THE BAGHDADI HOUSE
AN ANALYSIS OF ITS PAST
WITH REFERENCE
TO ITS FUTURE

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DEDICATION

This work is dedicated to my wife, NAWAL for her patience, assistance and consistent encouragement.

CONTENTS

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Abstract

This thesis presents a study of the Baghdadi house, its past with reference to its future. The study examines the prime factors and the issues related to the origin and development of the house in Iraq in general and Baghdad in particular.

The traditional Baghdadi house is shown to be the house form that is a direct result of the climatic, social, economic and structural needs of its residents up to approximately fifty years ago.

This is followed by an examination of the factors that led to the emergence of the modern house in Iraq and those factors which accelerated the abandonment of the traditional pattern. The author identifies the technological changes, the social and economic consequences of these changes which are considered to have produced very significant changes in the nature of the house, its form and the urban structure. The changes include a transformation from the traditional symmetrical arrangement of the plan into a modern and more functional one.

The fourth part is an appraisal of both types, aiming to pin point the advantages and short comings of each one.

The fifth part has listed future recommendations for both, the traditional and the modern houses to improve their quality. It also includes recommendations for the new housing in Iraq.

LIST OF ILLUSTRATIONS

Preface

This study started in the beginning of 1990, relying on the information about Iraq, available at that time. Then it was overtaken by the Gulf War in 1991 which has certainly effected the country not only politically but economically and physically as well.

Due to the difficulty of getting up dated information out of Iraq to indicate the situation after the Gulf war, this work is relevant to the situation before that war.

Introduction

This thesis concerns the housing that is being produced in Iraq today and asks the question "could it be better?"

There are two schools of thought currently. Those that are designing and producing "modern" housing in Iraq today express the belief that the fully westernised "American" suburban house is the answer. On the other hand, there is a growing movement particularly, in Arab countries that the traditions of those countries have been ignored and that they must be revived.
This thesis will examine these approaches and seek to analyse the good and poor points of both to form an objective judgment. From these proposals it will hopefully arise.

The aims of this study are:

1. It can be observed that the quality of housing being built in Iraq today, and Baghdad in particular is failing to meet the requirements of the people satisfactorily.

2. It is the intention of this study to try and discover exactly what these shortcomings are and to examine the history and origin of Baghdadi houses to see if these give any pointers to the production of better housing. The study also intends to bring out the potentialities and problems of both types of houses.

3. The method employed will be to examine the traditional house and the modern house against the following set of criteria:-

   a - Social and economic factors

   b - Climatic control methods

   c - Planning and form type

   d - The urban pattern created by the housing type.

4. From the results of 3 it is expected the criteria for the housing of the future can be developed and suggestions made for significant improvements to both the traditional house and the modern house.

Baghdad, Iraq, *ca.* 1900. A pleasing traditional equivalent of the modern "riverside drive"—wooden and brick row houses (only foundation walls and part of near wall are brick) each with one or more projecting bays or alcoves overlooking the Tigris. The round boat in the right foreground, made of reeds and sealed with pitch, is typical of this area. (Photo: Library of Congress.)

PART. I: GENERAL CHARACTERISTICS OF IRAQ AND BAGHDAD

I.a. Geographical and Topographical Elements

The plains of Mesopotamia form a cluster of four flat terrainian regions; the flood plain the middle, the alluvial terraces' region in the north, the Mesopotamian delta plain in the south-east and the marshes in the south. These regions are defined from north-west to the south-east by a fifth mountainous region. Baghdad occupies the middle of the Mesopotamian flood plain region which is situated in the centre of Iraq, where the two major rivers, Tigris and Euphrates, come closer; forming a distinctive micro-climatic region. It lies on the River Tigris, at latitude 33 .2 North and longitude 44 .4 East. The size of Baghdad is 22,972 sq. Km. forming 5.1% of the total area of the country which is 438,446 sq. Km.

I.b. Climatic Elements

There are various climatic regions in Iraq. The climate of the northern part is Mediterranean and of a continental character, whilst the middle and the southern parts have a sub-tropical hot climate.

The micro-climate of Baghdad is almost the same as that of the flood plain region. It is characterised by extreme differences in seasonal temperatures and very low humidity. There are four climatic seasons, two of which are significant for being extreme:

The hot period spans over five months from May to October. It is marked by high temperatures, with long daily duration of sunshine and dryness coupled with very low humidity.

- The cold period is shorter, covering approximately three months of the winter season, from December to February. It is identified by low temperatures, infrequent rains with occasional short heavy showers and relatively low humidity. The two short transitional periods, Spring and Autumn, are renowned for their mild climate. Spring lasts for 45 days, from the beginning of April to the middle of May, creating a climatic shift from the cold to the hot season. Autumn also lasts for 45 days, from mid-October to the beginning of December, forming a shift in the weather from the hot dry summer to the cold season.

I.b.1. The Prevailing Wind

The wind blowing across the plains of Mesopotamia and Baghdad is generally low in the morning, increasing towards noon to reach its maximum in the afternoon, and is sometimes accompanied by dust and sand. The north-west wind (NW) is the most frequent that blows to Baghdad, the northern wind (N) is in second place, and the western wind (W) is in third. But they also vary according to different seasons, as indicated in Table No. 1.

I.b.2. Temperature

The air temperature in Baghdad rises to its highest average in summer and lowest in winter. The period between May and October covers the hot season while the period between December and March covers the cold season. November is a transitional period from the cold to the hot season.

The monthly average of the durinal air temperature ranges between the lowest level in January and the highest in July and August. It is still high in September. For actual temperature see Tables Nos. 2 and 3).

I.b.3. Relative Humidity R.H.

The relative humidity varies with season and fluctuates with the changes of temperature, ranging between minimal in the afternoon to maximum at night. The relative humidity in Baghdad ranges between the highest level in January (52%-89%) and the lowest in July (12%-32%). The period of high R.H. is from November to April. The period of low R.H. is from May to October (Table No: 4).

The extreme durinal range of the R.H. is between its maximum at 6 a.m. and minimum at 15 p.m. of Baghdad's local time.

I.b.4. Atmospheric Pressure A.P.

The monthly average of the atmospheric pressure in the region of Baghdad "measured at sea level" is at its highest between December "1021.0-1018.9 millibar" and January "1020.5-1018.4 millibar", and at its lowest average between July "999.6-997.5 millibar" and August "1001.2-999.1 millibar" (See Table No: 5). October is a transitional season from low to high A.P. May is a transitional change from high to low A.P. season.

I.b.5. Vapour Pressure V.P.

The vapour pressure reaches its highest level in August, registering 12.4 millibar, this drops to 08.5 millibars in February (refer to Table No: 6).

I.b.6. Solar Radiation

The intensity of the solar radiation affecting the earth and surfaces depends upon the amount of reflected sunlight from the cloud layer and on solar altitude. In Iraq, the solar radiation received by the earth is around the same range as for an arid zone.

In the region of Baghdad, a great deal of solar radiation is received by the earth every year. The highest average occurs in June (30×10^3 KJ/m^2 per day), about 80% of the total amount is received by horizontal surfaces. The lowest average is in January (11 x 10^3 KJ/m² per day) when 61% of the total amount is received by horizontal surfaces (S. Al-Azzawi, 1984).

I.b.7. Duration of Sunshine

The durinal sunshine duration, in Baghdad, approaches its maximum average during the summer days, between May and September. The highest average is in June (12.23 h/day), slightly less in July (11.74 h/day) and August (11.70 h/day). The minimum duration is in winter days, it is (6.25 h/day) in December and (6.45 h/day) in January.

I.b.8. Cloud Cover

The Sky over Baghdad is relatively clear, though occasionally sand storms and dust haze disturb the full brightness of the summer days. The monthly average of the durinal cloud layer ranges between full and partial cloud cover (according to different seasons).

The condition of "full cover" approaches its highest level in April (3.5 Oktas) and lowest in September (0.3 Oktas), whilst the condition of "partial cover" is at its highest in January (1.3 Oktas) and drops down to (0.0 Oktas) in September (Table No. 7).

I.b.9. Rainfall

The plain region of Mesopotamia, where Baghdad is situated, is defined by its infrequent rainfall. Precipitation is likely to occur over the five month period "December-April" when the average fluctuates between its highest level in January (35.3 mm) and relatively high in December and April (22.7 mm and 22.3 mm) respectively. The dry season extends from June to the end of October when rainfall is seldom but it is possible in October with average of (3.7 mm). May is a transitional period from the relatively wet to a very dry season, with a monthly average of 8.1 mm, while November is a transitional period from the dry to the wet season with monthly average 17.2 mm, (Table No. 8). The total annual average ranges between 50-150 mm.

TABLE 1 – THE DIRECTION OF PREVAILING WINDS IN DIFFERENT SEASONS

MONTH	I	II	III	CALMS%	
JANUARY	NW	N	SE	8%	THE EXTREME
JULY	NW	W	N	4%	
FROM MID–MAY TO MID–OCTOBER	NW	N	W		THIS IS THE HOT DRY SEASON

TABLE 2 – THE FLUCTUATION OF THE AIR TEMPERATURE IN THE SHADE

A. MAXIMUM			B. MINIMUM		
MONTH	DEGREE	CATEGORY	MONTH	DEGREE	CATEGORY
JULY	43.4 °C	– HIGHEST	JANUARY	4.8 °C	– LOWEST
AUGUST	43.3 °C		DECEMBER	5.2 °C	
JUNE	41.0 °C		FEBRUARY	5.9 °C	
SEPTEMBER	39.8 °C		JULY	25.3 °C	– HIGHEST
MAY	35.8 °C		AUGUST	24.6 °C	
OCTOBER	33.4 °C		JUNE	23.4 °C	
JANUARY	15.8 °C	– LOWEST	SEPTEMBER	21.0 °C	
DECEMBER	17.6 °C		MAY	20.0 °C	
FEBRUARY	18.7 °C		OCTOBER	16.2 °C	

TABLE 3 – THE SEASONAL DISTRIBUTION OF THE MONTHLY AVERAGE (MEAN) OF THE DURINAL TEMPERATURE IN BAGHDAD

THE MAXIMUM/MONTHLY AVERAGE OF DAILY RANGE			THE MINIMUM/MONTHLY AVERAGE OF DAILY RANGE		
FROM – TO	DEGREE	NO OF DAYS	FROM – TO	DEGREE	NO OF DAYS
28 MARCH– 14NOV	25° C OR OVER	228	17 DEC– 2 FEB	BELOW 0.5° C	48
21 APRIL–29 OCT	30° C OR OVER	192	18 NOV–22 MARCH	BELOW 10° C	125
11 MAY–10 OCT	35° C OR OVER	135	24 OCT–16 APR	BELOW 15° C	175
6 JUN–16 SEPT	40° C OR OVER	103			

TABLE 4 – THE MONTHLY AVERAGE OF THE DAILY RELATIVE HUMIDITY (R.H)

MAXIMUM			MINIMUM		
DECEMBER	88%	HIGHEST	DECEMBER	52%	HIGHEST
JANUARY	89		JANUARY	52	
FEBRUARY	80		FEBRUARY	42	
MARCH	74		NOVEMBER	39	
APRL	67		MARCH	35	
NOVEMBER	68	TRANSITIONAL	SEPTEMBER	15	
JULY	32	LOWEST	JUNE	14	
AUGUST	35		JULY	12	
JUNE	36		AUGUST	12	LOWEST
SEPTEMBER	40		MAY	18	
MAY	48		OCTOBER	23	
			APRL	TRANSITIONAL	

TABLE 5 – THE MONTHLY AVERAGE OF THE DAILY RANGE OF THE ATMOSPHERIC PRESSURE (A.P.) IN BAGHDAD

MAXIMUM MILLIBAR RANGE			MINIMUM MILLIBAR RANGE		
DECEMBER	1021.0	HIGHEST	JULY	997.5	LOWEST
JANUARY	1020.5		AUGUST	999.1	
NOVEMBER	1018.8		JUNE	1002.1	
FEBRUARY	1018.4		DECEMBER	1018.9	
JULY	999.6		JANUARY	1018.4	
AUGUST	1001.2		NOVEMBER	1016.8	
JUNE	1004.3		FEBRUARY	1016.7	

TABLE 6 – THE MONTHLY AVERAGE OF THE VAPOUR PRESSURE (VP) IN BAGHDAD

MONTH	MILLIBAR	RANGE
AUGUST	12.4	HIGHEST
MAY	11.7	
JUNE	11.9	
JULY	12.1	
SEPTEMBER	11.6	
FEBRUARY	08.5	LOWEST
JANUARY	08.7	
DECEMBER	09.2	
MARCH	09.3	

TABLE 7 – THE MONTHLY AVERAGE OF THE DAILY CLOUD COVER AND NUMBER OF CLOUDY AND CLEAR DAYS

MONTH	CLOUD/OKTAS FULL	PARTIAL	NO. OF CLOUDY DAYS		NO. OF CLEAR DAYS		
APRIL	3.5	1.1	2.8		8.9		
NOVEMBER	3.0	0.8	2.6		11.3		
DECEMBER	3.2	1.0	3.9		11.2		
JANUARY	3.3	1.3	3.3		10.0		
FEBRUARY	3.2	1.1	3.1		9.6		
MARCH	3.4	1.0	3.7		8.2	LOWEST	
AUGUST	0.4	1.0	0.0		29.7	HIGHEST	
SEPTEMBER	0.3	0.0	0.0		27.9	TRANSITION	FROM HIGH TO LOW
OCTOBER	1.8	0.4	1.0	TRANSITION	18.4		FROM LOW TO HIGH
MAY	2.6	0.6	2.4		12.2		
JUNE	0.0	0.1	0.0		27.7		
JULY	0.0	0.1	0.0		29.6		
TOTAL			22.8		204.7		

TABLE 8 – THE RAINFALL IN BAGHDAD

RELATIVELY WET SEASON		DRY SEASON		TRANSITIONAL SEASONS	
DECEMBER	22.7 mm	JUNE	0.1 mm	NOVEMBER	17.2 mm
JANUARY	35.3 mm	JULY	0.0 mm	MAY	8.1 mm
FEBRUARY	24.7 mm	AUGUST	0.0 mm		
MARCH	23.7mm	SEPTEMBER	0.1 mm		
APRIL	22.3 mm	OCTOBER	3.7 mm		

NOTE: THE INDICATORS OF THE CLIMATIC ELEMENTS ARE OBTAINED FROM THE RECORDS OF THE IRAQI METEOROLOGICAL DEPARTMENT IN BAGHDAD, COVERING A LONG PERIOD OF CLIMATIC OBSERVATIONS (1941–1970).

I.c. DEMOGRAPHIC AND SOCIAL ELEMENTS

I.c.1. The Population

Estimated figures of population in Iraq suggest that the population of Baghdad is expected to be 5.5 million by 2000 while it was approximately 3,844,608 in 1987, when the total population of Iraq was about 16,278,000 (1) and expected to be 17 million at present, with nearly equal male/female ratio. Real or estimated figures of manpower and work force (W.F.) are not available at the moment.

I.c.2. The Women Involvement in Economic Activities

The increase in female participation in the work force (W.F.) is a major demographic change, the best information available is below.

According to Iraqi statistics published in 1983, the percentages of working women to the total work force in some major activities were as follows:-

(1) Source : Annual abstract of Statistics, 1988 - Central Statistical Organisation, Ministry of Planning, Baghdad.

Activity	% of women to the total (W.F.) in the activity
Insurance and Banking	46.0
Service	29.0
Trade	18.4

Absolute figures were not available at that time. Generally, the rate of women's involvement in the labour force has risen by 19% since 1980, compared with less than 6% in 1976. 38.5% of the total women working are serving in agriculture.

The last available statistics, in the form of percentages and approximate figures of the involvement of women in some economic activities were released in 1986 (1) as below:-

Activity	No. of W.F.	% of the total W.F. of the activity
Heavy Industry	22,000	19.0
Electricity	4,000	41.0
Public Health	10,000	36.0

(1) Source: Annual abstract of statistics, 1988 - Central Statistic Organisation, Ministry of Planning, Baghdad.

I.c.3. Size of the Family

Changes in family size have been a notable characteristic of recent years. According to estimation made by the Planning authorities in Iraq the average size of an Iraqi family is 5-8 members, Families of such size form 50% of the urban population while the largest size families, 9 and more members, form 18% and those with 1-4 members form 32%. It is expected that the number of families in the 5-8 members group will be 1,628.227 in 1995 (1).

The current growth rate of population in Iraq is between 3.3 - 3.5%, while the traditional Iraqi society is in favour of large families with no less than five children.

Undoubtedly, improving the health service and education has led to the reduction of the infant mortality rate and will raise the growth rate of population. According to UN's Children's Fund of (UNICEF), released before 1990, the infant mortality rate in Iraq fell from 72 per 1,000 to 47 per 1,000 at the end of 1987; it was expected to achieve a target of 36 per 1,000 in 1990 (2).

(1) Publication of Regional Development Planning (Family research) Ministry of Planning - Baghdad 1977. These are the only available figures.

(2) Annual abstract of statistics 1988 Central Statistical Organisation : Ministry of Planning, Baghdad.

Note: The above mentioned figures refer to the situation before the 1991 war.

Improving the rate of infant mortality would certainly increase the size of the Iraqi family but some other restraining factors minimize it. The most important ones are:

- Changes in the lifestyle and social attitude of the society, i.e. large families are no longer fashionable.
- The rise in the living standard and expenditure, smaller families allow more money per person.
- A notable improvement in women's social position, therefore, less emphasis on women's reproductive role.
- Extending women's education and their involvement in the work force gives less time and incentive to child production.

To meet the growing demand for manpower, during the last fifteen years, the Iraqi government offered some fiscal and nominal motivations to encourage families to produce more children. In 1987, a series of incentive measures were introduced, intending to extend the size of families, they are:-

(a) One year maternity leave for the working mother.

(b) Extra monthly allowance to be paid for every child after the fourth born.

(c) Offering a housing loan and free mortgage relief for those families.

TABLE NO. 9 DEVELOPMENT OF POPULATION IN IRAQ

POPULATION OF IRAQ ('000) 1947 - 1987			
YEAR	TOTAL	FEMALE	MALE
1947 (1)	4,816	2,559	2,257
1957 (1)	6,299	3,144	3,155
1965 (1)	8,047	3,945	4,102
1970 (2)	9,440	4,686	4,754
1971 (2)	9,750	4,840	4,910
1972 (2)	10,074	5,000	5,074
1973 (2)	10,413	5,169	5,244
1974 (2)	10,765	5,343	5,422
1975 (2)	11,124	5,521	5,603
1976 (2)	11,505	5,710	5,795
1977 (1)	12,000	5,817	6,183
1978 (2)	12,405	6,016	6,389
1979 (2)	12,821	6,218	6,603
1980 (2)	13,238	6,423	6,815
1981 (2)	13,668	6,634	7,035
1982 (2)	14,110	6,850	7,260
1983 (2)	14,586	7,082	7,504
1984 (2)	15,077	7,321	7,756
1985 (2)	15,585	7,570	8,015
1986 (2)	16,110	7,827	8,283
1987 (1)	16,278	7,913	8,364

ANNUAL ABSTRACT OF STATISTICS 1986: CENTRAL STATISTICAL ORGANISATION

NOTES: (1) CENSUSES
(2) ESTIMATES

SOURCE: BAGHDAD OBSERVER
19 OCTOBER 1987 p.2

I.d. Economic Elements

Iraq occupies the second place in the world oil reserve but because of the bureaucratic and other administrative barriers, the resources of the country have not been spent efficiently.

Before the economic and urban destruction during the war, Iraq possessed an outstanding economic potential and well-established infrastructure to rebuild an efficient and more diversified economy. But most of the economic potentials were irrationally wasted and the spending was extravagantly allocated to non-productive activities.

> "The rational development of many sectors of public life has gone by default, nowhere more obviously than in area of urban planning"
> (A. Gilbert & Patisy, 1986)

I.d.1. Economic Development and Planning

Due to the absence of extended private capital, the public sector played a pilot role in the nationwide investment policy. The productivity of this sector is low but could be revitalized by injecting more resources and incentive measures, in order to increase the productivity and enhance the mechanism of investment allocation.

The strategies of the economic development actually relied upon oil revenues as a prime financing resource. The current long term plan of economic development (1988-2000), which is hampered by the recent events, theoretically aims to reduce the total dependence on oil to finance the key projects. In fact, oil revenue covers 85% of the total financial resources allocated for development programmes. The 1991 predictions estimated the capacity of oil production in Iraq standing at 4 million barrels a day which is pre-war level (1). The actual production was 1.5 million barrels a day during the Iraq-Iran war (1980-1988).

> "Oil made up more than 98% of the total Iraqi exports to USA. In 1989 it reached $700m and in the beginning of 1980 jumped to $977m. It was expected to reach $1.3 billion by the end of the same year"
>
> (Middle East Economic Digest, February 1989)

The above mentioned plan, in its outline, has given a priority to the most decisive issues. This includes improving the environment and living conditions, upgrading the infrastructure and housing stock, developing health care, expanding the network of the social and educational services, rationalising the use of resource, using advance and high technology.

The main objectives of the plan are:

- Achieving a high productivity in non-petroleum sectors to increase their roles in financing investments and accumulation of capital.

(1) Iraqi-Iranian war (1980-1988)

- Increasing the economic efficiency of different activities and creating preconditions for the post-war reconstruction.

- Offering the private sector wider opportunities to make a larger contribution in the national economy.

- Raising the rate of women's participation in social and economic activities.

- Promoting the scientific research and training programmes.

- Ensuring a variety of sorts and sources of imported commodities.

In an attempt to eradicate the socio-economic inequality between different areas and to bridge the gap between the rural and urban communities, the above mentioned plan has adopted a policy of regional descentralisation and proportional allocation of the investments, manpower and population into other centres rather than the main three metropolitan centres, Baghdad, Basra and Mosul.

According to the annual statistics of 1986, published by the Central Statistical Organisation in Baghdad; the per capita income reached 818 Iraqi Dinar in 1987. (The official price of the Iraqi Dinar at that time was 3.32 Dollars)(1).

Per Capita Income and the Gross Domestic Product in Iraq, by I.D. at the Market Price (2).

For 1981 - 1987

Year	PCI (I.D.)	GDP (I.D. million
1981	735	11.012
1982	731	12.615
1983	728	13.096
1984	815	14.792
1985	809	14.547
1987	818 estimated	

(1) The Annual Statistics abstract/Central Statistical Department, Ministry of Planning, Baghdad 1986.

(2) The actual or market price of I.D. was 37 cent during the years (1981-1988), although the official rate is frozen at over US$ 3.3.

PART II: THE TRADITIONAL BAGHDADI HOUSE

II.a. The History of the Baghdadi House

Baghdad has one of the longest histories of any world city, a short summary is essential toward understanding of its present situation. The ruins of the ancient cities of Sumer, Assyria and Babylon are evident of Iraq's architectural heritage, dating back seven thousands years. The evolutional development of the Iraqi architecture culminated during the 9th century, mainly in Baghdad before it lost its importance after the Ottoman domination. (See the next two sections).

By virtue of its geographical and climatic characteristics, the fertile land between the two rivers Tigris and Euphrates, was an appropriate environment for the early human settlements, going back to the remotest antiquity. The Sumerians inhabited lower Mesopotamia before 3000 BC where they built profounded cities and cultivated an influential culture, believed to be the first civilisation in Mesopotamia. Cities like Ur, Lagash, Larsa and Nippur were famous during the first Sumerian Kingdom of Ur, in the middle of the third millennium (2500-2300 BC).

> "The Sumerians were civilised by modern standard. Their cities were well built and administered, their fields were properly irrigated and tilled, their arts and sciences were highly developed, and they had further claim to being the most advanced people in the world." (J.Wellards, 1972) p. 96

The Akkadians, on the other hand, settled in the north where they established the Kingdom of Akkad (2400-2300 BC), and then expanded towards the south to conquer Ur and Sumer. At that time the country was divided into rival city states which, after hostilities and mutual attacks, were united under the rule of the Akkadian King Sargon I (2303-2247 BC), forming a confederation of allied city states. This lasted from (2303-2108 BC). That Union included the cities of Akkad in the north, Sumer in the south and the central part which was later called Babylonia.

The first Babylonian dynasty in the middle part of Mesopotamia, rose in about 2000 BC and approached the zenith of its political power and cultural achievements in 1800 BC. Henceforth, it gradually weakened until it was overthrown by the Hittities in 1595 BC, whereas the last Sumerian dynasty collapsed in 1900 BC. (G. Daniel 1981). Alongside the third Sumerian Dynasty, the Babylonian Dynasty existed.

After frequent local wars and many foreign conquests over the region by Hittities in 1600 BC, Kissities in 1400 BC, and others, the first Babylonian Dynasty retreated and eventually diminished. On the other hand, the hundred years of Assyrian trade and political expansion from (1200-1100 BC) resulted in the domination of Assyria over the region in 1000 BC. Hitherto, the importance of Nieneveh grew to become the capital of Mesopotamia and the core of the

Assyrian Empire until its fall in 612 BC. Soon after, the neo-Babylonian Kingdom ascended, the city of Babylon, once again, became the capital of the Babylonian Empire, and that was the final phase of its imperial history which lasted from (605 - 538 BC), for the Persian Elamite invaded the country, sieged the city of Babylon in 539 BC and then destroyed it in 484 BC. Later the area survived but was ruined and the city scarcely populated after its last invasion by the Greeks in 331 BC. Later the Persian Sassanians ruled over Mesopotamia for about four centuries (226-641 AD).

From the above, it can be noticed that, over a period of about 2,700 years, 3000- 331 BC, the principal territories of Mesopotamia, Sumer, Babylonia and Assyria were ruled by competitive dynasties and kingdoms which frequently rose, deteriorated, rose again and eventually collapsed.

In spite of individuality of cultural and social characteristics and natural settings, the Babylonian and Assyrian cities, Babylon, Borsippa, Assur, Nineveh and Nimrud, retained the principal features of the Sumerian house and the concept of its neighbourhood which will be discussed in the next chapter.

II.a.1. Architecture and Monuments of Ancient Cities

The Cities of Mesopotamia were often built on flat open terrain and, therefore, were well protected against the frequent floods and enemy attacks. Their defensive measures were articulated by different construction means such as building fortified walls, digging ditches around each city and constructing important buildings, like palaces and temples, on high ramps. In many cases, the cities were planned in chequer board form where the King's palace either dominated its centre or formed a part of the city fortress.

Ur was a prosperous Sumerian city in about 3000 BC and became the capital of the United Babylonia cerca 2000 BC. Its impressive ziggurat is a symbol of the Sumerian architectural mastery. It was a three-storeyed erection, built entirely of brick, the core being of rubble, cemented with bitumen and the outer face of baked brick. The skill and artistry, involved in building the ziggurat of Ur are more astonishing today than the size of the 4,000 years old temple (J. Wellard 1972). Some architectonic features of the third Sumerian dynasty (2113-1900 BC) lie in the remains of the city of Ur; its wall, layout and foundations of the harbours on the Euphrates.

Babylon was the biggest and most distinguished city during the golden age of Babylon Dynasty (1800 BC). It was surrounded by multiple walls within which houses, buildings and palaces were erected on a rectangular plan, with gridded streets. The city was linked to a developed network of engineering infrastructure including water canals and reservoirs, bridges, dams and aquaducts which were the first of their kind in human history. The Tigris and Euphrates were joined by the Kings Canal about 400 km long.

The ziggurat of Babylon, "The Babylonian Tower" with its solid brass gates, was a masterpiece of architecture, admired by the Greek Historian Herodotus who himself visited the temple in about 450 BC. He described the ziggurat as a complex of eight-storey building with stairs and outer paths built around the structure. Big benches were placed to enable the visitors to catch their breath before going to the shrine on the topmost platform.

Spectacular examples of the architecture of the Neo-Babylonian Dynasty (605-538 BC) were the Hanging Gardens and the walls of Babylon. They were unique in their kind that were considered amongst the Seven Wonders of the World. About a hundred shrines were built within the city walls, fifty-five of them were devoted to god Marduk, other gods and goddesses including Ishtar had forty-three.

The old town on the east bank and the new suburbs on the west bank were joined by a stone bridge with a roadway of wooden planks which were withdrawn at night in order to control illegal passage of smuggled goods and ensure security and order.

Nineveh was a well protected Assyrian city, its fortress walls were about 33 m high and a few metres wide. It is believed to have had 1,500 towers. The ruins of the square shaped city of Khorsobad, south Nineveh, are evident of the Assyrian building art. In that city, the palace is a significant building, attached to a ziggurat and a complex of temples, constructed on artificial ramps, forming a citadel-like structure (See previous section).

II.a.2. Ancient Building Technique and Materials

The people of ancient Mesopotamia managed to adapt the surroundings to satisfy their physical and spiritual needs. By creating their shelters they paved the way to the further development of building practice in the region. The builders developed their artistic skills through the finding and processing of building materials. However, the monumental buildings in the area exhibit a highly developed architectural skill and domestic buildings reflect a rational response of the early dwellers to the natural and environmental circumstances.

Despite the simplicity and homogeneity concerning the arrangement and design of the ancient houses, there were some diversities in the sphere of the vernacular technique and materials, attributed to the differences in time, local environmental circumstances and also to the changes in dynasties and geographical location.

Due to the shortage of appropriate timber and lack of stone in the southern and middle parts of the country, where the

Sumerians and Babylonians dominated, construction depended mainly on brick. The technique of brick building and vaulting have prevailed in the area for thousands of years.

> "The absence of local stone and the scarcity of timber gave rise to a sophisticated building technology based on brick masonry construction with an architectural vocabulary of columns, piers, arches and vaults."
>
> (N. Schoenauer,1981) p.4

The early Sumerian cities were built by sun dried and baked brick which was invented by them and employed in vaulting, arching, decorative motifs and various structures of almost every temple, palace and important premises.

Incorporating burned brick and beams of palm tree trunks, the builders of that time, managed to construct efficiently. In domestic buildings roofs were flat, spanned by palm trunks, topped by reeds, covered by earth and coated with clay. The barrel shape brick vaults, with multiple arched rings, was a typical roof for the Babylonian monumental buildings, bitumen was applied for sealing joints and cracks.

The Assyrians, in the north, relied upon the availability of stone for their constructions. The impressive architecture of the Assyrian Empire (1000-612 BC) and that of its successors, the Hiris and the Sassanians, is still featured in architectural history in other parts of the world (See Banister Fletcher, 1975).

The building style, practised later by the Sassanians in Iraq for about four centuries (226-641 AD) was merely an evolutional continuation of the Assyrians' and Chaldeans' architectural ingenuity, transferred outside by the Sassanian conquest of Mesopotamia. The enormous vault of Ctesiphon Court, erected by the Sassanian kings in south of Baghdad, is a remarkable example of the architecture of the 3rd century AD (N. Beloff, 1948).

II.a.3. **The Courtyard House in History**

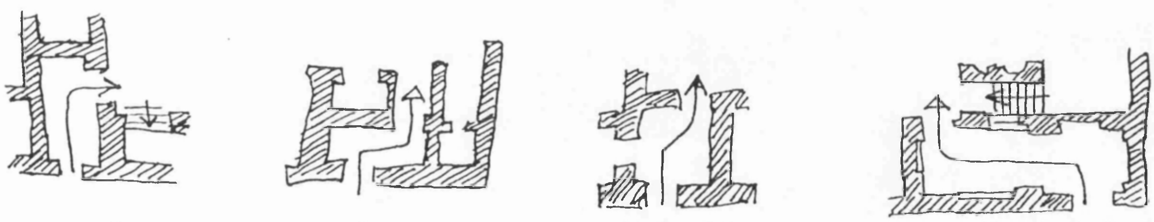
The traditional Baghdadi house and those of ancient Iraq are relatively similar in terms of concept, form and plan arrangement, as well as in the layout and concept of the neighbourhood. The courtyard was a common divisor in the houses of different dynasties in Mesopotamia, descending from the Sumerians to the time of the Baghdadi colonnaded courtyard house in the 19th century. Although the ancient cities of those dynasties had their own peculiarities in the architecture of palaces, monumental, religious and public buildings, they had much in common with regard to domestic construction and the arrangement of the layouts in their residential quarters. They all retained the basic elements of the house of Ur and other Sumerian cities, even after the fall of the Sumerian dynasties.

The Origin of the Courtyard House

Baghdad houses, up to the end of the nineteenth century, can be materially identified through the remnants found during the continuous demolitions in the old parts of the city and the experimental excavations that took place in other historical areas. It was affirmed that a vast number of the demolished houses were originally erected upon old ruined foundations and basements of decayed buildings, from the earlier centuries with an identical plan character. But still, there is no unified opinion about when the final shape of the traditional house was obtained, due to the lack of clear evidence regarding the houses of the period between antiquity and the most ancient survived ones. Most of the hypotheses suggest that the courtyard and the symmetrical arrangement of the rooms in the traditional houses of Baghdad are generated from the ancient house and inspired by the traditional art of building in Mesopotamia.

N. Schoenauer, 1981 and K. Creswell, 1989 relate the roots of the traditional and Medieval Baghdadi house to the dwellings of ancient Mesopotamia, focusing on the affinity of concept of the house, as both ancient and traditional societies ensured full privacy behind the humble appearance of the exteriors. The inward-looking form offered the house the required privacy which was also maintained by the arrangement of the entry way in a form of bent and indirect access. (See illustrations below).

Fig. 1. Arrangement of entry ways throughout history.



Ur 1900-1800 BC | Assur 687-637 BC | Babylon 700-600 BC | Baghdad 19th Century AD

It has been found that the Sumerian houses which were revealed through the archaeological excavations in Ur are largely similar to the traditional town houses of Baghdadi residents, in terms of spatial distributions of the ground plan, and to some extent, in the arrangement of the alleyways and awkwardness of the construction (Figs. No: 2, 3, 4)

The house of the early Sumerians was built with a central courtyard, where the family activities took place, and the rooms obtained light and ventilation through the only inward-looking windows. The internal walls were plastered and painted. Its rectangular plan was divided into private and working place sections. Some of the houses have more than one courtyard around which rooms and other spaces grouped, forming clusters of functional complexes.

In 1923 Norbert Schoenauer gave an illustrative description of the house of Ur, stating:

> "The typical urban house in Ur consisted of several rooms around a central court. A staircase, usually near the entrance, led either to the roof or to the upper floor. A reception room, kitchen and other ancillary household rooms faced the courtyard at ground level. In two-storey structures bedrooms and private family rooms were located on the upper floor, also facing the courtyard. The roof of a single-storey house was often used as a sleeping platform, but in humbler dwellings the reception room had to serve also as a bedroom".
>
> (N Schoenauer, 1981) p. 9

In this respect, another statement is made by J. Wallard (1972):

> "...They were living in some cases in two-storey house not so radically different from the residence of well-to-do merchants in the provincial towns of Iraq today" p. 91

Amongst the archaeological findings of the Akkadian dynasty (2400 BC) was a mansion house, composed of three distinct units; the first contained reception rooms for guests and business, the second was a wing for women and the third a serving quarter. A number of bathrooms and lavatories was provided to each wing and connected to an elaborated drainage system, discharged into a vaulted sewerage, running along one side of the house (S Lloyd 1974). Similar houses existed in the Neo-Babylonian kingdom "612-538 BC". . (See set of figures No. 5).

Some writers relate the pattern of the Baghdadi house to the "Hiri" style, of the pre-Islamic Arab society which inhabited the central part of Mesopotamia, as it was adopted and widely applied by the Abbasids in their new capital Samarra "835-889 AD" (K. Cresswell, 1989). The same pattern, however, was transferred to Baghdad when it became the capital city of the Abbasid state once again. Some houses of the Abbasid Samarra, built in the 9th century and revealed in the 1930s, (Figure No. 6), bear features significantly similar to those of the multi-courtyard houses, still existing in Baghdad (J. Warren and I. Fathi, 1982).

These archaeological findings can be considered a palpable evidence, tracing the evolutional development of the house and domestic architecture in the region since the ancient time.

The drawings of Al-Wasiti, the famous Iraqi miniature of the 13th century, are the only illustrative indicator which can be used for documentation and comparison between the existing traditional houses and those of the Abbasid time. They expose the form of the house, existed at that time as a two storey courtyard house with arcades, timber arches and galleries at the upper floors, and likely to have underground cellars. These drawings may prove that not much change has occurred in the form except some minor stylistic development.

A practical evidence concerning the style of architecture , practised in Baghdad during the Medieval times can be seen through the arrangement and stylistic treatment of the colonnaded balconies (Tarma) of the holy shrines in Kerbala, Najaf and Kadhimiya. They are arranged in a similar way to the balconies in the traditional house, though more elaborated (ibid).

The compactness of the form and the spatial arrangement have distinguished the Baghdadi house from the countryside one, although both houses are arranged around courtyards. The latter, however, is less stylistic, more functional and mostly arranged as a one-storey farmhouse with entirely different function from that of the urban house. The proportion of spaces is different as well, for the abundance of land and lack of building restrictions is usual in the rural environment.

The continuance of the general pattern of the dwelling house and its spatial arrangement around the courtyard show that, environment and the characteristic of local building materials were the major determinants which shaped the development of domestic architecture in the region.

This longevity of traditions is shown even better in the houses of Mesopotamian marsh dwellers. Today, the houses of the marsh settlers in the south-east of Iraq have remained almost the same as when the area was inhabited by the early Sumerians. These houses are entirely built of reeds in an identical form to that of the reed huts of the very early Sumerian settlements (See Fig. No. 7). At the front part of the reed house, a tall guest chamber is still the crucial feature of the form. R. Chadirji (1986) relates the reed huts of the Iraqi marshes to the early history of the natural mode of production, i.e., "the phase of hunting and gathering", when material was used in construction without undergoing any physical or chemical processing. It is strongly believed that more durable building materials came to be used by the late Sumerians when the settlers of marshes moved inland (S Lloyd, 1974). Since then the form of the house has changed, as well, when the concept of the courtyard was introduced to the plan. The reed huts, however, are still erected without courtyards.

II.a.4. Ancient Style and Arab Islamic Architecture

The influential ancient architecture, cultivated in Iraq, has continuously penetrated to the rest of the Islamic World. In 656 AD, the city of Kufa was built in the middle part of the original land of Mesopotamia and came to be the new capital of the Islamic state. There, buildings and houses bore architectural features that can be traced to the ancient tradition of the region, in terms of form and vernacular style. Later, those features were transferred to other Islamic regions, disseminated with the native culture and adapted to the local circumstances.

When Damascus became the capital of Amawiyat dynasty, in 661 AD, the Islamic architecture migrated to that city and benefited from the new potential and techniques which were largely adapted to the Syrian building craftsmanship and availability of stone and good timber. The techniques of brick and stone building were developed into a fine art and the engineering of "cross and barrel vault" and dome were perfected. When the Abbasids seized power a hundred years later, the capital was transferred to Iraq once more, then the second Abbasid Caliph, Al Mansour, built Baghdad in 762 AD, exploiting building experience from various roots. Kufa, Baghdad and later Samarra, were built of bricks and by and large, based on the regional building tradition, practised by their predecesors. K. Cresswell (1989) conveys a detailed description of ancient Samarra given by the famous Arab geographer and historian, Al-Yaqubi (who died in 897 AD) stating:

> "Having set out laid the foundations of the buildings on the eastern of Samarra side of Tigris, Al-Mutasim extended a bridge to the western side, and there, laid out buildings, gardens and orchards." p. 342

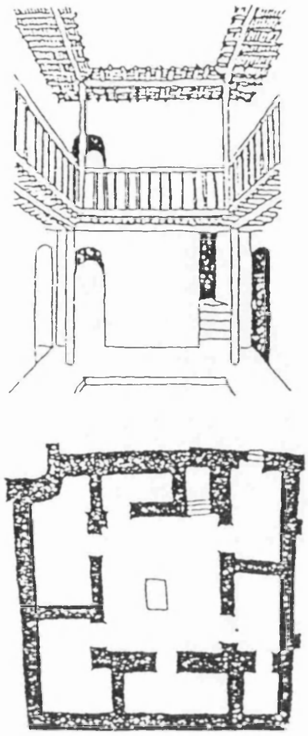
The great skill attained, can be seen in the brickwork of the historical buildings and the spiral minaret (Malwiyah), of Mutawakil's Mosque in Samarra. It is a remarkable piece of Abbasid monumental architecture of the 8th century.

To enhance their perception of building geometry, the Arab builders intellectually employed mathematical means in their designs. In the major architectural works, organic forms and Arabic calligraphy were used to add expressive appearance to the abstractive character of the interior and the exterior. Their forms often complied with the natural surroundings.

> "They drew inspiration from Hellenistic, Syrian, Roman and Byzantine sources and re-interpreted them in the term of local craft techniques of the many regions of the world which their empire eventually covered."
>
> (Bill Risebero 1985) p. 27

The multiple roots and the far reaching of the Islamic architecture were perfectly embodied in the remarkable building artefacts, erected in different parts of the world, forming a style of its own.

Fig. No. 2 The similarity between the house of Ur and the traditional house of Baghdad

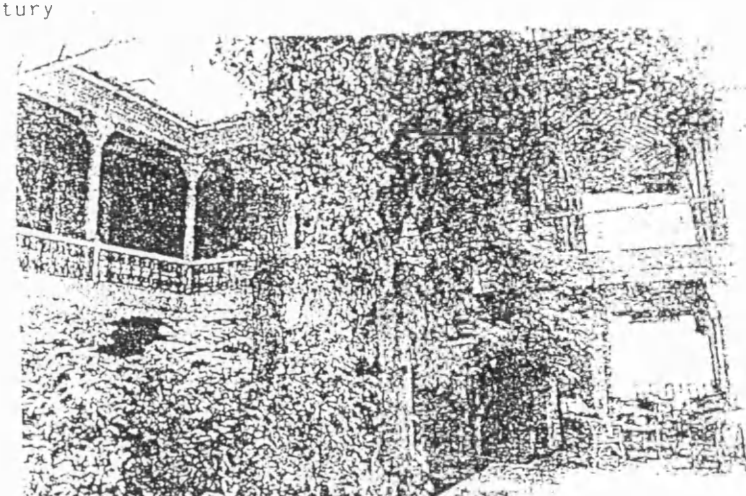


A- A reconstruction of elevation section & plan of a single courtyard house of Isin-Larsa from the Sumerian dynasty in Ur (C.1800 BC) by C.L. Woolley

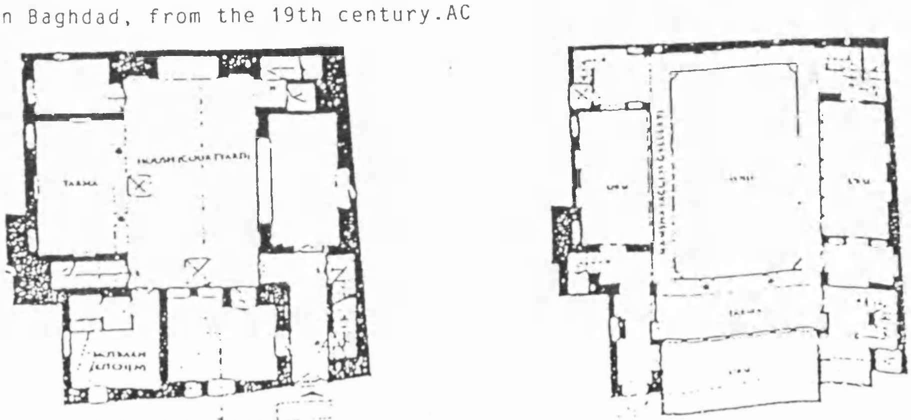
Source:J. Stankova & J. Pechar, 1979

B- A traditional house with a court-garden built in Baghdad in the 19th century

Source: Lloyd, S, 1980



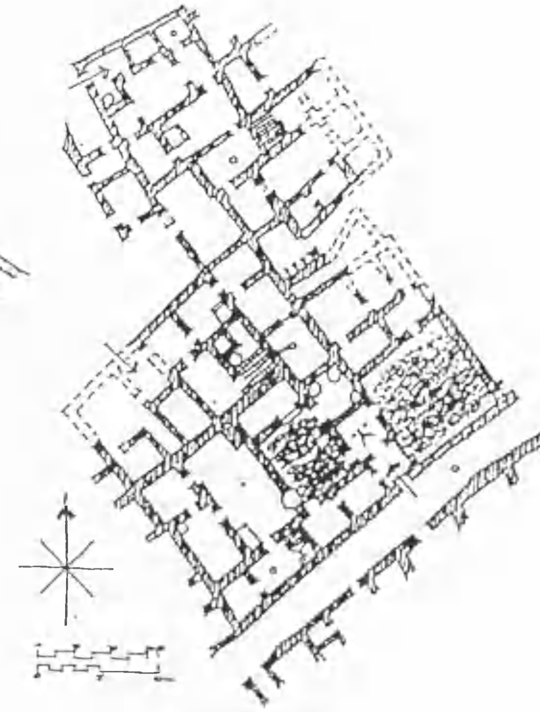
C- Plan of Ground & upper floor of a courtyard house in Baghdad, from the 19th century.AC



Source: Sumer, Vol. 18, No.1 & 2, 1962

Fig. 3 , Arrangement of layouts throughout history

Ur, 19th - 18th century B.C



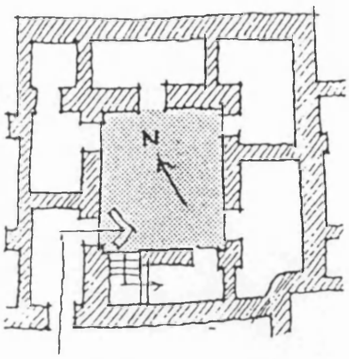
Tell Asmar, 2250 B.C

Assur, 687- 637 B.C

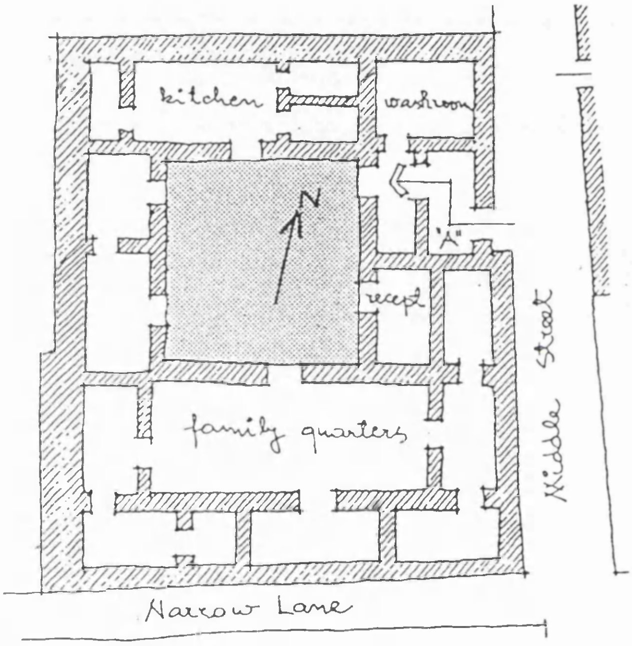
Babylon, 700 - 600 B.C

Source: N. Schoenauer, 1981.Comparison By The Author

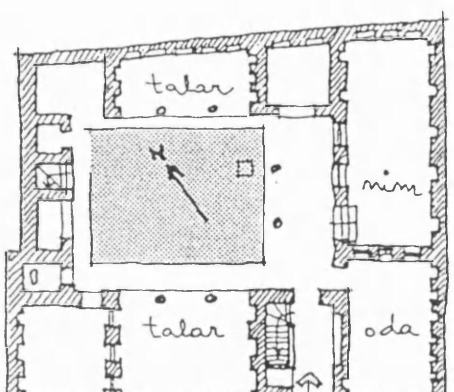
Fig. 4, Courtyard Houses In History



The house of Ur 19th - 18th century B.C



Babylonian house " Merkes Quarter 700-272 B.C



Baghdadi courtyard house of the 19th century A.D

Source: N. Schoenauer 1981 . Comparison By The Author

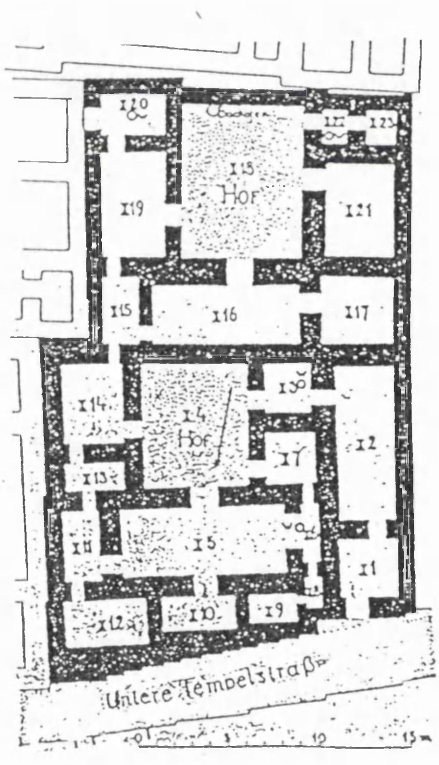
Fig. No.5, Historical courtyard examples

The ground floor plan of
a Multi-courtyard house
in the ancient city of Ur

Neo-Babylonian period

(circa 612-538 BC)

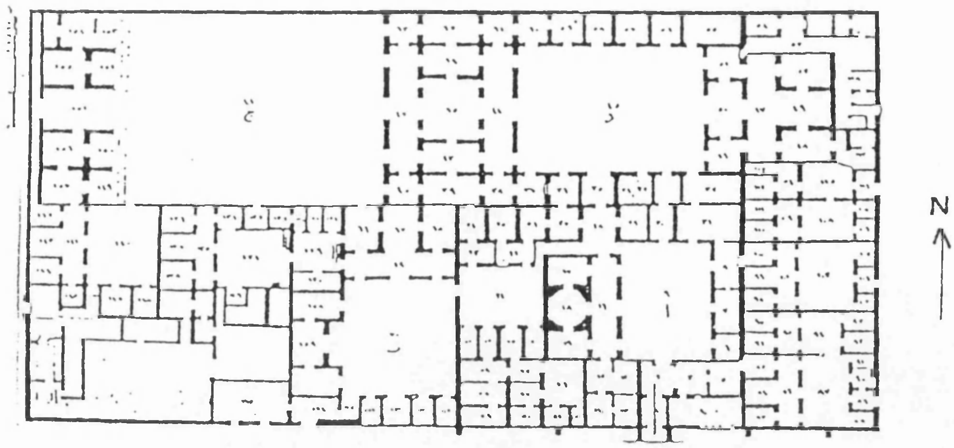
Source: Woolly C. Leonard
Ur Excavation, Vol. IX
London, 1962, plate 71



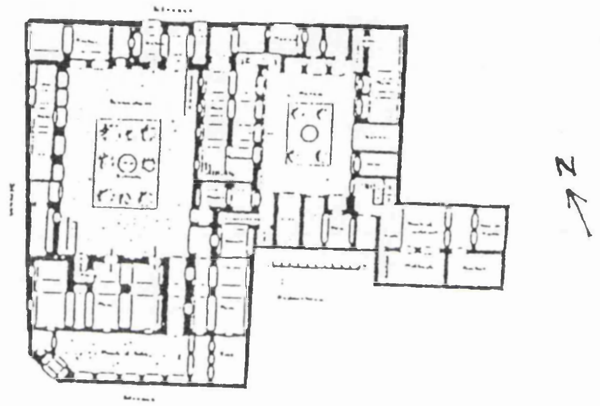
The ground floor plan
of a Two-cortyard house
in the ancient city of
Babylon, Neo-Babylonian
dynasty (circa612-538 BC)
Reuther Oscar, 1910
Ph.D theases, Berlin

Source: UR,Vol.3, 1985

Fig. 6 , Multi- courtyard houses



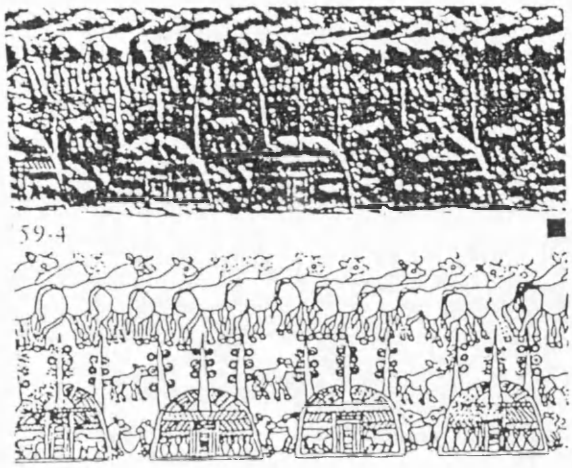
1- A large multi-courtyard house in Samarra
(836-889 A.D)



2- Ground floor plan of multi- courtyard house of the 19th century - Baghdad

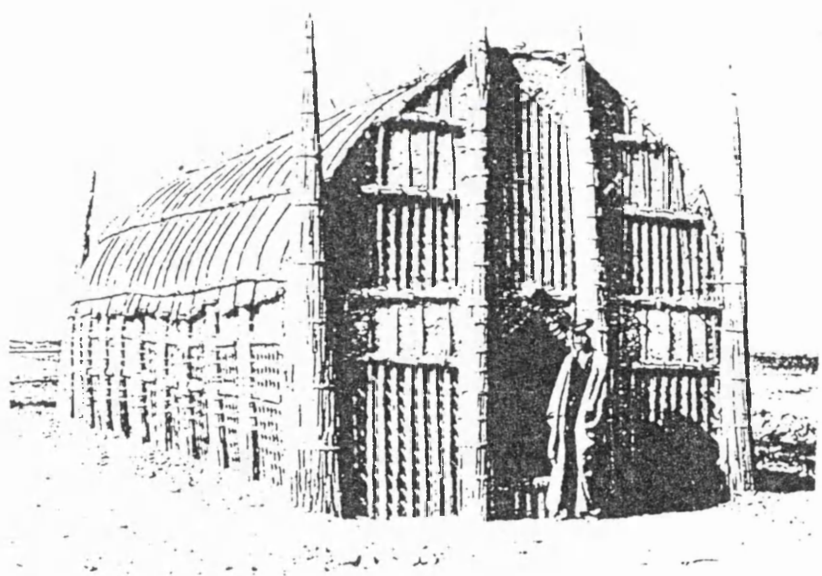
Source: department of Antiquaries Baghdad

Fig. No. 7 The reed house



An ancient reed house of the 4000 B.C as it is illustrated in the early Sumerian sylinder seal & its impression

Source; R. Chadirji 1986



Reed hut of the marshes area , (southern Iraq) resembling the early Sumerian house

S. Lloyd 1974

II.a.5. Baghdad and Its Cultural Roots

The city of Baghdad was built in 762 AD by the second Abbasid Caliph Al-Mansour (754-775 AD). It was round in form and covered a site of 500 Hectare in Karkh, on the west bank of the River Tigris. It was geometrically planned to consist of three circled concentric zones, divided by circular defensive walls (See Fig. No.8). The Caliph's Palace and his Mosque occupied the core of the royal city in the central zone, four radial main roads crossed the three zones, externally leading to four large fortified gates: Kufa gate, Sham gate, Basrah gate and Khurasan gate.

That well protected city had to accommodate in its Central Zone, statesmen, civil servants, police, soldiers, warriors and palace servants only. The second zone was devoted to four equal residential areas, separated by four rectangular arcaded markets. Initially four markets were located within the inner wall in the first zone but later, the Caliph ordered these to be demolished and rebuilt outside, in the second zone with a clear division between the residential and commercial areas (K. Cresswell 1989). In the residential areas, the inhabitants were grouped in quarters according to their place of origin, background, crafts, profession and occupation, some quarters were named accordingly. This practice has survived until recently.

The historical layout of Baghdad and its structure was planned in a way to maintain a harmony between the streets and other functional spaces (See map No 1). According to an account by Al-Yaqubi (O. Amireh, 1990); in each quadrant a number of secondary streets lay between the main axial roads and the residential areas. Each street was named after the profession or craft of its inhabitants, an outstanding figure living there or a dominant building on that street, e.g.,(Prison Street, Guards Street, etc.).

For defence and security purposes, a circular belt of open space (fasel) was kept between the outer and the middle walls, to provide easy movement for the army to defend the city in case of attacks. A similar space was arranged between the middle and the inner walls to be used for circulation of people and goods between the quarters of the residential zone (See Fig. No. 8). To enhance security and avoid possible weakness in the defensive measures, the axial roads were fortified by employing bridges, porches and gates, with a defensive moat surrounding the outer wall.

The building work of the city was thoroughly supervised and managed by the Caliph who himself chose the appropriate site, monitored the spending and quality of the material and laid down building norms and technical specifications, e.g., the sizes and weight of each brick had to be 1 cubit square "about 18 inch". This size of brick is still in use in Iraq today.

Al Mansour ordered the extraction at random of sample bricks from newly built walls and had them weighed and measured in order to ensure accuracy of specification.

A considerable number of builders, architects and craftsmen were brought from different cities and regions to take part in building the new capital. They later settled there and formed a significant part of its population.

Due to the extended function of the capital, the physical size of the nucleus city consequently expanded towards Rusafa, on the east bank of the River Tigris, when some administrative institutions were transferred there in AD 768. Rusafa, however, became so important that the seat of the Caliph finally settled there in the middle of the tenth century, when the round city ceased to be the government residence.

A network of infrastructure, health and social services was established in Baghdad. The idea of social welfare and public services was attributed to the economic prosperity and enlightenment of the rulers towards social issues. In the 12th century, The Arab Andalusian Voyageur, Muhamed Ibin Jubayr (AD 1145-1217) noted in his records that, a college and a hospital were linked to each grand mosque, and free medical care was available through a system of public infirmaries. Sixty free hospitals were founded in Baghdad, all in working order (J. Montague, 1984). It is worth mentioning that the earliest hospitals were founded in

Baghdad and Damascus and then spread to other main cities and Islamic provincial towns. Other charitable establishments provided the poor and sick people with food, shelter and spiritual comfort.

Since its foundation, Baghdad has flourished as a cultural and religious centre of the Arab and Islamic world, it reached the peak of its fame during the rule of the fourth Abbasid Caliph, Haroun Al Rashid (AD 786-809). At that time, the wealth of Baghdad was proverbial, the agricultural resources of the country brought prosperity to the city which maintained its reputation as a centre of power and splendour among Islamic cities. During the last phase of the Abbasid era Baghdad suffered catastrophic events; a series of floods, fires and frequent outrages of foreign conquests caused tremendous damage to its architectural heritage, but the worst of all was the major destruction of the city by the Mongols.

A relative relief followed the decline of Seljuks domination over Baghdad until 1180 AD. It enabled the Abbasid Caliphs to restore their power again and provide the required resources to rebuild their capital which regained its fame; until the final conquest by the Mongols and the fall of Baghdad in 1258 AD (J. Hoag 1977). This was followed by several other conquests, culminating in a long Ottoman domination over the country lasting for more than four centuries until the end of the First World War.

Consequently, the architecture of Baghdad and the rest of the Iraqi cities stagnated for more than six centuries. The walls and gates of Rusafa, the Medieval left-bank, successor of Mansour's Round City, were still preserved in reasonable intact condition until the flood of 1830. The walls were eventually demolished by the Ottomans in about 1870 to make way for further urban expansion (See II.a.6.). Al Mansour's original round city was ruined and its remains lie under the site between two districts in Baghdad, known today as Shalchyia and Utaifiya. This historic part of the city was certainly an impressive example of town planning, enhanced by monumental architecture, but unfortunately it has not been completely excavated.

II.a.6. The House and Architecture in the Post Abbasid Era

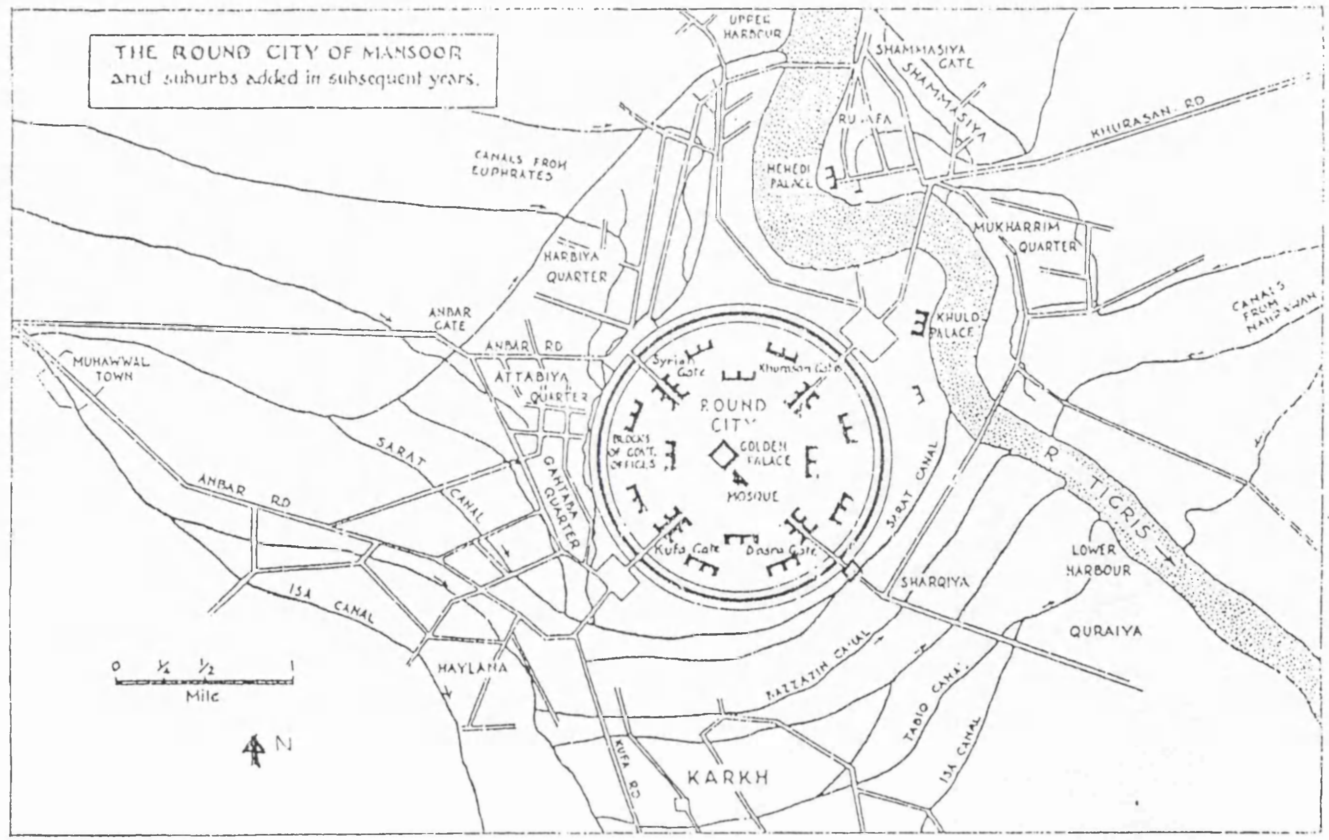
More than six hundred years of frequent foreign conquests and cultural decline might be one of the main reasons for the Baghdadi courtyard house retaining its form for centuries. Basically, the development of domestic architecture in this country seems to be relatively stagnant in both form and technique. The concept of the house and the pattern of the Abbasid architecture continued without foreign influences for the first three centuries following the fall of Abbasids and destruction of the country by the Mongols in 1258 AD. But during the Ottoman domination the development was slowed down until the nineteenth century when some stylistic changes were introduced to the design of the house. Among those were the intensive use of timber in the structure of the upper floors, frames, carved wooden columns, ornaments, cornices, decorated doors and windows, mirrors and colour glass. Iraq is not famous for production of timber, it is more likely that the timber used in the construction of the traditional houses was imported from India and the Far East.

It is hard to illustrate the style of the typical Baghdadi house at the Abbasid era, although some good examples of palaces and significant buildings, of that time, are still surviving in Baghdad and Samarra. The historical fabric of Baghdad was affected by the first comprehensive urban modernisation, carried out by the Ottoman governor, Midhat Pasha (1869-1872). At that time, the gates and the ancient wall of the city were demolished and their original bricks and those of other historical sites were used in public construction with disregard to the historical value of ancient buildings. In the last two decades of the 19th century, a European witnessed the Turks constructing dams and canals, in Baghdad, with bricks entirely taken from the site of the ancient city (Seleucia), he reported that:

> "...the Turks were dynamiting walls and towers in order to sell the bricks at from three to five piasters a piece, while cart load of brick were carried off to the dam on a nearby canal."
> (J Wellards, 1972) p.163

At the above mentioned date, only 34 distinctive public and religious historic buildings, from the Abbasid time, were left in Baghdad. Just eight of them remain today, four of which have undergone a great deal of modification (I. Fethi, 1985) while the others are definately authentic. They include:

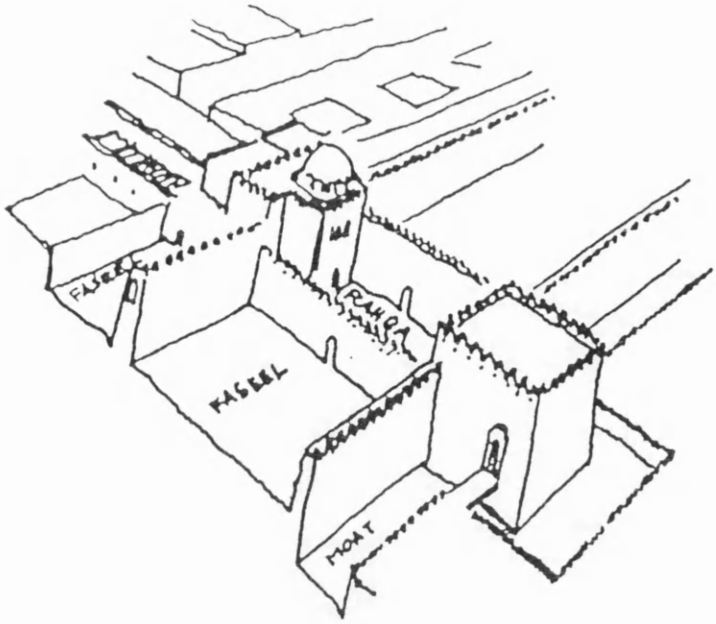
- Bab Al Wastani "The Middle Gate" built in (AD 1100-1135)
- The mustansirya School, built in the reign of Al Mustansir Billah (AD 1226-1242)
- The Minaret of Suq El-Ghazil, with a typical Abbasid brickwork is dated AD 1289.
- Khan Marjan, built in AD 1358, is an excellent example of the Abbasid Architectural style with its impressive brickwork and vaulted roof.



MAP No.1 - Baghdad (the round city)
Souce: John Bagot, 1976 - Haroon al Rasheed
and the Great Abbasids

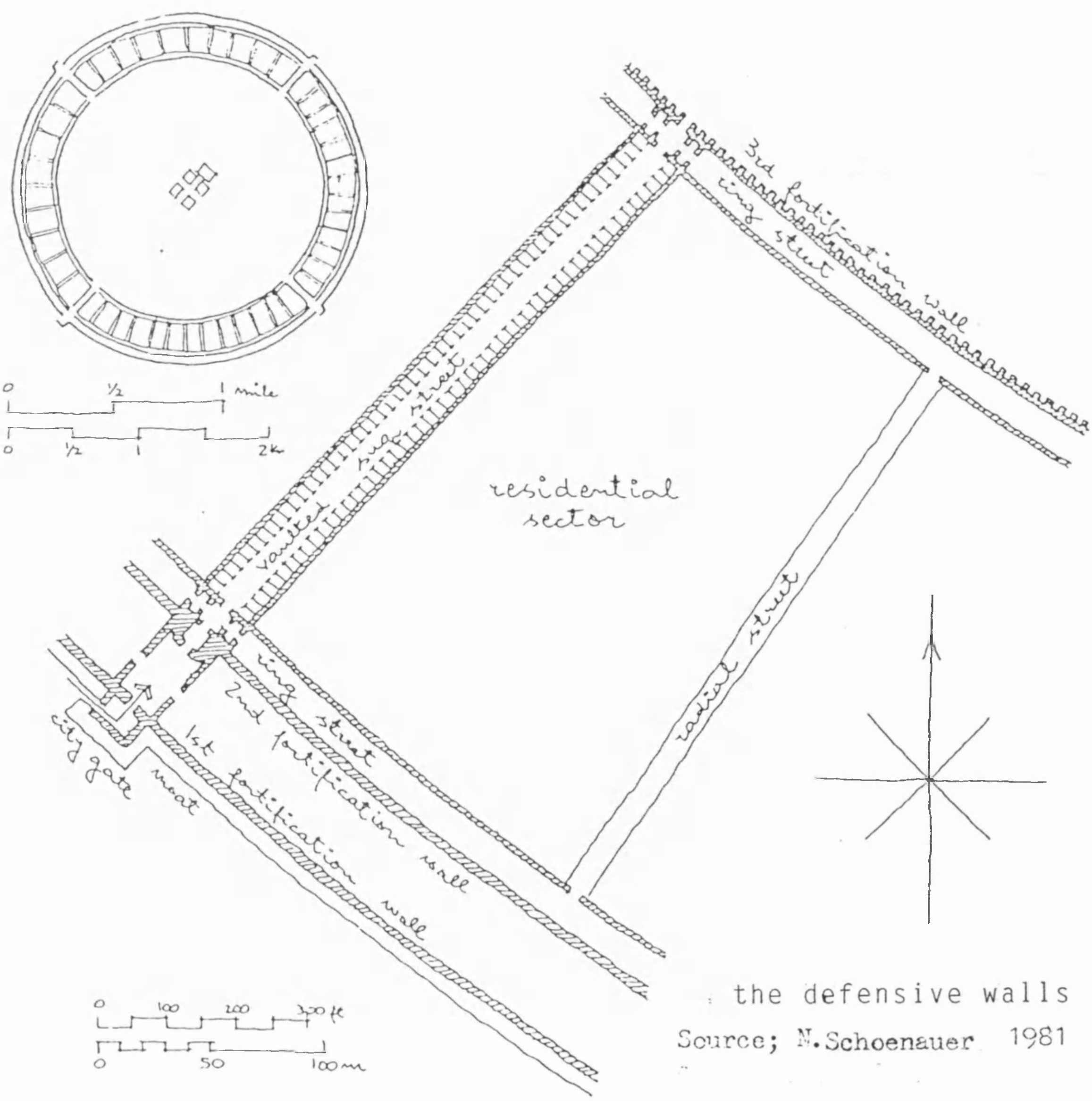
Fig. No. 8

City gate & defensive walls



THE CITY GATES, after LASSNER/HERZFELD (1970)

Source: O. Amireh, 1990



the defensive walls

Source; N.Schoenauer 1981

II.a.7. The Baghdadi Colonnaded House

Concept, Form and Space Arrangement

The design concept of the courtyard house was meant to meet the social, economic and environmental demands of the inhabitants. These were interpreted through the compactness, enclosure and maximum privacy of the inhabitants in their habitation "Sakan" (1). Through the upward opening of the courtyard towards the sky, man tried to maintain his immaterial contact with the external universe while he retained his tranquillity (Sukoon) and privacy within a protective enclosed space, i.e., a house with courtyard.

The typical Baghdadi house of the last three centuries was frequently illustrated in some stories and records of European travellers and adventurers who visited Baghdad in the 18th and 19th centuries AD. The house was described as a colonnade one, the distinguishing feature is the upper galleries, overlooking the courtyard. Sometimes a garden and a fountain were in the middle. It was built of brick with a humble exterior as the external elevation of the ground floor was mostly plain and lacked windows.

(1) Sakan (habitation) is derived from the arabic word Sukoon which means tranquility.

In order to build up a clear image about the house in Baghdad during the last two centuries, it is worthy to extract some impressions from the detailed descriptions given by European travellers and writers. The earliest was the German Voyager, Carsten Niebuhr (1776), who visited Baghdad in 1765. He illustrated the house saying:

> "....from inside there is usually a small square court on which look all the beautiful rooms, sheltered to counteract the heat of summer. Usually there is a vaulted underground room with ventilators facing north."
> (J. Warren & I. Fethi,1985) p.34

An English traveller, John Jackson (1799), gives a clear account of space arrangement:

> "Every house forms a square ... within the square are various offices: some underground where the people retire during the heat of the day. The kitchen, the water and not infrequently the horses are kept on the ground floor. ... they have generally two flight of steps; one leading to the hall, where alone strangers are admitted; the other leading to the harem to which but the family can have access." (ibid)

Tristram Ellis (1881) describes the house of Baghdad in the 19th century as quadrangle, with a central court and a gallery on the first floor, adding:

> "With smaller houses, the courts have frequently only rooms on two sides, and these generally face the north and east, so as to be constantly in shadow. In larger houses, there are more than one courtyard .... the ground floor consists of a series of vaults more than rooms, arched over with brickwork, and frequently with no windows ... the floor being somewhat lower than the level of the court; these are the surdabs. ... The rooms on the first floor are generally large, lofty and well lighted" (ibid) p.35

S. Lloyd (1980) conveys an illustration of the typical Baghdadi house, given in 1808, by the British Resident Claudius Rich:

> "Balconies around their open courts are supported on carved wooden columns; downstairs rooms have finely-proportioned vaulting in cut brickwork and the ceilings of the principal saloons above, are often ornamented with a geometrical fretwork of wood, inlaid with a mosaic of mirror-glass. Carved wooden grilles in the windows of the family apartments and wrought-iron work from Mosul are not uncommon."
>
> (S. Lloyd, 1980) p.34

For climatic and social reasons, the spatial arrangement of the urban traditional house, in Baghdad and other Iraqi cities, remained the same for centuries. The inner courtyard and the symmetrical colonnaded galleries continued to be the focus of the plan regardless of the size and shape of the land. The traditional master builders in Iraq followed the same principles and design norms of the past until the 1920s (refer to II.a.3).

Although the traditional houses are varied in size, shape, orientation and quality of stylistic details, they obey common principles in terms of plan, form, layout and elevation. They are designed in a way that all rooms are clustered around an open courtyard. This type of houses are mostly built of two floors but in some cases there are single storey or two storey houses plus a raised platform room or (Kabishkan).

Plan and Features

The ground floor plan often consists of one open courtyard arrangement but some large houses might have more than one courtyard complex, as will be discussed below. The habitable rooms and spaces are arranged around the courtyard, the ancillary rooms are placed along one or two sides of the courtyard and communicate through it.

The courtyard is the focal space of the house, due to its multiple function. Being in the centre of the house, it acts as a principal circulating area, providing visual and physical communication between the surrounding spaces. Incorporated with other components of the ground floor plan, the courtyard serves as an open living space where most of family activities take place, particularly during the hot season.(See next section).

A recess gallery (Tarar) is built rather to one side of the courtyard, forming an integrated part of it. An adjacent glazed room (Jamkhana) with a series of inward-looking sash windows and shutters, is placed above the cellar. It is used as a family living room during the day.

The plan of the first floor is almost symmetrical, it is allocated to the main rooms which are arranged around two or more sides of the house, circulating through balustraded access galleries (Mamsha) surrounding the courtyard. The pattern of the colonnaded balcony (Tarma) on the first floor is the brand which makes the Baghdadi traditional house distinctive from those existing in other Islamic countries. (J. Warren & I. Fethi 1982). This 'tarma' which is internally overlooking the courtyard from one or more sides, gives access to the main rooms. It is supported by tall columns rising to the second floor ceiling. The columns rising to the 'tarma' are twice as high as those of 'Tarar', a symmetric recess at the ground floor (See Fig. No. 9).

The main rooms at the first floor are varied in sizes and orientation, some are internally overlooking the courtyard and others are outward overlooking the alleyway or sometimes the river.

The distinguished features of these rooms are their external projections, forming a facade of alcoves locally named 'Shanasheel'. They are traditional Iraqi bay windows, built with fine wooden lattice-work and glazed screens, in a form of cantilevered balconies, overhanging the alleyways and offering an aesthetic appearance to the first floor front elevation. Shanasheel are arranged in consistence with the partially-timbered walls, reconciled with structural elements and other stylistic features like balustrades, columns and carved windows.
In addition to their aesthetic value, the 'Shanasheel' often extended the size of the rooms and corrected the irregular plot to provide rectangular shape to the first floor rooms, this projection provided the alleyway with shading to

protect the pedestrians from the sun in summer and rain in winter (See Fig. No. 10A).

Layth Raouf (1985) defines the shanasheel as:

> "decorative wooden structure that extended the private life of the occupants through a viewing platform into the public outside" Ur No.1 P 15

The study of architecture of Basra relied on observations of some earlier European travellers; Buckingham (1816), Wellsted (1840) and Denis Rivoir (1883) suggests that the feature of the Baghdadi Shanasheel was transferred to Basra in the second half of the 19th century and later to other parts of the Gulf region (See R. Lwecok & Z. Freeth 1978). 'Kabishkan' is a raised platform room used for retreat and relaxation, built on suspended level; halfway between the first floor and eave level, forming an isolated quiet space mostly used by the older members of the family. The height of this room is reduced to the minimum (1.80-2.00m) to keep in level with the ceiling of other rooms of the first floor (Diagram No. 1) The Kabishkan with its sash windows is projected to the alleyway. The difference between the Shanasheel and the Kabishkan is obvious in the height of the windows, i.e., The Shanasheel are twice as high as the Kabishkan (Fig. No. 10).

The reception area (Ursi) is the most elaborated room of the first floor, it is always located along the colonnaded gallery (Tarma) but has no direct access to it. A set of artistically carved windows and glazed partitions separate the Ursi from the 'Tarma'. Sometimes "Iwan", a recess is opening to the colonnaded balcony 'Tarma', it is varied from 'Tarar' by the absence of wooden columns. "Iwan" is not so common in the Baghdadi house as it is in the traditional house in Iran. A small similar recess, "Iwancha", may be employed as a corridor to provide access to the main rooms or staircases.

The flat roof at the eave level is always plain except for the air scoop towers built into the parapets. The subterranean level could comprise one or two types of rooms used by the family in summer days for the afternoon siesta and also for storing the food , due to their thermal characteristics (See II.b.1), these could be: basement (sirdab), semi-basement (Neen Sirdab) or a slightly sunken room (Rahrab).

The multi-courtyard form arrangement was also demonstrated in some prestigious houses built in Iraq, up to this century. They consisted of private and public complexes, sometimes extended to four units of different functions, each of which forms a complete house with its own courtyard, supplemented with habitable rooms, recesses 'Tarar' and colonnaded galleries with timber columns (Fig. No. 6). The functions of each unit of these large houses was mostly pre-allocated within the design of the house, i.e., private and public sections (Haram and Diwan).

a) - The private section (haram) is the largest of the four units. (The family apartment and female guests).

b) - The public Section (diwan khanah) of smaller units:

1 - Business and male guests unit.

2 - Serving and Kitchen unit.

3 - The stables unit.

The arrangement of the multi-courtyard house was seldom, except for those of merchants, well-to-do families and people running business, traditional crafts and industry in their own houses, as will be shown below.

II.b. **CLIMATE CONTROL SYSTEMS**

Summer heat has always been a prime concern to Baghdad's residents, even prior to the modern era, when the city was surrounded by vast open green areas and orchards. This is evident in the measurement of temperature, taken at the British Diplomatic Residency in Baghdad by Buckingham in about 1818. He found that' at 2.00 p.m. on a July day, the maximum temperature in shade was 122 F "50^{o}C" and the minimum at dawn was 112 F "44^{o}C" (S. Lloyd 1980).

Cooling and protection from the direct solar gain were well practised in the traditional houses of Iraq, as well as in similar buildings of ancient Mesopotamia, where the earliest builders skillfully managed to deal with the light and local environmental peculiarities. The traditional master builders, in Iraq, perceived that heat transmits to different parts of the buildings in the following forms: direct solar radiation, outdoor air currents or a long wave heat exchange with the environment. This was interpreted through the design of the colonnaded form, open courtyard and a variety of shading.

II.b.1. **Climate Control Means**

One of the main characteristics of the urban courtyard house is its capability of offering an appropriate thermal condition and limited exposure to the sun. Despite the constrained materials and elementary technology, the builders of the Baghdadi traditional house have managed to tackle the problem of the climate extremes.They relied on their skills, making use of the given potentials to provide the dwellings with acceptable micro-climate, implementing integrating passive cooling systems, based upon four elements:

- Compact form of the house.
- Thick walls, "of the lower levels" and thick roofs.
- Sirdab (basement).
- Badgeer (wind catcher).

House Form

The compactness of the form and the arrangement of the inner courtyard "Hoash" with its relatively narrow opening protects the house from the sun's glare, direct solar radiation and penetration of external heat in summer. Also the courtyard provides the house with consistant ventilation and acts as a sun trap in winter protected from the cold winds (See fig. 12A). For this characteristic, the courtyard is used as an open space where the family gather in summer, spring and autumn, but is not used for the same purpose in winter.

The height of the courtyard's vent; which is usually as twice as its length or width, incorporated with the stepped layers of the projected elevations, provide the house and the alleyway with adequate shading, protecting the inhabitants and passer-by from the harsh sunlight in summer and rain in winter (See fig. No. 11). These are:

A. **Internal Shading**

The inward looking balustraded access galleries, on the first floor, extend about 1 metre around the courtyard, adding extra shading to the courtyard area. A similar inward extension is arranged at the eaves' level to reduce the upper opening of the courtyard and overshade the access galleries on the first floor, as well. The main rooms, the colonnades and the access galleries offer different ranges of shaded spaces at this level of the house (fig. 10-B).

B. **External Shading**

The alleyways always benefit from the shading provided by the outward projection of the first floor (Shanasheel), beyond the external walls of the ground level and the external extension of the roof terrace beyond the front elevation of the first floor. Therefore, the alleyways are relatively wide at ground level, getting narrow at the first floor and narrower at the eaves' level, forming a semi-covered walkway,(fig. No. 11).

This composition of shading and breaking of sunligh through the various layers of the courtyard house is relatively consistent with the climatic requirements of the region.

Thick Walls

The thick mass of the roof and external walls help to impede the conduction of the direct heat toward the interior space because it retains much of the gained heat until it is disposed back to the sky at night by means of long-wave radiation. For calculations (see part V.). The clear atmospheric conditions of the summer nights accelerate the process of heat reversal. At night, the temperature of the exterior surfaces becomes relatively lower than that of the ambient air, particularly at dawn. On the other hand, the day time temperature of the ambient air is often higher than that of the interior surfaces. Due to their heavy brick walls and lack of exposure to the sun, the basement and ground floor, where the family spend most of their summer days, are the coolest areas (refer to diagram 3).

The roofs of the traditional houses were built of timber beams, covered by mats, topped with mud and straw, as waterproofing and insulating materials which were coated every few years and then tiled with square bricks. Therefore, they were capable of hindering the conduction of the extreme solar heat to the building in summer and preserving the internal heat in winter.

Sirdab and Neem Sirdab

This is a habitable space, located at underground level with small high windows overlooking the courtyard. Due to its thermal characteristics, the cellar "Sirdab" or semi-basement level "Neem Sirdab" of the traditional house was used as a family living room during the summer days and for the afternoon siesta in particular. The brick masonry of the sirdab, its thick walls, curved pendentives and the height of the shallow saucer domed ceiling, tend to reduce the rate of the heat gain in summer. In the old days, when the traditional courtyard house was the only pattern, the sirdab played an important role in the daily life of the people of Baghdad, particularly in summer as in the following account:

> "In the afternoon the city withdraws to its sirdabs to sleep.Between 5 and 6 p.m. it reassembles on balconies, in coffee shops and public gardens, and retires early to bed beneath mosquito-nets on the roof-tops."
>
> (S. Lloyd 1980) p. 35

The unexposed heavy structural mass of the underground "Sirdab" extends the time lag of heat transfer to the subterranean level. Furthermore, at a depth of more than

3m., the temperature of the earth remains close to the average yearly temperature of the region. This is due to the fact that, the temperature of the underground soil takes three months to rise from the minimum to the maximum only showing a slight difference in temperature during the two main seasons.

These thermal characteristics maintain the micro-climate at this part of the house in balance, offering it relative warmth in winter and coolness in summer. In this respect, "Sirdab" is therefore different from the other spaces of the house. With today's standards, sirdab is not inhabited during the cold season because this space is sunless and also damp due to the rising underground water in winter.

The average temperature of the cellar during the day in summer is about 30^{o}C when it is 48^{o}C up on the roof. The temperature and level of humidity within the cellar depend on its depth as well as on the efficiency of the cooling system, often a "Badgeer". The heavy porous construction also draws a certain amount of ground water into the building, raising the humidity to approximately 70%. (J. Warren & I Fethi 1982). These conditions may well be the cause of arthritis which is common amongst those who still dwell in these old houses.

A manual cooling device was used in the cellars of some traditional houses. It was a canvas fan dated back to the Abbasid era (9-13th century A.D.), and was known as "Khaysh" at that time. It was operated by a rope and constantly wetted to provide cool air.

Badgeer (Wind Catcher)

The traditional courtyard houses in Baghdad were often provided with air channelling system (Badgeer). It is a conventional passive cooling and ventilation technique. Badgeer is a term used for wind catcher throughout Iran, Iraq and the Gulf. It is called "Bukhari" in Middle Euphrates in Iraq, probably derived from "Bukhar" which means vapour. Regarding the history of the wind catcher, Susan Roaf states:

> "It has been suggested that wind-catchers were associated with the two recesses at the back of the great throne hall at Babylon (c. 600 B.C.)."
>
> Cited in (E. Beazley & M. Harveson) 1982 p.5

The most common type of badgeer is a chimney-like air duct of about 50 cm x 15 to 20 cm in cross section, linked in its upper part to a sharp shaped air scoop or air deflector, located up at the highest part of the roof and built into the parapet. In order to cause the air to flow down into the building, the air scoop built into the wall in various shapes must be oriented into the dominant air current of the area (Table No. 1).

The efficiency of the wind catcher (Badgeer) depends on:

- The height of the air-duct.
- Masonry of the Badgeer and thickness of its walls.
- The inner area of the shaft and its vertical partitioning.
- Orientation.

The vertical duct "shaft" is usually hidden between the thick party walls. It's internal surfaces are beyond the impact of the direct solar radiation and therefore, are cooler than the incoming external hot dry air during the day. The only exposed part of the badgeer is the 1.50 - 1.80 m. high and 700-900 mm. wide wind deflector, incorporated into the parapet of the roof terrace with its upper edge inclined at about 45^{o} on the horizontal level. The height of the vertical duct plays an important role in cooling and humidifying the air, i.e. high vertical shafts perform better than short ones. When the external air temperature is $40^{o}C$ and the relative humidity is 15%, a wind catcher of an 8 m. height may produce $20^{o}C$ drop in the air temperature within the shafts (B. Ditchburn 1990) and

improve the relative humidity to about 70%.
The thick mass construction of the Badgeer's walls is also an affective factor, it causes a time-lag of heat transmittance from the external to the internal surfaces of the air-duct.
A Badgeer usually incorporates one air-duct connected to one upper inlet at the roof and leading down to one outlet in a living space at the lower level, mainly the cellar "Sirdab" (see fig. 13). In some cases the air scoop is vertically divided by brick partitions, linked to several shafts channelling the wind down to different parts of the building, often Sirdab, Neem or Tarar. In other cases, two or more inlets at the roof terrace lead down to one outlet. The masonry of the vertical partitions enhance the efficiency of the "Badgeer" as they extend the internal surfaces of the shaft and increase the heat storing capacity of the duct. The most efficient wind catchers are those with wide opening air scoops built transverse to the prevailing wind and particularly facing the north-westerly summer wind to benefit from the summer breezes as much as possible.

Sometimes, the air scoop and the upper inlet opening of the "Badgeer" are oriented towards the north where the secondary prevailing wind blows from.

Cooling and Ventilation Performance

The "Badgeer" functions through the thermal means of conduction, convection and evaporative cooling. During the day, when the incoming external hot dry air is deviated through the air scoop down the shaft, it comes into contact with the cool inner surfaces of the vertical air-duct and therefore, losses some of it's heat and absorbs some moisture from the brick walls. As the air gets relatively cooler and denser. It descends to the lower levels and continues getting cooler before being released through the vertical outlet opening in the wall of the living space, usually the cellar "Sirdab". The hot exhausted air, on the other hand, rises up by convection mechanism and is being expelled through the small ventilation windows, of the "Sirdab", which are open to the courtyard.

In some designs, the vertical air-duct is extended horizontally under the floor of "Sirdab or Neem Sirdab", ending with a horizontal outlet. This aims to expand the channelling of air and to benefit from the cool moistured underground earth, before discharging into the basement.
The channel in the most sophisticated Badgeer ends down over either a water pool or a well in order to cool the air circulation and raise the level of humidity within the

space (see diagram No. 2). With ordinary types of Badgeer, further cooling and humidifying the incoming air can be achieved through a simpler process of evaporative cooling like; placing porous water pots by the tower outlet of the air-duct. In this way, drinking water is cooled and food can be stored in the same place for a short time.

II.b.2. **Auxiliary Thermal Protective Means**

Apart from the Badgeer, which was commonly used in the houses of Baghdad, other thermal manipulating means were also applied to make the internal climate of the urban houses more convenient for living in different seasons.

These are:

Controlling the admission and exclusion of the solar radiation by providing the courtyard with adequate shading means which help to reduce the amount of heat, gained during the day. During summer afternoons the area of the courtyard is sometimes covered by canvas awning in order to prevent the admission of the vertical sunlight into the house. A courtyard which has been covered, in this traditional method, is a few degrees cooler than an uncovered one. Attempting to achieve some evaporative cooling in summer, the inhabitants practised frequent water spraying to the tiled floors of the courtyard and other spaces around it, during the day, and to the roof terrace in the evenings. some traditional houses incorporated small court gardens for this purpose.

Gardens and Vegetation

The dwellers of ancient Iraq employed gardens and vegetation to mitigate the bitterness of summer heat and provide more convenient micro climate for their habitation. Vegetation was one of the main climate control means, used in the old days.

> "... the gardens and the plants actually assumed in the past a fundamental role in providing comfortable environment for human habitation.
>
> (S. Lesiuk,1983) p. 216

The residents of the early traditional houses of Baghdad realised the environmental functioning of vegetation so, they made use of some trees, vines, shrubs, orangeries, etc., within small court gardens of introverted pattern, "contained or entirely enclosed garden". (fig. 12-B). Some of them comprised fountains as well, so that a courtyard with water and plants acts as a cooling well and modifies the micro climate (A. Konya, 1984).
Within the urban context; the gardens form green spots, scattered through the residential areas. Due to the lack of

public parks and greenery in the traditional neighbourhoods, the environmental function of the introverted garden extended beyond the boundary of the courtyard house. It helped to regulate the macro climate, ameliorate the stress of summer temperature and scale down the effect of strong winds. Within the house, a small court garden was meant to provide shade, fresh air, humidity and ventilation in the dry hot summer days. In winter, the evergreen trees provided shelter from bitter cold winds. But absence of greens and gardens means lack of humidity reducing the environmental quality and the protection against dust in the courtyard area.

The court gardens have been neglected in the later traditional houses which tended to reduce to smaller sizes, due to the increasing demand on urban building lands (see II.c).

II.b.3 **Thermal Differences in Relation to Space and Orientation**

In the colonnaded traditional house, levels and spaces are varied in the extent of their shelter; ranging from being fully sheltered "basement", partially sheltered "middle levels" or fully exposed "roof". Accordingly, the thermal condition of those spaces are varied too.

An experimental research work carried out on the traditional house by Susan Roaf & I Fethi in 1981, revealed that; in the hot season, between May and September, the ambient air temperature on the roof is between 48-50^{o}C. It ranges between 42-43^{o}C in the rooms on the first floor and between 29-32^{o}C in the deeper underground cellar (sirdab) where the relative humidity fluctuates between 60-70% while it is 15% in the courtyard (see diagram No.3).
According to the solar orientation of the rooms, the differential temperature is more obvious at the upper levels of the house than at the lowest levels. The experiment above, showed that the difference in temperature between the rooms facing north and east and those facing south and west is 5-8C at the first floor, while it is 2-3^{o}C at ground level as well as the semi-basement. At ground level, the temperature varies at no more than 3^{o}C during the whole day.

Climatically, the thermal difference at different levels and sections of the traditional Baghdadi courtyard house provide the inhabitants with more possibilities to select the proper spaces for their activities and comfort.

In response to the climatic changes and thermal variation in these houses, the occupants spontaneously practise daily and seasonal inner mobility, seeking their thermal comfort. Using minimalistic mobile furniture, they move horizontally and vertically from one level or section of the house to another, escaping the heat to the coolest parts in summer and vice versa in winter (see fig. 14). They possibly move to the rooms and spaces facing south and west in winter and to those facing north and east in summer. The horizontal mobility is likely to occur only in the large traditional houses where it is possible to move to different rooms according to the seasonal requirements, i.e., to the rooms facing south and west in September or October, and to those facing north in April or May, though such cases are not so common.

In summer, the occupants move to the lowest levels during the day, they retire to the basement (Sirdab) for the afternoon siesta, to the courtyard area in the evenings and to the flat roof terrace to sleep at night (see fig. 14). Although the roof terrace is extremely hot during the day it is an appropriate place for night sleep in summer, as its temperature drops down sharply, due to heat reversal from the surfaces to the sky.

In winter the ground level, where the kitchen and ancillary area are located, accommodates the household activities from the morning to the afternoon, depending on the nature of the activity and the duration of sunlight.

The first floor, despite its thin timber walls, insufficient insulation on the walls and relatively large windows, is the favourite area where the inhabitants spend their cold afternoons and evenings. They choose the most appropriate rooms for this purpose, particularly those which are more exposed to the sun.

II.c. SOCIAL AND ECONOMIC FACTORS AFFECTING THE HOUSE

In the traditional Iraqi society there was a clear division between the private and public life, which has survived since ancient times until recently. So a member of the society retained a required equilibrium between the two conditions.

On the one hand, he was firmly linked to his family and on the other, associated with the neighbourhood and community. The structure of the Iraqi family and its patriarchal character demanded a typical regional concept regarding the size, form and function of the house.

A certain space arrangement was required to accommodate an extended family, sometimes exceeding fifteen members, (of three generations) living together under one roof; parents, their married sons with their families, unmarried sons and daughters. Sometimes, more than one wife of a well-off man might live in the same house, for polygamy was a demonstration of wealth and extravagance among the urban prosperous men. The heads of distinctive families had also a conventional liability to shelter, in their houses, the vulnerable members of kinship, particularly women in need, widows and orphans, for the protection of women is a moral obligation of the Muslim community according to the commandments of the Islamic jurisprudence (Sharia).

Sufficient room was required for different social customs and festivities. Hospitality and business engagements, often practised by rich families, required extra spaces to receive and entertain their guests, and also to shelter the servants. Some large houses may contain two courtyards' arrangements; one for family use, providing full privacy and another for public, business and hospitality, with attached wings for the servants (see fig.9).

In the traditional Iraqi urban society, the females were less involved in the outdoor public life of the community, i.e., the house is their world, where they spend most of their time, whilst the dominant males practised wider social and economic activities in public. However, the complexity of urban life, in its traditional sense, had simultaneously produced a social division between women and non-close relative men. This principle was obviously reflected on the form and space distribution of the traditional house. i.e., a clear spatial division between the private and public sections of the house was planned to ensure a separation between the male guests and female residents. A double circulation system was designed with an access to the males' reception room, through a bent entrance lobby. The circulation area of the women and their female guests was arranged through the courtyard, which sometimes had an independent side entrance for the family use. During the day, the courtyard was always dominated by women, children and sometimes female guests.

Despite the social division, mentioned above, the links between members of a traditional neighbourhood were very strong. Neighbours respected the privacy and sovereignty of family life. This social behaviour strongly survived until the middle of this century and gradually faded, due to the social and economic changes of the Iraqi society.

Full privacy of the family was a prime issue of the social concept of the Baghdadi house. It was maintained in the attitude of the traditional society. But within the house, the members of the extended family enjoyed very poor internal privacy because the house was usually overpopulated and internal acoustic was poor. The concern for privacy was articulated by various architectural means; the placement of the main door within the alleyway, in such a way to avoid exposing the interior. The door was always placed at one side of the facade, preferably not opposite a neighbours' door, leading to the core of the house through a bent entrance way "Majaz" (see pages 28 & 35). Furthermore, the design of the inward looking form offered the house both visual and acoustical privacy.

Ground floor windows were seldom put into the external wall and, where used, had to be small, grilled and high enough to avoid being seen through by a passerby. At the first floor, the large windows could overlook the alleyways but not the neighbouring courtyards and terrace roofs. The projected lattice screened balconies "Shanasheel and Kabishkan", allowed the residents to overlook to the outside without being seen by strangers. The height of all houses, in one neighbourhood was, more or less, equal in order to maintain full privacy for neighbouring houses, as a social order. In this sense, the social order is a moral code that had a similar power to the modern building regulations. The restrictions of the three dimensional forms always responded to the public convention order.

Some local traditional crafts and commercial activities might be undertaken in traditional urban houses by the working class people. They included tailoring, weaving, mat-making, bakery, food processing, cigarette making, etc. These jobs have usually been done by women, as men have worked in the commercial areas as a social custom since ancient times. All these factors extended the functions of the house and therefore, influenced its form and arrangement.

In term of size, the traditional house can be classified into two main categories:

a. Standard size house, for the low income and middle class families, "the building plot ranging between $50\text{-}150^2$".
b. Large size house of wealthy families with plot which may exceed $700m^2$.

Due to the scarcity of building land inside the historical boundaries of Baghdad and for economic and historical reasons, the residential density was high in the urban part of Baghdad. It exceeded 1,000 persons per hectare at the end of the 19th century. Consequently, the traditional house tended to reduce in size to the minimum.

The economic efficiency of land use in an average traditional house is quite high, according to resultant given by (J. Warren and I. Fathi, 1982).

In a traditional house, with a plot area of 100 sq.m a usable floor space of 350 sq.m may be achieved.

Floor to area ratio (F.A.R) = 3.5

Plot coverage = 100%

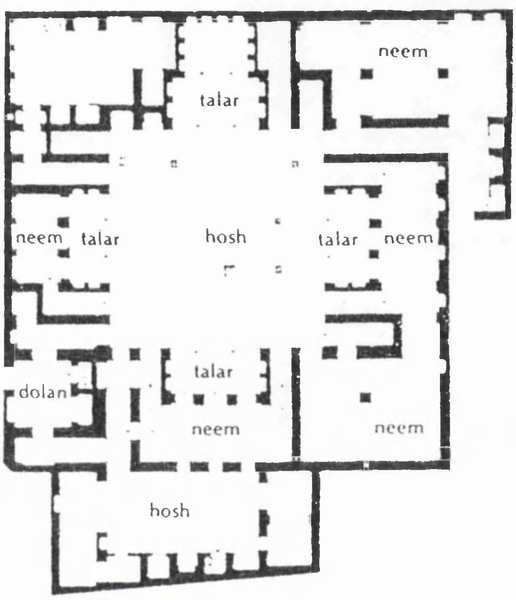
N. Schoenauer (1981), gives another account about land use in the traditional residential areas:
The building coverage is about 72% in average. In case of two storey house floor area ratio is 1.5. Court gardens cover 12% of the plot of the house.

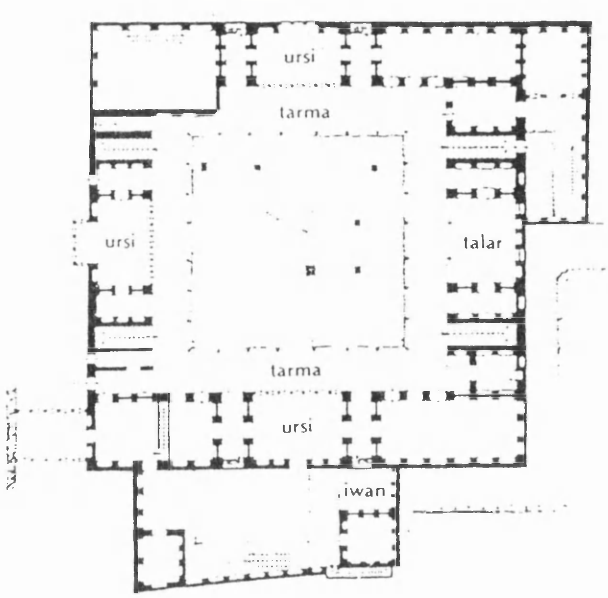
Regardless of the social and financial standing of the owners, large and small houses neighboured each other in one alleyway composing a mosaic of social urban structure, i.e., the neighbourhoods were not segmented according to class and strata of their inhabitants.

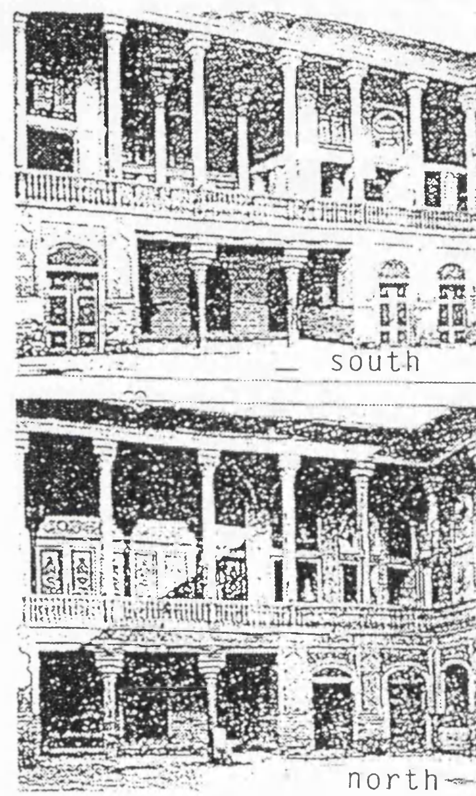
Despite the plain appearance of the ground floor elevation, high and low standard houses were distinguished by the quality of work and materials used in the exteriors, such as the front doors and the (Shanasheel) at the upper floors. The interiors, on the other hand, more corresponded with the social and economic status of the occupants. That was expressed through the quality of decorations, fittings, furniture, details and other stylistic elements. Other supplementary spaces including steam baths, additional "neem sirdabs" and extra recesses like "Iwan" could be added to the house, depending on the owner's ability to spend. But in fact, the house of the Iraqi urban layman was mostly compact and relatively small.

The masonry and building work involved in the traditional house embodies labour intensive technique, traditional craftsmanship and local construction materials. These elements have a direct impact on the outcome and cost of construction. However, these houses rely upon a building experience, generated throughout long historical epochs and being inherited by the younger generation of builders from their predecessors. But as the number of skilled traditional master builders has dramatically dropped, the artistic quality, which is a decisive element in such building has also declined. The technique itself as well as th building materials have changed too.

All these factors have contributed to make the building of these houses, today, costly[1] and of dubious functional quality. In fact, there are very few builders today that maintain the genuine artistic skills.







south & north elevation of the main courtyard

Fig. No. 9, multi-courtyard house

ground & first floor plans of an elaborated house of the 19th century (Baghdad)

Source: Ur, Vol No. 3, 1985

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(1) There are no official or concrete indicators concerning the actual price of work and building materials, spent of those houses, to be useful for the economic appraisal.

II.d **RESULTANT URBAN STRUCTURE**

The historic urban structure of Baghdad and other main cities in Iraq is characterised by its Medieval urban pattern of narrow labyrinthian alleyways, typical awkwardness of compact layouts and irregular fabric of the traditional neighbourhoods.

The alleyways network in the neighbourhoods follow a system of hierarchy which is to some extent, different from that of the modern roads. There are relatively wide alleyways between large blocks, narrow ones between sub-blocks and cul-de-sacs (blind lanes) leading to a limited number of houses and used mainly by their residents (see fig. 15). The integrations of concepts of the house and its neighbourhood is obviously interpreted through the transition from the external to the internal spheres.

The externally cantilevered balconies on the first floor and extended parapets at the eaves' level form stepped-out front elevations on opposite sides, making the alleyways semi-sheltered. The narrowest lanes lack light even during the day, particularly in winter, as the gaps between opposite houses are quite narrow at the upper levels (see fig.11 & 17). This arrangement was revealed in the accounts given by C. Rich in 1808.

> "... in the narrower and more ancient alleyways the wooden upper storeys of the houses are corbelled out until they nearly meet, and their opposed windows make privacy practically unattainable."
>
> (S. Lloyd 1980) p. 34.

Despite the disparity of sizes, building quality and content of the design (number of courtyards and rooms), the houses in the neighbourhood compose a texture of square rectangular mass with unbuilt central areas, i.e., courtyards which are open vertically and enclosed horizontally (see fig. 16 & 18). The external lower elevations of the traditional houses are mostly plain except for doorways avoiding facing each other directly (see II.c.).Traditional amenities like local mosques, public baths, "Hammams", caravansary "khan" are integrated with the densy urban fabric of the traditional houses.

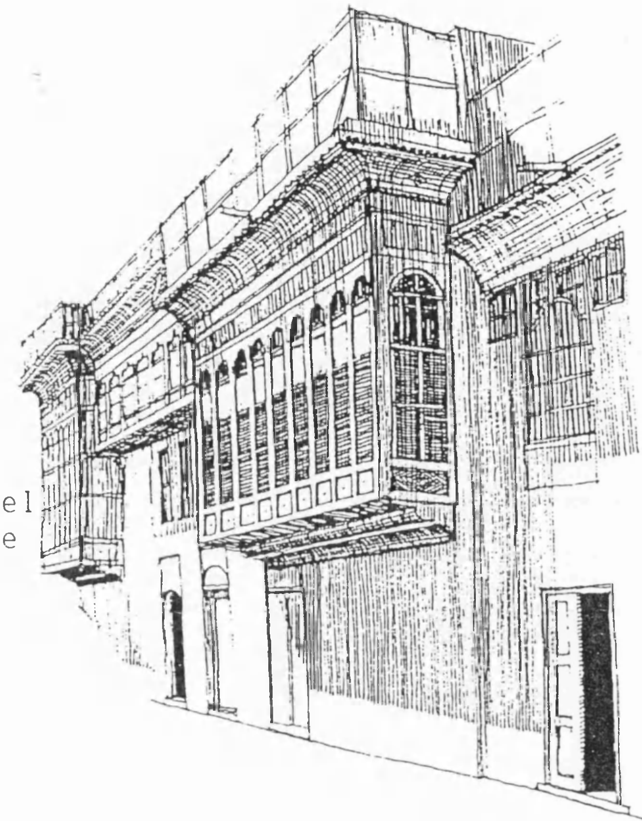
The main junction of the alleyways is usually named after a local mosque,a market place or sometimes, a well known coffee shop located there. Herbalists, barbers and few workshops often form a sub-centre on the same site. Some neighbourhoods have their own primary schools, usually based in large houses to be shared by other residential quarters.

Generally the alleyways are not wide enough for vehicle mobility. This has caused a shortcoming in providing local services and communal activities. The capacity of sewerage system is quite limited and sometimes absent except for the V-shaped gutters to discharge surface water. The traditional neighbourhoods suffer from a lack of public amenities; including clinics, children playground, public gardens and open spaces.

Fig. No. 10, Front elevation & section of the Baghdadi traditional house

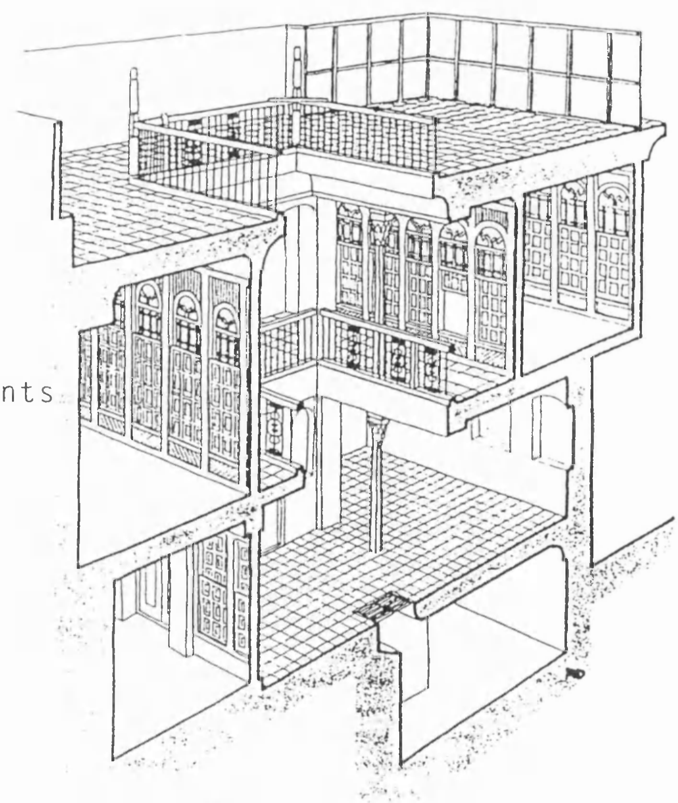
A.

The Shanasheel overhangs the street

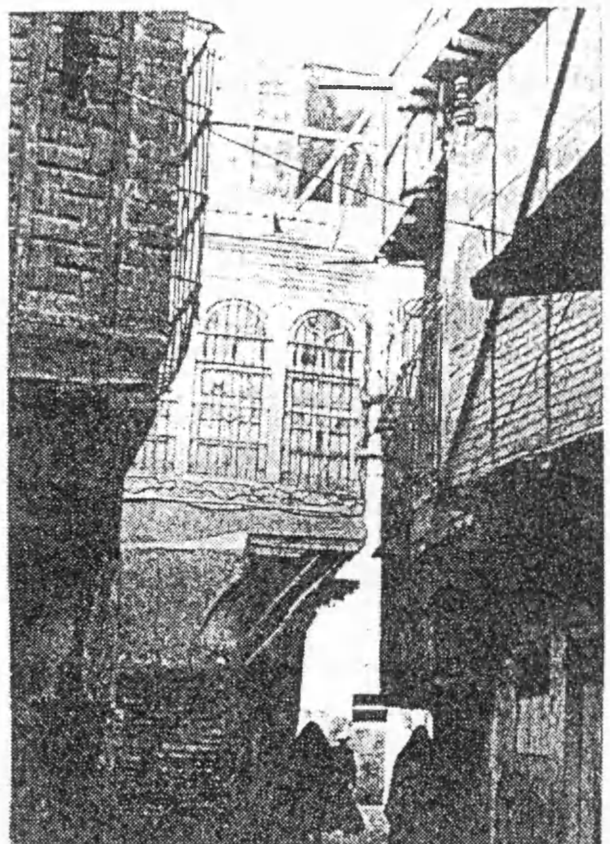


B.

Form elements



Source: J. Warren & I. Fethi, 1982



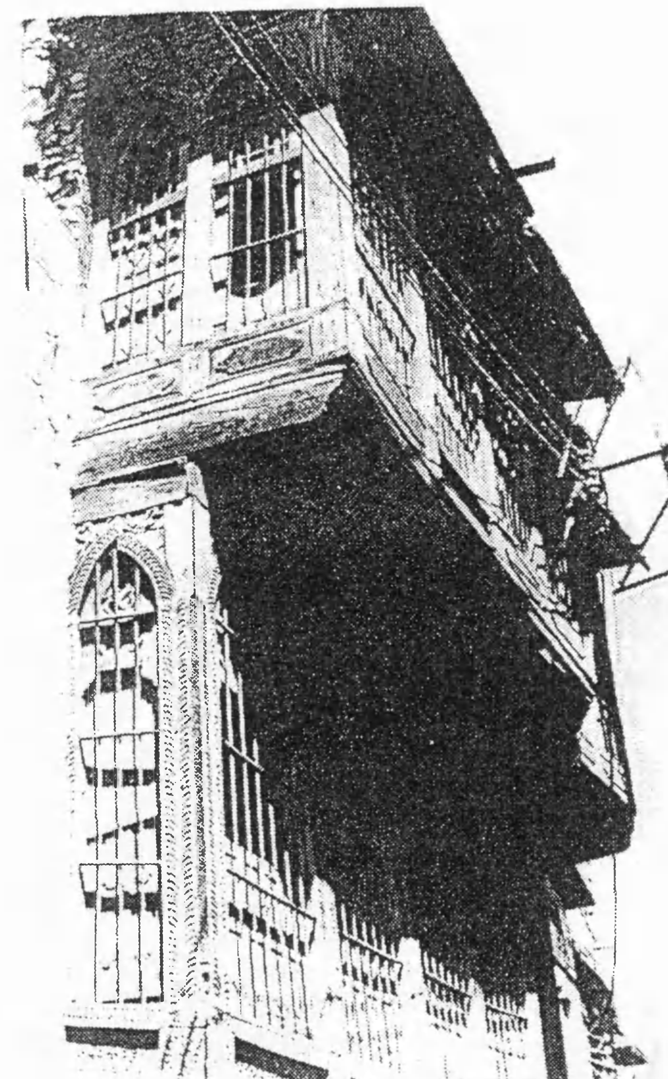
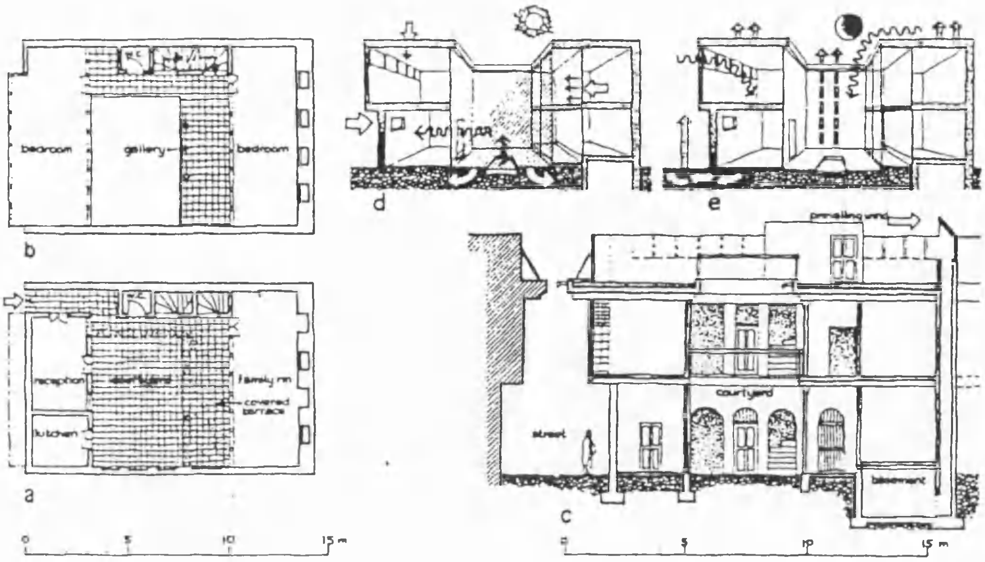


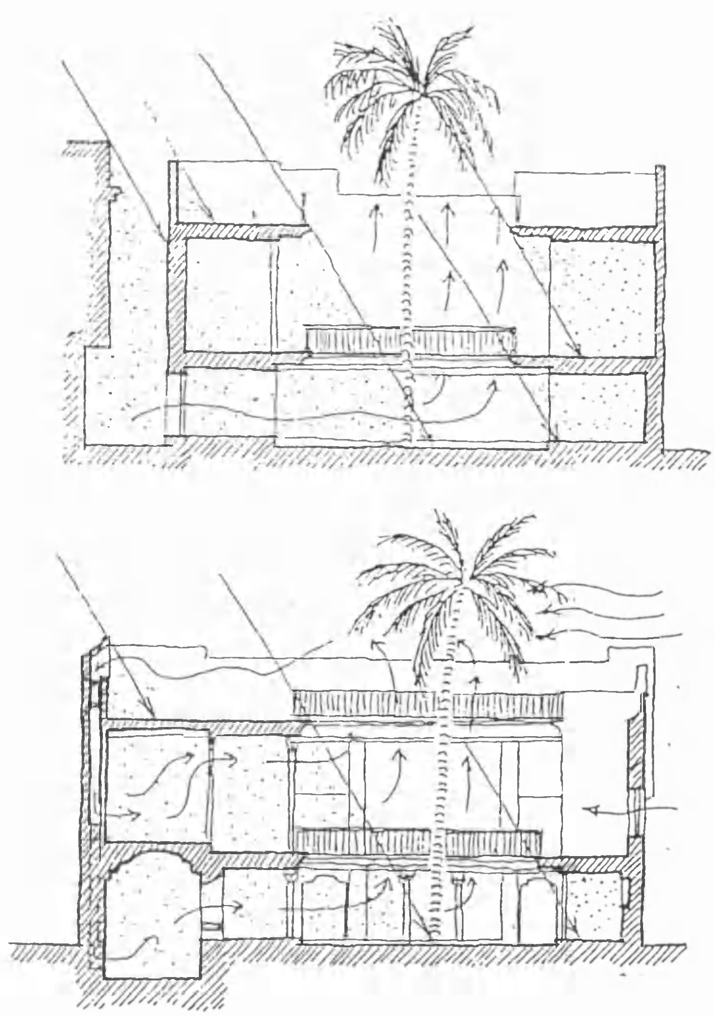
Fig. no. 11 Projections providing shading

FIGURE No. 12 ; climate control systems in the traditional house



A- air circulation during day & night

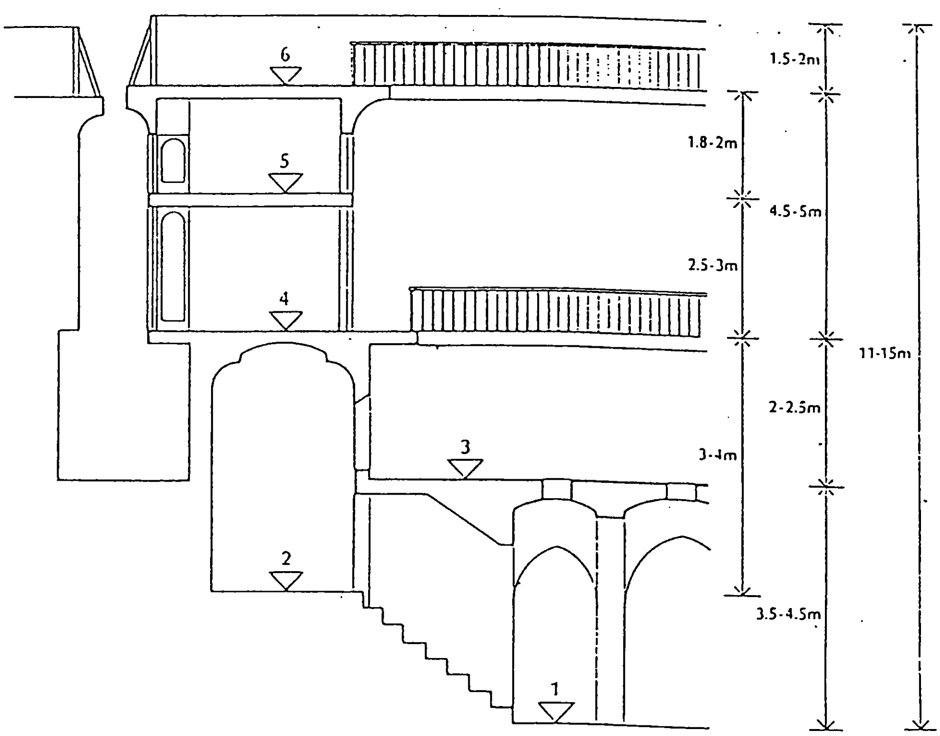
Source A. Konya 1984



B- the court garden in the traditional
house as a climate control means

Source: N. Schoenauer 1981

Diagram No. 1 , Section through on Iraqi courtyard house.

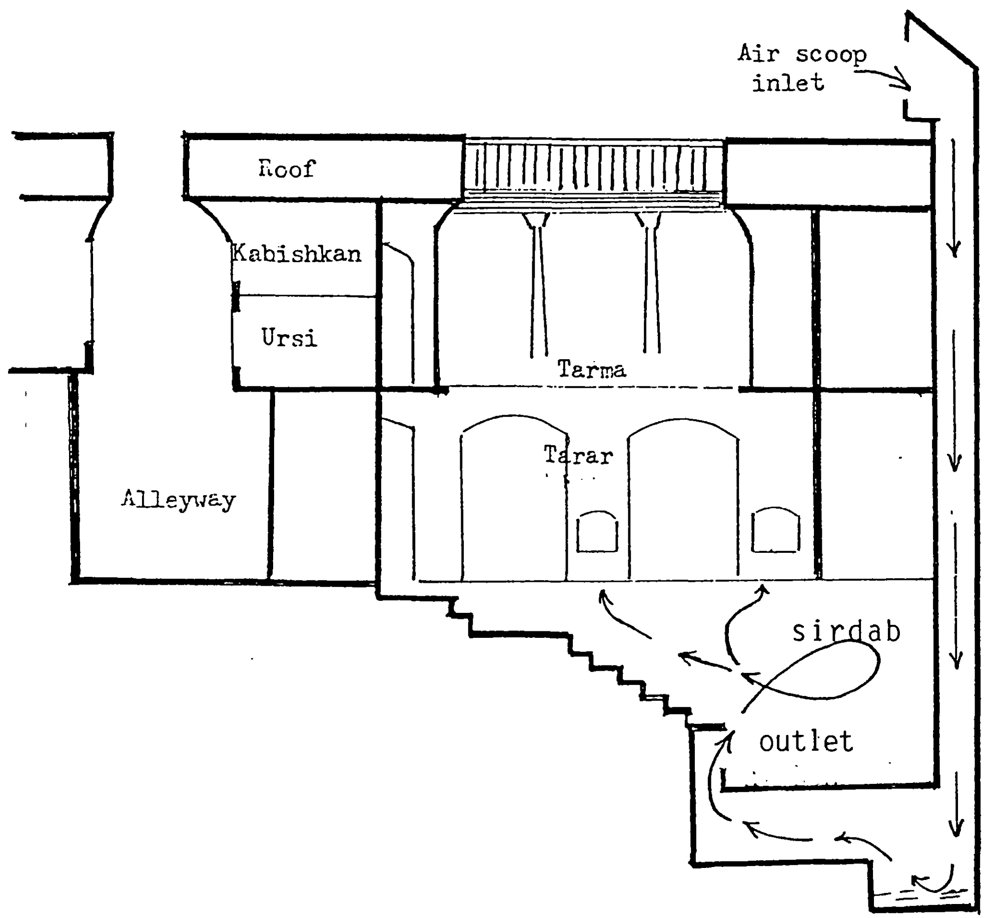


The six basic levels of the traditional house.

1. Basement — *sirdab* — 3.5-4.5m below ground floor level.
2. Semi-basement — *neem* — 3-4m high (1.5-2m below ground floor level).
3. Ground floor — entrance, *talar, neem,* and courtyard — 2-2.5m high.
4. First floor — *tarma, shanashil, ursi* — 4.5-5m high including mezzanine.
5. Mezzanine — *kabishkans* — 1.8-2m high.
6. Roof — 1.5-2m parapet.

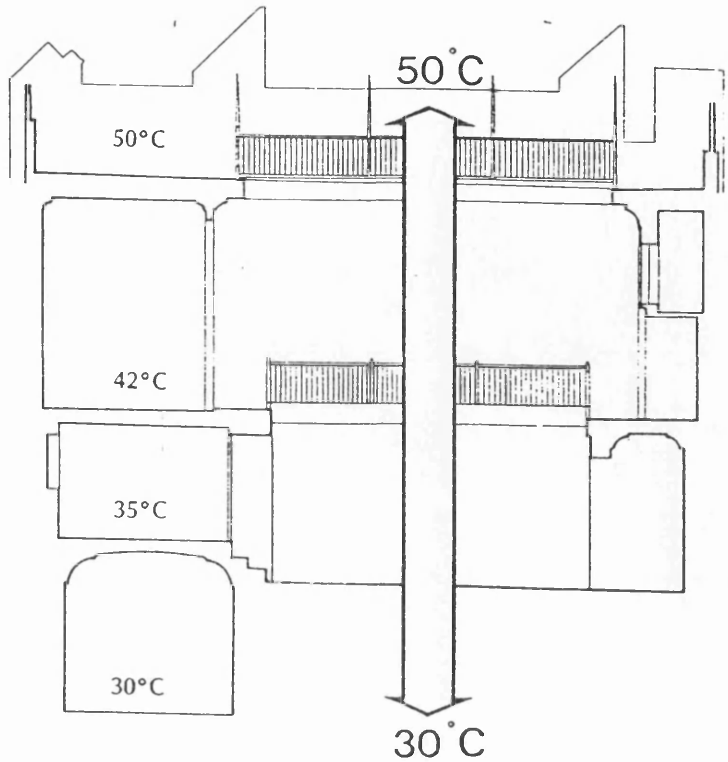
Source: J. Warren& I. Fethi, 1982

Diagram No. 2, cooling and ventilation performance of the Badgeer



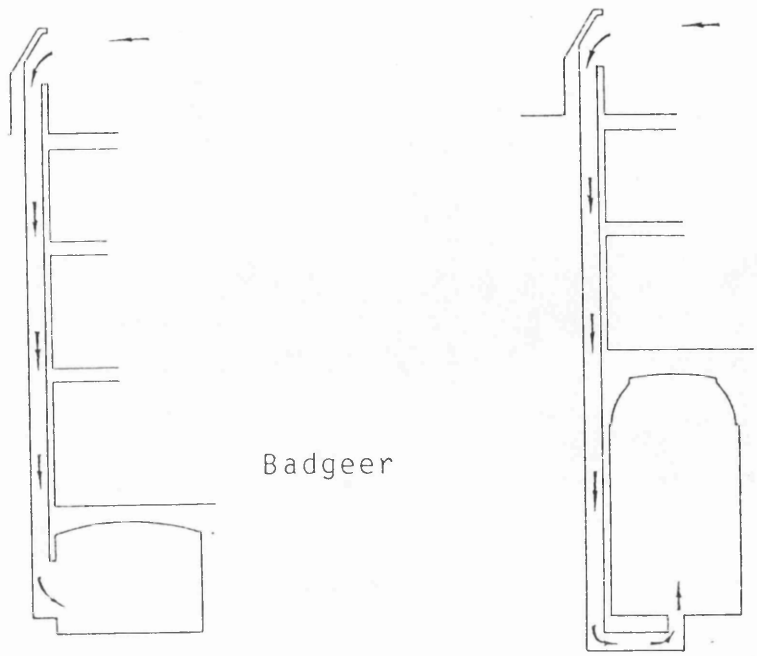
Source: The Author

Diagram No.3,The range of temperature in the courtyard house

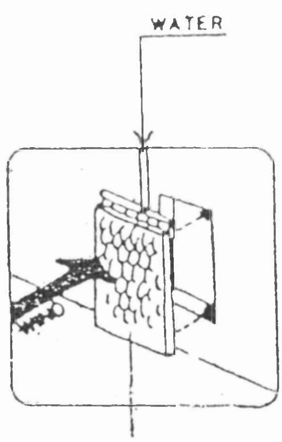


Source: J. Warren & I. Fethi, 1982

Fig. No. 13, Traditional cooling mechanism

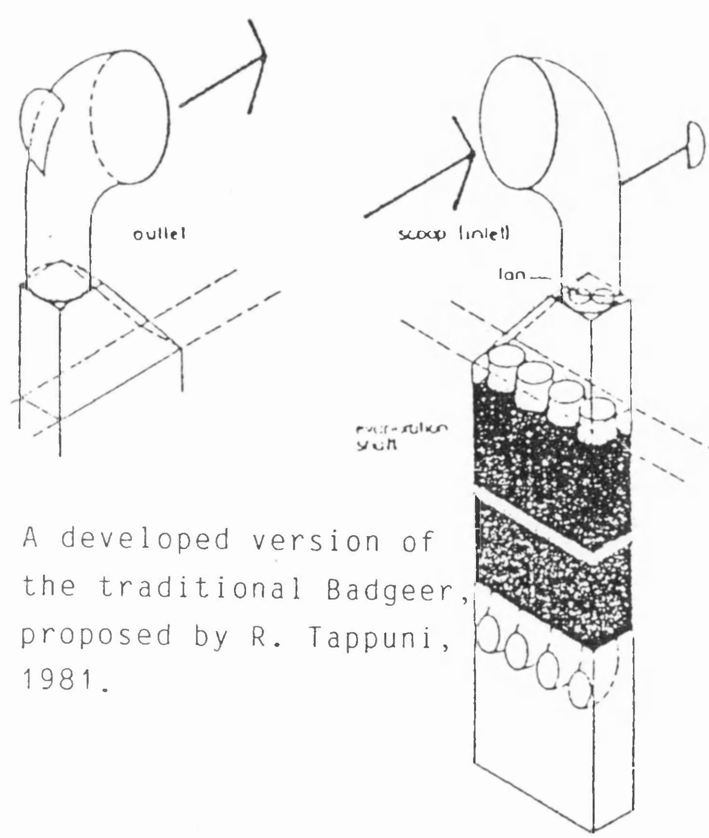


Badgeer



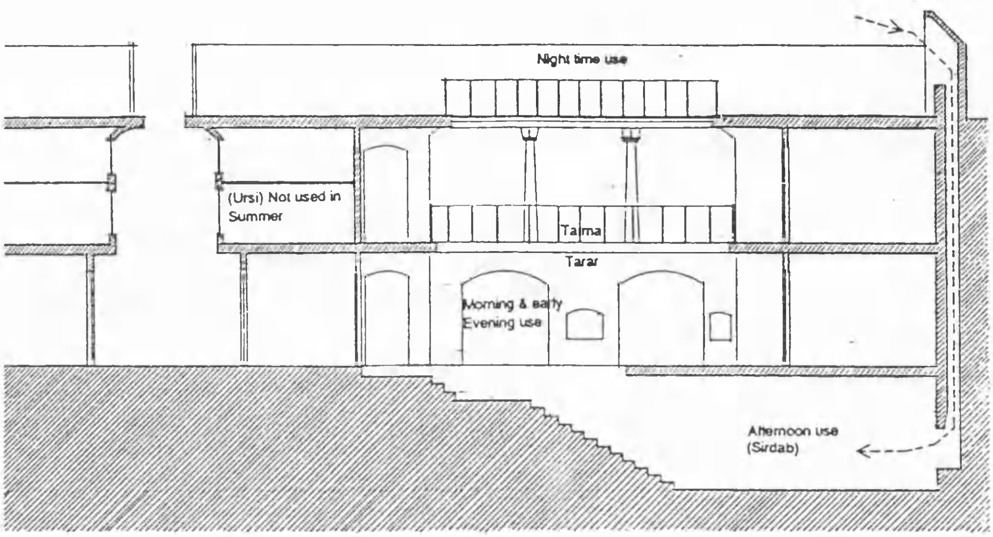
Ammaria

"Aqul"
wild thorn pads

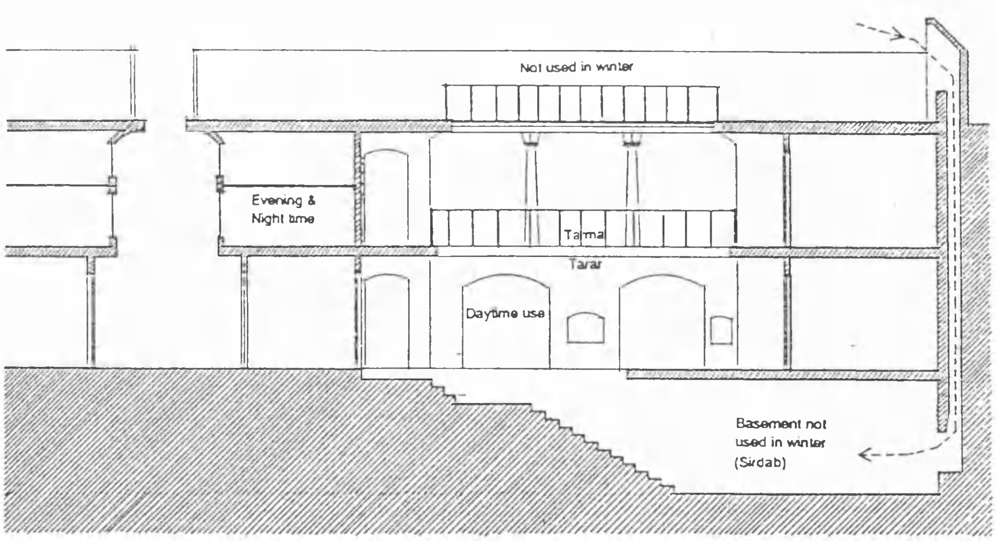


A developed version of the traditional Badgeer, proposed by R. Tappuni, 1981.

Fig. No. 14, Daily and seasonal inner movement of the residents in the courtyard house



SUMMER



WINTER

Source: The Author

Fig.15, alleyways system
in the Baghdadi
traditional neighbourhood

Fig 16, Mass of traditional houses
in relation to the streets

Source: N. Schoenauer, 1981

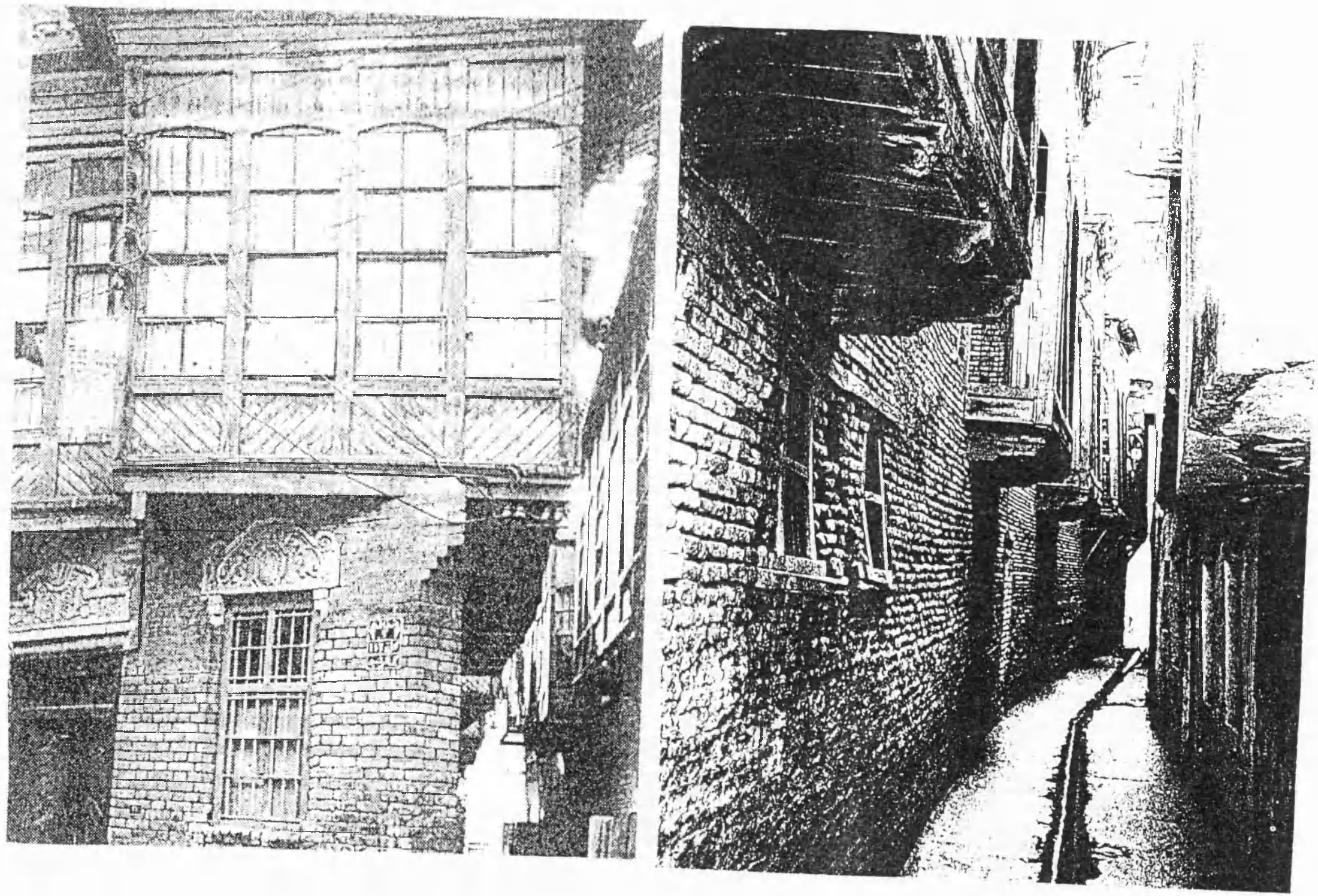
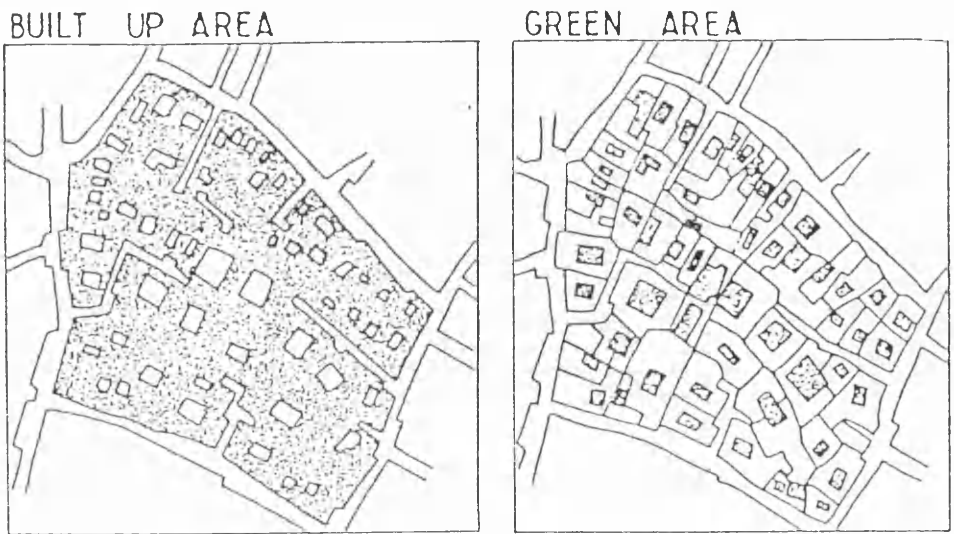
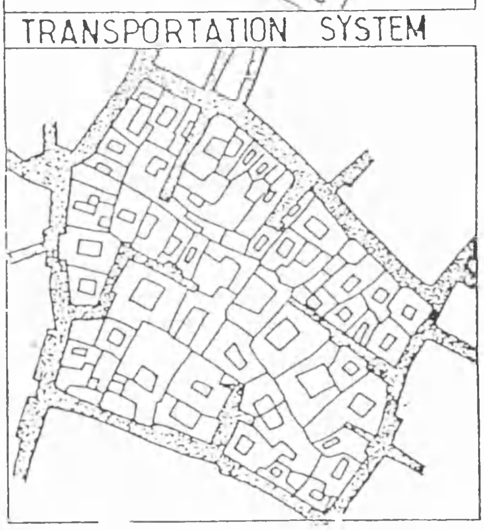


Fig. No. 17, Narrow Alleyways

Fig.18, Traditional urban concept of the courtyard house





INDICES

NUMBER OF HOUSES		66
TOTAL AREA (HA)		0.89
COURTYARDS About 50 per cent of courtyards area =green area	AREA (HA)	0.11
	PER CENT OF TOTAL AREA	15
BUILT_UP AREA (HA)	AREA (HA)	0.59
	PER CENT OF TOTAL AREA	69
ROAD AREA (HA)	AREA (HA)	0.19
	PER CENT OF TOTAL AREA	16

The figures above are analysed by R. Tapuni and S. Rassam, 1981

PART III: THE MODERN HOUSE IN IRAQ

III.a. History and Development

The evolutional changes in the Iraqi house that began at the end of the 19th century were, to some extent, parallel to those that took place in Europe in the 17th century. However, both the style and the form of the Iraqi house display a series of transfigurations similar to those which occurred in the European house, since the Renaissance movement left its mark on western architecture. It is actually, as in Britain, where the medieval house gave way to the Georgian town house with its compact regular plan and uniformed facades. Brick and stone walls replaced the timber framed structure, the staircase became a dominant part of the hall and the hall's function changed, after being the main living space, it became an entrance way and a central circulation area. The Iraqi house also experienced an analogous shift at the turn of this century, as will be shown below.

In the 19th century, the culmination of the industrial revolution and the growth of capitalism produced a new and different pattern of architecture in Europe and the USA, reflecting the culture and lifestyle of the rising capitalist society, that encouraged the movement of modern architecture, throughout the world. This was described in 1903 by the French architect, Hector Guinard as:

> "The principles of the Middle Ages and those of the 19th century, added to my doctrine, should supply us with a foundation for a French Renaissance and entirely new style ..."
> (Kenneth Frampton 1985) p.69

For economic and cultural reasons, the architecture in Iraq steadily reacted, in its own way, to the substantial changes in international building industry. In Iraq, however, the building tradition and domestic architecture were infused by modern elements in the very beginning of the 20th century, leaving out the three centuries of development that Europe has had. New techniques and imported materials became more available to the Iraqi building trade. This can be attributed to the development of transport that made it easy for Iraq to promote commercial links with the outer world.The international economy, and the influence of European life style and fashion are among the factors that gave rise to progressive types of Iraqi houses, forcing the Baghdadi house closer to the western standard.In this respect, Chadirji (1986) suggests that, in order to create a harmony between the recipient and incoming cultures, sufficient time is required to adapt and interpret the imported aesthetic values and technology, therefore he states:

> "The dissemination of culture usually became possibly only when the receiving society was culturally prepared to absorb the new forms impinging on it. Many factors determine the characteristic of such dissemination." p.21

On the same issue, another opinion by William J.R. Curtis

(1982) stresses that:

> "A distinction must be drawn between countries which receive modern architecture ready-made from the outside, and countries which, while they obviously relied on foreign stimulus, evolved modern movements of their own in parallel with the major development of western Europe." p. 195

From the preceding parts of this study, it can be gathered that Iraq, where the basic principles of building practice were founded, is not an architectural vacuum. It has established a rich architectural heritage throughout history and therefore, is capable of contributing to the development of functional and domestic architecture on both regional and international scale.

III.a.1. The Architecture of the Colonial Time in Iraq

With the expansion of the British Colonial system, a new pattern of architecture was cultivated in the colonies to be a symbol of the British power. Henceforth, the local culture and dwellings were influenced by the world market and European life style which was introduced for the first time.

Soon after the First World War, Iraq fell under the British mandatory rule for the period (1921-1932). The Department of Public Works was established by the colonial administration; in Iraq. This was directed by British military engineers and architects who designed and constructed several functional public buildings and infrastructure projects determined by the said Department to serve the objectives of the colonial mission there.

The design of public buildings between the two World Wars, even those done by non-British architects; operating in the country during that era, were influenced by the approach initiated by the British colonial architects. Their experience, acquired in India, marked the architectural works of the colonial era in Iraq (Fig. No.19). Some of them were impressed by the building achievement of the past and mastered the art of matching western classicism with the local practice. They successfully implemented this approach during their service as military engineers in India before they moved to Iraq. Earlier this technique was employed by Sir William Emirson in his design of Muir College- Allahabad "1871-1878" where he presented western engineering in Islamic dress, believed to be a solution to the identity of style (C. Hussey 1989). Later, Sir Edwin Lutyens developed a similar technique in building New Delhi in the 1920s (K. Sultani 1982).

Although the British architects did not directly contribute to the Iraqi domestic construction at that time, undoubtedly their new concept, used in public buildings in Iraq, was deeply penetrated to the form and design of the Iraqi modern house. This influence was mainly exhibited in the reshaped urban pattern and form of the contemporary houses, particularly those of wealthy and privileged Iraqis, built in the 1930s and 1940s, discussed below.

The Prominent Colonial Architects and Their Works in Iraq

J.M. Wilson

Was the first director of the Department of Public Works in Iraq, when it was established in the 1920s. He contributed to the design and implementation of several outstanding functional and public buildings. Many of his products in Iraq reflect the influence of Sir Edwin Lutyens' approach, practised in India, incorporating oriental features with the European classism. In his architectural works in Iraq, Wilson tended to infuse Western architecture with some Islamic features:

> "His buildings in Iraq are based on an elegant synthesis between Islamic architecture and Western classicism"
>
> (Ihsan Fethi 1985)

Wilson was always inclined to design his buildings in symmetrical form. The most dominant feature in his buildings was a dome, built over a circular central hall, complemented with regional stylistic details and Islamic motifs and implemented in a high standard of traditional artistic brickwork.

His works in Iraq were mostly done in partnership with J. C. Mason or other British architects. One of his best designs, which was never built for financial reasons, was the Palace of King Faisal the 1st, in Baghdad 1927. Wilson's individual major work is The University of Aal al Bait in Baghdad (1922-1924). Other works which he carried out in co-operation with his assistant, J..C. Mason, are:

1. General Maude Memorial Hospital in Basrah (1921).
2. The Court Royal Palace in Baghdad (1923), now demolish.
3. St. George's Church, Baghdad (1926)
4. Port Authority Headquarters, Basrah (1929).
5. International Railway Station, Baghdad (1947-1951). (Fig. No. 20)

J.C. Mason

Was an advisory architect to the Iraqi Government in the 1920s. The best of his architectural works were done in co-operation with J.M. Wilson.

Mason's individual designs show a lack of regional architectural flavour and an obvious disregard to local traditions. He was largely inclined to the western discipline which was frequently demostrated through the use of pitched roofs and a tendency to apply British stylisation and western ornaments including classic order and pediments.

A good example of this style is the Royal villa of Harthiya in Baghdad (1933), later called Al Zuhour Palace. This villa was built in a pattern of British countryside mansion house, where he employed round towers, spiral staircases, sloping roofs, Ionic and Doric columns, for the first time in Iraq.

In the building of the Post and Telecommunication Centre (1929), which was not fully executed, Mason planned to use glass roofs to provide sunlight to the building (K. Sultani 1982), disregarding the climatic characteristics, of the hot dry environment in Iraq. His major individual works are:

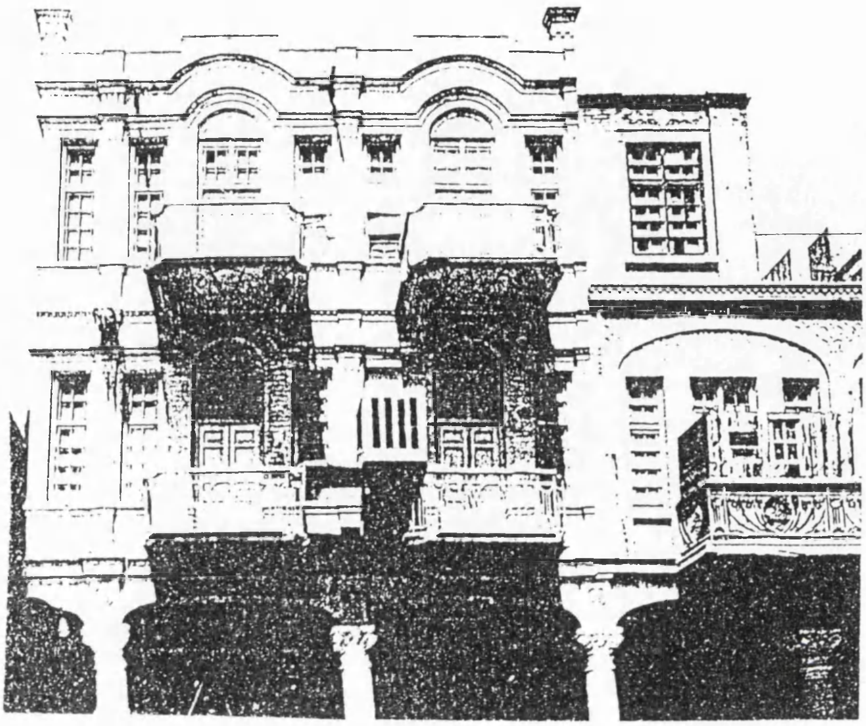
1. The Post and Telecommunication Centre (1929).
2. Baghdad Airport Terminal (1931).
3. The Royal Villa in Harthiya (1933).

J.B. Cooper

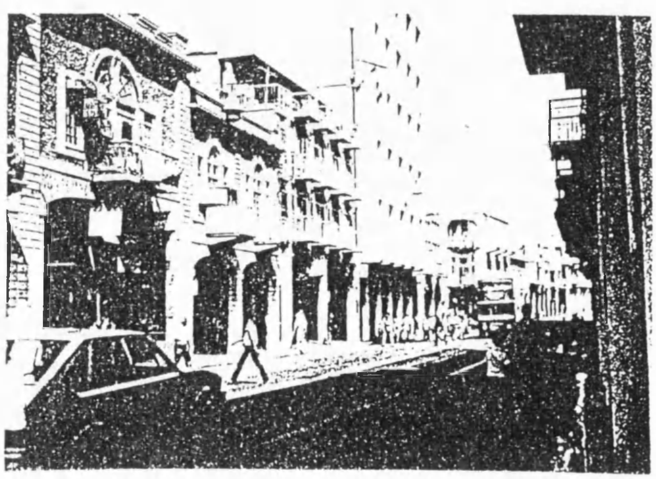
He succeeded J.C. Mason in his post as an advisory architect in Iraq in the mid-1930s. His architectural discipline was slightly similar to Wilson's, but the western character was dominant over traditional features. Besides his extended use of concrete, he also employed local materials, bricks in simple structural composition of load-bearing walls and arching vaulting.

The Royal Mausoleum in Baghdad (1934-1936) is Cooper's most outstanding design where he has more emphasised Islamic embellishments to fit the function of the building. The distinctive feature of the building is a complex of three circular halls with elegant domes, vaulted by bricks and finished with Islamic ornaments. The biggest one is the middle resembling a rotunda form, surrounded by supporting columns to carry the huge dome. In this building, however, Cooper adopted an architectural style, used by his predecesors, Wilson and Mason. In contrast, the College of Engineering in Baghdad (1937) was entirely designed in a Western style. The same is applied to the New Royal Palace in Baghdad (1957-1959), the presidential palace now, which was Cooper's last work in Iraq.

Fig. 19, Features of the colonial architecture in Iraq



Typical facade of colonial style on Rashid Street



Source: process ' Architecture', No. 58, 1985

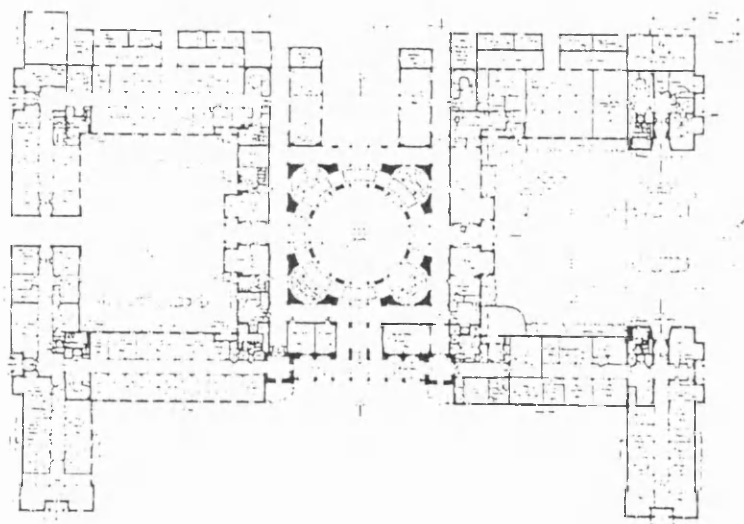
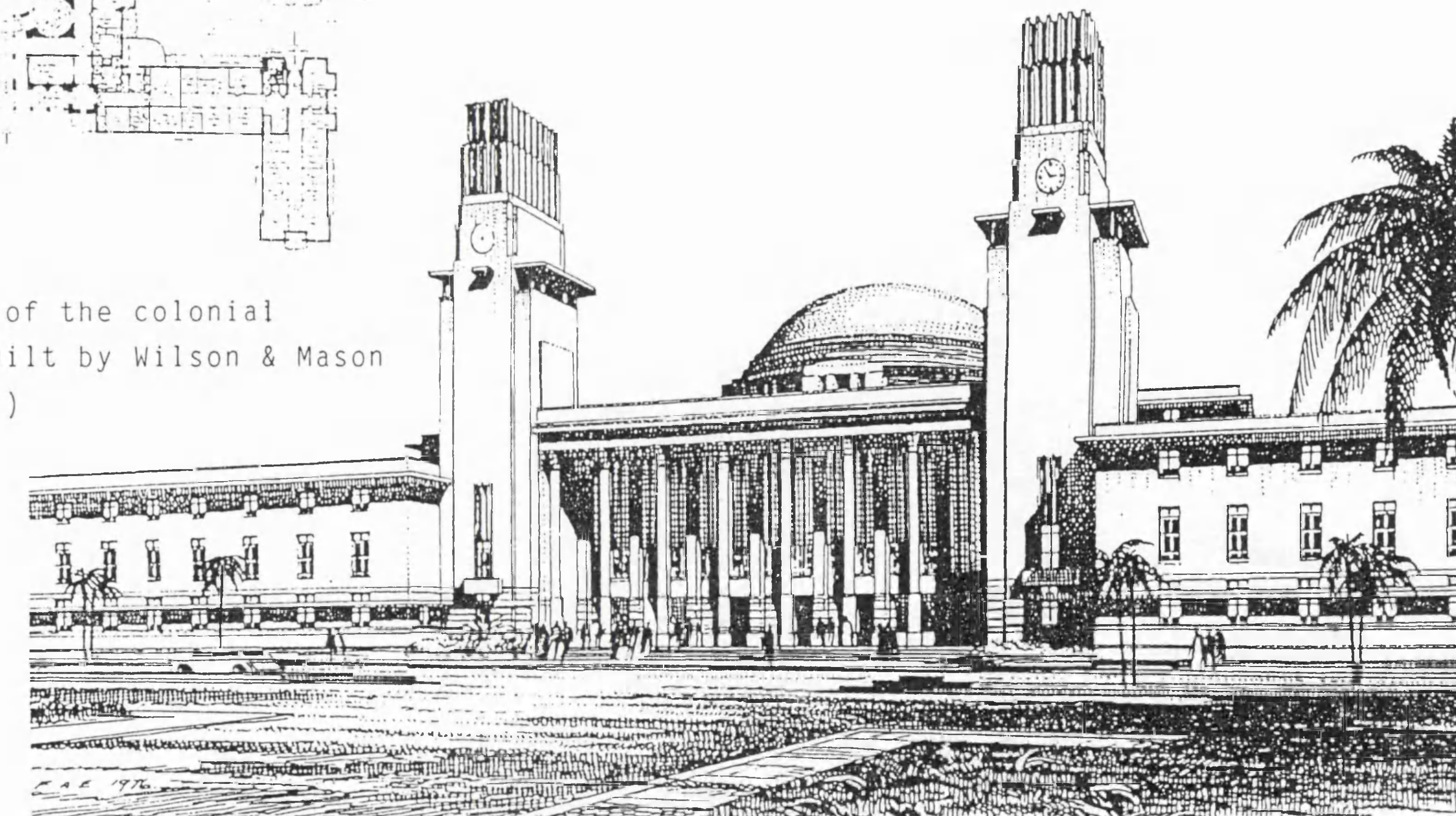


Fig. No. 20,

The International Railway
Station in Baghdad

An example of the colonial
pattern- built by Wilson & Mason
(1947-1951)



Source: K. Sultani, Ur, Vols. 2/3, 1982

III.a.2. Transition to the Modern House

Changes in Form and Building Technique

The concept of non-courtyard form utilised in public buildings in Iraq during the second half of the last century, eventually led to the emergence of the semi-extroverted house, in the early twentieth century. The demise of the traditional courtyard house led to the development of various new types of houses. Between the 1920s and 1930s a series of transfigurations occurred on the design of the traditional house as an evolutional or transitional step towards the modern type prevailing today.

Form and Features

The transition to the modern house, in its early stage, was manifested mainly in the implementation of new technology, materials and some modern stylistic features, i.e., the house has retained the features of the traditional form. The courtyard, semi-basement cellar, single or dual circulation areas remained the principal components of the plan (Fig. No. 2 1). Some stylistic changes were embodied in introducing architectural elements like open balconies which gradually replaced "Shanasheel", the traditional latticed screened bay windows.

The exterior of the house became more exposed with a tendency to place more windows on the frontal walls at ground floor. The facades of some of those houses were decorated by borrowed motifs, from Neo-Baroque architecture. The functional arrangement and the concept of the house remained relatively the same, as in the traditional practice (Fig. No. 22).

The mid-1930 signalled the crystallisation of a new era of architecture in Iraq which transferred the form of the house, its exterior, functional aspect and layout towards the modern house, widely used today. However, for the first time, a new type of house emerged in which the functions of spaces are designated. It is a one or two storey house with a portico type doorway with a front door in the middle. Although those houses are characterised by homogeneity of the facades, additional concern was given to the frontal elevations, porches and open balconies, that face the street, became common features (Fig. No.23).
Other new elements such as fireplaces and garages arose from the influence of European architecture.

Plan and Space Arrangement

Regarding the plan, the early modern or transitional form shared a distinctive similarity of spatial arrangement. A major change occurred in the form as the traditional open courtyard was converted to a fully covered central family living room, locally called "Hall". This room is the core of the house, surrounded by the other habitable rooms on two

or three sides of the house. The passage or entrance lobby leads to the frontal reception room, and opens directly into the living room "Hall" which also serves as an inner circulation area, through which the other rooms communicate. Sometimes, the reception room has an external door opening to a frontal sheltered terrace to be used by guests, particularly males. In some cases, the ancillary building is placed in one of the rear corners of the "Hall", but in most cases, it consists of an attached external service extension at one side of the rear garden. The access to this area is through either an open or sheltered terrace "Tarma", (See Fig. No. 24).
These houses are usually built of one storey and sometimes, of two storeys. In that case, the plan of the first floor is almost identical to that of the ground floor. The rooms have generally grown larger and increased in number. More architectural and aesthetic concern was given to the staircase which became a prominent visual component of the house. Sometimes, the level of the ground floor was raised to about 1-1,5 m. and provided a semi-basement cellar (Neem-sirdab). This also raised the level of the windows at the ground floor frontal elevation; above the heads of the passers-by to ensure privacy to the occupants.

This type of houses are usually built on uniformed plots, sited on more regularly aligned streets. The sufficient size of the plots offered more choice in term of situation, size of the built portion and number of floors. The houses were built as detached or semi-detached either on the front of the building plot or at the rear. In some cases, a garage is built to one side of the house with an attached room at its end.

After minor alterations, the same design was built on smaller sites as terraced houses with windows to the small front garden and the large rear one. That, sometimes, led to shortcomings in terms of space, insufficient quality of light, ventilation and sanitation. For this and other reasons, the converted pattern did not last long, giving way to the current modern type of today.

In this house the privacy of family, in its traditional sense, was maintained. It was articulated by placing high fence walls around the extroverted gardens and high parapets or by design, such as the location of the reception and its external access. Sometimes, screens and partitioning curtains were used between the public and private section of the house. The conventional bent entrance was largely used in this type of houses to ensure the required privacy of the occupants. Such applications have gradually dimished with the popularization of the recent type, as will be shown below.

Building Technique and Materials

When the new material and elements came into the Iraqi building industry in the mid-1930s, building technique underwent a radical change too (refer to III.c.). In constructing the modern houses, new technology and imported building materials were employed besides those of the native vernacular and conventional building skills. Steel, concrete and moulding became common in domestic construction whereas the use of timber has drastically decreased. Tiles and mosaic were widely used in flooring, they replaced the timber floorboards and paving bricks of the traditional house.

Many features were certainly adapted to the newly used materials and elements. The distinctive light structure at the upper floors of the traditional house was replaced by solid construction and the traditional timber-framed nogging was gradually abandoned in favour of thick load-bearing brick walls. In this respect, it is worth mentioning that in 1915, a new roofing technique (jack arch vaulting) was applied in Iraq for the first time, by German engineers in constructing some buildings for the Baghdad-Berlin railway company (I. Fathi 1985, K. Sultani 1982). Jack arching is a combination of traditional brick vaulting and beams of I section steel. The technique has become very common in Iraq because it was economic, durable and a practical way of quick roofing. Other western building elements such as fixtures, fittings and modern sanitation came into use with the emergence of the new pattern.

However, the combination of western concept, new technique and local building traditions, were the factor which gave rise to the modern Iraqi house. The designs of the British architects, applied in public premises in the 1930s, were complimented by the native workmanship and availability of the materials to become a distinguished pattern, known as the Colonial architectural style, discussed above.

III.a.3. Development of Concept,Form and Space Arrangement

The modern house in Iraq today, is not an indigenous or regional style but, in fact, a recent type of European villa house. That is why it is locally called (Gharbi); western. This concept was introduced to the area, as a result of necessities for development, where the form was adapted, to some extent, to the local environment and social and economic circumstances. This house emerged after the Second World War and has become widely spread since the 1950s. Western influence was one of the factors that led to the rise and domination of this type today, in the modern districts at the outskirts of Baghdad and other Iraqi cities. The new concept has overtaken even the popularity of the late transitional form which has entirely abandoned the traditional elements, i.e., the house does not comprise subground level (Sirdab, Neem Sirdab or Rahrab) and thus, has totally abandoned the traditional passive cooling technique in favour of energy driven cooling. Furthermore, the functional and environmental shortcoming of the early modern house accelerated the emergence of the current one.

The modern house can be built as detached or semi-detached but sometimes in a form of terraced house in case of small plots. The elevation can be of one storey or two storeys, the first floor is built either completely or partially with a roof terrace, the choice is entirely up to the owner and depending on the size of the plot rather than on building tradition (Figs. No. 25 & 26). There are no legal regulations interfering with the design whether internally or externally, except for the compulsory set back of the houses in relation to the street and those issues of public environmental health.

The Form, Plan and Space Arrangement

Modern houses are usually designed in a way that the reception-dining room and family living room "Hall" are the demonstrative elements and always placed in the front part where the exterior is more exposed than before (Figs. No.27 & 28). Each of these rooms overlooks the front garden and the street and opens to a small entrance lobby from one side and to the inner circulation area from the other. Sometimes a guest toilet/bathroom is built at the entrance lobby.
At the back end of the house, the ancillary rooms, staircase and sometimes one or two bedrooms are located and communicate through an inner circulation area which often has an external door to the rear garden (Figs. No.26 & 27). The high ceiling of the staircase acts as a ventilation tower, reducing the heat stress on this part of the house in summer. The kitchen is planned to one side of the house, rather close to the dining room and has front windows and external door open to the front garden and the car port. It is usually large enough to provide a sufficient dining

space for the family. Therefore, it has become an important part of the house.

In case of a two storey house, the first floor is always allocated to the bedrooms with a bathroom and/or toilet in some cases. These rooms open to the landing which might lead to a roof terrace at first floor or to one at second floor, in case of a completely built first floor area. In some recent designs there may be one multifunctional room, used as reception and family living room at the same time.

III.a.4. Technique and Materials

Bricks of burnt clay have been commonly used in constructing houses and public buildings in the central and southern parts of the country, while limestone has continued to be the most common structural element in the north (R. Tappuni, 1981). Mortar made from gypsum, locally called "Juss", is a common indigenous material used in bricklaying, vaulting and plastering.
For the availability of good quality of locally made cement, concrete became, technically and commercially prefrable for masonary and roofing in the modern houses and multi-storey buildings in Iraq. Presently, reinforced concrete is widely used in roofing the modern houses, despite its negative thermal impact on the building (See III. b. 2).

III.b **Climate Control in the Modern House**

We will now consider the technical changes that have taken place over the last decades.

The thickness and material characteristics of the external walls in the modern house are capable of hindering the ingress of the severe summer heat into the interior and reducing the loss of internal heat in winter. But this factor became less effective due to some technical and design shortcomings. These include lack of insulation on walls and roofs lack of shading, overhangs and balconies which make most of the external surfaces exposed to the direct solar radiation.

The rooms facing the sun benefit from a direct longer daily solar radiation in winter. But in summer this factor may have a negative affect particularly on those houses with too large windows, which transfer most of the solar heat load into the interior of buildings especially in the front, reception and living rooms. Large windows, certainly, have undesirable outcomes on the internal microclimate of the Iraqi house, as they are usually associated with overheating for being inadequate protection against the penetration of external heat during summer. They transfer most of the solar heat to the interior of the buildings and cause loss of internal heat in winter, often at night and on windy or cloudy days. Using large windows is attributed to fashion or to the influence of aesthetic value of outside culture, though it is less functional in terms of environmental requirements. Unproper orientation is another factor causing internal thermal disturbance both in summer and winter.

The thermal observations [1] done in a modern house by Al-Azzawi (1984) indicate that: between 10.00 a.m. - 22.00 p.m. in summer, all the internal spaces of the house produce undesirable environment conditions unless using evaporative air-coolers cooling or air conditioning devices. The desirable ones are produced in the open spaces; the garden and the roof terrace (in the shade), between 21.00 - 09.00 or 10.00 a.m. Between 03.00 a.m. - 08.00 a.m. the air temperature on the roof terrace drops to lower levels, due to the heat loss by convection caused by higher wind speed. Thus, the occupants sleeping there, get relatively cold. It is worth mentioning that, in case of different level roofs, the occupants may use the higher roof terrace during the hottest nights and the lower one for the cooler nights.

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(1) The over-mentioned observations were done in completely inhabited houses and during the constant use of cooling devices,which certainly affects the interpretation of the investigation.

III.b.1 **Climate Control Means**

As far as the micro climate is concerned, in the early type of modern houses, energy driven cooling replaced the full dependence on the traditional means of passive cooling, which has diminished since the emergence of those houses. Electric fans were the main ventilation and cooling devices available at that time. They were sometimes assisted by traditional ameliorating and passive cooling means, locally called "Ammaria", a wooden double grid frame, filled with a pad of fresh wild thorn, called "Aqul". These were placed on the external side of the windows and constantly watered, so that the air got cool and humid before infiltrated through them into the rooms (see diagram 13).

Regarding the current modern houses, electric ceiling fans are commonly used besides the evaporative cooling devices which are built on the same principle of "Ammaria", above. The device is provided with an electrical driven air ventilation and a water pump sprayer, pushing the cool moistened air through double metal reticles filled with straw or wood shaving pads. The cool air is pushed either directly through an opening in the window or through ducts channelled to different parts of the house. In more elaborated designs, the air cooling ducts are pre-allocated within the construction and the air coolers are usually placed on the roof and installed as a part of the fittings. For economic and maintenance reasons, this kind of locally produced air coolers are preferable to the full air conditioning system which is also employed in the well equipped houses and in functional and public buildings.

To build a traditionally integrated passive cooling system, in normal economic circumstances, may cost an additional 7 - 13% over the usual constructional cost of an average house in Baghdad (1).
The annual spending on energy in this case, is much less than half the cost of the energy in an ordinary house (with a full electric cooling system), in addition to the high cost of the electric cooling devices, their installation and maintenance. The cost of building materials and construction work spent on building passive cooling system may repay itself in about eight years. (Refer to III.C). An average size electrical air conditioner costs ID 2.500, - excluding installation work, and hardware which may increase the cost to more than 3,000 I.D. The parts of these devices are mostly imported to be assembled locally, i.e., they are fully reliant on foreign technology and therefore require skilled labour and valuable

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(1) Architectural and Planning Partnership - Baghdad, 1980,other figures are not available.

hard currency. The cost of electric energy, consumed in the Iraqi household during three months in winter and summer is:

type of house	**Winter**	**Summer**[1]
Large	ID 60,	ID 150
Average	24,	75

Assuming, in a traditional house, the winter consumption of electric energy is equal to that of an average modern house, in that case, the residents of the traditional house may be able to save about 50% of their summer spending as they benefit from a good combination of passive cooling means (Sirdab, Badgeer and Courtyard). The figures above show the spending of a household on electric energy in an average house is triple in summer when most of it goes for cooling.

Heating has not been a big concern in the houses of Baghdad. Mobile charcoal stoves (Manqla) continued to be used in the early modern house but to a less extent than in the traditional one. Portable paraffin stoves have been commonly used, they appeared and developed with the early modern house. In some of these houses, fireplaces could be found, but are rarely used. In the last two decades, mobile gas stoves

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(1) One ID = US$3.32 - officially before 1991.

appeared and are widely used today besides the paraffin stoves which are the main heating source in the modern house.Nowadays most of the houses which are built in Iraq do not observe the climatic and environmental requirements for they are cheaper to build though costly to run.

III.b.2 **Thermal Characteristics of Materials**

Although the mass of concrete structure allows slow heat penetration into the building, it is a highly heat conductive material, compared to bricks.

However, the buildings of concrete frame and glass walls do not necessarily suit the environment of Iraq and other countries of hot-dry climate zone for glass is a highly transparent material and allows the penetration of a great deal of solar radiation to the building.

> "A glass wall of 3m x 3m in one room when exposed to the sun's ray, lets in 2000 kilo/calories per hour."
>
> (Hassan Fathy, 1985) p. 44

The technique of traditional vaulting and the European "brick jack arching" (see III.a) has proven to be more appropriate to the Iraqi climate than other roofing means, used today. But despite its efficiency, it has been abandoned in favour of reinforced concrete roofing.

III.c. Changes in Social and Economic Factors

In the second decade of this century the lifestyle of the Baghdadi people began to change. This led to the introduction of a new house pattern, replacing the traditional one, to meet the requirements of the new era. The economic boost, following the production of oil for export in 1934, helped to increase the construction activities evolved by various projects of infrastructure works and oil industry. Domestic building, on the other hand, witnessed a qualitative and quantitative shift. Public urban housing schemes of modern western style were built besides private modern houses.

A new era of socio-economic transformations began after the 1958 revolution and led to greater disposable income and wider provision of welfare offered by the state. In the early 1960s, rural to urban migration intensified and has continued. The unpredictable growth of population, concentration of people, and economic activities in Baghdad have certainly developed a complex of urban problems;

Quantitative shortage in housing stock, decline in the living conditions, inefficiency of service and local amenities, traffic congestion, and shortcomings of the capacity of engineering and technical infrastructure.
The accelerated socio-economic transformations of the Iraqi

urban society have produced a demand for more advanced public and private transport, extending the capacity of infrastructure and upgrading the efficiency of roads to meet the increased number of vehicles.

The construction in the suburbs to form new residential areas had dramatic social and environmental consequences. It has created a class based urban structure, an obvious division in the residential areas, articulated by the formation of strata and segments. These factors have emerged for the first time in the urban social fabric in Iraq, in contrast to the traditional neighbourhoods where people of different social standing lived beside each other.

The irrational demolition ruined the communities of the traditional quarters, therefore, many inhabitants had to move to the suburbs after their houses were demolished in order to build new roads. Gradually, the traditional quarters were abandoned and what was left of their houses were let to poorer families living in multi-occupation. This practice furthered their physical deterioration.

III.c.1. Socio-Economic Changes and the House

Although the modern house is western in concept and style, the concern for privacy is still maintained in the design, though less strictly. The sufficient room in the modern house provides the members of a nuclear family with more indoor privacy. But attributed to the modern culture and development of social attitude, outward privacy became more socialized. The impact of this social phenomenon was reflected in the changes of the form and stylistic features of the house. The extroverted garden, surrounded by a rather low fence, has emerged as a prominent component of the form, the flat roof continued to be used for sleeping in summer, but it is surrounded by a low parapet, compared to that of the traditional one (Fig. No. 26).

The placement of relatively large windows to the frontal facade, particularly at ground floor is a common feature simply for aesthetic reason rather than climatic one. The homogeneity of height of houses has been abandoned in the modern neighbourhood in favour of free choice. In respect to the social and economic development, the modern house is a next phase of the evolution of the Iraqi house.

Although the family unit is still essential and respectable in the contemporary Iraqi society, modern houses, however, tend to accommodate smaller nuclear families as a result of fundamental changes in social attitude, associated with economic development. Generally, the modern house design obeys the functional requirements on international standard.

The introduction of European furniture, at the turn of this century, led to functional designation of spaces, since then the dining room has become a notable element in the design of the modern house.

Related to these observations are aspects of the evolving life style such as, "with the expansion of education" new demands for space have emerged when members of family who are students need individual bedrooms. Sometimes, there might be a study for this purpose.

During the last decade (1980-1990), the cost of masonry labour and building materials in Iraq, have risen to more than 700% of its previous cost, that is even higher than the actual inflation rate which actually exceeded 200% (1). The price of building lands has also gone up due to the shortage of supply and the overall economic disturbances caused by the war. So building an average urban family house in Baghdad costs I.D. 100,000 - I.D. 250,000, whereas the same house could cost I.D. 5,000 - 15,000 before 1980.

The war and sudden privatisation of the state owned construction firms have caused a big shortage and rise in the price of local and imported building materials and equipment, due to the shortage in hard currency in the current circumstances.
In 1980 housing stock in Iraq was estimated at about 1.25 million units, 400,000 of which were below the standard of habitable conditions. The shortfall was 0.5 million (M.

(1) Annual statistic abstract 1988 - The Central Statistical Department, Ministry of Planning, Baghdad.

Danby, 1982). These figures indicate that only half of the families were adequately housed then. However, the property market in the over-populated metropolitan areas in general and in Baghdad in particular, has boosted prices. Thus, the average income of an Iraqi layman does not allow him to own a house, for the yearly per capita income stagnated around (I.D. 736-809) from 1981 to 1985 (1).

> "If the gross national product there, is divided by the number of families, the resulting figure equals one quarter of the cost of an average house produced by the private sector in Baghdad."
> (M. Danby, 1982) p. 116

Therefore, a low income Iraqi family cannot afford to own a house satisfying their demands. To build their own houses, they rely mainly upon borrowing from the governmental Real Estate Bank, though the lending activities of this bank were reduced to I.D. 142 million in 1986, after being I.D. 750 million in 1981.

The result of these economic pressures has been that the generous traditional house is now economically impossible, except for the very rich who usually want an aggressively "modern" house anyway. The pressures have also affected the modern house in that, it is getting smaller and the cost of any imported materials and equipment is rising rapidly.

The Cost of Building Material by I.D

		Official	Black Market
Burnt brick		36,0	72,0
	1000 bricks		
Concrete brick		18,0	
Cement	one ton	32,0	
Sieve sand	Lorry 8m^3	50,0	
Mortar	6m^3	50,0	
Plaster	one ton	40,0	
Enforcement steel	one ton	250,0	900,0
Mosaic tiles	1000	400,0	
30 x 30 cm	Local production		
Marble	1 m^2	12,0	
Bathroom suite imported		600,0	
Water pipes		600,0	
Electrical			
Installation	one point	12,5	
Internal doors	one door	120,0-150,0	
Front door	mahogany	500,0-600,0	
Windows	one m^2 steel		
	and timber	150,0	

The Cost of building work	I.D. per day
Foreman (First Class) (Brick laying,plastering or tiling)	25,0
Semi-skilled worker	15,0
Unskilled worker	7,0-8,0

The minimal cost of needed building materials and labour excluding the price of land for a house of 120 m² is (I.D. 40.000,-)

Consists of	No.
Bedroom	2
Reception room	1
Dining room	1
Hall (Living Room)	1
Kitchen	1
Bathroom	1
Toilet	1

The above figures were obtained directly from professional building contractors working in Iraq - as the only sources today, October 1990.

These figures have probably risen to five times due to the constantly rising inflation

III.d. Resultant Urban Structure

The first attempt of urban development was initiated in Baghdad when the system of municipalities was established, during the rule of Midhat Pasha, the Ottomanian Governor of Baghdad, (1869-1872). Then the early wide straight through road, "Al-Nawab", was built so that vehicular traffic and horse-trucked tramway (1) could run through. Since then a new era of public transport began. The second earliest modern street, "Al-Nahar, was built at the end of the last century, now restricted for pedestrians because it is narrow in gauge and short in length, although it was widened in 1910. It runs through the central commercial area, on the river side in Rusafa. (See Map No 2). Thus, the urban pattern of historic Baghdad was affected for the first time, by those roads.

The diffusion of new technology, transport and western culture influenced the texture of the neighbourhood and the design of the house. The Western concept of the auto vehicular modern street was applied for the first time in Baghdad at the first decade of the 20th century. "Rashid Street" was built by the Ottomans before the First World

(1) The tramway, built in (1869-1873) was the main metropolitan public transport. linking the centre of Baghdad at Karkh with Kadhimia.

War, to be devoted to rapid transport and business activities. It became the main traffic artery of the Capital until the mid-1950s. Building those modern roads reshaped the overall urban structure of the city, affected the value of the land, promoted the commercial activities of the city and led to a further expansion beyond the historical boundaries of the Capital, targeting the surrounding suburbs.

Before the First World War, some physical infrastructure and other modern public services such as tapped water were provided in Baghdad. Soon after the war, Iraq fell under the British Colonial administration. During the first four years of the British Mandate (1921-1932), few public construction works were undertaken. They included improvement of the city roads, increasing their capacity and extending the water pipe network, initially installed in 1907. In the 1930s a further expansion of roads and traffic was carried out as the number of private cars approached 35,000 and lorries 11,000 in 1930, mostly in Baghdad. (Al-Samarii, 1968). By the end of the Second World War, the total network of the city roads covered a sum of 50 KM in length. (L. Raouf 1985).

III.d.1. The Modern Concept of Layout

The urban pattern underwent a major change in the arrangement of the neighbourhoods and their layouts, where the grid-like streets with terraced and detached houses dominated over the continganuous organic forms of the traditional neighbourhood (Mahallah), with its narrow irregular labyrinthian alleyways. Physical infrastructure, services and local amenities were then possible to provide.

The urban fabric of the old city was significantly influenced by the new breakthrough roads in their elementary pattern and by those built by the end of the Second World War. An example is Al Jamhuria Street (Khulafa), built in the mid-1950s to accommodate business buildings and establishments. This became the spinal axis of the central area, for being efficient, centrally located and accessible for business. Henceforth, the old residential quarters, on both sides of this road, have been outraged by irrational urban development and intensive demolition campaign for the sake of commercial buildings.

Generally, building the new inner city roads caused destruction of large parts of the traditional residential areas, demolished a vast number of genuine Baghdadi courtyard houses, built in earlier centuries and sacrificed several other buildings of historical and cultural value. The other victim was the hinterland of the green suburbs and orchards surrounding the city of Baghdad. It became a target for intensive construction when a new type of house emerged turning the suburbs into new residential districts for the wealthy and middle class people.

As discussed in (III.c) , the changes to the recent housing type were generated by different factors that were consolidated by the road and building law No. 14 of 1935. It also led to the creation of the new residential areas in the outskirts. The law implies the first planning legislations regarding building design and construction, issues of physical planning including the arrangement of roads and layouts. The law also specifies public facilities and ratio of roads for each area. Buildings, erected up to the front boundary lines, should not have enclosed external projections like "Shanasheel" unless they are unshaded balconies and not exceeding quarter the width of the street (Fig. No. 28). Bridging over public ways is no longer permitted, though it was not so common in the traditional type.

According to the law mentioned above, the urban residential areas are classified into six categories, determined by the minimum size of their building plots:

Category		Size m^2
1st		100
2nd		200
3rd		300
4th		600
5th	"Excellent	800
Special		2000

(L. Raouf 1985)

Districts (Zones) are, however, specified according to the predominant category in that area. While the traditional alleyways were no more than 2 metres wide, this law specified the minimum widths of roads in the new districts as follows:

Main roads	6 metres
Secondary roads	4 metres
cul-de-sac	3 metres

(ibid)

The law also implies a regulation for straightening the old narrow, irregular, labyrinthian ways. This was widely practised to widen the traditional alleyways of Baghdad by about 2 metres setback from the houses, thus, destroying their character.

In category 4, the buildings should have 4 metre setback to allow front gardens.

III.d.2. The Existing Urban Structure

The urban structure of the city was largely influenced by the above mentioned law. The grid-like, planned streets of the suburbs led to the development of a wider range of new forms of houses, regular layout and rectangular plot divisions. consequently, the horizontal expansion of the city extended the transport network, road service, infrastructure and other services.

The typical earliest modern neighbourhood is characterised by its geometric forms of layout and unorganic mass of houses,introvert, semi-extrovert or closed concept of the 1930s-1940s. These houses are distributed over regular shaped building plots, along a well planned layout of grid like narrow streets which often form a system of feeder streets leading to the main roads. The Battawieen neighbourhood situated between the parallel streets; Sadoun and Abu Nuwas is a good example of this type (See Fig. No. 30).

The current modern neighbourhood in the outskirt district is shaped by roads of different forms including: radial, curvilinear, circular or combination layout (Fig. No. 31). The main roads often pass through the most important areas while the distance between two subordinated roads is equal to two house plots. In this sense, the modern urban pattern has a character of planned main and subordinate roads, forming a block type layout.

> "The open-ended street patern and occidental urban spatial standards, along with the segregation of income groups, is contrary to oriental principles of environmental harmony and is incongruous with the climate realities of Iraq."
> (Norbert schoenauer, 1981) p.63

The cross section of a modern street is wide and exposed to the weather variations. The upper income modern residential districts are made relatively tolerable, even in the extreme climatic conditions with the help of landscaping. The modern districts of the lower income, besides their lack of adequate internal climatic control means, are deprived of outdoor shade trees. Generally, the modern wide streets provide no relief from the intensive external heat.

PART: IV. COMPARISON BETWEEN THE TRADITIONAL AND MODERN HOUSE TYPE

The previous parts of this work have tackled and analysed the main features which distinguish the traditional house from the modern one. These include, their climate control, form and development, social and economic characteristics, urban structure, etc. In order to identify and take advantage of the good characteristics in each type, avoid their shortcomings in future housing and suggest some solutions to the problems involved in the existing housing stock, it is necessary to compare and evaluate the two types:

IV.a. **Climate Control Appraisal**

Different types of Iraqi houses respond to the impact of climate elements and solar radiation in different extents, depending on their designs, masonry work, technique, materials and thermal protective means. These are varied according to place and time. Structural elements and building materials available in Iraqi regions provide various ranges of heat admittance.

Traditional House

Regarding climate control, the traditional house is characterised by a set of advantages and short comings:

Advantages:

- A range of thermal conditions

  The design of the house provides a wide range of thermal control means.The variety of levels and sheltered areas of the house offers various thermal atmospheres from which the inhabitants can benefit (see II.b.3). This characteristic makes the traditional house a relatively convenient place to live in, particularly during summer time.

- Well protected courtyard from the sun.

  The proportional dimensions of the courtyard allow minimum exposure to the direct sun glare and offer air ventilation i.e., the courtyard acts as a temperature regulator (see II.b.1 & fig.32).

- Restriction on form and construction.

  The compact form, the inward arrangement of the rooms around a courtyard and the thick walls of the ground floor and subterranean level have created favourable micro-climatic conditions in the lower rooms during the hot season. Furthermore, the house has incorporated some passive cooling and ventilation means "Badgeer". For the thermal performance refer to II.b.1.

- Efficient in heat resisting.

  Regarding heat admittance through the structural mass, the solid load bearing walls at the lower levels are efficient in extending the time lag of heat transfer to the building (see calculations on page 172). The roof, due to its technique, is also efficient in this respect (see II.b.1).

- Ease of building and maintenance.

  The traditional house is reliant on passive means for cooling, like "Badgeer", wind catcher and other elements used to maintain the climate control in the courtyard house. These are constructed by local skills and indigenous materials. Therefore, they are easy to build and maintain, although costly to construct today (see III.b.3).

- Properly oriented spaces give better climatic performance in different seasons.

  North-facing ground floor recesses "Tarar, Iwan and Tarma" are beyond the reach of the sun and are therefore, favourable spaces for summer. South-oriented similar recesses are more appropriate for the winter sunny days, as they admit sunlight and restrain the cold winds. The raised glazed room "Jamkhana", located along this side proved to be optimal for taking advantage of the winter sun.

  The same thing may be applied to the "Ursi", on the first floor, whose inward looking south-facing sash windows would admit the sun through the high , open colonnades.

- In spite of restricted range of materials and technology, the traditional house proved incredibly good at climate performance in summer. Although it does need some limited heating input for about two months in the winter.

Shortcomings:

- Lack of adequate insulation causes thermal problems particularly, at the upper floors, both in summer and winter. But this can be improved.
- Absence of greens and gardens causes low humidity, a dry atmosphere and less protection against dust, particularly in the courtyard area. This can be improved by reviving courtgardens (see V.b.1).
- All the rooms open to and communicate through open spaces, consequently, this causes heat loss in winter.
- The access to the ancillary buildings is through the open courtyard, i.e., it is poorly protected against the rain and cold winds in winter (see II.a).
- The thin timber walls at the upper floors are inefficient in hindering heat transfer, resulting in inadequacy of the upper rooms in summer and loss of internal heat in winter.
- The orientation of rooms towards the sun has not been given proper consideration due to the rigidity of the

design and spatial arrangement. As a result, not all the rooms benefit from the long daily solar radiation in winter. Therefore, the occupants have to follow the sunlight rotation in a horizontal manner during the day in winter and escape the sun in summer (see fig. No.11).

Modern

Advantages:

- Achieving accurate temperature.The modern house is reliant on mechanical and evaporative cooling devices or air conditioning.These are able to maintain accurate temperature in all rooms and provide desirable thermal conditions, regardless of the house form. But they have negative economic consequences (see III.c).
- Free plans.

  In contrast to the traditional house, the modern one enjoys full freedom of design and arrangement, so that it is possible to employ landscape and manipulate the technical issues' including orientation, ventilation, heating, cooling, etc.
- Providing potentials for green and open spaces.

  The extroverted form makes it possible to benefit from the landscape to create shade and ameliorate the harsh heat in summer.
- Orientation is possible.

  Due to the flexibility in the design and spatial arrangement of the modern house,it is possible to consider proper orientation (see III.a).

- All doors open into draught excluding lobbies that help conserving internal heat in winter and excluding air during summer days.
- The walls of the upper rooms are comparatively thicker than those of the upper levels in the traditional house. They are relatively efficient in heat conservation in winter.
- Protection against dampness

  Dampness caused by underground water is seldom in the modern houses, as they are relatively raised, exposed to the sun and protected by a damp proof course.
- Owing to its design and construction, the modern house is relatively appropriate for heat conservation, it really belongs to the temperate climate.

Shortcomings:

- More exposure to the sun.

  The extroverted form, sprawling layout, lack of shading and overhangs make most of the external surfaces exposed to the direct sunlight that transfers the heat into the interior, causing overheating in summer. Therefore, all the enclosed living spaces produce undesirable thermal conditions unless using mechanical cooling or air conditioning devices (see III.b.).

- Inadequate insulation makes the rooms, which are relatively large, hard and rather costly to cool in summer, keep warm in winter and be protected from dust particles.
- Expensive to buy, install and maintain.

  Cooling devices depend on electrical supply which is often not reliable in Iraq.They are greedy in the consumption of electricity and expensive to buy, install and maintain, even for middle class people (see III.b).
- Use of skilled labour and imported parts.

  Although most of the cooling devices are locally made, they require skilled labour and imported parts. This means using valuable hard currency which adds to their cost (see III.c.1).
- Incorporating large windows that admit much of the sun heat into the interior, causes overheating in summer, and loss of internal heat in winter (see III.b).

Summary of Climate Control Appraisal

The traditional house managed its climate control by passive means. The form and construction of the house (see II.b) giving sufficient control for the temperature not to rise above 30°C in summer of fall below 15°C in winter. This range, although manageable, is considered large by modern standards. To maintain these temperatures the houses form and construction have to accept considerable restraints (courtyard - thick walls) and some elements are built especially to maintain the control e.g. Badgeer: Wind tower. These are expensive to construct (see II.b.1) but they do not require imported materials or specialist skills. They are equally simple to maintain.

The modern house by contrast with its air condition system can adopt any form and still maintain an exact temperature regardless of the outside temperature (thermostat control gives about 2-3 degrees of difference only). However, the cost of such a system both to install, run and maintain is high. Its essential parts have to be imported and maintenance expertise is commonly difficult to find locally.

IV.b. **Social and Economic Appraisal**

Among the decisive determinants, which have affected the existence and development of the Iraqi house, are the social and economic factors to which the design concept of the traditional and the modern house respond differently.

Traditional House

Advantages:

- For social and economic reasons, the Baghdadi courtyard houses were mostly built to accommodate extended families, this, they did very well (see II.c).But these elaborated traditional houses are too large for nuclear families.

- Full privacy to the public.

  One of the main concepts of the traditional house is providing complete privacy from the neighbours and general public by various architectural means (see II.c).

  It might be suggested that the traditional house, in spite of its functional shortcomings, is economical, in the long run, for the following:

- Efficient in land use.

  The house with its open yard and multi-storey structure is efficient in terms of land use as the built area covers the whole building plot and benefits from the optimal vertical dimension. These houses are usually built on small sites (see II.c..).
- The compactness of the house makes the demand for urban land less demanding. With a given supply this might

reduce the prices and the cost of the complete house.

- Due to its social and technical characteristics, the traditional house consumes less public services per capita; such as water, electricity, drainage, etc. With consideration to the quality and standard of these services in the traditional neighbourhoods (see II.c).
- The thermal properties and more dependence on passive means for cooling in summer, made the traditional houses more economical in the running cost of keeping them cool in summer (see II.b.1).
- Use of local labour and materials to keep cost within the national economy.Building the traditional house does not require imported materials and therefore saves hard currency.

Traditional house

Shortcomings:

- The design form of the house does not allow for dividing it into smaller units to accommodate nuclear families, while maintaining internal privacy at the same time (see II.c).
- Poor acoustic privacy.

  The internal partitions and noggings, particularly at the upper floors, are inadequate acoustic protective means because they are so thin and uninsulated.

- Less functional in space organisation.

  The traditional house saved space by using its rooms for many purposes at different times of the day, i.e., eating and sleeping, but it lost effective space because the technology of the house meant that some rooms became uninhabitable during the periods of extreme climate experienced in the year (see page 63).

- Costly to keep warm in winter.

  The traditional houses are not so economical in the cost of energy used to keep them warm in winter as the lower floors are damp and sunless and the upper floors uninsulated, although they get some useful heat from the sun.

Modern House

Advantages:

- Fits nuclear family well.

  Although the modern house is usually large and land consuming, it tends to accommodate a smaller nuclear family whose members benefit from its space potential and therefore, enjoy more inward privacy inside their house. (see III.c).

- Can be divided.

  It is possible to convert a large modern house into smaller ones or build a small house or an apartment on the unbuilt part of the site. The structure maintains the required acoustic privacy.

Shortcomings:

- Visual privacy to the public is poor.

  The design of the house with its extroverted garden, large windows and low fence made visual privacy to the public unattainable. These might also be attributed to the influence of western culture, change in the social attitude and life style of the Iraqi modern society (see III.c).

  We may suggest that the existing modern house, is less economical in the running cost than the traditional one for the following:

- Inefficiency of land use.

  The modern house is less efficient in land use as the built area does not cover the whole size of the building plot for these houses are usually built on large sites (see III.c).
- The design of the house with an extroverted garden is land consuming. This has caused shortage in urban land and raised the prices of houses.

- Employing imported materials, requires valuable foreign exchange money. As discussed in III.c), the cost of building a house is very high today. Imported materials and equipment are either completely absent or very expensive,due to the shortage in hard currency.
- More functional but less efficient in space use.
  The modern house saves space by having technology, air conditioning, which enables all rooms to be used at any time. But due to cultural changes in living habits, it loses effective space by having rooms designated for specific purposes, i.e., Living room, Bedroom, and others which are used occasionally, e.g., Reception room, Dining room, etc.
- Energy consuming.
  For the reliance on technical cooling means, spending on energy is high in summer. The lack of adequate insulation causes heat loss from the house to the outside in winter and therefore, the cost of energy used to keep the rooms warm will increase (see III.c).
- High expenditure on services.
  Due to the wide roads, low density and loose sprawling layouts, the modern house consumes more public services. Per capita spending on technical infrastructure and various utilities such as water, electricity, drainage, transport and other amenities is higher than its

counterpart in the traditional residential quarters.

- Costly in spending on transport.

  The modern residential districts are generally located in the outskirts of the city, within at least 30 minutes commuting by public transport. This makes the demand on this service higher, causing additional spending on travelling to and from work.

IV.c. **Services Appraisal**

The houses in the traditional and modern neighbourhoods are different in their capacity for providing services: water, drainage etc.

Traditional:

- The house is poorly provided with internal and external services. It lacks proper sanitation, drainage, proper kitchen and bathroom. But services can be added to improve the living quality there (see V.a.1). The local sewerage system and other technical services are inefficient to serve these houses.

Modern:

- The modern house is provided with good services of modern standard. The house possesses potentials for further upgrading of services. Most neighbourhoods are provided with sewerage system and efficient network of engineering services (see III.d.3).

IV.d. **External spaces Appraisal**

The introverted form of the traditional house and the loose fit form of the modern house, exhibit different environmental and living potentials.

Traditional

The house with its enclosed inner yard provides the inhabitants with:

- Full visual privacy to the public.
- Good protection from noise intrusion.
- Adequate protection from dust intrusion.

Modern

- Externally less protected but does "set off the facade". The extroverted form of the house with its large front windows and external gardens have resulted in poor visual privacy to the public, less protection from noise and dust intrusion, but more exposure to the solar heat which is uncomfortable in summer but pleasant in winter.
- The modern houses are mainly extrovert in character and therefore, require free space around them, resulting in climatic exposure and lower density (see set of plans, Fig. 25, 26 & 28).

IV.e. Appraisal of the form

The form of the Baghdadi courtyard house and its spatial arrangement were mostly determined by technical requirements. The form of the modern house has signalled a transition to a wide scope of design and functional characteristics, compared to that of the traditional one. They include elements linked to the house and others associated with the layout.

Traditional

Enclosed compact form

- Symmetrically arranged rooms and spaces around an open space (courtyard).
- Internal open space.
- Uniformity of facade.
- Unspecified functions of the main rooms and spaces.
- The external profile of the house demonstrates, a plain frontal wall at the ground floor, except for the front door, and a set of overhanged windows on the upper floors. These are externally projected to the alleyway to extend the area of upper floors.
- Internal open space.
- The interior is characterised by richness of detailing and elaborate decorations.

Modern

- Adequate open spaces but lack of overhangs.
- The rooms are large, sufficient in number and functionally designated, i.e., they are pre-allocated, as family room (Hall), dining room, reception room, bedrooms, study, etc.
- The house comprises proper ancillary rooms; kitchen, store room, bathroom (western or Turkish steam bath room) and technical service such as, a system of hot water (boiler), water reserve tank, a flushing toilet, a drainage, rain water gutters and pipes connected to the public sewerage system.
- The transition from the external to the internal space is through a front garden and a portico leading to the front door way either in the middle or to one side of the front elevation.
- A variety of facades with lack of motifs.
- Loose extroverted form.
- External open spaces.

IV.f. Urban Structure Appraisal

The mass of introvert houses fitted along irregular narrow alleyways in the traditional neighbourhoods, have given the area a close texture. The modern neighbourhoods are characterised by loose and sprawling layouts. The modern extroverted houses are distributed over regular shaped building plots along geometrically well planned aligned streets. Each of these two patterns has its own peculiarities:

Traditional

Advantages:

- Efficient in land use.

  The courtyard houses in the traditional neighbourhoods form a mass of contiguous buildings, usually built on small plots along narrow alleyways. The layouts of the neighbourhoods are compact and developed organically, they are dense and efficient in land use.
- Provides pedestrians with shading in summer but lack of sunlight in winter. Groups of houses, densely built along the narrow alleyways, shade each other, cast shadow over the external profile of the buildings and create a desirable environment during the hot days. Thus, the pedestrians walking the streets are protected from the harsh summer sun. But too narrow alleyways lack sunlight in winter (see figs. No. 11 & 17).

Shortcoming:

- Poor vehicle access.

  Generally, the alleyways of the traditional parts of the city, where the courtyard houses are located, are not wide enough for vehicle traffic. They provide no access for emergency services, public or private transport (see II.d).

- Limited expansion of the built space.
  The spatial arrangement and the compact form of the house do not allow for further expansion except into the courtyard which is the only open space, or over the narrow streets in a form of cantilevered balconies "Shanasheel". Therefore, design change is not possible (refer to II.a).
- High density of buildings does not allow for change without destruction.
  Any development cannot be achieved without demolishing parts of the houses and damaging their quality, due to the high density of mass of houses and lack of space potentials.

Modern

Advantages:

- Efficient vehicle movement.
  Well planned streets and traffic feeder ways provide easy vehicular access from and to residential areas, facilitating amenities and giving access for public transport, private cars, and emergency services such as fire brigade, police and ambulance.

- Useful expansive room.

  The modern residential areas incorporate wide streets, extended open spaces and to some extent green areas. The houses on the other hand comprise sufficient unbuilt potential for future development.

- Low density, loose fit form, leaves land for limited future change.

  The arrangement of the modern layout makes future development attainable without destroying or causing physical damage to the house. Further expansion is possible (see III.c).

- Good planning.

  The recent modern residential districts are planned with houses, public buildings and local amenities pre-allocated in the plan of the area (see III.c). They are provided with fairly developed infrastructure.

- Unlike the traditional houses, the modern ones are not homogeneous in terms of conventional three-dimensional architectural concept i.e. There is free choice in terms of size, relation of the house to the plot, height and number of floors.

Disadvantages:

- No shading but good sunlight in winter.

  With exception to the trees planted along some modern streets, which are usually wide, the layout of the modern residential areas in general is not providing the required shading. For the lack of overhangs and balconies along the streets, the external elevations of the modern house do not provide shading to protect the pedestrians from sun and rain but admits good sunlight in winter.

- Low density in the modern residential districts has resulted in environmental problems i.e. over heating in summer.
- The modern neighbourhoods represent a class division among the inhabitants. There are high standard areas for well to do families, average standard for the middle class families and lower standard for the low income families. This is reflected on the standard of living conditions and services in these neighbourhoods.

PART: V. PROPOSALS FOR THE FUTURE

V.a. New Housing

In the design of the house as an integrated part of the built environment, the social, cultural issues have to be given a prime consideration. This includes the size of family and their space requirements in relation to climatic and social circumstances, for example, the efficiency of the roof terrace as a summer sleeping space with its relation to the size and structure of family. The garden, where the family spend their summer evenings, has to be considered in terms of social and climatic aspects, including the required extent of visual privacy to the public.

In order to form a comprehensive image of the past and deal objectively with the present and future development, it is far more realistic to design and build houses suiting the current circumstances and responding to the present demands. Therefore, the following guidance are suggested:

V.a.1 Guidance for Future Designs and Construction

- Compactness

  It is suggested that houses of compact forms of two identical floor plans are more appropriate to the climate of Baghdad for they reduce the surface area exposed to the sun (see fig. 32).

- Proportions

  Height to width or length ratio has to be considered. For better environmental performance, the height of the house has to be greater than each of the other dimensions, as in the arrangement of the traditional house.

- Small plots

  Due to the increase of population, there will be a tendency towards smaller size. For example, plot sizes within 200-300m^2.

- Houses for nuclear families

  Due to the tendency for nuclear families within the Iraqi society, the houses are to be designed to fit these families.

- Land use

  Better layout is required to reduce circulation area for economical reasons.

- Open space type

  Regarding open space, an adaption of courtyard will give a genuine private, protected space from visual intrusion. (see III. c).

- Local materials, wherever possible are to be used in construction to minimise import cost in hard currancy.
- It is suggested that an adaption of patio form or court garden offers more flexible orientation e.g. inward looking widows, wherever appropriate. It provides potential for plant shading, promotes cross ventilation and thus, helps to mitigate the micro climate.
- In case of employing some traditional features in today's buildings, great care must be taken to retain their genuine characteristics, function and materials, in order to allow them to function properly.

V.a.2 Guidance on Thermal Performance

The most serious issue, which deserves exceptional concern in the design of the modern Iraqi house, is overheating, for the extremely hot dry season extends over a long period (see I.b.). The internal climate of the buildings is largely affected by infiltrated external heat. These environmental aspects require careful consideration during the design through the following elements:

Glazing and Shading

In order to eliminate the impact of overheating in summer, the ingress of solar radiation to the building has to be controlled. The total glazed area is to be limited to about 10 per cent of the floor area, without scarifying the quality of light and visual condition (fig. 33). This rule can be modified by various means:

A. The heat of summer sunlight can be reduced to 22 per cent by using solar control glass, whereas the normal glass allows 80 per cent of the external heat to infiltrate to the building (R. Alives & C.Milligan, 1978). Windows using such glasses can be increased in area pro rata to their efficiency. They are very expensive to import.

B. Shading over windows is an effective, protective means, it helps to reduce the impact of solar radiation, particularly at mid-day in summer when the sun is in a vertical position. Shading may be created by overhangs, balconies, Shanasheel extended eaves or by employing special devices. Some could be in the form of outward-opened or rolled up wooden shutters which can be closed, while the windows are inward-opened to exclude sun radiation and allow ventilation at the same time. The amount of the required ventilation can be controlled by such sun-shading devices. It is also possible to hang over windows, wooden screens which climatically function as the lattice screens in the traditional house. Modern aluminium adjustable shutters are also effective, though more costly. They provide shading and allow some visual access to the inhabitants. Exterior louvers can be used for the same purpose. In Iraq, where date-palms grow numerously, the designers have to consider the use of sticks from the palm trees to make local, economic shutters and shading devices.

Where these means are employed effectively there need be no restriction on window area.

Insulation

Solar heat penetrating into the building can be controlled by promoting the heat resisting factor of the roofs, ceilings and walls. Increasing use of various materials such as styro-foam or glass-fibre or mineral wool affect heat decrement and remarkably increase the time lag of the heat transmittance through the structure, as revealed in the calculations (see page 172). Therefore using insulation in the roofs, floors and external walls is recommended in the Iraqi house, where the cost of cooling and heating is quite high. (see III. c).

Putting draft strips across windows and external doors will give a better protection against the external heat infiltration and dust.In this respect we suggest extending the local production of insulating materials like polystyrene and foam concrete slabs which are already made in Iraq. Other potentials have to be explored, these may include making wood wool slabs of palm-tree fibre, which require a proper termite proof treatment to make them usable. Plentiful petrochemical products can also be exploited.

Proper Orientation

To achieve good results, shading has to be coupled with proper orientation of the building like placing most windows on either the north or south facing walls, while keeping the east or west facing walls plain and relatively short (fig.33). Nevertheless, the designer has to take into account the wind direction to allow for a proper cross-ventilation system where possible.

Cross Ventilation

In order to benefit from the prevailing winds the daily and seasonal changes of speed and direction of the air movement have to be considered.The general micro climatic characteristics of the location has to be considered too.
Cross ventilation depends on the amount of the air moving through the structure, enforced by the difference in air

pressure between windward and leeward sides i.e. from a high pressure to a low pressure one. If the opening of the outlet is larger than the inlet one, the movement of air current will accelerate, unless the process is interrupted by objects or interior partitioning, particularly, by those placed close to the inlet window. These may divert the air direction and slow down its movement. The size and orientation of the inlet-outlet openings, which determine their capacity, depend on the direction of the prevailing winds and its efficient use largely depends on skill of the designer.

Horizontal or cross ventilation is desirable, only after sunset when the cool outdoor air is welcome to cool down the indoor air and reduce the temperature of internal surfaces of the buildings, while the hot ambient air has to be excluded from the interior of the house during the day in summer by keeping buildings air tight during the day.

Landscape (trees and vegetations)

In summer, it is vital to restrain the stress of sunlight glare; reflected by the terrain and other surrounding objects in order to maintain an acceptable bioclimate. So, the design of houses in Baghdad and other Iraqi cities has to enhance protective measures against intensive solar radiation in summer, e.g. plants and vegetation are effective means. They provide the best available immunity against glare, dust and erosion, help to hinder the stress of direct heat radiation and balance the thermal interaction between the house and its surrounding. Thus, a designer should take advantage of the existing plants and encourage new ones, where possible. In favour of a better technologically oriented design, the value of vegetation as a means for controlling and moderating the climate of the site has been frequently overlooked. The planting of trees and shrubs is very cheap compared to the use of technology to control micro climate. Highly reflective, paving and surfacing in the compound urban environment, escalate summer temperature even in the regions of temperate climate. On the other hand grass scales down the temperature around buildings during the day. A research work by Knochenhaver shows that:

> "differences in air temperature of as much as 7°C can occur between a grassed area and a concrete area near a building even over a short distance, and that differences ranging between 10°C and 14°C may vary with vegetation and other materials."
>
> (Cited in S. Lesiuk, 1983) p.221

Planted and shaded ground remains cool overnight so, the air above this surface gets cooler than that of the internal spaces. It is possible to take advantage of this to improve the micro-climate of a building, making use of appropriate cross ventilation. The warm air may escape through upper windows or similar outlets, drawing into the building the external cooler air which is trapped under the trees in the garden. The effect of this process largely depends on the size and content of the garden and on the efficiency of the cross ventilation system.

The above should greatly reduce the cooling and heating load enabling only simple environmental control system to be used e.g. fan assistance for air flow in summer and simple heating in winter.

It might be also suggested that specific building norms are to be laid down to be followed in the projects of major urban development, namely the designs of residential areas and housing schemes.

Regulations, requiring greater insulation or smaller windows, are very difficult to enforce and only affect new buildings which represent a small number of the total housing stock. But implementing various incentive means like providing grants, free technical advice, are more practical for the existing houses. It is known that, an increase in the cost of electricity will produce a demand for more efficient use of energy. As the cost of electricity in Iraq has sharply increased and the supply is unreliable, we believe people will be encouraged to look for effective means of energy saving instead of or in addition to regulations.

Climatic issues and maintaining the environmental equilibrium have to be achieved in order to make the residential space comfortable for human habitation. However, The study of the traditional building provides a fertile source of solutions to the micro-climatic problems.

V.a.3. Guidance on Urban Structure

The random horizontal expansion of Baghdad and other cities has to be restrained as the physical capacity of the land and transport systems have reached breaking point. Therefore we suggest the following:

Restraining City

This can be assisted by various means:

1 - Decentralisation of work opportunities to sub-centres, this has worked well in most modern cities.

2 - Satalite towns as a solution that has been used with mixed results (see any work on new towns).

3 - Incentives to help industrialists move to less densely populated areas or to unemployment black spots.

4 - Incentive to cause polluting industry to leave the city.

5 - Incentive to improve the efficiency of land use for domestic and business activities in the existing cities.

It is in relation to 5 that this thesis proposes a search for higher density dwelling system.

Some improvement measures are to be considered in future housing; including:

1. Roads - Housing areas should be designed with major through roads but only the minimum size of road for access to individual houses.
2. Parking is not essential in every cartilage but grouped provision is necessary.
3. A footpath system is necessary, this must take the priority for the shortest route particularly to schools and shopping. All parts must be shaded by houses or planting.
4. The adapted courtyard house (see FIG.34) enables higher densities to be achieved. This is essential to stop the uncontrolled spread of cities.
5. Planting the strips of public space along streets to give shading.
6. Improving the landscape by replanting the squares "which

have been paved" to reduce the exposed solid surfaces. Increasing greening in public parks, school's gardens, reserved open spaces and creating green strips around residential areas, children's playgrounds and sport fields. This may include the unbuilt sites.

7. Extending the use of water gardens in public spaces, increasing fountains, which have been neglected in the new housing projects, since water is adequately available in the country.
8. Maintaining the existing orchards in the peripheral areas and restricting buildings on such sites.
9. Restraining building close to the rivers' banks to preserve the existing date-palms, orchards and greening along the rivers' banks.
10. High density.

    The future urban structure has to be denser than the modern one and usually less dense than the traditional, aiming to reduce the exposure to the sun while admitting good sunlight in winter (fig. 34).

Density and the "Modern" Courtyard House

The present "modern" house has developed from foreign suburban prototypes. Iraq and Baghdad in particular require anew urban house capable of providing modern conveniences but compact in form and economical in land use.

It is suggested that adaption of the courtyard house would fulfil this requirement. These houses would need to have more sunlight than the traditional and slightly more space to overcome the wasteful division of the old house into:

Summer / winter and public / private apartments.

(See fig. No.34 for possible adapted courtyard house).

V.b Adaption of the Existing Housing Stock

Through the study of the traditional and modern types of Iraqi houses, the following conclusions can be drawn.

V.b.1 Adaption of the Traditional House

The Baghdadi traditional house is the indigenous type. Due to the lack of maintenance, many years of neglect and multi-tenancy, most of these houses have suffered a great deal of physical deterioration. Many of the inhabitants were evicted, eventually the houses were demolished and their neighbourhoods were transferred to commercial areas.

For their longevity, stylistic richness and architectural value, the remaining colonnaded courtyard houses are worthy to be preserved, improved and re-inhabited as they have the potential for development and functional change of spaces. These traditional houses are large, 300m is an average size. This means that they are only suitable for relatively rich owners who can afford to use their size, quality of space and decoration.

Such people are also capable of the relatively expensive upkeep of the building. It is therefore necessary to provide a totally attractive environment for such people. To make full use of this segment of the housing stock, we suggest the following:

1. Better services for the house
   - To provide the house with adequate sanitation, improve electric services raising the quality of natural light and ventilation, as far as possible within the existing aesthetic.
   - Supplying the kitchen, bathroom and toilet with cold/hot water and updated fittings.
   - Installing a reserve water tank (cistern) on the roof to overcome the erratic water supply problem. Such a task will also benefit from the solar heat in summer to provide warm water for showering during the hot months.

2. Upgrading the physical fabric. To make the house more comfortable and overcome its technical shortcomings, some improvement has to be done; including:
   - Applying a damp proofing course to the basement and ground floor to make them more functional as the rising dampness made most of the basements uninhabitable.

- Insulating the walls, ceiling and floor of the upper rooms to extend the time lag of their heat transmittance and conserve the internal heat in winter (see page 171).
- Fitting the doors and windows of the upper rooms to exclude the draft in winter and protect them against heat loss and dust.
- Applying termite-proof course, dry and wet rot protection of the wooden structure.
- Maintaining and rehabilitating the existing traditional ventilation and cooling system, benefiting from the experience of the past and today's potentials i.e. increasing the capacity of air channelling as it was practised in the sophisticated badgeers (see II.b.1).

3. Any spaces that become available or those surplus lands, resulted from the demolition to be used for;
   - Children's play ground
   - Greening
   - Car Parking
   - Sport fields etc.

4. To provide better services and technical equipment to the area. In order to raise the standard of neighbourhood to

the required level, it is important to install progressive technical infrastructure including, extending the sewerage system, telephone network, public services and amenities.

5. The demand for controlled circulation of the vehicular traffic is inevitable within the existing urban pattern, provided the layout of the traditional area will maintain its original density, wherever possible. As these houses are now existing in only small groups, organically scattered among the alleyways, vehicle access can be only to the periphery in normal circumstances. The new peripheral roads will serve the buildings well enough so that the alleyways and the historic narrow streets can be pedestrianised.

6. Some of the best examples of the traditional houses are to be restored to the original conditions and kept as museum pieces to be used for historical and development research. The historic and cultural heritage of many centuries have to be well presented through a good urban conservation and building restoration. This requires proper surveying to identify the architectural and physical conditions of the houses. In this respect we suggest the documentation of this traditional

architectural creative work, craftsmanship and the existing patterns of such works in many of the buildings which still survive in Baghdad today.

V.b.2 Adaption of the Modern House

Most of the existing modern houses are contracted with design shortcomings including too large glazed areas, unconsidered orientation, lack of shading, inadequate insulation for heat and sound. These houses require modification to improve their quality and overcome the problems, associated with human discomfort. Therefore, the following measures are suggested:

A. **To reduce cooling load by:**

- Shading of windows by overhangs, balconies, Shanasheel, trees, trellis and various kinds of shutters in order to exclude the sun glare and heat penetration into the interior.
- Using heat reflective glass.
- Reduction of window size.
- Improving heat time lag, particularly on roofs and possibly on walls to reduce the running cost of the cooling and heating systems.
- Improving external doors and windows by means of draught stripping.

- Using reflective light colours on external surfaces, e.g., white tiles on the roofs.
- Cross ventilation.

B. **To control the impact of glare by:**

- Shading of windows.
- Reducing the external light absorbent surfaces by means of reflective colours, texture and planting.

C. **Use of Garden**

Creation of shade for private spaces by means of landscape. Planting trees, shrubs and vines will help to ameliorate the micro climate, absorb noise pollution, dust and glare and create a desirable environment within the area. hanging plants are recommended on external walls, around windows and external doors.

D. **Improving the Form**

Improvements to the building's form to help protection of outside spaces or improve internal layout is highly recommended. These cannot be considered generally but will have to be solved for each individual building.

1. A research programme on how to increase the housing density in new built housing areas, without

destroying the environment, particularly if those houses are close to the inner city. Houses of compact form can be erected on the unbuilt parts of the site.

2. A research to discover suitable plants for shading,temperature reduction and dust filtration. It may include offering advice on maintenance of planting and choosing the appropriate plants for the local climate, such as those which provide shade in summer but admit sunlight in winter.

Thermal Performance of Walls and Roofs

The following calculations show that, in the climatic conditions of Iraq, heat penetration into the buildings can be manipulated by implementing different alternative structural technique and insulating materials.

We believe these calculations will be useful for the adaption of the existing housing stock and for the designs of future housing.

Value of Thermal Transmittance

'in conjunction with thermal capacity'

U = Coefficient of heat flow or thermal transmittance
Rate of heat flow W/m^2 per °C temp.diff.

$\int$ = decrement factor ($\int$=a/b)
Ratio of internal heat flux/external heat flux (the damping factor is equivalent ratio for temperature range).

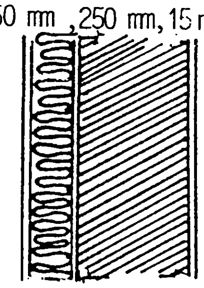
Ø= Time lag

For 24h cyclical diagram, see page 176

In the climatic conditions of Iraq, calculation shows

A Wall

1 215mm brick + 15mm plaster



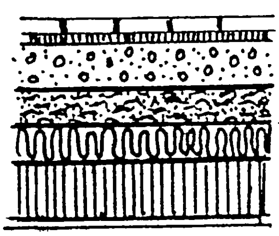
U=1.96 W/m^2 °C
$\int$=0.43
Ø=4.5 hours

2 Same structural material plus 50mm insulation and render (polystyrene) gave the following result;

U=0.506 W/m^2 °C
$\int$=0.174
Ø=10.3 hours

B Roof

With the same insulation material



18mm tile
10mm asphalt
75mm screed
50mm earth
50mm insulation
150mm concrete slab
15mm plaster

U=0.48 W/m^2 °C
$\int$=0.125
Ø=10.4 hours

Changing insulation from polystyrene to cork board gives;

U=0.54 W/m^2 °C
$\int$=0.12
Ø=9.9 to 10.0 hours — not a very significant difference

Comparative Decrement Factors and Time Lags for a selection of insulating and other materials.

150m Thick	ʃ	∅
Polystyrene	0.72	3.5
Mineral Quilt	0.85	1.73
Rigid Mineral Wool (Slab or Fibre Glass)	0.57	6.0
Fibre Board	0.47	7.9
Polyurethane	0.66	4.4
Blown Cellulose	0.67	4.2
Cellular Glass-Rigid (e.g 'Foamglass)	0.60	5.4
Woodwool Slab	0.47	8.1
Cork	0.31	12.2
Light Concrete	0.56	6.1
Timber (softwood)	0.46	8.2
Brick - Medium	0.62	5.1
Dense Concrete	0.68	4.1

Traditional House Wall and Roof

The Brick walls of the lower floors and the basement of the traditional house is 400mm, medium density brick gives;

$U=1.15\ W/m^2\ ^\circ C$
$\int=0.275$
<u>$\emptyset=13.6$ hours</u>

That is the case of the lower floors and basement of the traditional house.

Roof in the traditional house (mud reeds)
Overall 360mm thick
mud 300mm thick

$U=0.65\ W/m^2\,^\circ C$
$\int=0.36$
<u>$\emptyset=8.9$ hours</u>

N.B alterations to above values by changing assumptions with respect to thickness and thermal properties. (see overleaf)

Dynamic Thermal Performance of the Traditional Roof

Range of thermal properties and thickness indicating change to U-Value, decrement factor and time lag

		Density (Kg/m)	Thermal Conductivity ($W/m^2 {}^\circ C$)	Specific Heat Capacity (J/Kg°C)	Layer Thickness (m)	
Inside	Palm	900	0.13	2000	0.04	U=0.65
Middle	Mud slab	1730	0.298	1000	0.3	ʃ=1036
Outside	Sand/cement	1570	0.526	1000	0.02	O=8.9
Change 1	Palm	660	0.13	1380	0.63	U=0.6911
	Mud slab	1730	0.298	1000	0.3	ʃ=0.05
	Sand/cement	1570	0.526	1000	0.02	O=8.3
Change 2	Palm	660	0.13	1380	0.03	U=0.89
	Mud slab	1730	0.298	1000	0.2	ʃ=0.15
	Sand/cement	1570	0.526	1000	0.02	O=6.25
Change 3	Palm	660	0.13	1380	0.03	U=0.89
	Mud slab	1730	0.298	840	0.2	ʃ=0.2
	Sand/cement	1570	0.526	1000	0.02	O=5.9
Change 4	Palm	660	0.13	1380	0.03	U=1.32
	Mud slab	1730	0.65	840	0.2	ʃ=0.31
	Sand/cement	1570	0.526	1000	0.02	O=4.8

Change 1 Palm wood layers - assume thinner, lower specific heat capacity and less dense.

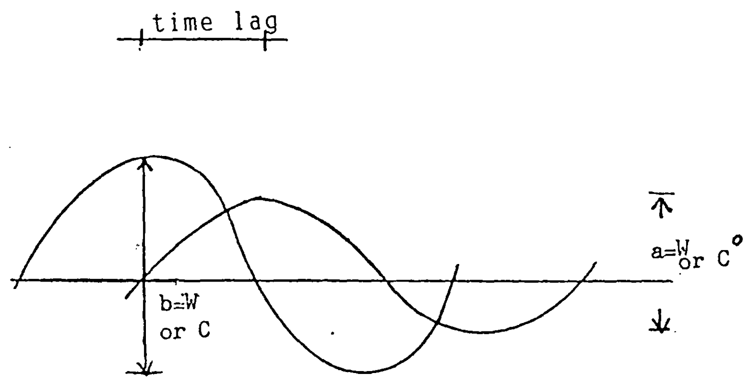
Change 2 Palm as1 but mud 100mm less thick i.e 200mm not 300mm.

Change 3 Palm as1, mud 200mm thick but lower specific heat capacity - from 1000 down to 840 J/Kg °C

Change 4 As 3, but now conductivity of mud increased to 0.65.

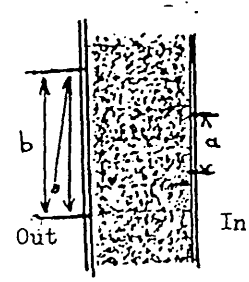
Note how decrement (ʃ) increases and time lag (Ø) drops with each change, and U-Value ($W/m^2 {}^\circ C$) increases - i.e construction less well insulated, less damping effect and shorter time for heat transfer to take place from outside to inside.

24 hour cyclical diagram



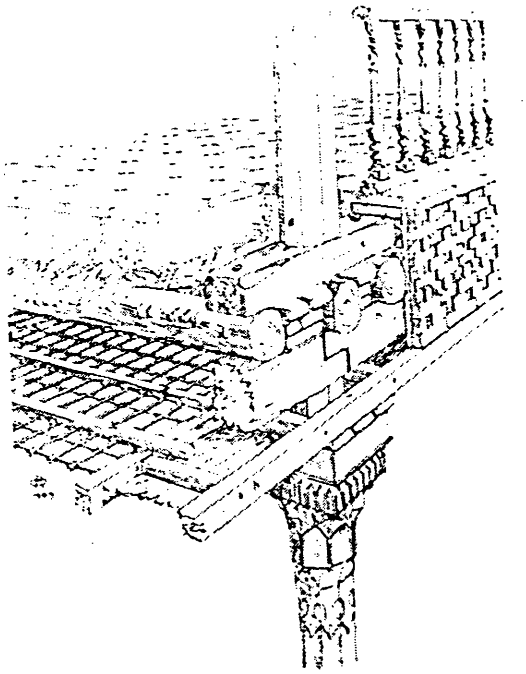
DECREMENT FACTOR: a/ b a & b in Watts

DAMPING FACTOR : a / b a & b in C°

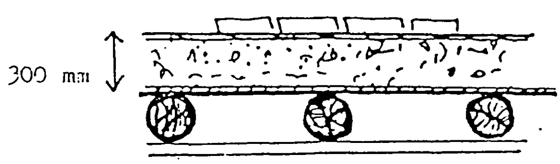


AMPLITUDE OF HEAT FLUX

Traditional roofing technique and possible adaption



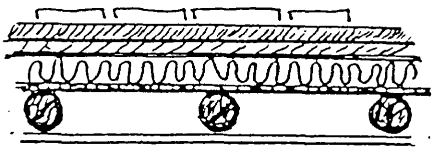
Traditional Materials



Time lag 8.9h

Modern Materials but Traditional appearance

change



Time lag 10h

The advantage is; less heat transmittance (lower U. value)and DURABILITY

Conclusion

Considering the objective set out in the preface to this thesis, it can now be reasonably stated that neither of the present "Schools" represents a definitive answer, both have pluses and minuses.

The solutions that will best serve Iraq in the future should combine the best of both systems. These are seen by the author in order of priority as being:

1. Designs for denser housing must be investigated. This will entail a recognition that when houses are built closer, together problems of visual and acoustic privacy arise. This will entail a reappraisal of the courtyard type but avoiding the claustrophobic atmosphere and poor lighting of the traditional house. Also orientation will have to be carefully controlled to obtain the desirable winter sunshine.

2. Designs for space efficient houses must be encouraged to reduce expenditure. This means that the traditional method of allowing for a high redundancy due to lack of effective environmental control systems is not realistic. This will entail a limited use of mechanical systems but the efficiency of these can be improved, see below.

3. Improvements in building technique to reduce energy requirements and reduce the reliance on imported, hard currency, technology is relatively simple to implement and increase the thermal efficiency of buildings, maintain and improve comfort.

4.The use of planting which is well developed aesthetically requires considerable, education and demonstration to enable the designers and public to understand how to design with plants for effective environmental improvement.

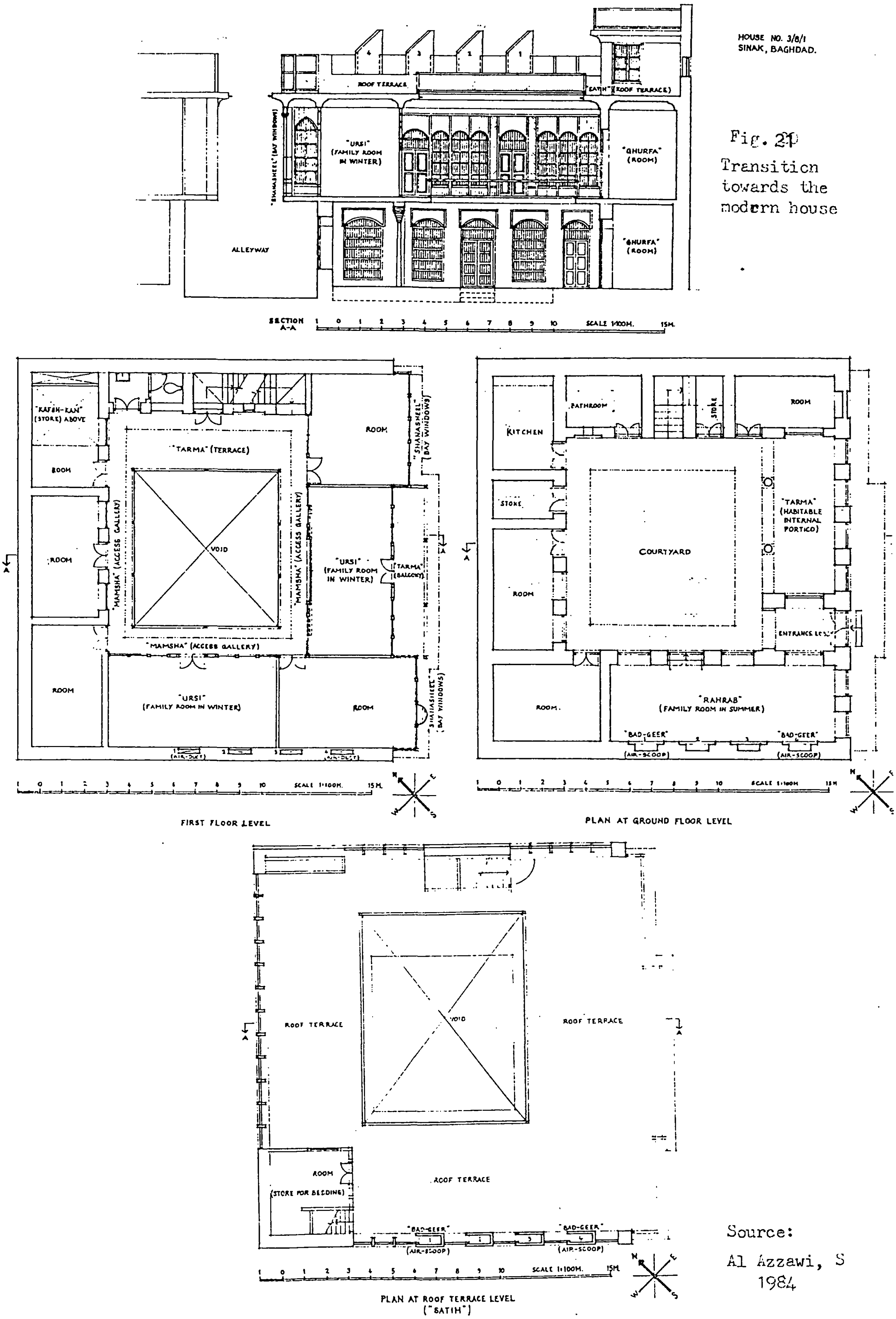
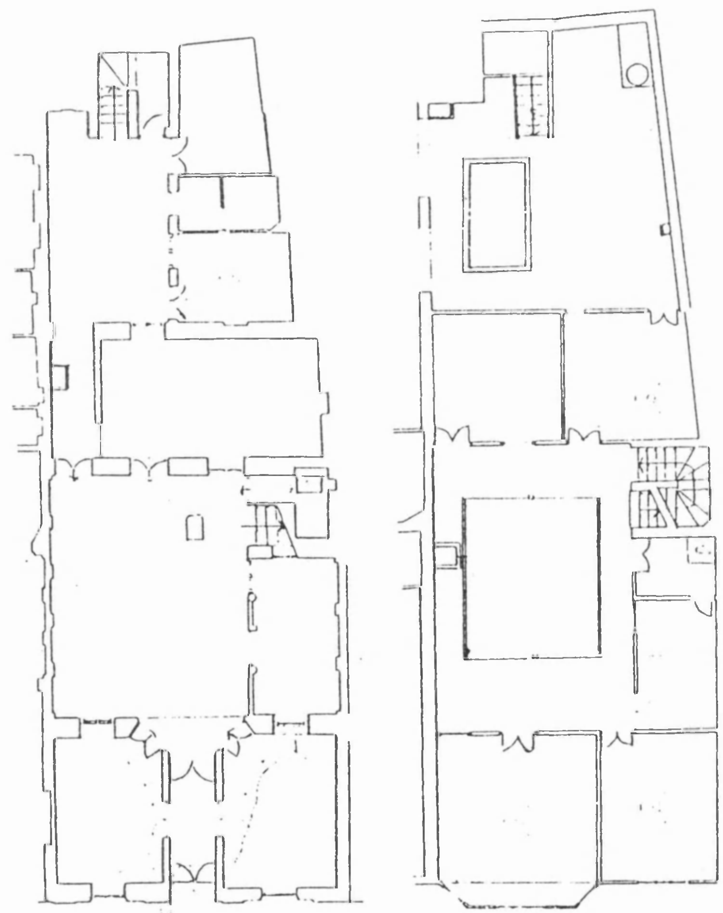


Fig. 21
Transition towards the modern house

Source:
Al Azzawi, S
1984

Fig. 22, The early modern house, form and features



GROUND AND FIRST FLOOR PLANS:
house on a long plot with primary and secondary courtyards.

Source: Warren. J.& Fethi. I. 1982

CROSS-SECTIONS

ELEVATION

LONG SECTION

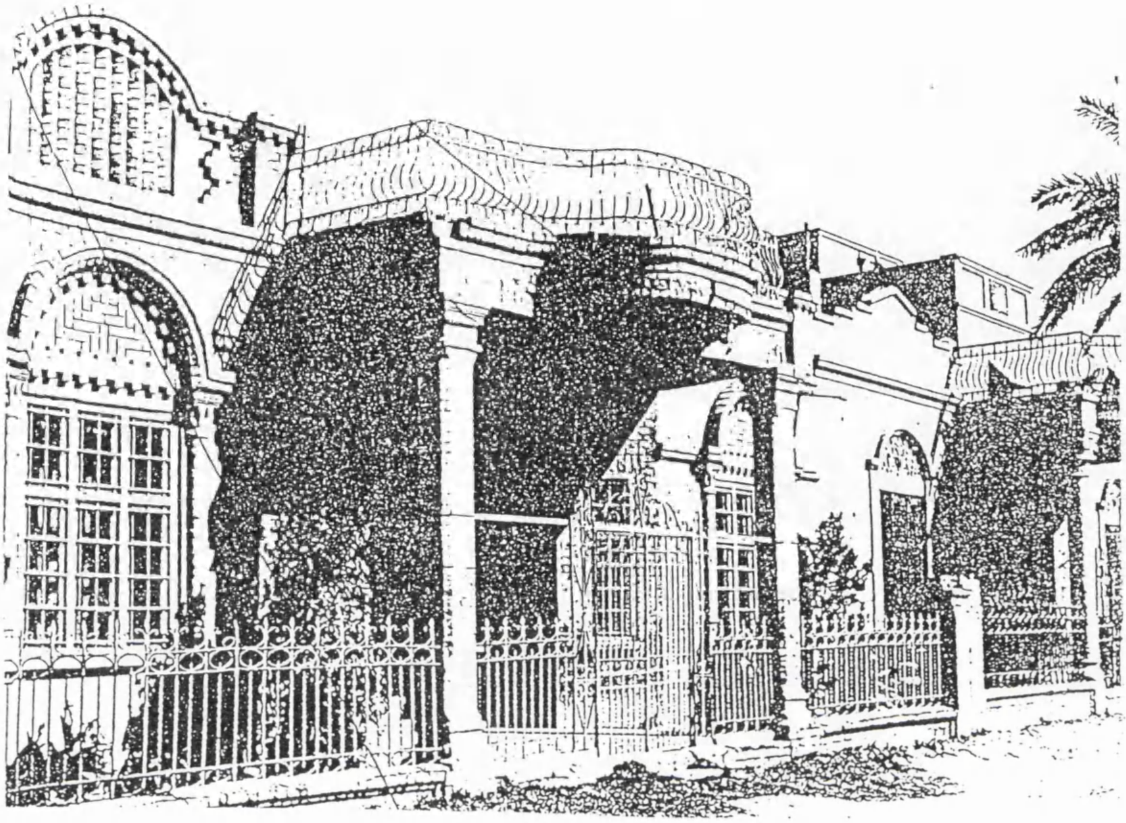
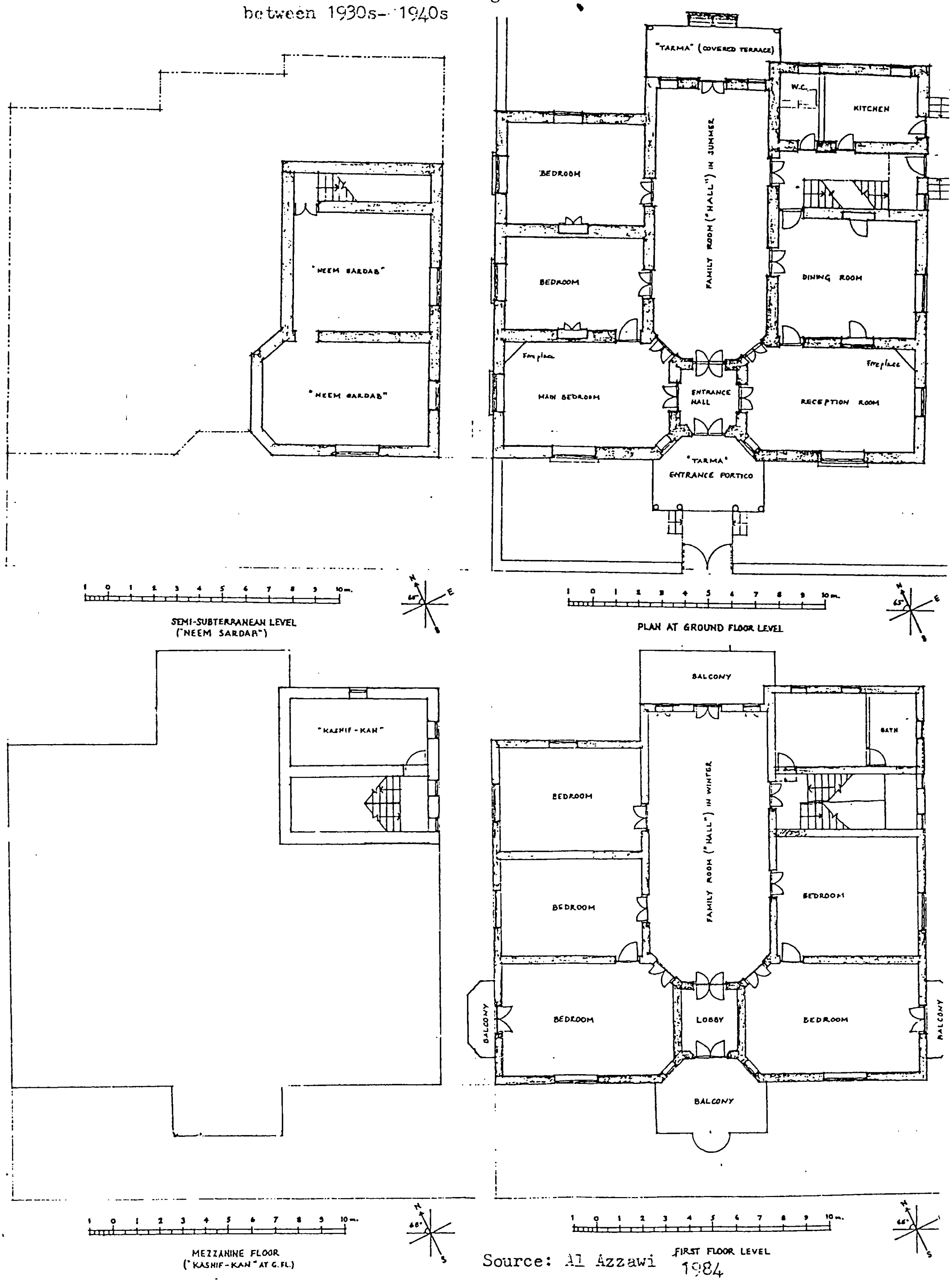


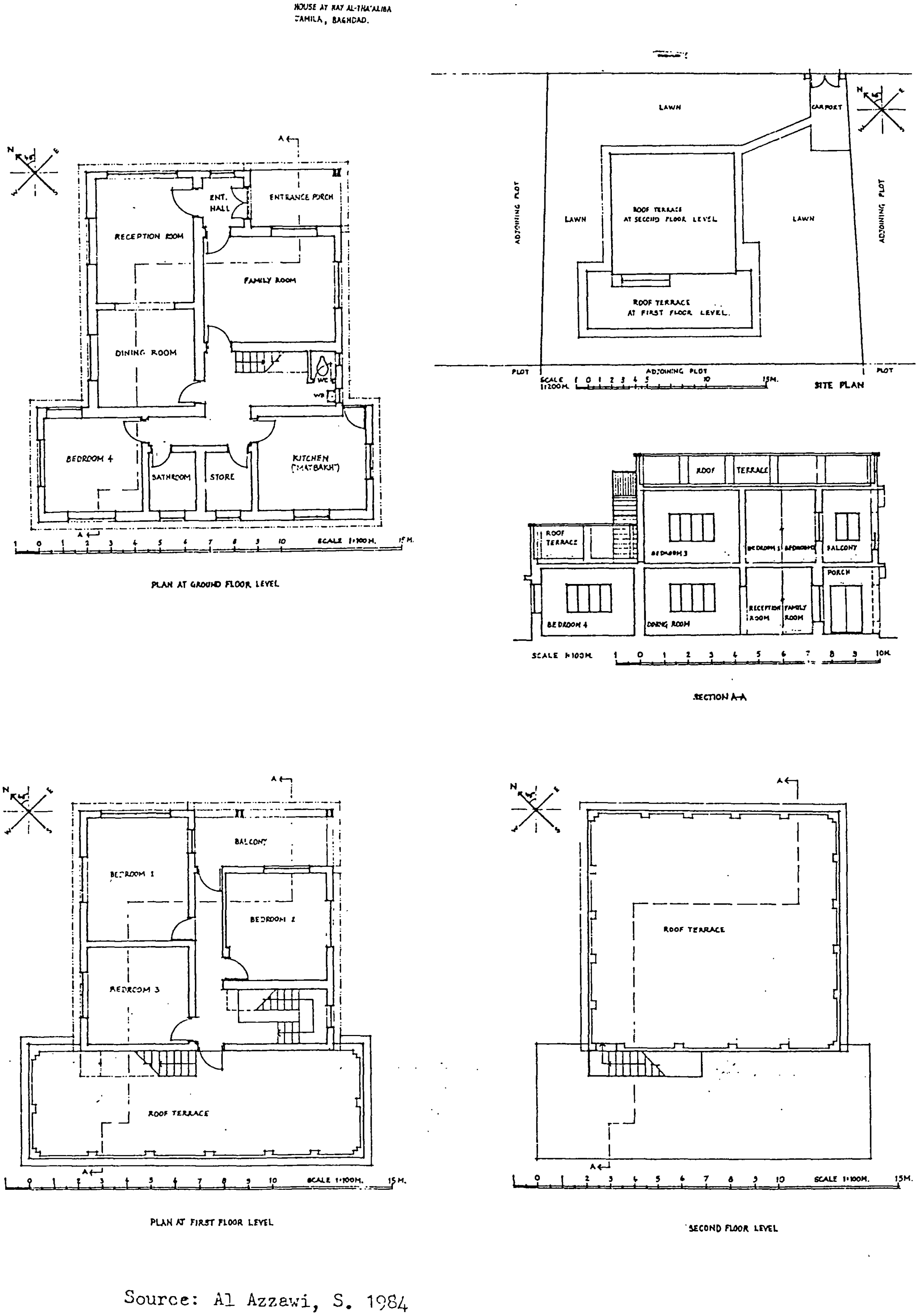
Fig. No. 23, Exterior details of an early modern house built in Baghdad between the 1930s-1940s

Fig. 24. Plan of a typical early modern house built in Baghdad between 1930s–1940s



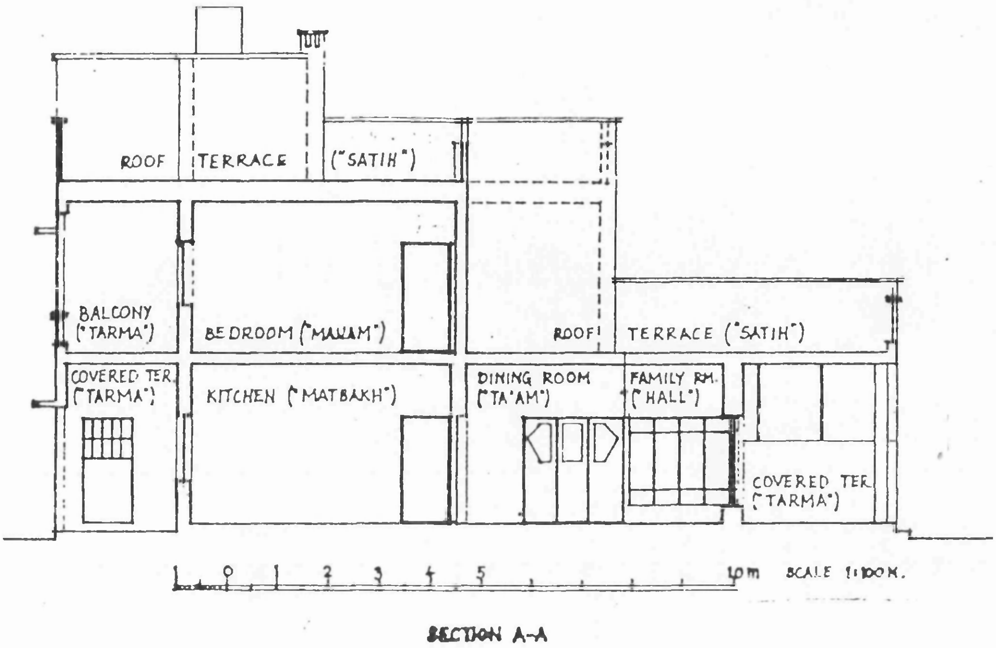
Source: Al Azzawi 1984

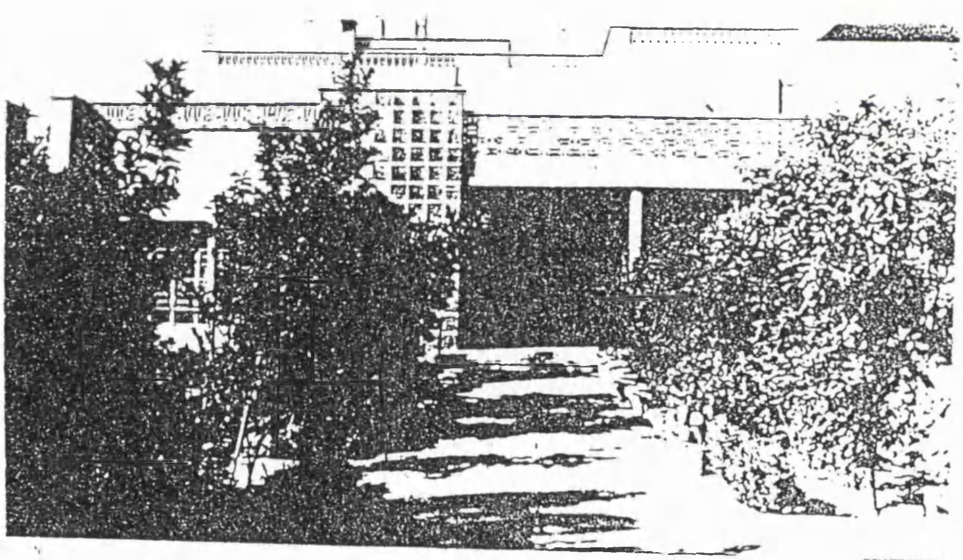
Fig. no. 25 an example of modern house of the 1960s-1970s



Source: Al Azzawi, S. 1984

Fig.26, A modern house of the 1960s

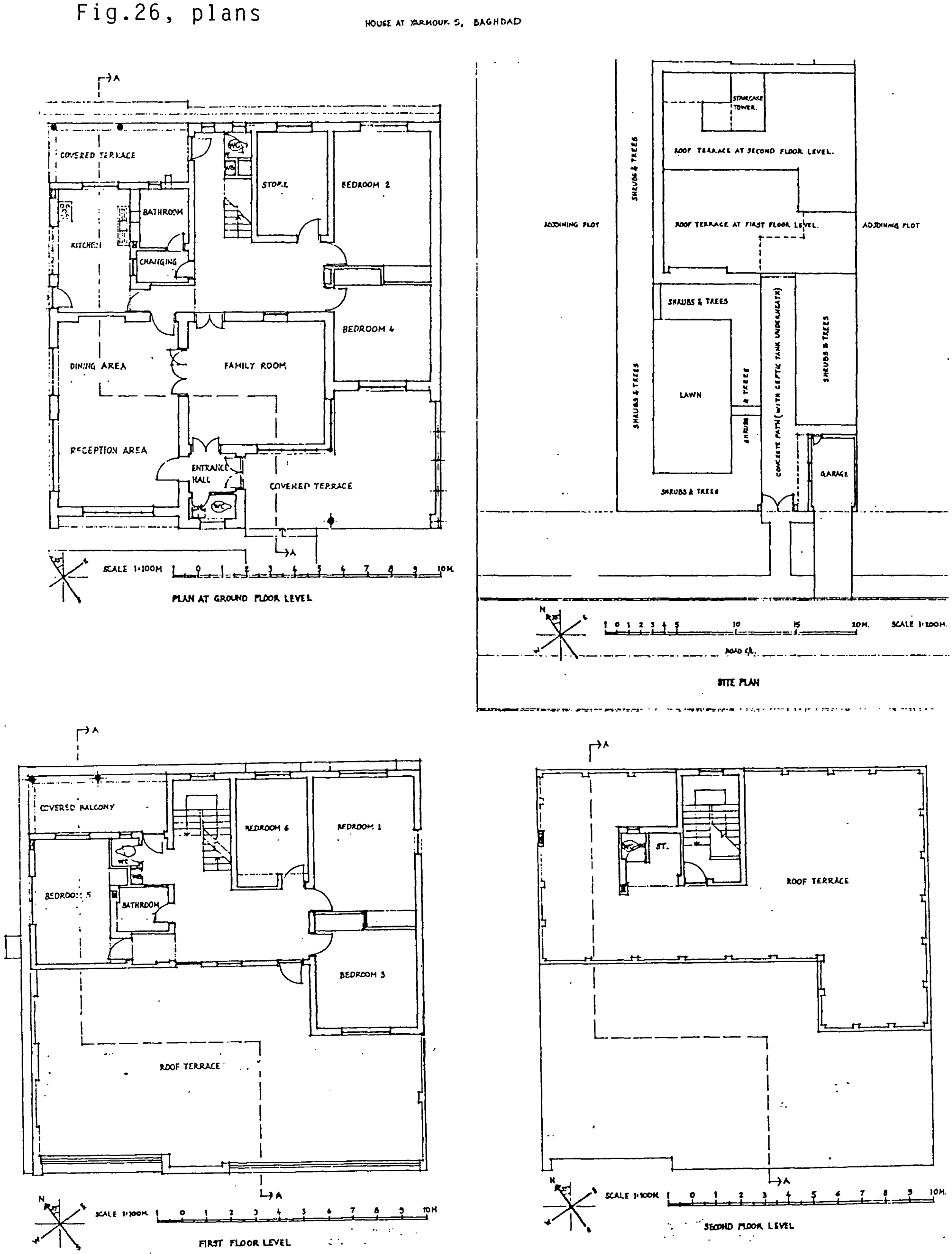




A view of the front elevation.

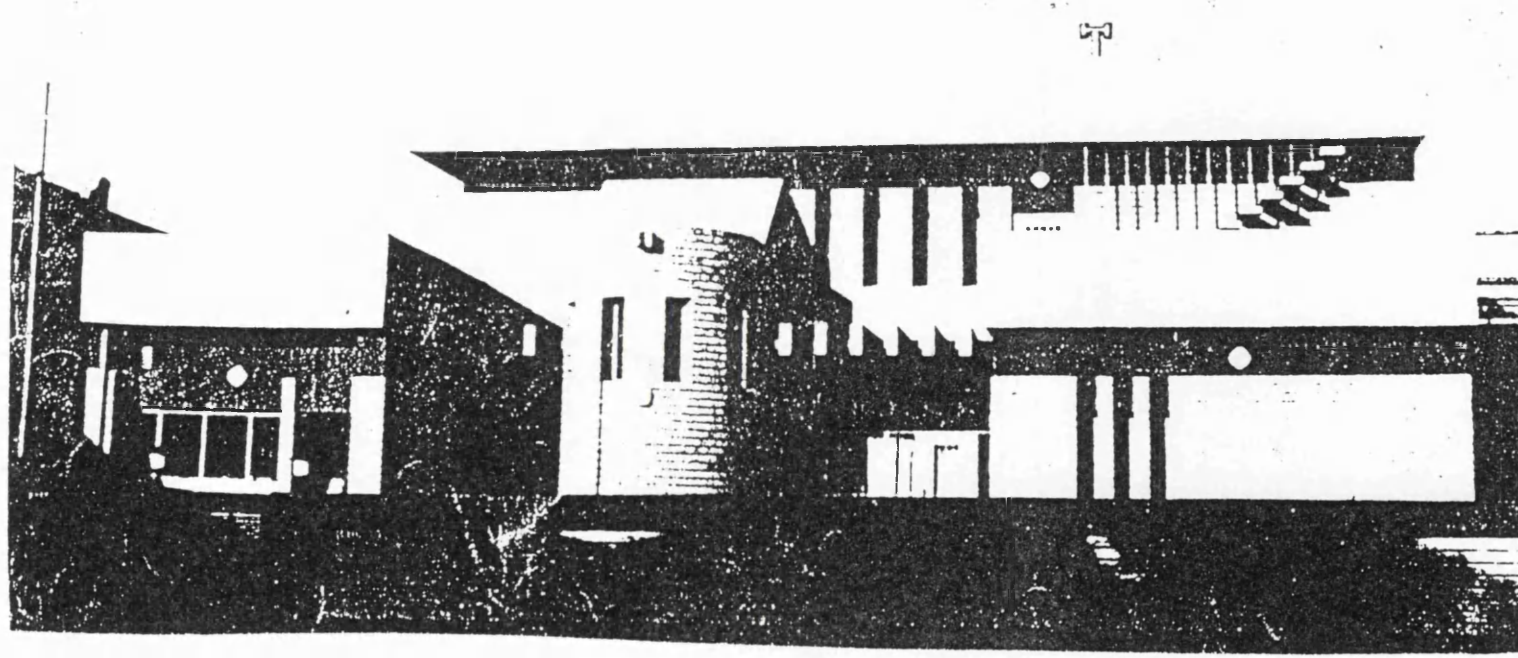
Source; Al Azzawi, 1984

Fig.26, plans



Source: Al Azzawi 1984

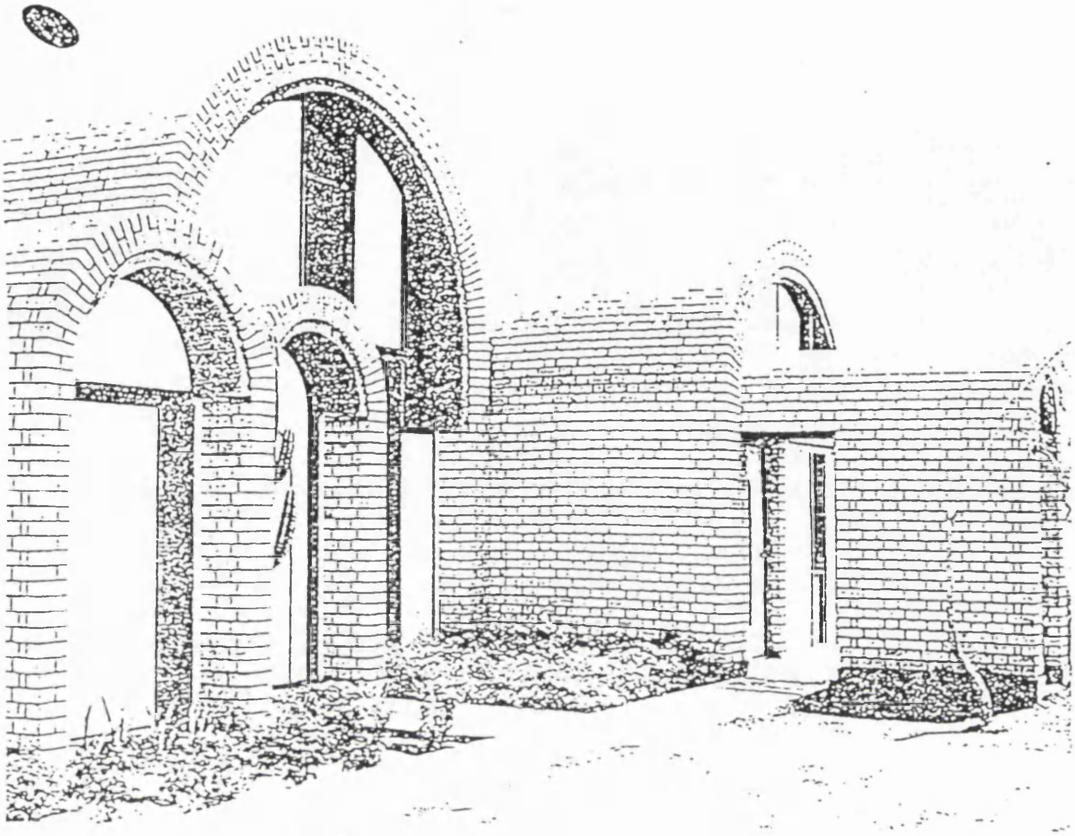
Fig. No. 27, House of recent modern style, built in Mosul. 1972

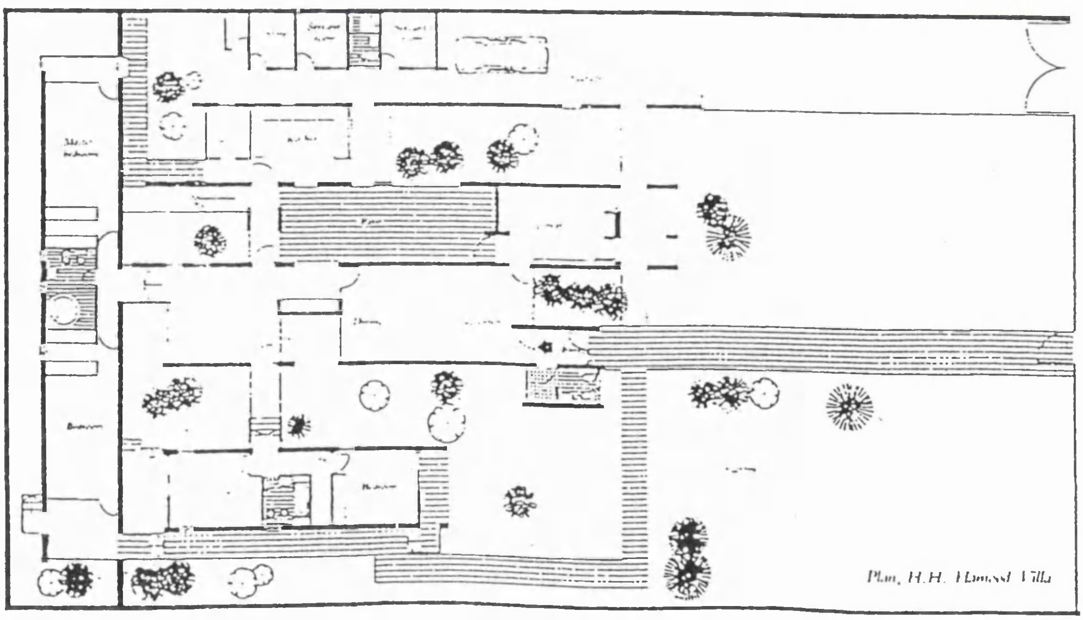


Source: Raof, L 1985

Fig. 28, Modern house inspired by tradition

built by R . Chairji, 1972





Source: Mimar No. 5 1982

Fig. No. 29, Exterior details of a currant modern house " advanced designs "
built by R. Chadirji, 1963

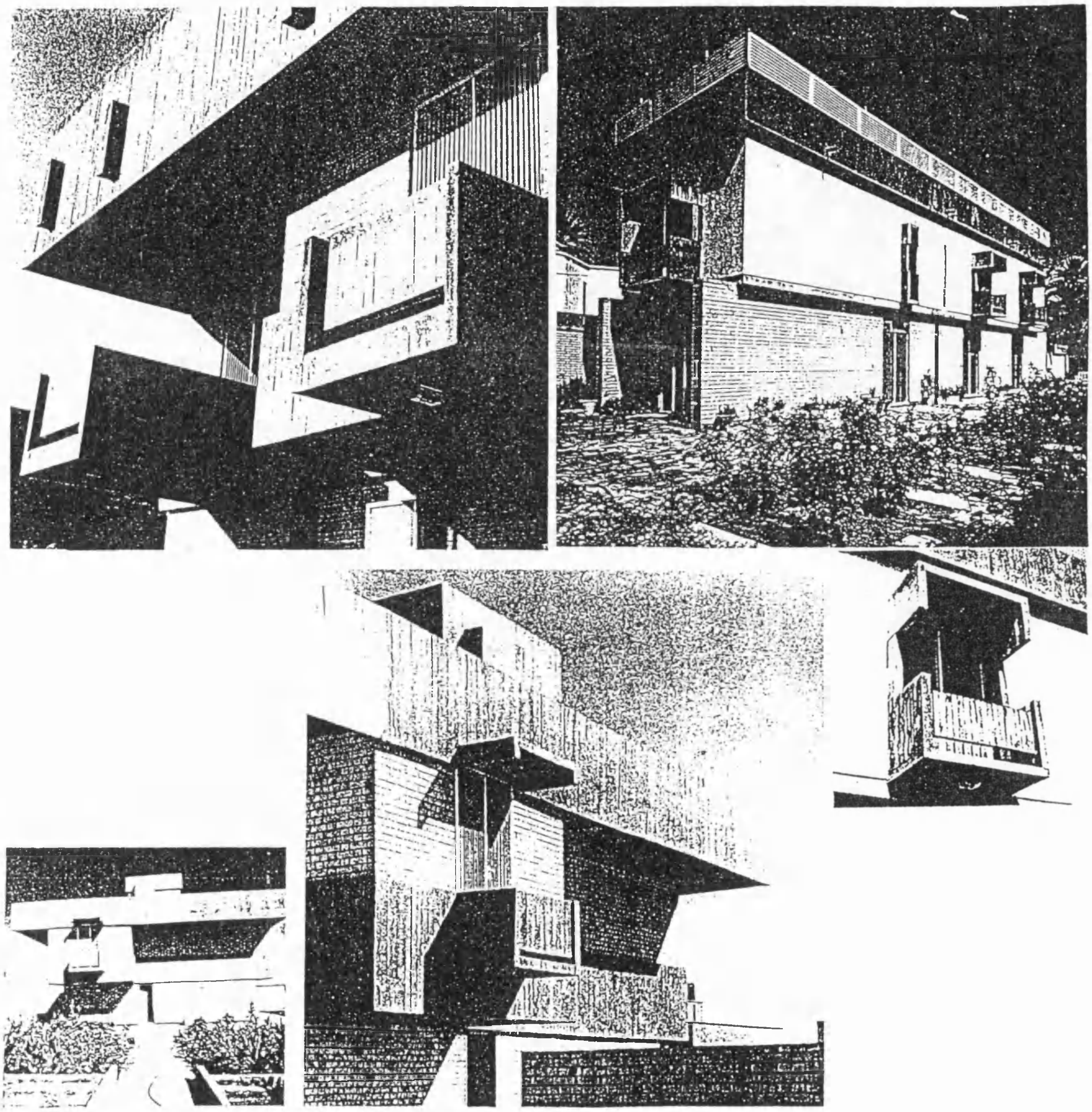
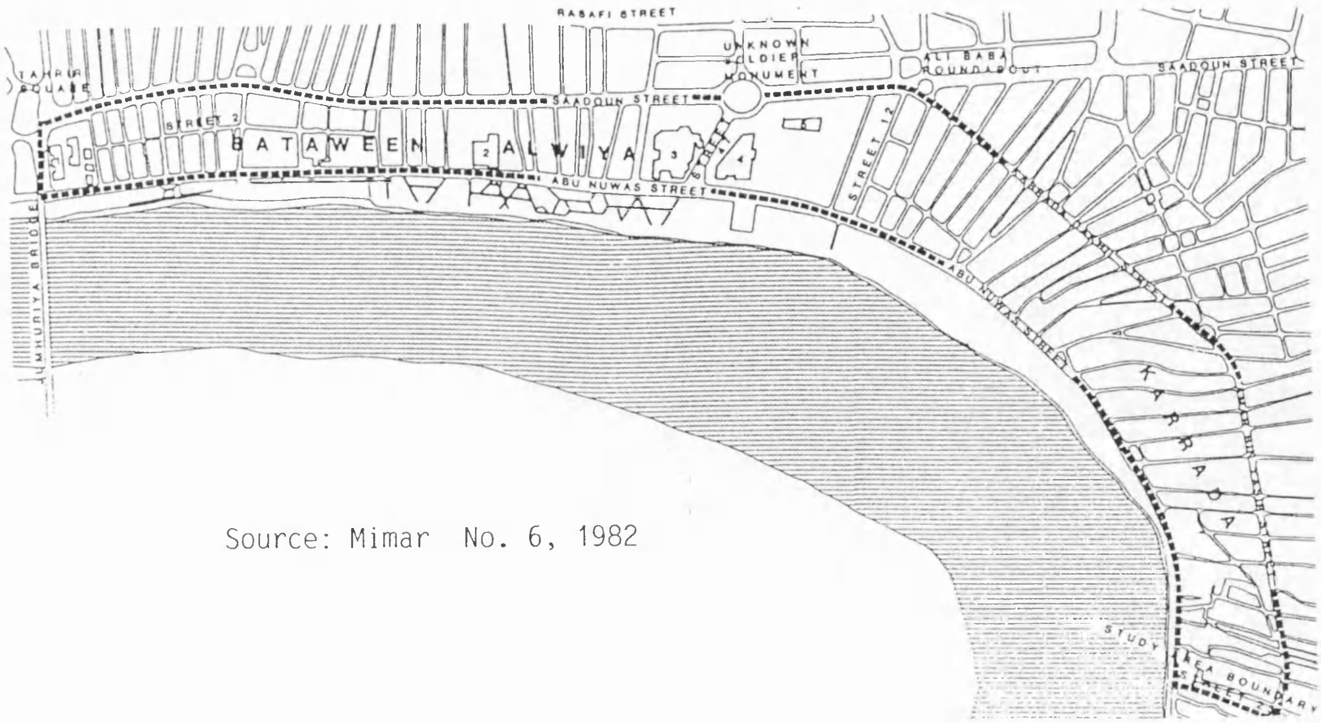
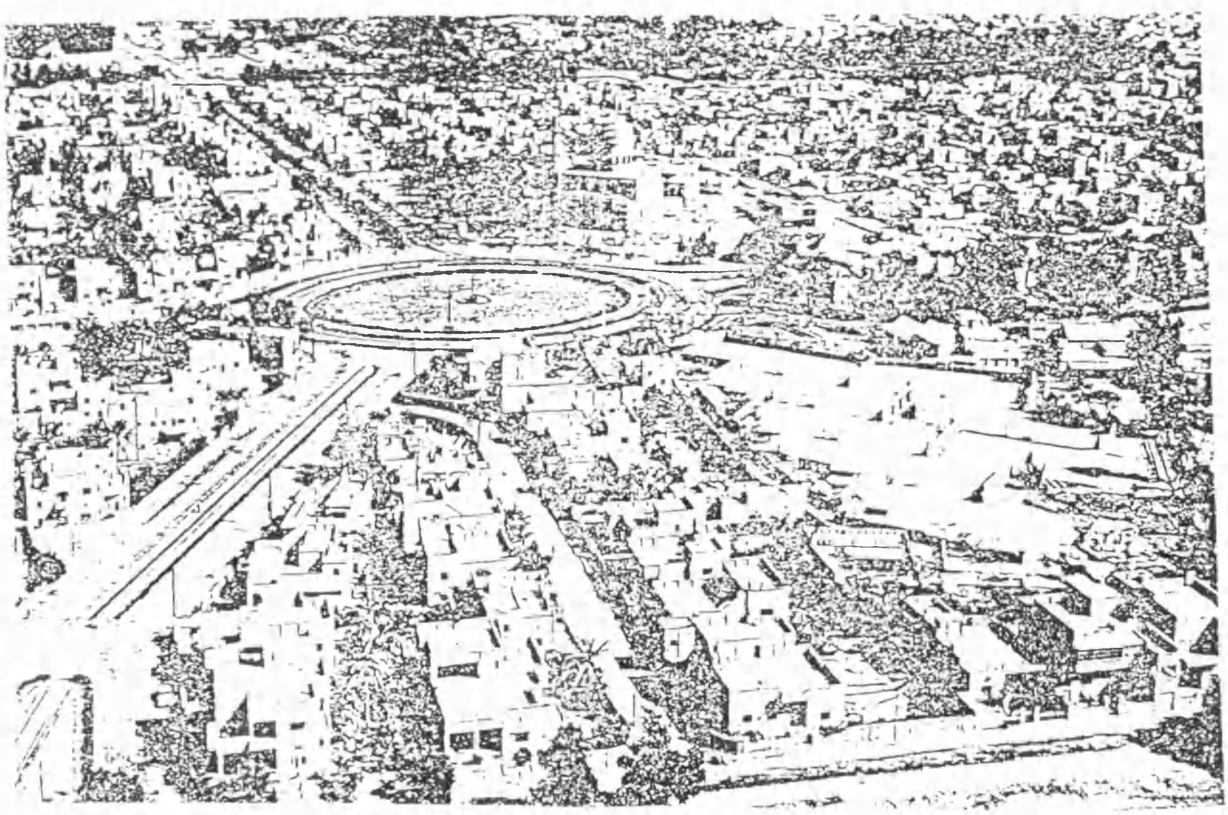


Fig. No. 30, Modern Urban Pattern

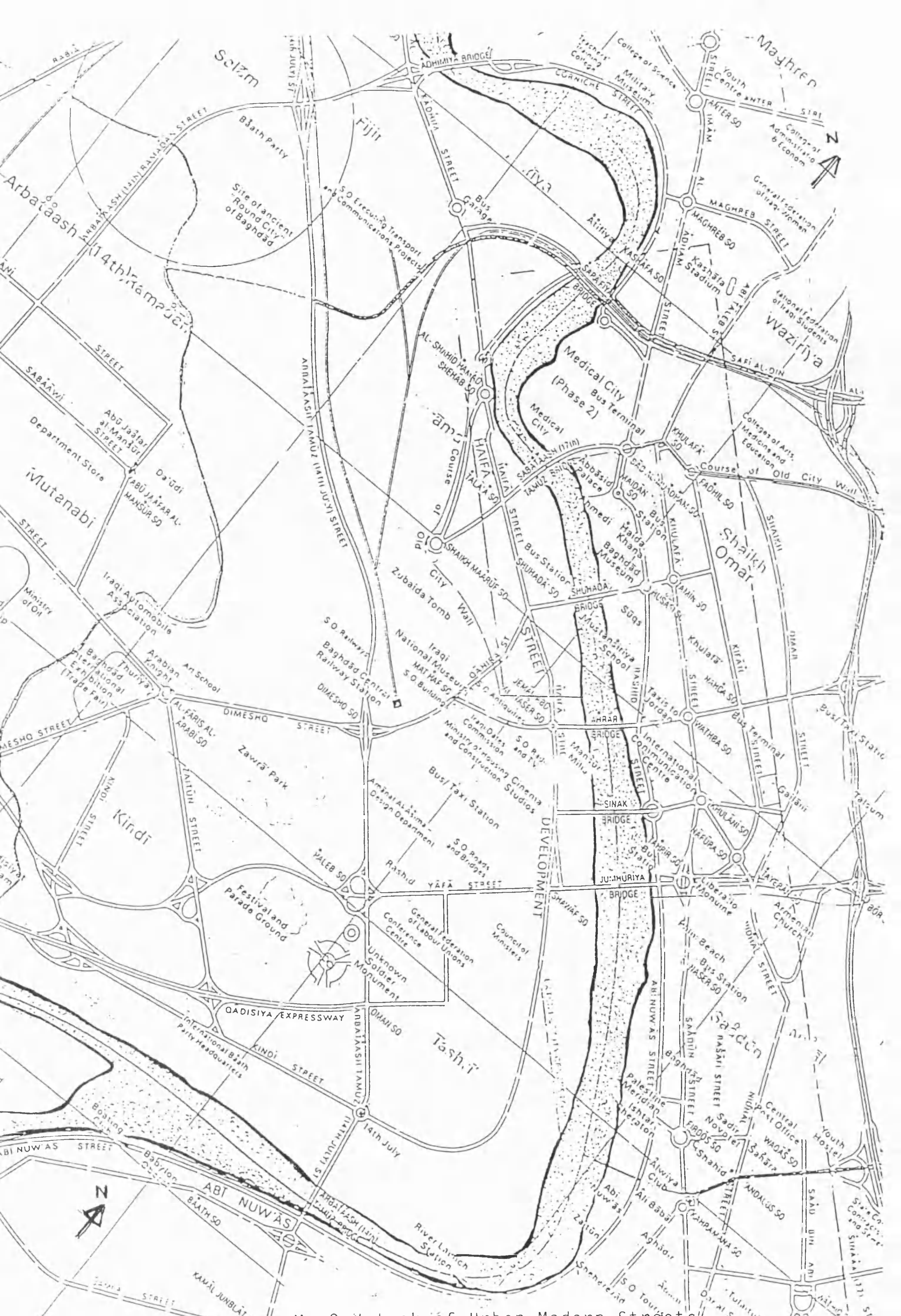


Source: Mimar No. 6, 1982

Fig. No. 31, Modern streets system and density of buildngs

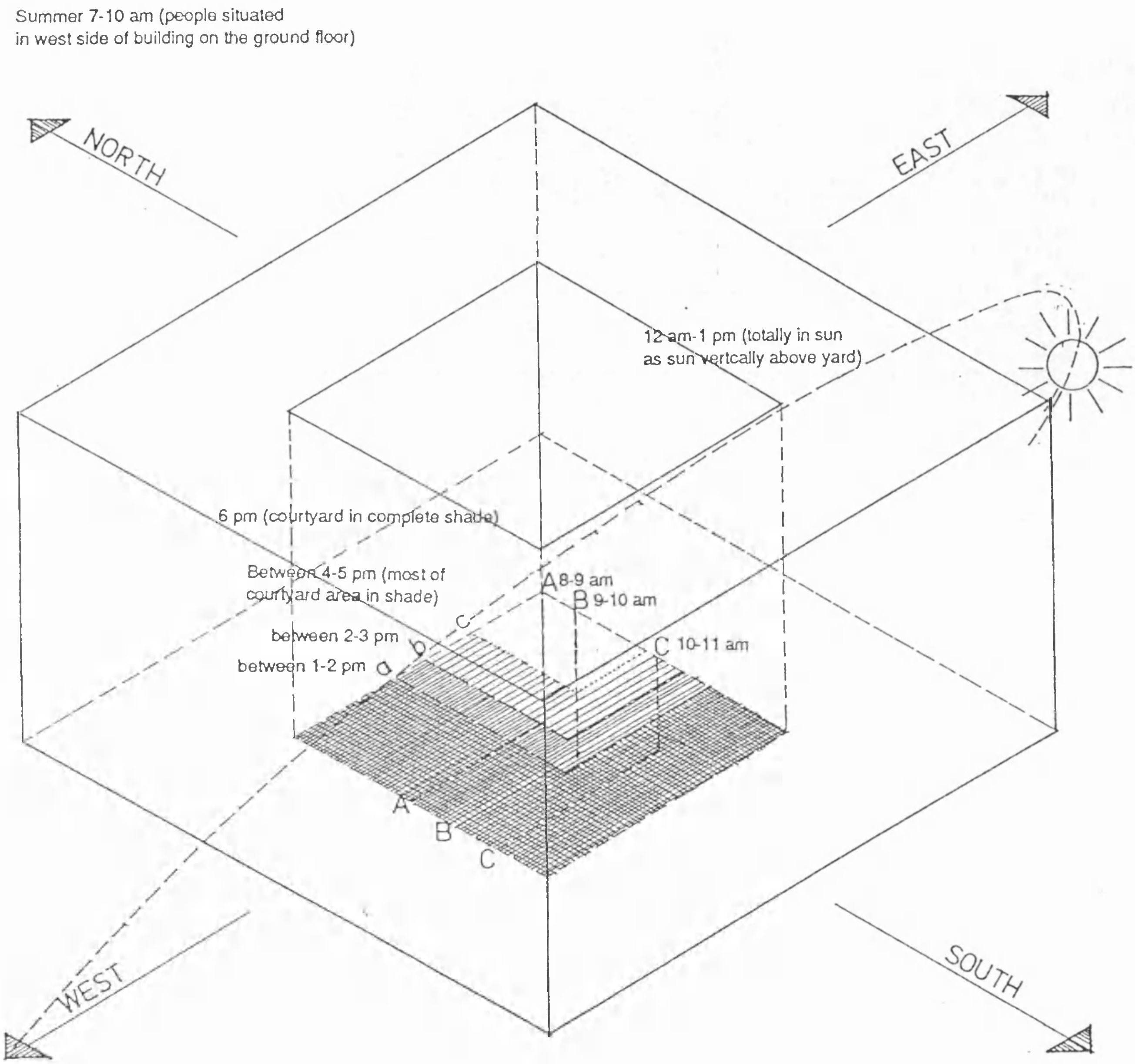


Source: BP. Co.

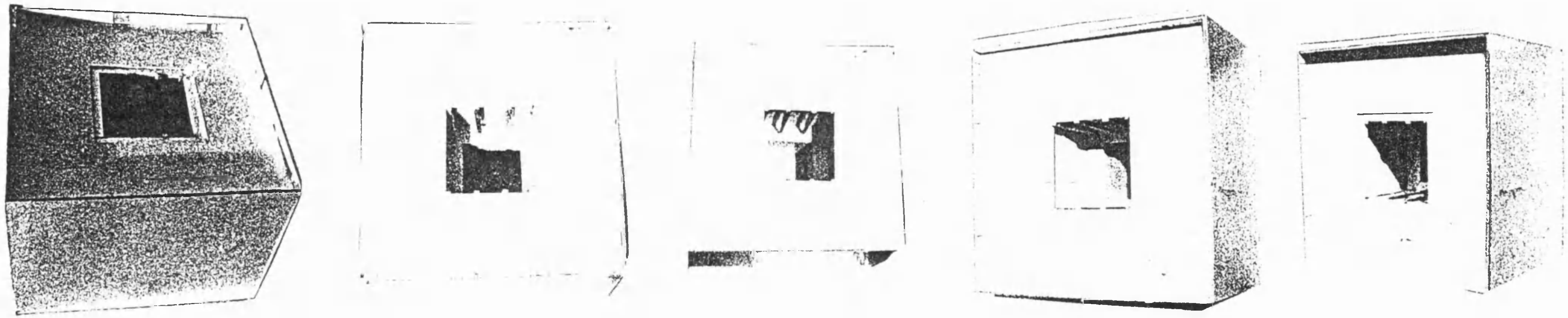


Map2,Netwok of Urban Modern Streets

Fig. 32, Shade created by enclosed form

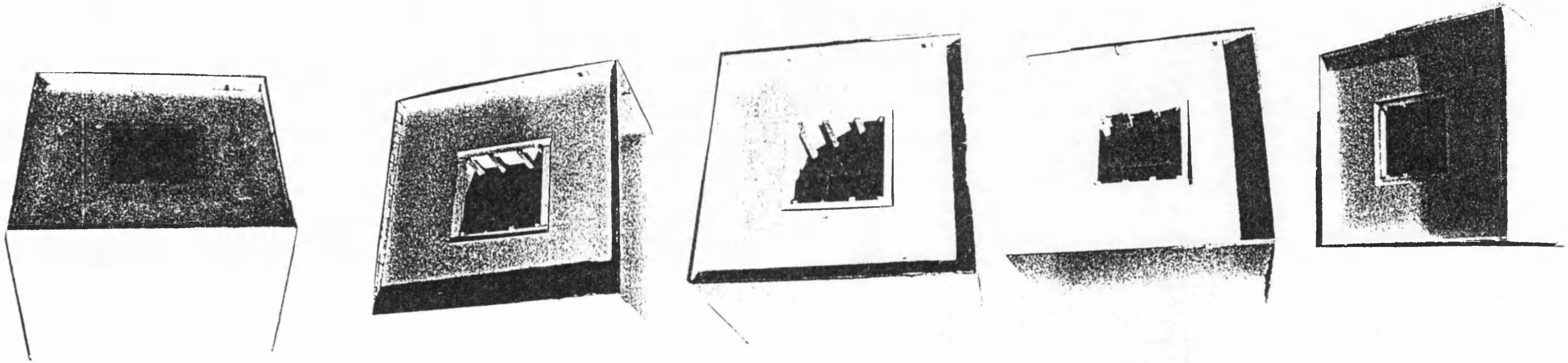


Drawn according to the measurements done
by the auther, using heliodome



SUMMER

4.00-6.00.pm 2.00-4oo.pm 12.00.am 10.00-12.00.am 8.00-10.00.am



WINTER

Photographs showing the sunlight on courtyard house, heliodome experiment done by the author (see Fig. No.32)

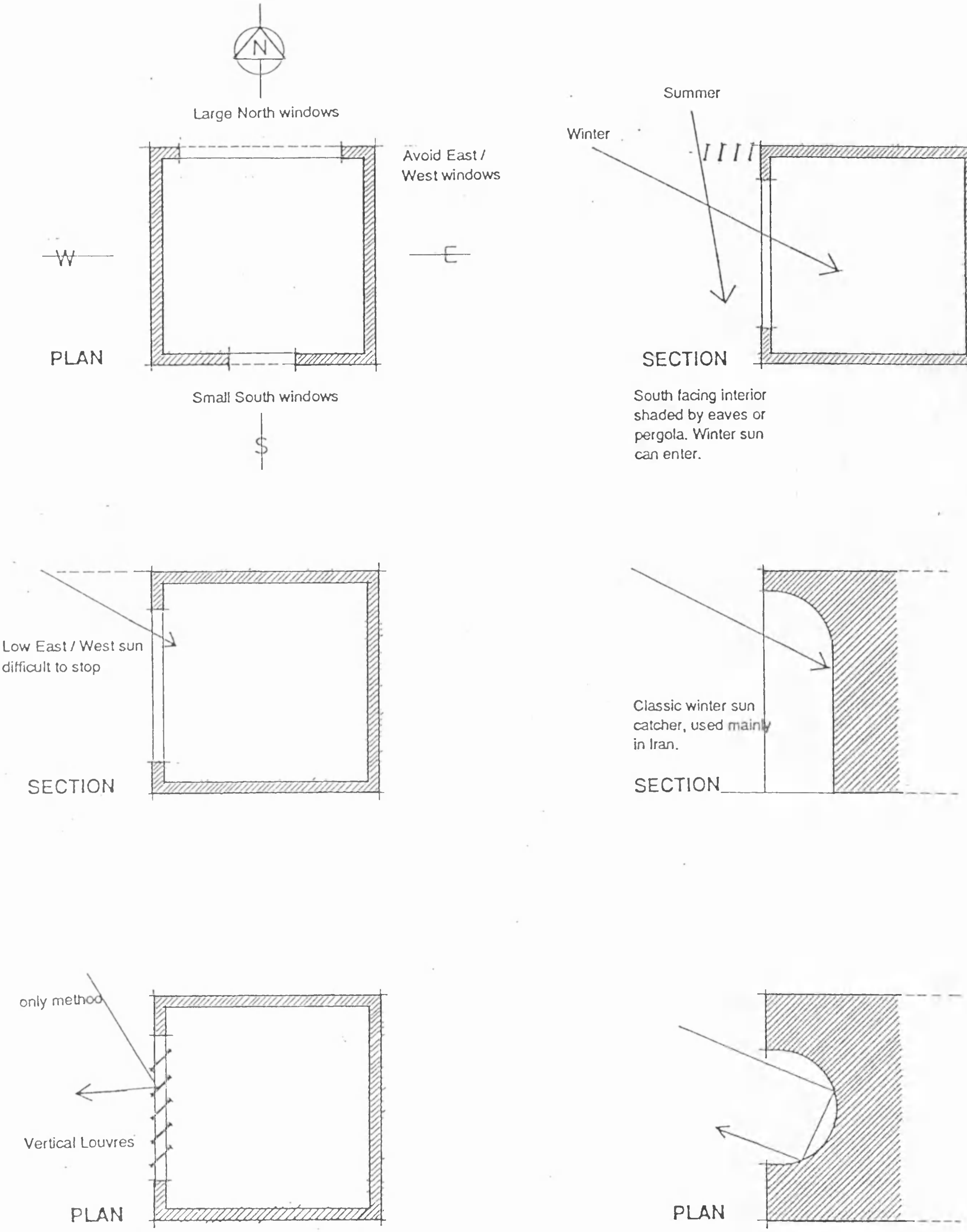


Fig. 33, Set of suggestions for climate control

Density Comparison

To achieve a meaningful comparison, the following rules were accepted.

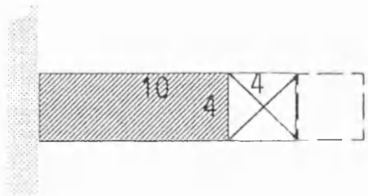
1. All houses to have about 120 m^2 of built floor area. This is a reasonable size for a nuclear family.

2. Minimum courtyard/open space of 4m x 4m. By observation from the existing houses, this is a reasonable minimum.

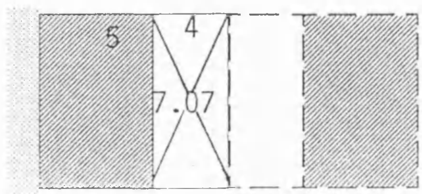
3. Minimum dimensions of habitable space 3m. Less than this does not represent usable room.

4. Maximum depth for light penetration accepted as 5m.

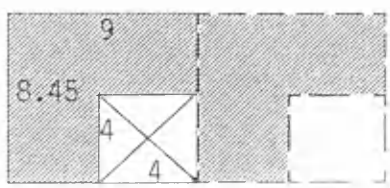
Fig. 34, Density Comparison A



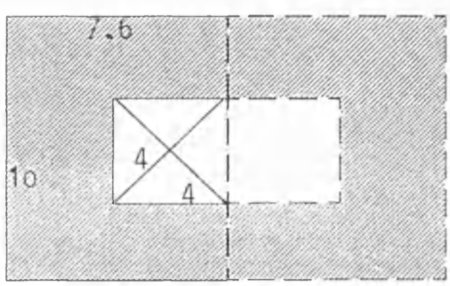
3 Floors height
Floor area 120 m^2
Site area 56 m^2



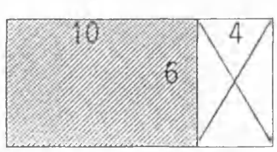
3 Floors hight
Floor area≃120 m^2
Site area 63.6 m^2



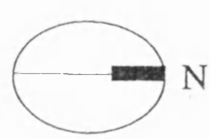
2 floors hight
Floor area≃120 m^2
Site area 76 m^2



2 Floors hight
Floor area≃120 m^2
Site area 76 m^2

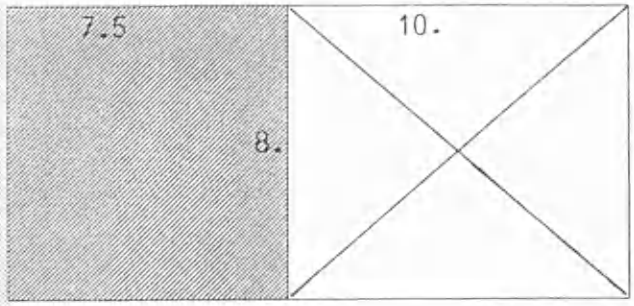


2 Floors height
Floor area =120 m^2
Site area 84 m^2

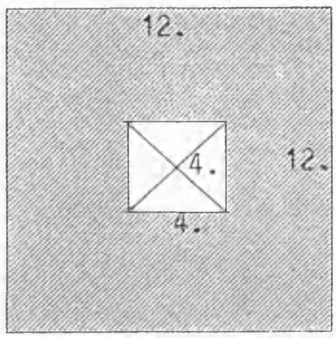


Source: The Author

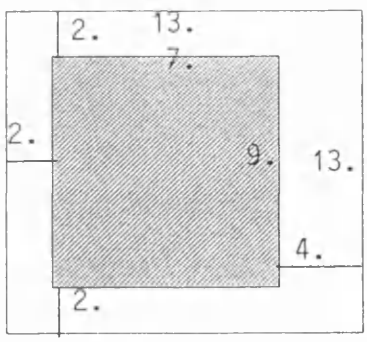
Fig. 34 B



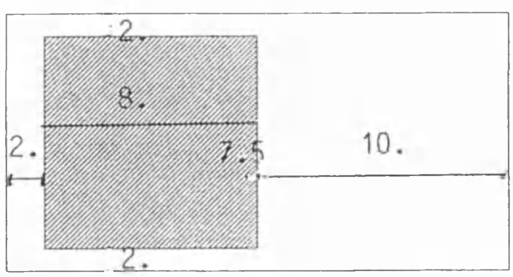
2 Floors height
Floor area $\simeq 120\ m^2$
Site area 140 m^2



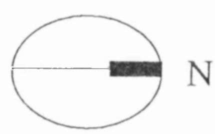
1 Floor height
Floor area $\simeq 120\ m^2$
Site area 144 m^2



2 Floors height
Floor area $\simeq 120\ m^2$
Site area 169 m^2



2 Floors height
Floor area $\simeq 120\ m^2$
Site area 200 m^2



Source; The Author

House 1. Is minimal, not recommended, due to the difficulty of the light depth and the high courtyard walls.

House 2. Still small but more easily planned.

House 3. Recommended

House 4. Recommended

House 5. Recommended

House 6. Terrace house with garden

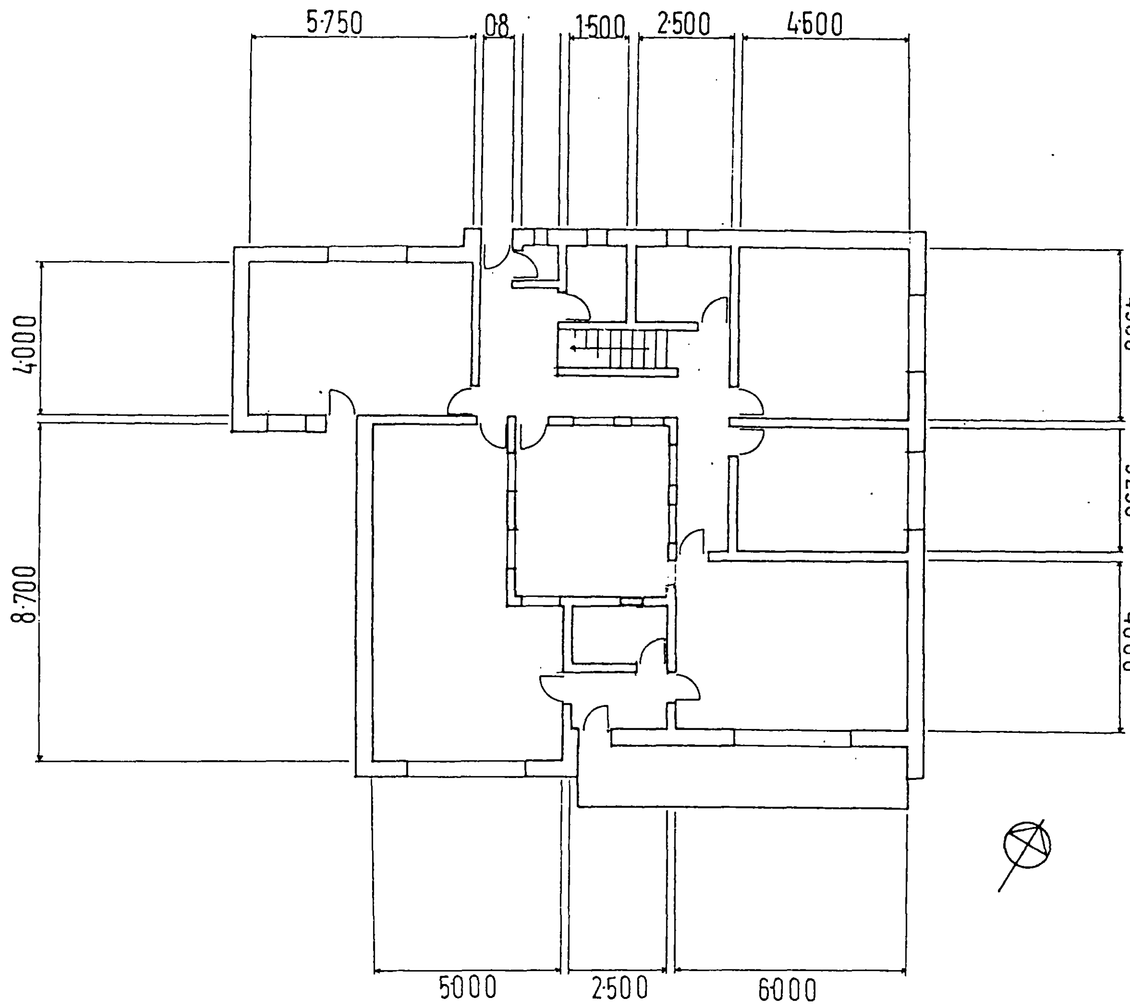
House 7. Could be applied but less economical in land use.

House 8. Utter minimum Villa. Poor land use due to wasted side spaces.

House 9. Standard modern Villa. Note the use.

Note: The standard Modern Villa House 9 uses nearly four times as much land as the minimum house 1 and nearly three times the land use of the recommended house type 3 & 4.

Fig. No. 35, A Modern Court-garden House

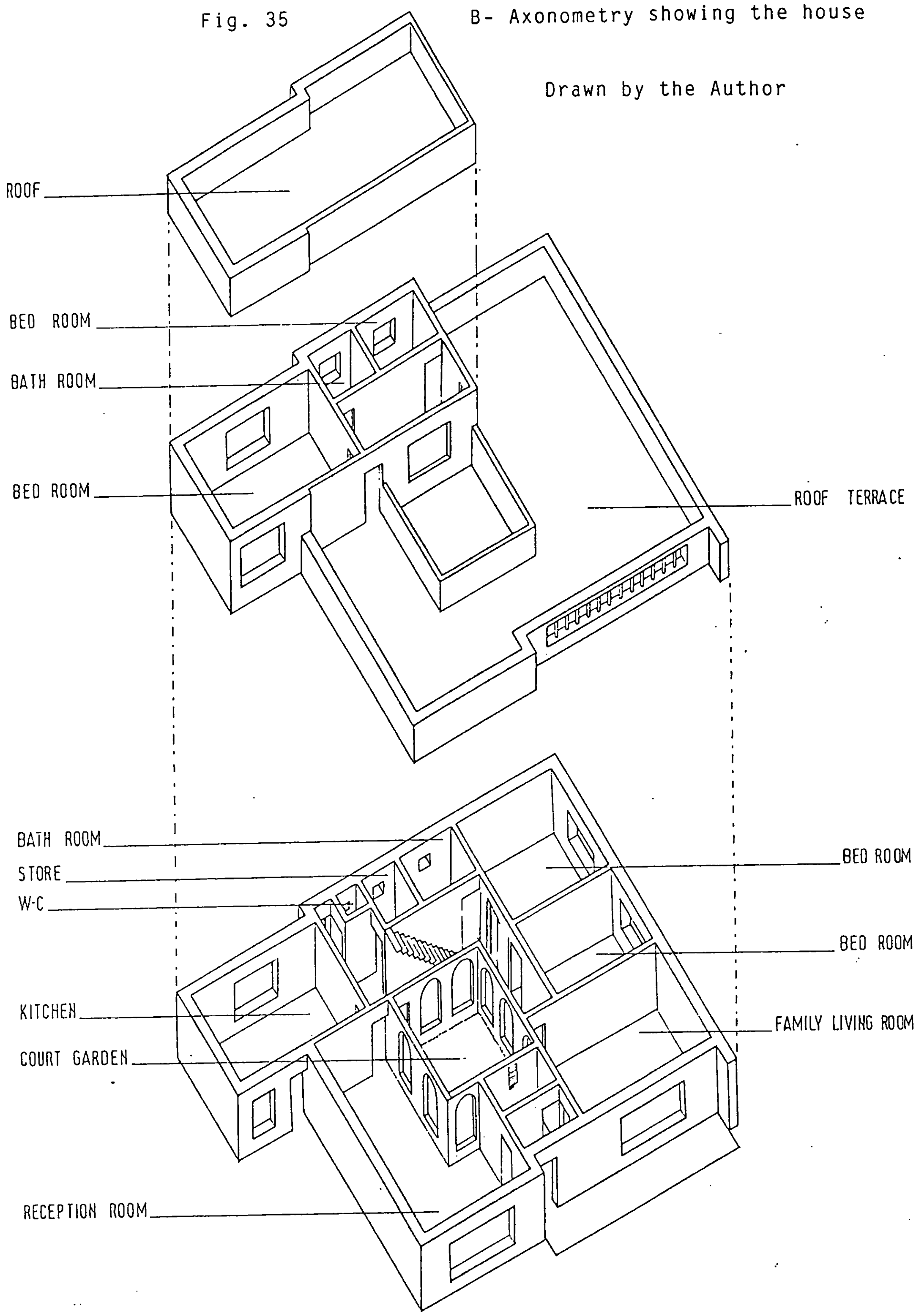


A- ground floor plan

Designed and built by Master Sadiq Al-Warid, 1973
Measured and drawn by the author

Fig. 35 B- Axonometry showing the house

Drawn by the Author



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