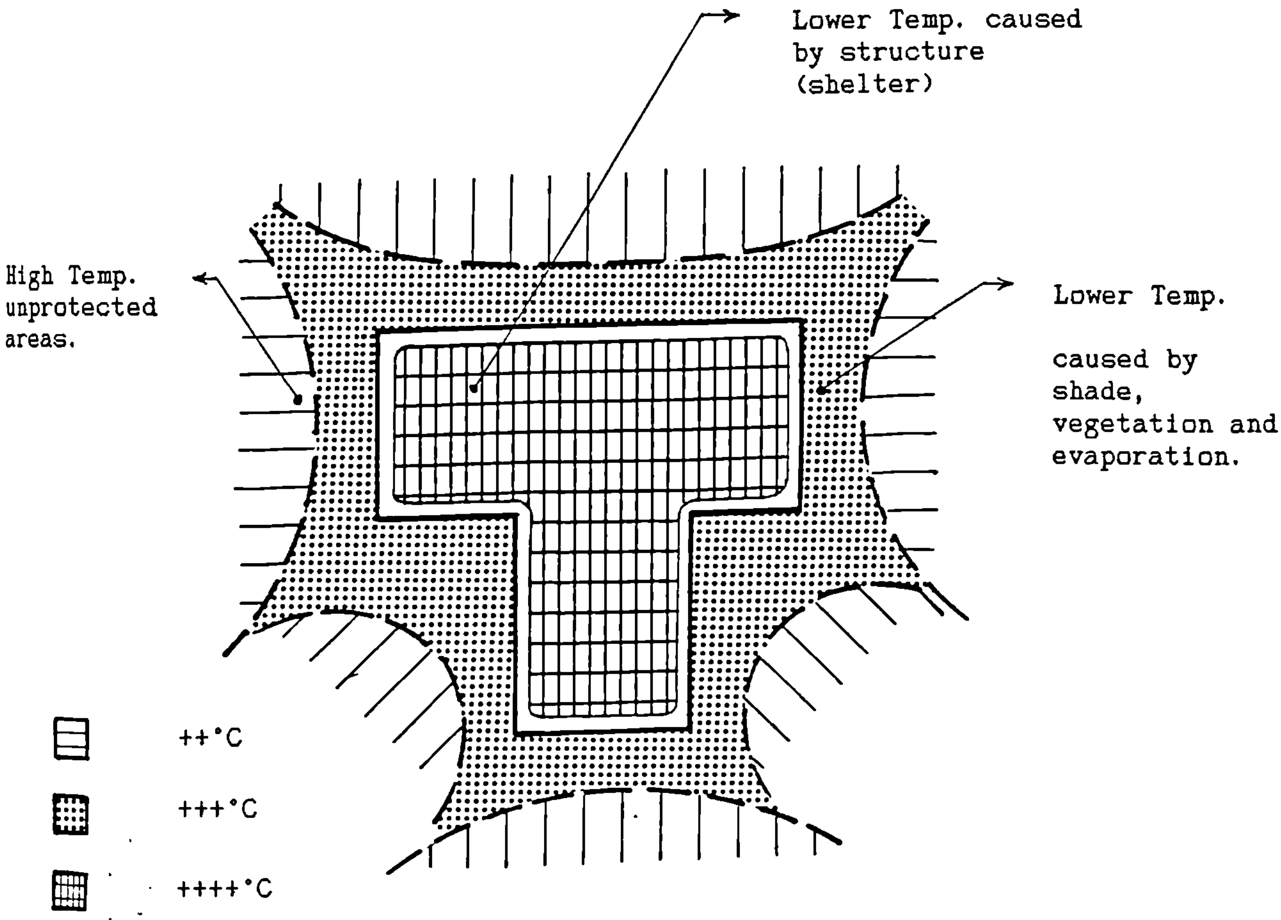


SECTION

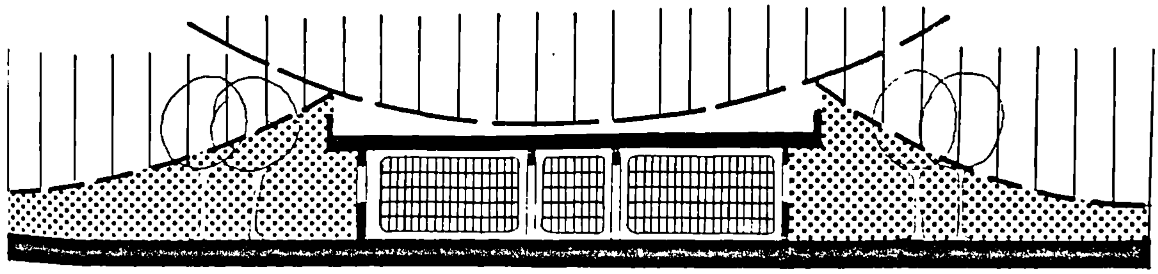
FIGURE 7.5.



CENTRAL CORRIDOR LAYOUT

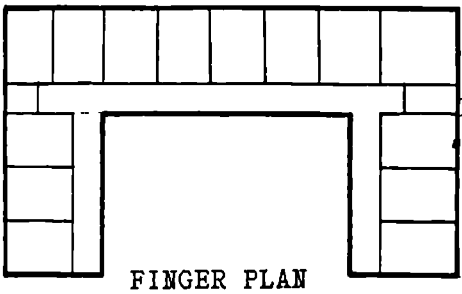


HIERARCHY OF TEMPERATURE



SECTION

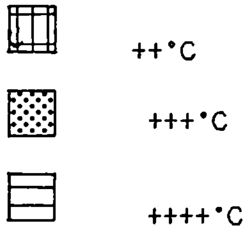
FIGURE 7.6

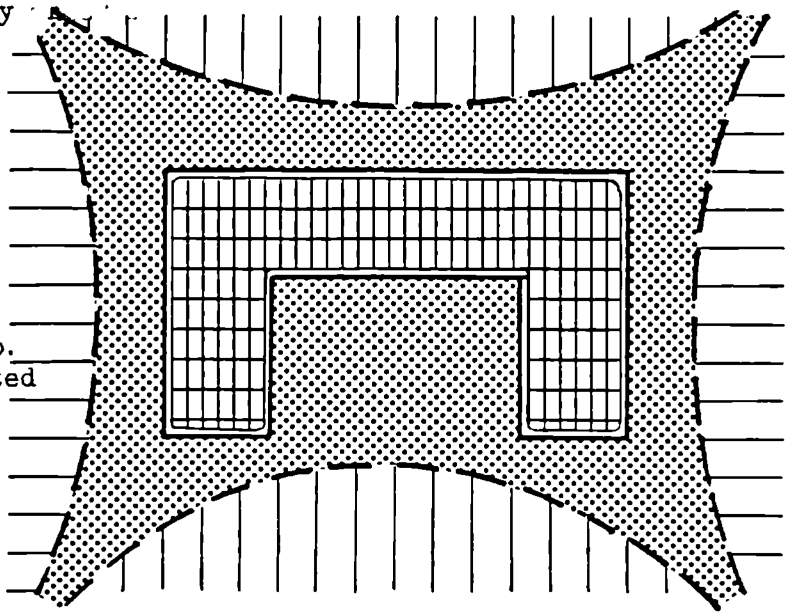


FINGER PLAN

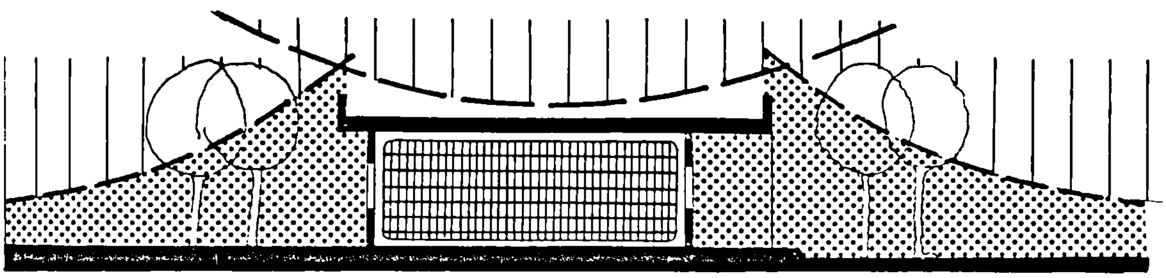
Finger Plan:

- Good Cross-ventilation
- Poor Stack-effect ventilation.



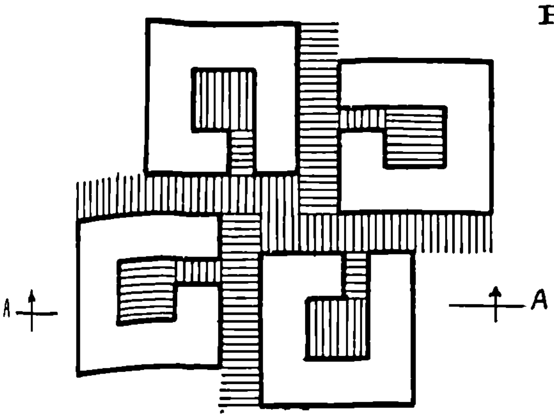


HIERARCHY OF TEMPERATURE

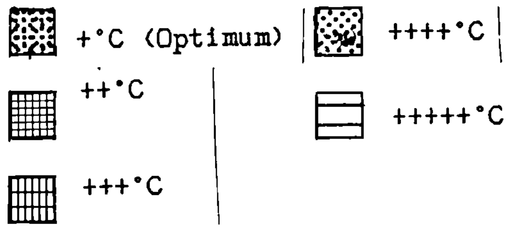


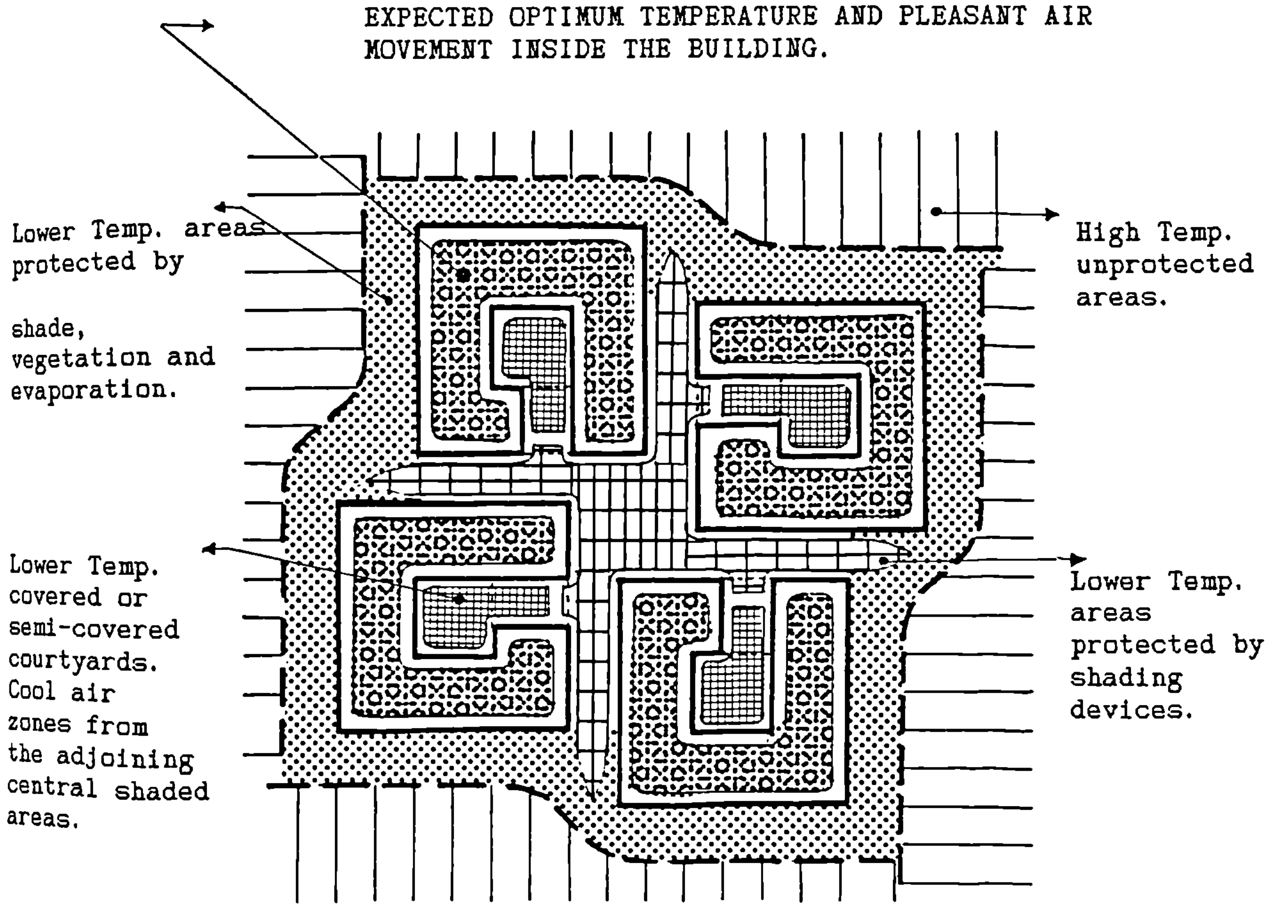
SECTION.

FIGURE 7.7.

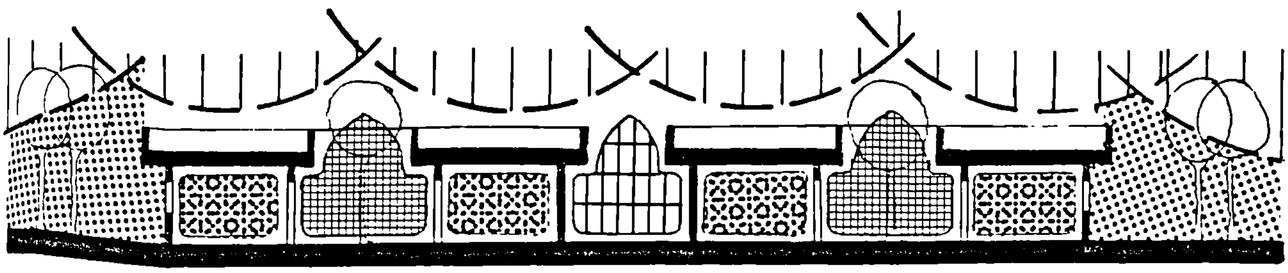


CLUSTER COURTYARD AND STREET TYPE LAYOUT.





HIERARCHY OF TEMPERATURE.



SECTION. A - A.

inside and outside the building. The outward and inward cluster layout with its courtyards and shaded circulation areas will have the following advantages:

(a) Five different temperature zones rather than three, as in the other closed systems (central, central corridor and finger plan layouts).

(b) The outside hot air will pass through four zones, which will act as filters before it reaches the internal teaching spaces. This long travelling distance will help the air to be cooled. It would be possible with relatively little expense to allow for dust collection and air filters.

(c) In addition to the above points, courtyards and open spaces will help to reduce the internal level of noise and provide natural lighting and create a pleasant atmosphere. It should be noted that planting is of importance in these schematic layouts.

(3) Areas in each cluster that require natural cross-ventilation (i.e. classrooms), and which can be located in the prevailing wind direction, should be provided with separate inlet and outlet openings.

(4) During the early afternoon period when the outside air temperature is high (exceeding 30°C), and/or in areas which cannot enjoy the prevailing wind direction (usually onto south facades), the 'stack effect' system should be applied. Because the system requires differences in temperature between certain areas of the building and the exterior to

work, air should be cooled down before entering the rooms. Devices which can be used are:

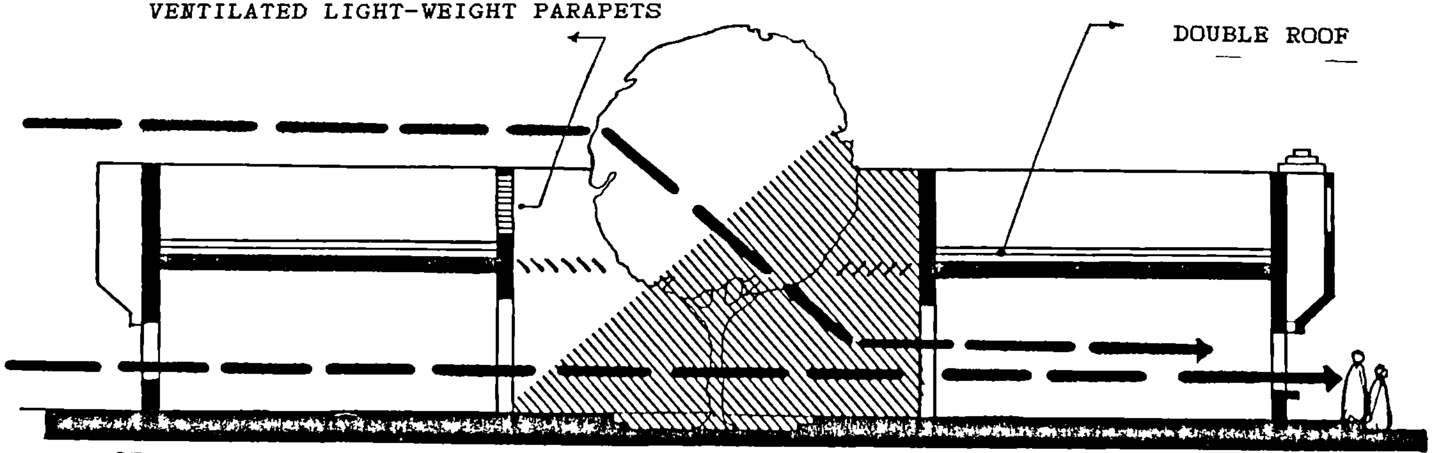
(a) All areas around the building should be planted and provided, if possible, with water where air can be cooled by evaporation. The use of water containers is traditionally used in India for example. Fountains and decorative pools can also be used.

(b) Circulation areas inside and outside clusters need to be designed to act as narrow covered or semi-covered streets and courtyards to give shade and prevent heat build-up by exposure to direct sunlight. Plants and shade should also be provided in these areas where appropriate. The relatively cool outside air around the building will be cooled further inside these circulation areas before entering the teaching rooms. (See fig. 7.7.).

(c) The hot air inside the teaching rooms can be disposed of vertically through high level outlet ducts. The planning and shape of these ventilators form a separate study. Convection can be assisted in a variety of ways.

(d) To increase the pressure differences between inside and outside, the higher part of the chimney or the area directly outside the outlet opening should be designed to increase the air temperature at a high level by using suitable materials such as glass and steel. This in turn will speed up the air movement which will cause a pleasant effect inside the rooms. (See figs. 7.8-7.16).

FIGURE 7.8.



SECTION A-A: DIRECT CROSS-VENTILATON.

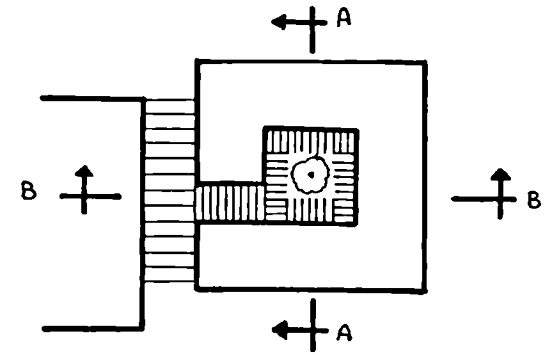
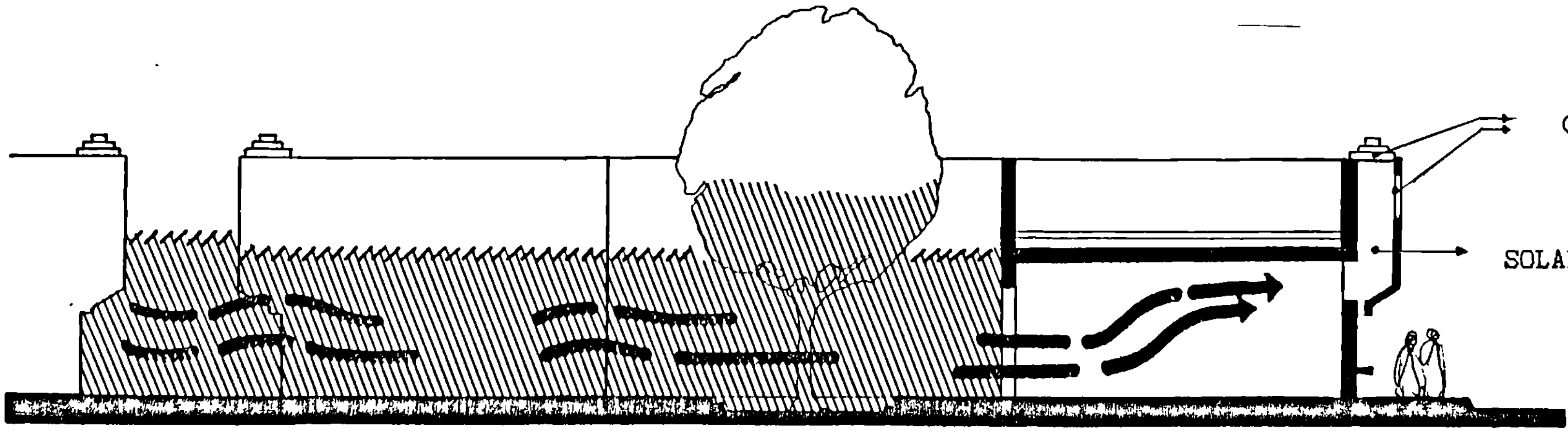


FIGURE 7.9.



SECTION B-B: "STACK-EFFECT" VENTILATION SYSTEM.

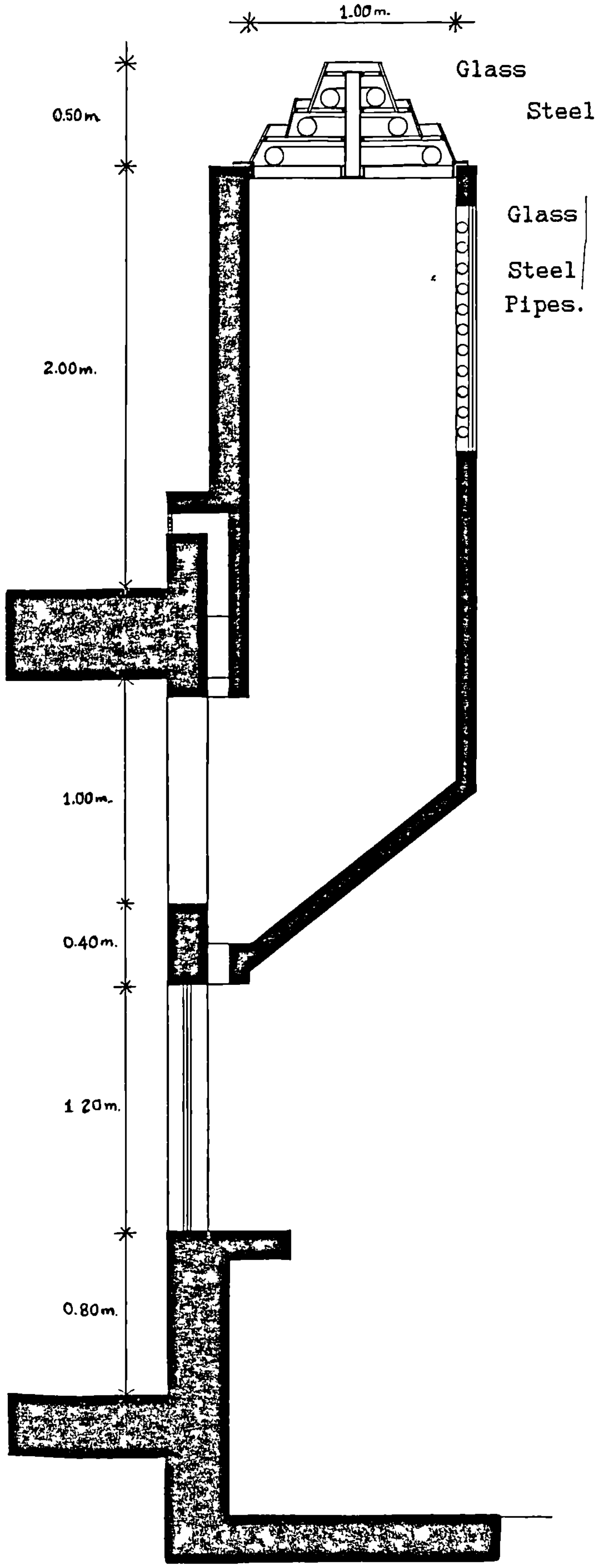


FIGURE 7.10

Section in the
Solar Chimney Duct.

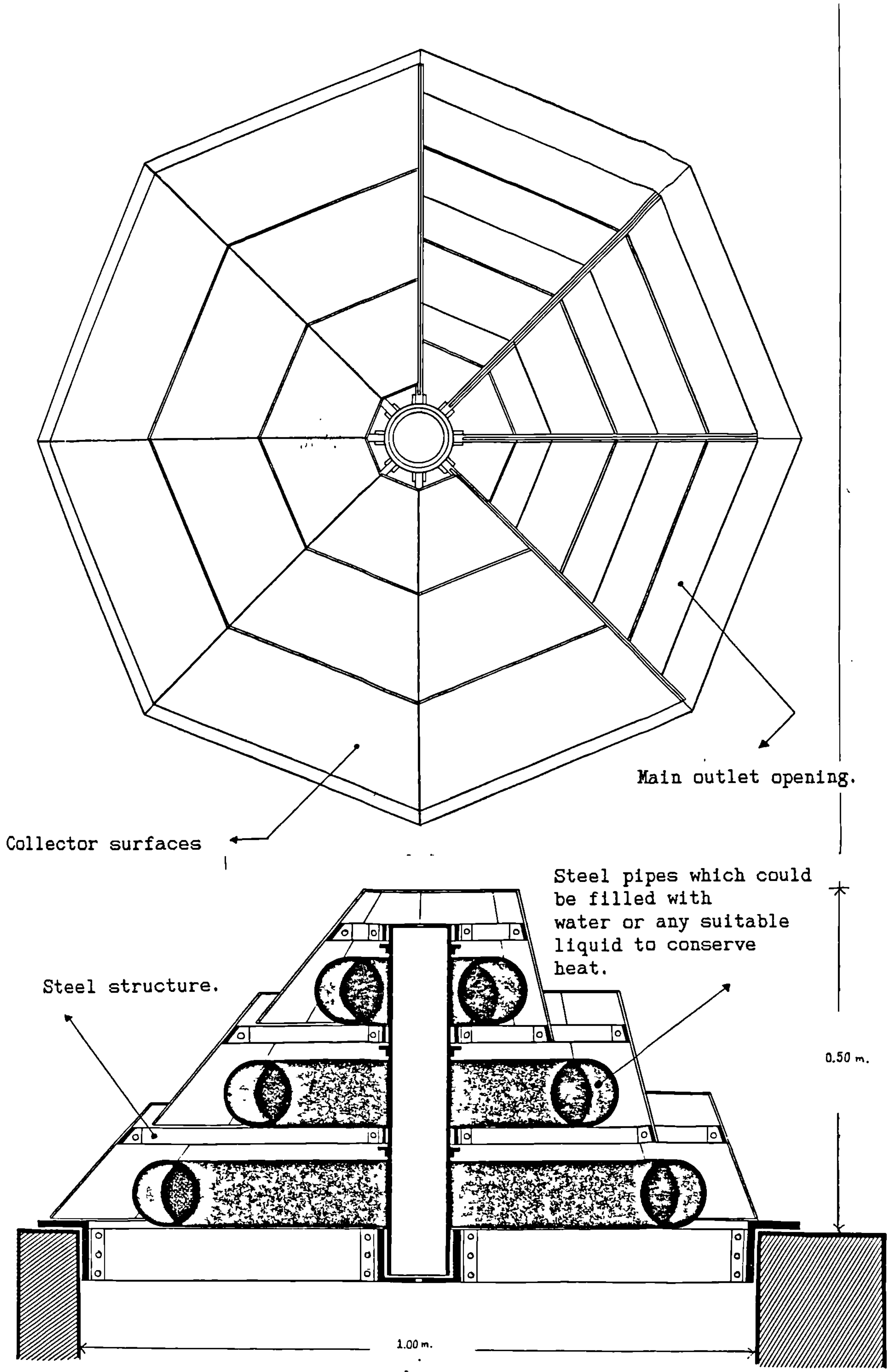
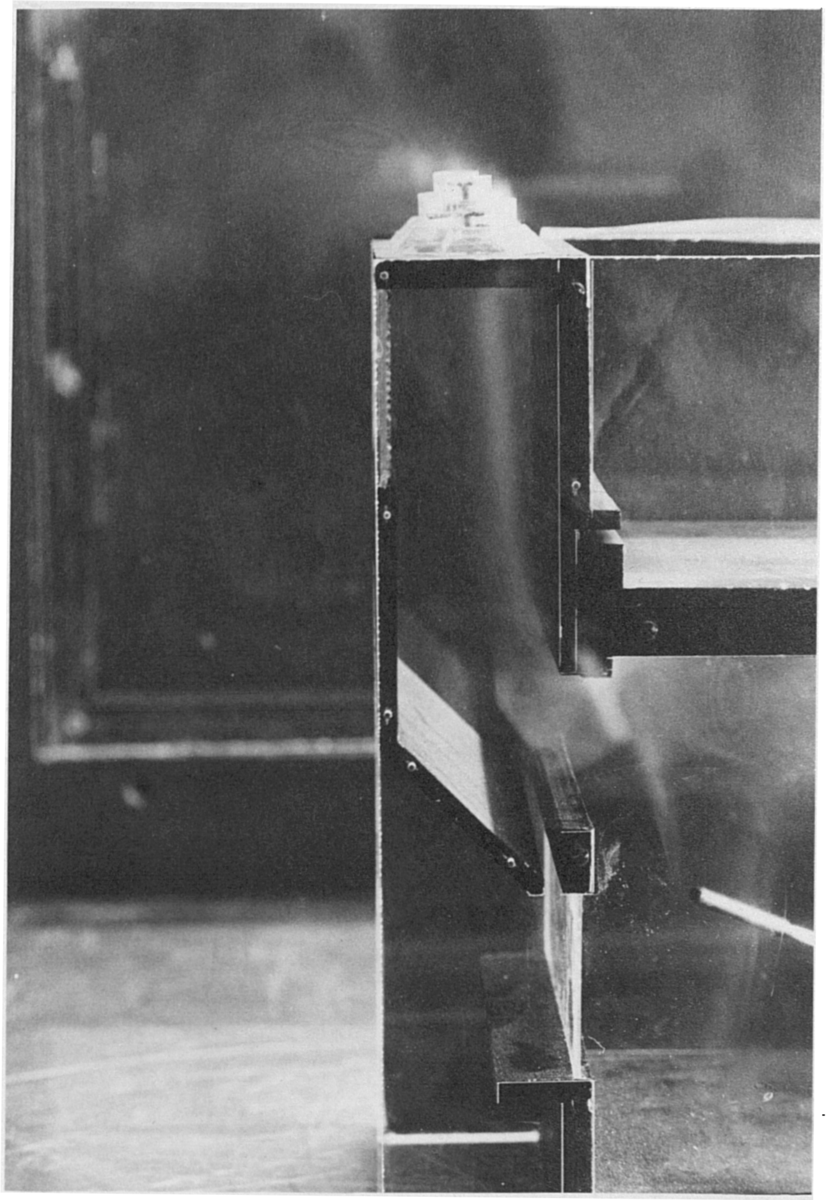
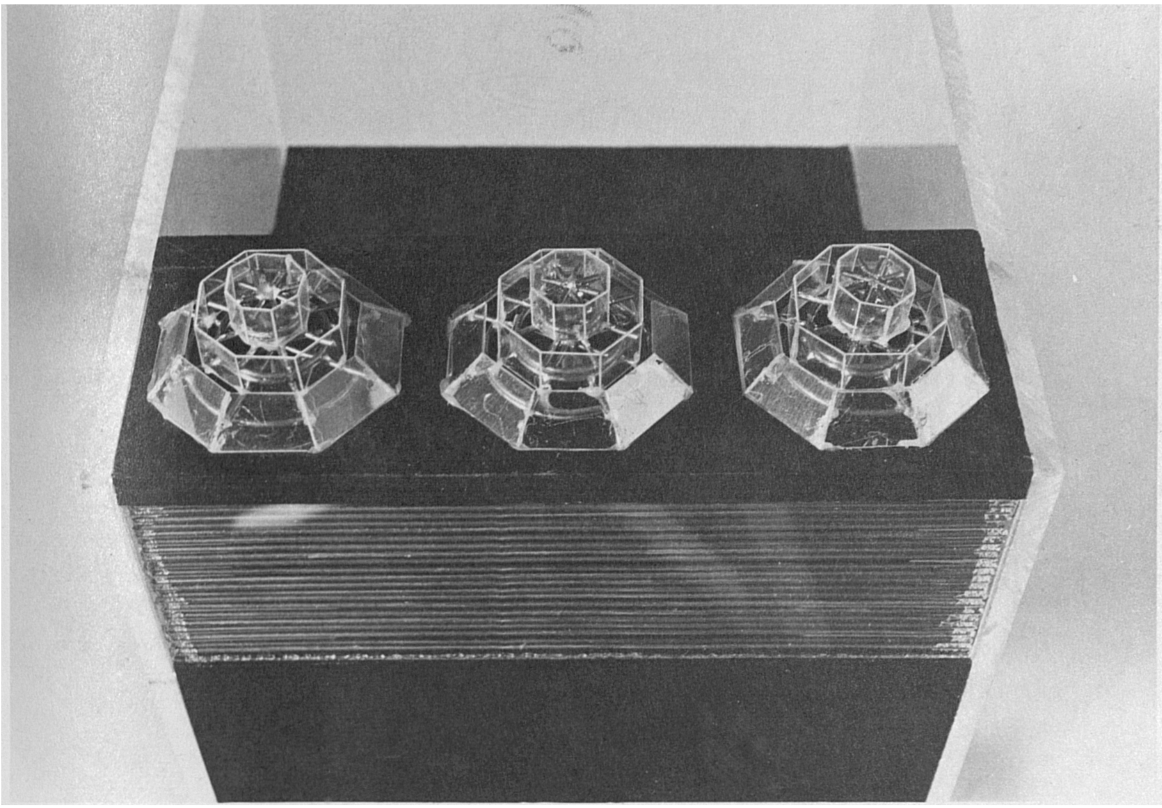


FIGURE 7.11 - A detail section showing the top part of the solar chimney. Part of the octagon venturi shape should be designed to collect heat (up to 80°C) and resist wind. The other part is to be shaped to let hot air escape through. The octagon or circular shapes help to overcome the problem of orientation.

FIGURE 7.12.



A model of the chimney duct has been made to examine the air flow by using the wind tunnel. This picture shows the flow of the smoke in and out of the chimney.



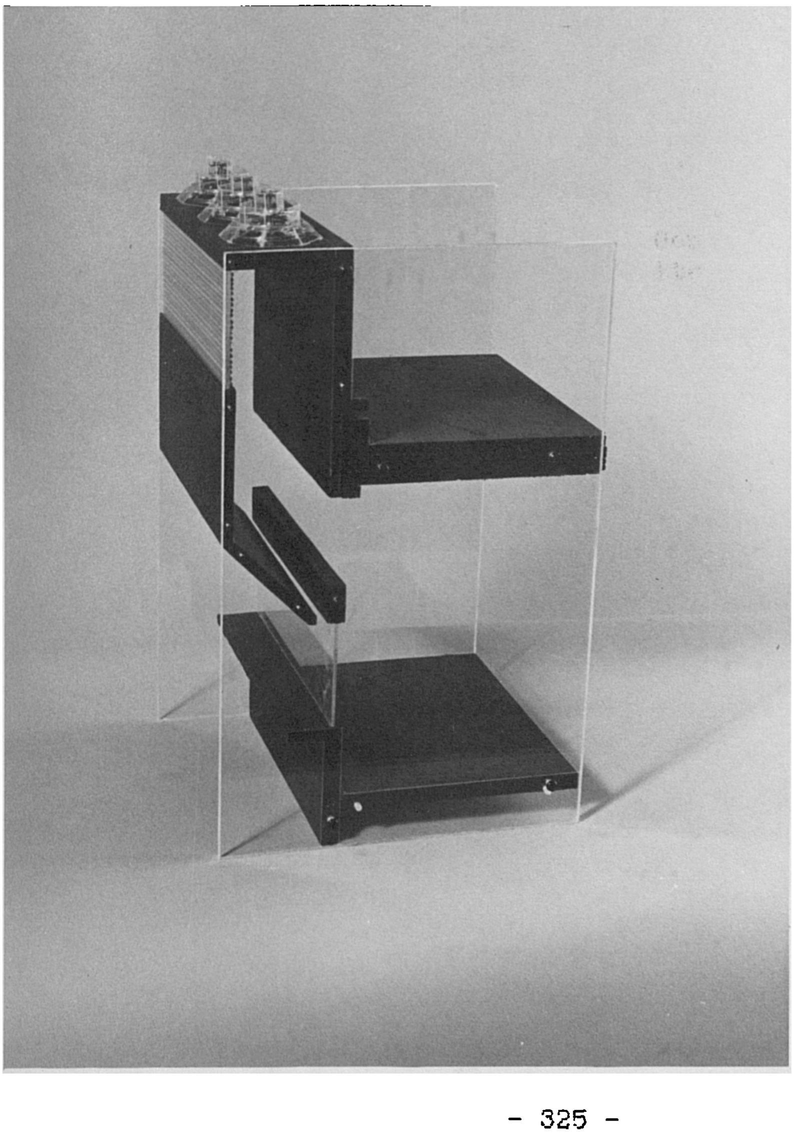
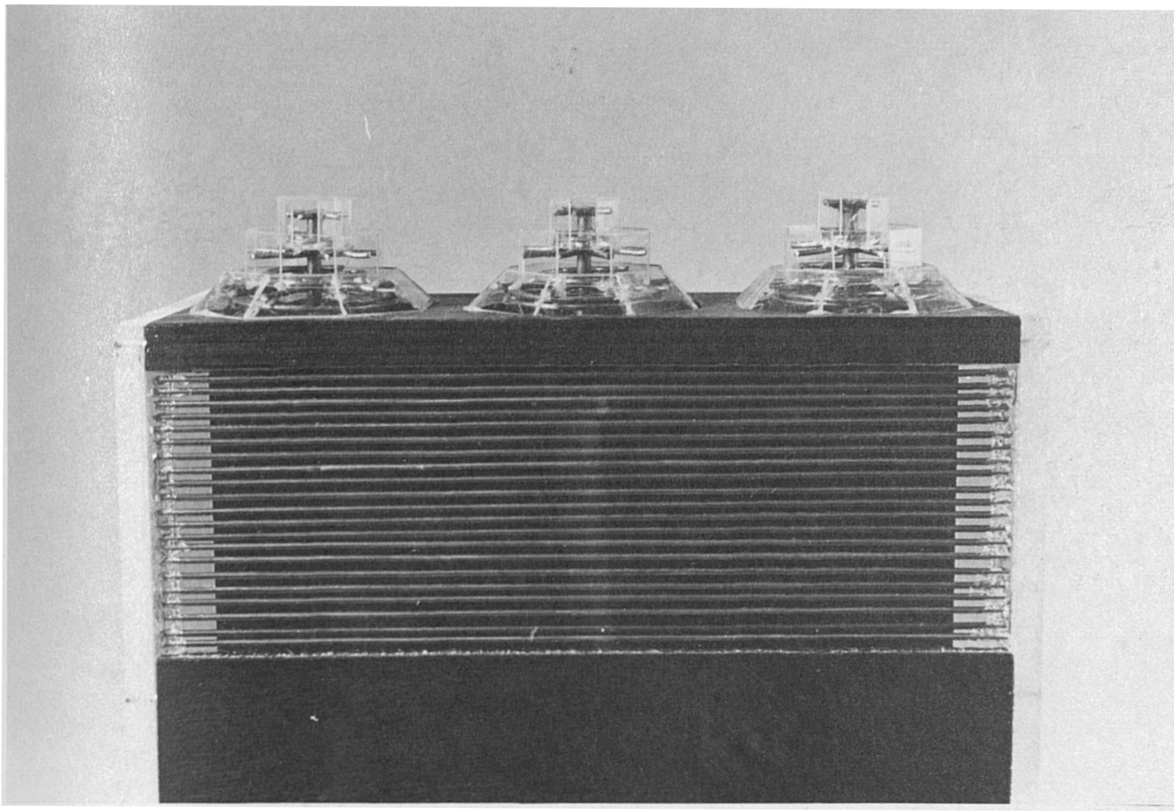


FIGURE 7.13.

FIGURE 7.14.

General view of
the model.



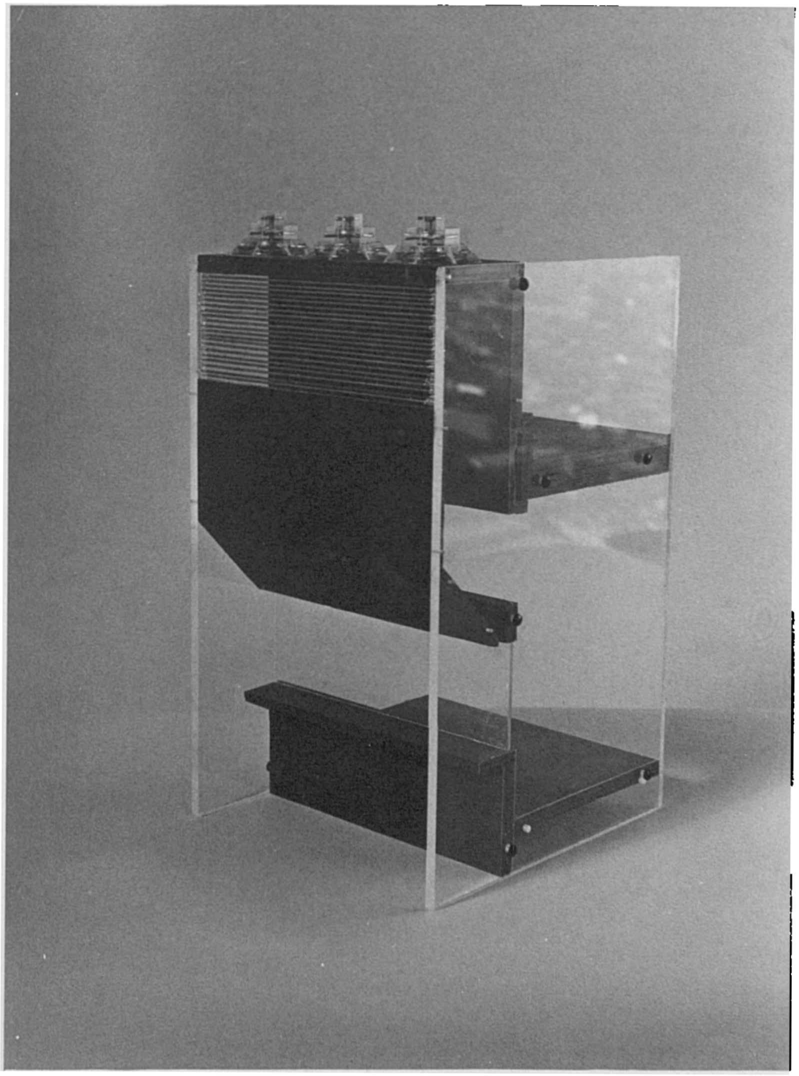


FIGURE 7.15.

FIGURE 7.16.

General view of
the model.

(e) Chimneys should be protected from dust, rain, flies and other insects by using suitable covers and the use of suitable fine wire mesh when required.

(5) To permit the building to cool down quickly during the evening and at night time, the techniques used earlier can be used. Shading of the structure to prevent heat build-up is clearly of importance. Where this cannot be avoided, e.g. protection from low angle west sun it is often difficult to provide economically. The use of reflective surfaces and materials which do not have a high thermal capacity is of value. An alternative is to calculate the thermal lag of materials so that discharge of heat into the interior takes place when the building is not in use and heat can be dissipated in a cooling period before the occupants arrive. This technique is usually used overnight and has implications for community use in evenings. It might be worth zoning such areas to the east so that natural cooling takes place before use.

(a) Since the concept of movement from upper floors to the lower cooler floors is not applicable in most school buildings, the treatment of the roof is of great importance. Roofs, in addition to the provision of suitable insulating materials, should be given special shading protection, such as:

- fixed or movable shading devices using light coloured concrete tiles, asbestos cement tiles or any other suitable light-weight substructural materials.

- creation of a vertical space between an upper roof and the lower structural roof.

- Plantation using creepers, vines or grass if possible can be used. This in turn may encourage the roof to be used for teaching or non-teaching activities.

Parapets should be high, vented and of light-weight material. The height of the parapet will provide some shade for some parts of every day.

(b) Large external openings can be used, providing that they are fully shaded. This helps the spaces to cool down as well as providing good natural lighting. In girls' schools, privacy will dictate the size of openings and it may necessitate the use of "mashribia". For such a situation, high-level or top openings will be required.

(c) The provision of the cooling chimneys in the building will also help to ventilate and cool down the structure safely during the night for as long as the convection airvents last.

PARTICULAR REQUIREMENTS AND DESIGN ASPECTS OF INTERMEDIATE SCHOOLS IN JEDDAH.

In this section the particular requirements and design aspects of intermediate schools accommodation will be proposed, but before going any further in this, it is necessary to consider first the spatial requirements of new schools. This includes basic information on the size of the school, the categories and organization of spatial accommodation required in each case, and the site and area allocation needed.

SPATIAL REQUIREMENTS.

I - THE SIZE OF THE SCHOOL.

In project no. 203, the Deputy Ministry of Town Planning has proposed the following standards for boys' and girls' intermediate schools:

CATEGORY	RECOMMENDED STANDARDS BOYS		GIRLS	
	New Districts	Existing Urban Areas	New Districts	Existing Urban Areas
Population served	30,000	20,000-30,000	30,000	25,000-30,000
Pupil place per classroom	25	-	25	-
Classrooms	24	-	24	-
Site area per pupil place (m^2)	23-25	-	15-16	-
Floor space per pupil place (m^2)	4	-	4	-
Site area ha,	1,5	,8-1,0	1,0	,7-,9
Building area (m^2)	2,600	-	2,600	-
Parking spaces	30	-	30	-
Capacity (pupil spaces)	650	400-650	650	500-650

The report goes further to give what is called "general design criteria for schools:[1]

(1) The site should be properly graded and landscaped with plant material that is not dangerous. Cactus plants should be avoided.

(2) The site should be fenced for security and safety of children; barbed wire fencing should not be used.

(3) Appropriate parking areas for staff and visitors should be provided within the premises.

(4) The site should be appropriately treated to provide outdoor area protection from noise, pollution, smoke, dust, sand storms and other environmental hazards.

(5) The building layout should be preferably introvert and open onto a court. It should also ensure natural ventilation and daylight.

(6) A judicious choice of building materials and colour scheme should be made.

(7) The form of building should be attractive and cater for psychological and physical development of the children.

(8) Covered play areas admeasuring $500m^2$ for games like volleyball, basketball, badminton, etc., should be provided.

(9) Outdoor play areas should be provided for active recreation and any loose top soil should be stabilised.

(10) The building should be acoustically controlled and walls and openings should be treated so as to provide protection from dust, smoke odours, noise and pests.

(11) Girls' schools should be designed to ensure an appropriate level of privacy.

Although the above recommended standards and design criteria have been formulated with consultation with the Ministries/ Departments responsible for the provision of school facilities, and which will be accepted, some of the recommended standards are questionable and need to be reconsidered in the light of the surveys made and developments elsewhere in the world.

First: The recommended pupil place per classroom (25 students per classroom) is not an ideal figure within the existing situation of a shortage of school places and teachers. An average of 30 students per classroom has been widely accepted as a practical compromise. However, some flexibility is needed. Since the number of students per classroom is variable, the area per student will vary too, but at the same time, it should neither fall under the minimum $1.5m^2$ per student, nor should it exceed a maximum of $2.0m^2$ per student. With the acceptance of the report's recommendation (25 students per classroom) as an ideal minimum, the maximum will therefore be around 33 students per classroom if the area per student is to be maintained.

Although the average class/group which is accepted as a working size for the purposes of this thesis is 30 students, there is some margin for the architect to achieve flexibility in planning. A further point is that the teaching space should be at least 60% of the total floor area.

Second: The capacity of the school 650 (students) is recommended by the report for all schools is a result of work which led to the adoption of standard layouts. This is uneconomic as a substantial swing can be made by reducing the number of class groups. It appears from calculations (See Appendix C) made by the author that 22 class teaching areas would suffice. The original number was dependent upon classes of 25. The survey showed a number of unused rooms.

II - ORGANIZATION OF TEACHING ACCOMMODATION.

The organizational proposal will be based on the principle of 'year group centres' as has been justified earlier in this chapter. Three year group centres will be needed for general teaching accommodation. Each centre will be provided with a reading and private study area.

The three year group centres will be served by a specialized teaching facility. This is expected to become a learning resources centre in the future, giving the required flexibility for educational change. This includes arts and crafts, workshop centre, laboratories (both science and language), needle crafts and home economics. A multi-purpose hall will be provided to be used for social, recreational and dining activities.

FUNCTIONAL REQUIREMENTS AND DESIGN ASPECTS.

I - YEAR GROUP CENTRES.

It is beyond the scope of this study to decide the optimum size and capacity of a school. Such a decision, which is the responsibility of educational planners, involves many variable factors such as demographic trends, student enrolment, availability of school buildings, financial support, etc. However, for the sake of example, a hypothetical figure of 550-600 students will be used as the basis of planning for a medium sized urban school with a frequency of use for specialized and non-specialized spaces of 75% and 85% respectively. The architect will require the exact size, space standards and cost limits to which he is to work for a specific school.

Since the teaching activities in the three centres are expected to be similar at the mean time, the contents of the centres will be equivalent too. Each centre will consist of:

- classrooms (1.5m^2 per student minimum).
- storage spaces and wash basins.
- reading and study area (mini library).
- teachers' base and accommodation.

Although the arrangement of the year group centres and their relation to each other will secure economy of movement of both students and teachers about the building, accessibility and circulation between them should be easy and protected. On the other hand, the total internal environment should provide students with a strong sense of belonging to "their" centre. In responding to the traditional qualities of Islamic school buildings (See Chapter 5) as well as modern educational concepts, a home-like atmosphere should be created. Spaces such as the reading and study areas as well as circulation routes in each year group centre will be the target for creating such an atmosphere. Traditional architectural elements such as the "iwans" and shady courtyards can still be applied to accommodate the above requirements. It is considered that the sense of identity is most important in this context.

CLASSROOMS.

Although most of the classroom's activities will be expected to be formal, where students sit in rows facing the teacher and blackboard, stimulative measures should be introduced to encourage teachers who are willing to use any other particular layout to give a suitable ambience to their teaching. Such measures are:

- light-weight movable desks and seats, or bench seats for two can be used. Fixed desks and seat units and desks with sloping surfaces should be avoided.

- Although fixed chalkboard can be assumed to be cheap, a movable rotatory chalkboard is functionally flexible, as well as reducing the static relationship found with a fixed position for a chalkboard.

- Floors in classrooms should be flat. Any kind of stepping or raking of floors will obstruct the possibility of change.

- With the large number of subjects that will be taught in the teaching area, the equipment and furniture of such spaces are important in improving the quality of learning activities. For many subjects such as science and hygiene, geography, history, etc., horizontal and vertical display surfaces are essential. The horizontal surface is needed to display any three dimensional illustrative aids. A light-weight movable bench must be provided. It can also be used by teachers, who need a place for their papers and other belongings. The vertical surfaces are needed to display large and small light-weight materials such as maps, diagrams, photographs, etc. For this, soft display boards are required.

Teachers, who may need to use projectors for short slide shows, etc., require well positioned electrical outlets and reasonable darkness. For this, internal or external devices can be used, such as venetian blinds, opaque roller shades and fabric curtains. It will be appreciated if one external device can be used to provide shade and darkness when any one is required. There are clear implications for admission of light and ventilation openings in the climate of Saudi Arabia.

Activities such as speech training, writing and listening in classrooms, necessitate an adequate level of lighting, ventilation and acoustic conditions. The decision to provide natural ventilation (See Chapter 4) makes the problem of sound and noise in classrooms difficult to predict. However general measures can be set up to reduce the background noise level, which can not be totally eliminated either inside or outside.

First: for external noise:

- the distance between a classroom or other teaching areas and sources of noise (main road) should not be less than 20m., if the size of the site permits this.

- A high, solid wall, or another building (kitchen, storage, etc.), between the noise sources and teaching areas can be used for sound reduction purposes.

- Some authorities contend that high and closely spaced trees and grassed areas will help to reduce the background noise level. Trees lose their leaves at seasonal intervals. The use of grassed mounds has been shown to be effective.

- If the above measures can not be achieved for reasons such as limitation of siting, very high level of external noise and pollution, mechanical ventilation (air conditioning) could be used, and the external noise will consequently be brought under control. There are then of course other constraints on the design, and this should only be considered in really difficult areas.

Second: for internal noise control, the 'classroom' concept is effective, but the need for cross-ventilation makes sound and noise transmission through the building and between classrooms more easy. However, problems such as echoes or other acoustic phenomena will not be expected to be found in classrooms. Therefore, the main internal noise problem is the reduction of the background noise level which is created by activities in the classrooms themselves, to about 30 to 35 BNL. For this:

- Partitions and walls between teaching spaces should be of high sound absorption materials.

- The noise transmission paths from one classroom to another through other areas such as circulation spaces, should be detected to identify any possible sound reflective surfaces. Such surfaces can then be constructed and treated to be sound absorbent rather than reflective.

Lighting standards in classrooms and other parts of the school have been shown in detail in Chapter Four. However, the contribution of design in improving the quality and quantity of the total lighting and visual environment should be considered. In general terms school work requires a uniformly high level of illumination at the working surface level. This is usually taken to be at desk height. The depth of the classroom plays an important part in achieving uniform illumination. The greater the depth, the less the achievement of uniform illumination.

In a cross-ventilated classroom, two openings are inevitable. Although this may seem advantageous from the lighting and illumination point of view, in Saudi Arabia, as in other tropical countries, this is not so simple. This is because:

(1) Natural daylight often means heat, so large unshaded windows cannot be used.

(2) If the second window on the opposite side opens onto a covered or semi-covered space (corridors, or other circulation areas), some of the reflected light, which is coming from the main window will be lost through the glazed area of the second window.

(3) Having too many glazed areas on the other side of the classroom means that the area of the reflective surfaces will be less.

Within such a situation available surfaces in the classroom and in the adjoining spaces should be treated to re-reflect light while avoiding glare. This can achieved in the following ways:

(1) The use of light colours, of course, will enhance the reflectiveness of surfaces of classrooms and the adjoining spaces. Such a scheme of light colours could, on the other hand, cause a visual monotony and unwanted pale. Therefore, surfaces which are not expected to contribute in reflecting a great amount light can be given different bright and contrasting colours. These surfaces are furniture, doors, display board frames, etc.

(2) Surfaces outside the classrooms and in the adjoining spaces should be treated to direct the reflected light into the classroom.

Since all activities in classrooms are expected to be within the lecturing form, walls and floors do not require any special treatment of materials. However, durability and ease of cleaning and maintenance are essential. It is preferable for wall surfaces to be smooth to prevent the accumulation of dust and harbouring of insects.

Finally, although most of the teaching activities will be held within the range of the class group of 30 students, occasionally two class groups may join one activity, such as examinations, a film show performance or even when one teacher is absent ill. Such activities require a medium size space in each centre. For obvious economic reasons, such a space can not be provided for those occasional activities. However, two or more already available spaces could be joined together by using openable partitions of the folding, sliding or accordion types. The use of such partitions will imply all previous requirements as regards sound insulation and light reflective qualities.

READING, STUDY AREA, TEACHERS ACCOMMODATION AND STORAGE SPACE.

The educational concept of the progressive year group centre argue that decentralization of some specialized facilities is needed to serve as a small group learning resource and practical work area in each centre. As has been shown earlier in the chapter, this can not be achieved within the existing formal teaching space with an organization based on class groups. It is therefore necessary to partially decentralize non-teaching facilities such as libraries, staff rooms and storage space. In each year centre, there will be a small library and reading area, as well as a teachers' base. Both should be designed to act as a local social centre relating to the group accommodation. This social centre could be adopted in the future to be used as a multi-purpose practical area or as a learning resources centre.

The area needed for this reading and study area and teachers' base can be obtained either by cutting down the area of any main library and the usual group of teachers' rooms centrally planned, or by cutting down other non-teaching areas such as circulation.

The functions and design aspects of these spaces can be explained as follows:

(1) The reading and study area will contain a mini-library and reading space. Arabic and English subjects such as reading, composition, handwriting and dictation will benefit from such a facility. Books can be related to the teaching material required and the levels of achievement expected in each area.

(2) For more utilization during non-teaching periods (i.e. mid-day break), the area should be designed for public use by students. For this the layout can be either open or semi-open by using openable partitions (folding or accordion types). It can also open onto a circulation area, which will be used as an extension area for formal and informal activities.

(3) The reading and study area will contain furniture such as books, shelves, tables and seats, display board. The shelves can be provided with glazed doors and locks, if security is needed. The use of carpets will reduce the level of noise and it will give the home-like atmosphere needed. Similarly, surface finishes could reflect the non-institutional character which is aimed at in these areas, in contrast to the formal teaching areas.

(4) The provision of a teachers' base in the centre will improve the social atmosphere between students and their teachers. The base will be a place for teachers to do their own work, meeting with each other and to provide a private space to talk to some students when it is required. The presence of teachers in the centre will keep it under control.

(5) Although the number of teachers in each centre could vary from one school to another, it is unlikely that more than half of them will be wanting to work on their own at once. Therefore, depending on the number of teachers, worktop or tables 90.0cm. for each place should be provided. Shelves, cupboards, a low table and appropriate chairs should be provided. Again, carpets and curtains would 'soften' the atmosphere.

(6) The location of the teachers' base should be central and visual links to other spaces such as reading and study area, circulation area, etc., should be provided by means of glazed screens or windows. This would help to maintain discipline and assume control of the supervised spaces.

(7) In trying to satisfy the endless demand on storage spaces, decentralization of such a facility in between classrooms is advantageous. This should allow for present demand, but also for the future needs as well. Illustrative materials, papers, text books, chalks and innumerable items of small stock should be handy for everyday use, and such a space is important. For future needs and in addition to the provision of practical area bays, storage and wash basins which are essential for all kind of practical activities will provide each classroom with a 'self-contained' character. This in turn will help to reduce the movement of students and teachers about the classrooms and circulation areas.

Finally, figures 7.17-7.20 show possible layouts of a year group centre of 6 class spaces. This example is a straightforward response to the brief, where emphasis has been given to traditional values, climatic needs and existing and future educational requirements.

The traditional school building image has been restored by using architectural elements such as courtyards, aisles and iwans. The latter is put in to serve as a mini-library and study area, and additionally only to use their traditional qualities to create a mosque like atmosphere. They are environmentally essential, where they help to cool down the air temperature and to reduce the noise level inside the building. They therefore play a part in the total cooling system.

Earlier in the chapter it was shown that ventilation could be used positively to cool working areas. The air is drawn through cooling areas and powered by convection through chimney ducts on the perimeter. It is necessary that each classroom should overlook the courtyard. This in turn has meant that the functions of external windows is to serve mainly for viewing and lighting. As they are not primarily used for ventilation control is much easier in these respects.

Although the layout of classrooms have been designed to respond to environmental needs, it is also designed with a multi-purpose character to serve both existing and future educational requirements. The latter require the provision of different sizes of teaching spaces, practical area bays with storage and wet space facilities.

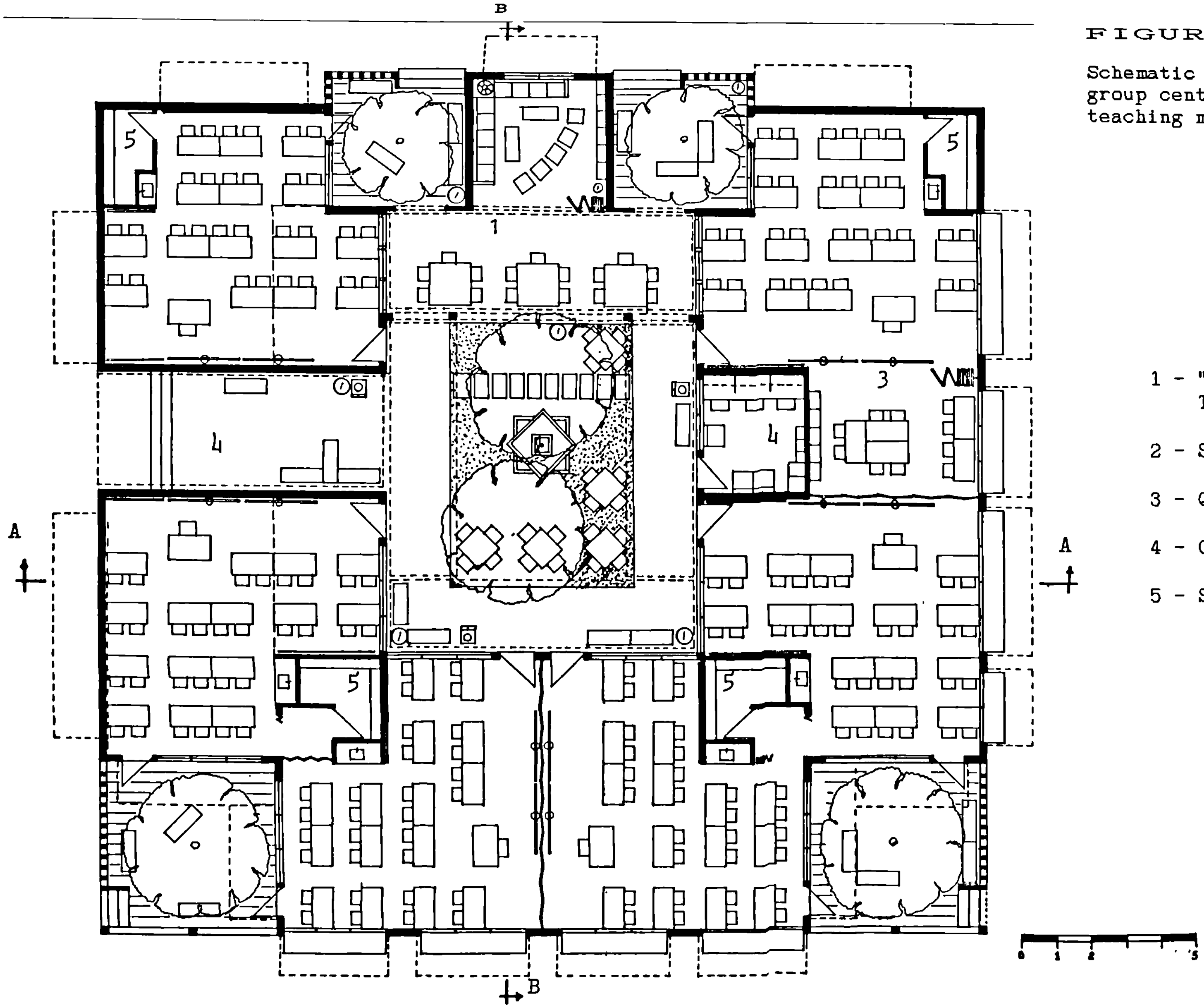


FIGURE 7.17.

Schematic layout for a year group centre. Formal teaching methods are applied.

1 - "The Iwan" Mini Library and Theoretical Study Area.

2 - Staff Base.

3 - Quiet Study Area.

4 - Clear Story.

5 - Storage.

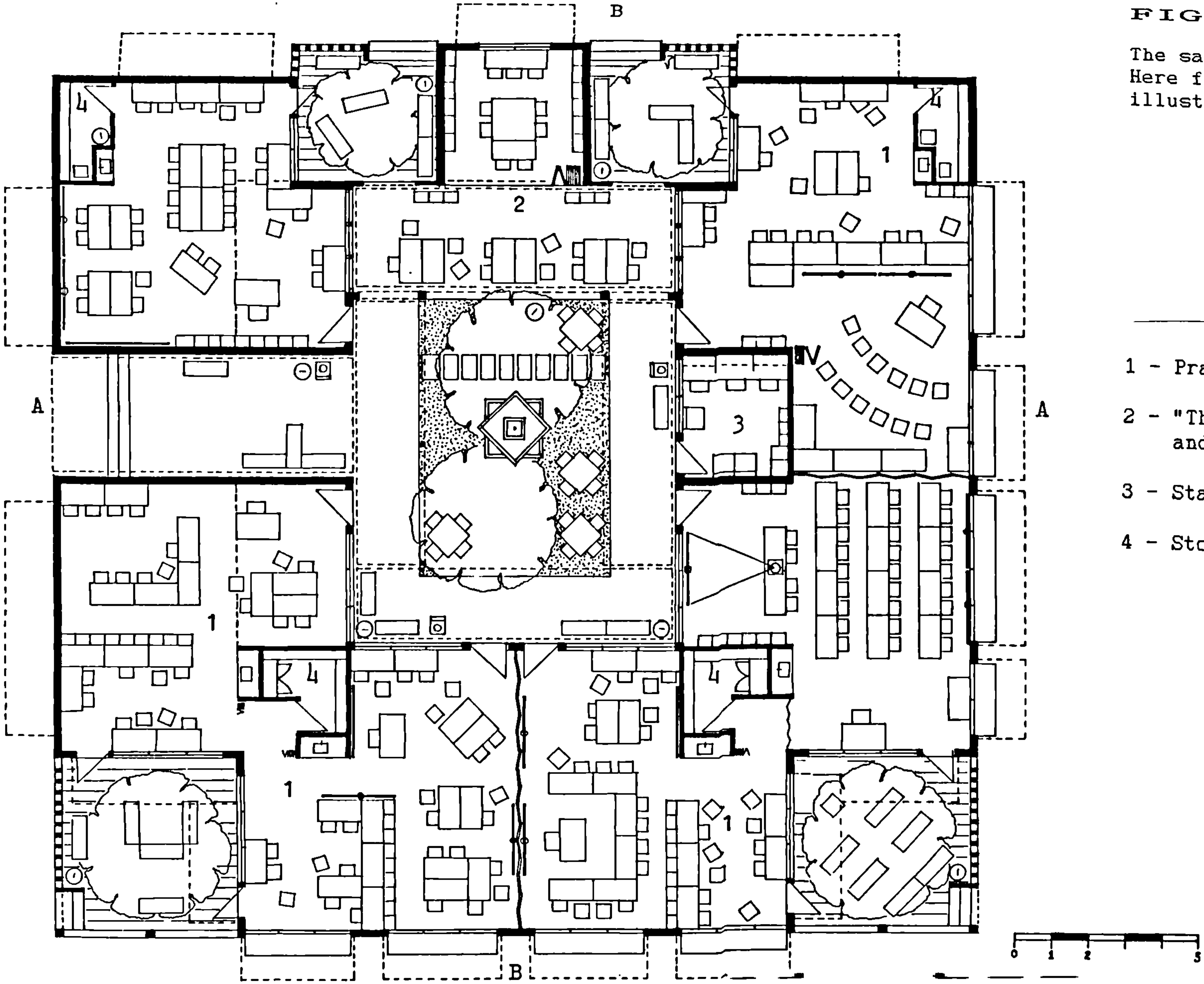


FIGURE 7.18.

The same layout of Figure 7.17. Here future possibilities are illustrated as an example.

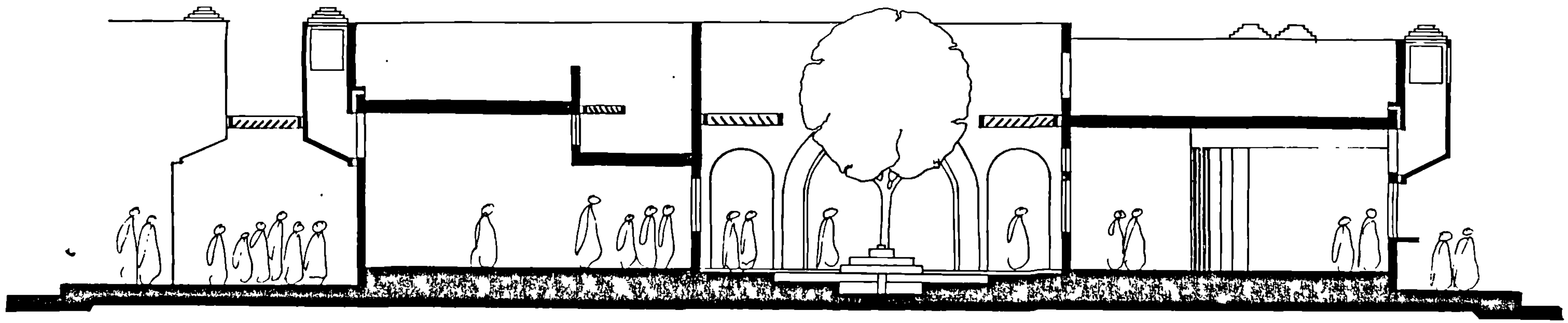
1 - Practical Activities.

2 - "The Iwan" Mini-Library and Learning Resources.

3 - Staff Base.

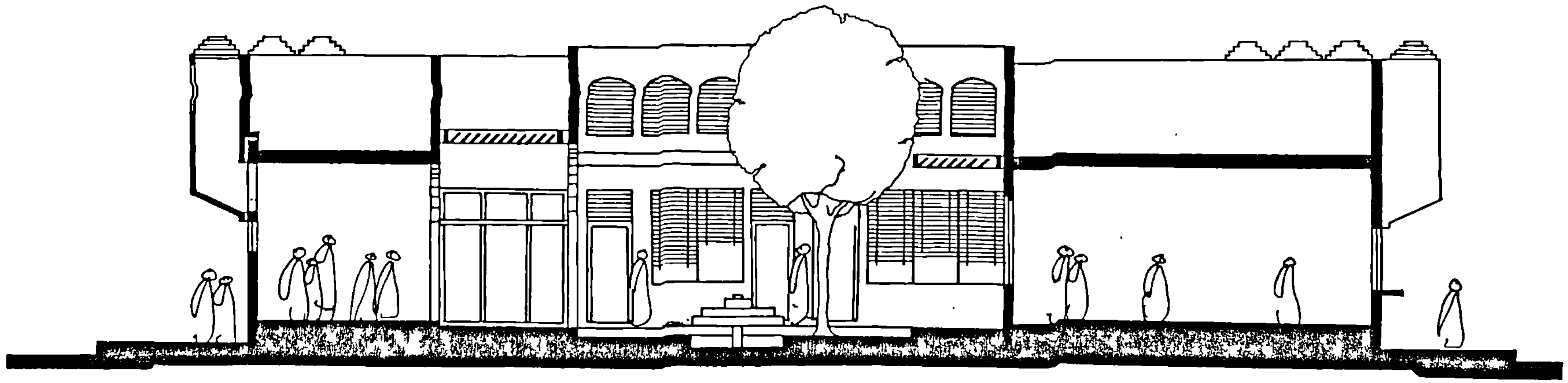
4 - Storage.

FIGURE 7.19.



SECTION A-A

FIGURE 7.20.



SECTION B-B

The concept of using circulation space for practical activities in the future is not applicable to this layout. This is simply because internal corridors have been avoided for climatic and economical reasons. However, this was found to be advantageous. It helped to locate such an activity where it is functional suitable rather than be dictated by the location and layout of the routes through the school. On the other hand, it became easy to control the size of the practical area too. Some or all students can be engaged in either practical of theoretical activities without causing and under or over utilization problems. This could happen if corridors were used. Such a flexible layout, while responding to future requirements, can also be easily used for the present formal teaching methods which are used in the country. Figure 7.17 shows the layout under formal use, while figure 7.18 shows the same layout with possibilities of future use.

II - SPECIALIZED TEACHING FACILITIES.

Within the Saudi national curriculum of general education, distinction has been made between boys' and girls' curricula regarding specialized teaching facilities. Subjects such as textile work (embroidery, knitting, needlework, etc.) and cooking are for girls only, while woodwork and metalwork is for boys. Other specialized subjects common to both are drawing and painting, and laboratory work in both science and language laboratories. In this study such a distinction will not be emphasized, since these activities can be performed equally by boys and girls within the same standards of provision.

It is necessary to emphasize that provision of subjects such as metalwork and woodwork, clay modelling and pottery, etc., will be basic, although at a preliminary level for the age group (12-14) of intermediate schools. Advanced and more elaborate provision will be expected to be found in secondary and technical schools and colleges.

Information and data in this section are based on the British Standards, which are internationally accepted. However other international experiences have been used as alternatives.

A - WORKSHOP AND ART STUDIOS.

Activities which are expected to be found within workshops and art studios are: drawing and painting, three-dimensional work (wood and metalwork), clay modelling and pottery, cooking, needlework and embroidery, and hand or machine sewing. Before going any further in dealing with each activity, it is possible to brief the general requirements common to most activities.

A-1 GENERAL REQUIREMENTS.

Although the above activities range from dry to wet or quiet to noisy ones, their relation to each other should be carefully considered. It is of course necessary to control such conflicting aspects of the activities, but not by segregating the activities from each other by means of isolated departments or rooms. The activities themselves are not in conflict with each other. They all depend on practical craft work and accept a higher background noise level than classrooms or libraries. They are all practised within informal teaching methods, with teachers moving from one work point to another to oversee each pupil's work. Such stimulative unity is best accommodated within one appropriate environment, not only because of economical reasons (reduction in circulation area, etc.) but also educational ones. Practical subjects need to be learned by first and second hand experiences. The former is what the student can do himself, the latter is what he sees and hears of what other students are doing. For this, general visual links should be provided. Areas, for example, which produce a high level of noise such as wood and metalwork and which need to be 'separated', can be provided with some internal screens. On the other hand, adjoining 'dry clean' and 'wet' areas can be separated by a large mat possibly in a mat well to minimise the spread of dirt on floors.

FLOORS.

Floors in general need to be of non-slip materials and resistant to water, oil and weak acids. It should also be easily cleaned by sweeping and washing rather than by special maintenance treatment. Material like quarry tiling (with gullies) should be avoided since it will need to be scrubbed and hosed down. In general materials such as linoleum, rubber tiles, etc. can be used.

WALLS.

Walls in general should be designed for display and fixings. For this soft plaster materials or display boards, etc. should be used. Acoustic plaster materials usually contain light-weight aggregates. This in turn makes them soft, acoustically absorbent and fire resistant. Walls in areas where messy substances such as clay, water, painting, etc. are likely to be splashed will need protective wall finishes such as glazed tiling or easily cleaned impervious surfaces.

CEILINGS.

Ceilings in general need to be designed for reflecting light and absorbing noise. Materials such as acoustic tiles or asbestos spray and insulating boards can be used to reduce noise levels.

DAYLIGHT.

Daylight for crafts activities should be achieved within a minimum of $30Lm/ft^2$ (300 LUX). The use of conventional side windows used in classrooms can not be totally applied in studios. this is because ample wall surface is needed simply for display. High-level wall or roof windows should be applied. However, small side window are still needed to prevent the sense of enclosure and to provide a visual contact with the external environment. Again there are special requirements of climate which have to be recognised if good lighting is not to be compromised by thermal considerations.

ARTIFICIAL LIGHTING.

In regarding artificial lighting, fluorescent tubes concealed from sight can be applied for general lighting. Adjustable spot-tungsten lights can be used after dark for blending and colour rendering purposes, as well as to provide local light and shade patterns. These can create heat where it is not wanted. Supplementary artificial lighting systems can be used in large spaces, if natural lighting for one reason or another can not be adequately provided. With the expectation that occasional slide shows may take place, elimination of light in some areas should be considered (see classrooms).

COLOUR.

The function of colour in studios are: to reflect light, to provide suitable background for display and to provide brightness-grading around light sources. For this, high value neutral and near neutral colours such as white, light grey, etc. are preferable.

VENTILATION.

Natural ventilation should be considered as a priority. However activities such as cooking, wood and metalwork, clay and pottery can be artificially ventilated. Air conditioning units with low noise levels can be used. The use of air conditioning should help to control noise, smells, dust, etc. If this is used then thought must be given to controlling ventilation and avoid high cooling loads. The possibility of breakdown should also be remembered.

PROVISION FOR DISPLAY.

There is no doubt that displaying students' work is educationally essential. The provision of display material, equipment and furniture necessitates first knowing the possible requirements of display. Such requirements have already been identified by a British Educational Building Bulletin as follows:[2]

(a) Very large projects, calling for equally large, uninterrupted well lit surfaces.

(b) Very small, possibly precious and breakable exhibits - perhaps a piece of jewellery, rare shells, butterfly wings and old manuscripts - asking for an entirely different setting, carefully protected and with preferential lighting.

(c) Some exhibits, which may include both two and three-dimensional objects, some to be looked at from one direction, others from all angles, and requiring both vertical and horizontal display surfaces of varying dimensions, some of them suitable for pinning and writing on for explanatory notes or diagrams.

(d) Long lengths of materials requiring some kind of fixture from which to hang from a height, perhaps a horizontal rod or track at high level...

(e) Some exhibits, tools and materials which may be needed temporarily in various places about the school. These would call for a number of mobile units of various kinds.

(f) Some much larger than normal exhibitions at certain times, whether on special 'open' days, or in connection with examinations when work may have to stay on show for a week or two, taking up a considerable amount of space.

For such requirements, the provision of display should consider the following measures:

(a) Walls, as has been mentioned, should be a target for vertical display and fixing. For this reason wall surfaces should not be interrupted by arbitrarily placed fixtures such as switches, pipes, clocks, etc., they should also be soft, light coloured.

(b) Ceilings can be designed for display. For this, fixing points for patterns screens, partitions, pulleys should be considered. A plain, flat, hard plaster ceiling at a low level will not encourage vertical display.

(c) Light-weight movable shelves of varying widths, both horizontal or sloping. One sided shelves can be backed by display surfaces.

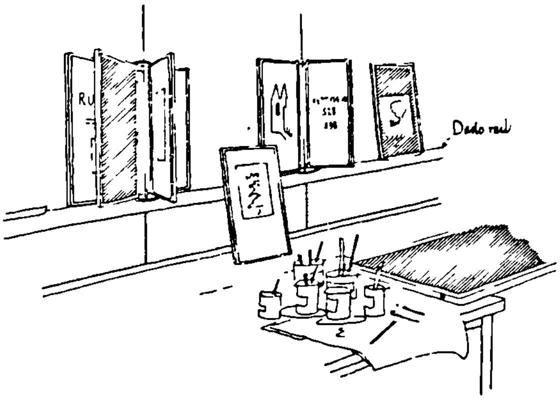
(d) Pivoted vertical display screens, which can be fixed either along walls or free-standing (see figs. 7.21-7.22). The screens themselves are movable and faced on one side with a pin-board, while on the other with linoleum. This helps using them jointly for chalking or as a work surface.

(e) Mobile show units can be used for clay modelling and pottery or other three dimensional work. small materials, tools, paints, etc., can be displayed and stored in trolleys. (See figs. 7.23-7.24).

(f) Ledges and battens can be provided for resting on and suspending things from.

(g) 'Shop window' display, with glazed panels and some shelves across it can be provided. This can be located by the entrance to the studios, or in other circulation areas or

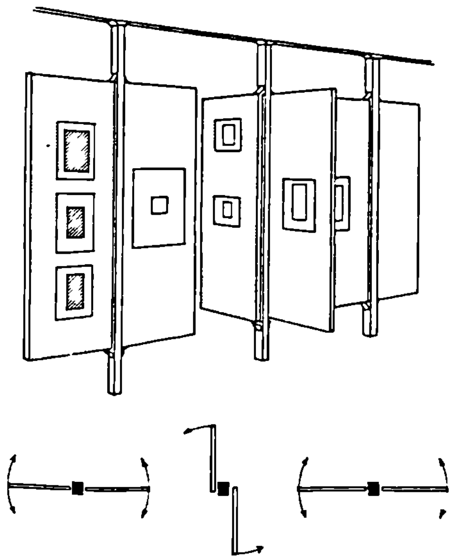
FIGURE 7.21



Pivoting Display Leaves.

These display leaves can be pivotted on wall brackets or lifted off to be used as individual display panels or as horizontal work surfaces spanning between tables. The leaves shown here are 0.90m by 0.60m, with PVC lipping. They are faced on one side with pin-board, on the other with linoleum that can either be used for chalking or as a work surface.

FIGURE 7.22.



Pivoting Display Screens.

Screens are used here to subdivide a large space as well as to provide display surfaces. Each screen is 1.70m by 0.60m, and is pivotted to brackets on 8cm square droppers. A drop-in bolt locks each screen either in the closed position or open, at right angles.

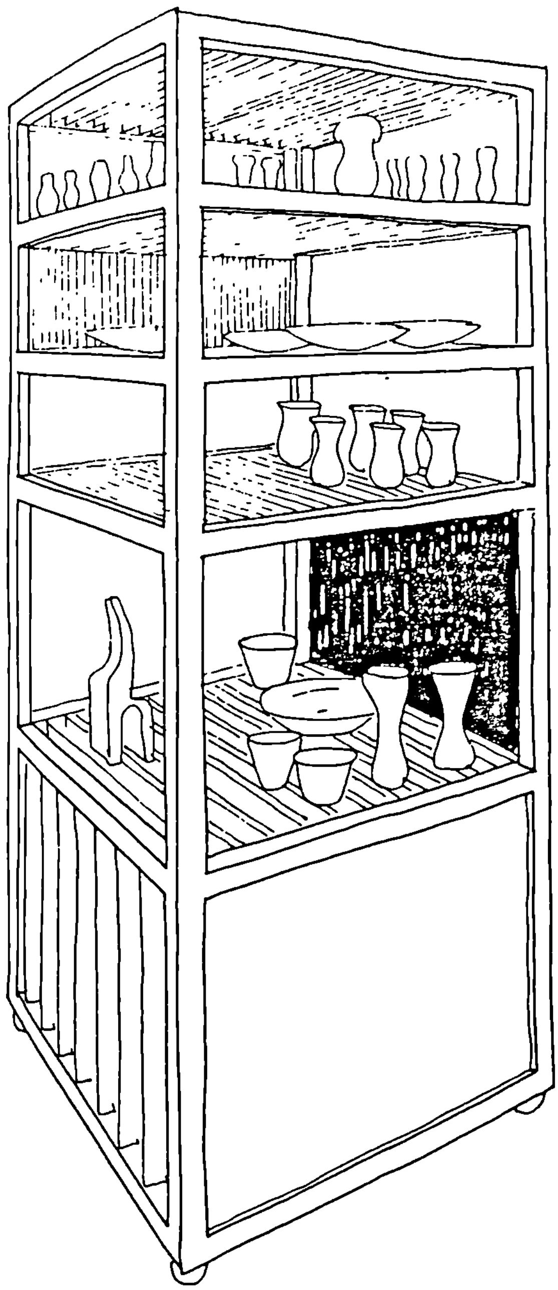


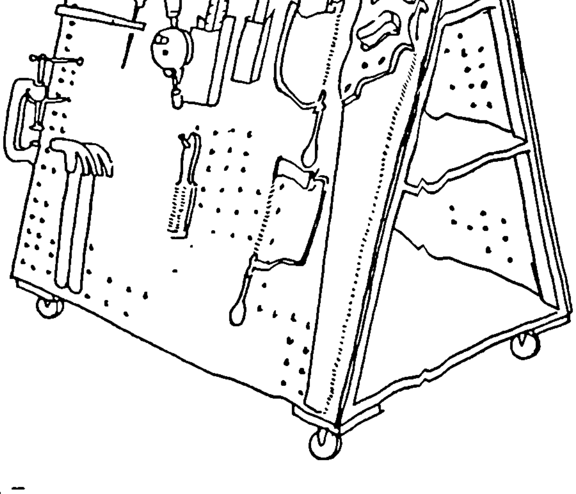
FIGURE 7.23.

Movable display and storage rack.

An example of a movable storage and display unit, for clay modelling and pottery, and particularly useful in kiln and drying areas where much racking is needed. This unit is 90cm by 90cm by 225cm high and made of softwood frame. It is mounted on four spherical castors. The vertical display panels for two-dimensional display can be inserted at any level.

FIGURE 7.24.

Trolley for tools.



Source: Building Bulletin 34.

even by the school's entrance. This is essentially for public display.

PROVISION FOR STORAGE.

Storage needs for studios can be classified as follows:

(a) storage for bulk supplies of materials and equipment.

(b) storage for materials and equipment in daily use.

(c) storage of work in progress and completed work.

TEACHERS' ROOM.

Teachers in workshops and studios private spaces to work, rest and to keep their belongings. For this, working surfaces, shelves, drawers, etc. should be considered.

REFERENCE AND STUDY AREA.

A small resource centre should be provided. This includes a small reference library for books, periodicals, newspapers and files and a study area for students. Such a space needs shelves, cupboards, tables and seats, carpets, curtains, etc. It is possible to use this space for slide shows if elimination of light can be controlled.

PROVISION FOR WORKING OUTSIDE.

Some large scale three dimensional work needs a large amount of space. For this outside covered and paved areas may be needed. Spaces such as terraces, verandas, courtyards, etc. can be integrated within the layout. In some climates they may need to be sheltered or shaded.

SAFETY PRECAUTIONS.

The layout for workshops and other practical activities is important. Locations of benches, machines and apparatus should be planned to reduce unnecessary movement about the area. The width of gangways and circulation areas should be designed so as not to cause any incursion on the working spaces. The layout in general should enable the teachers to see and hear at least activities which may be dangerous to get quickly to any part of the space. For the workshop studio at least three emergency-stop switches should be provided. Chemicals should be provided with lockable cupboards. Non-slippery floors, first-aid box, as well as fire equipment should be provided.

A-2 DRAWING AND PAINTING.

Although normal teaching methods in Saudi schools are formal, in drawing and painting studios it becomes informal. This is because individuality, imagination and creativity are required within the disciplines of art. In two dimensional acitivities students will learn more about dealing with colours, scale and proportions, small and large scale work, etc. General requirements for such activities have been defined by Building Bulletin 34 as follows:[3]

(1) Space in which the furniture and equipment can be arranged in a number of different ways, in which a variety of working surfaces are provided, and in which all surfaces are tough, durable and easy to clean.

(2) Facilities for storing materials, equipment and work, designed with understanding of what they are to store.

(3) Facilities for display of work and reference material.

(4) Controlled daylighting and adjustable artificial lighting.

(5) Provision of water and service points.

PROVISION OF WORKING SURFACES.

Several types of working surfaces such as trestle table tops which can be placed on low easels, double sided easels, small A0 or A1 sized tables, stackable table board rests and large strong tables are needed. It is, of course, economically unwise to provide a full set of each, even if a group of 30 students are working at the same kind of activity. A combination of them are preferable. Figs. 7.25-7.29 show some types of these surfaces and the flexibility and adaptability that working surfaces should provide.

PROVISION OF STORAGE.

(a) STOCK ROOM.

Accessibility, ventilation, lighting and dust control are needed in such small rooms. Materials and equipment which are expected to be stored range from small sizes of papers and cards to large ones, and from small to miscellaneous bulky items. Ample shelving with good access is required.

Materials such as sugar papers, coloured papers, brushwork papers, strawboards, white and coloured cards, etc., need to be stored in different sizes on shelves. A ream of sugar paper, which will be expected to be consumed each term by a group of 30 students, is about 15/16mm. deep. Each ream will need a shelf or tray of its own, dimensioned to give tolerance of at least 25mm.

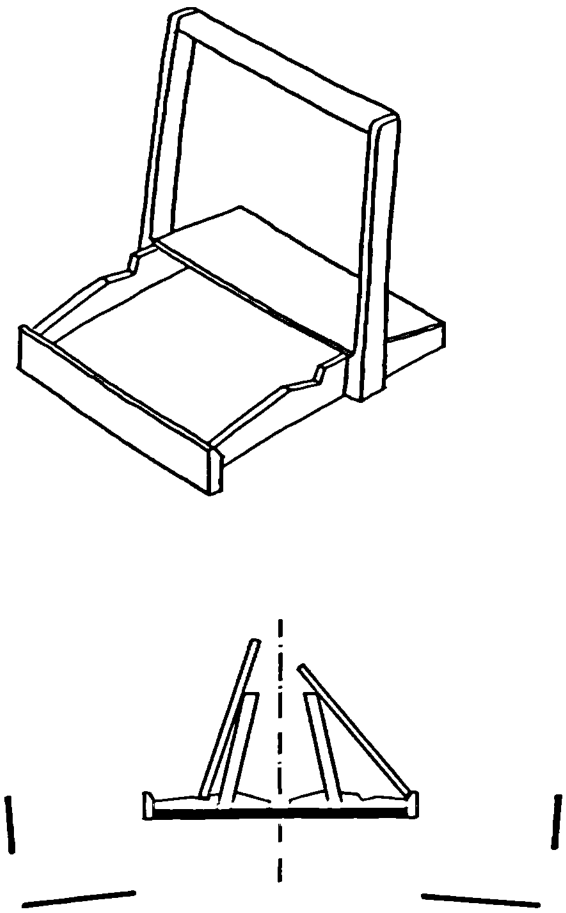


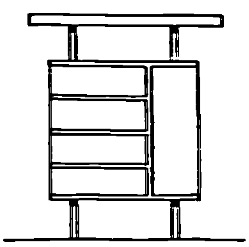
FIGURE 7.25.

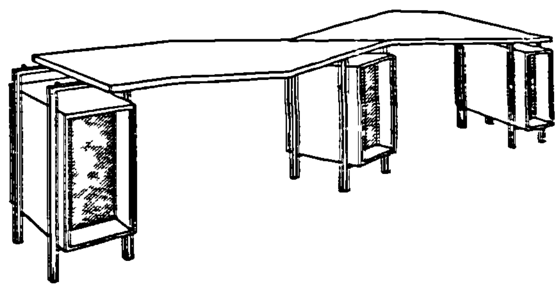
Table Board Rest.

Simple working surfaces are generally preferred to elaborate or highly specialized equipment. A firm horizontal surface on to which smaller sloping surfaces can sometimes be placed will answer a number of needs. For example, they can be placed on table of standing working height, with stools. The board rests can be stacked, so that many can be stored in a small space.

FIGURE 7.26.

Tables with lockers.
In this example the removable worktop is located by dowels on the 1in square tube legs of the supporting pedestals. The section shows the subdivision for storage.





Source: Building Bulletin 34

FIGURE 7.27.

Proprietary art desk top.

This diagram shows a proprietary development of the table board rest. It consists of a 'box', the top of which forms a flat writing surface, or can be adjusted to several positions, two of which are shown here. It can also contain books and painting equipment. This unit can be placed on a table, carried about or stored away. Alternatively, it can be fixed on to a proprietary stand to form a desk for writing and drawing.

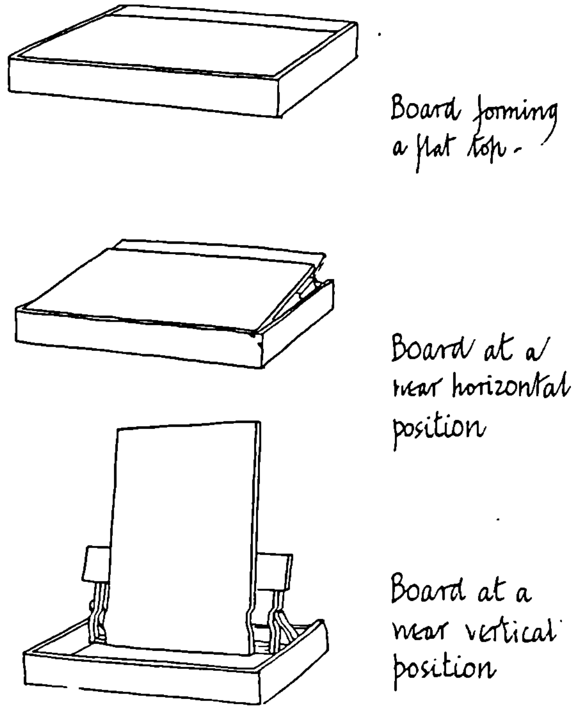
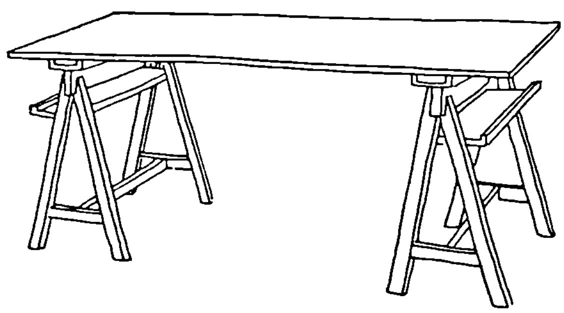


FIGURE 7.28.

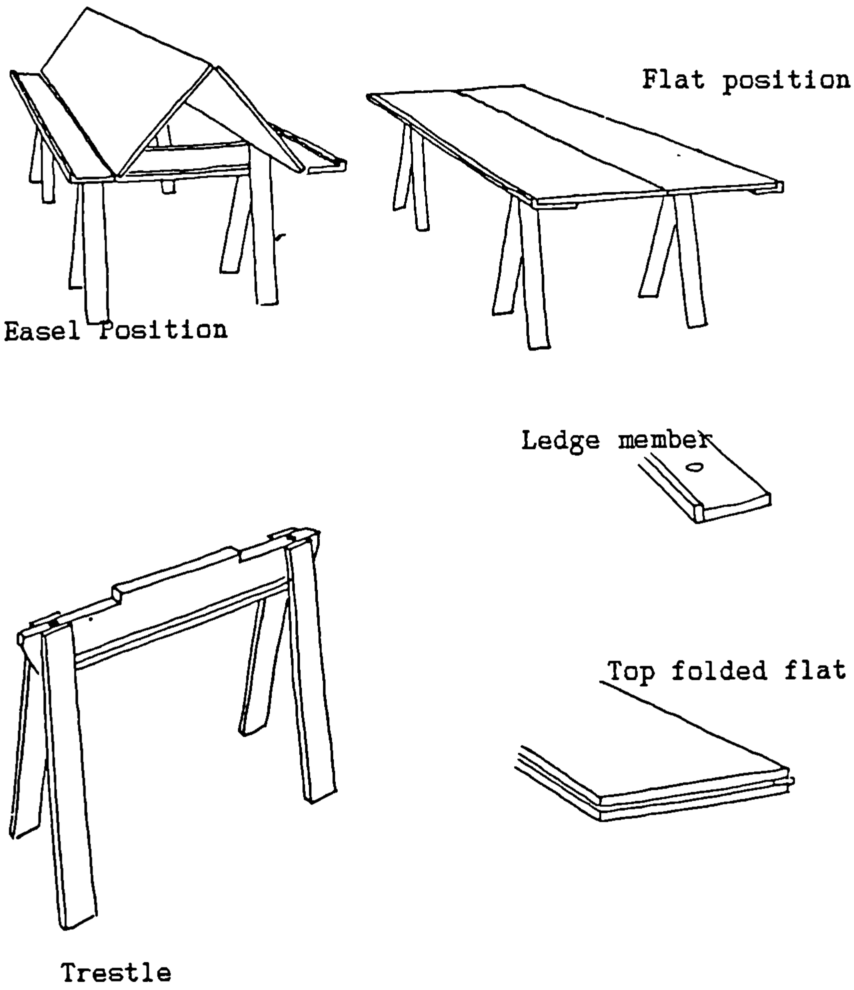
Trestle Table.

Trestle tables are commonly used in studios, for they provide generous horizontal work surfaces, and can be dismantled to make way for different arrangements within the room. The trestles shown here, with their lipped shelf, can be used independently as board rests. Trestle tables are available in different sizes and to various designs in both tubular metal and timber construction.



Source: Building Bulletin 34.

FIGURE 7.29.



Adjustable table.

This table in softwood consists of five parts: top, two ledge members and two trestles. It can be assembled to form either flat or sloping work or display surfaces.

all around the papers, otherwise handling will become difficult. the height of the shelves should be carefully measured. They should be placed between the heights of about 760mm-1.350m. from the floor, with a hinged flap at 76cm. in front of them, for placing papers temporarily. (See Fig. 7.30).

For small items such a tins of powder and poster paint, brushes, inks, pastes, pencils, etc., adjustable and fairly narrow (100mm.-300mm.) shelves can be useful. (See fig. 7.31).

Spaces under shelves can be used to store most miscellaneous bulky items such as boxes, *objects and other paraphernalia*. trolleys can be used or designed as small movable 'stores' for different kinds of materials, and for this space may be needed for one or two trolleys in the store room.

(b) WORK AND MATERIALS IN DAILY USE.

Spaces under worktops can be used to store almost all daily and current work. Such spaces need to be subdivided into standard sized compartments (i.e., 600mm. front to back and 900mm. wide), which may consist of shelves, cupboards, drawers and mobile units.

For current work, shelves or trays (at least one compartment per teaching area) can be used for storing papers. Drawing boards can be stored vertically between top and bottom grooves or pegs. (See fig. 7.32). Inks, paints, brushes, charcoal, clips and many other tools and items can be kept in sets of drawers or trays. Other bulky items can be stored in spaces left unfitted, which can also be used for mobile storage units. (See fig. 7.33).

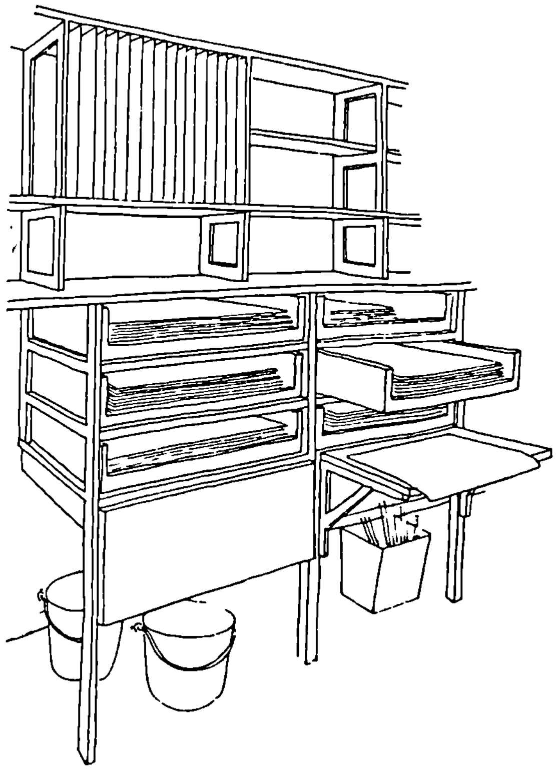
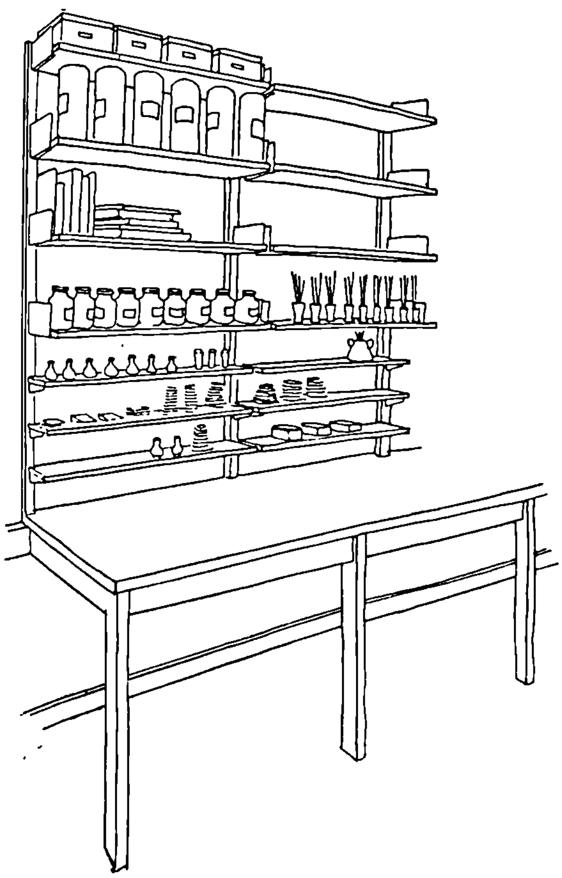


FIGURE 7.29.

Fittings in Storerooms (1).

This shows one method of storing drawing papers and cards. The paper is stacked in shallow, rather than in deep (and heavy) piles, on removable trays. This makes it easier to take out or put in the sheets, and the flap at worktop height is useful for sorting and off-loading. It is not advisable to store paper outside the range of about 60cm to 120cm above the floor. Bulky items of equipment can be stored under, and drawing boards, etc., over this fitting.



Source: Building Bulletin 34.

FIGURE 7.30.

Fittings in Storerooms (2).

In order to make the fullest possible use of storeroom space, some of the shelving needs to be dimensioned to take large numbers of small things so that these can be easily accessible wihout wasting volume. This diagram shows adjustable shelving at 15cm and 25cm vertical centres. The bench at worktop height is useful for arranging things on, and leaves space for bulky equipment underneath. (This is probably preferable in many circumstances to taking the shelving down to floor level). Provision for trays could with advantage be made in the storeroom as well as in the studio.

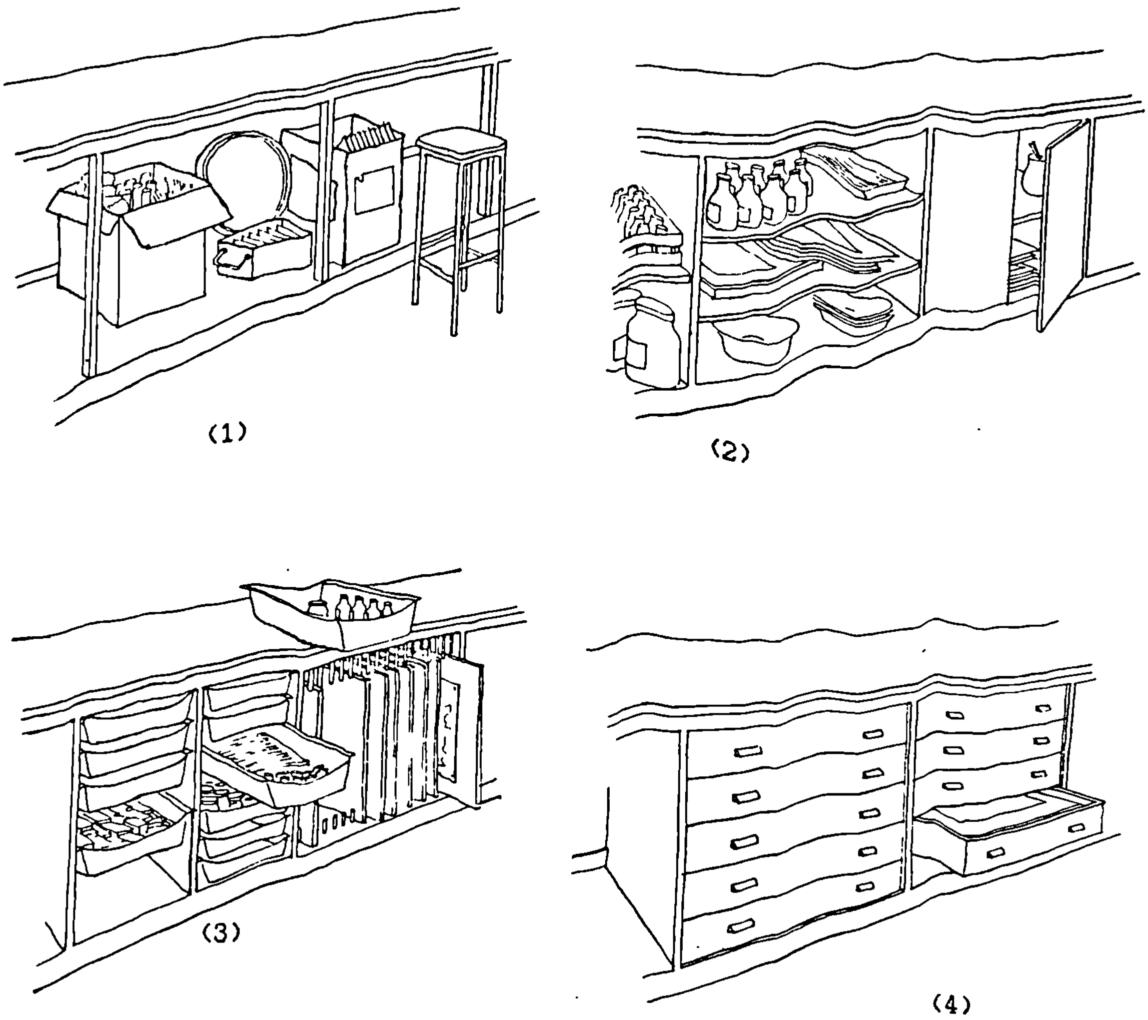


FIGURE 7.32.

Storage under worktops.

Different ways of utilizing standard-sized compartments under worktops:

(1) worktop with open space under for storge of bulky items, or for knee room;

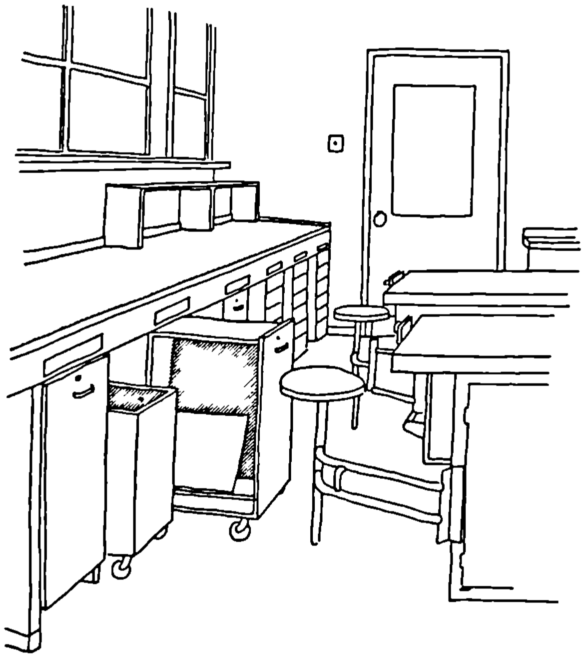
(2) worktop with two or three shelves under, with or without doors.

(3) worktop with space under, fitted for plastic trays in which small items can be kept, and with racks for royal or half-imperial drawing boards;

(4) worktop with space under, fitted with drawers for work in progress or for short term paper stocks.

Useful details to note are: plinth for easy floor cleaning; top overlaps 5-8cm to permit clamping; no projections on side-hung doors; worktop finished in unpolished hardwood, linoleum or hardboard.

FIGURE 7.33



Movable units under worktops.

Here there are two types of unit on castors, which can be pulled out from under fixed worktops: a larger unit which can be used as an open cupboard with top surface for putting things on, and a smaller bin unit. These are just two of many types of mobile units that encourage flexibility.

WATER AND SERVICE POINTS.

For washing brushes and jars, mixing paints, cleaning tools and equipment, etc., two 'general purpose' sinks are needed. Location of such sinks should be carefully considered. Corners, congested circulation areas or doors should be avoided for locating sinks. Facilities for draining painting equipment should be provided.

Several electrical points should be provided for local lighting or other visual aid equipment.

A-3 THREE DIMENSIONAL WORK.

Every three dimensional project may involve one or more technical operations such as carving, sawing, shaving and turning wood; moulding and carving plaster; modelling clay; bending, hammering and chasing metals; twisting and soldering wire, etc.

1 - PROVISION OF EQUIPMENT.

Equipment needed in workshops have been defined by Building Bulletin 34 as follows:[4]

- Tabling (probably some trestle tables and some of a heavier type;

-benching, with vices, for woodwork;

-benching, with vice, for metalwork;

-'Scopas' felt and cork jawed vices;

wedging bench for clay (only about 4 sq.ft. (.37sq.m.) in area);

-grindstone (about 2ft. x 2ft. 3ft. 6" (60cm. x 60cm. x 91cm.) high, and sharpening stones;

- modelling stands with revolving tops and modelling boards;
- possibly cross-cut saw;
- gas ring and glue pot;
- electric soldering iron;
- small blow lamp;
- large sinks or sinks with clay trap;
- some wood and metal-work tools.

2 - PROVISION OF STORAGE.

(a) LONG-TERM STOCK.

This is similar to the drawing and painting storeroom. If a separate room, it requires good lighting, ventilation and accessibility too. Open shelving and racking, and space for storage bins for rough work and bulky materials, space for finished work, should be provided in this storeroom. Raw materials - woods, stones, clay and plaster - can be stored in either this main space or in other additional stores. It should be located to have access from the route into the area for delivery of materials.

(b) MATERIALS AND EQUIPMENT IN DAILY USE.

Cupboards and racks above working benching can be used to store tools, small equipment and light materials. While under such benches, heavy and bulky materials can be kept. Bins and damp cupboards may be needed for clay and plaster work. In general standard sizes compartments, as in the drawing and painting room, should be provided for all work in progress.

(c) COMPLETED WORK.

Some of the completed work may need to be stored (in the long-term storeroom), some may need to be on display (on mobile units, 'shop windows' or free-standing, etc.).

A-4 EMBROIDERY AND TEXTURE DESIGN AND DRESS DESIGN AND MAKING.

The range of textiles activities will vary from embroidery, needlework, hand and machine sewing to the simple design and making of clothes and furnishings. The general procedures of such activities start from:

(1) DESIGN STAGE.

The design stage in general requires the availability of references such as books, files, patterns, periodicals, charts, drawings and photographs of fabrics, threads, wools and examples of work. The display of such materials and facilities require in turn a suitable space; either to be shared with other studios or to be private for textiles activities. However, such space, whether it is shared or not, requires the following items and equipment:

(a) simple devices for hanging clothes and fabrics, with suitable plain background and interesting lighting;

(b) filing cabinets of foolscap folders, cuttings, samples of materials, specimens of processes;

(c) adjustable shelving for books, periodicals and three dimensional display;

(d) Well proportioned, uninterrupted wall panels which can be pinned into, and upon which large hangings can be designed and embroidered.

(e) Chalkborad surfaces.

2 - PRACTICAL WORK STAGE.

Activities involving cutting-out and sewing of materials require good daylighting as well as some adjustable local artificial light points. Design care must be taken to avoid heat gain when either natural or artificial lighting is provided. Firm tables for cutting-out of about .80m x 2.0m. working space all around and adjustable tables are generally required.

Standard sewing machines (one machine for every two students) with back support chairs are needed. 2-Seater tables with hard tops (wood or linoleum) and electric points at bench height sould be provided.

Embroidery is usually done by hand, however, storage space for frames (drawers) should be provided. Pressing activities require several ironing boards, which can be let into the wall permanently, or brought out from the store, and a sink. Fitting, on the other hand, requires dress stands and long mirrors (fixed or movable). It is necessary to provide facilities which give privacy for fitting work, etc. This need not be permanent, but should allow for dressing and modelling in private.

PROVISION OF STORAGE.

(1) LONG TERM STOCK.

The quantities of materials depend on the periodical time of supply. However, a space of about 90cm. - 100cm. wide for bolts (10 to 12 bolts) should be considered. Shallow drawers or trays and chest drawers can be used for knitting and embroidery wools, and stocks of haberdashery. Deep shelves or racks (75cm. to 80cm.) will be used for charts, manilla paper, stocks, etc. Other equipment such as dress stands, ironing boards, irons, etc., should be considered to be stored in this space. (See fig. 7.39).

(2) MATERIALS AND EQUIPMENT IN DAILY USE.

Standard sized compartments under worktops with small drawers or trays and shelves are useful for small and large items such as cotton, scissors, tapes, drawing boards, frames for texture design and embroidery, paper charts.

Small uncompleted work can be kept with students, while large uncompleted work such as dresses can be kept in a wardrobe fitting, or simply on a hanging rod in the general stockroom, or in a small separate store. Large uncompleted textile work and garments can be stored under worktops or in hanging cupboards.[5]

A-5 DEMONSTRATION KITCHENS.

One of the main considerations involving the layout of kitchens in general and kitchens used for teaching in particular, is safety. Not only safety from fire, although that is important, but also the safety of the process of work that involves a large number of students. Layout is important, for example a layout with cookers on one side of the room, with washing and sinks on the other side, with working table and cupboards between them, is not safe due to the heavy traffic and cross-circulation across the room. On the other hand, a kitchen layout with several small working units, where each unit will be equipped with sinks, cooker, cupboards, shelves, worktops and other kitchen utensils, china, glass, etc., is recommended. With such units housing a number of working units, there will be a minimum of traffic across the room and a major hazard will be minimized.

Within the kitchen layout, arrangements have to be made for demonstrations. This requires, first, a space large enough to accommodate the pupils and their teacher; second, a demonstration table. This may be portable. It may also include washing up units, with two sinks and space for waste receptacles, (bucket, etc.), cupboard with drawers, a gas and or electric cooker, and a cupboard with pull-out shelves on top and storage space for pots and pans underneath.

Other equipment, which is needed in kitchens is a combined working and dining table about 110-120cm. long, 75cm. high and 60cm. deep. The tables can be provided with drawers or shelves for students' belongings. A trolley is required in large kitchens to be used for transporting food from the storeroom to the working units. Valances or canopies with internal blower fans should be provided over cookers. This helps to control smoke, smells and build-up of heat.

In the storeroom, a space should be provided for a refrigerator and a freezer for keeping food (meat, vegetables, fruit, cheese, milk, etc.) fresh. There should also be different sizes of cupboards with movable shelves and movable drawer units for storing materials and equipment of infrequent use. Materials and equipment in frequent (daily) use will be stored in the working units. (See fig. 7.39).

B - LIBRARY.

With the provision of sub-libraries in year centres, the function of the traditional main library will begin to change. Traditionally in Saudi Arabia the library is timetabled to be occupied by one class group of 30 students for the purpose of free reading and study in quiet conditions. On the contrary, it will now become open and freely available to be used by any pupil in any grade at any time. It should be remembered that specific level material will be found in the teaching units. Similar to public libraries, there will be some pupils who will only stay a few minutes to collect information for use elsewhere, while others will be researching for longer periods. Some of the students will be reading periodicals, others will be working intensively using books and references.

For such future needs, the traditional long rectangular room that was furnished only with tables, chairs and bookcases, and which is guarded by a librarian and a small closed door, will not be the suitable architectural response. The need here is for an attractive, well equipped and furnished place. The basic requirement are natural lighting and ventilation. Location should be easily accessible to the year teaching centres.

Although a label on the door "library" can indicate what is going on inside, a suitable glazed opening can be more impressive and will get the message of openness across. Inside the library there should be carpeting, reading tables and study spaces. A suitable table with drawers, shelves and cupboard should be provided for the librarian. the ambience may be improved by the use of plants, paintings, etc. A small storeroom with floor to ceiling shelves should be provided for the library to deal with book temporarily withdrawn from the shelves. There should also be a facility for simple book repairs.

C - LANGUAGE LABORATORY.

The teaching of a foreign language (English language only at present) starts in the first year of general intermediate education, and continues until the end of secondary education. This necessitates that the provision of foreign language facilities in intermediate school should be given special care and consideration.

Within the process of language learning, three interconnected activities normally take place: first, the presentational activities, where students start to acquire and to exploit the skill of speech; second, activities where students need to practice these skills individually; third, activities where students can develop their skills to acquire a deeper knowledge of the language. The first and third activities can be done mainly through reading, writing and visual learning (audio-visual aids, pictures, etc.). Such activities can be practiced in general classrooms. The second activity on the other hand depends mostly on oral speech (listen and imitate techniques).

Such activities have to be practiced within special equipment and space, which is normally called a "language laboratory". (Se fig. 7.39).

FUNCTIONAL REQUIREMENTS AND DESIGN ASPECTS.

(1) EQUIPMENT.

Equipment available in the market differs in layout, performance, materials used and cost. However, their basic principles are similar: that each student can practise speaking in private, either with or without the help of the teacher, who can give individual attention to any student, either with or without interrupting or holding up the work of the others. This is done from a central control operated by the teacher.

The simplest equipment, which is called "listen-respond" or "audio-passive" system, can only help students to listen to a record of phrases through headsets and respond to them. Another system called "audio-active" can be provided with amplifiers to help the student to hear his own voice as others hear it. The teacher in such a system can also cut in to listen and correct individual students. Although the "audio-passive" and "audio-active" systems are simple and movable, they do not provide enough privacy for both students and teachers.

For more privacy and students' control over his own tape recorder, "listen respond record" systems are normally used. the system can help each student to record his own responses and immediately play back both the original phrase and his response. A two-way private communication between each student and the teacher is also possible with the system. Because of the complexity and delicacy of the installation of such systems, they should always be kept permanently at each work place. There must be suitable and ample storage for discs, records, etc. in such a laboratory.

(2) ACOUSTICS.

Whether mobile or fixed equipment is chosen the following acoustic measures are applicable to all areas in which it may be used.

(A) SOUND INSULATION.

(a) The location of the space should be considered in relation to external sources of noise, such as traffic noise, playgrounds, etc., as well as with internal sources of noise such as heavy craft work, physical education, etc;

(b) heavy construction should be used for walls and maybe roofs;

(c) reduction in glazed areas and use of sound attenuation can be applied if required.

(d) A quiet mechanical ventilation system should be used. The suppression of all mechanical, electrical and waterborne noises is obviously required in any space where tape recorders and microphones will be used.

(B) SOUND ABSORPTION.

(a) Absorbent ceiling and soft floor finishes such as carpet are essential.

(b) Worktop surfaces and side panels between each work place should be designed to absorb local noises. Materials such as linoleum is recommended.

(c) Wall surfaces should be of soft materials to absorb sound; they may also be used for display.

(3) LIGHTING.

In circumstances where the glazed area is reduced for sound insulation, supplementary artificial lighting of the 'cold' quality fluorescent type should be used.

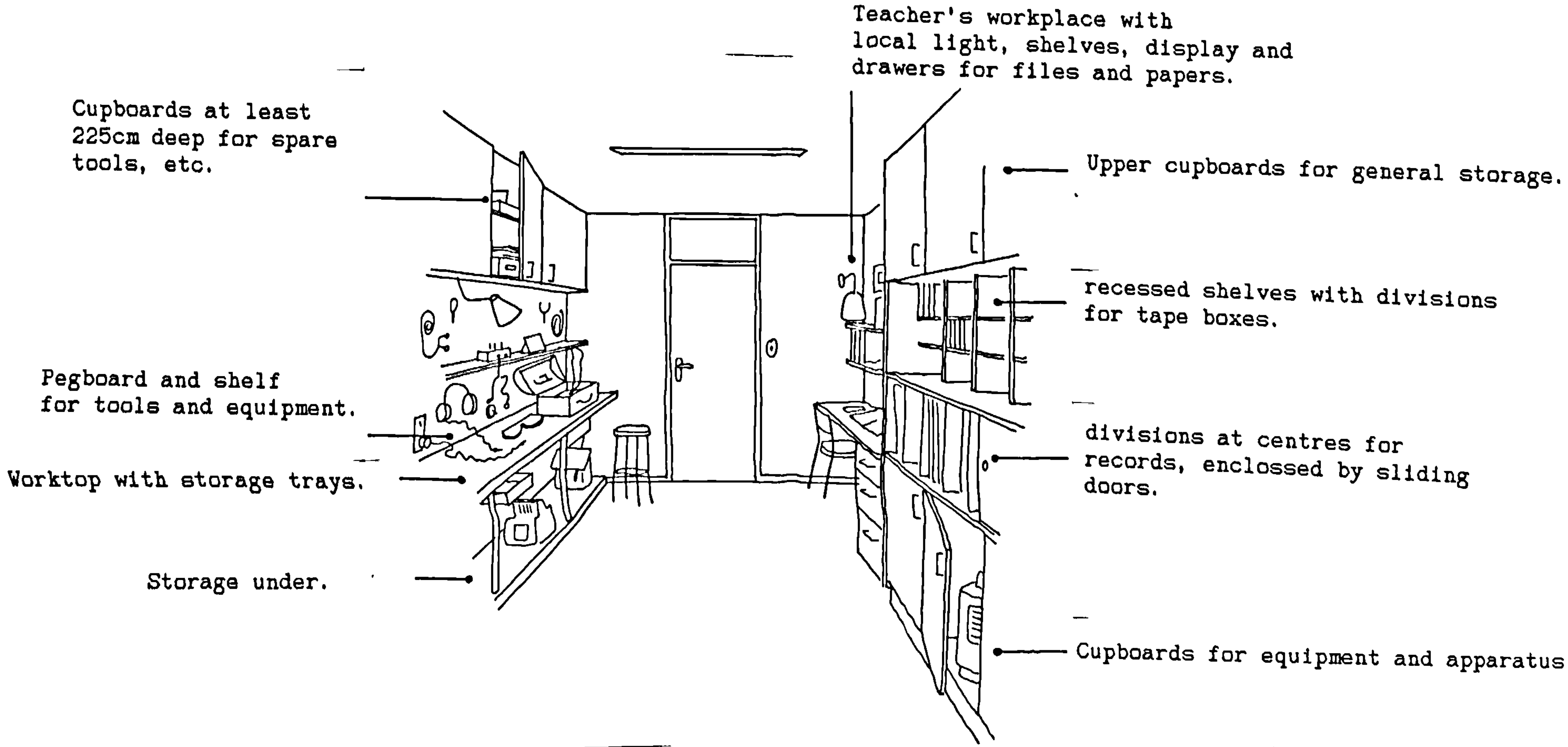
(4) STORAGE SPACE.

Audio-visual equipment such as tapes, records, films, slides, transparencies for overhead projectors, video recorders, televisions, spare parts, tools (pliers, screwdrivers,) etc., need to be kept in a purpose-built store. Providing that this equipment is movable, the store can become central for all other activities within the school. Equipment in this area is of high value and security is paramount.

Large equipment such as televisions, video recorders, etc., can be kept in cupboards about 60.0cm. deep. Spare parts, tools, etc., need smaller cupboards about 25.0cm. deep. Simple small-scale facilities for basic maintenance may need a workbench, lockable drawers, shelves, local light and electric points. (See fig. 7.34). Under such a workbench, bulky items, trolleys, etc., can be stored. Slides and film strips can be kept in a special cabinet. Figure 7.35 shows a sketch of part of a cupboard in a Swedish school. A teacher's work place is needed with a display

FIGURE 7.34.

A ROOM FOR STORAGE AND MAINTENANCE.

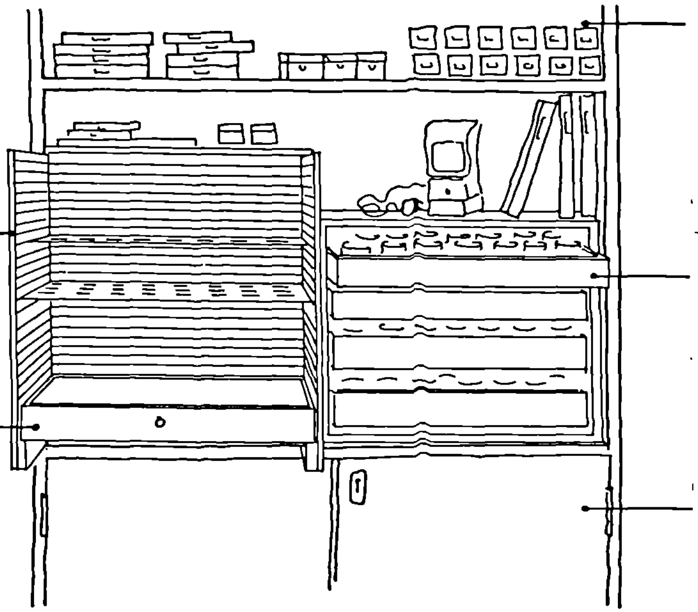


Source: Modern Languages, *Building Bulletin 43*.

A sketch of part of a cupboard seen in a Swedish school. Two cabinets have been inserted, one with trays for up to 224 film-strip tins and the other with sheets on which slides (5cm) can be mounted for storage and for direct viewing over a pull-out 'drawer' whose top is an illuminated translucent sheet. The doors of this cabinet, when opened, provide support for these sheets in grooves, between which are title strips, and also for the illuminated 'drawer'. The cabinet holds up to about 1,200 slides.

Such a unit could well be fitted into the storage fittings shown in Figure 7.33.

FIGURE 7.35.



Source: Building Bulletin 43.

surface, shelves and drawers for files and papers, local light, etc.[6]

D - SCIENCE LABORATORIES.

Science subjects in intermediate schools are basic and general. Sciences such as physics, chemistry and biology are integrated to form one course called "Science and Hygiene". Most of the science and hygiene activities are taught in classrooms and with a theoretical teaching form. However, students have an opportunity to visit the laboratory one a week, if required, to watch simple experiments demonstrated by the teacher.

Future change in teaching methods can be expected to expose students to some first hand scientific experience. For such a variation in teaching methods and activities, a multi-purpose laboratory should be provided rather than the provision of specialized laboratories for physics, biology and chemistry. The multi-purpose laboratory approach is educationally advantageous, as well as economical. Such a laboratory will provide a wide range of flexibility, where experiments can be demonstrated by the teacher himself, by individual students or by groups of students. In turn, the layout will be adapted easily for each situation.

In general a science laboratory can be divided into two main zones: preparation and storage space and working and demonstration space. (See figs. 7.36-7.38).

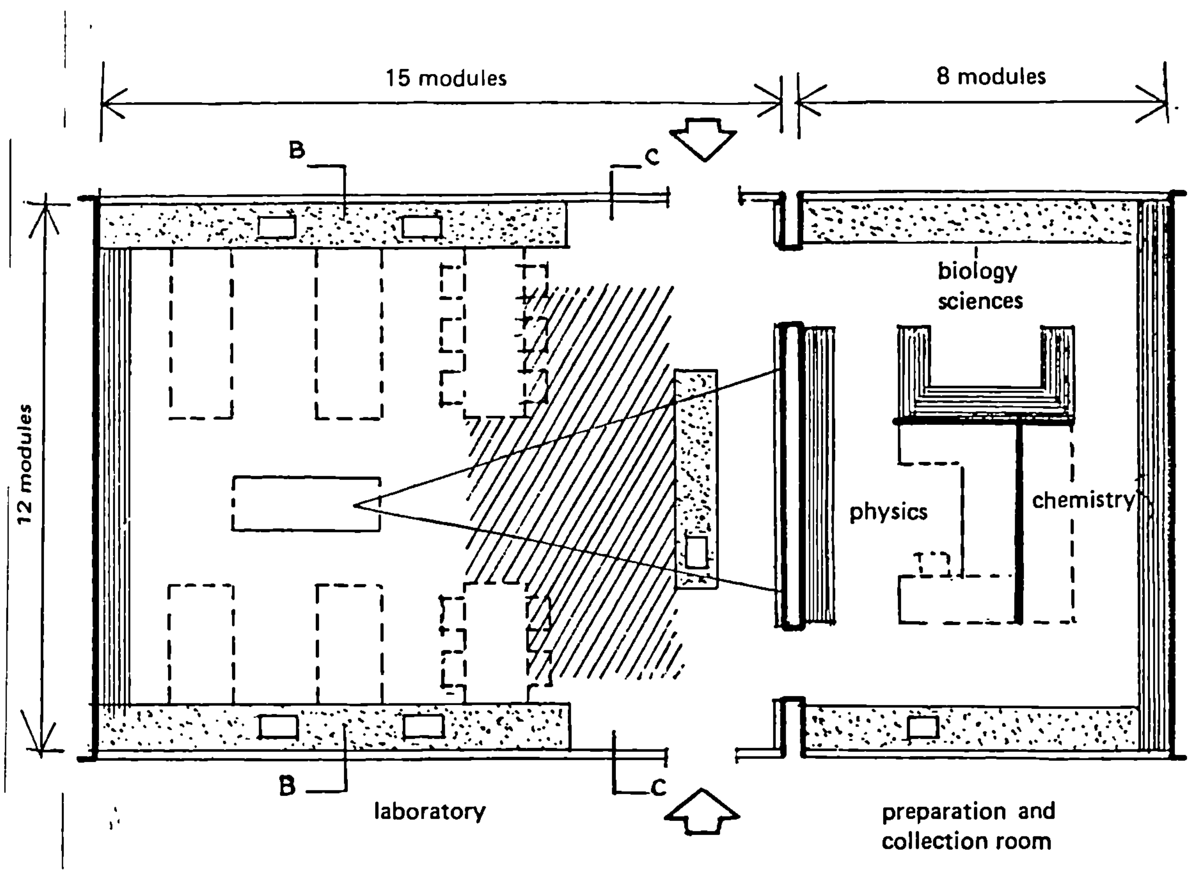
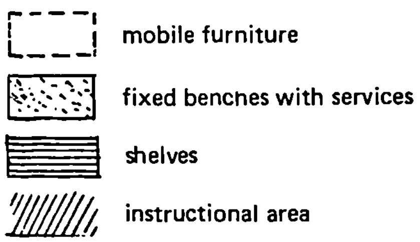


FIGURE 7.36.

MULTI-PURPOSE LABORATORY

1 module = 60 cm



capacity: 30 pupils
usable area:

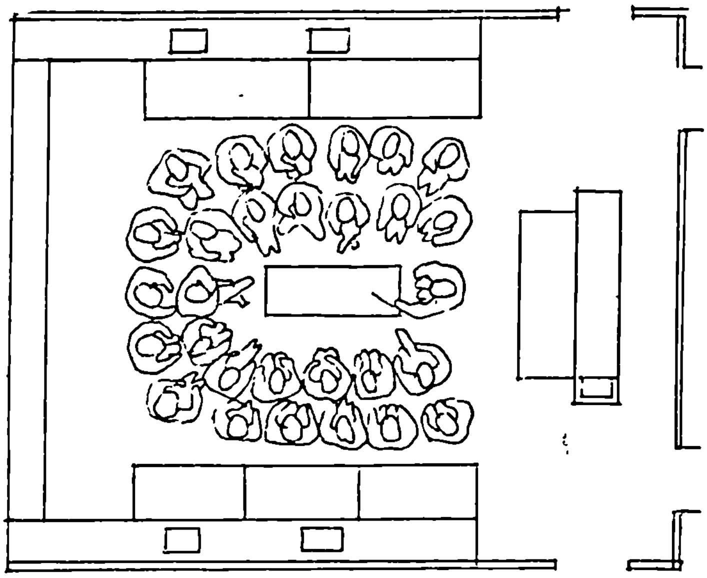
lab.:	64,8 sq. m
prep. & coll. room:	34,5 sq. m
Total:	99,3 sq. m
area per pupil place:	3,3 sq. m
scale: 1 cm pm.	

Source: Educational Development. UNESCO 1976, Paper No.2.

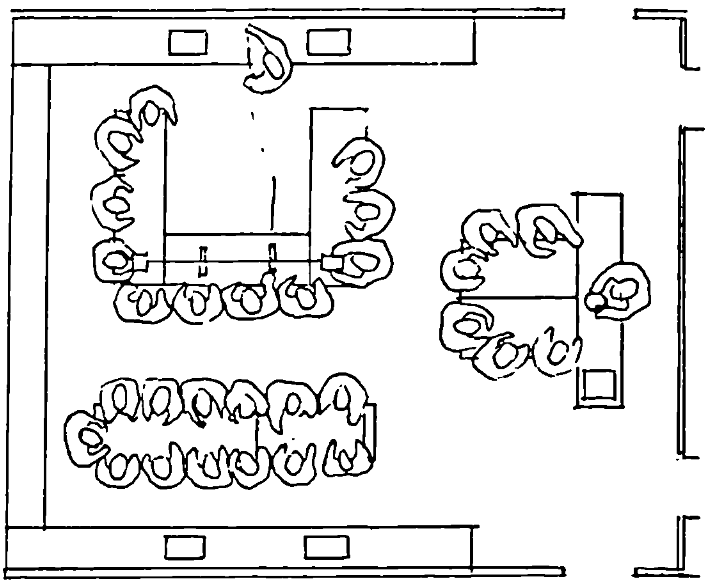
FIGURE 7.37.

Multi-Purpose Laboratory

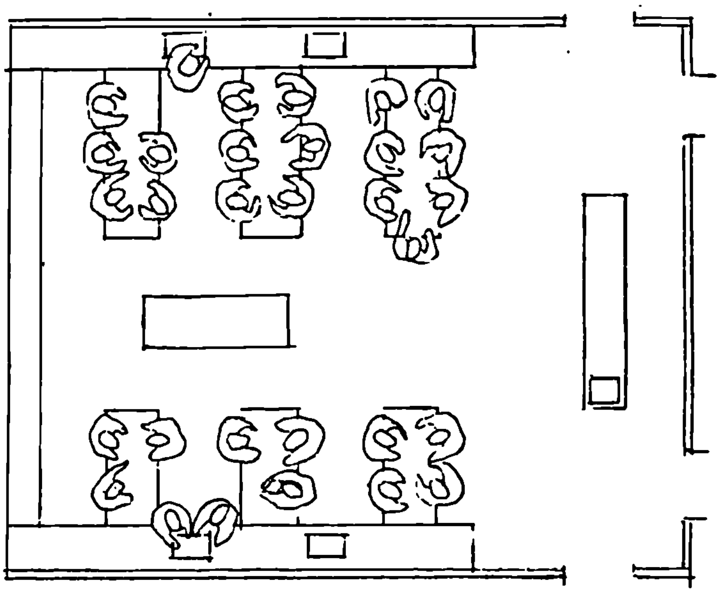
Example of multi-use
Scale: 1cm pm.



Briefing to class unit



Experimentation by large groups

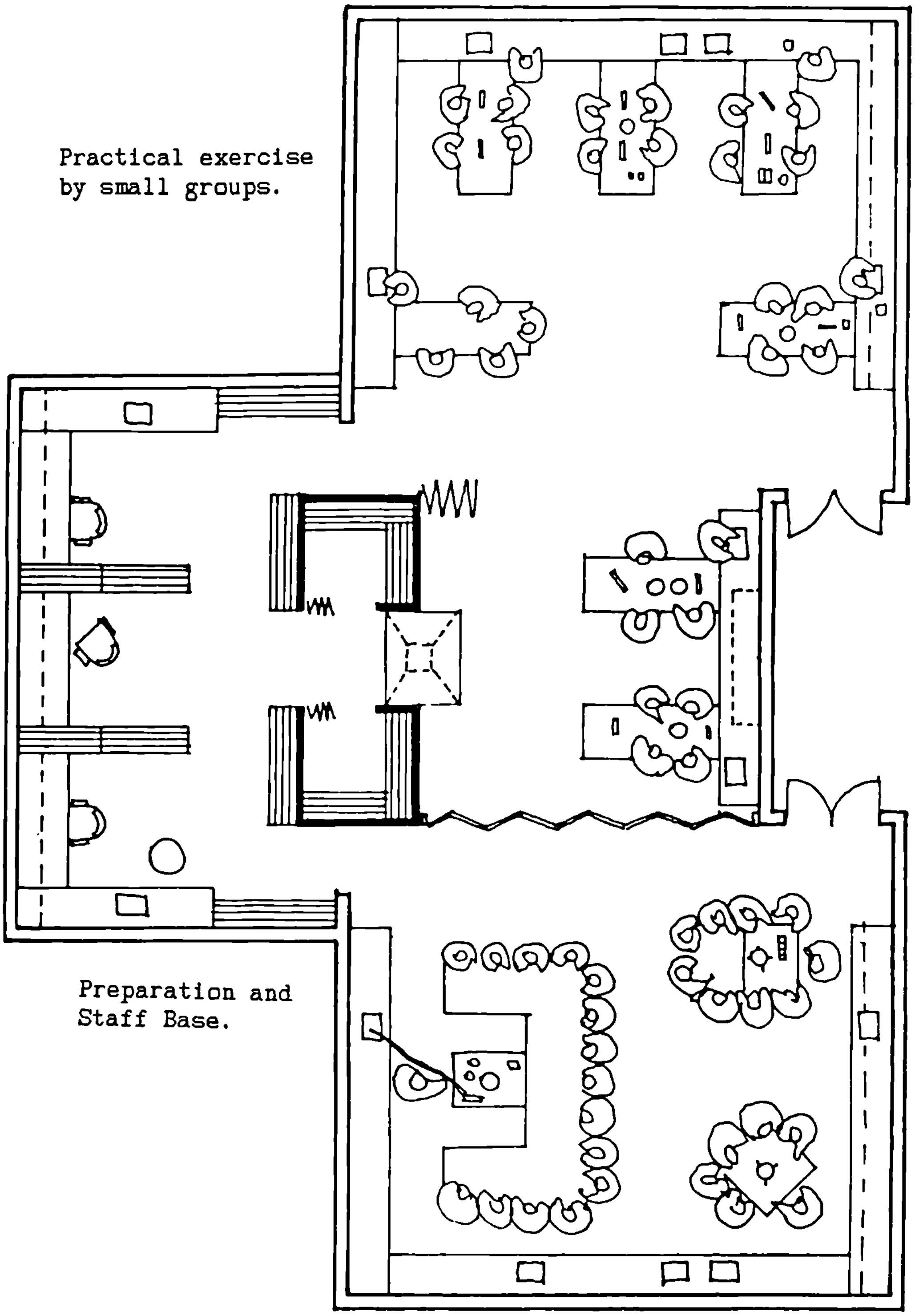


Practical exercise by small groups

FIGURE 7.38.

SCHEMATIC DIAGRAM FOR TWO MULTI-PURPOSE LABORATORIES

Practical exercise
by small groups.



Preparation and
Staff Base.

Experimentation by large
group of students.

PREPARATION AND STORAGE ROOM.

The preparation and storage of materials and equipment are routine work which is usually done by teachers and assistants. such routine work will be subject to very little change over the years. For this, flexibility of furniture is needed rather than adaptability of the layout.

The layout can be divided into three permanent zones: physics, chemistry and biology. Each zone will have its own preparation surfaces and storage spaces. Movable benches with taps, generally 60cm. deep and 85cm. high can be used. Materials such as hardwood (teak, iroko), melamine veneer, solid laminate, ceramic, etc., are resistant to: chemical attack, staining, heat, etc., and can be used for the worktops. A wash-up sink (preferably to be positioned near or in the wet chemistry zone), electric points (the most convenient position is above the bench, as near to shoulder height as possible), and refrigerator are needed in the preparation room.

Wall shelving and cupboard units can either be placed on the preparation work tops or hung from a continuous aluminium or steel picture rail. Under-bench spaces can be used for storing bulky items and for storing mobile units and trolleys. It is necessary to indicate that a heavy reliance on under-bench storage in laboratories is no longer appropriate. This is because if the volume in under-benches is going to be used for storage, items in general use will be distributed all over the laboratory. Under such circumstances, even with careful labelling and satisfactory locks, it is difficult and time consuming to check the equipment and materials for replacements, re-stocking, etc. Therefore, it is preferable if materials and equipment are: first, to be stored in one space for management needs; second, to be placed within the convenient and acceptable limits of body sizes. A recent L.I.U. (Laboratories Investigation Unit) survey of storage use patterns indicated that the higher or the lower the storage space from waist height, the less the utilization rate. (7) Finally, a technician workplace is required with display surfaces, shelves and drawers for general belongings, files, papers, etc.

LABORATORY WORKING SPACE.

The type of working space layout is not only affected by the teaching activities, but also can be dictated by the choice of servicing methods. Four servicing methods are available: pipes in a floor trench; pipes suspended from the ceiling; pipes on the ceiling of the floor below; wall mounted pipes. Although cost and availability are strong factors in determining the choice of servicing methods, suitability of the method to the function is important too. Since learning methods in intermediate schools are simple, and depend on demonstration and re-experimentation rather than on individual and advanced research work, servicing methods should be equivalent. Therefore, neither pipes in a floor trench, pipes suspended from the ceiling nor pipes on the ceiling of the floor below are recommended for use in intermediate school laboratories. The first and third methods are not adaptable, while the second can provide a very high level of adaptability that, unfortunately, cannot be fully utilized in intermediate schools. The most suitable and economical method with a medium range of adaptability is wall-mounted pipes serving wall benches. By using movable benches, the plan layout can be changed to meet a wide variety of situations. (See figs.7.36-7.38).

Worktop materials should be resistant to chemical attack, staining, heat, solvents, impact and indentation. The choice of materials can range from hardwood (teak, iroko), solid laminate to ceramic and stainless steel. For floor materials, linoleum, rubber tiles, or any synthetic resin cover can generally be used.Walls, in general, are needed for display. However, parts of the walls above the wall benches, if there are any, should be designed for resisting heat, solvents, etc., and for ease of cleaning and maintenance. Ceilings should be designed to reflect light and to absorb noise.

Fume cupboards are a vital piece of laboratory equipment where certain chemicals are used. Both fixed or movable fume units should have glass surfaces and external lighting (otherwise lamps and fittings may be damaged by gases). In certain cases internal fittings are preferable remote-controlled, but may not be necessary at this level. Movable fume units are advantageous with their 4-5 glass surfaces and mobility, although they require a range of flexible connections for direct linkage to the fume extractor. Self-contained movable cupboards with filters fitted to allow recirculation of air to the laboratory are preferable but expensive in intermediate schools.

VENTILATION AND LIGHTING.

With the sensitivity of materials and equipment in the laboratory, mechanical ventilation is recommended. High-level wallor roof windows are preferable for daylighting. However a small side window should be provided for viewing. Colours of walls, ceilings, and furniture should be of high reflectance factors. (See Fig. 7.39).

E - PROVISION OF PHYSICAL EDUCATION.

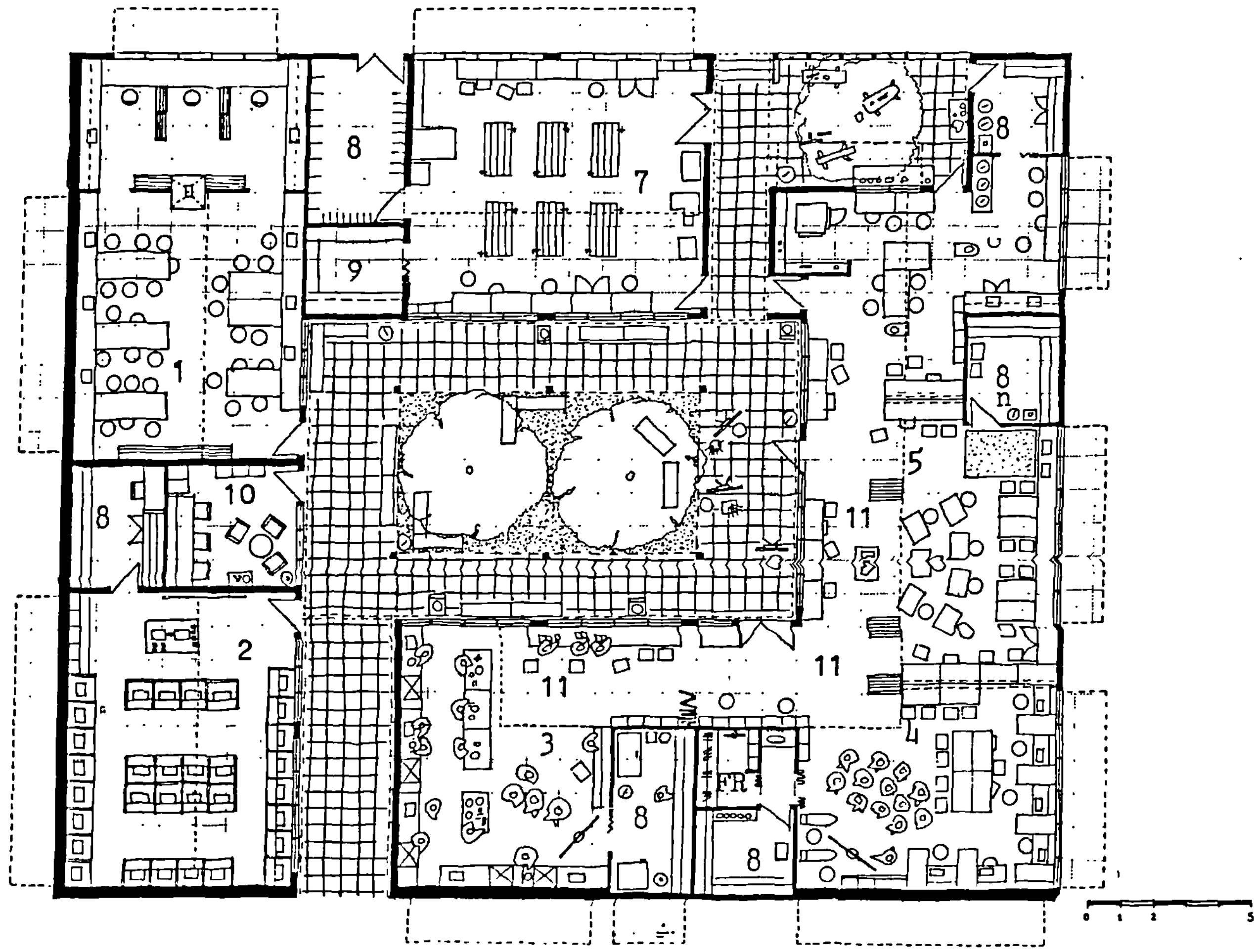
Activities within the term "physical education" have been broadly defined as follows: first, the balance and control of the body and movement. This can be achieved through gymnastics, dance, etc. Second, training and practice in specific sports and games skills. For this, sports and games such as basketball, handball, volleyball, tennis, badminton, jumping, etc., require practice. Third, live sport experience. This includes camping, climbing, sailing, etc.

In school life, the first and second activities need permanent accommodation. Such accommodation could be an internal space or an external one, covered or open. The activities in the third category are not yet part of everyday school life, therefore, they are out of the scope of this thesis. They do require, however, more organization and equipment rather than permanent space or shelter.

For intermediate schools in Saudi Arabia, activities under the heading of physical education will include mainly gymnastics, volleyball, basketball, handball, football, tennis and badminton. for boys' schools, all physical education activities can take

FIGURE 7.39.

A schematic layout for a group of some of the specialized teaching facilities. The concept here is similar to the year group layout. Separation between noisy activities or activities which require good acoustic environment has been achieved. Activities such as drawing and painting, textile work and clay modelling were grouped together. Such a space can be rearranged or it can be used for exhibition purposes.



1 - Science Laboratory

2 - English Language Laboratory.

3 - Cooking work.

4 - Textile work (Needlework, design and making of clothes, etc.).

5 - Drawing and painting.

6 - Clay modelling and pottery.

7 - Three-Dimensional work.

8 - Storage Space.

9 - Work in progress.

10 - Staff Room.

11 - Reference Areas.

place either in open spaces (football playground) or under covered playgrounds for games such as gymnastics, volleyball, basketball, handball, etc. However, if gymnastics activities are required to be practised indoors, the space for this should be designed to accommodate other non-teaching activities, i.e. lectures, examinations, eating or prayers.

In girls' schools, covered playgrounds can be provided if their design ensures an appropriate level of privacy. However, in circumstances where the site is small or in heavily built-up areas, a multi-purpose hall for sports, gymnastics and other non-teaching activities can be provided.

E-1 - GYMNASTICS.

ACTIVITIES AND SPACE.

The activities of balance and control of the body can be achieved with a wide variety of movement, which may need continuous contact with the floor or with apparatus (as in rolling or sliding), or it may need intermittent contact (as in stepping, running, cartwheeling or scuttling about on all fours), or it may require no contact at all (as in flight: the leaping or springing from one surface or object to another).

Equipment for such activities should be stimulating, flexible and adaptable. Some objects and components may be needed to provide possible means of transportation across space. Other equipment should be movable and light-weight. This enables them to be carried around or attached in various way to other objects or surfaces. It also allows easy movement to and from stores. An alternative is to fold them back to walls or ceiling.

Such equipment should be easy to erect (without complicated mechanisms) and adjustable for the various sizes, shapes and skills of students. For this, light alloy tubular equipment, which may be fixed by sockets horizontally and vertically, can offer more flexibility and variation of adjustment than heavy wooden apparatus.

With the variety of activities and equipment, a good deal of surrounding space is required. Pace, for example, may vary from very fast (about 12m. can be covered in two seconds) to very slow. A sequence of movements could finish 10m. or 12m. from where it started. A rope suspended from a height of about 5m. could cover in its swing as much as 9m. Therefore the minimum area required for gymnastics is about 260m^2.

If the gymnastics space is to be used as a meeting of theatre hall, a movable, adjustable and light-weight stage, and changing space is needed. This requirement can be provided either by allocating additional space for a stage or within the same space. The latter can be achieved by designing the storage area in such a way that it could be used both as a stage and changing space for students.

FLOOR FINISHES.

Floor materials should be suitable for students to sit, lie and roll on as well as to work on in bare feet. For this, timber or rubber and plastic materials can be used. If timber is chosen for gymnastics activities, loose textile carpets can be laid over the floor for occasional use at meetings and theatre activities. The rubber and plastic sheets, which should be loose and thick, (6mm. or over), can be laid over a hard floor surface such as mosaic tiles, vinyl sheets or tiles, etc. The soft rubber floor will be used for gymnastics activities while the hard surface will be used for other activities. However, different agility mattresses are still needed for activities requiring landing from a height, or with considerable velocity. Such mattresses can soften the impact and prevent accidents in case of a fall. Storage for these items is a prerequisite.

WALL FINISHES.

For the choice of wall materials, consideration should be given to: first, durability, cleanliness and smoothness, and second, acoustics. Smooth, fairface or painted brick or blockwork, or any other smooth and hard finishes can be used for the lower part of the wall, where sharp impact or bodies or other objects are expected. For acoustics, the upper parts of the walls should be covered with absorbent materials to reduce the reverberation period to the optimum level of 1.5 to 2 seconds at 500 cycles per second. Since absorbent materials, which reduce reverberation are soft and easily damaged, especially on walls, protective measures should be introduced. For this, timber battens with gaps between can be placed over the soft absorbent materials to achieve reasonable resistance to damage by impact. In general wall surfaces should be considered not to have any kind of protuberances such as protruding handles, knobs, hooks, cleats or unprotected mirrors. Such protuberances can be not only inconvenient, but also dangerous.

CEILING.

Absorbent material on ceilings is required, providing that it can not be damaged or dislodged by impact. Such materials should light in colour to reflect light. Protection of light fittings from balls should be considered.

LIGHTING AND VENTILATION.

Low level windows in gymnasiums are expensive because of the need of laminated safety glass. However, they provide a good visual contact with the external environment. Top lighting or clear story window, on the other hand, can provide good light if glare is controlled, especially on walls to with goal backboards are fixed. Artificial suspended flush lights are preferable, providing that glare is controlled.

Natural ventilation in both situation (low or high level windows) is difficult. A low level window should be fixed or close, otherwise it becomes dangerous, while a high level window will make cross-ventilation difficult and slow. In such situations, mechanical ventilation (not necessarily air conditioning) is required to assist the natural air movement.

E-2 - MULTI-PURPOSE SPORT HALL.

As has been mentioned earlier in this section, a multi-purpose sports hall should be provided if privacy can not be ensured in a covered playground or where the site is small. The hall can be equipped for volleyball (netball), badminton, basketball, gymnastics and other non-teaching activities such as meetings, examinations, drama and theatre activities.

FLOOR FINISHES.

A hardwood block floor finish is durable and suitable for multi-purpose halls, but the cost of installation and maintenance is high.

Composition blocks, which are formed from cement, sawdust, fillers and binders, can be used for multi-purpose halls providing they are bedded to a concrete slab.

Combination floors are usually formed by placing a rubber foam over a concrete slab. Wet polyurethane is applied to seal pores and joints. then a final coat is applied to provide the matt finish required.

Rubber and plastic sheet can be bonded, while thicker materials (6mm. and above) can be loose laid on hard floor surfaces.

WALL FINISHES, LIGHTING AND VENTILATION.

Treatment of wall finishes, lighting and ventilation in sports halls are the same as those in gymnasiums.

SPECTATOR SEATING.

Provision of seating in gymnasiums or sports halls is useful, not only for sporting events, but also for other large scale occasions. For this, movable seating, including pull-out seating or movable 'bleachers' can be used.

E-3 - COVERED PLAYGROUNDS.

Although the main concept of covered playgrounds arises from the need to provide shade for players, it can also be cooler by providing any cross-ventilation. For this reason walls in general should be avoided. The choice of a suitable structural roofing system can range from a conventional concrete structure to a space frame of trussed steel roof. The supports should be kept to a minimum and spans need to be large enough to give a clear span over accepted pitch sizes.

The use of such space can be extended for other activities such as students' assembly, mid-day break, prayers, etc. For such uses the location of covered playground should be considered within the following three main points: first, it should be located in such a way that other quiet teaching activities, such as classrooms, language laboratories, library, etc., will not be disturbed. Second, for prayers, the qibla direction should be considered to be as perpendicular to the main axis as it could possibly be. Third, because of limitations of the prayer time, the location should not be far away from the main teaching buildings.

FLOOR FINISHES.

Timber, rubber and plastic, combination floors are not suitable for outdoor sport. Asphalt in general can be used. Additives to asphalt can lower its stiffness and reduce the risk of indentation. Red shale finishes which are normally used for tennis courts, can be used for multi-purpose outdoor sport space. For gymnastics activities rubber and plastic loos sheets and soft mattresses can be laid over the hard surface. For prayer occasions, carpets and thin plastic sheets can be used. Thought must be given as to how these are laid and who is responsible for storing and positioning them at the appropriate time.

E-4 SUPPORTING FACILITIES FOR P.E.

CHANGING ROOM.

A changing room for about thirty students should be provided. This includes individual lockers, changing clothes and shower cubicles and w.c.'s. This implies that one class group will use the sports facilities at one time.

Floor finishes should be non-slippery (grooved, ribbed or studded), durable, easy to clean and water resistant. Walls, especially the lower parts of walls, should be smooth, durable and easy to clean.

High level windows are preferable. This is because wall surfaces may be covered with lockers and cubicles, and because of the need for privacy. Ceiling and other vertical surfaces should be light in colour to reflect light. A high rate of natural ventilation should be provided.

STORAGE SPACE.

Equipment which is in everyday use, such as buck horses, box horses, parallel bars, benches, etc., can be kept in a storage space which opens directly into the hall. Storage room for covered and outdoor games should be in convenient location and should be large enough to store gymnastics equipment: balls, rackets, mattresses, etc.

STAFF ACCOMMODATION.

For teachers of physical education, an office and a changing room is required. The office should be located to overlook the playing areas for either indoor or outdoor games. Equipment and furniture, such as cupboards, shelves, notice board, first aid kit, loudspeaker, balls, carpet, easy chairs, filing cabinet and worktop surface should be provided. The private changing room should include a shower an lavatory facilities.

III - NON-TEACHING FACILITIES.

A- STAFF ACCOMMODATION.

A-1 TEACHING STAFF.

Accommodation for teaching staff should be considered within the general needs of teachers, *who required, in addition to those* teaching spaces, a place in which they can work, meet together and relax, eat and prepare hot or cold drinks, keep their personal belongings, wash and rest, and to talk privately to a student, parent or another teacher.

The distribution of such accommodation depends on the school organization, where it could be centralized or dispersed. For the proposed organization, a compromised distribution is suggested. A central place is required which may include the headmaster's accommodation, secretaries, common and meeting staffroom and first aid room. Other decentralized accommodation will include deputies rooms, working places for teachers of general subjects, (teachers' base in year centres), rooms of other teachers with special responsibilities (workshop, art and crafts, physical education).

A-2 HEADMASTER'S AND DEPUTIES' ACCOMMODATION.

Although the character of the head's room can vary from a study to a drawing room or have a business-like character, it is more likely to be a mixture of all three. The rooms in general should be a pleasant place for work, friendly and welcoming for children, parents and other visitors, comfortable and private for personal relaxation, meetings or interviews, and impressive to create an atmosphere of authority and prestige when needed.

Furniture and equipment such as a desk, cupboards, shelves, adequate lighting and ventilation, can basically make the room a place for work. Other things such as carpets, rugs and curtains, easy, comfortable chairs and low table, gay colours, plants and maybe paintings, will give the room the necessary friendly and welcoming atmosphere. On the other hand, facilities such as a lavatory, with a private entrance (preferably not opening straight off the head's room, waiting space, secretary's room or a main corridor), a suitable occasional space for some visitors to wait outside the room, enough internal space for meetings with adequate sound insulation, will provide a good deal of comfort and privacy. Finally, the higher the standard of quality of furniture and finishes, the higher the atmosphere of authority and prestige they may reflect.

Adjacent to the head's room, either a small secretary's room or a large general office for the secretary and a number of clerical assistants should be provided. Spaces should be provided for cupboards, filing cabinets, tables and typewriters, etc. An internal walk-in protected strong room for the safe keeping of valuable equipment and confidential documents and papers is essential.

Although provision of a special waiting room for visitors is expensive and cannot be fully utilized, a waiting space for occasional use should be made available. In some English schools, for example, the medical room (first aid room) is planned en suite with the head's room to be used as a rest and a waiting room.

A small room for making and preparing tea and coffee for the headmaster and other staff and teachers should be considered. It should be equipped with cupboards and shelves, kitchen units, sink, electric points, etc.

The requirements of the Deputie's rooms are usually similar to that of the head, except that they are usually smaller in size. Location of the Deputy's rooms can vary from one school to another. However, since each deputy is usually responsible for a number of classrooms or grades, the location of his or her room should be central or easily accessible to those areas.

A-3 STAFF COMMON ROOM.

The room should be domestic in character and atmosphere. For such requirements, a carpet, curtains, easy chairs, coffee tables, etc. could help teachers to relax, exchange views with each other and may promote the interchange of professional knowledge. Other furniture such as a bookcase, pin-board, some cupboards and locker units for storing teachers' belongings, will help to keep the room tidy and organized. A private lavatory should be nearby. In addition to the use of the room as a common room, it may be used for staff meetings, committees, correcting examination papers, etc.

B - CARETAKER'S ACCOMMODATION.

Cleaners and other ancillary staff, who are responsible for keeping the school clean and in good order, should be provided with suitable rooms and storage space for the equipment necessary for their work. Since they should be immediately available to the head teacher and other senior members of staff, their room should be situated near the main administrative area. Storage and service points for cleaning should be located at convenient points throughout the school.

C - PROVISION OF CAFETERIA.

It is necessary to mention that all students are expected to have their meals during the mid-day break. It is not usual to provide a special dining space as this demands extra cost. The meals are light in character and a small kitchen is required for the provision of self-service snack meals, such as sandwiches, biscuits, hot and cold drinks, etc. To enable this function, a large space with good lighting and ventilation should be provided for queuing. As pupils pay for their meals, the servery area should be provided with cash points as appropriate. The kitchen areas should not be near to classrooms, the head's room, main entrance, etc. On the other hand, spaces such as covered play areas, multi-purpose hall, courtyards, etc., can be accepted as suitable locations for the kitchen and servery. Such accepted areas, as well as other circulation areas, should be designed and facilitated with suitable movable and fixed seats, and perhaps tables, shades, plants, waster-paper baskets, fountains and maybe music to attract students to stay in or nearby, rather than moving around the school's site searching for suitable shaded areas. This in turn will help maintenance and cleaning.

D - PROVISION OF TOILETS AND ABLUTION FACILITIES.

Spaces such as covered play areas, multi-purpose hall or courtyards will be expected to be utilized for prayers. The location of toilets and ablution facilities is important, not only to be convenient to the above spaces or others, such as classrooms, laboratories, etc., but also to the ventilation system of the school which was suggested earlier in this chapter. For the convenient movement of students and staff, and for hygiene reasons, toilets and ablution spaces can be dispersed and located on the external circulation areas rather than locating them inside the buildings. This may be achieved by providing a suitable standard sized units which can be located where demand is expected. It is expected that some of these units will be required to be located in the prevailing wind direction or maybe inside the cool temperature zone, and for each situation direct horizontal cross-ventilation must be avoided, and should be replaced by using the vertical ventilation system by using the chimney ducts which were discussed earlier in the chapter.

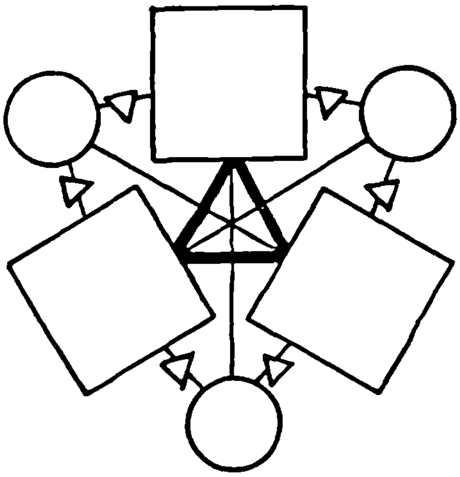
As has already been mentioned in Chapter 6, traditional low level basins should be provided rather than the high level wash basins, which can be considered not only unsuitable for ablution purposes, but also dangerous.

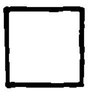
IV - THE FUNCTIONAL LAYOUT OF SCHOOL.

There are many factors which can determine the layout of the school. Some are variable, such as topography and size of the site, size of the school, etc., others, such as climate and the quality of movement are more constant and therefore easy to generalize. In addition there are some functional relationships which must be observed and which tend to influence planning. The climatic requirement has been defined earlier in this chapter. This necessitates that the layout should take a certain pattern. It is paramount that certain elements should be used, such as shaded courtyards and narrow shaded external circulation. This is of vital importance for the natural ventilation process. It is of help with satisfying the educational too.

The movement of students inside the school is determined by the location of specialized and non-specialized and other non-teaching facilities. This in turn is determined by the interrelationship between those facilities and their daily use by students. In general there are two forms of distribution which can determine the quality of movement in the school. In the first, priority is usually given to non-specialized areas (classrooms), and therefore they always take a central and dominant position in the layout while the position of other specialized areas such as laboratories, arts and crafts, etc., are of less importance and therefore they can take secondary positions. This kind of layout reflects traditional educational concepts and the general understanding of the function of specialized and non-specialized areas and the role of the teachers in the teaching process. (See fig. 7.40).

FIGURE 7.40.

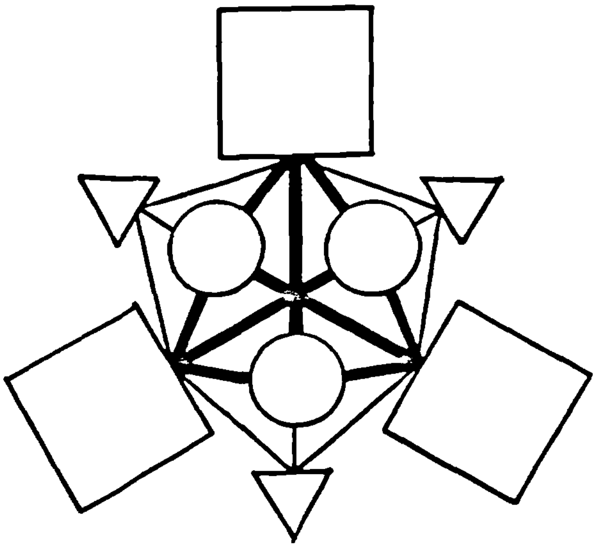




Non-Specialized areas.
(Classrooms).

Specialized Areas.
(Arts & Crafts, Laboratories,
Administative, etc.)

FIGURE 7.41.



Non-Teaching areas.
(Toilets and ablution, General
Storages, etc).

In the second form of distribution, attention is paid to specialized areas as well as non-specialized ones. The importance of specialized areas come from the realization that they should play a major part in the teaching process. As a result they always require convenient access and take more or less central positions. (See fig. 7.41). Although such a layout reflects progressive the educational approach, it is still applicable for the traditional approach too. It therefore fits into the position of future flexibility based on evolution from the existing system which forms one of the main thrusts of this thesis.

Non-teaching facilities such as toilets and ablution areas, which it has been suggested may be supplied in standard units, can be located where demand is expected. Finally the application of the second form of distribution can be achieved in a linear or circular layout as well as vertical of horizontal distribution, depending on size and shape of the site.

FINAL STATEMENT AND EVALUATION OF FINDINGS.

This thesis is based upon a study of educational provision both in Saudi Arabia and in other countries. This was followed by an analysis of the main trends which have been outlined in previous chapters. From this study emphasis has been placed on those main areas which affect school design. They are educational, environmental and architectural. These three major factors are joined by many others of secondary importance. These recognize the constraints place upon design by economic, administrative and social factors. Attention to these factors will determine the quality of the provision of school buildings in general.

Early investigation of the whole problem showed that, although there were many issues which determined later stages, working procedures and the eventual results of the study, there were two major issue which were found to be essential and were given priority. First: the relationship of the existing educational situation to its future. The western educational model was the origin, yet Islamic education could not be disregarded. Any change in the system will inevitably be religiously oriented. For this, the architectural response should be, on the one hand local and related to the traditional and existing Islamic value and culture. On the other, it should be modern and up to date, with future needs borne in mind.

Second: for many obvious educational, health and economical reasons, the internal environment should be of a high standard. However this should be generated by natural ventilation and lighting processes. This is an important aspect of the work and looks ahead to the possibility of Saudi Arabia being forced to consider the economic implications of a national economy tied to one commodity.

In the last chapter the above two issues and many other related factors have been discussed in detail. Original thought has been given to the ways in which function, climate and tradition could be brought together in an interactive way. The architect's brief has been formulated to help the integration of those factors. Examples have been given to illustrate the following:

(1) Educational: the year group centre and the multi-purpose and self-contained classrooms concepts have been selected as being of most value. Their layouts have been originally developed to show that it is possible to build for the existing and future educational needs without sacrificing either the quality of the present situation, nor demanding any physical structural alterations or additional expense in the future.

(2) Environmental: the illustrations show how two systems of natural ventilation - those of cross-ventilation and of convection powered stack effect - could be utilized. for cross-ventilation, teaching areas have been designed to enjoy the advantages of opening onto shaded courtyards. These have been used to enhance cross-ventilation, natural

daylight, as well as assisting in sound control. For the stack effect system to become operative, the traditional idea of using shaded circulation routes have been used. Thought has been given to the application of solar chimneys. Their use is expected to enhance and improve the stack effect system by drawing air from the cooler, shaded areas deep in the plan.

(3) Finally: traditional architectural elements such as courtyards, narrow streets, iwans, aisles, multi-purpose use of space, have been used functionally. In addition to this response to the need for Islamic architectural identity, the overriding aspect has been the recognition of the Mosque as a symbolic factor in design.

This study provides a general framework and points to an approach in the field of school buildings in Saudi Arabia, with particular reference to intermediate schools in the city of Jeddah. However, further architectural studies are still required. Some of those can be summarized as follows:

- There are several climatic regions in Saudi Arabia which in turn require new and different climatic solutions.

- The solar chimney concept is applicable not only in schools, but also in other building types, such as housing, administrative buildings , etc. It is also applicable in some other climatic regions, such as the central and eastern regions of Saudi Arabia. Therefore, further technical studies are essential to develop the concept in detail.

Finally, the results of this study need to be put into an experimental and feed-back process. This in turn should help further development and lead to a continuous innovational process.

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