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Courtyard Housing

A Typological Analysis

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in partial fulfillment of the requirements of the degree of
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Abstract

In the forthcoming decades housing will be facing major controversial issues such as those of achieving higher densities, obtaining socio-cultural acceptance through the retention of the inherent qualities of low rise, low density dwellings, and that of attaining sustainability.

Courtyard housing addresses these issues fairly effectively with at least one individual courtyard allocated to every single dwelling unit. Apart from achieving higher densities, it possesses qualities such as ground relatedness, security, territoriality, dwelling identifiability, image of home, personalization, adaptability to alternative lifestyles, the provision of private outdoor space, and child surveillance possibility. These are qualities seldom found in other housing typologies with similar densities and are almost non existent in high-rise, high density projects. Sustainability is achieved through economies in land, infrastructure, building materials, energy, as well as socio-cultural stability.

This study investigates the courtyard, the house, the neighborhood, the city and how these relate to the qualities mentioned above. A comprehensive and exhaustive review is also made of courtyard housing projects published since 1960. These are compared and analysed in order to derive possible improvements and suggest alternative solutions.

Résumé

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Dans les décennies à venir le logement fera face à des problèmes très controversés: des densités de plus en plus importantes, l'obtention d'une reconnaissance socio-culturelle à travers la rétention des qualités inhérentes aux bâtiments de 1 au 3 étages ainsi qu'aux unités d'habitations de basses densités et l'accomplissement d'une soutenabilité.

Le logement à cour intérieure adresse ces problèmes d'une façon assez efficace avec au moins une cour intérieure individuelle pour chaque unité d'habitation. En plus d'abatir à une plus haute densité ce type de logement apporte des qualités telles que: la relation au sol, la sécurité, la térritorialité, l'identification du logement, l'image de la maison, la personalisation, l'adaptabilité à des différents styles de vie, la création d'espaces extérieurs privés, et la possibilité de surveiller les enfants.

Ces qualités sont rarement trouvées dans d'autres typologies de logement avec des densités semblables. Elles sont presque inéxistantes dans les projets de plus de 8 étages et de haute densité.

La soutenabilité est atteinte par une économie territoriale, une infrastructure, des matériaux de construction, l'énergie ainsi qu'une stabilité socio-culturelle.

Cette étude est une enquête sur la cour intérieure, la maison, le voisinnage, la ville et comments ces éléments agissent par rapport aux qualités mentionnées ci dessus.

Une vaste et complète critique des projets à cours intérieures publiès depuis 1960 est également proposée. Ces projets sont comparés et analysés afin de tirer les meilleures améliorations possibles et de suggérer d'autres solutions.

Acknowledgements

This thesis would not have been possible without the assistance, advise and know-how of many I would like to acknowledge. My deepest appreciation is due for the guidance, support and advise I received during my studies from the faculty, staff and fellow students of the Minimum Cost Housing Department at the McGill school of Architecture.

While thanks are due to many, I feel particularly indebted to my thesis advisor, professor Ricardo Castro for his insight and invaluable guidance, and without whom this thesis would never have attained its present form. Thanks are due to professor Vikram Bhatt for his advise and comments during the initial stages of the study. I would also acknowledge the support and guidance of professor Norbert Schoenauer, whose personal interest and enthusiasm convinced me initially to pursue this topic to the very end. A special word of appreciation is also due to mr. Andres Musta, for patiently rereading, criticizing and editing the text.

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Introduction

As the end of the 20th century approaches and land and resources get increasingly scarce and expensive, an alternative has to be found to the predominant yet costly and land and space consuming housing types on the market today, such as the suburban single-family detached house and the monotonous and often socio-culturally unacceptable highrise apartment block. Both of the above mentioned typologies have advantages and disadvantages, yet, aside from their extroverted nature, are completely opposed. Thus, the former has inherent beneficial characteristics of low-rise housing and the latter retains the advantage of higher densities. It is desirable to possess an alternative housing typology which has many of the advantages of both opposing typologies.

Changing economic and socio-cultural conditions around the world will undoubtedly force housing authorities to develop new forms of housing to suit future needs. These will be more energy efficient, and will cost less to build, run and maintain. They will allow for greater densities while emulating low-rise building forms, will be more viable socio-culturally, will allow access to both public and private open spaces, and will occupy less land.

Such a "futuristic" and "sustainable" housing typology has been around for several millenia and has been developped for contemporary use by architects around the world in the present century. This typology is contemporary courtyard housing.

A recent resurgence of this traditional house form suggests that it supports considerably higher densities than other low-rise forms, yet has most of the advantages of the latter. This thesis is a study of that recurring house form, the contemporary version of the traditional courtyard house, where its assets and liabilities are thoroughly analysed and discussed.

The other trends for "houses of the future" will include increased efficiencies and savings achieved through house miniaturization without compromising spatial quality, urban or contextual continuity, ground relatedness via a linking of indoor and outdoor

spaces, the relationship of the dwelling to the street, neighborhood and city, as well as community interaction. Neither will it sacrifice planning philosophies that aim to save land, gain space, and to achieve land use efficiency. To what extent does contemporary courtyard housing satisfy these and other 'futuristic' and 'sustainable' trends? Does it also possess advantages not apparent in other housing typologies? This study hopes to explore these issues and to provide some answers. The aim of the study is not only to record and observe the social, physical, and qualitative characteristics of the courtyard house, but to also make a thorough analysis of the reasons that give them their distinctive individuality, transcending culture, time, and place.

The research methodology is based on an exhaustive litterature review. It is vital to clarify serious misconceptions in housing litterature about the term courtyard house or what courtyard housing represents. Some include European-type perimeter planning as courtyard housing, in which open space surrounded by the buildings is referred to as the 'courtyard'. Others cluster a few extroverted, detached housing units around a common garden-space and refer to that as 'courtyard housing'. Peripheral walk-up apartments clustered around a common courtyard and row housing clustered around a common public open space are also referred to as 'Courtyard Housing'. In this study, Courtyard Housing denotes housing projects composed of single-family dwelling-units, each possessing one or more *private* courtyards surrounded by living areas on one or more sides. The houses are introverted, having the courtyard as the focus, and are surrounded by walls on all sides, where at least two of these exterior walls are blank. The dwelling units may be arranged or clustered horizontally, vertically, or diagonally .

One of the primary aims of this thesis is to assess the role courtyard housing could have in attaining sustainability. The possibilities of its adaptation to harsh environmental conditions, such as those of Canadian weather or other temperature extremes, is a topic of no lesser importance, while in itself, its adaptability to current lifestyles merits further exploration.

The thesis is composed of five major chapters and a conclusion:

Chapter one is an introduction with an argument favouring a reversion to

introvertedness.

The second chapter examines the courtyard and the logic behind its configuration as well as the various social, cultural, and climatic forces shaping its proportions, form and size.

Chapter three discusses the contemporary courtyard house and the various forms it could attain as determined by social and climatic variables, with occasional references to indigenous solutions to climatic and environmental extremes.

Chapter four analyses the validity of the courtyard house and the clusters, neighborhoods and cities it generates with respect to land use efficiency, energy efficiency, and socio-cultural sustainability.

Chapter five is a review of contemporary courtyard housing projects published in the international architectural press since 1960. These are classified into typologies according to their plan layouts. The typologies are analysed and their assets and liabilities established. An attempt is made to cover the most important documented projects. However, the abundance of projects and their recurring commonalities have resulted in the representation of plans in a schematic, abstract manner which can be adapted to any courtyard housing project of similar configuration. The most significant existing projects are included in the survey as examples. The aim is to categorize them in order to be able to derive new, unexplored routes leading to new alternatives.

The thesis terminates with a concluding discussion about the present and future validy of courtyard housing in the contemporary context of rapid technological, socio-cultural and stylistic advances.

Chapter One
The Little House on the Prairie versus
the Little Prairie in the House

The two most basic spatial conceptual aspects of housing are introvertedness and extrovertedness. This chapter will try to establish a *raison d'être* for the adoption of introverted housing. Although it may initially seem that the discussion concentrates more on the Euro-American context, it is pertinent to mention that the true scope is global, for basic conceptual aspects remain constant regardless of geographic location. Besides, there is a universal tendency to imitate North-American planning practices and lifestyles. For instance, discussing aspects of an American suburb is also pertinent to many planning practices in far-away countries.

Housing worldwide is the result of socio-cultural forces as well as physical environmental conditions. According to Amos Rapoport, social and cultural factors, rather than physical forces, are most influential in the creation of house form (1). Socio-cultural forces are primary and result in conceptual form, and the others are secondary or modifying and are more physical (2). Conceptual house form is not simply the result of any single factor or physical force, but the consequence of a whole range of socio-cultural factors and behaviour. These components determine the overall aspect of the house as an abstract form, denoting either introvertedness or extrovertedness, and are constant in both cases. This form in turn is modified by secondary factors such as climatic conditions, methods of construction, materials, labour and available technology, as well as financing, among others.

In order to better comprehend the differences and relationships between the two

conceptual extremes, it is appropriate to investigate them in the context of an ancient civilization which was familiar with both introverted and extroverted housing types. In doing so, one will better construe contemporary disparities between the two, for an analogy exists between conceptual form, be it in the past, present or future.

The reviewed historical setting is classical Rome, where both the extroverted villa and the introverted courtyard house or *domus* coexisted. The *domus* was the typical urban house during the late Roman period. It had two rectangular interior courtyards, the *atrium* and the slightly larger *peristyle* (Fig.1.1). The *atrium* was next to the entrance and with its surrounding area formed the public portion of the house. The *peristyle* was a collonaded courtyard adapted from Hellenic houses and was more secluded and, with its surrounding rooms, served as private family quarters. The plan was axial, and guests were received in the *tablinum*, a living and reception room facing the entrance across the *atrium*. All the rooms of the *domus* opened onto these two courtyards.
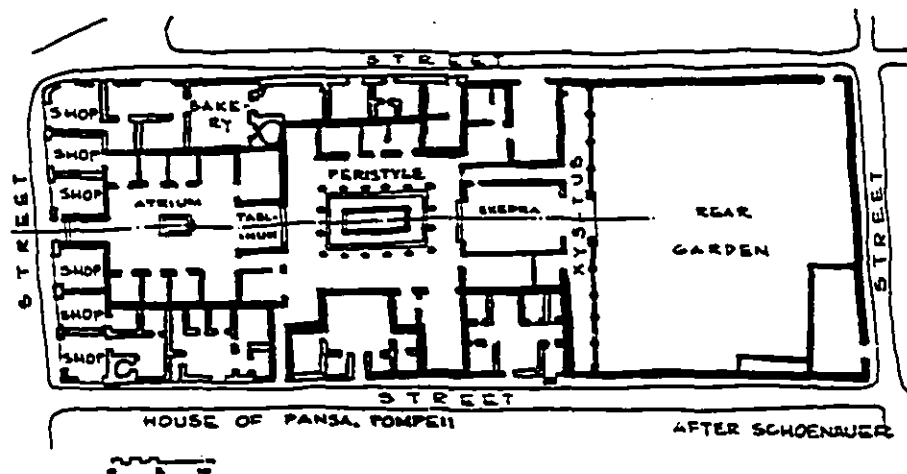
Fig. 1.1 House of Pansa at Pompeii. (after Schoenauer).

Often, at the far end of the house and visible from the *oecus* (living area)was a *hortulus* or enclosed garden, terminating the axial sequence of entrance, *atrium*, *tablinum*, *peristyle* and *oecus* (3). Wherever a rear garden was not possible, the *peristyle* often served as garden with climbing vines and potted plants. Garden views were controlled and

carefully planned.

The exterior of the *domus*, with shops opening on the street, was simple and unpretentious, while the interiors were sumptuous and lavishly furnished. Axial planning and a centralised access prevented the domus from acquiring the typical bent foyer and visual privacy screen wall or "spirit wall" provided in most non Roman courtyard house entrances that would block "peeping Toms" with their inquisitive glances (Fig. 1.2). However, the socio-cultural factors dictating the primary spatial concept, introvertedness, were the same in all courtyard houses.
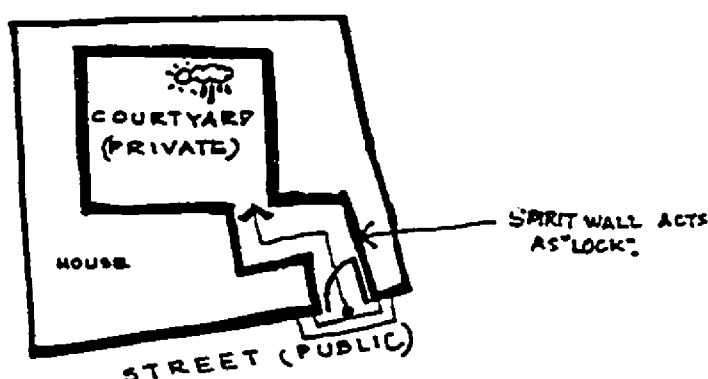
Fig. 1.2 Bent foyer or "spirit wall" entrance.

Throughout various periods in history, city dwellers idealized life away from the hustle and bustle of the city. They were living in a crowded urban milieu, and wanted to move away to quieter premises surrounded by nature, either for short periods of time, for leisure, or permanently. Thus, the ancient well-to-do Romans began to establish homes outside their city limits.

The aspiration of wealthy Romans was to have several *villas* or country residences, with commanding views of the surrounding landscape and preferably within commuting distance (4). When located near the city, the villa was called *villa suburbana* and enjoyed picturesque scenes of nature on all its four sides. The desirability to possess vistas is best demonstrated in the letters of *Cicero* and *Pliny the Younger* (5). Adressing a friend in a letter describing his Tuscan villa and its beautiful surrounding countryside, Pliny the Younger wrote:

...for as the land lies below you it looks more like a beautiful landscape painting than the real thing, it is a refreshing picture both in its variety and in its regularity. The view from the house is like a mountain view though the house is really at thefoot of the hills...(6).

The villa was a temporary dwelling meant for leisure, as well as a getaway, a recluse away from the sophisticated, urban Roman way of life. These villas were often located in the centre of large farming estates supplying city market-places. Housing and agriculture coexisted. During this period in time, suburbs and countryside were undistinguishable. Initially, the Roman suburban villa began as a rural version of the typical town house, the *domus* (7). After the first century A.D., the scheme was turned inside out in order to take advantage of the best views. The villa reversed the usual order of the urban domus-with-peristyle so that the tablinum and the reception suites clustered around it could enjoy the view through their generous windows (8). The house was entered through the peristyle, the private domain (9). The difference between domus and villa was best explained by the Roman architect Vitruvius in book VI of his *Ten Books on Architecture:*

...In town atriums are usually next to the front door, while in country seats peristyles come first, and then atriums surrounded by paved colonnades opening upon palaestrae and walks (10).

The views were always framed through windows, doors or colonnades. Pliny's second century descriptions of his villas and the enticing views from all the rooms indicate that the Romans preferred raw nature to be framed by the room and its windows for the scene to be delightful. Disclosing the merits of his seaside Laurentine villa and the attractive views available from his anteroom and dining room, Pliny the Younger addressed his friend Gallus with the following words:

... Further on is an attractive anteroom and a very nice dining room which runs out towards the shore and is washed by the waves whenever the south west wind ruffles the sea. It has folding doors and windows as large on each side and so you have three different views of the sea from the front and the sides, while from the rear you look back at the part we have just come through: the anteroom, the colonnades, the atrium, the woods and far off in the distance, the mountains (11).

The cultured Romans invariably preferred architectural intervention as a necessary part of framing views (12). Instead of looking onto courts, there were porticoes from which to look out at the surrounding countryside (13). The Roman introverted *domus* was thus transformed into the extroverted villa composed of many wings extending into the landscape, the consequence of a complex set of factors (Fig.1.3). Villas were often raised on platforms in order to be seen from afar, and to enjoy views and a commanding placement. Thus, the extroverted nature of the villa was the outcome of the implicity Roman desire to expose wealth and status, to look out and to be looked at. The nature of Pliny's letters addressed to his friends indicates that he enjoyed the fact that he owned villas and was not in the least reluctant to describe them, their magnificent facilities, and the views they commanded. All villas were conceived for a leisurely and ostentatious lifestyle, and were considered to be prestigeous possessions worthy to be displayed.
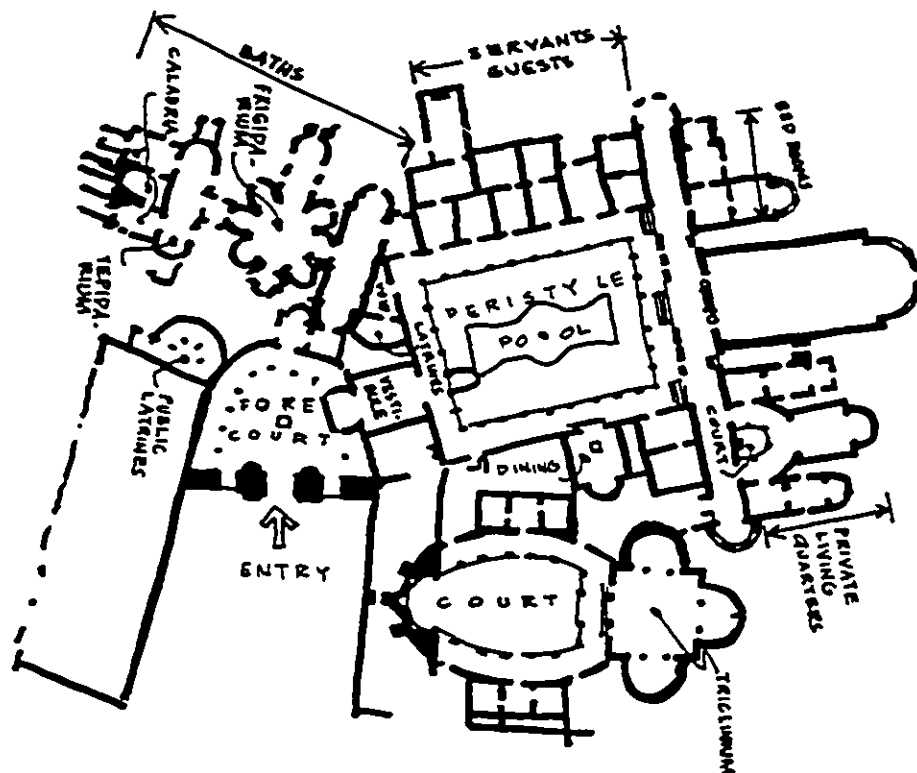
Fig. 1.3 Villa at Piazza Armerina, Sicily. Early fourth century A.D. (after R.J.A. Wilson).

This infatuation or "view mania" became so pervasive that eventually urban housing began to imitate villas that commanded rural views. Wherever there was no possibility to obtain views, either due to modest means or restricted urban conditions, the Romans compromised by using paint, stucco and mosaic decorations to create imaginary views (14). Various landscape features such as statues, tiny grottoes, painted landscapes on courtyard walls, canals dug out in the garden, pools, fountains and plant material were introduced (Fig.1.4). All elements were sequentially arranged and framed to emulate rural views. Courtyards with the atrium tablinum axis oriented towards the artificial, rear garden and opening directly onto it were created, with the peristyle often moved to one side, the entire ensemble conceived to bring the countryside and associated scenery within the party walls of city houses.

Fig. 1.4 Corinthian Atrium. (from Gwilt).

Although nature was often included in Roman atria and peristyles before the introduction of the villa, a feat alien to Greek peristyles, which were devoid of any landscape elements, a more conscious effort was made to make the ensemble of atrium, tablinum, peristyle and rear garden look and feel as if they were located in a "rural" setting, enjoying well orchestrated, framed "rural" views (Fig.1.5 a and b). It was an effort to recreate nature and its effects within one's own premises. All the rooms still looked onto these interior court gardens, even though they were supposed to give the impression that they didn't. With wishes to imitate the opposite concept, the Romans had inadvertently

reinforced their own initial concept of introvertedness!

Fig. 1.5 a. Peristyle at Pompeii, and b. Door and Prothyrum, Pompeii. (from Gwilt).

Whereas Roman suburban villas were conceived specifically as temporary getaways, their more recent descendants, 19th and 20th century suburban dwellings, were meant to be permanent residences located outside the city limits and its inconveniences. Contemporary desires to get away from the city commenced following the industrialization of the western world. By the mid 1800s, uncontrolled industries were emitting noxious fumes into the city atmosphere. Migrant labourers were cramped in tiny, unhygienic lodgings, and living standards were very low. Life in city centres had deteriorated, and the desire to move away from the unhealthy conditions of the town centers towards the green countryside or suburbs was born.

Initially, suburbs were occupied exclusively by the rich, leaving the city centre to the poor and working classes. Eventually, the middle and the poorer classes also acquired their own suburbs. This was due to the availability of cheap land and public and private transportation, starting with railroads, streetcars, and finally automobiles as well as supporting infrastructure (15). Affordable suburban houses, inexpensive energy, and the

availability of food and consumer goods brought in from far away places all contributed to the growth of the suburbs. The post World War II suburb rose with the decline of the city centre, accompanied by a disintegration of the traditional values of the city and the deterioration of civilized life (16). By the 1970s there were more suburbanites living in North American cities than in cities or rural areas (17).

Currently, high rents, prices, urban crime rates and established values still continue to drive young families to the suburbs. The principal reasons for obtaining contemporary detached suburban housing are property, increased social status, informal "countryside" living, handsome views, relaxation and a retreat from the hustle and bustle of urban life-reasons reminiscent of the intentions of the original Romans who probably came up with the idea initially. Suburban housing was not intended to incorporate any of the traditional virtues of urban housing, be it in ancient or contemporary times.

Actual North American suburban settlements are mostly composed of single family detached housing units remotely reminding one of Roman suburban villas by their extrovertedness and occasional pretentiousness. However, they are placed on small plots (mock landscapes), and similar designs are duplicated over and over, unlike the Roman villa, where each and every house was unique.
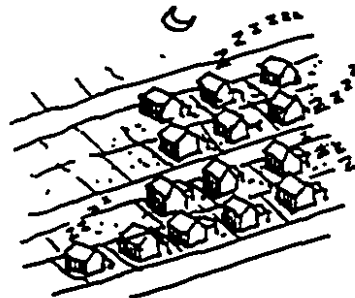
Fig. 1.6. (adapted from Lynch).

Contemporary extroverted suburban housing commands neither status as a monument nor the views of the "extroverted Roman villa". From the exterior, one house appears similar to all the others, and hardly constitutes a landmark (Fig. 1.6). Looking from the inside out, all one sees is a drab streetscape, perhaps a well maintained front lawn, with seldom any significant outdoor activity.

A single family detached suburban house not only looks like most of the other

houses on the street, it also resembles most other houses of the same typology on the
continent, regardless of regional, cultural or climatic differences.

This house type favours a homogeneous family type, basically the nuclear family,
and a consumerist lifestyle common to the entire continent. It occupies a central place on the
plot, suggesting ownership and a false sense of territoriality. However, this is accompanied
by a series of expectations related to the look and homogeneity of the street, primarily the
manicured front lawn matching those of the neighbours. The bedrooms of this house are
considered to be private spaces, whereas the living rooms with their picture windows,
designed more for passers by to look in rather than for residents to look out, are a sort of
space for the family to congregate and expose their lifestyle and belongings. The picture
window has nothing to conceal from the outside world. It favours extrovertedness and
openness, and lays the contents and activities of the most important room in front of any
viewer. The private detached house expresses the egocentricity of the individual, exhibiting
possessions and social status to onlookers, yet favours a sort of reserved attitude towards
strangers and communal activities at large.

The viewer on the outside is ideally supposed to be a neighbor passing by. He or
she is supposed to be living in the same neighborhood, occupying a home of similar design
and character, having a family similar in structure to all the other families in the
neighborhood, and generally belonging to the same income group. The lifestyle and
belongings of one neighbor are quite similar to another's, thus minimising feelings of
hostility or jealousy. Complete extrovertedness does not seem to cause any foreseeable
problems, provided things are as "Utopian" and prosperous as they were in postwar North
America of the 1950s and 60s.

Unfortunately, the conditions of the 1990s are a far cry from those days. Family
structure has been altered tremendously. High land costs, high interest rates, rising fuel
prices, as well as troublesome economic times have disrupted the ideal suburban lifestyle.
The abundance of unemployed or underpaid individuals has led to economic discontent and
hence to a rise in the crime rate. Suburban households are no strangers to frequent
burglaries. This itself raises questions about the validity of extrovertedness and the
exposure of the contents of the house to the outside via the picture window or the cars

parked in the car port.

The suburb is no longer associated with the imagery of houses sitting peacefully in nature. Some stereotypical images include monotonous and uniform neighborhoods inhabited by white middle-class residents (18). However, reality is quite different from the type-cast imagery as seen nowadays. They are no longer homogeneous ethnically, economically, or architecturally, and are beginning to show considerable diversity, for there are rich and poor suburbs, minority suburbs, and suburbs with high-rise apartments, condominia and town houses. In his 1991 book, *Edge City*, Joel Garreau points out that the nature of suburban growth has changed dramatically during the last thirty years (19). They are no longer chiefly residential; manufacturers, retail stores and offices are increasingly relocating to the suburbs, and suburbanites are no longer dependent on the city core for employment, shopping, or entertainment (20).

Thus, the suburban house today looks out at a diverse but carelessly planned and disorderly neighborhood. Supposedly green suburbs are rapidly being transformed into commercial, quasi-urban conglomerates.

Fig. 1.7 a. View looking out to suburban backyard. b. view looking onto enclosed courtyard.

The recent suburban heterogeneity means that the desired effect of the house located in the countryside overlooking nature or a garden city is no longer valid. What is required is a redefinition of the focus of the suburban house (Fig. 1.7). Which is more desirable; a house on a monotonous street with a character that is neither urban nor rural, but at best could be described as confusing, shapeless and unsightly, or an introverted house with a private courtyard-garden as its main focus, featuring well orchestrated, controlled views and a clear definition of the house's private and public domains? Should suburban housing

aspire to become more reminiscent of urban housing rather than rural housing (or villas) as suburbs begin to resemble cities? Could houses better serve their purposes if they solved the perplexities associated with them by adapting the reverse process of the development of the Roman villa and turned their focus to look inwards towards a courtyard garden instead of a characterless and disorderly neighborhood up front and a conventional backyard (and the neighbour's laundry) at the back?

Are the above reasons a sufficient pretext to revert to an introverted housing typology? What were the justifications made by previous cultures for adopting courtyard living? Could some of these also be valid today?
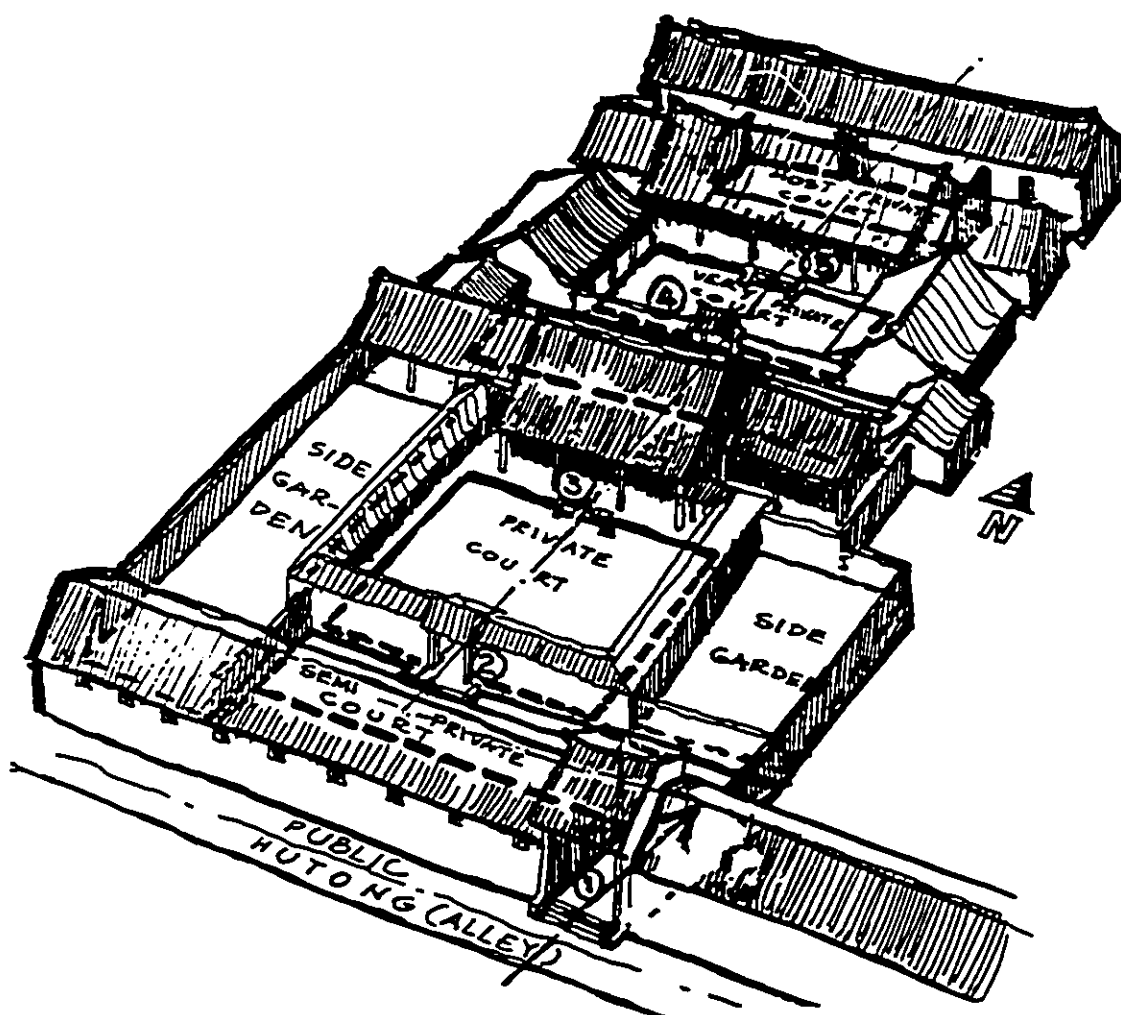
Fig. 1.8 Traditional Chinese courtyard house dwelling with hierarchic privacy levels. (adapted from D.K. Ching).

In most traditional communities with a predominant courtyard housing culture, introvertedness resulted not only from pressures to obtain a garden within one's own premises, but was also the result of economic factors, defensive precautions and several other socio-cultural pressures. Social and religious factors often required the cloistering of women, and the courtyard house provided the perfect private recluse. The house was a secluded domain and was accessible only to family, relatives and clan members, while strangers were denied access to all but its most public parts. Neighborhoods formed homogenous monocultures resulting in an intense sense of community and sociability, in which everybody knew everything about everybody else. Privacy for the family, obtained through the courtyard, became a consequential necessity as a defensive measure against overly inquisitive neighbours. Some cultures went even further by providing houses with several consecutive courtyards, with a hierarchy of privacy increasing with decreasing accessibility as one penetrated further into the house. Traditional Chinese courtyard dwellings, for instance, were prime examples, where the outermost courtyard was reserved for receiving total strangers and the innermost was a sanctuary for the home owner's wives, daughters and concubines, and hence the most private (Fig. 1.8).

Whereas it is inconceivable in most communities to revert to courtyard housing solely for the reasons regarding women mentioned above, some of the requirements regarding privacy are as valid as ever, and include some traditional factors and many newer arguments. Except for certain spots in contemporary Islamic societies such as in Saudi Arabia where women are often sequestered, the main arguements for a reversion to introvertedness apart from the ones mentioned above may also be cultural as well as physical, as manifested in climatic extremes, excessive noise, or unattractive street environments. One of the primary reactions towards extrovertedness has to do with the negative responses expressed towards monotonous and wasteful public exterior spaces resulting from many 20th century housing projects. Instead of providing large, anonymous public open spaces to residents, such as leftover spaces between public highrise and midrise housing or the useless spaces between suburban houses, it is preferable to control and limit these as much as possible and instead provide housing with individual house plots with large introverted private courtyards which would be used at the discretion of the

owner (Fig. 1.9).
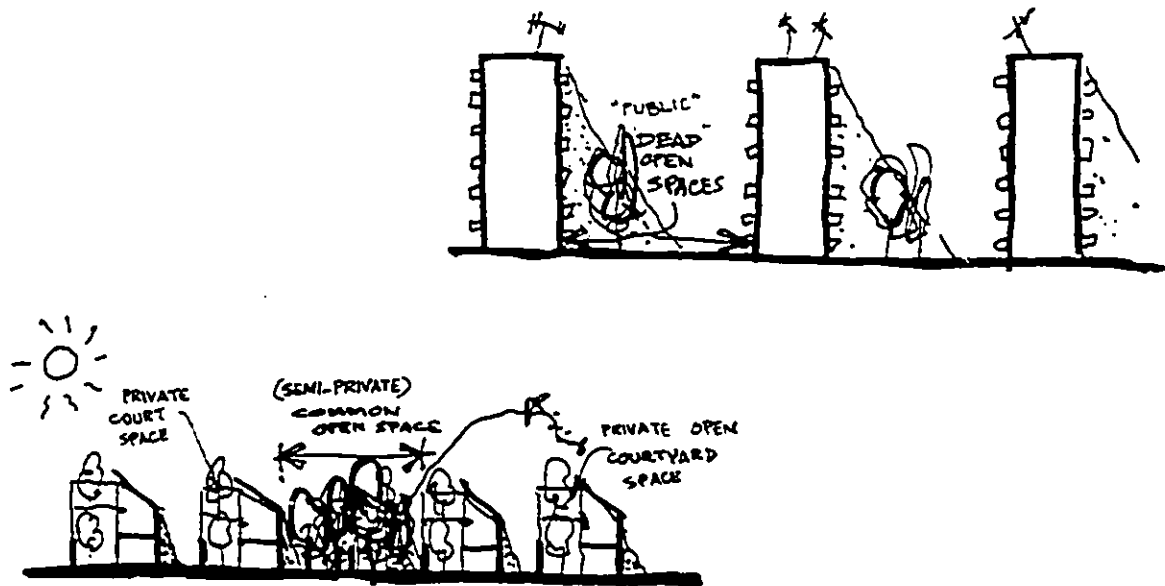
Fig. 1.9 a. "Dead" public residential open spaces versus b. private and semi-private open spaces.
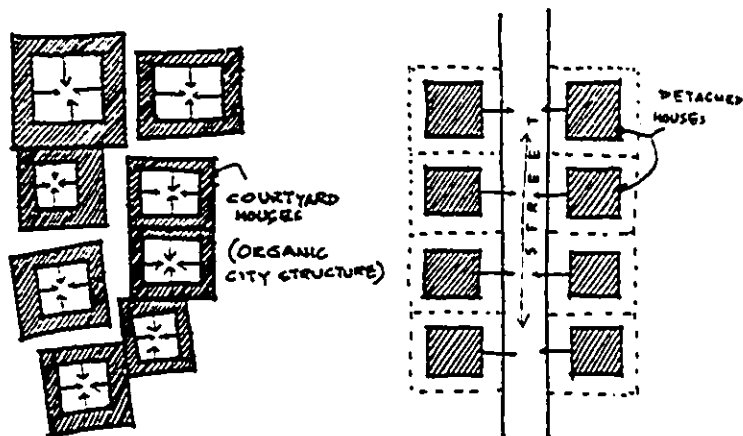
Fig. 1.10 a. Organic city structure with introverted courtyard houses versus b. Suburban city structure with extroverted houses. (adapted and modified from Rapoport).

If the desire to have comely views and advantageous conditions from one's own house was reason enough to adopt the villa, or, in case that was unattainable, to alter the introverted house in such a manner that it imitated the villa with its desirable views, then the

reverse logic should also be true. The complete absence of desirable views or the presence of objectionable views and conditions should prompt housing to obtain an introverted form, seeking controlled views and favourable environments within one's own premises (Fig. 1.10).

That is the essence of courtyard housing, where a tame, cultivated representation of nature is confined within the domestic enclave. That this "house with an exterior space" simultaneously meets the demands of much more complex socio-cultural issues and handles climatic, economic and space saving requirements in addition to providing a garden indicates that its many assets outweigh its liabilities.

Chapter Two

Inner Space

The purpose of this chapter is to study the individual private residential courtyard as a conceptual and physical entity. Its overall configuration, size, proportions and orientation should be the rational outcome of physical and socio-cultural factors rather than the result of random leftover open spaces on the house lot. A rationale has to be established by which the variables affecting its physical morphology can be properly manipulated in order to obtain an optimum desired effect, for courtyard form reciprocally influences the house. Thus, the study of the courtyard is also a part of the study of the whole house, and should be thought of accordingly.

Territoriality and the Idea of Threshold

Devices for defining and locating thresholds vary with different cultures, and consequently with different house forms. Thus, thresholds occur at different points in territorial space for different housing typologies (1). In courtyard housing, the threshold is at the edge of the site, where the private lot and the public entry gate meet. In the extroverted, detached (Euro-American) or suburban house, the threshold is located at the entry of the house proper. The threshold of the latter is within the site territory. This indicates a different sense of territoriality, and an obligation for the entirely enclosed courtyard house plot to be put to good use as required by the resident, whereas the entire front of the extroverted house has to be treated as a semi-public domain, visually and physically accessible to everyone, and along with its manicured front yard, serving aesthetic rather than utilitarian purposes (Fig. 2.1).
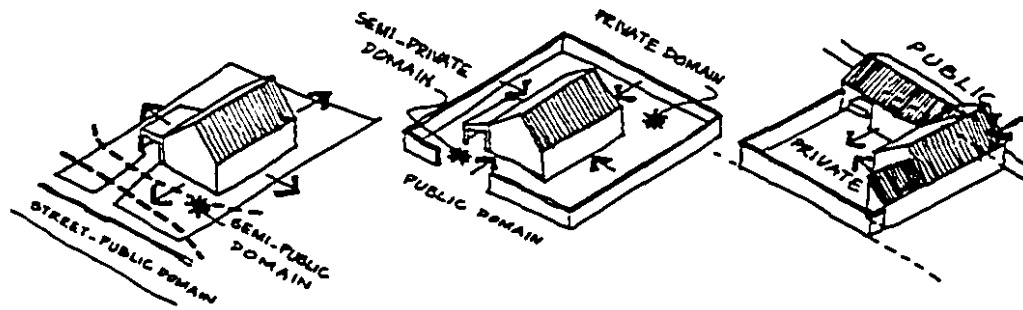
Fig. 2.1 Sense of public and private domains in different dwelling types. (after Rapoport).

Increasing the density of a residential neighborhood means increasing the crowding of that neighborhood, and a demarcation of territory and place becomes necessary. Human beings, like animals, are subject to stresses generated by the penetration of the individual's "bubble" of space, as pointed out by Edward T. Hall in *The Hidden Dimension* (2). The ability to deal with crowding varies with different cultures. Different types of housing or settlements serve as more or less successful devices for controlling densities (3). As densities increase and crowding occurs, people have a tendency to separate their domain from their neighbour's in order to retain their own "bubble" of space, to avoid noise, and obtain privacy, for they no longer possess large distances between themselves and their neighbors to keep their "bubbles" intact and obtain visual and other types of privacy. The result is a well defined private domain, preferably surrounded by a higher than eye-level wall. With the elimination of required distances between neighbours, the building can start at the edge of the site and can theoretically occupy the entire site. The necessity of acquiring air, sunlight and a possible garden or a piece of nature on the plot forces a volume to be cut and removed from the building mass. The resulting void becomes the courtyard (Fig. 2.2). The focus of the house is on this void, an outdoor yet sheltered space, perhaps regarded inversely as a part of nature enclosed by the house walls.

Exterior Space

Territorial space may be demarcated by both interior and exterior space. The nature of the boundary that distinguishes internal space from external space is of utmost

importance (4). Space is formed by the relationship between an object (the house, walls,
etc.) and a human being who perceives it. The object inevitably creates a boundary that acts
together with the ground plane. Elements such as walls describe these boundaries or limits,
and define spaces as well as their qualities (Fig. 2.3 a). For instance, when a natural
element such as a tree is surrounded by walls, exterior space is created around the tree.
Exterior space is created by delimiting "nature", and is thus separated from "nature" by a
frame or a wall (Fig. 2.3 b). Exterior space develops within itself a centripetal order, since
it is surrounded and enclosed (5). Thus, it becomes a positive space, bordered with human
intentions and functions, all created inside the frame (6).
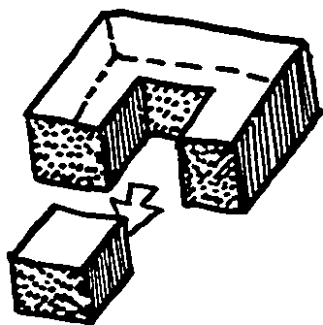
Fig. 2.2
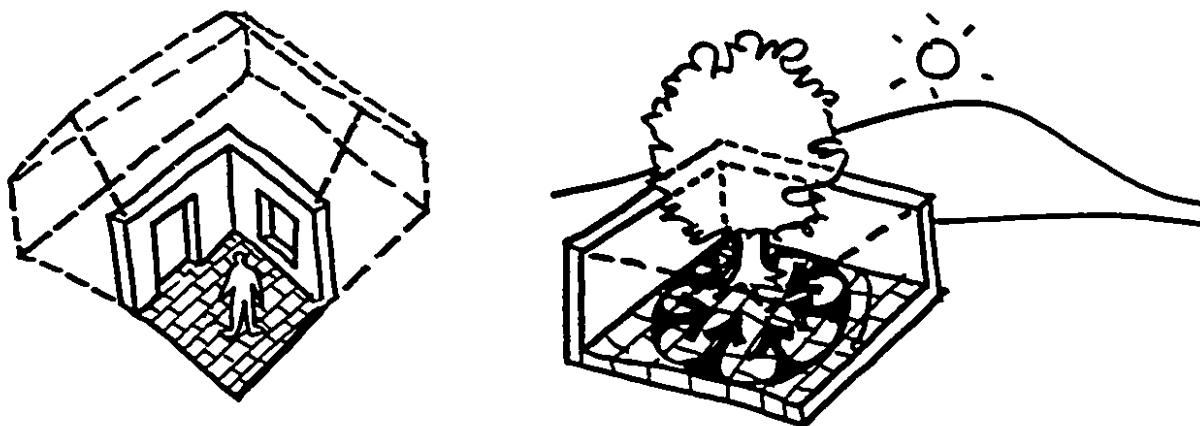
Fig. 2.3 a. and b.

Courtyards do not extend infinitely but are delimited, creating an order of "inside"
and "outside". Thus, the courtyard is a private architectural exterior space demarcated with
a floor and at least two walls, without a ceiling, open to the sky. It is the focal feature of the
very boundaries that delimit it, the house. Whether or not it was conceived initially as a

subtractive form carved out from a solid (the smoke-hole/impluvium-atrium concept) or was the result of the leftover outdoor space in a compound of several structures clustered around an enclosed, exterior open space (the rural farmstead/tribal compound concept), the nature of the space remains the same. The primary socio-cultural factor is the desirability to attain introvertedness, with activities focused on an enclosed exterior space, a courtyard.

Having delimited the courtyard territory and established the kind of space it represents, the main questions remaining are: what are the different types and sizes of courtyards and what are the modifying factors dictating their form, configuration, scale, proportion, and orientation?
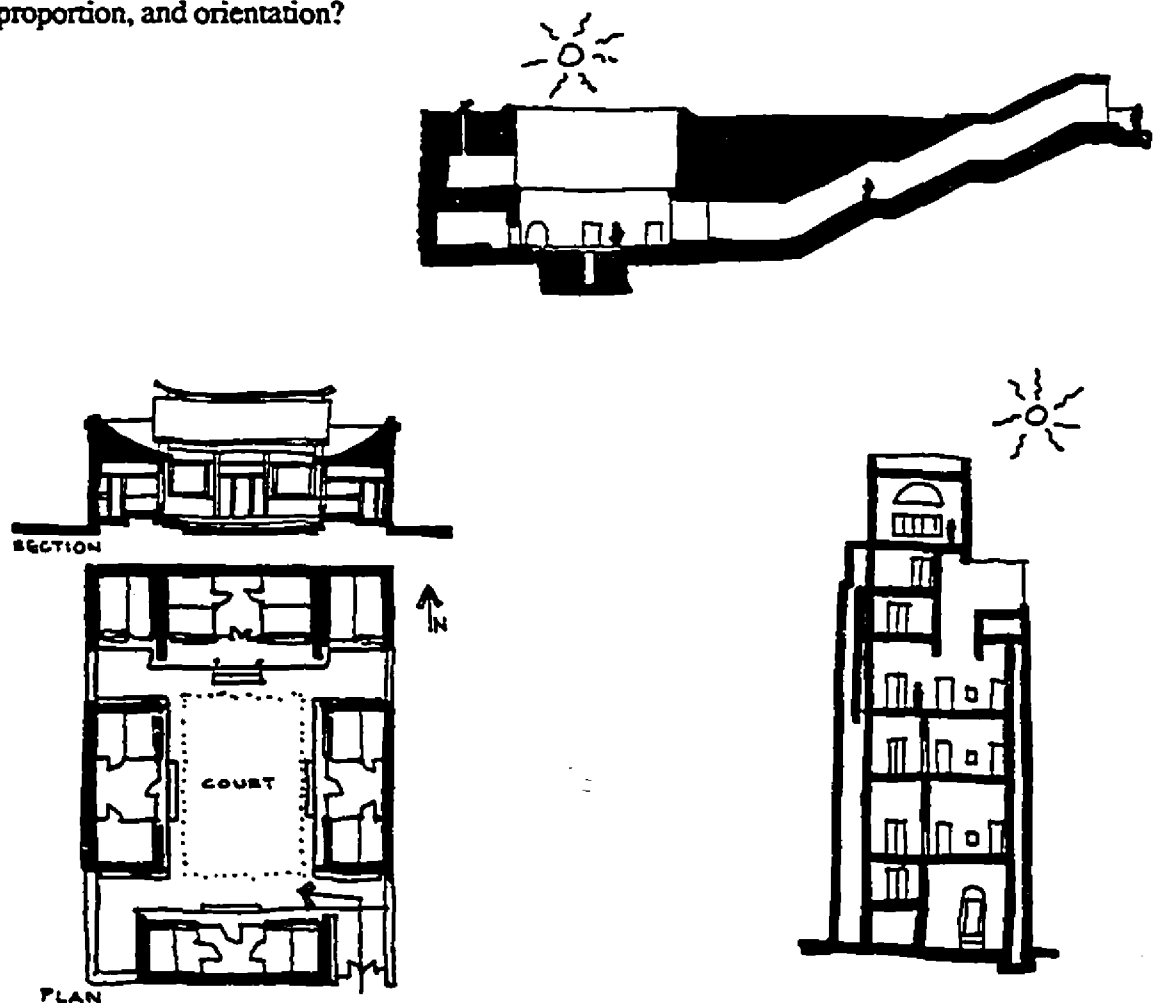
Fig. 2.4 a. Sunken courtyard in the Sahara region (After Bukamur). b. Standard courtyard in a Chinese dwelling (after D.K. Ching). c. Elevated courtyard in Yemeni tower house, San'aa, Yemen (after Sergeant).

There are no established rules that apply to the proper sizing or proportioning of the courtyard and its enclosure. One cannot establish formulas or rules of thumb to determine these factors or their outcome. However, variables and parameters can be set within which the courtyard may be sized, proportioned, and its position located within the house. The factors affecting the size and ratios controlling a courtyard's width, length and height are diverse and vary with cultural, geographical, regional and climatic differences. These include the desirability to obtain the sun's radiation or to escape it, and the amount of sunlight desired, as well as the desire to capture the wind or to deflect it. Other factors include psychological determinants affecting the feeling of enclosure within different cultures as well as socio-cultural controls affecting the degree of introvertedness required.

Careful thought must be given as to how to orient, design, plant, proportion, size, and enclose a courtyard or courtyard garden in a given location for a particular geographical or cultural setting. Through proper conceptualization, one can attain a truly livable courtyard, efficient both as a microclimatic moderator and as an attractive, humane, outdoor living environment. The most important factors dictating the size and proportions of the courtyard are communicated in more detail below.

Type and Size

One could categorize courtyards in numerous ways, based on various criteria. For the purposes of this study, courtyards are categorized according to their location with respect to the ground plane. Thus, *standard courtyards* are located at ground level, *sunken courtyards* are located below the ground plane, and *elevated courtyards* are located above the ground plane (Fig. 2.4 a, b, and c). Each possible type of courtyard may best suit a particular situation, and consequently would have its size and proportions affected, for each has to have an optimum shape and size to perform adequately. Another related factor may be the type of available technology in a particular area which would restrict shape and size. Availability of space is also an important factor, for it may affect the choice of courtyard type as well as its actual physical allotment. Each courtyard type generates specific housing

typologies which may best suit a particular climatic condition, as will be shown in the next chapter.

Latitude

The courtyard house receives most of its natural daylight through the courtyard. Thus, the courtyard has to be wide enough to receive the desired amount of sunlight. This required minimum width varies from latitude to latitude. The nearer one gets to the Equator, the smaller the width requirements, for the sun tends to attain a higher orbit. Conversely, courtyards require wider proportions to capture the low winter sun as one moves nearer to the Earth's poles. These considerations affect the proportions and size of the courtyard. Thus, the nearer its location is to the Earth's poles, the greater are its width requirements, and consequently the greater its size and lower the height of its enclosing walls. This also implies, for instance, that courtyard houses located in more Southerly latitudes (of the Northern hemisphere) require less area for their courtyards and may actually acquire higher densities because of the possibility of having smaller courtyards (hence smaller plots) and multiple stories. The possibility of acquiring higher densities through the provision of medium-rise courtyard housing is also more valid in locations of lower latitudes, for the multi-storey character of the house itself provides shade, a welcome situation in most locations in Equatorial latitudes.

Density

The dense, Arab courtyard houses packed in a cellular pattern or the compact dwellings located in the Greek islands and their subsequent settlements could be attributed to the needs of defence, lack of financial and material resources, (so that the houses shared walls and often themselves had to form the city wall), lack of arable land and the need to conserve it, the need for protection against undesirable winds and the climatic need for shading (Fig. 2.5).

Since all of these factors undoubtedly play a part in obtaining higher densities, no single factor could be considered as the most important. It is perhaps not by coincidence

that the need to provide courtyard housing with sparse densities in order to capture the maximum amount of low Northern sunlight also reflects the Northern dislike of crowds. Inversely, this phenomenon applies equally to courtyard housing located in equatorial territories where the affection towards crowding by most people living in these areas coincide with the necessity of houses being tightly nestled together, as well as to the higher densities imposed by overpopulation.
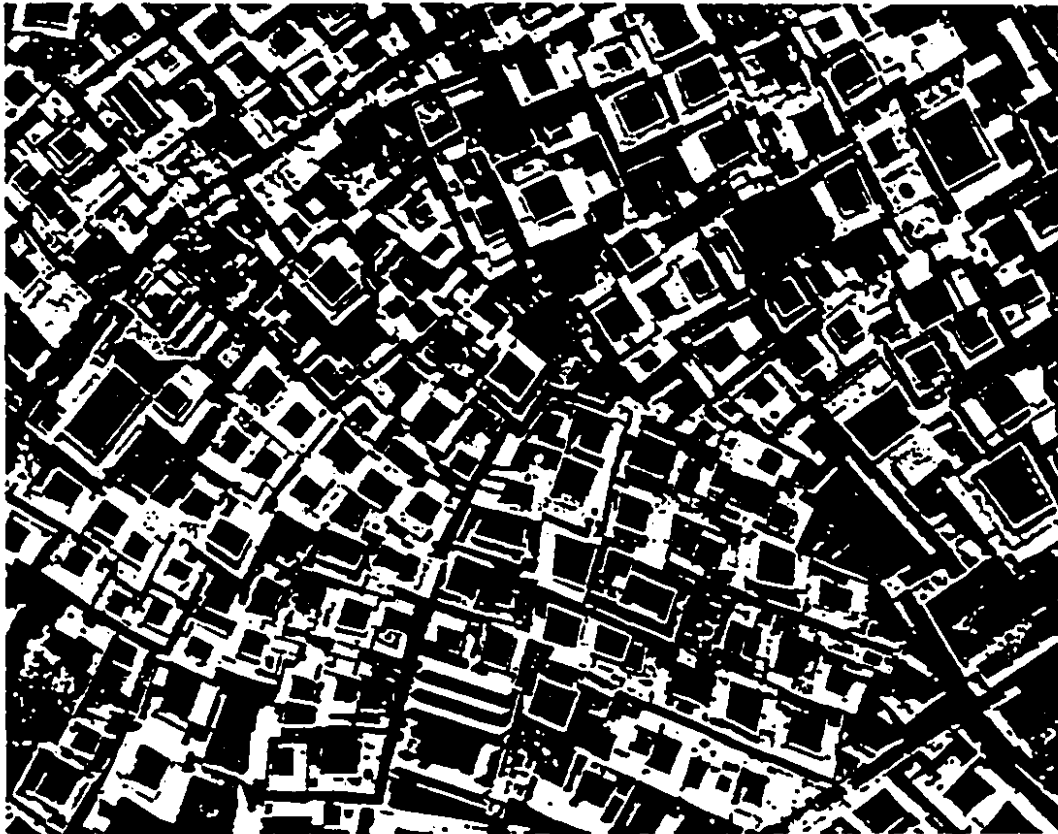
Fig. 2.5 Marakesh (Morocco). Aerial photo of traditional courtyard houses (from Chiaia).

Culture and Feeling of Enclosure

Different societies of the world have different notions about the degree of enclosure an exterior open space or a courtyard should have. This may have to do with the degree of sociability of a particular culture, psychological factors propagating a morbid dread of

confined spaces, as well as elements of choice, as exemplified by a fondness of crowding (7). Native Canadians and certain nomads may never accept the concept of enclosure around their own dwellings because their sense of territoriality is completely different from that of possessive cultures. For instance, Native Canadians or Arab nomads traditionally have no sense of land possession. People belonging to such cultures may actually feel claustrophobic in an introverted, walled environment, and may never accept to live in an enclosed courtyard. Arab town dwellers, on the other hand, may feel very much at home in a tiny courtyard with very high confining walls.

Fig. 2.6 a. D/H=1:1, b. D/H=2:1, c. D/H=3:1, and d. D/H=4:1.

Proportions and Feeling of Enclosure

Feeling of enclosure in an exterior space is determined by the relation of viewing distance to building height as seen by our normal frontal field of view (8). When we look ahead, our normal frontal field furnishes us with a general impression of the space we are in. Our perception serves as a three-dimensional visual scanning device, and, together with simultaneous images of the space observed and proce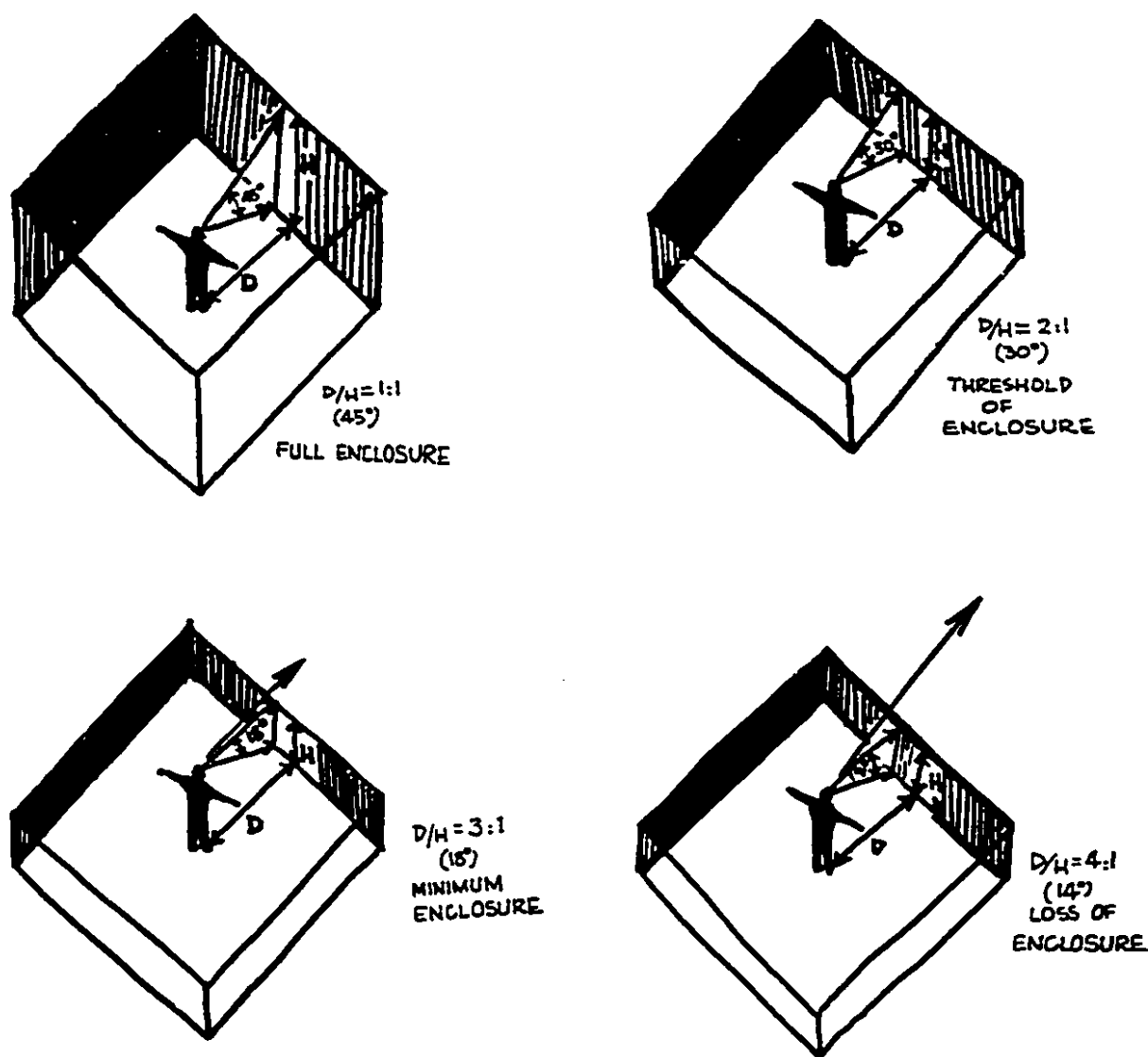ssed in the brain, relay the information to our consciousness which determines the degree of enclosure, the sense of space or the lack of it which we feel.

The following are some rules of thumb concerning the feeling of enclosure in exterior open spaces, adapted from Spreiregen (9) and Ashihara (10). Although both refer to urban open spaces such as streets and piazzas, these proportions and recommendations can be applied equally to courtyards, for they are based on proportions of visual factors.

When the height H of a building facade equals the distance D of the observer from the same building facade, i.e. D/H=1, the cornice would be at a 45° angle from the horizontal line of our forward sight (Fig. 2.6 a). Since the enclosing walls would be much higher than the upper limit of our forward view (30°), we feel well enclosed. Different spatial qualities may be attained by increasing or decreasing the D/H ratio. As this ratio increases, the space opens up and there is less feeling of enclosure. When D/H is between 1 and 2, a sort of balance is achieved (11). When a facade or wall height equals one half the distance we stand from the building, (D/H=2), it coincides with the 30° upper limit of our normal view (Fig. 2.6 b). This is the threshold of distraction, with the enclosing walls attaining the lower limit for creating a feeling of enclosure (12).

When the facade height equals one-third the viewer's distance from the building (D/H=3), the top is seen at about an 18° angle (Fig. 2.6 c). The space gives an impression of expansiveness or vastness. Visually prominent objects beyond this space are perceived as much as the space itself. When D/H=4, the top of the wall is seen at a 14° angle and the space loses its containing quality and peripheral facades function more as edges (Fig. 2.6 d). Spatial sense is all but lost and we are left instead with a sense of place (13).

When D/H falls below 1, space grows increasingly intimate until eventually a

feeling of restriction and claustrophobia creeps in. Different locations, cultures and situations require different D/H ratios, and the above mentioned proportions should be considered as mere guidelines, as each particular situation should be handled separately. Spatial enclosure is also a matter of continuity of wall surface, and too many gaps in the walls, abrupt changes in the cornice height, and drastic facade variations will weaken the feeling of enclosure.

In tiny Arab courtyards the D/H ratio may be 1/2 or less, for the sun being in a near vertical position maximum shade may be provided in this fashion, whereas a D/H ratio of 3 to 4 may feel very appropriate in a Scandinavian or Canadian courtyard (Fig. 2.7). In any case, enclosure may also be achieved by the introduction of various landscape devices such as overhangs, trellises, climbing plants, trees, etc. However, sunlight and feeling of enclosure are not the only factors affecting the proportions and size of the domestic courtyard.
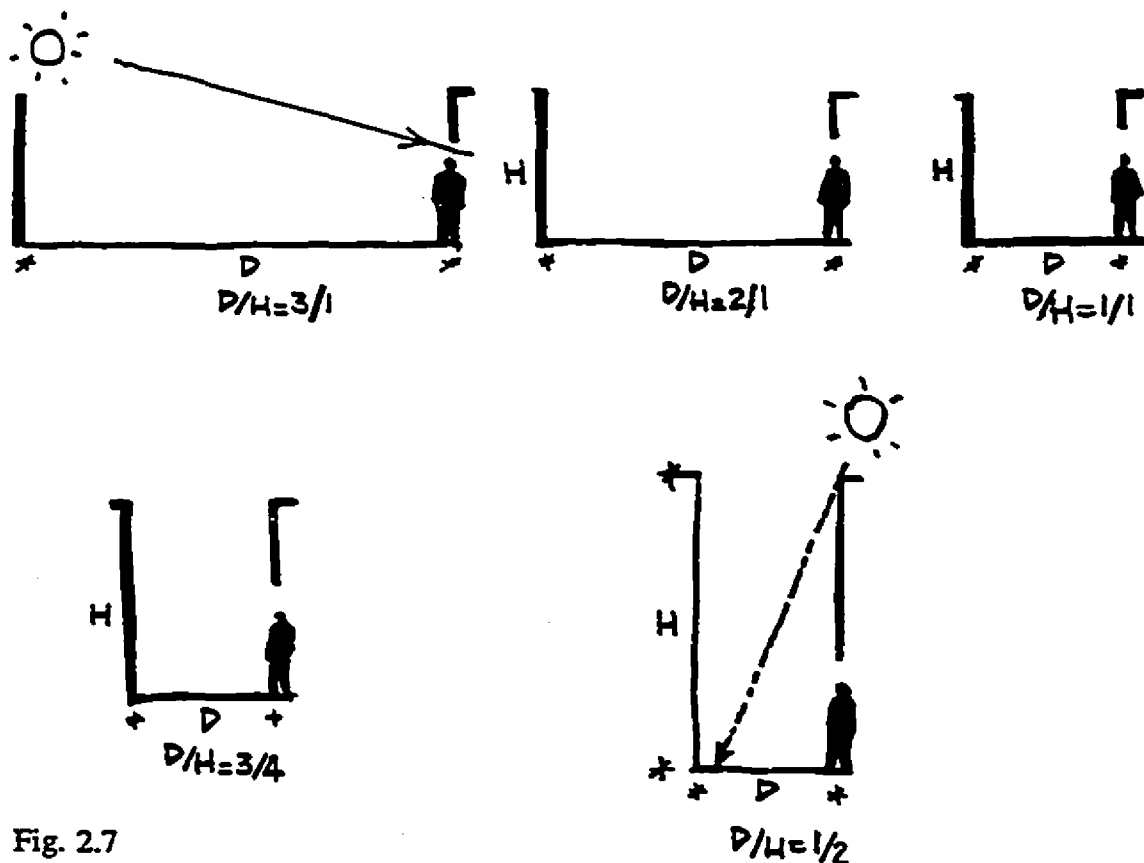

Fig. 2.7

Proportions and Acoustics

Acoustics play an important role in the proper proportioning of the courtyard if noise elimination is to have an effective role in the design. The need for open courtyards create problems of privacy, particularly acoustic privacy. Some cultures tolerate very high noise levels and accept less acoustic privacy while others require social as well as physical controls (14). Courtyard housing is extremely adequate in eliminating noise emanating from neighbours, for it is introverted and most noise is considerably reduced before it leaves the courtyard. However, it is preferable to have the neighbour's blank house wall adjacent to one's own courtyard wall rather than the neighbour's courtyard wall for the building mass and the distance between the two courtyards greatly reduce the noise levels (15). According to Schoenauer and Seeman, both the width and length of the courtyard each have to be at least twice the largest height-dimension in order to be acoustically viable as a noise control device (D/H≥2). The higher the enclosure, the greater the area required in the courtyard to eliminate noises (16). Contemporary architects may use the D/H ratio to obtain desirable sunlight and privacy, or eliminate noise. It is up to the architect or designer to achieve the desired balance between the two requirements.

Different locations and cultures require houses of different sizes. Some houses may be too large and more than one courtyard may be required to cope with the larger house area. Other courtyards may be open ended at one or more sides which gives the effect of a partial enclosure. The desired size and proportion of the courtyard have to be considered in relation to all of the above mentioned factors and have to be weighed in relation to other factors to be discussed below.

Outdoor Rooms

(farmhouse) courtyards and the dimensions thereof should be determined by the number of cattle and the number of yokes of oxen that will need to be kept herein .

Vitruvius 6.6.1 (17)

Whereas the number of domestic cattle would hardly constitute a vital criterion for

dimensioning a contemporary courtyard, the message remains clear even after two millenia: courtyards should be dimensioned to serve their purposes.

Courtyards can be large enough to cultivate food or quite tiny, suitable only for miniature ornamental gardens or light and air wells. Speculative mass-produced housing has often resulted in courtyards taking the form of underused backyards, light wells, or simply unhealthy areas given over to garbage and decay (18). Care must be taken to avoid these situations, for a typical courtyard should also be able to serve as an outdoor living area or as an extension of indoor living activities. Its introverted nature should ensure social privacy and permit a multitude of uses (19).

All courtyard activities are performed in complete privacy, without disturbing the neighbours or being disturbed by outsiders. Sensitive designers may actually put the courtyard and its functions to full use thus creating domestic outdoor spaces of great beauty. The courtyard plan must be logically proportioned, and may have a square, rectangular, polygonal, circular or any other configuration.

Vitruvius describes three atrium plans based on the courtyard proportions of length L to width W (Fig. 2.8). The first has a proportion of length to width of five to three (L/W=5/3), the second has a proportion of three to two (L/W= 3/2), and the third, an atrium in plan whose width is used to describe a square figure, with the courtyard being assigned a length equal to the diagonal line of this square (L/W=√2/1) (20).
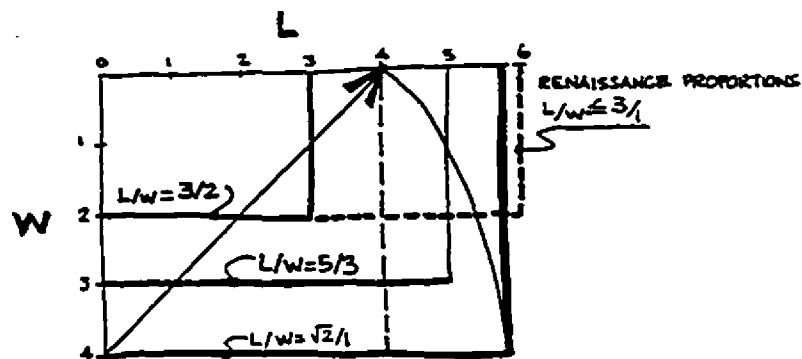

Fig. 2.8

These proportions give a pleasing feeling of harmony to the courtyard enclosure. For Renaissance architects, however, it was imperative to have open spaces with length to

width proportions not exceeding three to one (L/W=3/1), for spaces with larger proportions would have the illusion of the space "leaking out" (21). The Renaissance proportions conform to Vitruvius's standards. All these ratios, if relevant, should be used in conjunction with the D/H ratios discussed previously.

To be fully livable, the courtyard should allow for an environment where the needs of human comfort are met sufficiently through the appropriate use of sun, shade, light, wind, air r- vement, and humidity. The role of the courtyard as a micro climatic moderator is of prime importance, and is discussed below.

Courtyards and Microclimate

Well conceived courtyards possess their own microclimates. This is effective for both diurnal and seasonal environmental variables. A courtyard may be cool during the day when the ambient temperature is high, and warm at night when it is low. Solar heated air in the courtyard rises and causes air movement at noon, sucking cooler air down from nearby shaded alleys or wind catchers, thus creating breezes during the most uncomfortable time of the day (Fig. 2.9). When a shaded court is used in conjunction with a sunny court, where the shaded one is located on a slightly lower level than the sunny courtyard, the heated air will rise, and cool air will flow from the shaded courtyard into the sunny one passing through intermediate rooms, thus creating cross ventilation (Fig. 2.10).
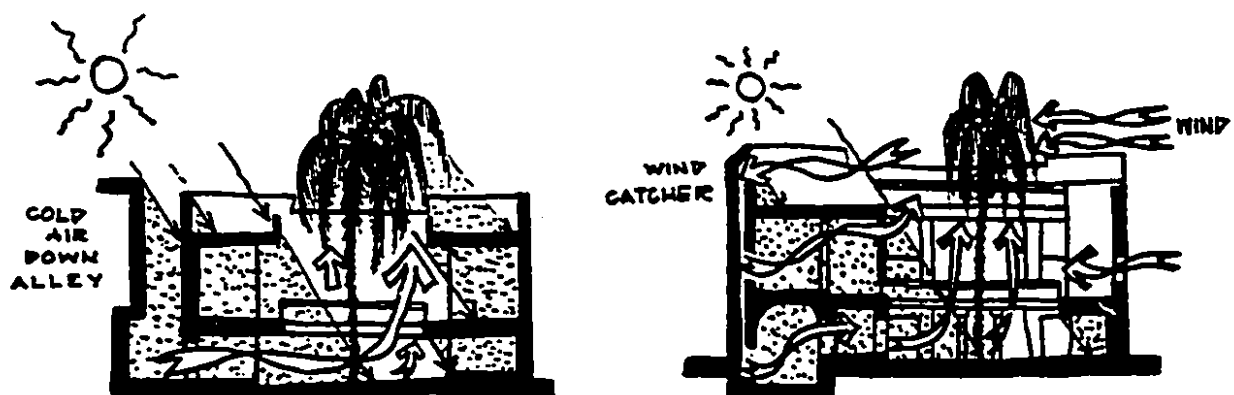

Fig. 2.9 Climate control in Islamic courtyards (after Schoenauer).
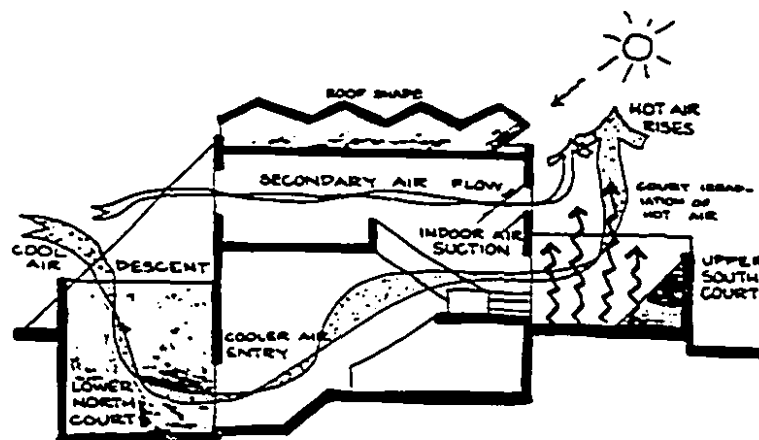
Fig. 2.10 Cooling and ventilating effect in double courtyard (after El-Masty).

When provided with greenery, water and shade, the courtyard acts as a cooling well and modifies the micro-climate drastically (by lowering ground temperatures and radiation by evaporation). Deciduous trees in a courtyard provide shade in summer yet let in the winter sun. Temperature, humidity and light may be each modulated towards a desired result by the form of the patio, by the sizes, types, and colours of the garden plants, paving, and by the colour and treatment of walls (22). Heat and glare can be reduced through the provision of vegetal ground covers, trees, as well as pools of water inside the courtyard (Fig. 2.11).

Water and vegetation increase humidity levels through evaporation and also have soothing psychological effects, adding to a pleasant outdoor living area. Other humidifying devices include trickling water pools and fountains, the trickling of water over grass matting in windows, and the utilization of porous pottery, as found in traditional houses of India and Egypt (23).

In windswept areas, courtyards and their walls protect from winds and also give protection from sand and snowstorms (Fig. 2.12). The courtyard receives much less blowing snow (or sand in desert areas) than houses with open gardens, all due to the densely packed nature of the houses as well as the high courtyard walls.

Fig. 2.11 Factors affecting the physiology of the courtyard (adapted and modified from Bagneid and other sources).

Fig. 2.12 (after Bjorkto).

Fig. 2.13

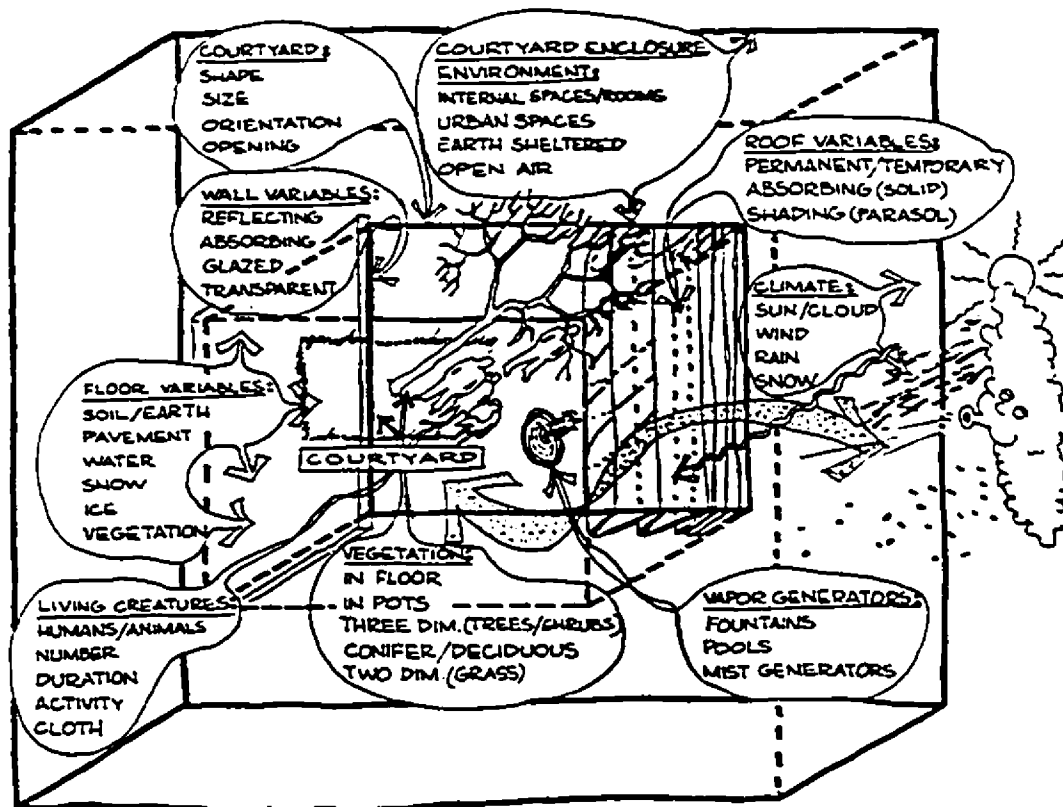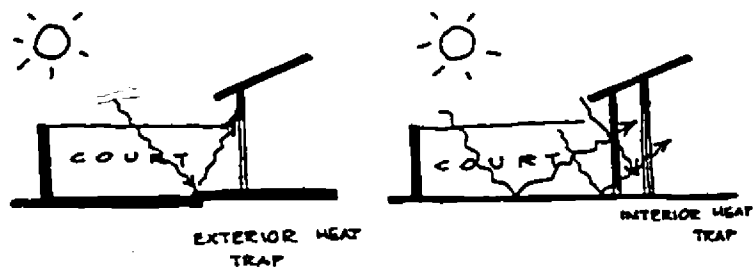The courtyard is a natural solar collector if it is designed and oriented to be so (Fig. 2.13). The South oriented courtyard in the Northern hemisphere is necessary in cold countries such as Canada and desirable in other countries with temperate climates.

However, in hot, desert regions it is absolutely necessary to orient courtyard houses away from direct sunlight as much as possible. Solar penetration must be considered in conjunction with latitude, climate, and other priorities such as density and function and must be planned accordingly. Since the courtyard house has a walled garden, sunlight may enter rooms directly or by reflection off the opposite courtyard walls. This characteristic makes several of the planning concepts omnidirectional in many climates. The softer, diffused and penetrating quality of reflected sunlight in a house, and the view from inside onto the facing sunlit patio wall, will often be preferred to shaded walls, except in desert-like climates where even the brightness of the reflected sunlight may cause a blinding glare. In such instances, additional precautions have to be taken to diffuse the light penetrating the household. It may be preferred that some parts of a house look into a shaded, vegetation-filled patio with cool air, rather than the intensity of sunlight. Considerable skill is required to solve these problems and much can be learned by studying vernacular buildings and the solutions for solar control and the modulation of light which have evolved over time. Solar control devices include louvers, shutters, wide overhangs, arcades, galleries, and *musharabiyyas* (open arab screenwork windows).

Sunlight and the resulting microclimate can also be moderated and even controlled through the provision of several types of courtyard covers. Although most courtyards are open to the sky by definition, extreme climatic conditions force them to be partly or totally covered in order to moderate the microclimate. These covers control the amount of sunlight entering the courtyard, or, contrariwise, could act as devices to retain the heat and radiation received from the sun. These covers could be fixed, mobile or operable, permanent or temporary. For example, the Colloseum in ancient Rome was covered by a sail-like cover to provide some comfort to the spectators from the scorching Roman sun. Similarly, the Roman peristyle received additional shade in summer through the use of red-dyed veils

called *courtinae* (24). Similar tent covers are still in use in traditional Iraqi courtyards and Spanish patios-where they are referred to as *tendidos*. There is no reason why contemporary architects cannot design completely operable, tent-like covers for courtyards which would let breezes in, let hot air escape, and provide just the right amount of desired sunlight. Ivy-clad trellises can also provide shade, and solutions to hotter temperatures include the complete elimination of sunlight through the construction of dome-like structures with clerestory windows for ventilation and natural lighting, or the complete covering of the courtyard with a slab except for a small opening in the roof (Fig. 2.14 a and b). These solutions, radical as they may seem, reduce or eliminate the sun's access to the courtyard and hence to the house and result in a better microclimatic control.

Conversely, glazed, greenhouse-like courtyards with operable windows may be used to capture and retain as much sunlight as possible in areas where it is desirable, and may provide for a pleasant, heated and green courtyard space in long, snowy winters.

Fig. 2.14 a (after Bagneid) and b (after Aymo).
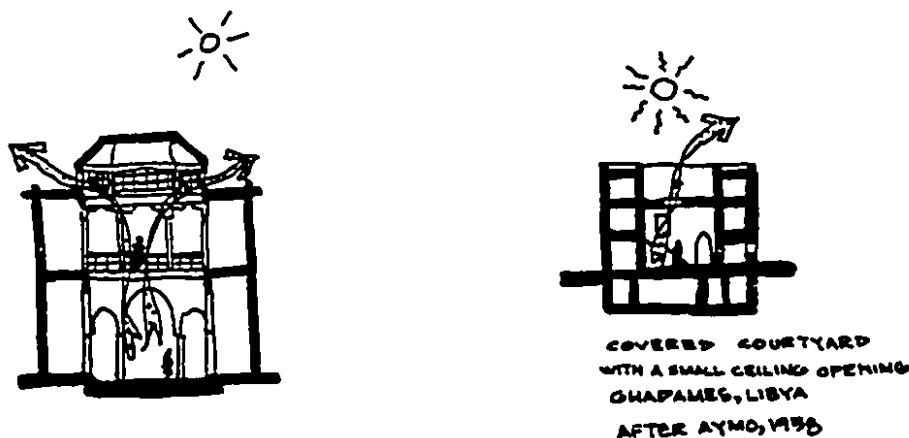
The Secret Garden

Microclimatic features make the courtyard an ideal place to cultivate plants that are indigenous to a warmer climate (or a colder, more temperate climate in desert or equatorial areas). Courtyard walls act as backdrops for plant life, and offer protection from the wind and excessive sunlight in desert climates, and provide additional reflected sunlight. Walls

also radiate heat that is captured during warmer periods of the day, thus contributing to the microclimatic factors affecting the courtyard and its plantlife. The courtyard enclosure helps retain more moisture in the courtyard thus extending vegetal lifespans. The location of plants, their protection from cold draughts, as well as the amount of sun and shade they receive must be carefully planned for different zones in a courtyard, for these may also have different microclimates.

Snow, when retained in courtyards in winter has the advantage of being an excellent insulator. Thus, a layer of several feet of undisturbed loose snow on an exposed courtyard floor insulate the earth below from any ground frost. This protects the dormant plant-life, and offers a better opportunity for early spring propagation (25). The reflections off the snow in the courtyard also act as a secondary light source for the house.

A tiny, well-designed courtyard garden can have the visual effect of a much larger garden, for young trees and new planting appear more in scale within an enclosed space (26). The effect of visual depth is also better achieved through the creation of several layers of foreground, middleground and background planting. In addition, a tiny courtyard is much easier to plant and maintain than a larger garden (27). Courtyard gardens offer an incentive towards gardening and landscaping, for the owner of a courtyard garden will appreciate the quick results obtained from the little time consecrated to the task, especially as opposed to the high maintenance conventional suburban front lawn. A front lawn must conform to the expected image at all times, whereas one can work on a courtyard garden when and how one pleases. Besides, contemporary individuals do not possess substantial amounts of time to devote to the upkeep of larger gardens.

The courtyard garden can be planted by a variety of different species of the owner's choice, whereas the 'front lawn' and often 'back-yard' of a typical detached suburban house has to follow the planting norms established by others. A partially paved court will reduce both maintenance and material costs, as well as provide substantial economies in irrigative water. The paved area will also serve outdoor activities.

The courtyard garden has a well-defined limit. It does not extend visually into the street or neighbour's yard. The lack of well-defined garden borders often discourage potential gardeners from commencing the gardening task at hand (28). It becomes the

responsibility of the inhabitants to maintain their courtyard gardens, not an obligation to the community. If one chooses to neglect the maintenance of one's courtyard garden, it will only affect the household concerned and no one else.
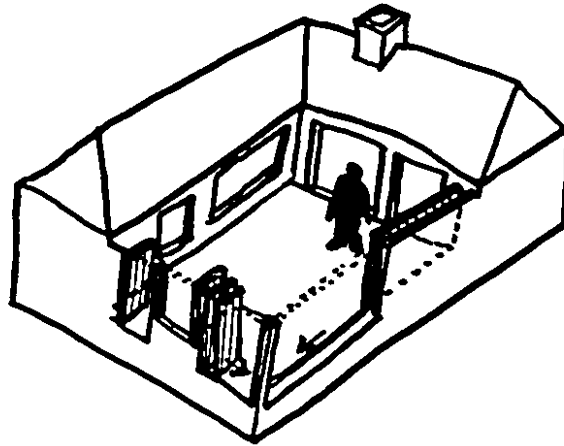
Fig. 2.15

Some courtyard walls may be pierced to extend the spatial and visual limits, if exterior conditions permit. The existence of surrounding open grounds, nature and spectacular or panoramic views contribute to the decision to provide courtyards with views. Exterior walls may be equipped with retractable doors or shutters (Fig. 2.15). Apart from controlling views and privacy, these shutters may also be used for microclimatic control. The pierced walls may also serve as landscape elements, framing selected choice views while eliminating undesirable ones. Contemporary inhabitants may eliminate as many as two exterior courtyard walls while retaining a feeling of partial introvertedness, as total seclusion may neither be a necessity nor a desire. This type of patio house is best observed in Jorn Utzon's Kingo housing project in Denmark, where the focus of the house is the court-garden, yet large cuts in the exterior courtyard walls expose the courtyard to views of the surrounding landscape (Fig. 2.16 a and b).

Effects on Working Individuals

People in the industrialized world often spend their workday in a synthetic environment, where the air and climate are artificially controlled, and their physical

surroundings are based on "production efficiency". In the near future, perception may be controlled by computer screens, artificial imagery and virtual reality. People have, and will continue to have an urgent need for direct contact with nature. A stronger sense of reality and solidarity with nature has to be established, at least at home, in order to counterattack the effects of this artificial "reality". Exposure to plants and other forms of life, as well as climatic, diurnal and seasonal variations, must be both visual and physical, thus creating a sense of merging with nature.

Even a tiny private courtyard-garden, open to the sky and the elements, fulfils the occupant's need to be in contact with nature. It also confines the extents of his/her vision, thus demarcating his/her territory and providing a frame to enjoy the ever-changing diurnal and seasonal time. Thus, the escape from everyday city chaos, the realization of territoriality and the constant exposure to nature and solar time make the residential courtyard an ideal remedy for the contemporary "cybermedia" syndrome. The contemplative nature of the courtyard garden has healing effects which individuals in an industrial society require.

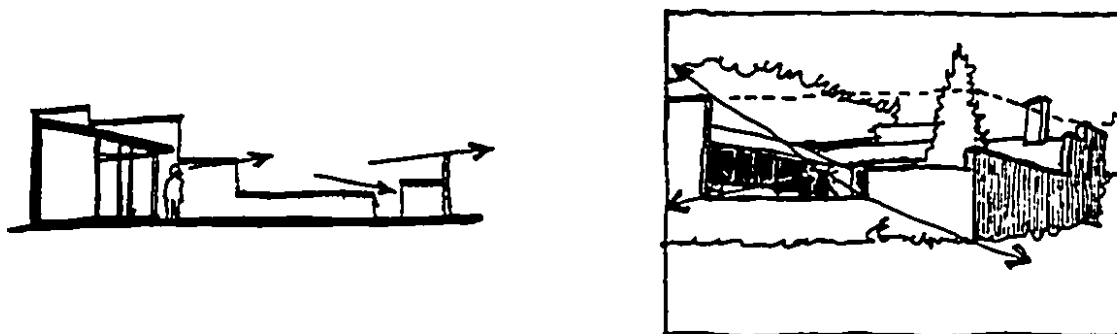Fig. 2.16 a. Section and b. views through a typical courtyard in the Kingo housing estate. Jorn Utzon, architect.

Dust Control

,   The courtyard can be used to control dust entry into the house. Both enclosing walls and the surface treatment of the courtyard floor restrict the circulation of dust in the court enclosure (29). That most courtyard houses have their fenestration opening onto the

courtyard is a big asset in dust control, especially in desert areas. However, most courtyards with paved surfaces accumulate a substantial amount of dust and have to be swept or washed down periodically. Accumulated sand from desert sandstorms may have to be removed periodically as well. Plant material, such as ground cover and low bushes, prevents the creation of midday wind turbulences in summer which can bring a significant amount of dust indoors.

Regionality and Character

Last but not least of all the virtues of the courtyard is the fact that it expresses individuality and character. One can easily discern a courtyard's "nationality" or "ethnic belonging" from its design elements. A Chinese courtyard, for example, is invariably oriented to the south and is the setting of everyday family life. It is axially symmetrical, and is surrounded by elevated pavillions on four sides. The courtyard's corners are hollow, occupied by *erfangs*, or 'ear gardens' to provide visual depth.

Japanese courtyards, on the other hand, are mostly contemplative. They create a miniature universe within themselves. Plants, water, rocks and other landscape elements recreate an idealistic landscape and the illusion of a much larger scale. Tension is often created by the total omission of plants in gardens of carefully selected and placed rocks of various configurations floating on seas of white sand or raked pebbles-perfect spaces to ponder at and contemplate.

Arab courtyards are distinguished by the presence of trickling fountains and lush greenery, representing the garden of Eden, and are in stark contrast to the exterior desert environment. They are microcosms of an idyllic environment, where water and greenery predominate. Often, rich, complex geometric arabesque tile patterns covering the enclosing walls and floor replace plants and still evoke a paradisaical garden.

Careful studies of many other "ethnic" courtyards worldwide would reveal unique and personable characteristics all their own, and would add to the richness of worldwide "courtyard culture".

Architects conceive courtyards with particular intentions. The results are courtyards

with individuality, distinctive characteristics and distinguished design elements, acting as
"signatures" for particular architects. For instance, Le Corbusier's courtyards are
diminutive forms carved out of solid rectangular house volumes (Fig. 2.17). They are
invariably elevated and linked to the roof by ramps, making the entire roof and courtyard
ensemble an artificial, sculpted concrete landscape. Mies Van der Rohe tried to establish a
continuity between the indoors and the courtyard through transparency. His outer house
walls opening on the court are completely transparent. The floor plane, the cantilevered
roof and solid lateral walls are continuous from inside to out. Courtyard walls never
intersect-they continue past each other, creating the illusion of spatial flow and continuity
(Fig. 3.4). Alvar Aalto, on the other hand, uses the functional spatial form of the
courtyard, shaped as an outdoor room or lecture theatre, to determine the shape of the rest
of the house (Fig. 2.18).
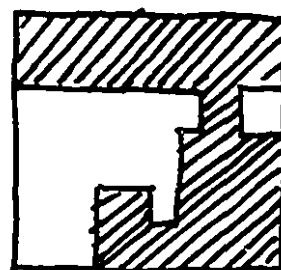
HOUSE AT POISSY
LE CORBUSIER.
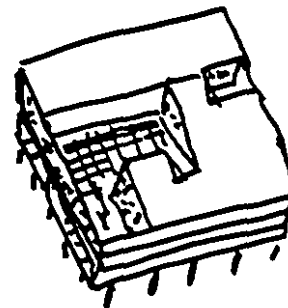
Fig. 2.17 (after Le Corbusier).

Both Luis Barragan and Tadao Ando conceive minimalist courtyards with few
design elements. Both use sunlight as a major design element, and both end up with empty
looking, Surrealistic and 'de Chirico'-esque courtyards. However, their courtyards are
very different from each other. Barragan lets the warm, changing Mexican sunlight bring
out the presence of the tall, plastered, textured, and colored courtyard walls. These act as
backgrounds for lonely trees, tall vases or a low fountain or waterfall, often set in rough-
textured floor tiles of volcanic rock. The quality of light changes dramatically due to the
rich variety of textures present and the halo-like atmosphere created from reflections off
different bold, warm colors.
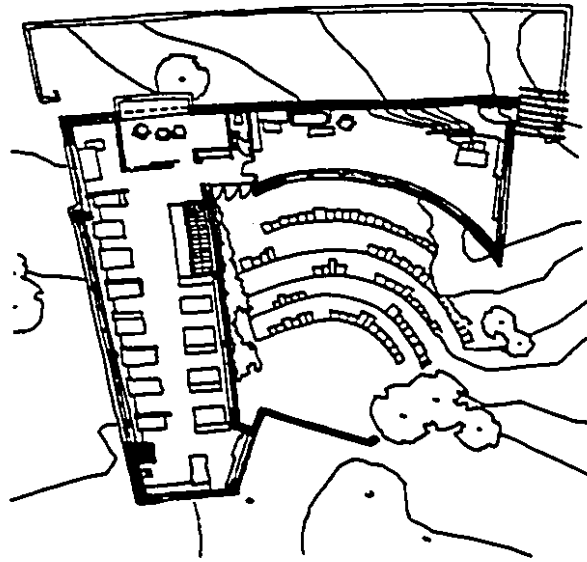
Fig. 2.18 Alvar Aalto's home and studio in Helsinki, 1955.

Ando's raw concrete courtyards are mostly devoid of any visible objects. The courtyard is given life by the play of natural sunlight on the surfaces creating sharp contrasts in light and crisp, complex shadow patterns, all changing continuously throughout the day. Often, ground covers are planted on an inclined, 'for your eyes only' courtyard floor to increase planting area, provide visual illusion and obtain more sunlight. His courtyard aesthetics result in an expression possessing a perfectly executed, almost 'hard' look without the syntheticity and coldness associated with other immaculately constructed projects. As can be seen, the methods to animate and give individuality to a courtyard are numerous and can be personalized.

This study does not pretend to have covered all the pertinent influences affecting the physical shape and size of the residential courtyard. Special circumstances may cause the courtyard to possess particular characteristics or have special requirements whose analysis is left to the discretion of the reader.

The courtyard defines the domain of the house or private indoor space through its own clear definition of private outdoor space. Although examined as a separate entity in

this chapter for reasons of convenience, it forms part of the territory of the whole house. Its influence on the house is as important as the influence of the house on the courtyard. Several factors and components influencing or forming parts of the courtyard will be discussed within the context of the house in the following chapter, for the courtyard and the house form an inseparable entity.

Chapter Three
A House For All Seasons

The following section will analyse the physical components of the courtyard house and their variables, as well as their socio-cultural and psychological implications. The newer courtyard housing schemes represent many improvements and innovations over traditional courtyard houses for they include contemporary facilities such as vehicular parking spaces, utilities, and services, as well as a marriage between traditional and contemporary planning trends. However, a thorough understanding of traditional housing is imperative in establishing the proper role of each and every typology.

The Courtyard House

Since rooms in a courtyard house are completely introverted, there is really no need for the present setback requirements from the property line facing the street. As for the streetscape, it will have an enclosing, continuous exterior spatial character, rather than a disorganised "arrangement", so characteristic of detached housing, for the houses will be nestled together and will form a continuous street facade, providing a vivid sense of urbanity.

The utility rooms may be placed between the street and the living areas thus reducing street related nuisances such as noise and odours. This also helps reduce the cost of links to municipal services since the utility rooms are nearer to the street and that is where most of the infrastructure occurs (Fig. 3.1).

If the courtyard house were free-standing, its exposed surface area would be equal or more than that of a simple rectangular house, and would therefore result in more heat

loss in the winter and consequently, more heat gain in the summer. However, courtyard houses are inevitably nestled together with at least two exterior walls protected from the elements. This, coupled with the fact that most of the fenestration overlooks the courtyard is thus protected from wind, results in less infiltration of cold air and greater fuel economy. The orientation of the courtyard, and thus the house walls to the South, may also result in considerable amounts of passive heat gain which also helps reduce heat costs in colder countries.
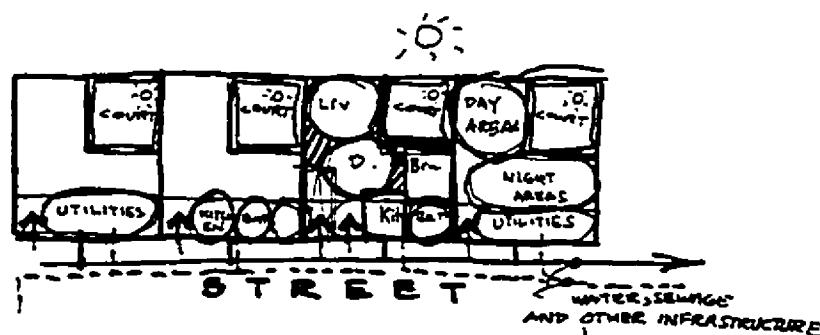
Fig. 3.1

Cross Ventilation

Cross ventilation occurs naturally in the courtyard house, for all major spaces and rooms have direct openings onto the inner courtyard. These rooms may have completely opening surfaces which can be located as desired and kept open at all times, for the patio is private and not subject to public glances as with windows in a conventional dwelling. Partial lack of cross ventilation in the side wings of courtyard houses adjoining neighbouring buildings may be resolved by the introduction of appropriately located rooftop skylight-windows which create air movement, somewhat reminiscent in function to the wind towers in traditional Islamic Courtyard Houses, sucking in colder fresh air or releasing hot, stagnant air.

Home Improvement

Housing should respond appropriately to the socio-cultural context and living

patterns of inhabitants in a particular area, and future house extension and expansion has to be considered in many cultures with growing family structures. The possibility of future expansion also has to be considered in courtyard housing. Individual houses have to offer the possibility of modification or extension according to the social and economic evolution of the user "family" unit. In theory, houses could grow horizontally, vertically, or both, according to need. However, house extensions are easier with ground related housing units, and they should be conceived in such a way as to permit progressive construction in several stages. Extensions in courtyard housing occur by the addition or extension of building wings (Fig. 3.2). A courtyard house may initially have only two wings, and with time may have four wings fully encompassing the courtyard.
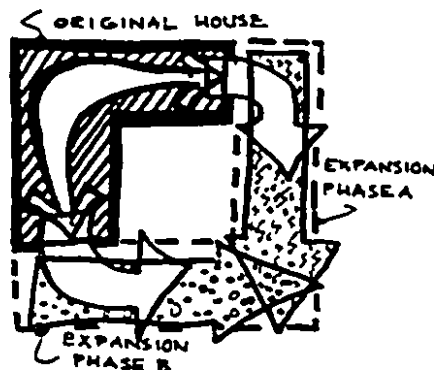
Fig. 3.2

Elements such as terraces, arcades, galleries and trellises may also serve as devices extending the house. They form covered platforms opening onto courtyards serving as a transition between indoors and outdoors, or as extensions onto streets and help regulate the microclimate. Patios and porches serve as breathing spaces for narrow front houses. They provide shade, and create pressure differences thus contributing to ventilation. For houses where extension onto the street may be desirable, these "devices" define territories, act as transitory spaces between indoors and outdoors, and may accommodate a wide range of social and work activities which require small, semi-public settings and contribute to the variety and richness of the streets.

Flexibility and Adaptability to Different Lifestyles

The courtyard house retains the freedom of individual self-expression, as opposed to the suburban single family detached house where there are many conformities to follow, such as washdays, maintaining and upkeeping of the front lawns, fences and hedges, etc. It is almost impossible to go against local taste and usage in a neighbourhood of single family detached housing units, whereas the courtyard house reestablishes this freedom completely (1). One is free to do whatever one wishes in one's own courtyard, without annoying or visually disturbing the neighbours.

A more drastic factor affecting conventional conformities is the recent shift in household structure. Family size and kind has been modified drastically and varies significantly from household to household and from culture to culture. Single-parent families, persons living alone, elderly couples, people of no relation to one another co-habitating, couples of different or same sex living together, and the persistence of young people in their parent's home are becoming trends rather than exceptions (2). Alternative lifestyles are becoming increasingly trendy in North America and Europe and the Nuclear family seems to be in a decline.

People are not living in the same fashion as they used to a few decades ago. For example, the dominant type of household in China is fast becoming the single-child family. The world is becoming a place with basic changes in family structure. These in turn imply changes in households and thus housing types. They also infer different housing typologies of different sizes and configurations for different locations and different households. The single-family detached house, located in a suburb and designed for the universal nuclear family of father, mother and two or three children, is not the *modus operandi* any more. What is required is a different house typology, with basic conceptual differences. In this thesis, an introverted form of housing is considered to be more suitable in coping with the needs of a changing society, for it provides maximum privacy from inquisitive peers, strangers, or neighbours, and allows freedom for new, alternative lifestyles.

A courtyard house exterior rarely makes apparent the occupant's lifestyle, status or ethnic affiliation. Furthermore, its interior configuration is well adapted to promote different arrangements for alternative lifestyles, especially since the entry and services usually occupy a central location in the house, halfway between the day and night wings. This makes the house naturally 'zoned' for partitioning as desired. In addition, its complete introvertedness does not allow for any offensive remarks or querries from neighbours.

Thus, people with alternative lifestyles co-habitating together and sharing a courtyard may behave freely in any fashion they desire, without offending visitors or upsetting their neighbours, for courtyard houses possess tremendous visual and acoustic separation. The separation among neighbours in courtyard houses make it easier for people of different age groups, social standing, or various ethnic religious groups to live side by side (3). In multi cultural communities and cities, people of different cultures, ethnicities, traditions and lifestyles form a rich mosaic which has to be harmoniously blended, and segregation between existing neighbourhoods has to be diminished. Courtyard housing achieves that, integrating divergencies inherited by tradition or adapted by choice (4). Thus, one may claim courtyard housing as a more "politically correct" typology, for it copes for every possible group and is not destined for a particular lifestyle.

Home Workspaces

There is a contemporary tendency in North America to promote the advantages of home workplaces, small-scale domestic manufacturing, home offices, etc.. For such tendencies, a courtyard provides a natural and efficient buffer zone between two opposite wings of the house, where one is private and the other semi-public. A "U" plan courtyard house may prove to be the most suitable for zoning a home work-space, for separate wings are provided for different zones: a wing may be allocated to night functions, another wing to day functions, and the wing on the opposite side from the night functions and nearest to the street as the "home workplace" or "home office" (Fig. 3.3). House front shops, which will be discussed in the next chapter, may act as a buffer between the street and the house.
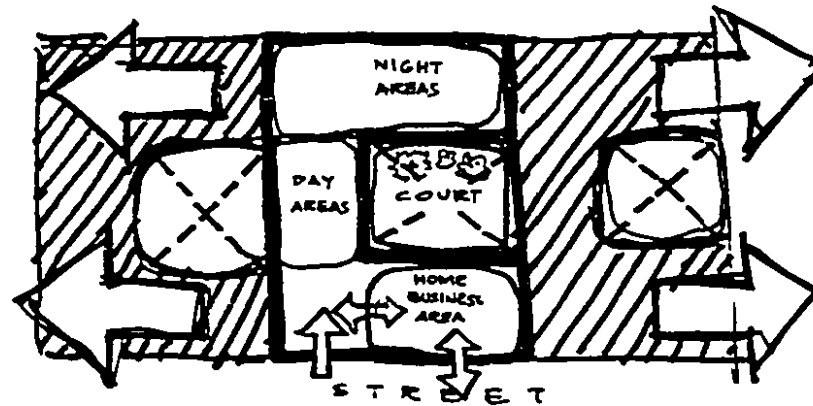
Fig. 3.3

Action Radius

The courtyard house is well adapted to the particular needs of individuals of any age. Whereas high-rise housing is ill suited to the requirements of households with children, courtyard housing is very well accomodating to households with children of different ages. Each member of the family has his/her own *action radius*, a radius of travel distance from an identifiable physical entity, located inside the house. The action radius varies according to age group, establishing environments of different extents for each person (5). The individual has the cradle as the primary action radius, followed by the playpen, the playroom, courtyard-garden, play-lot, neighbourhood, and with adulthood, the largest action radius. With old age, the action radius decreases until one is once more confined to the immediate proximity of the home (6).

A courtyard serves as a safe play-space for toddlers under adult supervision from the house. The common recreational outdoor spaces propagated by courtyard housing clusters and neighbourhoods will serve as a play areas for older children as well as casual areas for adult social interaction. The concept of action radius is somehow related to the concept of hierarchy of realms which will further be discussed in the next chapter.

Providing affordable housing is one of the greatest challenges of contemporary times. From the spontaneous, self designed and constructed courtyard houses in slums of developing countries, to the architect designed and developer constructed patio housing schemes in western practice, this type of housing is a very economical typology to adapt.

The problem of the provision of houses for families in all sectors of life exist in both developed western countries as well as developing countries. An alternative to buying developer constructed houses may be the provision of self-help techniques, as almost 50% of the cost of construction is the cost of labour and profit and which may substantially be saved. This is especially true for people who cannot buy a ready made house. The self help process, along with proper organisation and motivation, may result in high quality workmanship as well as initiative for owning a home. In addition, the possibility of incremental building whenever possible also becomes an advantageous prospect.

Home ownership is an important prerequisite for social stability. A house is a genuine and stable asset and can be handed down from generation to generation, offering security and refuge in difficult economic times and providing a base for stable family life. If housing is self-owned, residents stay for prolonged periods of time, and as a result, neighbourhoods automatically become self-policing, for most residents know one another: vandalizing intruders would be easy to locate and the social and physical environment can be properly maintained.

Honey, I Shrunk The House

Rybczynski and Friedman state that there are three factors which need to be considered when designing an "affordable" home: Area, Complexity and Quality (7). A reduction in any of those factors will result in a cheaper house. They propose to retain quality while reducing area and complexity. Thus, by designing simpler and smaller houses, substantial savings can be achieved in the initial cost.

Peter Land points out that as resources are limited, modest income houses must be modest in size, but the quality of design, materials and equipment must be high (8). Of

these, design is the factor that can be controlled easily by the architect to create a truly exceptional quality, he claims. From the above strategies, one can observe that both authors agree that the size of the house has to be reduced in order to obtain substantial savings. Reduction in the size of a house is one of the surest ways to reduce costs. A small, miniaturised and low cost house may be very attractive to live in. The tendency for the future may be to live more efficiently and more qualitatively, which requires more compact designs with higher workmanship and superior utilities consuming less resources, especially in western cultures.

Houses will inevitably be more compact in the future. However, it is necessary to have at least one space in the dwelling unit that is comparatively large, to avoid any feeling of cramping or claustrophobia. It is preferable to have the day areas (living/dining) more generous in size than the others, for this is where most of one's time is spent when awake and at home. These spaces should have a special relationship to the courtyard for they occupy a central role in the house and deserve to have generous access and views to the courtyard. Reciprocally, the courtyard, when planned carefully, lends an impression of spaciousness greater than reality to the interior space, for it gives a feeling of continuity between the interior and exterior, as evidenced in the early experimental courtyard house schemes by Mies Van Der Rohe (Fig. 3.4).

Maximising the impression of size in a small house encompasses not only the aspect of the interior spaces, but that of the exterior appearance as well. The impression of a larger interior size may be achieved through transparency, where a room opens up on two courtyards, preferably on opposite ends of the room, as well as through the provision of contrast, variety and depth. These characteristics should be designed logically with the unit and not be applied as forced visual devices. As for the exterior appearance, a house may look more impressive if two or more houses are attached together, for a tiny house standing alone in an empty 'cityscape' or landscape tends to look smaller than it really is. This also reinforces the concept of packing or clustering several courtyard houses together.
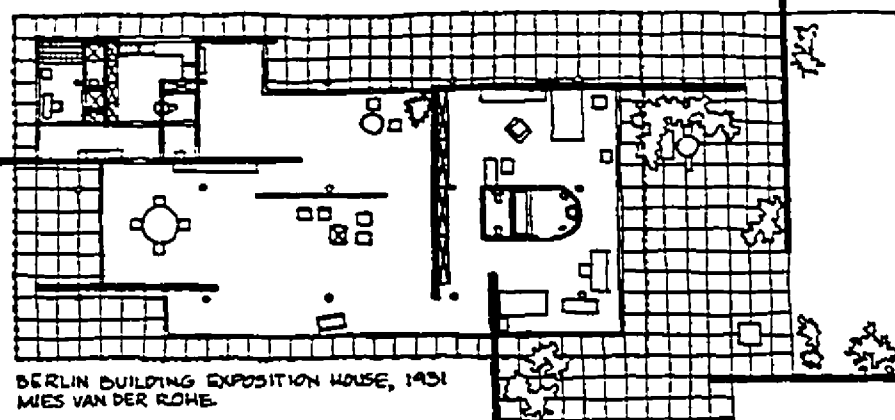
Fig. 3.4 Berlin Building Exposition House, 1931. Plan and view through the courtyard. Mies Van Der Rohe, architect.

Courtyard Housing as Minimum Cost Housing

Most contemporary underprivileged societies in developing countries have access to traditional and regional house design and construction knowledge and expertise which could be applied to reduce their poverty. This expertise includes minimum cost income generating techniques. This is an asset considering that most minimum cost housing is performed in stages, extended over a long period of time, with modifications introduced

along the way. Regional techniques are mostly easier to perform than imported techniques, are economical in terms of materials and energy, and are therefore accessible to most people in a poverty stricken society. Local construction techniques are comprehended easily by the people. This traditional building knowledge is often passed on from generation to generation and is adjusted to satisfy local contemporary needs along the way. It is intriguing to observe that many underprivileged communities around the world design and build courtyard houses for themselves using their traditional know-how, as observed in many squatter settlements. The process of making the most of the plot and building materials by adopting courtyard house schemes come naturally and unconsciously.

Indigenous people create their own comfort by building shelters which respond to the environment. "Primitive" people often build more wisely than trained architects, and follow indigenous principles of design which planners ignore at great cost. However, one must not idealise their accomplishments blindly. With respect to many contemporary minimum standards of size, hygiene, health, amenity, safety and permanence, the actual forms and configurations of many of their buildings are quite deficient. However, the basic principles and accomplishments of indigenous housing are of value, and often, minimal intervention by architects, through the amelioration of hygienic standards and the provision of communal fresh water supplies and sanitary installations, may be the most efficient way of improving conditions. Besides, a small sum of money may be all that is required to drastically improve the living conditions of a house located in a squatter settlement, whereas many award winning, "designer" housing projects remain misused or altogether abandoned, with substantial sums of money gone to waste in their construction.

The Influence of Climate on Courtyard House Form

Although climatic factors are not by far the most important in determining the diversity of house forms, they are, however, of significant importance as modifying or secondary form-generating forces, especially if humans wants to adapt their houses to climate and nature rather than to dominate it. Thus, even though it may be argued that the courtyard house in one indigenous form or another is not the optimum shape for any

specific climate, it is fair to say that it can be arranged, adapted, reconfigured and reorganised to accommodate different climatic conditions, thus becoming suitable for most conditions. It being a typology that never imposes itself, its scale and flexibility make it ideal for adaptability to almost any climatic zone.

Climatic Comfort

The climate influencing human comfort is a synthesis of air temperature, humidity, solar radiation, light, air movement, and precipitation. To achieve comfort, these components need to be balanced so that the body is neither losing nor gaining too much heat, is not losing too much humidity, nor is subject to other excessive variables such as winds in places where it is undesirable, and inversely receives just the right amount wherever it is. In climatic terms, a house needs to respond to heat, cold, ground and sky radiation, wind, humidity, and other factors, and the various parts of the building may be considered as environmental control devices (9). Perhaps more than any other housing typology, courtyard housing is the type where each component forming part of the house forms an effective microclimatic control device. As a consequence, the entire house acts as a comprehensive environmental control device, as manifested in its overall physical shape. Each climatic zone would generate house forms appropriate for that particular region.

The following pages include a brief survey of the various forms courtyard houses would attain in different climatic zones around the world. The idea behind the investigation is to provide the reader with various options for different locations, for courtyard housing hardly constitutes an "International housing style" but rather, a common idea adaptable to a multitude of unlikely scenarios.

For the purposes of this study, a system of climate classification has to be adapted. In 1936, W. Koppen developed a system based on the use of vegetation patterns around the globe as indices for climatic zoning (10). A modified, simplified Koppen system based on the original classification will be adapted here, consisting of four general climatic zones instead of the original five:

1- Hot Humid (Tropical-Rainy)

2- Dry Arid (Hot-Arid, Hot-Dry)

3- Warm and Cool Temperate (Warm Temperate and Cool-Snow-Forest)

4- Polar

Each climatic zone is briefly analyzed below. The best possible courtyard house forms for each classification are suggested.

Hot, Humid Climate

The areas with hot humid climates are characterised with high humidity and temperatures, little daily or seasonal temperature variation, heavy rainfall, and intense solar radiation. Maximum ventilation is required to help the body lose heat. Heavy constructions with high capacity heat storage walls are considered to be a big disadvantage. The requirements call for open buildings with maximum cross ventilation, and hence a long, narrow geometry and widely separated forms, with heat absorbing walls reduced to a minimum and shading provided at a maximum. House compounds in such zones may be composed of huts clustered loosely around an empty space forming a courtyard-like enclave, encouraging cross ventilation (Fig. 3.5).
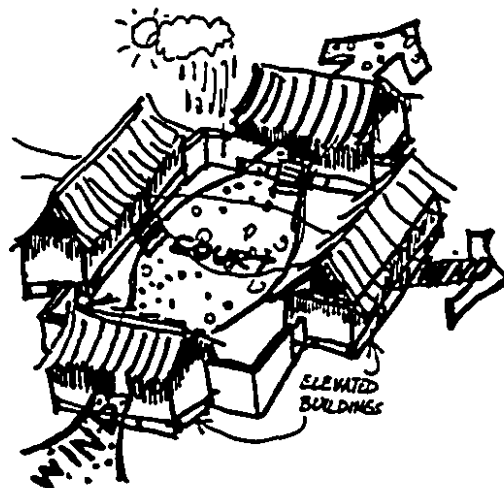

Fig. 3.5

Higher density requirements, coupled with open geometry requirements and privacy, may theoretically be met by the provision of courtyards, but the main problem remains the reduction of the humidity content in the air through the creation of air

movement.

The creation of shade over the entire structure (as well as the courtyard) is of prime importance. However, this shading device should allow for air to flow through, hence the concept of the freestanding parasol roof. This should be waterproof, sloping steeply to shed torrential rains, opaque to solar radiation, and of minimum mass to avoid heat build-up and subsequent radiation. It should also avoid condensation problems. It should also have deep roof overhangs, for these allow ventilation during rain.

Floors may be raised, for better ventilation, exposure to breezes, flood protection, and as a defence against large insect and animal populations (11). Humidity generating devices, such as plants and water fountains are discouraged, resulting in barren courtyards often decorated with rich geometric patterns. In Muslim Pakistan and North India, for instance, visual privacy is socially important because of the attitudes towards women, but since ventilation is essential to cope with humid heat, the development of open-work screens *(Jali)* has taken place. These provide shade and privacy for women while allowing effective cross ventilation (12). In addition, the humid tropics possess an unbearable glaring sky. Use of pierced screen walls, of woven or other materials, will block the sun and glare out, but let the wind in, as well as provide privacy.

Hammocks and swings provided in shaded courtyards may be used for outdoor sleeping in such places as Columbia, for they help the flow of air from below, and, as one swings, air flow past the body is created by little effort (13). The hammock has a negligible heat capacity, and feels perfectly at home inside the courtyard (Fig. 3.6).

In Indian, as well as other Asian cities, courtyard houses have acquired a longitudinal configuration emulating thin courtyard row houses, in order to create a wind corridor from the front entrance through the courtyard at the middle, to the back of the house. The progression of voids and masses throughout the house help in creating adequate pressure and temperature differences for ventilation and wind movement. Most Courtyard housing typologies are considered to be unsuitable for hot humid climates by some "experts", yet persist in hot humid areas such as India and Latin America where they seem to cope well. As elsewhere, they provide an acceptable solution to both socio-cultural and climatic factors.
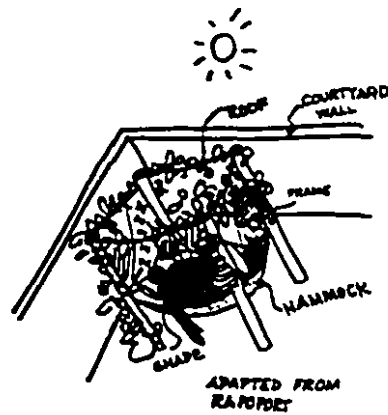
Fig. 3.6 (adapted from Rapoport).
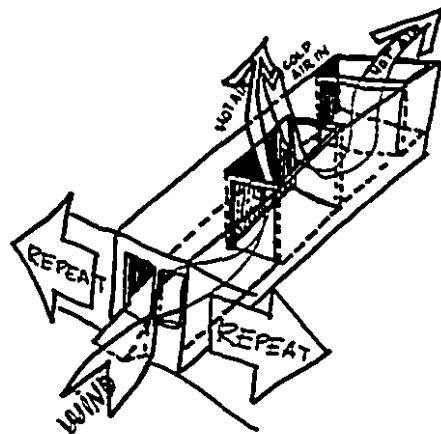
Fig. 3.7

Dry Arid Climate

Hot, dry areas are characterised by very high daytime temperatures and uncomfortably low nighttime temperatures. The best way to cope with this situation is to delay heat entry into the dwelling enclave as long as possible so that it reaches inside at night, when needed. The use of high heat capacity materials, such as adobe, pisé, mud-brick, stone, or combinations thereof, provide a "heat sink", thus absorbing heat during the day and radiating it during the night. A compact geometry would provide maximum volume with a minimum surface area exposed to the outside heat.

Reciprocal nestling of houses with compact, cellular patterns, provides shading, reduces the area exposed to the sun, and increases the collective mass of the whole building group, thus increasing the time lag. Windows may be reduced in number and size and placed high up to reduce the entry of ground radiation. By painting the house white or a light colour to reflect a maximum of radiant heat, and by minimising ventilation during the hottest time of the day, a substantial amount of comfort may be achieved. For instance, Arab courtyard houses located in dry, hot regions have their courtyards (and consequently major openings) facing North to avoid solar exposure, a befitting solution to climatic demands. In addition, outdoor courtyard cooking in the summer, as practised by some cultures, avoids indoor heat build-up. These indigenous practices also substantially reduce cooling loads on air conditioners, as compared to "International style", glass clad, exposed, and improperly oriented housing.

People often sleep outdoors on rooftops, verandahs or courtyards during cool evenings in hot, dry areas, and sleep indoors when it is cold. They move around different areas of the house with climatic variations, choosing to dwell in the space which possesses the most comfortable micro-climate at a chosen time, be it the courtyard, roof, room or basement. It is recommended to provide high heat capacity walls for daytime living areas, and low heat capacities for nighttime zones. In the Punjab house, for instance, the walls are thick, with few openings, in order to keep the sun out (14). The interiors are cool and dark all day. The roof or walled courtyard is used during the evening on warm nights, and the interior during cold ones. Outdoor sleeping is common. Many houses have two kitchens, one indoors (for the winter) and one outdoors in the courtyard for the summer. Summer living takes place largely outdoors in the courtyard and the house is more of a storage space rather than a dwelling, although it would be very comfortable to live in (15).

A traditional method utilised in increasing the dwelling's heat capacity is to use the heat capacity of the earth mass, by building *sunken courtyard houses* (Fig. 3.8 a and b). Traditional examples include the Chinese cave dwellings in the Yellow river valley (16), and the Troglodyte's dwellings in the Matmatas of Tunis and the Ghadames in Libya-both in the Sahara desert region (Fig. 2.4 a). These examples possess sunken courtyards, in which the surrounding rooms are carved out of the earth mass, and use it as insulation-an

excellent solution for areas with hot temperature extremes. In these arid area courtyards, rain is often caught and stored in cisterns located under the courtyard floor for future use, as well as for the prevention of its evaporation.

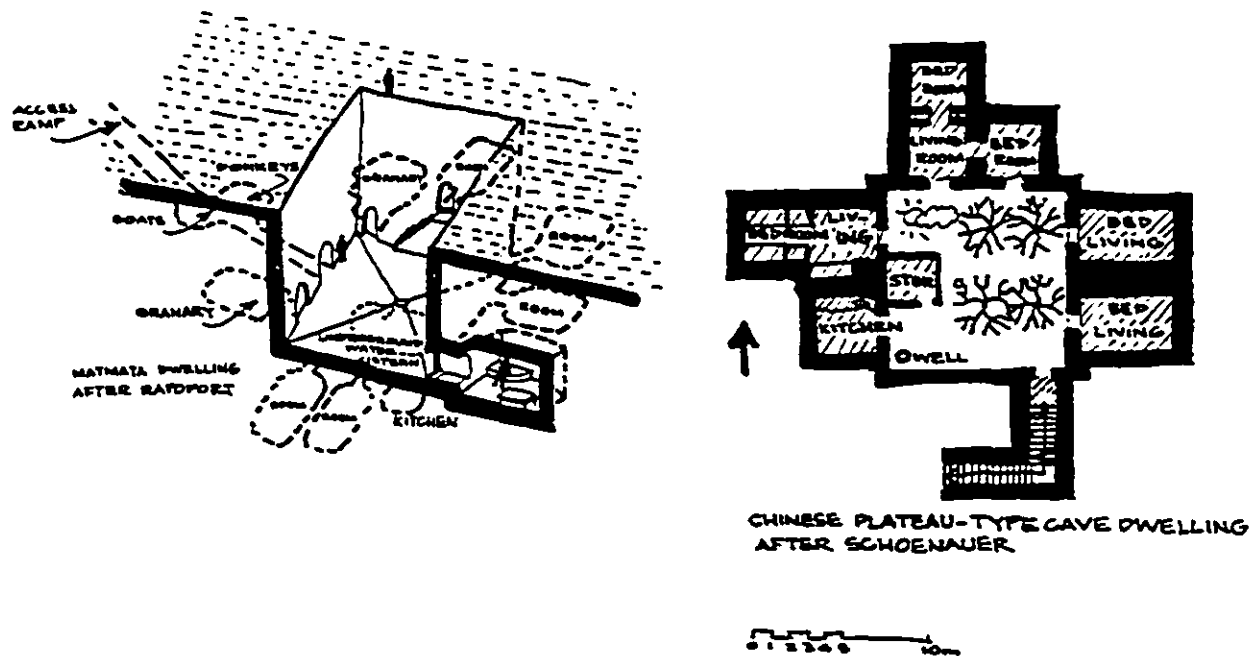CHINESE PLATEAU-TYPE CAVE DWELLING AFTER SCHOENAUER

Fig.3.8 Sunken courtyard houses. a. Matmata dwelling (after Rapoport) and b. Chinese plateau type cave dwelling plan (after Schoenauer).

Traditional Yemeni tower houses, initially conceived in response to a lack of space and a desire for ventilation, possess *elevated courtyards* near the roof (Fig. 2.4 c). Cross ventilation is encouraged at the top of the courtyard wall by providing slots, inducing suction through solar heating of the courtyard air. Elevated courtyards would usually be surrounded by day functions, while the lower levels are usually used for services. A more recent example of an elevated courtyard is Le Corbusier's Villa Savoye at Poissy, France, (1928-31) (Fig. 3.9 a, b, and c). It is important to mention that the creation of an artificial ground plane for the house through the elevated courtyard, holds tremendous potential for non-ground related, or high-rise, housing and requires further study.
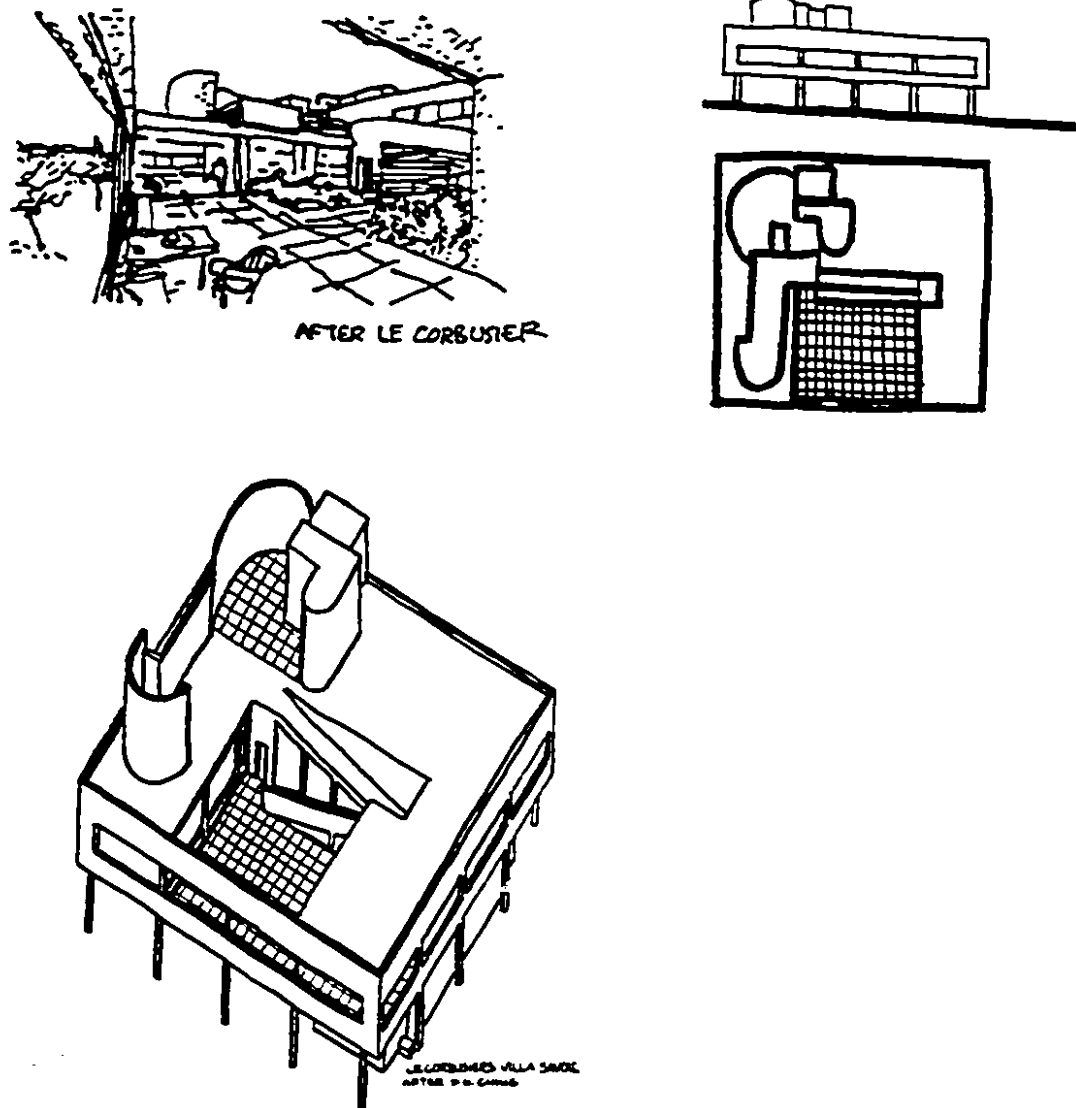
AFTER LE CORBUSIER

Fig. 3.9 Le Corbusier's Villa Savoie. a. view through the courtyard (after Le Corbusier), b. elevation and roof plan, and c. 3D view of dwelling (after D.K.Ching).

Warm and Cool Temperate Climate

Standard Courtyard houses are the most common types, with courtyards located on the ground level, and adjoining rooms opening directly onto them. Though spatially they feel fully enclosed, they are completely open to the sky. Regular courtyard houses are the most suitable for temperate zones, although they may not necessarily be confined to

these climatic zones.

Some adjustments may be required to adapt this particular typology to any particular situation. The conditions necessary for comfort in cool temperate zones are, although much milder, quite similar in wintertime to those of colder climates. Similarly, warm temperate climates may possess summer conditions reminiscent of dry, arid climates. In both cases, environmental control elements from other climatic zones may be modified and adapted to suit each and every particular case.

Cold/Polar Climate

Cold appears in different intensities, degrees and durations. The principles for keeping warm are to possess a heat source inside the house, and stop the heat flow to the outside. Heat loss is avoided by minimum surface exposure to the outside (especially to the North), and by proper insulation of exterior walls and roof. The capture of as much solar radiation as possible is desired, and dark colours are encouraged. This desire is subject to the need to shelter from the wind and to reduce the surface area exposed to the cold. Compact grouping and subterranean or semi-subterranean dwellings are frequently encountered (17). This also implies compact courtyard housing, with the openings on the courtyard oriented towards maximum solar heat-gain, yet protected from cold winds (Fig. 3.10). It is also important to note here that Canada, with its long winters, possesses strong winds, limited winter sunshine, heavy snowfalls and very low, nearly polar, temperatures. Any desirable effect, such as the maximum capture of direct or reflected sunshine off the snow, has a welcome effect (18). The elimination of wind, through the proper orientation of courtyards and their walls, has the benefit of providing better conditions for the immediate exterior microclimate, thus prolonging the usability of the courtyard. The microclimatic control of the immediate surroundings of the house has also a positive effect on the control of its interior environment (Fig. 3.11).

It is absolutely necessary to eliminate the windshield factor in polar climates around dwelling compounds. This can be achieved by providing walled courtyards where most of the exterior openings occur.
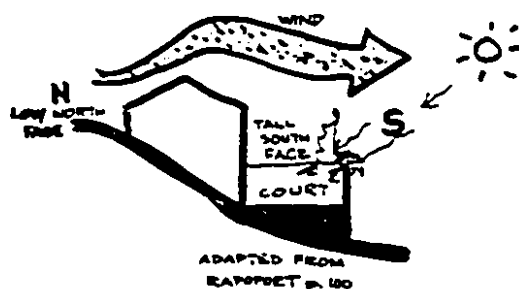
Fig. 3.10 (adapted from Rapoport).
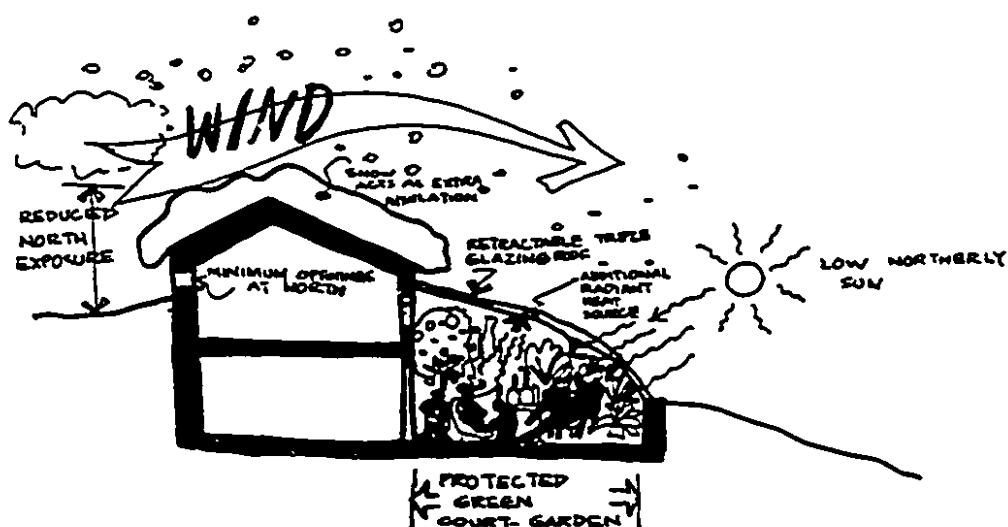
Fig. 3.11

Windbreaks are the simplest device for controlling the wind. These may be man made, such as walls and earth berms, or natural formations such as hills, cliffs, clusters of trees, and depressions in the topography. Houses should be sited to avoid or minimise the wind. They may also be countersunk into the ground to escape the wind. Northern facades may be substantially smaller with few significant openings in order to avoid excessive heat loss from that side.

Since solar radiation and light are desirable in cold areas, properly oriented large

openings could let in radiant solar heat but would also create heat loss problems at night. Triple glazed windows with an interior radiating film coating should be used to prevent heat loss at night, in addition to the protection provided by the courtyard enclosure from winds which would also decrease the amount of heat loss. Special shutters may also be used to seal the heat in at night.

Factors which greatly reduce heat loss in the winter may include natural insulators such as snow. Accumulated snow acts as an additional insulator on rooftops, and is very beneficial since a tremendous amount of heat loss occurs through the roof.

Socio-cultural and climatic factors shape the courtyard house and its configuration. However, the house cannot be seen in isolation from its settlement, but must be viewed as part of a total social and spatial system which relates not only to the house and its way of life, but to the whole settlement, cityscape, and even landscape. Humans live in a whole settlement, of which the house is only a part, and the way in which the settlement is used affects the house form, as, for example, in areas where the meeting place is the house, in contrast to others where the meeting place, such as a street or plaza, is part of the settlement (19). All this indicates that the house must be further studied in its entirety as an integral part of the settlement, and in its effects on the larger entity. Contemporary concerns, however, include the possibilities of sustainability in future settlements and communities, and how they should be conceived in order to preserve dwindling resources. That is the topic of the next chapter.

Chapter Four
The Sustainable Courtyard

It is envisaged that world population will continue to increase at tremendous rates in the forthcoming decades. This growth will be accompanied by enormous housing demands. Energy, resources and land will not be as easily accessible in the next century as they were during the 19th and 20th centuries (1). While housing demands will increase, available resources will diminish. These indicate the necessity to provide housing typologies that use less land, materials, resources, and labour than the prevailing typologies available on the market today.

The rapid expansion rate of both low and high density urban growth is based on the principles of extracting resources quickly, developing housing for quick profit, and has no consideration whatsoever for limited resources or land. To cope with this situation, the concepts of "infinite economic growth", "pioneer town America" and "economic monoculture" have to be altered, for our globe possesses finite resources and cannot satisfy such opulent demands forever. At some point in the near future, a gradual transition has to occur from the wasteful, industrial-machine age to a more resource conscious and frugal period, if cities and settlements are to thrive properly. What is needed is a system of planning and management where resources would be utilized in such a way that they do not become exhausted, and would renew themselves constantly: enter the concept of sustainability.

Sustainable developments are those meeting the needs of the present generation without compromising the ability of future generations to meet theirs (2). Sustainable regions, cities, settlements and communities are those designed and built today in such a

manner that they are self supporting, self generating in terms of energy, do not exhaust resources and use them sparingly so that they renew and replenish themselves, and will thus be available for future generations. The sustainable city could be considered an antithesis to the contemporary suburban city, for its concern is not the creation of an "ultimate" environment through the unregulated use of available resources, but rather represents an attempt to control these indefinitely in a finite world.

This chapter studies how courtyard housing and the streetscapes, neighborhoods and cities it generates would perform as sustainable developments. The provided topics are mere guidelines indicating various possibilities and benefits resulting from the application of courtyard housing to different conditions.

Metropolis

A city is a form in a space of a particular geographic and topographic setting, possessing a particular climate, and existing in a region with particular cultural, political and socioeconomic factors, at a given period in time and history. Physically, it is composed of a collection of neighborhoods, buildings, roads, squares, etc. (3). A city must be economically and ecologically sustainable in order to be able to live and evolve with time; it should be able to provide shelter, subsistence and social cohesion. Sustainability on a city scale has to be considered as a comprehensive totality, yet each and every constituent element in itself has to form a sustainable whole within possible limits. Many of the qualities inducing sustainability on the city scale apply equally well on the household and neighborhood scales.

To achieve physical sustainability, strict physical boundaries should be placed on cities and growth beyond these limits prohibited. Consumption of such vital resources as freshwater, air, rural and agricultural land by growing cities, as well as natural landmarks, landscapes, forests, etc. should be limited and controlled. Waste should be eliminated, and a balance should be established between long-term consumption and sustainable production.

The biggest dilemma concerning the provision of cities with physical limits in North America seems to be the continuous demand for low density suburban developments. These were ideal for the period following World War II when there were high incomes, purchasing power, as well as a high rate of economic growth, supported by relatively cheap and readily available sources of energy and raw materials. These circumstances facilitated the long term prospect of general economic security (4). Currently, income and purchasing power are no longer what they used to be in the days of cheap suburban expansion; recessionary times have hit hard on the consumer, and any savings in time, resources and expenses should be considered a welcome gesture, for they encourage sustainability.

Ironically, the best examples of sustainable development are not from the 1990's, but date back to pre-industrial times. Most pre-19th century cities demanded very little of the environment in terms of land, resources and energy. Their size was limited to walking distance, as well as the abundance of nearby agricultural land. Accessible urban land and cheap energy were not available. These cities were a model of conservation, material frugality and sustainability. Densely packed housing, including courtyard housing, were natural choices for many traditional cities. Even pre-suburban North American cities were compact and contiguous, as evidenced by densely packed row-housing still in use in older sectors of some cities.

A good example of a traditional high density "sustainable" city is medieval Dubrovnik, and is best described by Norbert Schoenauer below (Fig.4.1). Although it is not composed exclusively of courtyard housing, the lessons to be learnt remain relevant and provide the reader with insight about dense cities and their many assets.

The fortress city of Dubrovnik today covers about 40 acres (16 hectares), an area equivalent to that of a cloverleaf intersection of a typical American interstate highway. Within this area live about 5000 persons in about 2000 dwelling units. This community is served by 26 churches or chapels, a synagogue, a mosque, two monasteries and a convent, and a college. There are scores of shops, workshops, and restaurants, one indoor and two outdoor theatres, a few museums, a palace, a city hall, a customs house and a mint, a granary and an active harbor. The physical layout includes several squares, a wide main street,

and a network of pedestrian streets and lanes. It is a city with no wasted space,
where every nook and corner is precious and cared for. Grandeur and pomposity
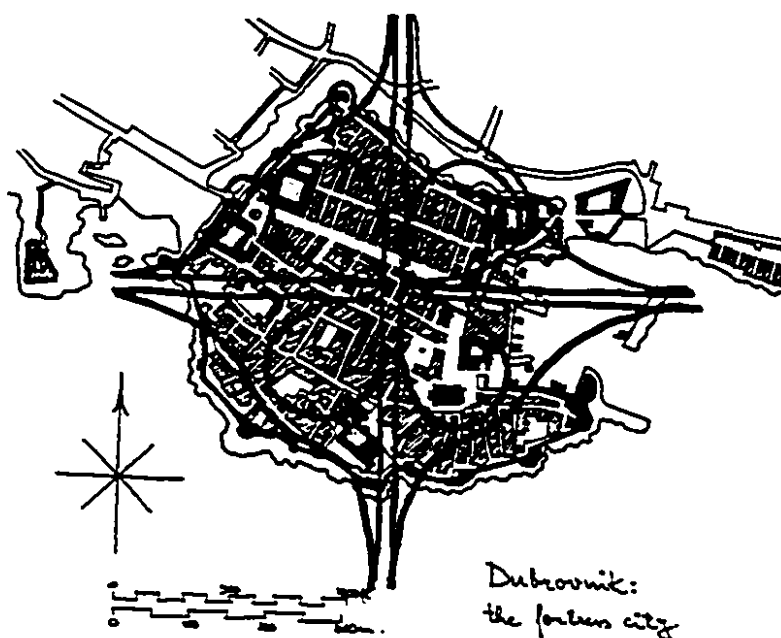*are absent in this city, but human scale and simple beauty prevail everywhere (5).*

Fig. 4.1 The fortress city of Dubrovnik overlapped by a U.S. interstate highway. (from
Schoenauer).

From the above description one can learn how much could be included in a tiny plot
of land, which, by current North American standards, would only be sufficient for a
desolate fragment of a highway intersection. Wasted space is apparent in most North
American cities which are full of empty, unused or underused tracts of land. A dense
cityscape, with diverse functions weaved throughout the urban fabric continuously and
with streets and squares as the only public outdoor empty spaces, is considered to provide
a far more enjoyable urban experience than a city with buildings sprinkled haphazardly on a
quarter-mile grid. As a rule of thumb, compact cities consume much less land and space
than spread out or "suburban" cities. As a result, more land is preserved outside the city

limits for agriculture or as nature. City running costs are reduced dramatically due to the proximity of functions, and house construction expenses are reduced due to economies in energy, land, infrastructure and construction materials: factors affecting economy, jobs and politics. Conversely, the less dense the community, the more land it will consume. Suburban communities themselves, being of very low densities, consume and waste a lot of land, and should be avoided altogether.

The House Site

In housing developments, sustainability is achieved through such qualities as compactness, reductions in the consumption of land, energy and building materials, as well as long-term socio-cultural stability. A housing typology with tremendous potential for sustainability is courtyard housing. The benefits of this typology are often overlooked because of prejudice and established norms. One of the most obvious advantages of the courtyard house with respect to sustainability is its minimal claim upon land (Fig. 4.2).
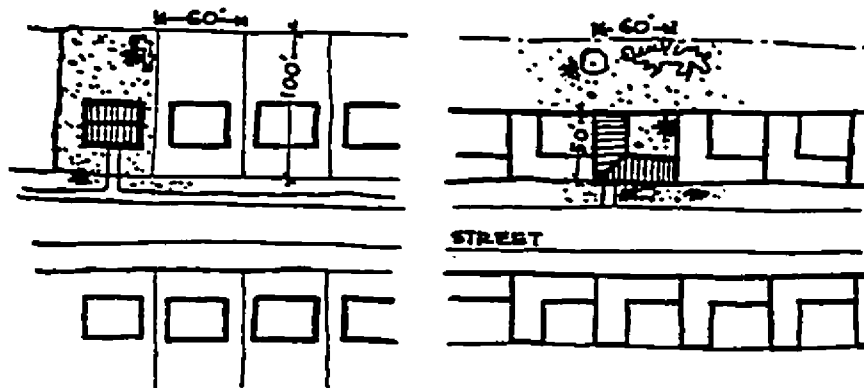

Fig. 4.2 Detached suburban house plot versus courtyard house plot (after Schoenauer).

Among the advantages of courtyard housing over the detached bungalow is the fact that the former occupies one third to half the land of the latter for a housing unit of similar floor area (6). This is possible due to the complete elimination of the side yards and the combination of the front and the back yards into a single courtyard. The result of smaller house plots is shorter neighborhood distances. Consequently, compared to a courtyard

house, a suburban single family detached dwelling requires 2-3 times more streets, sidewalks, sewers, streetlights, services such as snow removal, maintenance, as well as extra travelling distance, extra police patrols, and extra bus routes (7). The courtyard house is more efficient in land usage than *all* other individual house types and should be considered as a prime choice for increasing densities. Courtyard housing developments are the only building forms that increase in density (the relative increase of which decreases with the higher number of floors) with increasing numbers of floors (8). Thus, housing densities can be substantially increased by the provision of multi-storey courtyard housing.
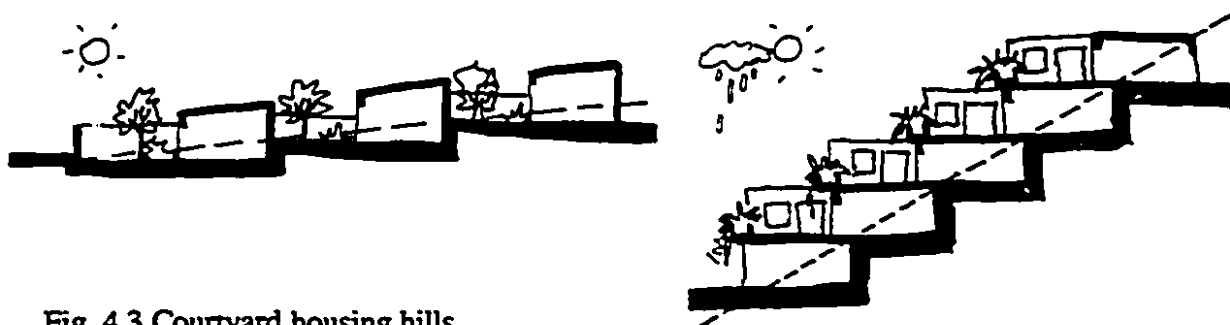

Fig. 4.3 Courtyard housing hills.

In a dense urban setting, courtyard housing units may be stacked one over the other, vertically or diagonally, forming a housing hill and providing both privacy and the sensation of a ground related individual house with a courtyard garden (Fig. 4.3). In such instances, densities rival those of mid-rise housing and may even reach those of higher densities. Care must be taken, however, to provide housing with individuality and character, as many high density repetitive housing projects indulge themselves in the complex intricacies of collective design, disregarding individuality and often resulting in anonymity.

As an overall concept, settlements composed of courtyard housing result in more compact cities. This, however, contributes to physical sustainability, which in itself is not sufficient to achieve comprehensive sustainability and should be accompanied by socio-cultural stability, an alternative yet vital form of sustainability.

The latter is a very important factor on all possible levels of human interaction, ranging from the most public human domain on the city scale to the tiniest private realm.

The prevailing problem is how to give form to socio-cultural stability, a factor which is not physical. This dilemma is best observed by Kevin Lynch who states the following:

> *Social interaction, coherence, or integration, change or stability are cited keys to the value of any settlement. But they are features of the social system, and not of the physical, spatial one (9). We look for physical features that have some bearing on these social features (10).*

Although socio-cultural stability cannot be expressed in true physical shape, some types of arrangements and urban forms would probably enhance it more than others, because of their effects on behaviour. According to Chermayeff and Alexander, the domains for human interaction should be clearly articulated in the urban context (11). A proper method of articulating domains is through the application of the idea of hierarchy which is persistent in planning and seems to be a natural way of ordering things (12). Chermayeff and Alexander propose a hierarchy of spaces and realms extending from the largest aspect of public urban life to the smallest of individual solitude, reflected in the design of a rational order of physical relationships based on human qualities. The articulation of different domains in the city, through the creation of physical hierarchy of spaces and realms, has a direct bearing on privacy levels for the individual (13).
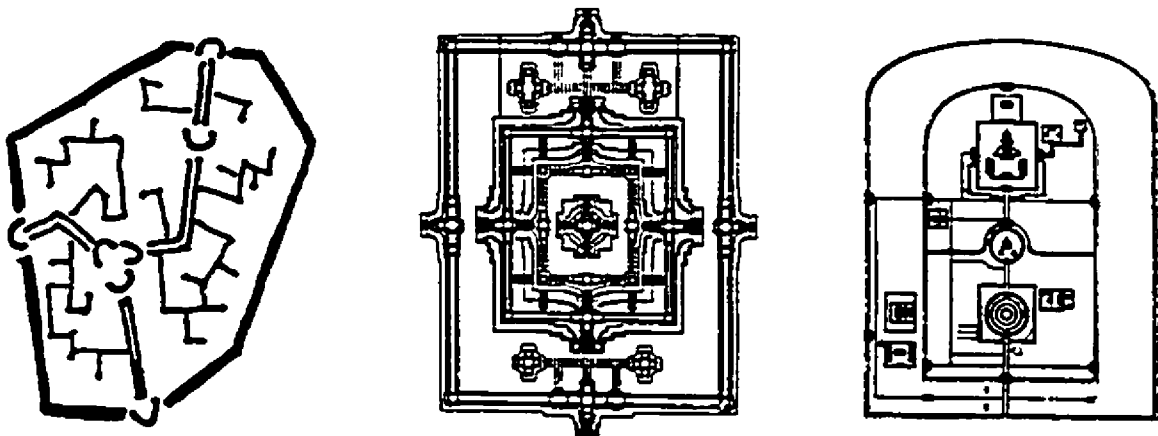
Fig.4.4 a. Islamic city, (from Lynch). b. and c. Cambodian and Chinese temples, (from S. Chermayeff and C. Alexander).

In traditional examples, the closed, intensely private or "inward" cities of the medieval Islamic world, or nested Hindu or Chinese cities, dealt best with the proposed social hierarchies (Fig. 4.4). For such cities, the ruling metaphor was the container: everything was walled and gated, from the city itself, to wards, streets, and quarters of the city, including local residential clusters, the courtyard house and its rooms (14).

Most contemporary cities are much too large in scale and far too complex in structure to be contemplated as an entity in order to achieve a visible hierarchy. However, most cities can be divided into components over which the proposed hierarchies could be applied (15).

Physical Hierarchy

The setup of the physical components forming the settlement are made up of elements of different sizes and levels of importance. Thus, all the elements making up the city follow a distinctive spatial order, a hierarchy of sizes and privacy levels. This will contribute to the orderly development and integration of the settlement, as well as community interaction (16). Infrastructural efficiency, and the promotion of the up-keep of public facilities and services, will automatically follow from a well articulated settlement, as will be seen later on.
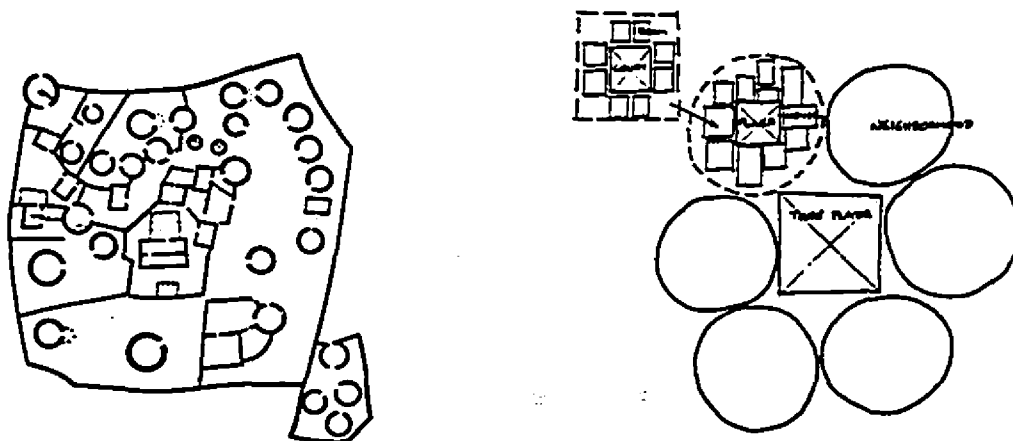

Fig. 4.5 a. Cameroons farm compound from Chermayeff and C. Alexander and b. Mexican courtyard city structure (from Rapoport).

The courtyard house, with its extreme flexibility and clear, well-articulated public and private zones, provides the perfect typology to satisfy all levels of social and physical hierarchies required in its vicinity (Fig. 4.5). Townscapes generated through courtyard housing deal extremely well with the vital physical junction of the private familial residential realm and the larger public group environment. This junction is the link between the dwelling and the city (17). The easy linking of the dwelling and the city, provided through courtyard housing make it a typology that could be adapted to any part of any situation, in any city, appropriate for dense downtowns as well as less dense suburbs.

Neighbourhood

Large, anonymous city sectors should be divided into several identifiable neighbourhoods or well defined clusters because these enhance community integration, thus contributing to better social, economic and political interaction (18). It is desirable to let each neighbourhood or cluster stand out as an independent and distinct community in itself, but at the same time remain well connected and integrated with the rest of the city by commercial, vehicular and pedestrian streets, linked public facilities, continuous spaces and volumes.

A group of courtyard houses may be organized around a local street, or could be clustered around an exterior open space, thus defining a neighbourhood building block. The outdoor open space would form a compact, semi-public common area for use by all residents. A centripetal cluster arrangement would encourage the formation of communities through the enhancement of social interaction. Well integrated housing units within a cluster would not only maintain the social unity of the residents but would help maintain the physical environment as well, all due to the prevailing active community spirit.

Clustered courtyard housing can promote such socially and ecologically conscious living alternatives as Communal Housing or co-housing, where a micro-community would emerge. The residents would have their own elected council, their own nursery and child-care program, private cultural and sports services, communal cooking and dining facilities, etc. For the more communally inactive resident, the introverted courtyard house would

provide the perfect private recluse.

Since houses would be clustered around a common exterior semi-public space, part of that space may be utilised as a service route during certain hours. This provides access to the rear of the house or the back courtyard and is very efficient for the provision of infrastructure, maintenance, services, delivery, etc.
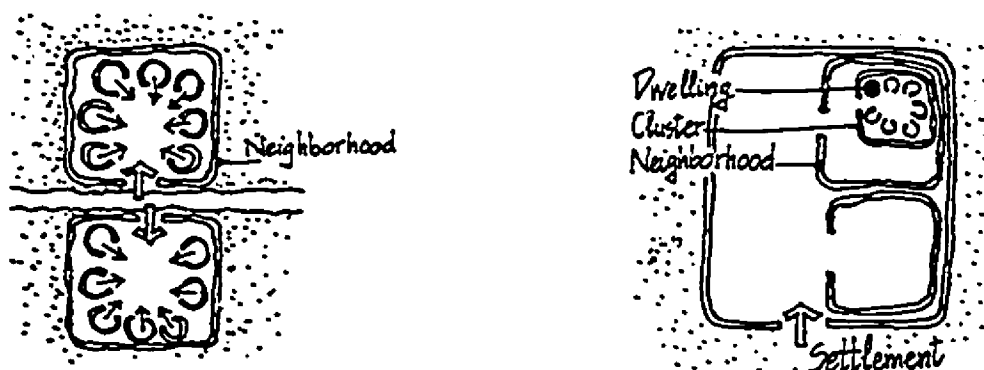

Fig. 4.6 (after Bhatt et.al.)

The ultimate number of housing units per cluster depends on technical, cultural or personal preferences and the availability of space. The ruling guideline would be the provision of a minimum number of housing units to give the impression of community, preferably more than 4 or 5. The maximum housing units per cluster should range from 40 to 50, for more units would result in anonymity and a loss of community spirit.

Urban Sense

Creating city sense in an urban environment requires the enclosure, containment, scaling and shaping of space. City sense is created by the provision of streets and urban spaces which would serve as backdrops for human social interaction, an element non existent in most suburbs and high-rise, high-density housing developments. The latter is mostly due to the lack of street elevations or walls which create streetscapes or exterior spaces. It is in traditional cityscapes that one finds the most efficient backdrops for human interaction, as Chermayeff and Alexander so eloquently point out:

*Among the great visual pleasures of an urban environment are the well-designed
walls, fences, and facades of attached houses, like those that make the streets,
squares, and terraces in a historic city like Bologna* (19).

It is argued that courtyard housing creates homogeneous urban landscapes, most of
them having similar scale, mass and similar building materials (20). Flexibility of interior
planning layouts and hierarchies of privacy levels, do not affect the consistent generated
streetscapes. The prevailing fear, however, is the creation of street elevation monotony
generated through repetition.

This can be avoided by promoting variety in the facade through the provision of
individualized entries, galleries and projections, metal grillwork and gates, windows of
different shapes and sizes, occasional openings in the courtyard walls, as well as rich plant
life, whether on the street side or apparent from behind the courtyard walls. Mixed land use
planning, such as the introduction of plazas, small neighbourhood cafés, gardens, recessed
activity niches, integrated offices, street front shops and commercial facilities will also
provide variety and dispel street monotony. The prevailing public exterior urban spaces will
serve as stagesets for human interaction, face-to-face contact and the growth of human
culture. On the contrary, courtyard housing can provide a city with streets fit for
pedestrians which would actually bustle with people. It would be more congenial and
varied than most streets propagated by detached or high rise housing.

In order to retain the human scale of these courtyard neighborhoods, pedestrians
should be given priority over vehicles which should preferably be stored out of sight. The
compact urbanscapes generated through dense courtyard housing would actually result in
reductions in walking and cycling distances, thus making them more enjoyable. Walking
and cycling would promote a healthy way of life and would make automobiles unnecessary
and save fuel.

Garden City

Courtyard housing is primarily an urban residential typology. This does not mean
that it cannot be conceived as part of a distinctly low-profile, residential garden
neighborhood. Contact with nature often leads the list of desired features in a place (21).

There is a confusion about what this "nature" is and may be interpreted differently by different cultures. In a city, the value of a garden does not reside in the thing itself, but rather on our interpretation and perception of it (22).

While courtyard housing would provide private court-gardens within houses, public gardens may be woven into the urban fabric and would provide open space for daily contact at the neighborhood scale, contributing to the hierarchy of realms. A residential district carefully planned and landscaped may become one extensive urban garden pleasing to both the eyes and senses.

Thus, suburbs may be spared the agonizing monotony of look-alike landscapes if its streets and gardens are defined by the carved, leftover spaces between courtyard houses, with the entire ensemble of public areas visually forming a spatial continuum.

Those housing units which are in close contact with the ground environment have an immediate concern for maintaining the small public gardens and the surrounding outdoor environment which are an integral part of their community. Thus, ground relatedness becomes an important asset in maintaining open public grounds and community self-policing.

Housing Diversity

Sustainability entails different answers in different cities, as well as diverse solutions in different parts of the same city. A diverse city must project different images in the way it is put together. Diversity of cities and neighbourhoods also imply diversity in housing typologies. Each region develops unique housing and building forms, based on regional characteristics. Courtyard housing is suggested as one of the housing typologies creating diversity in a polycultural city. It is a mistake to plan entire settlements composed of only one type of housing, for several types should be mixed in order to avoid monotony and provide for different needs. The ability of courtyard housing to integrate with existing and unlikely conditions make it a prime choice for adaptability in diverse environments.

Settlements should be planned in harmony with the natural elements: sun, prevailing wind and land form. Neighborhoods and urban spaces must be carefully oriented to obtain the desired amount of sun or shadow in different seasons. Reflected sunlight from neighbouring buildings must also be considered for it contributes to the well-being of urban spaces in winter.

Entire towns may be shielded away from undesirable winds by the provision of peripheral "windscreen wall" buildings, yet in the meantime be properly oriented to obtain maximum sunshine. This may help regulate the microclimate of cities in polar areas, as demonstrated by architect Ralph Erskine, and is of prime importance for Canada. Conversely, environments in cities and streets located in hot areas are improved by the provision of very narrow circulation alleys squeezed between houses which provide shade and force hot air to rise and create breezes and winds. Thus, proper exterior urban space orientation and design promotes environmental control as well as economies in the use of urban land and space, welcome factors in sustainable developments.

Energy

Energy conservation occurs both in the individual house and cluster, or micro scale, and on the macro, or urban, scale. This includes fuel for heating, lighting, transport, as well as time and human energy. It is estimated that direct and indirect energy consumption may be as much as 2000% more for a suburban detached household than a dense urban household (23). The objective is to minimize the consumption of energy for these uses and to maximise the efficiency of their utilization by planning and designing against loss. This affects the size and shape of houses and neighborhoods and also requires an appropriate level of technical knowledge in building science, insulation technology as well as skilled labour (24).

There can hardly be such a thing as 100% energy efficient housing. Some housing typologies are more energy efficient than others by nature. Thus, closely nestled housing typologies, such as courtyard or row housing, are more energy efficient than detached

housing, for the sole fact that the additional exposed surfaces of the latter require much more energy to heat in the winter than the others (25).

Whereas measures may be taken to reduce energy needs and utilise alternative energy sources, conventional energy will always be required, albeit to a lesser degree. However, this energy may itself be also supplied by more fuel and energy efficient systems. A detailed enumeration of various energy efficiency and regeneration measures which could be pertinent to courtyard housing are explained in appendix B.

Downtown

The contending viewpoint is that contemporary city regions are, and should be multinucleate (26). Whereas the city centre or downtown should be maintained as a dominant and symbolic center, there should also be a number of essentially equivalent subcentres, of lesser size, each serving a portion of the community. This gives the whole city structure a sense of "conceptual hierarchy" and is helpful in identifying different regions possessing different characteristics.

Unfortunately, most contemporary urban cores suffer either from excessive congestion or chronic decongestion, or both, at different times of the day. The move of the inhabitants of North American cities to the suburbs has left many downtowns devoid of any life, their economies, buildings and streets dilapidated. In order to re-obtain a healthy city, old city cores must be rehabilitated not only through the provision of sustainable businesses but also through the re-introduction of dwellings mixed in with the commercial establishments. Downtowns should be rendered valid to serve the needs of today and tomorrow without compromising their original qualities, such as diversity, compactness, humaneness, sense of scale, etc..

A continuity has to be established between the past and the future. Catering for the future by neglecting the past will result in a negation of history and culture and as a consequense will end up with a synthetic urban environment possessing no memories and an unstable, socio-culturally and economically unsustainable background. This continuity can be achieved through an integrating process whereby relevant buildings and urban

elements of the past are fused with the needs of the present and the future. The core of the city has to be maintained as a cohesive, continuous whole with no empty lots at all times, for these create discontinuity. Newer structures must occupy these empty lots, blending in harmoniously to create continuity.

For instance, downtown Montreal presently (1994) is full of empty lots which do much harm by de-urbanizing the city. Courtyard housing may be used as infill for empty lots in dilapidated contemporary downtowns. Low or medium-rise courtyard housing used as infill and located next to high rise, high density office towers or other commercial facilities create diversity, add a human touch to the impersonal character of these facilities, and regulate the sudden change in density between built and unbuilt lots. Ingenious planning may actually result in intimate, village like neighborhood characteristics with feelings of community among the inhabitants, all integrated with small businesses and tiny public gardens (27).

Contemporary Courtyard Housing is a suitable alternative for rebuilding contemporary downtowns, for it can be very easily knitted into the existing urban fabric as infill, harmonising with the existing businesses and housing stock. Its introverted character gives it the advantage of being able to be located on busy, noisy commercial streets, unaffected by the inconveniences of the city core, providing the city dweller with a congenial living environment sheltered from everyday city chaos. In addition, residential zones created in and around downtown areas are a great asset for they reduce commuting distances and solve the problem of isolated downtowns after working hours. They also create a hierarchy of privacy levels and buildings sizes.

Some building codes should, however, be amended in order to make way for the new densities and nesting patterns propagated by courtyard housing if this typology is ever to be used efficiently in dense downtown areas (28).

A Streetcar Named Distance

Commuting distances to the work or market-place are typically too great and so consume a lot of time and energy. Extensive daily travel consumes vital resources which

could alternately be fruitfully invested in work, leisure or in the home for the enrichment of family, community or cultural life. Several years in the lifespan of the average North American are sacrificed to commuting (29). Reducing daily commuting distances on an urban scale reduces commuting time, fuel expenses, and induces savings on the construction and maintenance of transportation networks. This is well illustrated by comparing a traditional Islamic city to a contemporary North American city. The Islamic city possessea all required functions in a compact area, with no need for commuting and with limited mobility (Fig. 4.7. a and b).
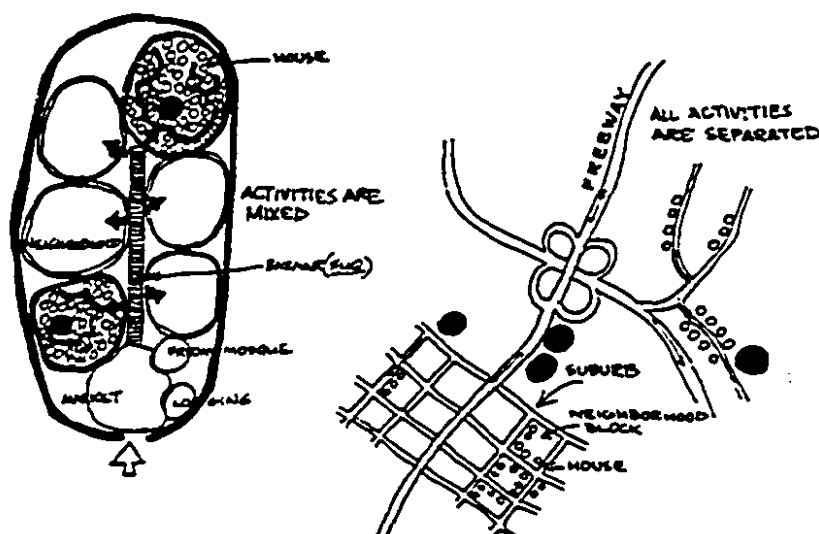
Fig. 4.7 a. Moslem courtyard city structure where access is limited to market, suq, mosque, and lodging, and mobility is limited. b. North American city where almost everything is accessible and there is maximum possible mobility (from Rapoport).

Shopping

Proximity of home and work imply the necessity of the provision of workspaces and shopping facilities tightly knit into the urban fabric, together with housing (Fig. 4.8.). Shopping market streets are usually composed of many small and diverse retail or similar commercial activities, and may be brought together under one roof to simulate a small, covered pedestrian street or oriental souk. There is no reason why one cannot design small scale sheltered and climate controlled pedestrian streets with very limited vehicular access,

with shops, restaurants and businesses flanking it. These may have housing above and at the back, as is common to so many cities in Europe and the Mediterranean basin.
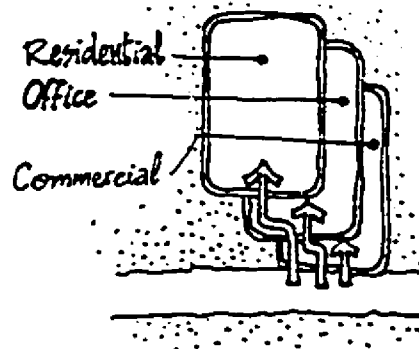

Fig.4.8 (from Bhatt et.al.)

The isolated and "synthetic" feeling of a shopping mall, which has replaced the traditional shopping street, is in itself reverting back to look more and more like its predecessor, and may someday be replaced by mixed shopping, housing and offices weaved within existing streets, thus becoming completely inconspicuous (Fig. 4.9). There is an unconscious reversion to mixed use planning, propagated by a need to create "variety". There is no doubt that the introverted courtyard house is the most ideal typology for this type of mixed setting, for it reduces street and other noises dramatically and creates another isolated world within its own realm. Residents of the same and nearby neighbourhoods will shop in these markets, thus saving time, energy for longer automobile trips and eliminating the need for parking spaces. Additional parking areas for residents and visitors may be integrated discreetly within the existing urban fabric, either dispersed in small groups among open spaces or hidden underground. Huge, open parking lots, as observed around North American shopping malls that are only used during shopping hours, should be eradicated.

The traditional "shop-house", with business on the street side and a courtyard house behind, may be a proper example of mixed housing and business. Its configuration can be similar to the home workspace described in chapter three. The use of the house front as a shop would have its services exposed to street traffic, a beneficial aspect for most businesses.
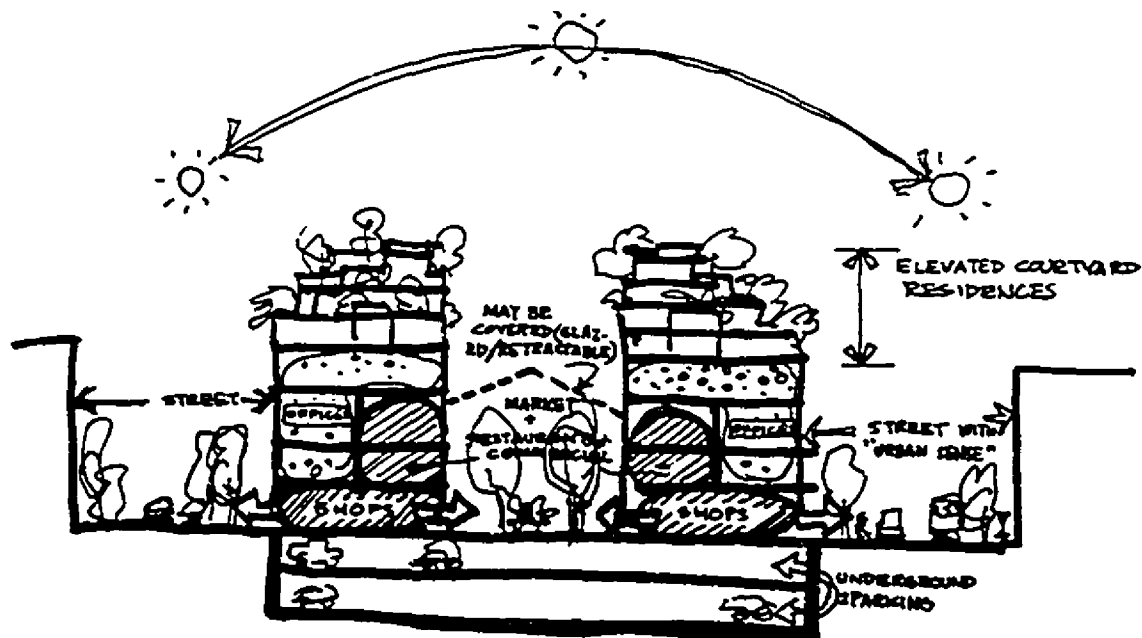
Fig 4.9.

Both small and large businesses should be included in a given area in order to create variety. Larger scale mercantile activities and businesses should be located along main commercial streets or major road networks, while smaller ones may be mixed in with the larger ones or be placed along minor streets. Additional spaces should be provided to set up other income-generating activities such as small workshops, in order to create diversity. The organization and scale of businesses and shops within the settlement should closely follow the scale and hierarchy of the street within the overall circulation network, in order to produce a congenial living and working environment.

We have observed that well conceived courtyard housing requires less land, energy, and resources than other housing typologies. As a result, costs are dramatically less than those of other housing typologies of the same size possessing similar characteristics.

We have also observed how this type of housing would create a sustainable community, and how a city has to be conceived as a whole in order to be sustainable. The concept of sustainability is thus naturally compatible with courtyard housing. The

contemporary courtyard house, however, comes in different shapes, sizes and configurations. A study of the different options available will be the topic of the next chapter.

Chapter Five
Alphabet Soup

The recurring question remaining for this chapter is, how many possible shapes can the contemporary versions of this introverted house type attain ? How valid and useful are they as housing for today and tomorrow?

The following pages deal with the physical shapes, the designs and configurations of various contemporary courtyard housing schemes and their nestling patterns. The emphasis here is more on individual houses that can be clustered, nestled or terraced together to form "housing" as a collectivity, rather than on isolated or detached houses. The following pages are the outcome of a thorough survey of published contemporary courtyard housing projects, mostly spanning the period between 1960 and 1994. The mentioned examples were abstracted into typologies through analysis as well as through the production of drawings and descriptions.

This typological classification is based on plan configurations. There is no chronological order. The logic of the interior zoning principles of each and every typology is provided. Individual house plan drawings are often accompanied by their sections and site plans, where necessary. Alternative nestling, clustering and terracing configurations are also explored. The abstract representative nature of the typologies give designers the opportunity to adapt, reinterpret and further develop any design as deemed necessary.

Several factors affecting courtyard house forms have already been observed. Apart from the ones already discussed, house configurations may vary, due to horizontal and vertical deviations, as dictated by the existing topography and the shape of the site (1) (Fig. 5.1).
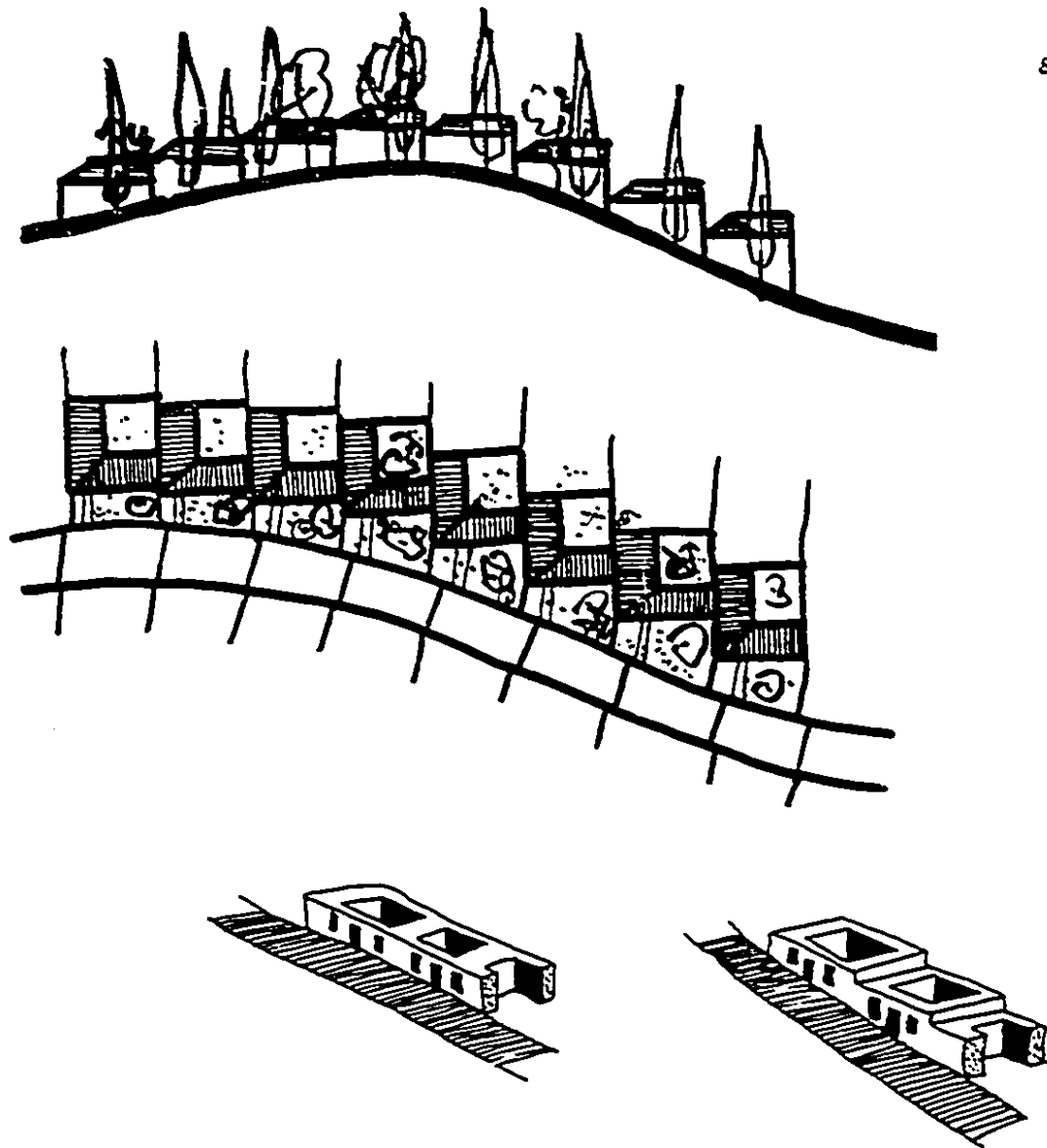
Fig. 5.1 a, b, (after Schoenauer) and c, d, (after Rapoport).

The various interior arrangements of courtyard houses are the result of the separation of domains in general, and are used in cultures which are both crowded and hierarchic (2). Adult privacy requirements necessitate the possibility to be able to 'get away', while the adult presence in the familiar territory of the family or clan group remains compulsory. The separation of domains achieves that. In cultures with no overall hierarchy, this type of development does not take place. For contemporary western users, separation is achieved through the provision of different levels of privacy, thus creating exceedingly

private interior domains within a dwelling enclave. Creating an intimate parental domain, secluded from that of the children's, within the house is extremely important (Fig. 5.2 a).

Another zoning method is the creation of different areas where spaces can be grouped according to their use at different times of the day. Thus, the interior zoning of the day-time functions, (living-eating-cooking) and the night functions, (sleeping) is considered to be an efficient form giver for the house plan (Fig. 5.2 b). This leads to having one or more zoned wings wrapped around the courtyard. The more wings in the plan, the more segregated are the various functions. Since only one facet of a function is adjacent to the next in most courtyard house schemes, zoning occurs naturally.
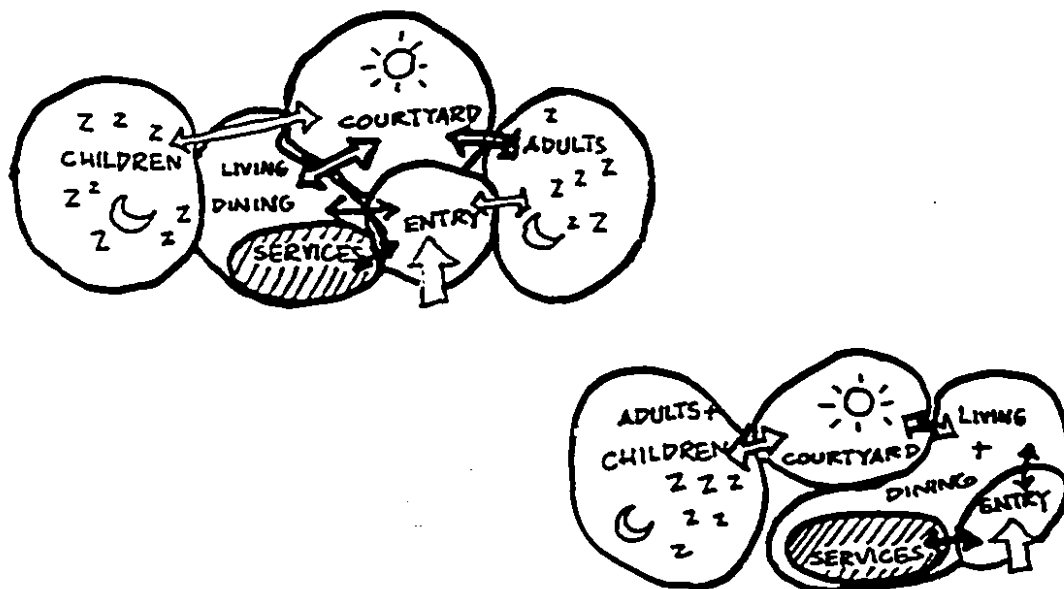

Fig. 5.2 a, and b.

Most contemporary courtyard houses possess a single courtyard. The major disadvantage of zoning the house interiors around a single courtyards is that the private outdoor space is not differentiated: all areas requiring different levels of privacy open up onto the same courtyard, creating a major inconvenience. This indicates that the courtyard is more of a family realm than a private adult domain, resulting in conflicts between adults and children, and preventing both domains from acquiring sufficient visual and acoustic privacy. Although it is preferable for adults to obtain a view of their children's domain, the same cannot be said about the children being in close visual and acoustic contact with their

parent's realm. With reception areas overlooking the same courtyard as the bedrooms, this problem is agravated. These inconveniences could be remedied through the provision of multiple courtyards, by the construction of special barriers within the courtyard, or by locating openings above eye level. The children's domain could have a direct access to the outdoor play spaces so as not to disturb adults. On the other hand, two or more functions with contradictory privacy requirements overlapping within the same courtyard provide an activity realm, a meeting place for different household members who, by their very presence, enliven it (3).

Clear zoning must not be limited to the interior of the house realm but must include the link between the house to the street. According to Chermayeff and Alexander, separation between the street, or public outdoors, and private indoors should be clearly indicated physically, through the creation of "locks" (4). These are similar in concept to the acoustic locks in broadcasting studios and the anticontamination separations from sterile areas in hospitals (5). The traditional bent foyer or *spirit wall* entry as discussed in chapter one is actually a "lock" providing an adequate buffer zone against visual, acoustic, climatic and other forms of intrusions, and may be adapted to contemporary courtyard housing. This can act as a transition space between the exterior public areas and the private domain, the dwelling (Fig. 5.3). In addition, it can serve as a climatic lock, an area of prime importance for houses located in very hot, desert areas or those with very cold climates, such as Canada. The lock is the area that can also serve as a wardrobe for external clothing, shoes and equipment.
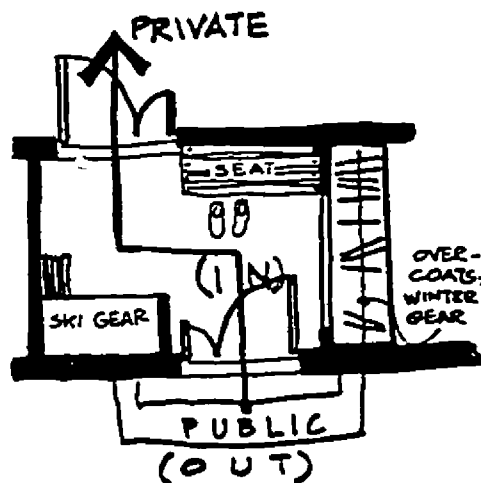

Fig. 5.3

Having determined the broader aspects of zoning in courtyard houses and their constituent ingredients, it is time to review the different typologies and their zoning possibilities as well as their idiosyncrasies and suitabilities for different contexts.

The examples presented below are suitable for adaptation by most cultures with "Westernized" lifestyles, but can be easily modified to satisfy almost any contemporary culture. Some cultures which previously had courtyard housing as an indigenous vernacular form have already adapted its contemporary reinterpretation as a direct successor of the original typology of their ancestors (6). These cultures include countries around the Mediterranean basin, Latin and Central American countries, and East and South Asian countries. However, an increasing number of countries with little or no courtyard housing tradition have molded variations of courtyard houses to suit their needs. These comprise Scandinavian as well as other North European countries. The U.S. and especially Canada have been very reluctant to experiment with courtyard housing, yet, as will be seen by the variety of typologies available, many of its typologies can be extremely suitable for the diverse North American housing market.

The "I" Plan Courtyard House (7)

The row house is a narrowly shaped housing typology with a nesting pattern in which the houses are fully attached in rows. It was originally developed due to density and site constraints, and is usually two or three stories high, with living-dining facilities on the ground floor and bedrooms above (Fig. 5.3 a). Additional bedrooms can possibly be accommodated on a third floor, if the need arises. Interior zoning may also be achieved by placing the day functions on the top floor in order to take advantage of possibly higher ceilings and skylights (Fig. 5.3 c). Another zoning strategy is to segregate the adult night-time functions by putting them on the ground floor and locating other night-time functions on the top floor, with day-time functions located in between (Fig. 5.3 b, d).

The row house poses some inconveniences in their relation to the ground, especially if it is adjacent to public or semi-public spaces. The open front yards can't be used as outdoor living spaces, for they have neither a physical nor a psychological barrier

Some architects have resolved this problem by enclosing the front yard by a higher than eye-level wall, wherever permitted, converting the yard into a front entrance courtyard or court-patio-garden, thus partially imitating a courtyard house (Fig. 5.4). This court-patio identifies the private domain, provides enclosure, visual, acoustic, and psychological separation, and provides the home with an outdoor living space-a lower than eye-level fence indicates a transition into a semi-private realm, not a fully private patio emulating a courtyard.
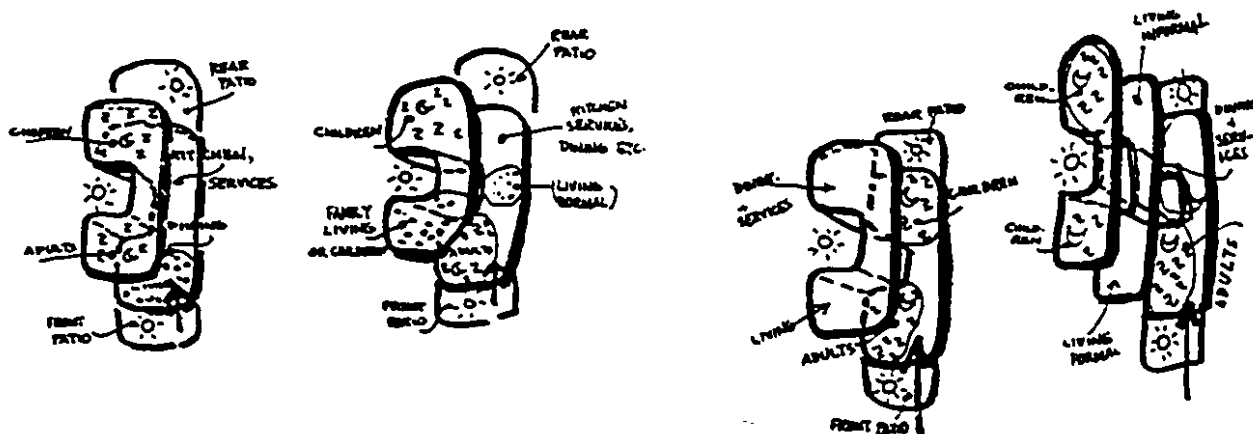
Fig. 5.3 a, b, c, and d.
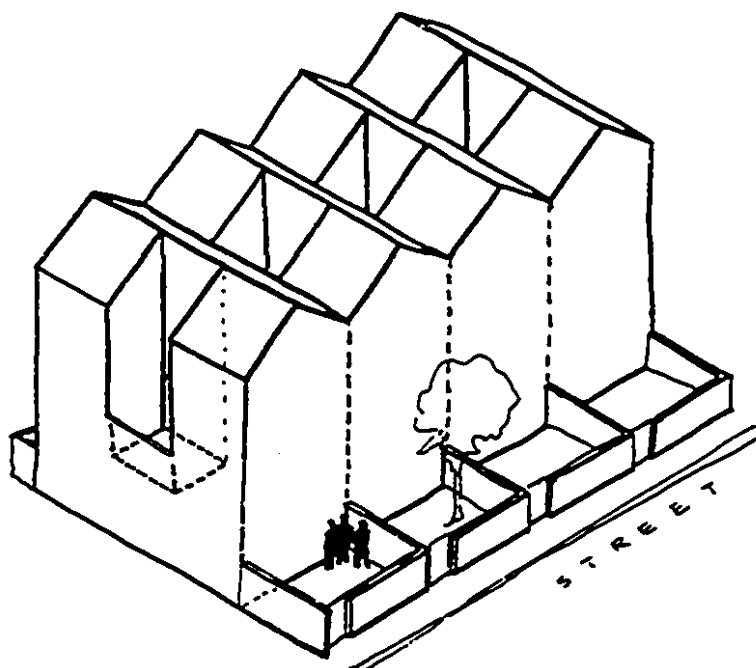
Fig. 5.4
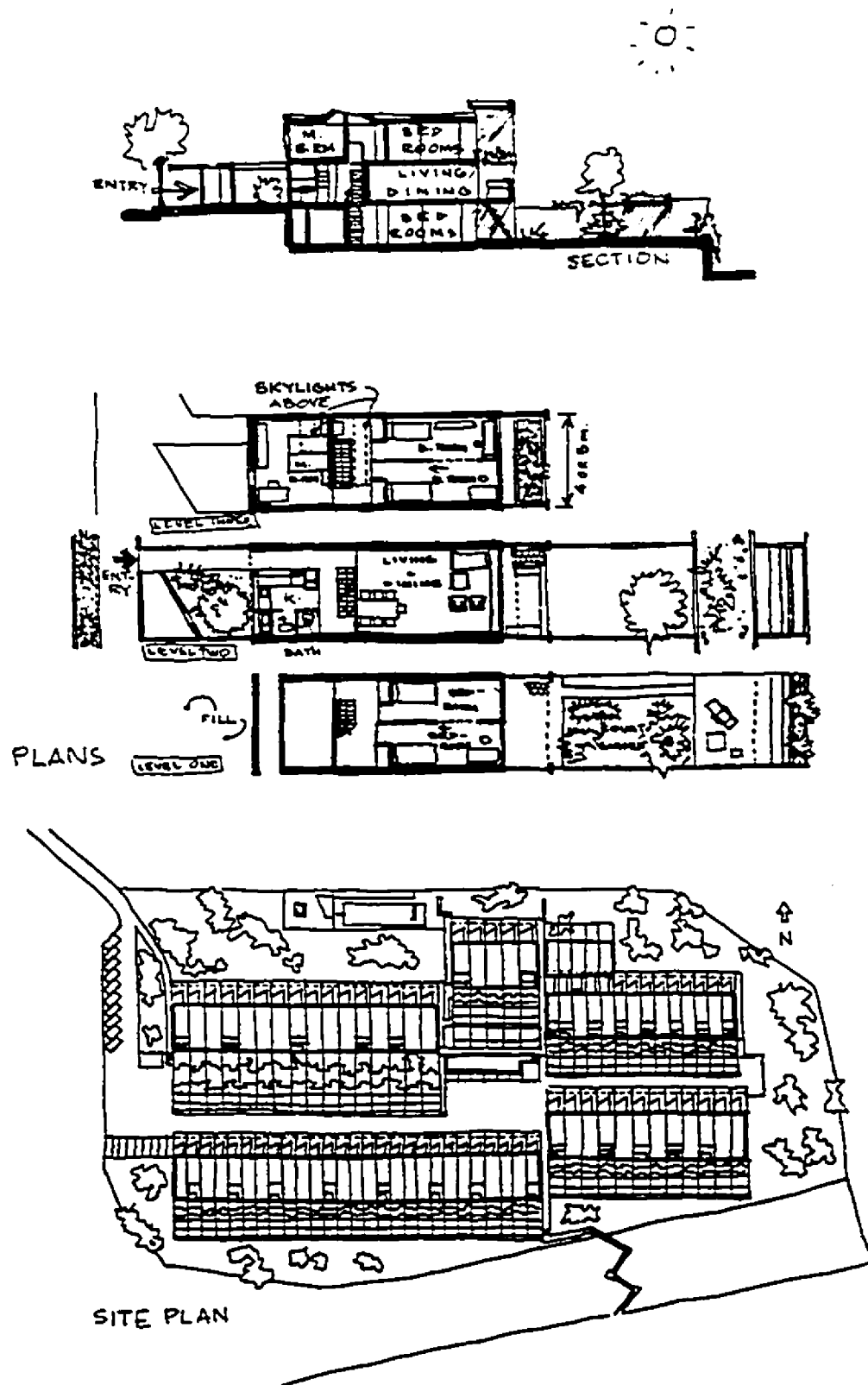
Fig. 5.5 Siedlung Halen Housing Estate, near Berne, Switzerland. Atelier 5 architects, 1961.
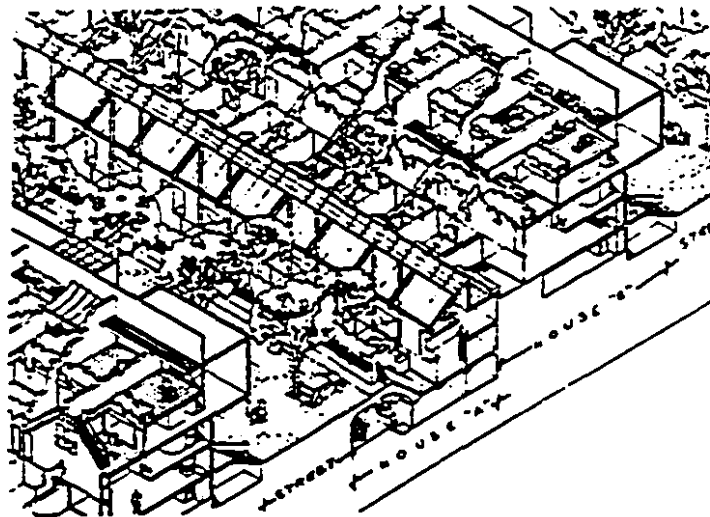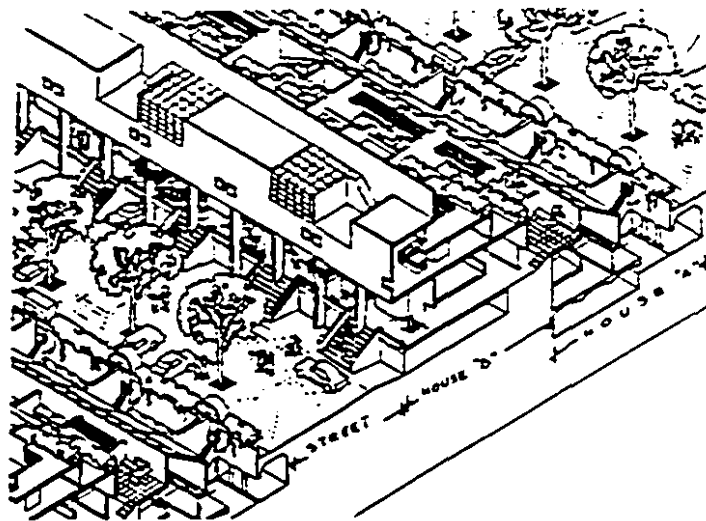
Fig. 5.6 Competition scheme where row courtyard houses are stacked back-to-back, yet possessing consistent exposure. James Tice, architect 1979.

Rear yards can also be fully walled in, creating private patios at the back. A row-patio house may be thus formed, having both front and rear court-patios. For rooms located in the middle of the house, which do not receive sufficient air or sun, one or more central court-patios may be provided if deemed necessary. Though this is not a genuine courtyard house in the strictest sense but rather a narrow front house with a courtyard-patio, it may yet be useful as a replacement typology for row housing.

An example utilizing the "T" plan is the 1961 Siedlung Halen housing estate near Berne, Switzerland, by Atelier 5 architects (8). This project is clearly influnced by Le Corbusier's "Roq" at Cap Martin scheme, and splits the night-time functions on the top and bottom levels of the house, creating a buffer by locating the diurnal functions and access in the middle level. The courtyard is located at the bottom level. The houses look perfectly integrated with the sloping site forming terraces (Fig. 5.5).

The advantages and disadvantages of this typology are mostly similar to those of the row house. Among the advantages one can include the fact that it is ground related, has a street address, and the adaptability of a person moving in from a rural or suburban dwelling to this housing typology is much easier than to an apartment house (9). This typology is very land use efficient, for it uses only 1/3rd of the land required for a single family detached housing unit of similar floor area (10). It can give the illusion of both extrovertedness and introvertedness simultaneously if the front yard is open and yet possesses an interior patio or enclosed rear court-patio. It clearly defines the hierarchy of indoor and outdoor spaces, and collectively forms a continuous street facade. It is economical to construct, for it saves on structural end walls, is energy efficient and provides good cross ventilation. A major disadvantage is the difficulty that vehicular parking creates for houses possessing narrow fronts. If parking space is incorporated with the basement of a house, a considerable amount of the front "yard" is lost to the driveway. As a consequence, parking may be provided in clusters away from the houses, either outdoors or in underground garages.

The provision of openings on only the two house extremities is another disadvantage. Centrally located court-patios carved out of the house volume on the upper level provide additional flexibility in orientation.

Individual outward expression is limited because of the limited facade area.

Being attached to its neighbors forms a greater fire hazard and accoustic nuisance. As a consequence, party walls have to be fire-proofed and acoustically treated, thus increasing costs.

The provision of housing for mixed income groups is more difficult with this typology and may result in social problems such as the creation of ghettos.

Access to the rear courtyard-patio for repairs is limited and virtually inpossible for vehicles: narrow service lanes at the back may be necessary.
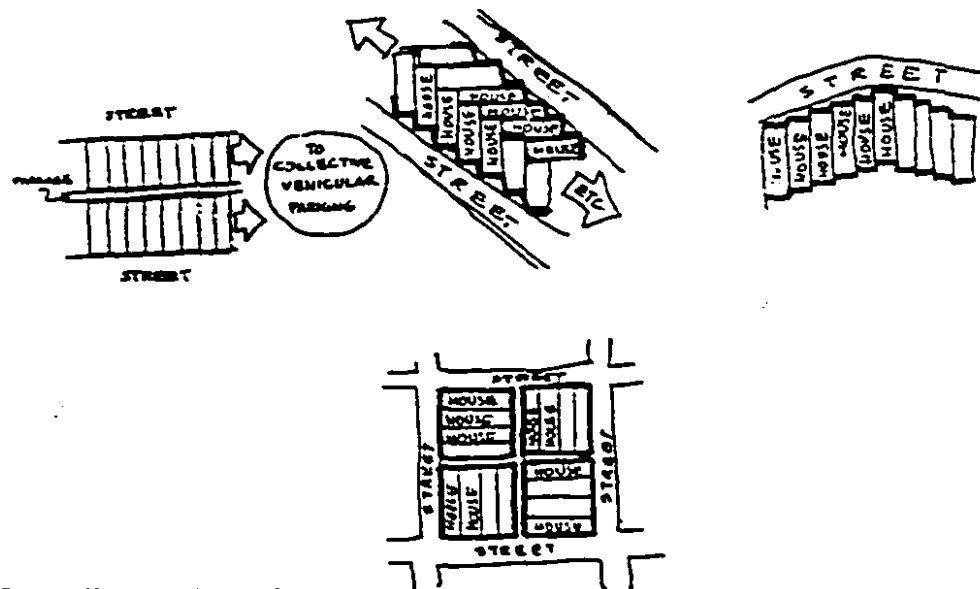

Fig. 5.7 Nestling configurations.

The Linear Patio House (11)

The linear patio house is remotely related to the row house, but is spread out on a single storey in most cases, and generally occupies most of the plot; rooms are arranged consecutively in a linear fashion. Additional functions and bedrooms are accommodated successively aided by the introduction of inner courtyards which increase the amount of exposed building surfaces to the outside and hence the possible number of rooms.

The zoning and arranging of spaces is usually done hierarchically from the least to the most private, starting from the entry. Bedrooms usually end up at the opposite end of

the house from the entrance (Fig. 5.8 a).

Zoning options include locating the adult bedroom and associated functions, near the entrance to control access, living and common functions in the middle, and children and their bedrooms at the farthest end. An alternative includes locating a service core in the middl, to act as a buffer zone (Fig. 5.8 b, c, and d).
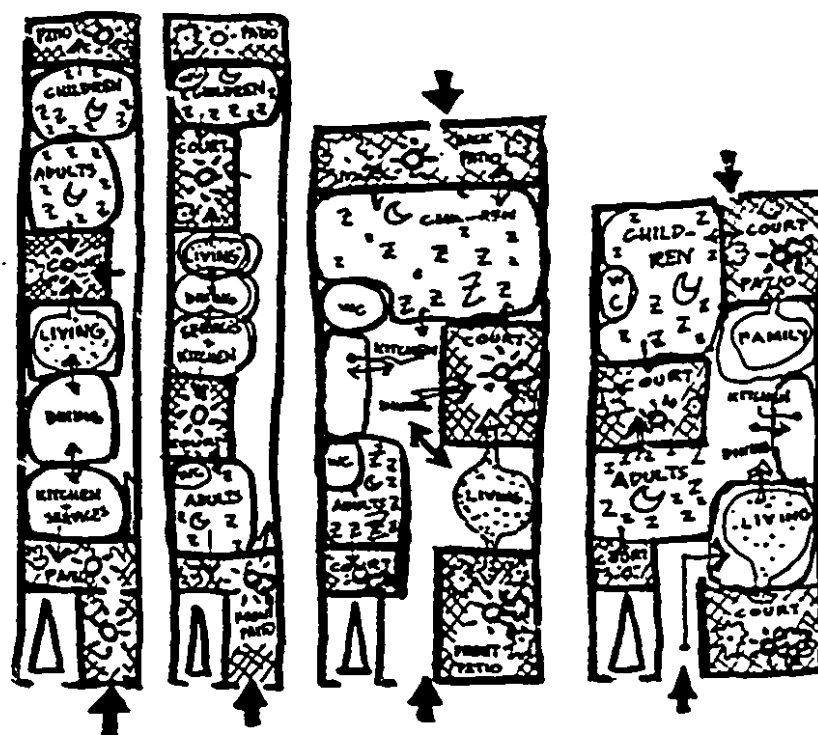

Fig. 5.8 a, b, c, and d.

A house lot ratio is the ratio of the width to lateral depth of the site plan. A lot may have have any of the following proportions: 2:1, 1:1, 1:2, 1:4, 1:6, etc. (Fig. 5.9). As the lot ratio decreases, building densities as well as economies in infrastructure and land increase. House plans with more linear forms possess higher lot ratios and thus achieve higher densities and savings.

Advantages of this house type include schemes with versatile interior spatial zoning possibilities and very low lot ratios. Compared to plot subdivisions with a lot ratio of 1:1,

the long house subdivision (ratio 1:2-1:6) offers a tremendous economy in roads, pipe runs, and other infrastructure and results in increases in densities, all depending upon actual lot ratios. The possibilities for providing multiple courtyards give this typology the advantage of separate exterior realms for adults as well as children, a major asset for privacy level requirements inside the residential domain.

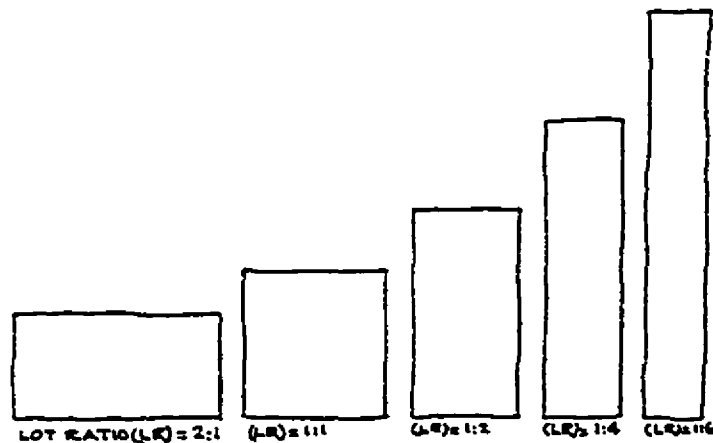LOT RATIO(LR)=2:1   (LR)=1:1   (LR)=1:2   (LR)=1:4   (LR)=1:6

Fig. 5.9 (after Land).

Ease of construction is apparent, for framing and dimensioning can be simplified, and structural elements reduced to two. Floors or roofs have short spans between simple load bearing walls or beams supported by columns. Building components such as floors and walls may be standardized, allowing for systematic savings in their construction.

The long house can give the interior impression of greater size than a square house of similar area. This illusion is due to the fact that through its length will be court-patio gardens enriching the transparency of the long interior perspective. Solar penetration in this typology is less limited than the row patio house, for the inner court-patios provide some directional flexibility.

A major disadvantage is that one has to walk enormous distances in order to reach one end of the house from the other. Since zoning is done in a linear fashion, one has in theory to pass by all the rooms before reaching a destination located at the other end of the house.

Peter Land has developed a version of this typology possessing two or three
storeys, with the extra floors being placed at the extremities of the house so the central,
elongated portion is left as a one storey courtyard entity in order to receive more sunlight
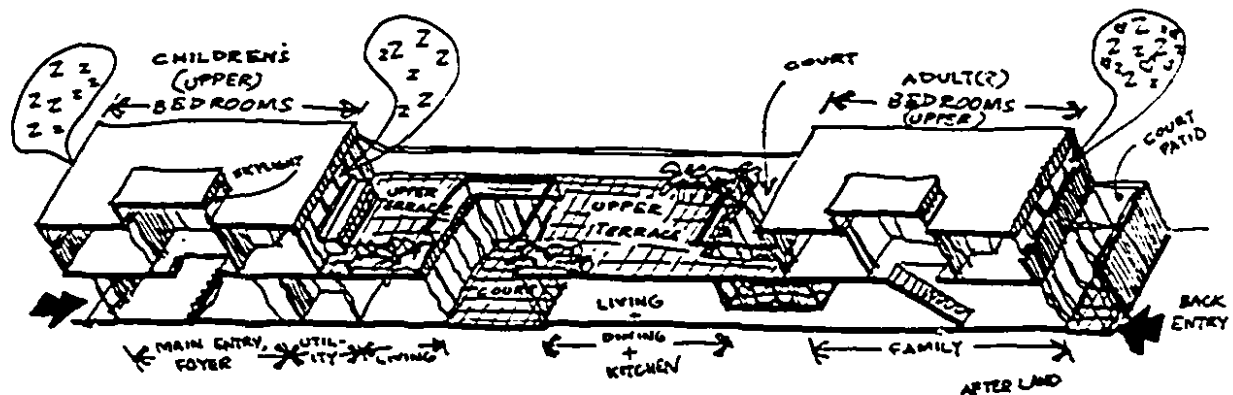(12) (Fig. 5.10).

Fig. 5.10

The Single Bar Courtyard House

This typology is composed of a single wing occupying half the width and the entire
length of its site. The unoccupied half forms the courtyard, and is usually located at the
back-side of the house. This is mostly a single storey typology. Similar to the row
courtyard house, it is not a real courtyard house, but rather a house trying to imitate a
courtyard house.

Services and the main entry are located in the middle of the bar, and the day-time
and night-time functions are located on either side (Fig. 5.11 a). An alternative is to locate
the entry on one side of the bar, and zoning can be achieved by sequencing the rooms from
the most public to service areas to the most private located at the furthest end (Fig. 5.11 b).
The separation of the adult bedroom from the children's sleeping quarters by locating them
at the two extremes of the bar, with diurnal functions and service areas in the middle is a
third possibility (5.11 c).

For bars more than one room wide, zoning can be achieved by having the night-

time functions on one long side and the diurnal functions on the other, facing the courtyard, or vice-versa (Fig. 5.11. d). On two storey plans, the nightly functions may be provided for on the upper level.
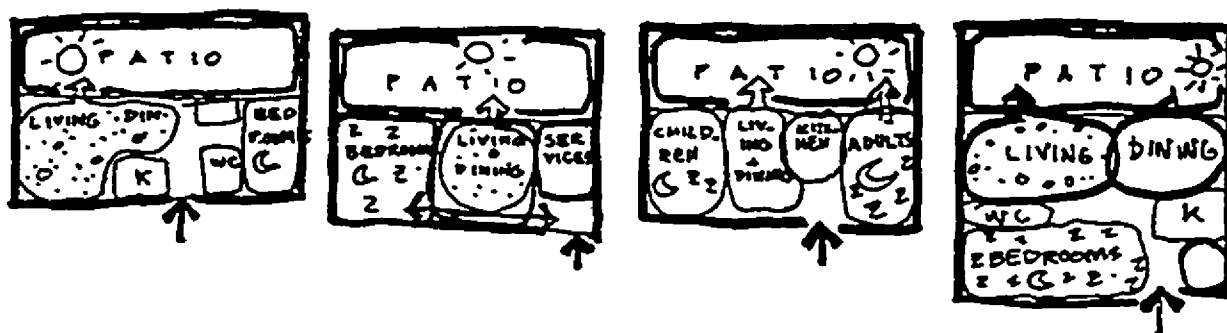

Fig. 5.11 a, b, c, and d.

An advantage of this type is that it possesses a larger exposed surface area to provide more natural light and cross ventilation than a row courtyard house.

A major disadvantage is exposure of an entire length of a facade to the public exterior disturbing the concept of introvertedness. There is no feeling of total enclosure in the exterior space, since the house walls do not enclose the courtyard on two or more sides (Fig. 5.12).
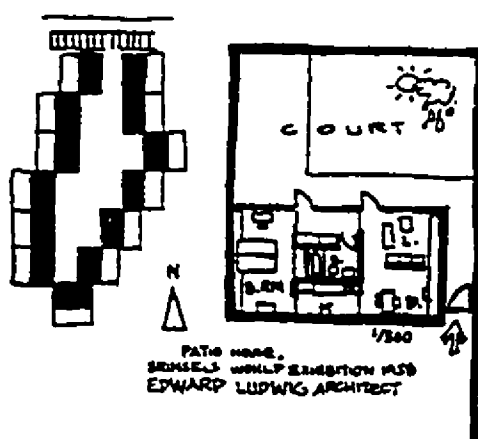

Fig. 5.12 Patio house, Brussels World exhibition 1958. Edward Ludwig, architect.

It is also less energy efficient than Narrow front courtyard houses, and requires more infrastructure, and land, and as a consequence results in lower densities than the row or narrow front courtyard house.

Nestling Configurations

Two storey Single-bar courtyard houses are suitable for sloped configurations, for they can provide a lower unit open at the sloping end and act as a retaining wall on the opposite end, leaving the upper level thoroughly cross-ventillated while having the neighbor's courtyard on the same floor level as that of the upper storey (Fig. 5.13).
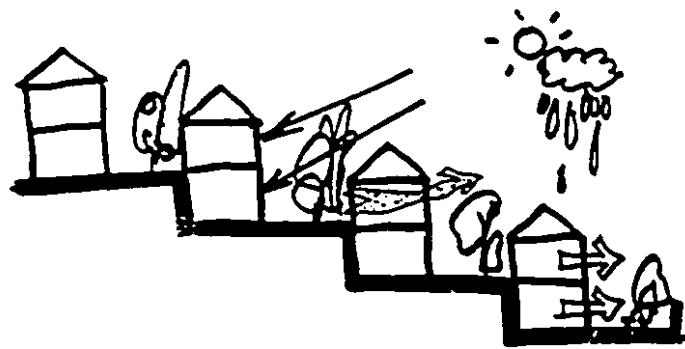
Fig. 5.13 Two storey, single bar terraced patio houses.

The "L" Plan Courtyard House

The "L" plan courtyard house consists of two intersecting wings perpendicular to each other, forming an "L" which encloses a private courtyard. This is by far the most popular contemporary courtyard housing configuration. Zoning within an "L" plan may be achieved according to the separation of daily and nightly functions, with service, kitchen and entrance areas located at the intersection of the two wings (Fig. 5.14 a). Another variation in zoning is placing the adult bedroom at one extremity of the house and the children's bedrooms at the other, with the living, dining, kitchen, services and entrance areas forming a buffer between the two (Fig. 5.14 b).
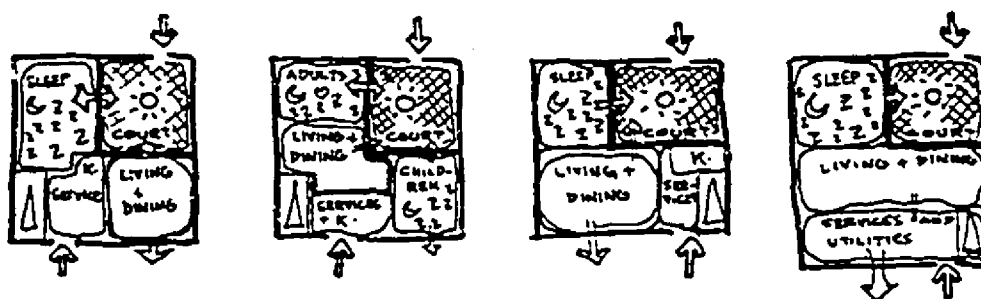
Fig. 5.14 a, b, c, and d.

Zoning may also occur linearly according to increasing levels of privacy, with the entrance located at an extremity, and the kitchen, dining, living, bathroom and bedrooms following in sequence (Fig. 5.14 c). An "L" plan typology may also occur where the wing parallel and next to the street would be two room deep. The rooms on the street side can be service and utility areas that act as a buffer zone to the more private functions inside, which open up onto the courtyard (Fig. 5.14 d).

Some "L" configuration schemes possess greatly elongated and exaggerated proportions, thus emulating a long-house. These have thin, longitudinal courtyards yet retain the zoning configurations of the "L" house. These long forms are required for serving special purposes such as the provision of extra exposed surface areas for solar energy collection (Fig. 5.15).

An advantage of the "L" type is that the entrance to an individual house may be from the courtyard side through a (pedestrian) lane or from the street, on the house side. Since most natural lighting and ventilation can be aquired from the courtyard, obtaining complete introvertedness is a workable possibility.

The house may be expanded in one or two directions according to the families' needs, providing the house wings don't fully occupy the entire length on both sides of the lot. House sizes are modest, thus making them suitable for use in low-cost housing projects.

A major disadvantage of this typology is the limited cross ventilation on the house wing which is adjacent to the neighbor's property (13). This may be remedied by the introduction of skylight windows or tiny secondary courts. Another disadvantage is the fact

that the provision of a single courtyard, with all functions opening onto it, conflicts with the different privacy realms within the house.
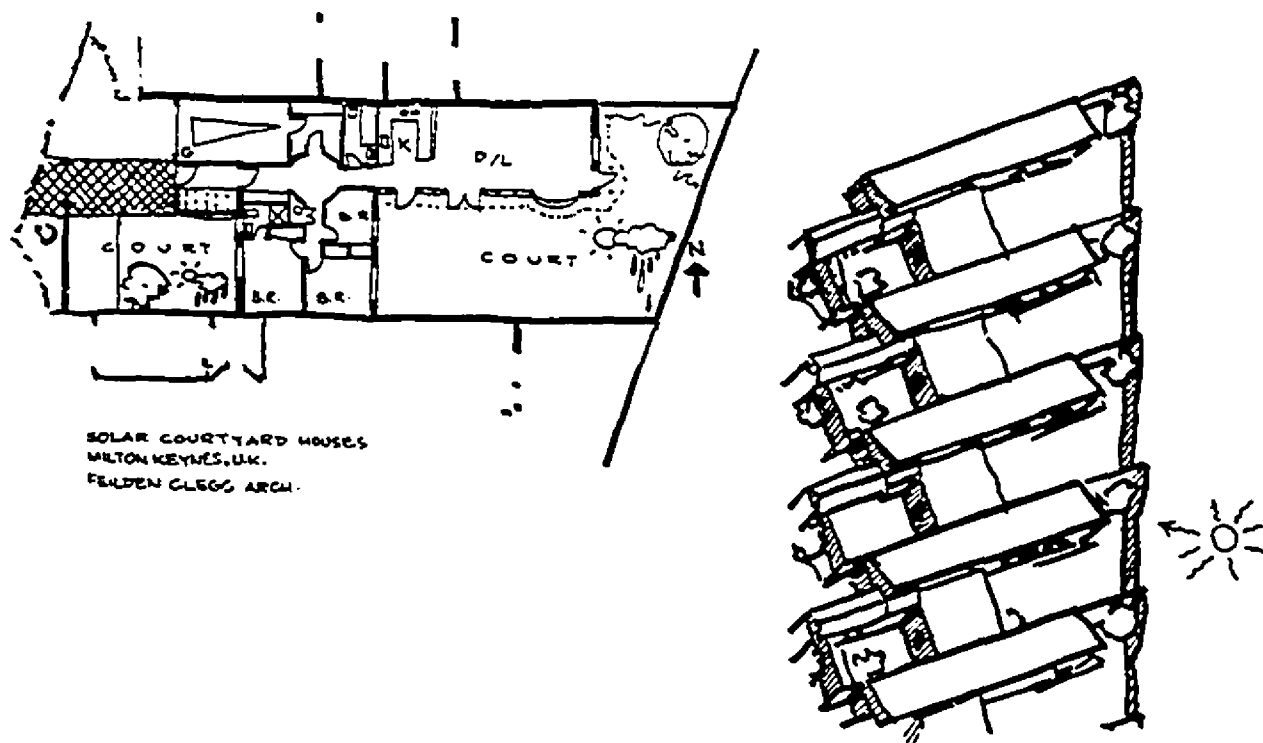

SOLAR COURTYARD HOUSES
MILTON KEYNES, U.K.
FELDEN CLEGG ARCH.

Fig. 5.15 Solar Courtyard Houses, Milton Keynes, U.K. 1986. Fielden Clegg, architect.

Nestling Configurations

The "L" plan is very flexible in its packing configuration. It can be grouped back-to-back or end-to-end, or both (Fig. 5.16). Houses may also be grouped in an "organic" fashion, either blending in with the topographic contours or going sharply against them.These cases are both experimented by Jorn Utzon in two different "L" plan courtyard schemes (Fig. 5.17). They may also be grouped together into terraces, on both flat and sloping sites, creating hill housing and diagonal or artificial slope housing, thus substantially increasing densities.
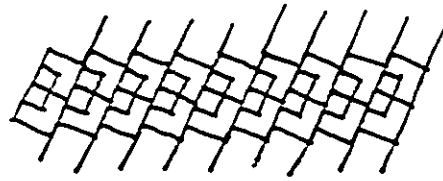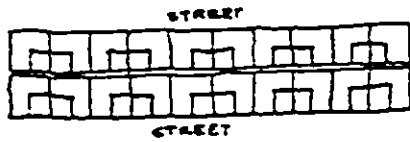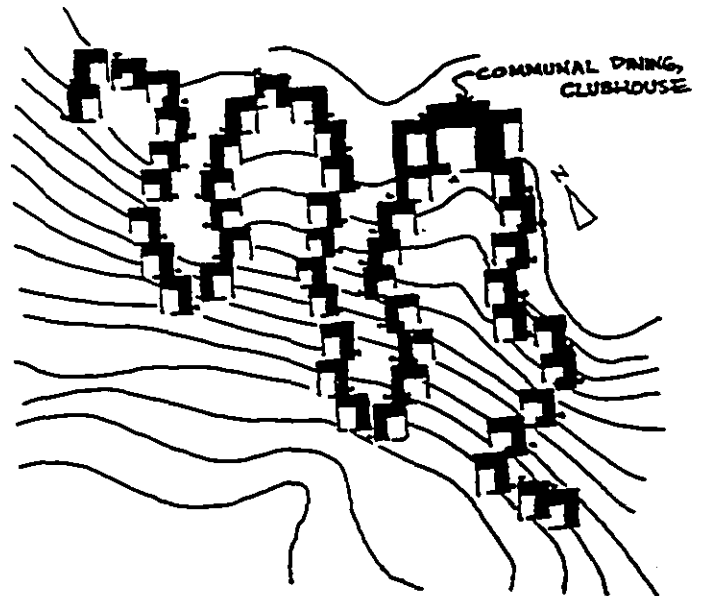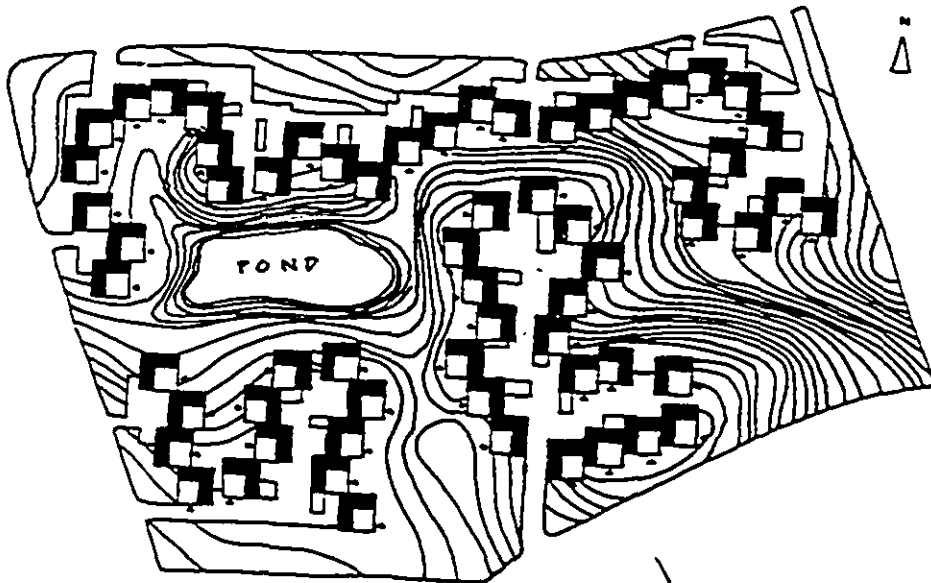
Fig. 5.16. Nestling Configurations.

Fig. 5.17 a. Kingo Housing Estate 1958-1963. Houses blending with site contours, and b.

Bakke Draget Housing Estate, 1958-1963. Houses going sharply against site contours.
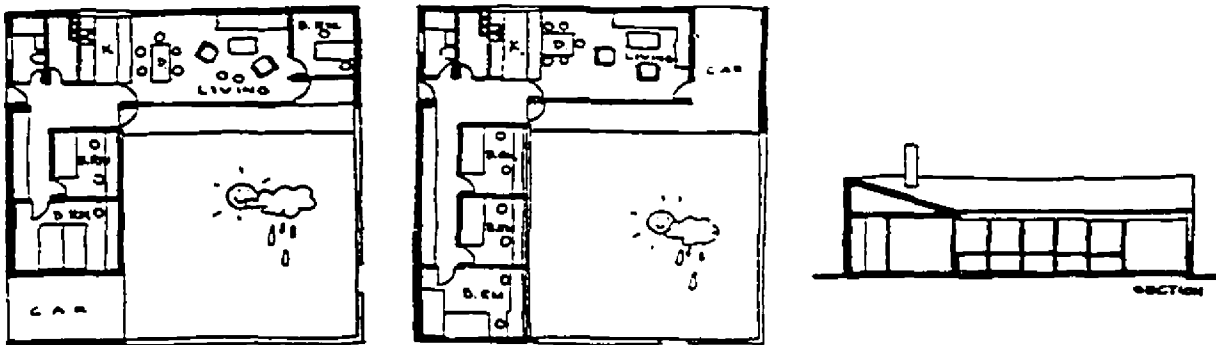
Jorn Utzon, architect (Denmark).

Fig. 5.17 c. Typical house plans and section of Kingo housing estate.

The Two Storey "L" plan

In two storey "L" plan courtyard houses, the diurnal areas usually occupy the ground level while the sleeping areas would occupy the upper (Fig. 5.18 a, b). Houses may possess an upper floor on only one wing of the "L" in order to provide the house with an upper terrace. In some cases, the second floor may be set back to improve the angle of light into the patio. The portion of the house possessing only a single storey can be positioned to allow more light into the court. These units may obtain different orientations, for the plans may be mirrored in several directions. The second floor wing may be parallel or perpendicular to the frontage on the left or right, or at the front or back, thus giving multiple choices in orientation (14).
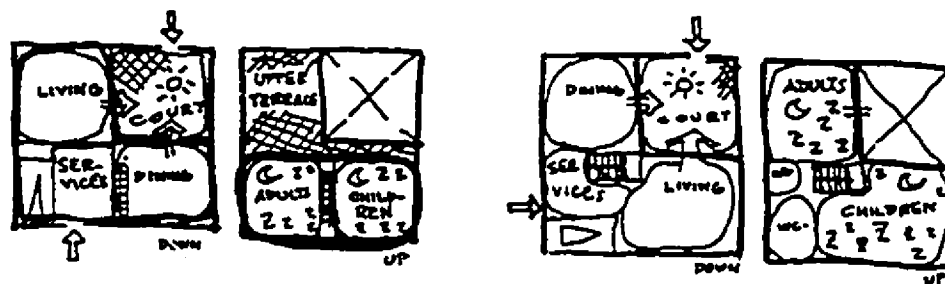

Fig. 5.18 a and b.

A Montreal project by architect Richard de La Riva published in *the Canadian Architect* (15) indicates a conventional ground related "L" plan courtyard house piggy-backed by a single-bar duplex housing unit belonging to a separate occupant with a private access, while occupying part of the roof of the lower unit as its own private terrace (Fig. 5.19). An inconvenience of this project is the diminutive size of the courtyard located on the ground floor, that was dictated by the lot size. However, the possibilities of stacking different house typologies one over the other in order to increase densities is well illustrated in this project and will be discussed later on.
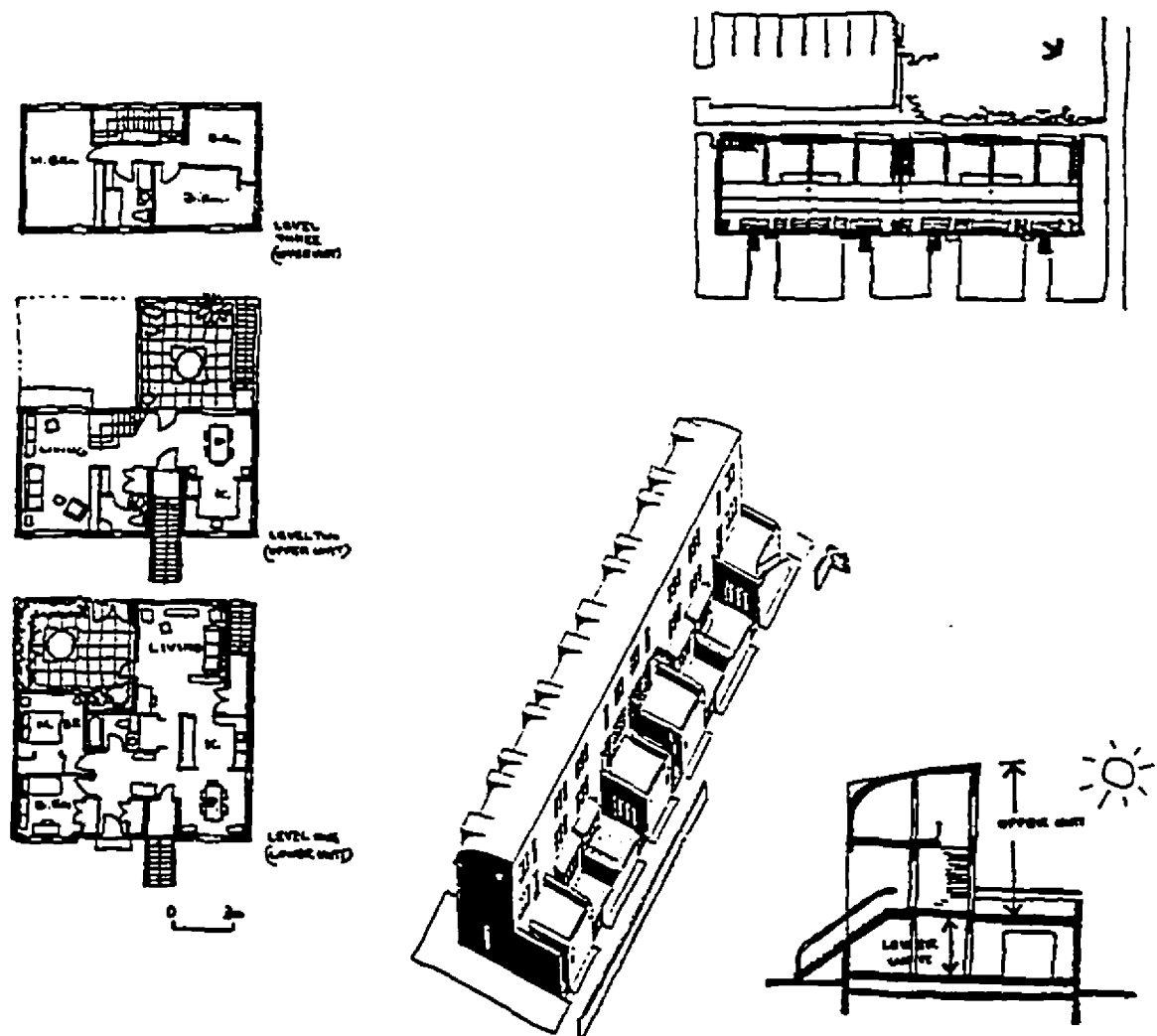
Fig. 5.19 Montreal Patio Houses 1992. Richard De La Riva and Georges Legacé, architects.

The "U" Type Courtyard House Plan (16)

The standard "U" type plan results when the house is composed of three wings forming a "U" enclosing a courtyard. Zoning is achieved by having a wing forming the sleeping area, with the opposite wing serving as the diurnal areas and the connecting wing acting as the service core and access areas (Fig. 5.20 a).

Fig. 5.20 a,b,c and d.

Another zoning strategy is to sequence the functions according to increasing privacy levels by having the garage, entrance lock, and services located in the end wing, living functions in the connecting wing and sleeping quarters in the other end (Fig. 5.20 b). Sometimes an additional courtyard may be added to the front or the back of the house.

A third variation of the "U" type plan is the separation of the adult and children's domains through the location of the children's bedrooms at one end of the "U" plan, and the adult bedrooms in the opposite wing, thus providing maximum separation between the two (Fig. 5.20 c). The day functions and services can be located in the main wing connecting the two and can also occupy part of the night wings. Frequently, one encounters a slightly modified arrangement wherein the entry lock, diurnal functions and services are located in the central wing, flanked by two bedroom wings. An example from 1961 is a "U" plan courtyard housing group at Hyde Park, Chicago by Yau Chun Wong, architect (17) (Fig. 5.21), while a scheme by Arne Jacobsen retains a wing as the sleeping areas and gives the remaining "L" wings to the daily functions (Fig. 5.22).

An advantage of the "U" configuration is that an end wing can be completely given over as a "home workplace" as discussed in chapter three. Thus, the provision of a wing

overlooking the street and acting as a public zone for the reception of strangers, becomes a possibility. The remainder of the house could possess the configuration of an "L" plan (Fig. 5.20 d).
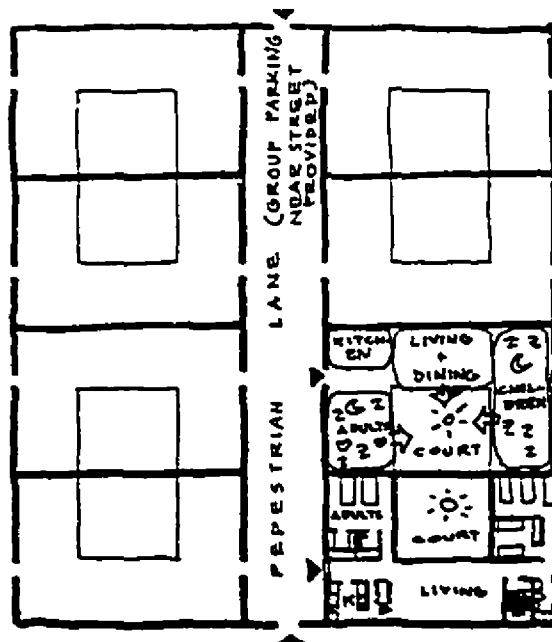
Fig. 5.21 Patio Houses in Chicago, 1961. Yau Chun Wong, architect.
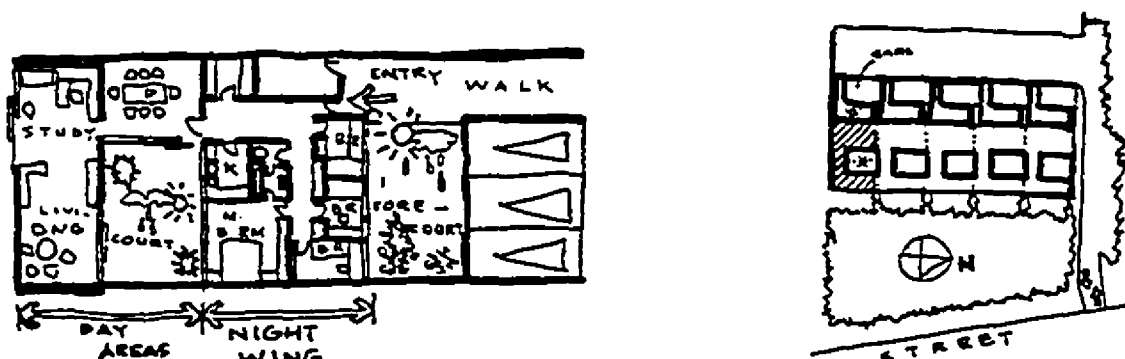
Fig. 5.22 "U" plan courtyard houses at Klampenborg, Denmark, 1961. Arne Jacobsen, architect.

A considerable disadvantage of this type is that its ample size can make it less affordable than a house with an "L" plan; it would lose more heat in the winter, and gain excessive amounts of heat in the summer, because of the additional exposed areas, thus requiring additional insulation and extra cost.

Since all major spaces would look out over the same courtyard, its acting as a buffer between the living areas and sleeping quarters is disadvantageous because of the lack of articulation of the privacy between adults and children or the public and private zones of the house. Conversely, contradictory activities opening up and meeting in the same courtyard can add to its liveliness.
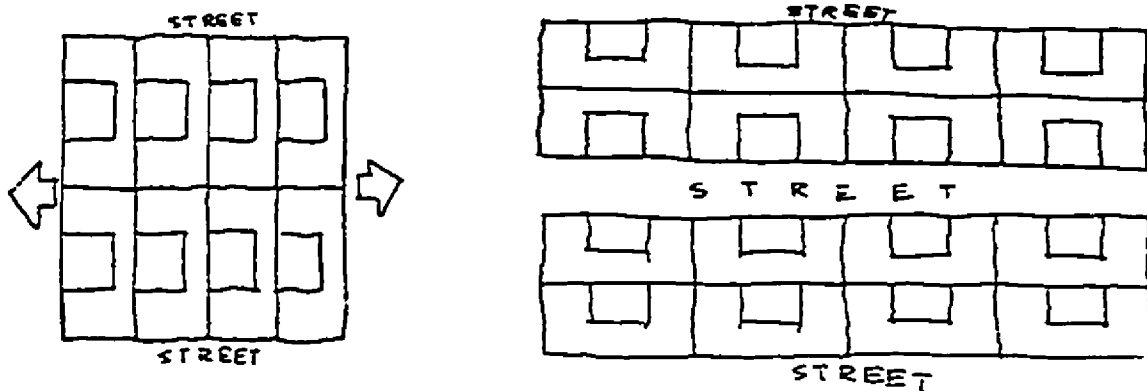
STREET

STREET

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Fig. 5.23 Nestling Configurations.

A variation of the "U" type plan is a house scheme by Peter Land possessing two courtyards located on an "L" shaped plot (18). The house emulates an elongated "U" type plan with an annex. The sleeping areas occupy two wings and the other functions and services occupying the remaining larger wing (Fig. 5.24). A large forecourt, which happens to occupy an entire wing of the "L" plot, serves as front entrance and main court-garden for the living-dining areas. Their nestling configurations in plan result in interlocking patterns.

The Two Storey "U" Plan

A two storey "U" type courtyard house plan may see the ground floor occupied by the day functions, with living functions located in one wing, kitchen, dining, and bathing located in the opposite wing; an entry wing overlooks the courtyard, acting as a link and zoning area between the two. The upper level can be occupied by the bedrooms, with the adult sleeping areas occupying one end wing of the house and the other bedrooms the

other, with a linking wing creating some segregation between the two. Part of the roof of one wing may be used as a terrace overlooking the courtyard.
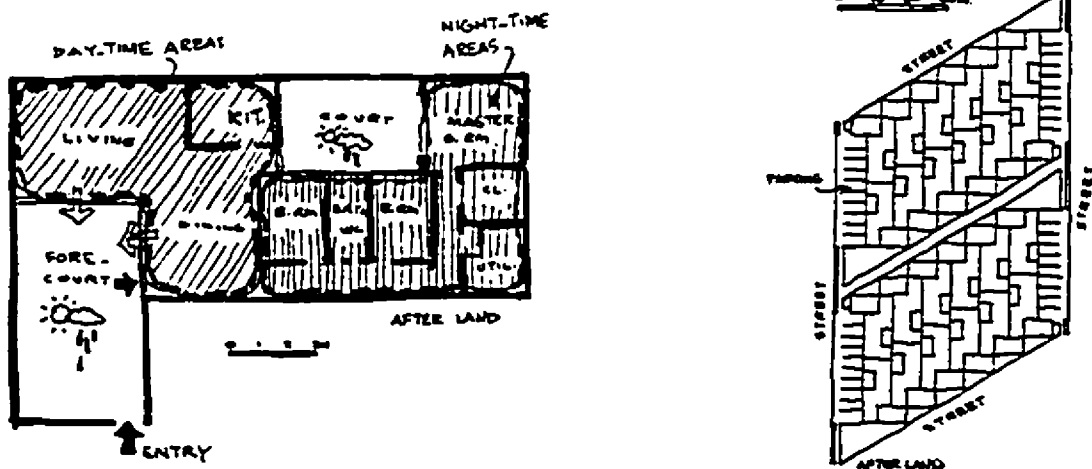
Fig. 5.24 (after Land).
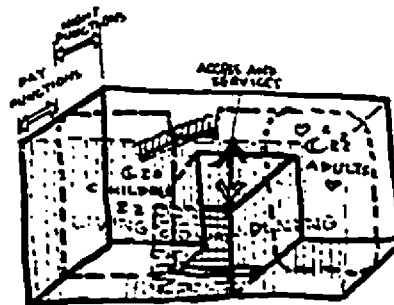
Fig. 5.25

The "O" Plan

This typology is remotely similar to ancient Greek and Roman court houses, for the courtyard is fully enclosed on four sides by rooms in daily use. It is fully introverted, and indicates introvertedness *par excellence*.

The "O" plan may be used in cases where spatial requirements are greater than those of the "L" or "U" type residences. It may also be used in conjunction with projects requiring neighborhood surgery, where completely introverted houses located in tightly knit urban areas may perform well. It is generally suitable for larger households possessing

a large number of functions and having demanding zoning requirements. Complex spatial requirements can be easily satisfied due to the existence of four wings.

An "O" plan house may be created by building a roofed, double colonnade at the open end of a "U" shaped plan (Fig. 5.26 a). This colonnade, whose main purpose is to facilitate circulation around the house, may be glazed or walled in, and can serve as an entrance lobby, including a link to a car port or garage. It may also serve as an efficient semi-transparent separation from a neighbour's plot or may frame a view from the courtyard. In addition, the possibility of a complete circulation loop may help in zoning the house without reverting to conflicts in the hierarchy of privacy levels interrupted by circulation paths crisscrossing between different zones of the house. The allocation of space is efficient because connecting corridors can be eliminated or minimized.
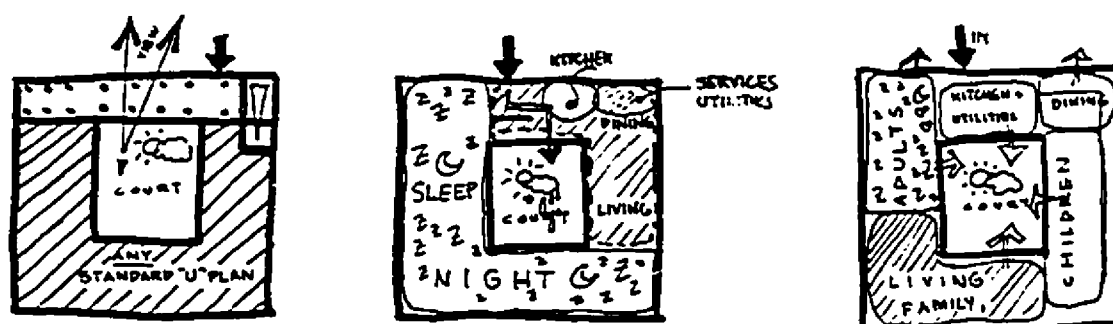
Fig. 5.26 a, b, and c.

The "O" plan may also be an atrium house of generous proportions with two adjacent wings devoted to the night functions and the other two occupied by the day functions (Fig. 5.26 b). As in other typologies, adult and children's bedrooms may be separated by locating them at opposite areas of a house (Fig. 5.26 c). The main advantage of the "O" plan courtyard house is that it allows a 360 degree orientation due to the provision of openings overlooking the courtyard on all sides. It provides excellent cross ventilation and is particularly suitable for milder or hot temperate climates such as those found around the Mediterranean basin. The atrium may serve as an outdoor extension of the living and dining areas.

A fourth wing added to a "U" plan patio house converts the plan into an "O". A

1965 example from Helsinki houses a sauna bath and guest facilities in the additional wing thus completing the "O" (Fig. 5.29 b).

The two storey Atrium house may provide a second floor on one, two or three of the four sides. This addition may be shaped as an "T", "L", or "U", and may have many possible configurations, as long as it allows for proper penetration of sunlight (19). Zoning may be achieved by locating the bedrooms on the upper level (Fig. 5.27). Alternatively, the adult night zone may be located near the entry "lock" to control access while being isolated from the other night functions.
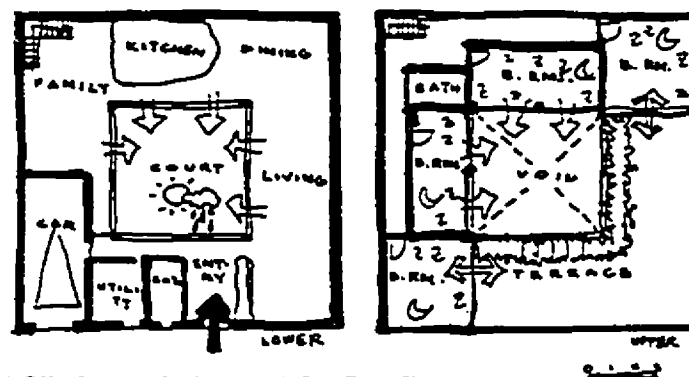
Fig. 5.27 Two storey "O" plan patio house (after Land).

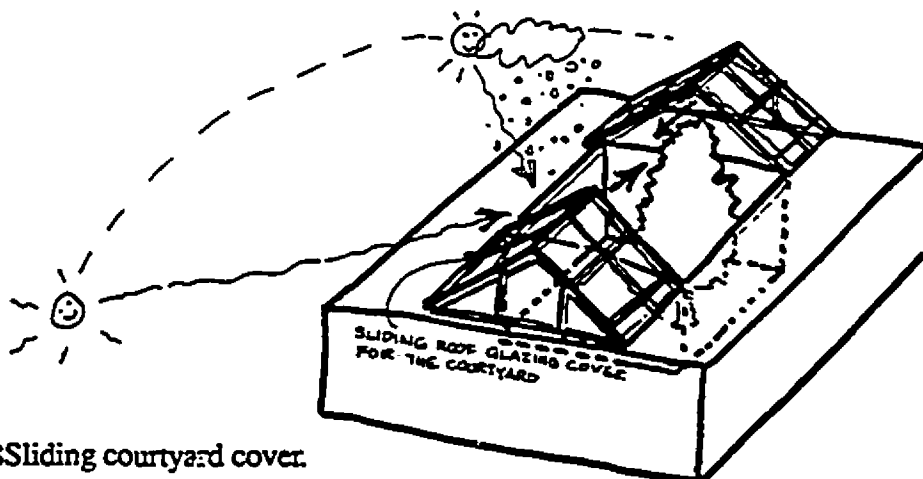

Fig.5.28 Sliding courtyard cover.

A possible alternative for places with harsh winter climates is the covering of the entire courtyard with retractable glazing, thus rendering the courtyard both an interior as well as exterior living room, according to season (Fig. 5.28). The courtyard may also serve as a greenhouse, light well and passage, and is in this manner particularly well adapted for

the Canadian winter.

A two storey penthouse "O" plan example from Milan, Italy arranges the day and adult night functions so that they form a "U" around a tiny but well planted atrium (Fig. 5.29 a). Services occupy the remaining fourth wing where a spiral staircase permits access to the upper floor, composed of 2 children's bedrooms, occupying only the wing above the services (20).
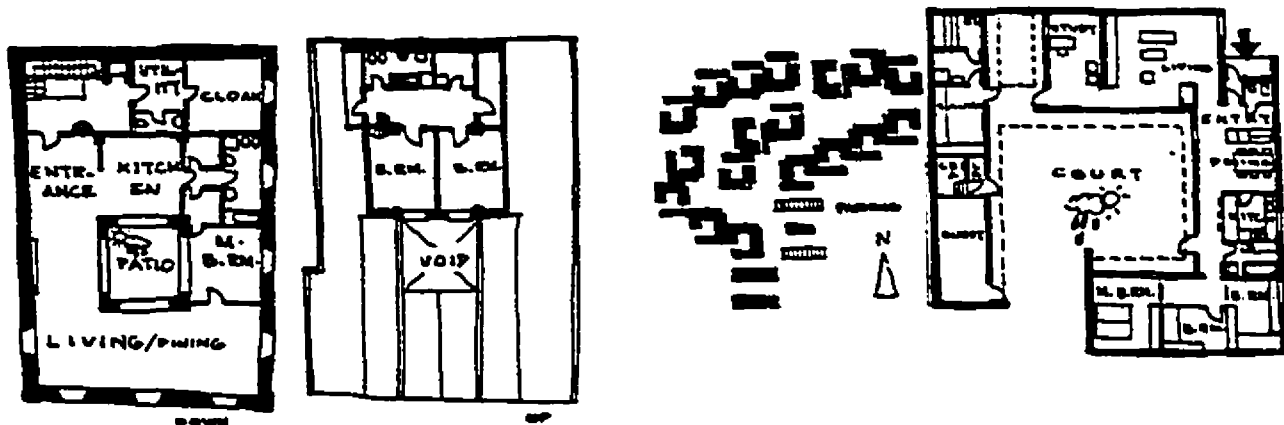
Fig. 5.29 a. Architect's own residence, Milan, Italy 1992. Federica Zanuso, architect. b. Haka patio houses, Helsinki 1965. Pentii Ahola, architect.

British architect James Stirling developed a type of "O" plan atrium house in 1969 for a barriada (slum) in Peru where groups of four housing units were clustered around a common service core. Each house started off as a single storey, architect designed and prefabricated "L" typology, that was expandable into a full "O" (Fig. 5.31). Each house could also expand up onto a second floor later, using traditional construction methods or be reduced back in size again, as required (21). Privacy was achieved by keeping services (bathrooms, kitchens, etc.) near the central core, with the functions occupying two wings on one side and the functions occupying the other two. Stirling promoted the use of a prefabricated construction system as a structural base, to help add and subtract the house rooms and floors at will, in addition to using local building techniques for molding the dwelling to the user's needs. (22). This concept of subtraction, however, proved to be inflexible and this type of custom designed prefabrication, which was so popular in the 1950s and 60s, was later to be dropped for more flexible, interchangeable component

systems available on the market.

Fig. 5.30 Nestling Configurations (after Land).
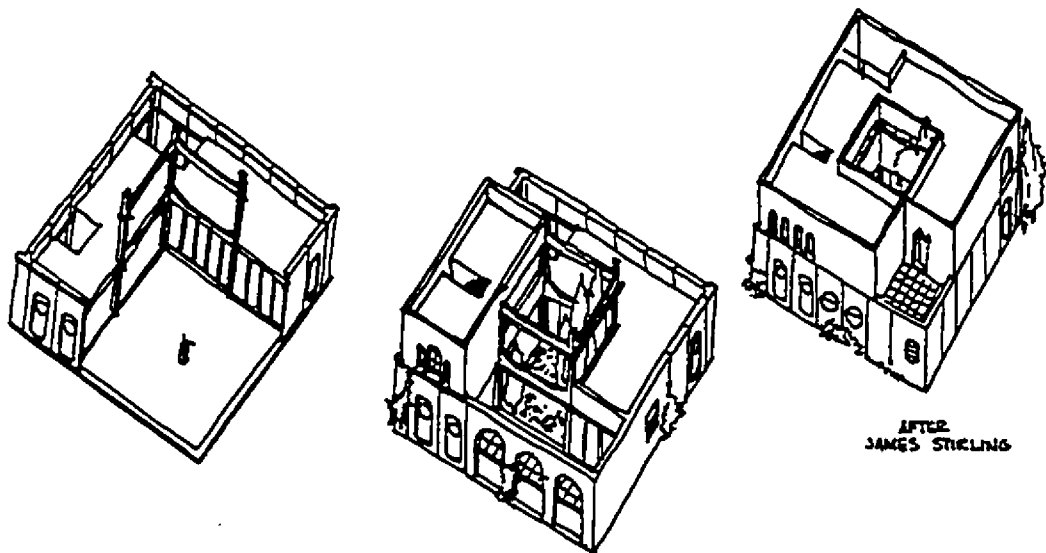
Fig. 5.31 (after Stirling).

Stirling's scheme was very luxurious for a barraida settlement in which he should
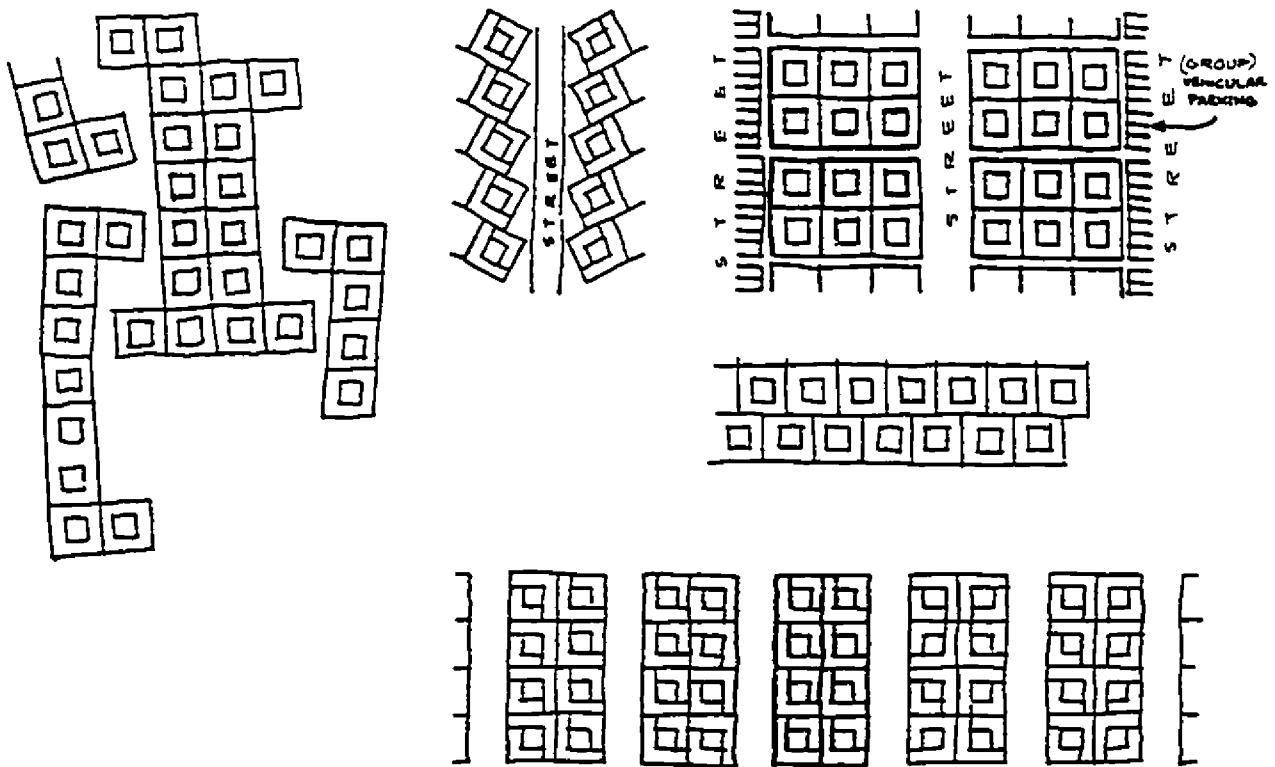have been thinking in terms of minimum cost housing, rather than as a technical exercise in
the combination of prefabrication and local techniques. The atrium nature of the plan,
however, together with the possibilities for expansion, contraction, and construction in
several phases, responds well to the lifestyle of the barraida, and holds many lessons for
advocates of minimum cost housing in developing countries.

The Double "O" or "B" Plan

This typology may also be traced back to antiquity for it has its origins in ancient
Greek Peristyle and Roman Atrium houses. Plots occupied by these houses are mostly
narrow and deep, and the house usually occupies most of the surface area. The rooms
receive daylight through two (or more) patios. Secondary patios may be used as utility
courtyards. A variation of this typology are luxury types with one, two, three or more
bays. Examples are houses by Serge Chermayeff.

Advantages include clear interior zoning possibilities without the conflicts of private
and public spaces overlooking one another (Fig. 5.32 a).

A disadvantage is that this typology is too expensive to construct and too large to
maintain; it is more suitable for wealthier households. However, it can be constructed in
several phases over a long period of time, thus being modified according to need (Fig. 5.32
b). It is also suitable for cultures with large, clan-like family structures requiring large
homes.
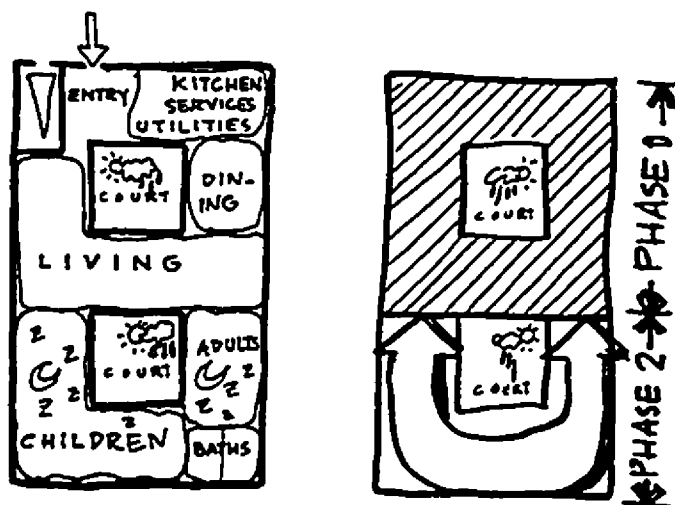
Fig. 5.3.2 a and b.

The "T" Plan and The Double Courtyard

The simplest "T" plan is composed of an inverted "L" plan with a wing attached to the end forming a "T". This annex usually houses a carport or a garage with some utilities (Fig. 5.33). The created outdoor space serves either as a minor courtyard garden, as a utility courtyard, or as a frontal access yard.

In other examples, the extra wing of the "T" serves as kitchen and storage, where the intersection of the wings house either a dining, entry, and circulation zone, or part of the living room extended into the wing.

The "T" plan house possesses two or three courtyards, each may serve as an area around which functions compatible with one another may be clustered: a major advantage for maintaining interior hierarchies of privacy levels in a dwelling.

Mies Van Der Rohe has utilized a "T" type courtyard house plan with elongated arms to create three separate court-gardens on a square plot (23).
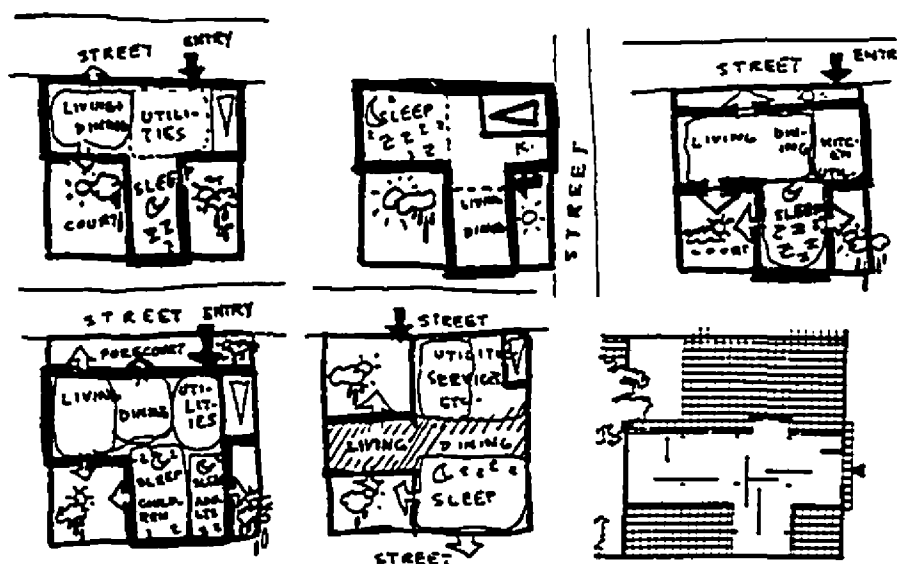
Fig. 5.33 a, b, c, d, e, and e (after Mies Van Der Rohe).

The "H" and The Double Bar Plan

The simplest double bar courtyard plan is conceived by having the bars at opposite sides of the courtyard (Fig. 5.34a). Zoning can be achieved by having the sleeping zone in

one bar and the other functions in another. This arrangement, however, is unreasonable for geographic areas lacking temperate, tropical or sub-tropical climates, for circulation between the two wings involves exposure to the elements.

A link (such as a corridor or an arcade) between the two bars through the middle of the courtyard would divide the courtyard into two separate courtyards, thus creating an "H" plan (Fig. 5.34 b). This link may be used to include common services such as bathrooms, kitchen, dining etc. with a peripheral wing serving as living-dining areas and the others as sleeping areas (Fig. 5.34 c).
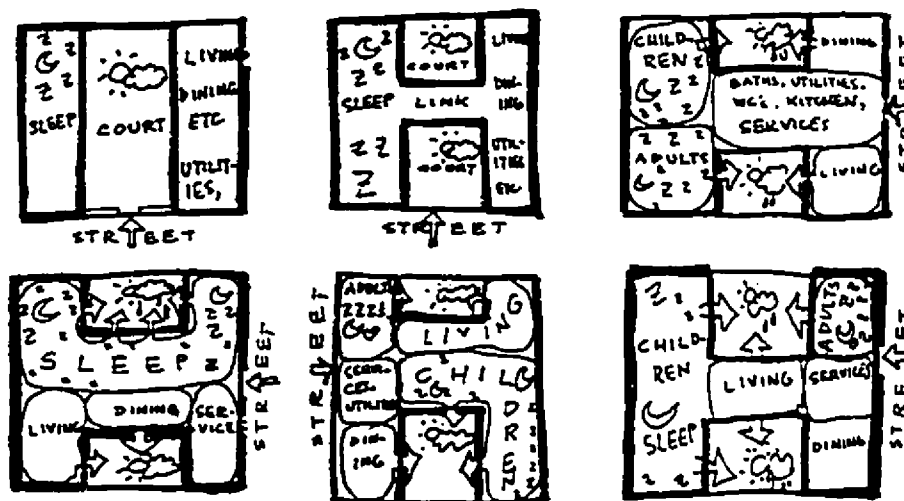
Fig. 5.34 a, b, c, d, e, and f.

Another zoning strategy would be to locate the day functions overlooking one courtyard and the sleeping areas the other (Fig. 5.34 d). The advantage of this layout would be the clustering of different zones possessing different privacy requirements around different courts. The locating of the parent's domain on a courtyard separated from the children's, or the reception and living areas, would help maintain the desired privacy (Fig. 5.34 e, f).

The "H" plan may result in two unequal courtyards, and if one has a southern exposure, the other may have an undesirable northern exposure. This may result in rooms overlooking a cold courtyard with a harsh microclimate and excessive glare. However, an

east-west exposure may help solve this problem. In addition, the creation of two

courtyards, wherin one is warmer than the other, will induce passive cooling of the house;

it is further discussed in chapter three (Fig. 2.10).

Fig. 5.35

The "Z" Plan

This is composed of a rectangular plot with the house occupying all of the site

surface except for two courtyards located diagonally from each other in two opposite

corners of the house (Fig. 5.35). The courtyards may be unequal in size and divide the

house into three wings. The linking wing usually houses the services while the bedrooms

occupy one peripheral wing and the day functions occupy the other.

Multi-Storey Types

Rem Koolhaas and the office for Metropolitan architecture have completed a multi

storey courtyard residential complex in Fukuoka, Japan (24) (Fig. 5.36).

Dwelling units are accessed from below, through the pilotis level. The first floor is

composed of bedrooms forming a "U" overlooking the courtyard, for the latter is located

on the pilotis level. (Smaller housing units have the same layout on an "L" plan

configuration). Natural illumination is received not only through the courtyard, which in

itself might not suffice to capture the low northerly Japanese sunlight, but also through a

large, continuous skylight purposely designed to bring in the low winter sunshine into the

house interior. The living and other day-time use areas are located on the top floor to take

FIRST FLOOR

STREET

GROUND FLOOR
1/500

S T R E E T

Fig. 5.36 b. Fukuoka residential complex, Japan 1992. Rem Koolhaas and OMA architects. Ground and first floor nestling plans.

One Storey, Two Storey, Three Storey More

Single storey courtyard housing possess advantages over multi-storey courtyard housing for its units are simpler to design and build, and allow for more light penetration into patios, provide better cross ventilation, and are more ground related. However, house

plots are usually slightly larger and densities are lower than those of two storey courtyard houses.

Two storey units give a larger house area for a given lot size, and privacy is easier to maintain with sleeping areas located on the second floor and living-dining areas on the ground (or vice versa) (Fig. 5.37). Second floor garden patios may be conveniently located next to the bedrooms, as sleeping usually require less area than living and dining. Single storey houses may be too small to give the impression of an urban scale, while two storey houses look more appropriate in urban situations. Roof surface area is also relatively decreased with two storey houses and consequently less energy is dissipated (25).
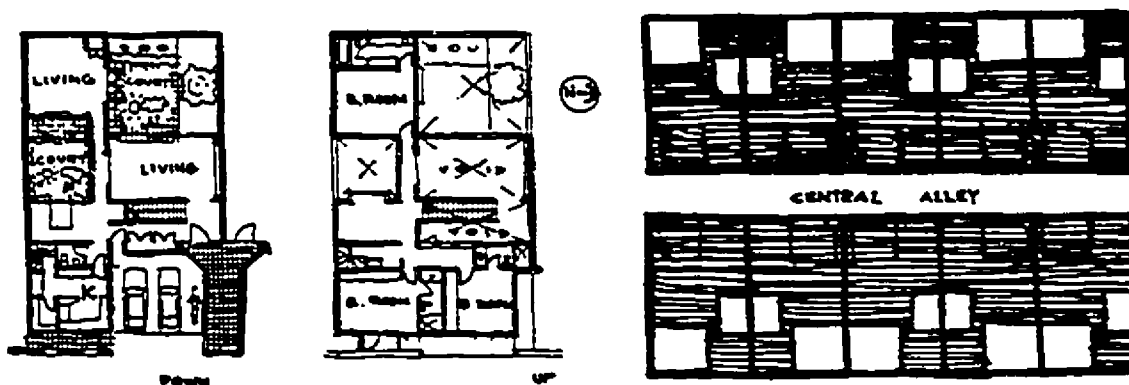
Fig. 5.37 Band houses, Tlalpan, Mexico 1992. Albin, Vasconcelos, Elizondo architects.

Raising dwelling densities requires the provision of courtyard houses with more than one or two storey heights. Each courtyard housing unit may possess several levels. However, unless each dwelling unit is a tower type residence, the creation of housing units with more than three or four levels would be impractical, both in terms of human effort and wasted space used for vertical circulation.

Three to four storey walk-up courtyard houses are the upper limit for courtyard housing if they are to be used separately. However, these may be combined with other typologies, such as row houses, or apartments. Commercial and office spaces on the first few floors may be topped by two or three stories of courtyard housing duplexes or triplexes in order to increase densities. Mixed use buildings are the trend of the future and

further experimentation may be required to determine the degree of viability of the concept in a given scenario.

Another method to obtain higher densities would be to stack several single-storey or multi-storey courtyard houses, with more complex configurations, one over the other, in a stepped pattern, with part of the roof of the lower unit serving as a court-patio for the upper unit (Fig. 5.39). This could be achieved without necessarily reverting to a special, expensive structural support. In addition, orientation must be rationally conceived and consistent throughout the scheme. The leftover spaces under the stepped housing units should be put to good use and could house commercial facilities, offices, and vehicular parking spaces, thus further contributing to the mixed use character of the facility (Fig. 5.38 a and b).

A further endeavour that substantially increases densities is the introduction of commercial and retail facilities at the ground level, topped by two or three levels of office or work spaces. These would be topped by row house triplexes and can be piggy backed by two or three storey "L" or "U" houses and crowned by two storey "L" or single bar patio houses (Fig. 5.40). Care must be taken to make the building mass only one unit thick in order to promote natural cross-ventilation, solar penetration, and to avoid mega-scale, inhuman projects.
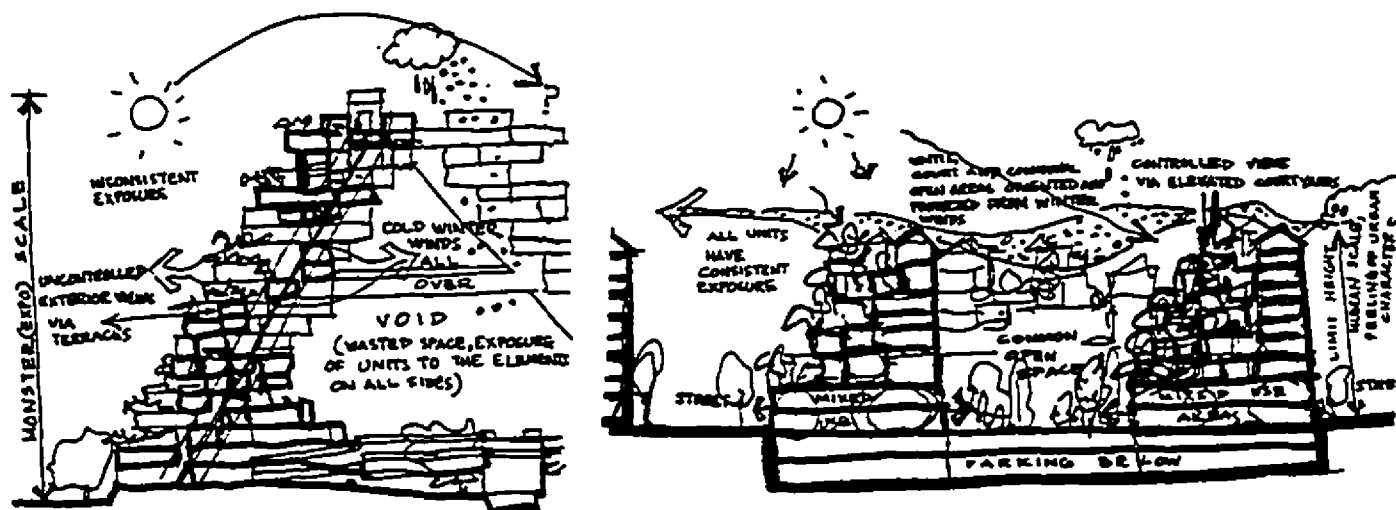
Fig. 5.38 a. Original Habitat proposal by Moshe Safdie architect, versus b. Elevated courtyards with perimeter block style arrangement.
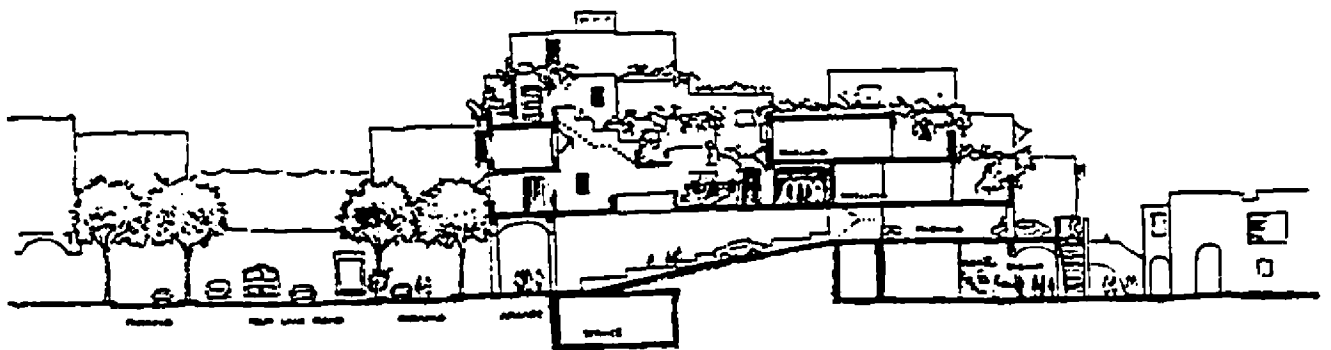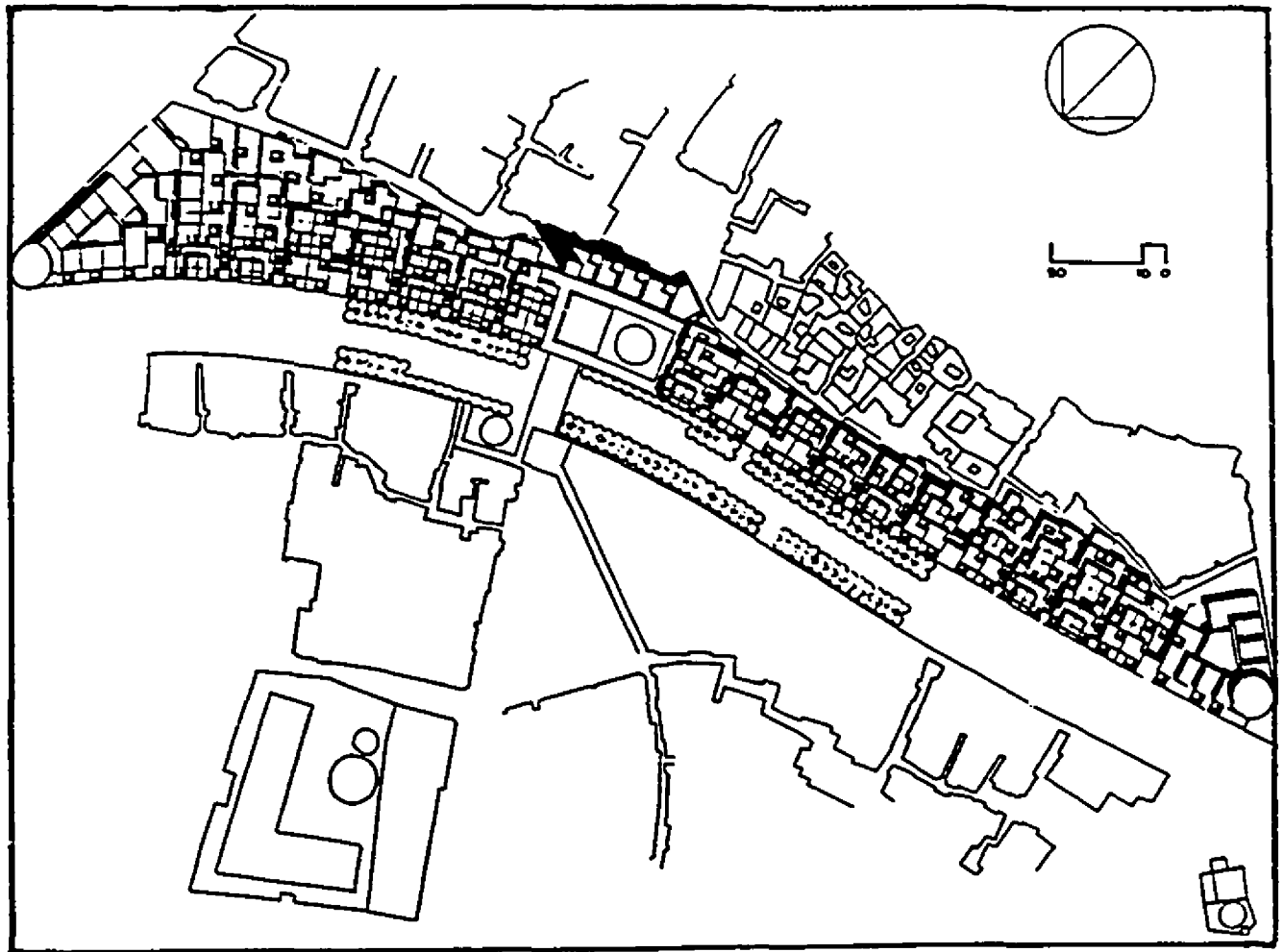
Fig. 5.38 Bab El-Sheikh redevelopment competition entry, Baghdad 1982. Ove Arup Associates. a. Intensifying neighborhood texture via a weaving of spaces to recapture original urban sense. and b. creating a high urban density of public and private uses by stepping buildings.
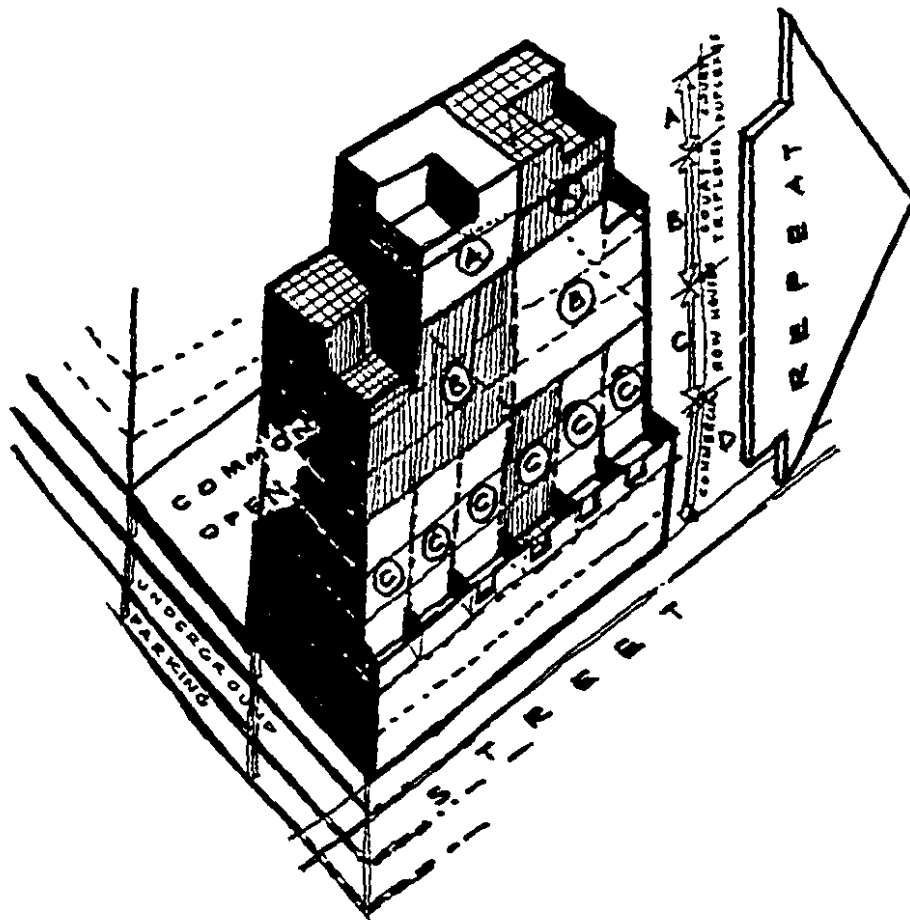
Fig. 5.40

Conclusion
Back to the Future

Perhaps it is time to ask once more what has already been posed and answered at the inception of this study: what is a courtyard house? Is it solely a contemporary version of the 'nemesis' of the extroverted house, as it has existed throughout history? Does contemporary courtyard living demand a return to traditional lifestyles and forms?

First, it should be noted that a reversion to introverted living cannot result in a return to traditional courtyard housing with its accompanying lifestyles in a strict sense, for social pressures dictating the decision to resort to these types of lifestyles and dwelling configurations are different today from those of the past, just as they will be different in the future from those of today. Contemporary courtyard housing differs from traditional examples as much as a current North American suburban bungalow differs from a mediaeval European cottage. Although general characteristics, such as the desire to attain introverted living and some forms of privacy, remain constant, different types of social pressures in different times and places affect the articulation, interrelationship of spaces, and the degree of introvertedness required, as well as the collective configuration of houses.

It is difficult to predict what type of social pressures will be in play in the future and how they will act on the individual, and the social, or familial, unit. One thing is certain: as time passes by, social structure becomes increasingly complicated, and the links required between individuals and their peers tend to become more and more intricate.

Housing in the future has to be flexible enough to be able to cope with these increasingly sophisticated socio-cultural demands. Since courtyard housing represents a set

of typologies whose very configurations are based on an outcome of these social stresses, perhaps it is best to describe it as the "other half" of housing, representing the (other) introverted 50% of all dwelling typologies. Courtyard housing does not represent a single typology but a group of typologies and should be treated as sucn.

One of the most impressive arguments against courtyard housing is an objection to adapting a historic dwelling form to suit a contemporary way of life. In other words, how can a traditional house form satisfy the lifestyles of today and tomorrow? How can rapidly occurring stylistic and technological innovations be integrated into a historical dwelling type, and how can this be properly expressed in architecture of the house?

Certain fundamental human needs, such as the requirement of shelter, are deeply rooted in our genes, and must be satisfied by all humans by one means or another. Shelter must not be the privilege of some societies, but must be an intrinsic right for all humankind. Thus, the prevision of shelter is better than the provision of no shelter. However, the provision of good shelter is better than the provision of bad shelter. Good shelter cannot be determined or judged by the external appearance of the dwelling. Rather, it is based on many factors but mostly on very complex socio-cultural issues and is distinct for each and every culture. However, the "contemporary look" of a dwelling is apparent from its exterior and is a prime factor dictating its commercial merits. For instance, while the interior of an extroverted house may respond to complex socio-cultural demands, its external appearance or "look", whatever the architectural style, is usually not the result of socio-cultural, behavioural, or other intricate factors, but is often related more to trends similar to those in fashion and the decorative arts. The lifespans of these exterior appearances are short and most probably alter during the lifespan of an individual, thus making the "contemporary look" of the dwelling less contemporary after a period of time.

The courtyard house does not possess an external appearance in terms of decor or fashion for it possesses neither an exterior "look" nor style. What it does possess is a set of elements responding to human needs. Not only is its entire configuration based on human social and cultural inter-relationships, but the links established between the dwelling and the exterior world respond directly to established human bonds as well.

Unlike stylistic factors, socio-cultural demands are directly related to people's

lifestyles and are based on customs, human experiences, habits and behaviour, and remain unaltered for prolonged periods of time. For instance, certain fundamental social requirements, such as adult privacy within the dwelling, may remain unaltered for several centuries and even millennia.

In other words, the way a courtyard house "looks", inside and out, makes sense because it is a setting for a particular type of human behaviour, and remains valid for a long time. Most socio-cultural changes that could alter the dwelling drastically are minimal during the lifespan of an individual and therefore have a negligible influence in promoting significant changes in the house.

Another major argument against courtyard housing may be made with respect to technology (not building or construction technology): with constant, rapid technological innovations, an introverted courtyard house form deals primarily with social requirements and does not express the latest technical trends; there may have to be accompanying changes which would affect our norms, values and socio-cultural behaviour, requiring alterations in our living environment in order to be able to cope with them. To analyse this issue, one should ask if the demands on the house of the future should express the latest technological trends? For instance, there is ample talk nowadays, among other technological innovations, about the "information highway" and the effects it might have on domestic lifestyles, and consequently, on the house form in the near future. Does a dwelling have to express, in its physical shape, the latest technological innovation it houses? Should a house, or parts of it, reflect the shape of an electronic device if it contains one?

Certain standardized values and social and cultural principles have taken our civilisation several millennia to shape, and they are eternal in terms of human experience. As seen above, alterations in these social principles are and should be negligible over the lifespan of an individual. Because technology changes so rapidly does not mean that fundamental socio-cultural behaviour, basic psychological responses or human relationships, temperaments and dispositions alter as well. Unlike stylistic trends, culture, as it affects housing, takes prolonged periods of time to alter, and thus tends to prevent certain major aspects of a dwelling from undergoing drastic modifications. Technology, on

the other hand, is similar to stylistic trends in that it alters more rapidly than culture and is subject to several major transformations, improvements and innovations during the lifespan of a person.

Advances in technology certainly change the standard of living. However, the evolution of the home should not be dominated by technology, and the latter need not dehumanize the home. The evolution of the dwelling need not be confused with the evolution of technology. Newer technologies render older technologies and not homes or lifestyles, obsolete: human social relationships, and therefore rationally conceived houses based on those relationships, remain unaffected.

One of the most influential technologies that modified settlement form was the revolution in transportation which helped propagate the move to the suburbs and influenced the size of the city and its links with the dwelling as well as its location, but it had a rather minimal impact on the interior configuration of houses.

Even if a major technological innovation were to occur which could drastically modify the dwelling, one should keep in mind that such a change initially caters to the demands of the operation of the innovative technical device and not necessarily the needs of the human being. What is to come first in a house: human demands or technological requirements?

Factors based on human relationships are more vital for the survival of the home than formal changes caused by constant technological innovation. What is really needed is a constant and familiar living environment where everyday technological innovations, improvements and gimmickry will not make dramatic behavioural changes. The real advantage of technological innovations should be the reshaping of humanity (and everyday life) for the better. These innovations should be innocuous devices enhancing and enriching life and should be subservient to the main factors shaping the house. Information, or any other technologies, should be adapted and integrated into the house discreetly, without interrupting the physical structure established within the house. Stylistic and technological innovations should be personalisation devices within the courtyard dwelling and should help retain the inhabitants pleased and in more keep with the times, in a house form that discreetly integrates innovations yet retains its form.

Despite all the advantages of the courtyard house, which heavily outweighs its liabilities, North Americans are still hesitant to adopt introverted courtyard living. This is hardly a solitary conviction complying to the conformities of the inhabitants of the "Brave New Frontierless World", for even in those countries where successful courtyard housing projects have been constructed and dwellers have happily settled in ever since, there seems to be certain reservations towards it.

Rejection of courtyard housing is often a matter of premature judgment. Although initial predictions may indicate that a state of repulsion may arise between the prospective nester and the dwelling, no significant antagonism has yet been recorded against recent courtyard housing by their dwellers. This is a matter of prejudice against a somewhat foreign housing form where the cityscape is dictated by house walls and small shops, instead of open grounds where houses sit all alone. The greatest perplexity stems from a perception of confinement and the inability to escape when inhabiting a capsule-like courtyard environment; some believe it will result in unbearable nervous stress. There is no rational justification for such a belief, for courtyards are open at least to the sky and the fear of inhabiting a claustrophobic environment occurs mostly to people who have never experienced this kind of living. With time, after a trial residency period in a courtyard house, opinions tend to change.

It took several decades for North American consumers to appreciate the virtues of compact, space and fuel efficient, rationally devised automobiles. Their infatuation with excessively bulky, fuel inefficient, irrationally conceived vehicles enjoying status via extravagant chromium trim (as with the manicured suburban lawn) was a result of such established values as "bigger is better", and a bias against everything that was "foreign", "cheap", "miniature", "imitative", "imported", etc..

Since housing happens to be one of the components of a civilization which is most difficult to change it is conceivable that it will take several decades for the North American public to appreciate the virtues of courtyard housing. What is required is some large scale pilot demonstration projects which would mature with time and kindle the interests of professionals, the public and developers as well. It was the energy crisis of the early 1970s that sparkled the interest in fuel efficient, rational compact cars. Perhaps a similar spark is

long overdue to kindle the interest in rational, energy efficient, and socio-culturally sustainable courtyard housing.

The aim of this thesis was to reestablish the legitimacy of courtyard housing, both for the architect's drawing board and the housing market. If these pages have convinced the reader towards that end, then its purpose is served. This conviction, however, should not be a temporary trend but must result in a process of ongoing experimentation and research.

As for providing an answer to the initial question, an incomplete definition of the courtyard house would describe it as an introverted dwelling encompassing a private courtyard with a configuration devised to satisfy the most intricate socio-cultural requisites. However, a partial definition is hardly sufficient, for its recurrence in a variety of shapes and sizes make it a suitable shelter adaptable for all income groups. Its variety and conformity to different lifestyles make it a housing typology for all cultures. Its adjustability to all climates make it a house for all seasons and its continuous recurrence in history and its sustainability make it a housing typology suitable for all time.

Notes Chapter One

1 Amos Rapoport, *House Form and Culture* (Englewood Cliffs, NJ: Prentice Hall, 1969) 58.

2 Ibid. 47.

3 Norbert Schoenauer, *History of Housing* (Montreal: McGill UP, 1992) 115.

4 John R.Clarke, *The Houses of Roman Italy: 100B.C.-A.D.250: Ritual, Space, and Decoration.* (Berkeley: University of California Press, 1991) 19.

5 Witold Rybczynski, *Waiting for the Weekend* (New York: Penguin Books 1992) 166-169.

6 Pliny the Younger, *Letters* (Epistulae, Book V, Letter 6). Helen H.Tanzer, ed. and trans., *The Villas of Pliny the Younger.* (New York: Columbia UP, 1924) 17.

7 Witold Rybczynski, *Looking Around: A journey Through Architecture.* (Toronto: Harper Collins, 1992) 36.

8 Clarke 19.

9 Ibid. 19.

10 Vitruvius, *Ten Books on Architecture* (New York: Dover 1960) 182.

11 Pliny the Younger, (Epistulae, Book II, letter 17) 7.

12 Ibid. 20.

13 Rybczynski, *Looking* 36.

14 Clarke 21.

15 Rybczynski, *Looking* 100.

16 Ibid. 99.

17 Ibid.

18 Ibid. 101.

19 Joel Garreau, *Edge City: Life on the New Frontier.* (New York: Doubleday 1991) 7-15.

20 Ibid.

Notes Chapter Two

1 Amos Rapoport, *House Form and Culture* (Englewood Cliffs, N.J.: Prentice Hall, 1969) 80.

2 Edward T. Hall, *The Hidden Dimension* (Garden City N.Y.: Doubleday, 1969) 40.

3 Rapoport 81.

4 Yoshinobu Ashihara, *Exterior design in Architecture*. (New York: Van Nostrand Reinhold, 1970) xi.

5 Ibid. 11.

6 Ibid. In contrast, nature as space extends to infinity. It is not delimited and has no order of "inside" and "outside". It does not focus on any one feature or element. According to Ashihara, it is regarded as a centrifugal or negative exterior space.

7 Rapoport 31.

8 Paul D. Spreiregen, *Urban Design: The Architecture of Towns and Cities* (New York: McGraw Hill, 1965) 75.

9 Ibid.

10 Ashihara 11.

11 Ibid.

12 Spreiregen 75.

13 Ibid.

14 Hall 42-43.

15 Norbert Schoenauer and Stanley Seeman, *The Court-Garden House* (Montreal: McGill UP, 1962) 125.

16 Ibid.

17 Vitruvius, *Ten Books on Architecture* (New York: Dover 1960) 183.

18 Christoph Luchsinger, *"Courtyards"*. *Werk, Bauen + Wohnen* : Zuricher Ausgabe, March 1992, 5.

19 Outdoor living, sitting, napping, dining, entertaining, barbecuing, casual social

interaction, food drying, children's play, storage, sunspace, laundry drying, outdoor crafts, small-scale income generating activities, pets, gardening, outdoor recreation, etc. may all be a part of everyday courtyard life.

20 Vitruvius 177.

21 Spreiregen 75.

22 Amr Bagneid, "Indigenous Residential Courtyards: Typology, Morphology and Bioclimates".*The Courtyard as Dwelling*; Nezar AlSayyad, Jean-Paul Bourdier Eds., Centre for Environmental Design Research, Traditional Dwellings and Settlements Working Paper Series. Vol. 6, IASTE WP06-89, (Berkeley: UC at Berkeley, 1989) 47.

23 Rapoport 96.

24 Norbert Schoenauer, *History of Housing* (Montreal: McGill UP 1992) 237.

25 Schoenauer and Seeman 129.

26 Ibid. 132.

27 Ibid.

28 Ibid.

29 Ibid. 127.

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1 Norbert Schoenauer and Stanley Seeman, *The Court Garden House* (Montreal: McGill UP, 1962) 132.

2 Francois Cadotte and Jocelyn Duff; *Logements et Nouveaux Modes de Vie.* (Montreal: Editions du Meridien, 1992). Refer to for a complete evaluation of this situation in North America and especially in Quebec.

3 Schoenauer and Seeman 133.

4 Ibid.

5 Ibid. 131.

6 Ibid.

7 Witold Rybczynski and Avi Friedman, *An Affordable Cottage.* (Project paper

no.5, Affordable Homes program, School of Architecture, Montreal: McGill University, August 1990) 4.

8 Peter Land, *Economic Garden Houses: High Density Development*. (Chicago:Illinois Institute of Technology, 1977) 17.

9 Victor Olgyay, *Design with Climate* (New Jersey: Princeton UP, 1963) 6.

10 Ibid.

11 Amos Rapoport, *House form and Culture* (Englewood Cliffs, N.J.: Prentice Hall 1969) 95.

12 Ibid.

13 Ibid.

14 Ibid.90.

15 Ibid.

16 Schoenauer and Seeman 55.

17 Rapoport 96.

18 Schoenauer and Seeman 145.

19 Rapoport 69.

Notes Chapter Four

1 Herbert Girardet, *The GAIA Atlas of Cities: New Directions for Sustainable Urban Living.* (New York: Doubleday Anchor books, 1993) 142.

2 Van der Ryn, Sim: and Peter Calthorpe: *Sustainable Communities: A New Design Synthesis for Cities, Suburbs, and Towns.* (San Francisco: Sierra Club Books, 1991) Refer to for a complete appraisal of sustainable communities.

3 Hassan Fathy, *What is a City?* excerpts from a paper delivered by Hassan Fathy at Al-Azhar university, Cairo in 1967. As cited in James Steele: *Hassan Fathy*, (New York: St. Martin's press, 1988) 122.

4 Peter Land, *Economic Garden Houses: High Density Development* (Chicago:

Illinois Institute of Technology, 1977) 20.

5 Norbert Schoenauer, *History of Housing* (Montreal: McGill UP 1992) 212-214.

6 Norbert Schoenauer and Stanley Seeman, *The Court Garden House* (Montreal, McGill UP 1962) 115. The row courtyard house utilizes 1/3rd the land required for a detached house for a house of the same floor area.

7 Ibid.

8 Herald Deilman et.al., *Housing Groups: City, Suburb, Country* (Stuttgart: Karl Kramer Verlag, 1977), 42.

9 Kevin Lynch, *Good City Form* (Cambridge: The MIT press 1984) 369.

10 Ibid.

11 Serge Chermayeff and Christopher Alexander, *Community and Privacy: Towards a New Architecture of Humanism* (New York: Doubleday, 1965) 121.

12 Lynch 389.

13 Chermayeff and Alexander 121.

14 Lynch 384.

15 Chermayeff and Alexander 121. Chermayeff and Alexander have divided the urban hierarchy of spaces or realms for community and privacy into six domains: urban public (civic parks, passages, etc.), urban-semi-public (city halls, courts of justice, schools, hospitals), group-public (service areas near home), group-private (public reception areas in the house domain), family-private (living-dining-family areas) and individual private (one's own room).

16 Vikram Bhatt et. al., *Housing a Billion: Design Ideas for Rural China*. (Research Paper no.14, Minimum Cost Housing Group, Montreal: McGill University, 1993) 41.

17 Chermayeff and Alexander 141.

18 Bhatt et. al. 41.

19 Chermayeff and Alexander 126.

20 Schoenauer and Seeman 119.

21 Lynch 370.

22 Ibid.

23 David D'Amour, *Sustainable Development and the Canadian Housing Sector.* (School of Urban Planning, Montreal: McGill University, 1990) 146.

24 Land 23.

25 It is preferred to have substantial energy savings based on house form and nestling configuration and breathe healthy air rather than superinsulate buildings and suffer the sick building syndrome.

26 Lynch 390.

27 Care must be taken not to locate housing under the permanent shadow of high-rise buildings.

28 One of the main problems for this type of arrangement is the available density of the land. How can one use low-rise housing, mixed with highrise developments and achieve a reasonably high F.A.R.(Floor Area Ratio) without creating discontinuity? Here are some suggestions for consideration:

> *1)* Reduce the general F.A.R. requirements of the region.
>
> *2)* Integrate a general total F.A.R. for whole block i.e. old highrise construction (F.A.R.10) + new lowrise (F.A.R. 3) = say, 6 total new F.A.R.
>
> *3)* Let the high-rise scheme pay or invest or subsidize part of the low-rise project.
>
> *4)* Increase F.A.R. of low rise by increasing no. of floors, building very densely, building utilisable basements, and piggy-back courtyard housing on retail, offices or other housing typologies.

29 Assuming a person starts commuting back and forth to work at the age of 25 and retires from work at 65. His/her workspan is 40 years. If he/she spends an average of two hours commuting per day, his/her weekly time consumption commuting is 5x2=10 hours/week. At 49 working weeks per year, 49x10=490 hours of commuting per year. With a workspan of 40 years , 40x490=19600 hours. Dividing 19600 hours by the number of hours per year (365x24= 8760 hours) we obtain: 19600/8760=2.23 years. Therefore, over two years of a person's lifetime is wasted commuting to and fro on a freeway from his/her way to work.

1 Norbert Schoenauer and Stanley Seeman, *The Court Garden House* (Montreal: McGill UP) 117.

2 Amos Rapoport, *House Form and Culture* (Englewood Cliffs N.J.: Prentice Hall) 81.

3 Christopher Alexander et.al., *A Pattern Language* (New York: Oxford UP 1977) 562-564.

4 Serge Chermayeff and Christopher Alexander, *Community and Privacy; Towards a New Architecture of Humanism* (New York: Doubleday 1965) 216.

5 Ibid.

6 Schoenauer and Seeman 51-52.

7 This typology may also be referred to as the Narrow-front courtyard house, or the row patio house.

8 Hubert Hoffman, *Row Houses and Cluster Houses: An International Survey.* (New York: Friedrick A. Praeger 1967) 70-75.

9 Norbert Scoenauer, Unpublished notes for Housing Theory course at McGill university, 1993.

10 Ibid.

11This typology may also be referred to as the long house.

12 Peter Land, *Economic Garden Houses: High Density Development* (Chicago: Illinois Institute of Technology 1977) 224-274.

13 Schoenauer and Seeman 119.

14 Land 25 .

15 *The Canadian Architect* Feb.1992, 24.

16 This typology is also referred to as the patio house.

17 Hoffman Ot and Chris Repenthin. *Neue Urbane Wohnformen: Gartenhofhauser, Teppichsiedlungen, Terrasenhauser* (Berlin: Verlag Ullstein 1966) 68.

18 Land 64-67 .

19 Land 25.

20 "Federica Zanusso architetto" in *Abitare* no. 319, 106.

21 Charles Jencks, *Architecture 2000: Predictions and Methods* (New York: Praeger Publishers 1971) 78.

22 Werner Blaser, *Atrium: Five Thousand Years of Open Courtyards* (Basel: Wepf&co. AG, Verlag 1985) 24.

23 Hoffman and Repenthin 18.

24 *Werk, Bauen+ Wohnen:* Zuricher Ausgabe, no.3, (March 1992) 20-21.

25 Land 9.

Appendix A

These standards are based on Professor Norbert Schoenauer's unpublished notes for the "Housing Theory" course at McGill university. Throughout this thesis, the following Density Standards have been adopted:

Low Density:

      20 Dwelling Units/ Acre....................70 persons/Acre.

      70 Dwelling Units/ Hectare.

Medium Density:

      20-40 Dwelling Units/Acre...........70-140 persons/ Acre.

      70-140 Dwelling Units/Hectare.

High Density:

      Over 40 Dwelling Units/Acre........over 140 persons/Acre.

      Over 140 Dwelling Units/ Hectare.

Acre= 4840 sq. yards, 43560 square feet = 0.405 hectares, 4047 square meters

1 Hectare=ha=10000 m2   = ~ 2,47 acres

are= a= 100m2   = 119.60 square yards

Appendix B

1. Non Conventional Energy Conservation and Efficiency

Non conventional energy efficiency can be achieved through the following:

Reducing Energy Demand

Reducing energy demand is obtained by providing a very high standard for building insulation and the promotion of low-energy use household appliances, fixtures, etc. In addition, natural lighting obtained through courtyards reduce the need for artificial illumination during daytime. The advantage of multiple orientation in most courtyard houses aid in obtaining daylight from many directions.

Promotion of Passive Heating and Cooling

Passive heating and cooling are achieved through proper planning and orientation. Tightly nestled courtyard houses with common exterior walls save energy through controlled heat loss in the winter, and excessive heat gain in the summer. Proper orientation aids maximum solar heat gain and protection from winds in winter. Courtyard houses are particularly suitable for passive heating and cooling, for their complete introvertedness allows them to have large glazed interior elevations, ideal for capturing the suns' rays yet allowing for complete privacy. Furthermore, through the use of multiple operable door-windows on opposite facades of the building in addition to the location of operable roof openings, passive cooling might be induced through cross ventilation. The excessive and high south summer sun might be controlled through the provision of horizontal overhangs over the windows, which will allow only the low winter sun to penetrate. Adjustable vertical louvers would control the east and west sun in a similar fashion.

Significant economies in heating may also be gained through the collection of heated air inside South-oriented, glazed spaces acting as interior heat traps during the day and the subsequent storage of the air in "hot stone" tanks located in the basement for re-use at night. There are also experiments to store heat gained in summer for use in winter but a proper and economic heat storage medium has yet to be discovered.

Exterior courtyard masonry walls tend to absorb a substantial amount of heat and

Exterior courtyard masonry walls tend to absorb a substantial amount of heat and re-radiate it afterwards, thus prolonging the usability of the courtyard during the day. In areas with no risk of frost, water piping is embedded in solid courtyard walls to provide the house with hot water during the afternoon. Wind energy might also be considered if sufficient open spaces and the proper wind conditions exist. Furthermore, enclosed and south-oriented courtyards themselves act as sun pockets or heat traps, and can be used to retain heat during the colder months of the year. The provision of both glazed interior and exposed exterior (courtyard) heat traps will affect the microclimate of the house and the courtyard and will result in savings in energy, as well as the prolonged habitability of the courtyard.

Active Solar Energy

The collection of solar energy through the use of solar panels, both for hot water and space heating are most appropriate for courtyard housing, for their location in an introverted outdoor space on a roof or wall does not cause any visual inconvenience to neighbours and passers-by. Solar panels are more efficient in snowy winters if they are located on vertical surfaces such as interior courtyard walls where they catch the low winter sun, as well as additional reflected light from the snow-covered courtyard floor. This arrangement is extremely suitable for cloudy days when diffuse light from the sky as well as snow reflections will substantially increase the amount of light obtained by the panels.

As for artificial illumination, the provision of photo-voltaic cells may help reduce electric bills. The use of solar-electric exterior cladding or roof tiles on the interior courtyard side will make the cells look inconspicuous, for they will be invisible from the exterior. Visual inconveniences for residents looking out onto their own courtyard from inside will be minimal, for they will be unable to see their own house exterior. Regarding the argument that solar energy and solar-electricity collecting devices are visually offensive to people using the courtyard, one must be reminded that most of these devices are located higher than eye level and that the limited size of the courtyard enclosure prevents the user from acquiring a wide enough visual field in order to be able to perceive the devices.

Besides, most contemporary solar energy devices are designed to look less conspicuous nowadays. In addition, special "solar" courtyards may be provided which might serve primarily as areas for solar energy gathering contrivances.

Nowadays, new technologies allow us to go beyond what was traditionally possible. Passive (and active) solar environmental control, aided by computer simulations make a whole new range of studies possible before implementation. Thus, a much more accurate estimate of the amount of sunshine received or air movement can be assessed, resulting in better functioning solar energy devices.

2. Conventional Energy Efficient Power Systems:
Utilization of CHPs

The CHP or Combined Heat and Power plant, are currently used in Helsinki, Stockholm, Stuttgart and other North-European and Scandinavian cities. These are local neighbourhood dual heat and electricity plants, and are considered to be among the most efficient energy supply systems. They are centrally located miniature power stations generating electricity and producing hot water as a by-product (water heats up as it cools the turbines). This water in turn is pumped to heat the houses. An energy generating plant is considered efficient nowadays if the energy or heat produced as a by-product of the energy generation is also put to use, thus increasing its efficiency. These types of power stations are most efficient in compact and dense districts. Courtyard housing, by its very nature promotes dense, compact clusters, neighbourhoods and housing districts. A centrally located CHP in a courtyard housing neighbourhood has many advantages, mainly that the electricity produced has to travel short distances, reducing loss and making prices competitive. The GAIA atlas claims that CHP's are 90% efficient versus conventional power plants which are 35% efficient. Moreover, when used in conjunction with passive or active solar energy, domestic heating requirements will decrease, thus providing for significant reductions in costs.

The location of CHP's in dense urban areas cause no major pollution problems, because of the provision of chimneys with scrubbers and catalytic converters to clean flue

gases. CHP's release a minimum amount of pollution (SO2, NOx, etc.), and are considered to be 'environmentally clean'.

Local Resource Control, Recycling and Food Production

It is claimed by many authors that food production at the home or neighbourhood level is a prime factor for resource conservation. It is assumed that the supply of staple foods from local sources is a key element for the sustainability of a community.

Although the intention to produce nutrition locally is highly commendable, most private or public urban or suburban gardens or courtyard gardens are relatively tiny and are hardly suitable for food production except perhaps for some kitchen-vegetable gardens or an occasional fruit tree. Some rooftops may also be utilised as roof-gardens or even as heated winter greenhouses, however, these measures are hardly sufficient to feed a population, for food production requires extensive land, resources and expertise.

Sustainable communities need not be totally autonomous or self-sufficient. The sheer thought of such a concept sounds unattainable and Utopic. There will always be foods and other products grown, raised or produced by expert farmers which will have to be brought in, though preferably from nearby regions.

The provision of local community gardens inside cities and suburbs will only provide some food for local consumption-hardly enough to feed the population on a year long basis.

Waste Reduction and Recycling

All non-organic waste, garbage, plastic, bottles, etc., may be collected in a neighbourhood recycling station and sorted out for recycling. This has to be accompanied by rigorous training and cooperation programs for the residents to follow if it is to be implemented. Thus, the sheer fact that a community is formed by clustering courtyards together aids in implementing collective communal feeling and the implementation of such programs.

Greywater or used non sewage water may be treated in neighbourhood treatment plants and pumped back for use as irrigation water or water to flush the toilet. Similarly, blackwater or used toilet water may be treated in neighbourhood sewage treatment plants, thus reducing enormous municipal infrastructure operation and installation costs. Furthermore, the dense packing of courtyard houses, one next to the other, reduce the distances blackwater has to travel to the main carrier pipe, consequently reducing the piping costs. The sewage may be treated, dried and composted, tfor use in local court-gardens or semi-public neighbourhood gardens as fertiliser. The cleaned water may be used for irrigation.

Another alternative to treating sewage water is the use of dry toilet systems where human waste, as well as organic kitchen waste is collected in a sealed basement chamber or container and allowed to compost. Dry toilets use no water to flush at all and thus save several gallons per visit. There are several known methods of dry sanitary treatment, most of them involving composting, such as *single vault (Clivus Multrum)*, *double vault*, *aerobic*, *anaerobic*, etc. techniques. The main disadvantage of these types of treatment is the amount of odours and noxious gases (including methane) produced during the composting process, as well as the long period of time it takes for waste to compost (1-2 years). In China and India, cleverly devised, centrally located, huge composting tanks are supplied with organic human and animal wastes from surrounding homes and farms. The methane gas resulting from composting is stored and diverted via pipes to nearby kitchen cooking ranges, and in Venezuela, even public buses are operated from the same type of methane gas.

Dry composting systems are highly disadvantageous in higher density neighbourhoods because of their high odour risk as well as the skill required in operating the system. However, properly engineered systems with filtering and deodorizing devices may reduce or even eliminate that risk in the future. Courtyard housing located in isolated, rural areas may idealy be equipped with dry toilet systems, especially if water is not readily available. Dry systems save also on septic tank construction and maintenance expenses.

Compactly nestled courtyard housing possess a highly advantageous configuration for waste collecting, composting and recycling human wastes and collecting methane gas.

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