

**COURTYARD HOUSING:
A SOLUTION FOR HIGH-DENSITY,
LOW-RISE SINGLE-FAMILY HOUSING IN THE U.S.**

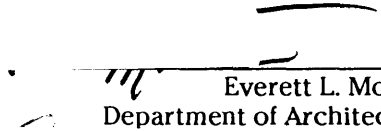
by Everett L. Morton
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May, 1976

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Everett L. Morton

Submitted to the Department of Architecture
in partial fulfillment of the requirements for the Degree of
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ABSTRACT

This thesis examines the potential application of the L-shaped courtyard house in an American context. Privacy for the dwelling and its grounds is a key issue to be addressed. It is shown that a traditional single-family detached house will provide sufficient privacy on lots of one-quarter acre or more. However, an alternate solution must be developed in higher-density applications of one-eighth acre or less. The principal design elements desired in a traditional home are identified and incorporated into an alternate design solution. The courtyard house is proposed as an alternate and it is shown that, contrary to popular belief, such a house form can function in temperate climates without excessive heat loss. The reason for prizing an L-shaped courtyard house over other variations in a high-density application is explained in light of privacy and solar access issues. A detailed discussion of design elements in an L-shaped application include: inter-unit privacy issues, the courtyard size and passive solar heating applications, the dwelling layout and interior zoning, entry location, circulation, facade treatment, parking, grouping or clustering, and expansion potential. It is demonstrated that the L-shaped design will satisfy American standards within a high-density urban context of eight to twelve units per acre.

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Courtyard Housing: A Solution for High-Density, Low-rise Single-Family Housing in the U.S.

INTRODUCTION

The American Context

A major part of the American dream is to own one's home. Typically, this dwelling has taken the form of a two-story detached house on a piece of land bordering a tree-lined street. The detached house and its suburban environs have become the symbol of the good life, and making it in America. Single-family house forms in general, and the detached home in particular, continue to be the dominant dwelling type of most Americans. According to the National Association of Home Builders, three out of five of the 1.5 to 2 million new homes constructed annually are single-family detached houses.

Since the early 1950's this symbol has been marketed to the American public as the best compromise between urban overcrowding and rural isolation. However, since the middle 1970's the cost of financing a home, coupled with escalating home prices, has made the attainment of the American dream problematic for the average American household.

Buildable land sites in close proximity to, or easy commute of, urban centers and suburban satellite centers are becoming increasingly scarce. These sites are commanding higher prices. The building industry has responded to such increases by attempting to reduce the cost of home construction through, for example, rationalized construction techniques, better project management, and off-site manufacturing of components. To further limit rising prices to the home-buyer, the industry has down-sized the lots and increased house densities. Whereas a typical lot (prior to the 1970's) would be more than a quarter acre; more recent developments have had lots of less than a quarter acre. Yet conventional single-family detached house design solutions are employed. The majority of homes are built by small contractors using stock plans of conventionally laid-out dwellings. These houses are being placed on sites with insufficient land to insure internal or external privacy. This basic design requirement of sufficient surrounding land increasingly is more difficult to fulfill. When contractors have asked architects for solutions to this problem of smaller lot size, the response generally has been single-story zero

lot-line housing. An example of this is Barry Berkus' zero lot-line design for the NEST '90 prototype house of the National Association of Home Builders Convention (See figure 1). This house can be sited on eighth acre lots and provide reasonable degrees of privacy both inside and outside. It does not present a "conventional" street facade because of its placement of the garage at the front and placement of major social spaces toward the rear.

PROBLEM

The conventional two-story detached house no longer is an "appropriate" solution, i.e. privacy for unit and land cannot be maintained at densities of less than a quarter acre. Achieving higher density single-family housing without loss of privacy for the individual unit and yard is the major challenge to be addressed in this study.

Privacy Issues of the Single-Family Detached House

Privacy issues are the key problems to be addressed in finding alternates to the single-family detached house at higher densities. Isolating the household and its activities from observation and auditory intrusion of neighboring houses and the street defines

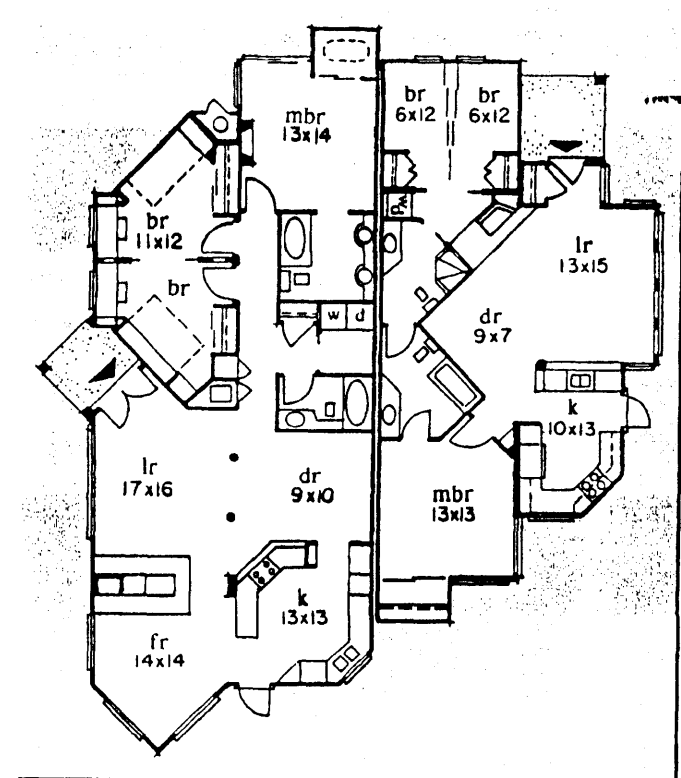


figure 1 Barry Berkus' zero lot-line design

this privacy. How this isolation is achieved is one of the characteristics that differentiates one house from another.

Inter-Unit Privacy

The detached house is extrovertically oriented. The occupants' privacy is derived from the quantity of surrounding land and the distance from neighboring buildings. In the absence of land and distance, the exterior privacy is jeopardized. Similarly interior privacy is infringed as unwanted sights and sounds can intrude.

On a quarter acre or larger lot, appropriate siting of the structure and landscaping can provide privacy for both house and grounds. Failure to address site and landscaping issues will compromise inhabitants' privacy.

When the lot size is reduced to an eighth acre or less, modifications to the conventional house plan are necessary in order to attempt the creation of private interior space. For example, windows, which normally would be present on the side walls, are eliminated. Only the street and rear facades have windows. In effect the two-story house is transformed into a free-standing rowhouse.

On eighth acre and smaller sites, exterior spaces are minimal. They usually are governed by a particular function such as parking cars or pedestrian walkways; or at their worst, they consist of what is left after the house is sited according to zoning setbacks. High fences or walls of shrubbery may be used in an attempt to create visual and acoustical barriers, and provide exterior privacy. This is the exception rather than the norm. At grade level such barriers may achieve their objective, but in the presence of two or more story buildings their effectiveness is diminished. Exterior spaces are open to neighbors' views. The backyard is not a private space.

In the case of the detached house on an eighth-acre lot, privacy exists only within the building envelope. As adjacent dwellings often are located within eight to sixteen feet, windows are almost permanently closed and curtained to maintain privacy. That is the sunlight, ventilation and view functions of the window are limited in order to achieve the sense of privacy.

In sum, a conventional two-story single-family detached house will provide for inter- and intra-unit privacy on quarter acre or larger lots without layout modifications if attention is paid to siting and landscaping. However, an alternate solution must be developed for higher density applications of an eighth acre or less.

Under these conditions, a different house layout is necessary to provide the desired privacy.

Design Intention — design elements to be incorporated into any alternative

As has been discussed, the conventional single-family detached house can not easily provide the desired privacy at densities of less than one-quarter acre. Thus, alternative house forms should be evaluated. To do this, the key desired elements of a single-family detached house which should be incorporated in any substitute design must be identified. These include:

- Inter-unit privacy — for both dwelling and site.
- Sufficient square footage allocated among rooms that will support the domestic activities of a traditional household, with a separation of social and private areas, and a circulation which does not compromise the function of any of the rooms.
- On-site parking, and where possible attached garages.
- A facade with “curb appeal” that supports the existing urban streetscape.
- Expansion potential of the dwelling’s floor area.

In evaluating alternate house forms, the privacy issue often becomes a major constraint on design

options. Single-family house types such as rowhouses and duplexes (side-by-side) are able to achieve higher unit counts per acre than the conventional detached house. Yet these house forms have privacy problems similar to those of the conventional detached house since they too look out on to a landscape which is not buffered from outside intrusions.

An alternative form of the single-family house, which can be attached or detached, is the single-story courtyard house. It can maintain privacy for both house and yard in high-density applications. As will be shown, it can also satisfy the other design criteria.

COURTYARD HOUSES

Many Americans are familiar with the courtyard house of the Mediterranean, Middle East and American southwest. They have come to consider it suitable only for such warmer climates. In fact, they are correct unless a critical issue is addressed in the building design. In essence, the issue revolves around properly-sized courtyards, and appropriate orientation of glazed wall areas facing the courtyard. This will eliminate excess heat loss in temperate climates. The courtyard house can be successfully adapted to a wide variety of climatic zones. This has been amply demonstrated within a northern European context.

A SHORT HISTORY OF TWENTIETH CENTURY COURTYARD HOUSING

Single-aspect Courtyard Housing.

Hugo Haring is credited with inventing the first modern courtyard house in the form of a single-aspect house in 1929. This dwelling was a long thin structure similar in dimension to today's mobile home, or single-wide prefabricated house. (See figure 2 and illustration 2). Unlike the mobile home, Haring's house is designed with windows on one long wall, leaving the other three walls windowless. The dwelling is sited with its long blank wall on the property line and its window wall looking across a courtyard formed by an adjacent dwelling's blank wall and two high fences at the front and back of the site.

L-shaped Courtyard Housing.

Hugo Haring's single-aspect house formed the basis of the L-shaped courtyard dwelling later developed at the Bauhaus by Hannes Meyer and Ludwig Hilberseimer. By 1931 Hilberseimer, working alone, is credited with developing the archetypical L-shaped courtyard design, segregating bedrooms and living rooms into two separate wings. (See figure 4).

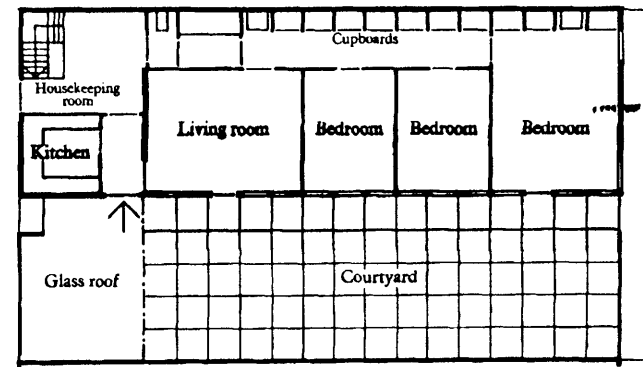


figure 2 Hugo Haring
Single Aspect House

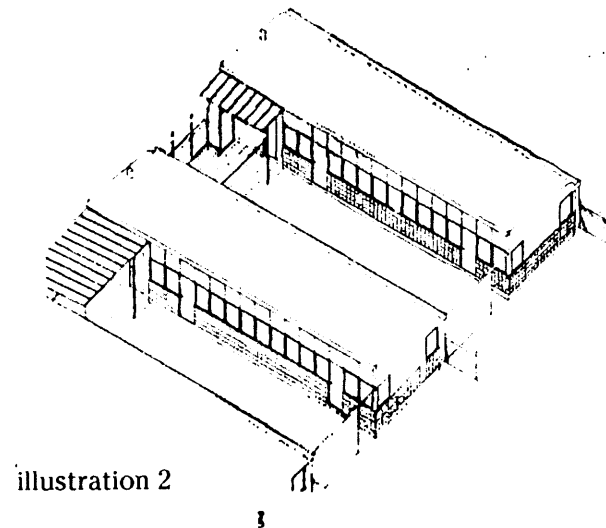


illustration 2

Further development and large-scale use of the courtyard house type had to wait until after World War II and the reconstruction of Europe in the 1950's and early 1960's. The L-shape design was applied in places as diverse as Italy and Finland. (During this time period, American architecture was entranced with the other international school invention of high-rise buildings.) The first large-scale use of the (L-shaped) courtyard house is credited to Adalberto Libera (See figure and illustration 5) for his design of a 126-unit project at Tuscalano in Rome in 1952.

This scheme typifies much of the thinking on grouping courtyard dwellings still prevalent in Europe today as well as the siting of the same. The site is viewed as a large parcel of land, surrounded by roadways, with car access limited to perimeter parking areas. Within the parcel, private outside space is defined by the individual courtyard. Public exterior space is allocated into mazelike walkways punctuated by small plazas. This same site plan and public circulation approach was still being used in 1970 by Roland Rainer for his design of a housing estate at Puchenau, Austria. These schemes hold little promise for direct use in an American context given the limited car access to the individual units.

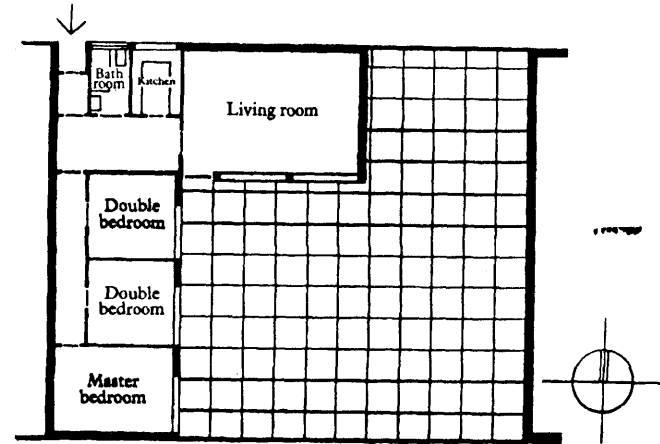


figure 4 Hilberseimer
Courtyard House

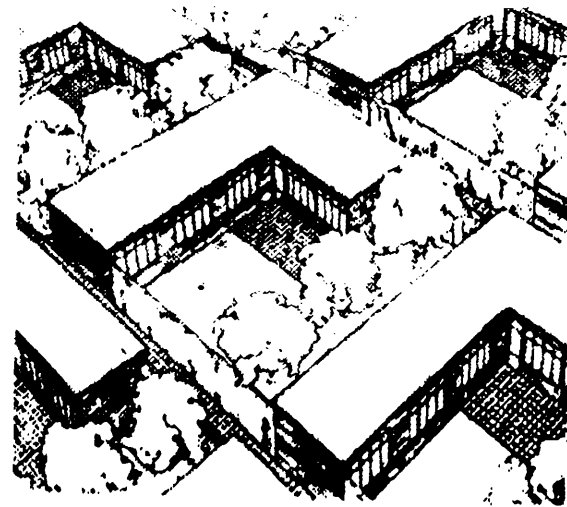


illustration 4

One or two courtyard applications that appear to be adaptable to American vehicular needs are Jorn Utzon's designs at Helsingfors and Fredensborg in Denmark. These designs use a ring road with feeder roads to dwelling clusterings, and driveways to individual dwelling's attached garages. (See figures and illustrations -6 and 7 on the next page)

Within the U.S. only limited exploration of the courtyard house has occurred. In the opinion of this author this dwelling form merits such exploration. Inter-unit privacy at densities of eight or more units per acre is, as stated above, a major challenge. The courtyard design can address these visual and acoustical privacy issues for both house and yard. It can do this within the higher density context for which the conventional single-family detached house is ill-suited. It can combine the ease of single floor living with many of the characteristics of the detached house. It will be shown that the courtyard house (particularly the L-shaped variation) can satisfy needs for privacy and space in a low-rise high-density (eight to sixteen units per acre) setting.

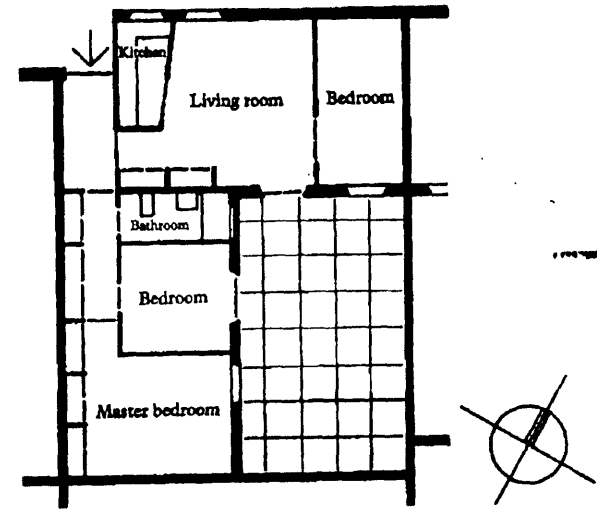


figure 5 Adalberto Libera's Courtyard House

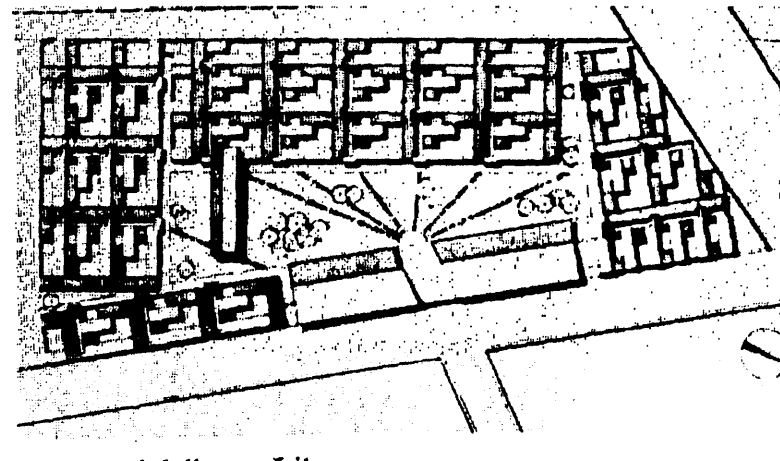


illustration 5

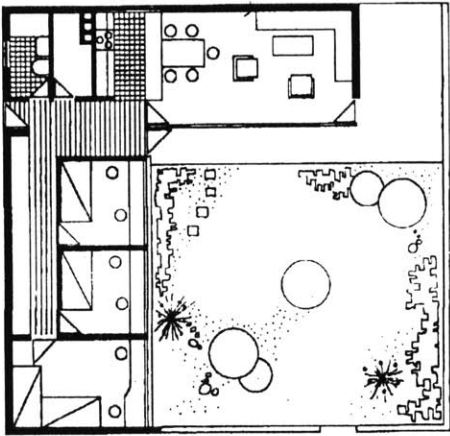


figure6 Helsingfors
Courtyard House

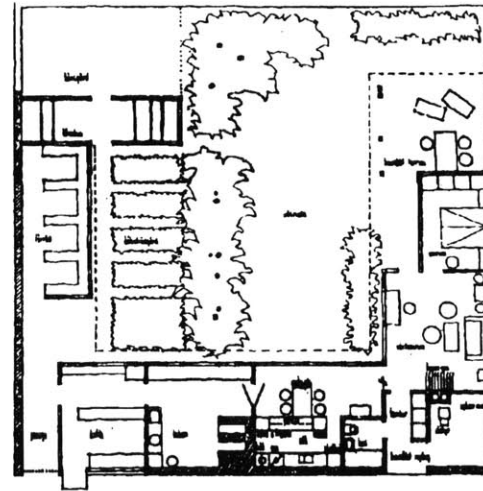


figure7 Fredensborge
Courtyard House

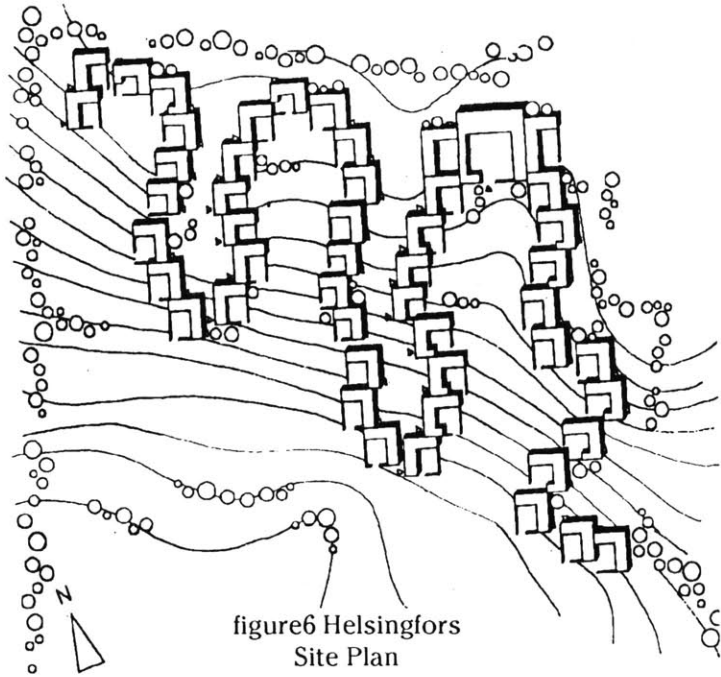


figure6 Helsingfors
Site Plan

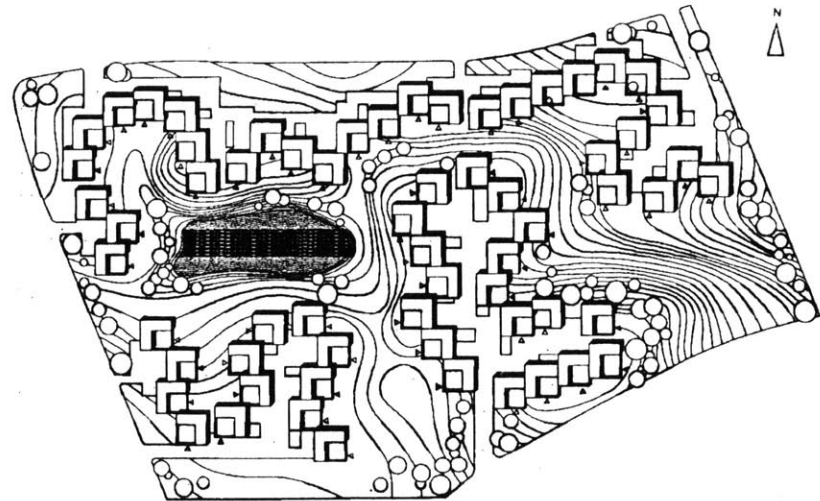
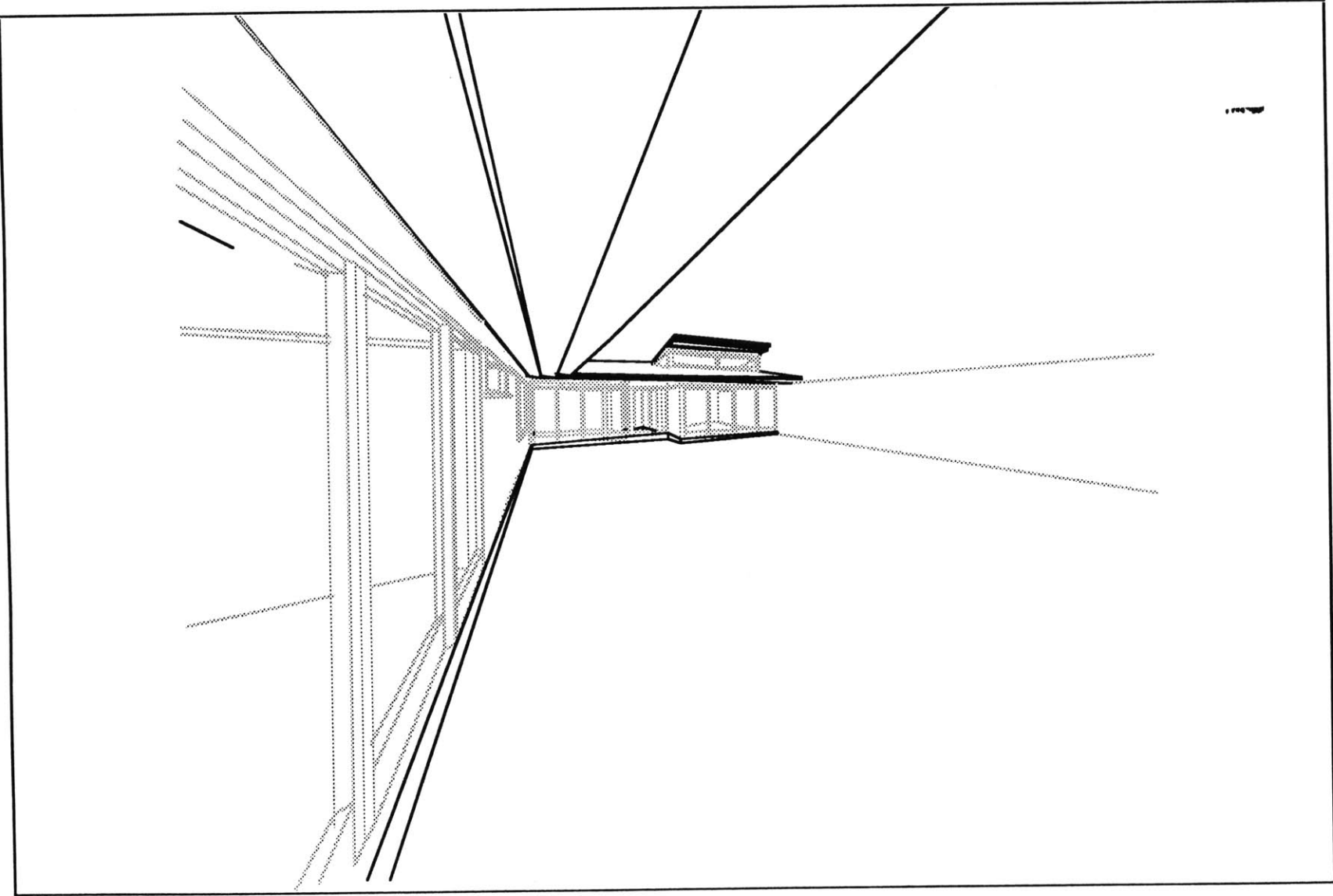


figure7 Fredensborge
Site Plan

A DESIGN FOR AN AMERICAN COURTYARD HOUSE



A Design For An American Courtyard House

To achieve densities of eight units or more per acre, there are clustering issues which must be addressed. In addition, there are design requirements particular to the courtyard house which must be resolved while satisfying the general design requirements of a single-family detached house listed above, including:

- Service access to the courtyard without having to go through the house, or pass through major spaces (i.e. living and dining rooms)
- Sufficient sized and oriented courtyards to allow adequate solar access for passive systems.

Why the L-shaped courtyard house

There are six possible courtyard dwelling configurations: I, L, C (or U), T, H, and O shaped. It will be demonstrated that the L-shaped house is the most flexible form and the only courtyard configuration which satisfies design requirements of privacy, space, courtyard size, expansion potential and density.

Given a limit of 1600 square feet, there is not sufficient floor area to be shaped in C (or U), T, H, and O configurations and simultaneously to allow for a large

enough courtyard for passive solar heating in a temperate climate. (See figure 8). Not only would the courtyards be too small, but they would be difficult to properly orient.

At densities of eight units per acre, the I-shaped house can meet privacy, space and courtyard size criteria. However, there is limited flexibility in expanding plans. Furthermore, orienting the plan for proper solar access becomes difficult. At higher densities, the courtyard becomes too small to allow adequate solar access for the passive heating system.

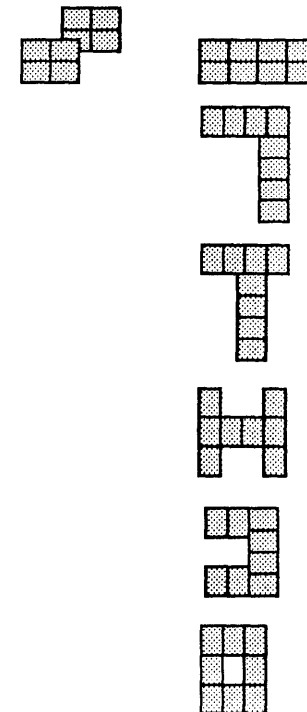


figure 8

A DISCUSSION OF DESIGN ELEMENTS

Inter-Unit Privacy

The courtyard house's privacy is achieved by its introverted orientation into a yard as private as any of its rooms. In any individual application, walls enclosing the courtyard, created by the dwelling as well as landscape walls, clearly define the private and block visual or acoustical intrusions. In a one story application, such walls can perform well. When clustered, neighboring dwellings' walls function as landscape walls, enclosing the courtyard. This enables a high-density application which would not be possible with a conventional detached design.

Courtyard

The courtyard house, through its courtyard, creates a private exterior space unique to its form. A private exterior space cannot be generated by conventional single-family detached houses on sites of one-eighth acre or less. The courtyard allows the windows to perform functions of light, view and ventilation. Such functions are limited in a detached house in high-density applications.

The size of the courtyard is critically important for solar access. The courtyard house has a large external

surface area for its volume. Thus, heat losses would tend to be greater than that of more conventional designs. However, a properly oriented courtyard of sufficient size will contribute positively to the dwelling by enabling adequate solar access for passive heating systems. As previously stated, the size of the courtyard becomes a limiting factor in all courtyard forms other than the L-shaped form.

Any courtyard house of similar size to that of a detached house will have a greater wall area, and thus a potentially greater heat lost. Yet this liability can be minimized in an L-shaped courtyard house with appropriate siting and orientation. In fact, this expanse of wall area can be turned into a benefit of an L-shaped courtyard house design by allowing for optimal passive heating which more than offsets any additional heat loss. It is possible with properly sized and oriented windows, storage mass, and highly insulated walls and roof to reduce the heating requirement for a courtyard house to less than that of a similar sized conventionally laid-out detached house on a similarly sized lot.

The size of the courtyard is determined to optimize solar gain given the (low) sun angle in wintertime, and barriers around the courtyard. In any clustering application of the single-story L-shaped house, twelve-

foot high barriers (walls and roof) will surround the courtyard. It has been determined that a 32 foot depth is needed in front of any solar collector surface in the Boston area (latitude 42 degrees). Given the required thirty-two foot dimension in the courtyard, its total size in a sixteenth of acre site application will equal that of the interior space, or create a one to one ratio of interior to exterior space.

To maximize solar gain during the winter, a south-east/southwest orientation of the L-wings would be favored. Further fine-tuning of this passive system is possible by arrangement and orientation of floor plans so individual rooms are heated at the time of day they are most likely to be occupied, i.e. bedrooms in the southeast facing wing and living rooms in the southwest facing wing. However, a south orientation for one wing coupled with either an east or west orientation for the other would also work.

Dwelling layout and Interior Space Zoning

The single-family detached and courtyard house forms' interior organization can be quite similar. Two zones, one social and another private (individual), are common to any American dwelling type. The detached house design has the option of separating its zones by locating them in different wings or on separate floors.

The L-shaped courtyard house being proposed is a single-story building and must separate the zones using wing orientation.

The social spaces are for group activities and include the two largest rooms in the house, the living and dining rooms. Associated spaces include entry, hall, kitchen and half bath. In larger dwellings there may also be a family room or den. In smaller dwellings, the option of using the living room as an occasional guest room is an important amenity. The social area is usually located at the front of the house, with windows facing on to the street, enabling surveillance of the public way. A bonus feature of the courtyard design (as illustrated in figure 9 on the next page) is the ability of social spaces to also have windows on to the private courtyard. The special nature of the courtyard house enables privacy for both dwelling and yard and allows each to be opened to the other. Expansive glazing in the wall facing onto the courtyard becomes possible, and with it an expanded sense of space for rooms. The sense of space can be further enhanced with the use of vaulted ceilings and clerestories.

Individual or private spaces typically include two single bedrooms for children and a double bedroom for the parents. In addition there are associated service spaces such as a hall, child's bath, and parent's bath. A

larger house might include an additional guest bedroom/study. This area is typically located away from the front of the house and the street. All of the bedrooms face the courtyard enabling their windows to perform the functions of light, view and ventilations — with privacy. A design option would substitute sliding doors for windows thus providing direct access from the individual rooms to the courtyard.

Entry Location & Circulation

The key to circulation is to provide access to all the rooms of the house without compromising the function of any room, including the “exterior room” or courtyard. Particularly critical is movement from the front door to any other room. Some designs require transit through the social spaces, effectively causing them to function as hallways and imposing on the privacy of the room. In the courtyard design a special challenge is present in providing service access to the private yard without having to go through the house, or pass through major spaces (i.e. living and dining rooms). In a dense application (such as the twelve-unit cluster plan) there is only one wall on to the public way. This wall must provide for entry to the dwelling as well as enable passage into the courtyard if the aforementioned objective is met. In dense applications, the use

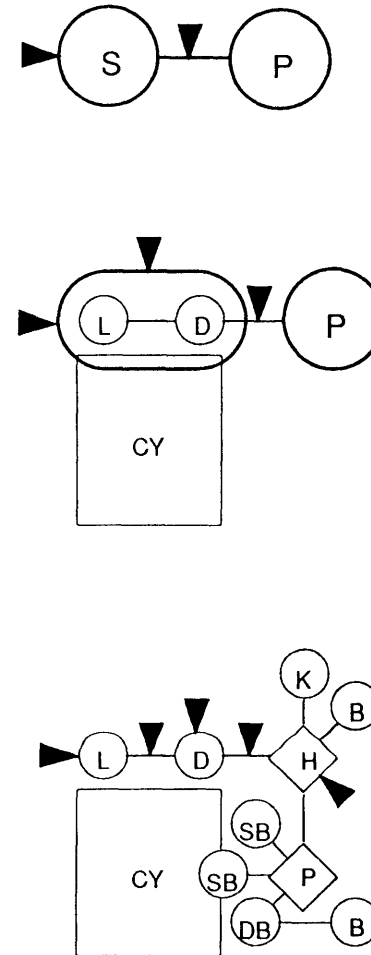


figure 9

of the one entry for both house and courtyard is a good design solution to minimize wasted space. Additionally, having the entryway open to the courtyard facilitates emergency egress.

Given the dual functions of the entry, its location in an L-shaped courtyard house is critical and further governs the building organization and circulation patterns. Five different placements of the entryway are possible and should allow for: location on a public wall; access to the courtyard; possible conversion of the living room into a temporary private room, e.g. guest bedroom.

Two obvious locations for the entry are at end of a wing, or at the corner of the “L”. If the entry is placed at one end, it forces one to walk through the social rooms to gain access to other rooms, which may not be a desirable solution. (See figure 10, Plan 1.) This is particularly so in a narrow structure with rooms in series. In addition, it is not possible to temporarily isolate the living room for private conversation or other private functions.

If the entry is located in the corner, it reinforces the separation of social and individual spaces. However, there are some difficulties, which can be resolved, in gaining access to the courtyard. (See figure 14 Plan 5

and variations.) Flexible use of the living room is possible with this entry placement.

Other entry placement is possible by locating the entryway between social rooms. Plan 2 (and variations) locates the entry between the living and the dining rooms. This arrangement allows the living room to be isolated and closed off better than in Plan 5 (and variations). In Plan 3 (and variations) the entry opens into the dining room and also allows the living room to be closed off. As the dining room is used for relatively short periods of time three times a day, its functions will not be severely disrupted if it also performs entry/circulation functions. (See figures 11, 12, 13).

Plan 4 has the entry located between the kitchen and dining room. While this might be uncommon it is an option worth considering. This becomes a more viable solution, if the kitchen has a breakfast nook which limits the need to transit the entryway to the dining room.

COURTYARD PLANS

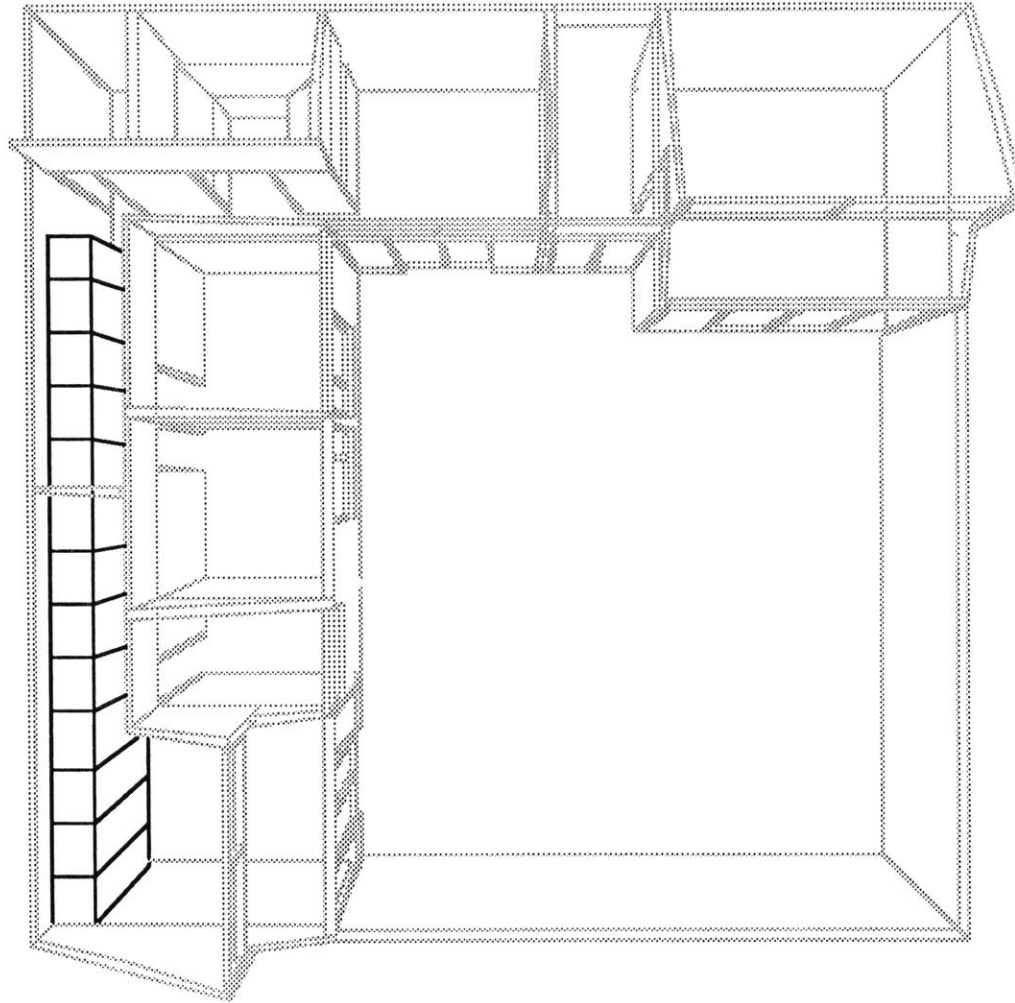
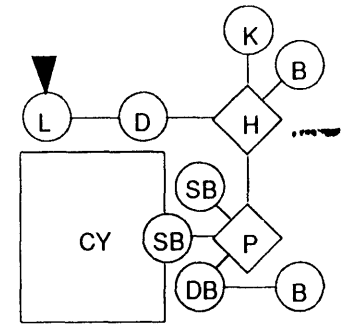
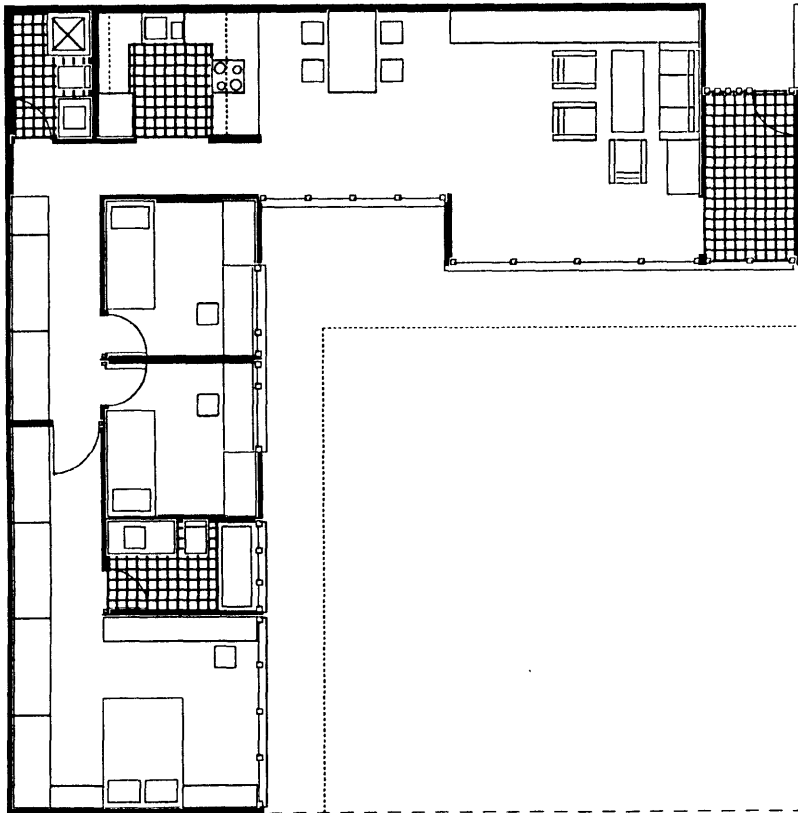


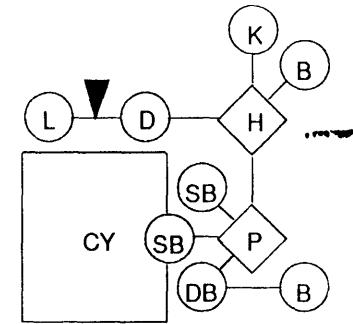
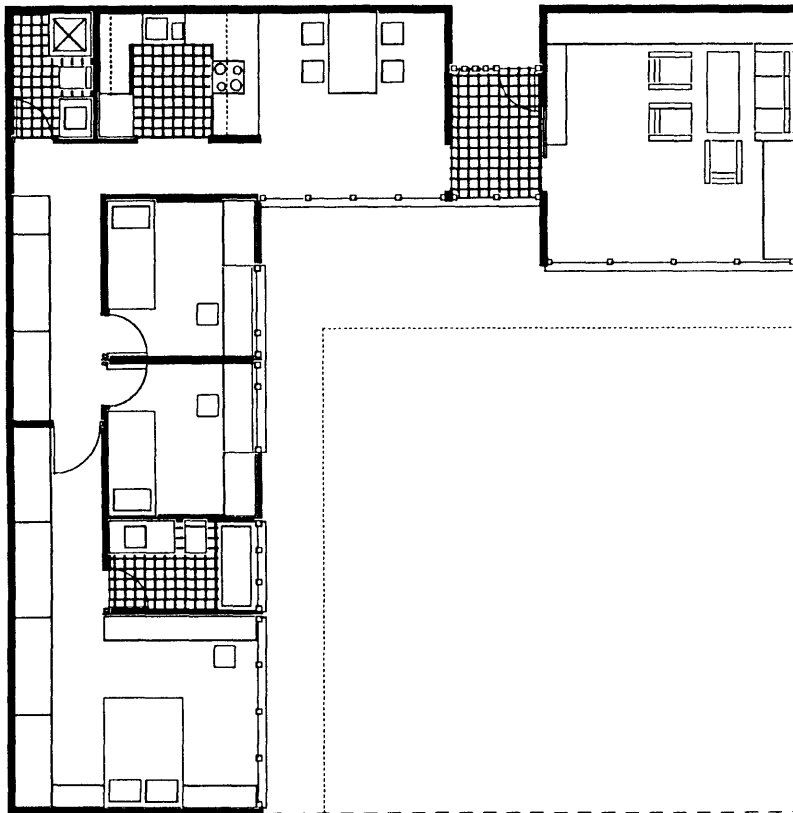
figure10



Type One

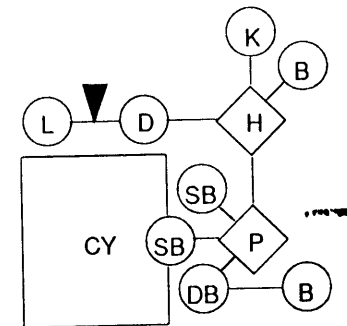
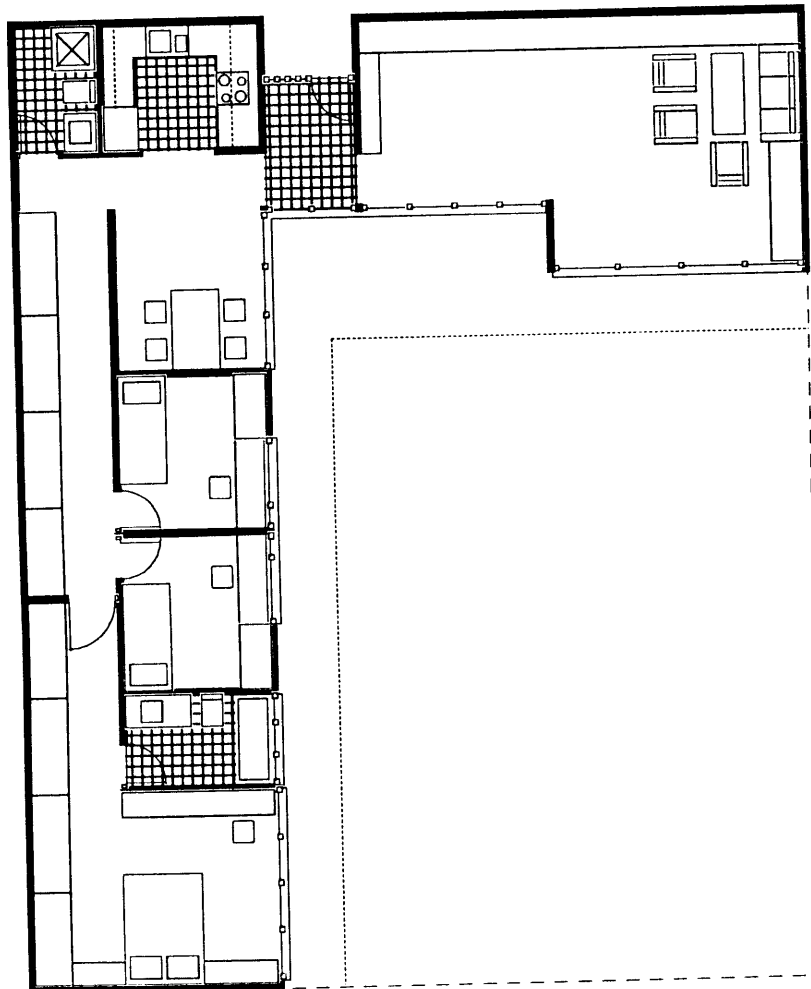
Site	2,500 s.f.
Unit	1,260 s.f.
yard	1,240 s.f.

figure11



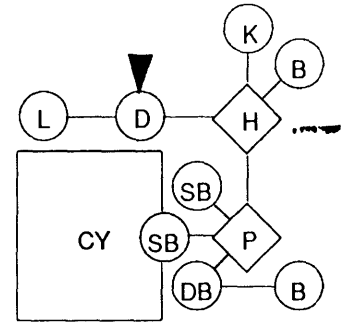
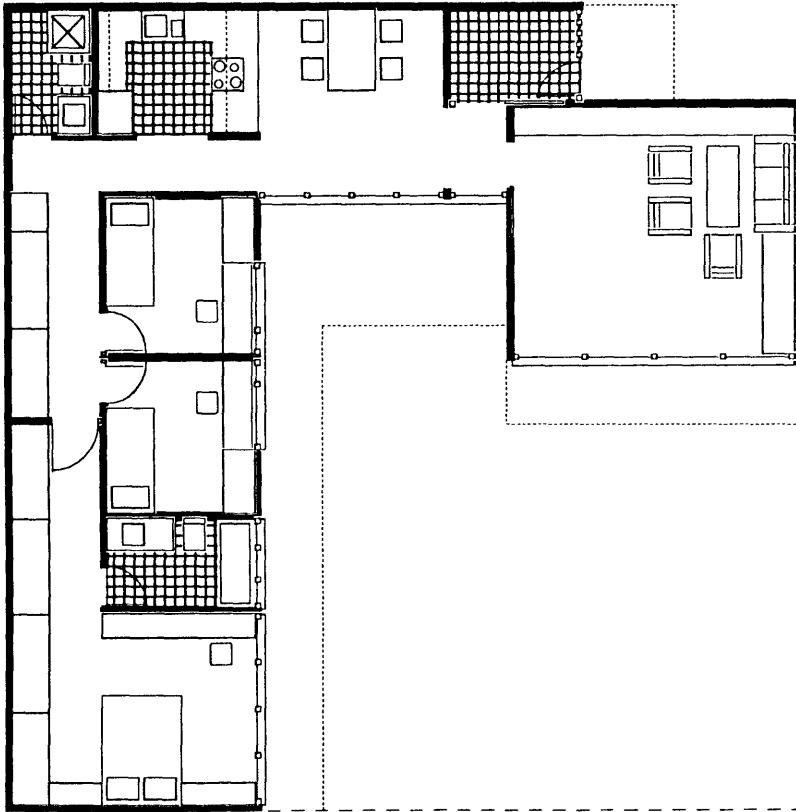
Type Two

Site	2,500 s.f.
Unit	1,248 s.f.
yard	1,252 s.f.



Type	Two-B
Site	3,000 s.f.
Unit	1,400 s.f.
yard	1,600 s.f.

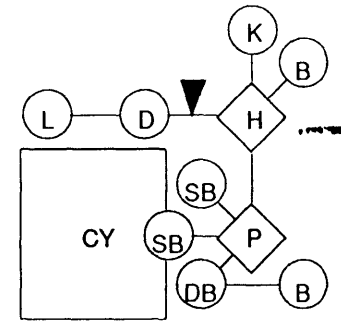
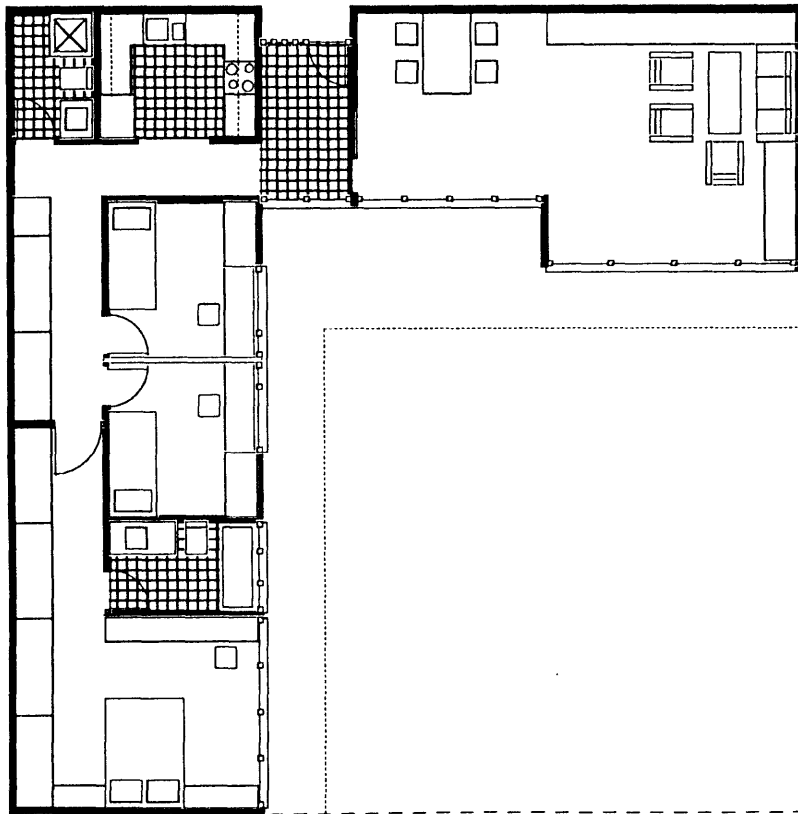
figure12



Type Three

Site	2,500 s.f.
Unit	1,284 s.f.
yard	1,216 s.f.

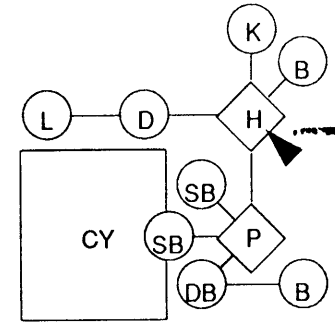
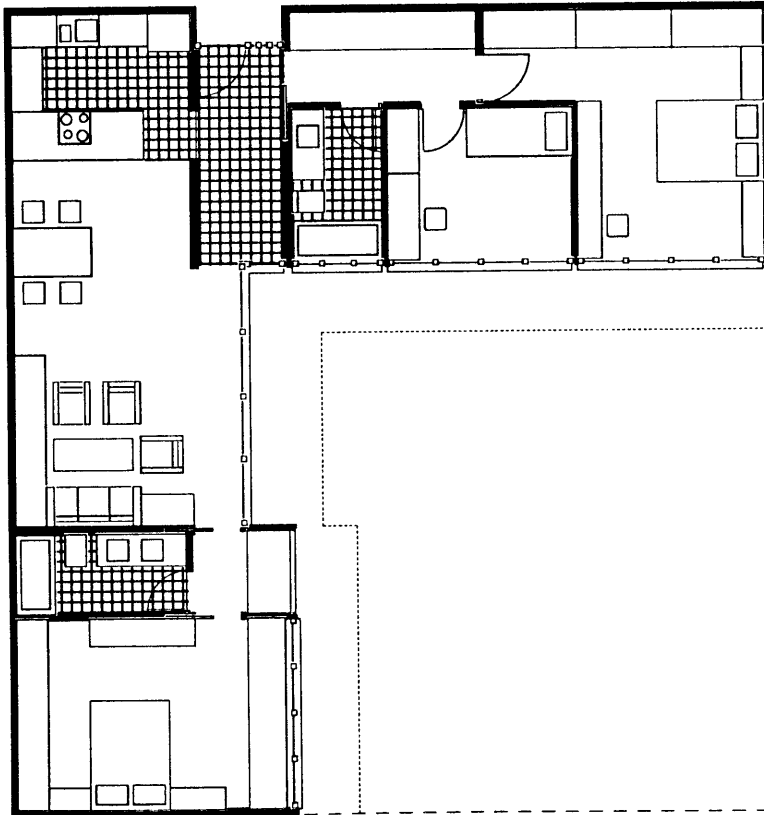
figure13



Type Four

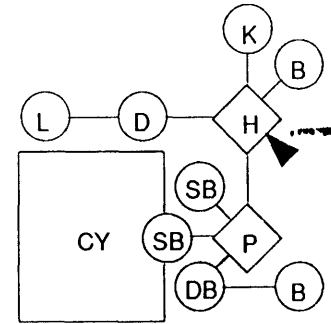
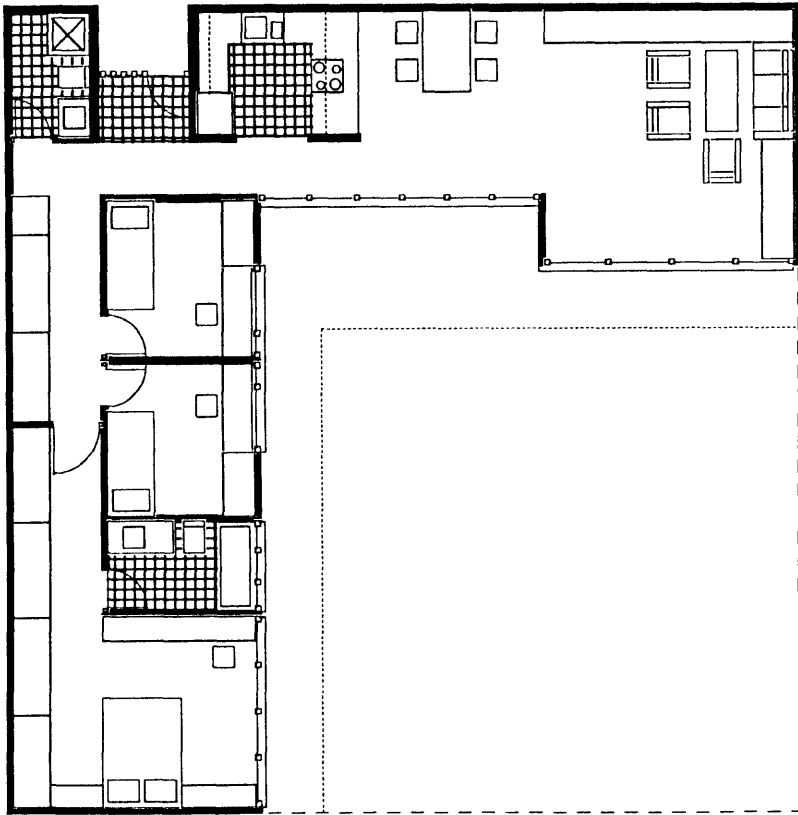
Site	2,500 s.f.
Unit	1,248 s.f.
yard	1,252 s.f.

figure14

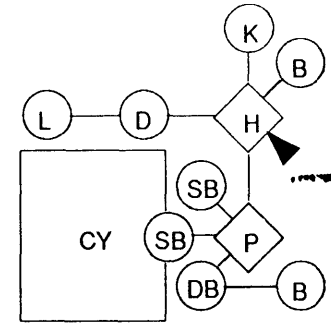
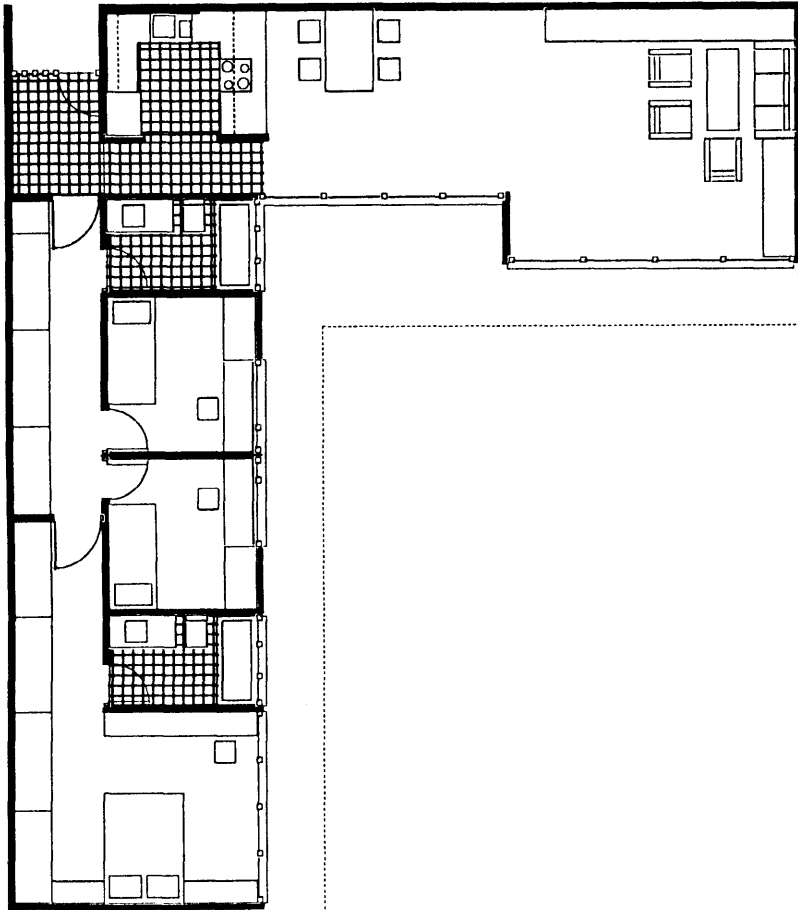


Type Five

Site	2,400 s.f.
Unit	1,382 s.f.
yard	1,018 s.f.

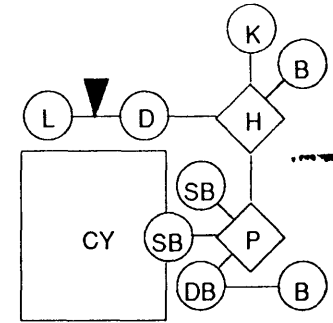
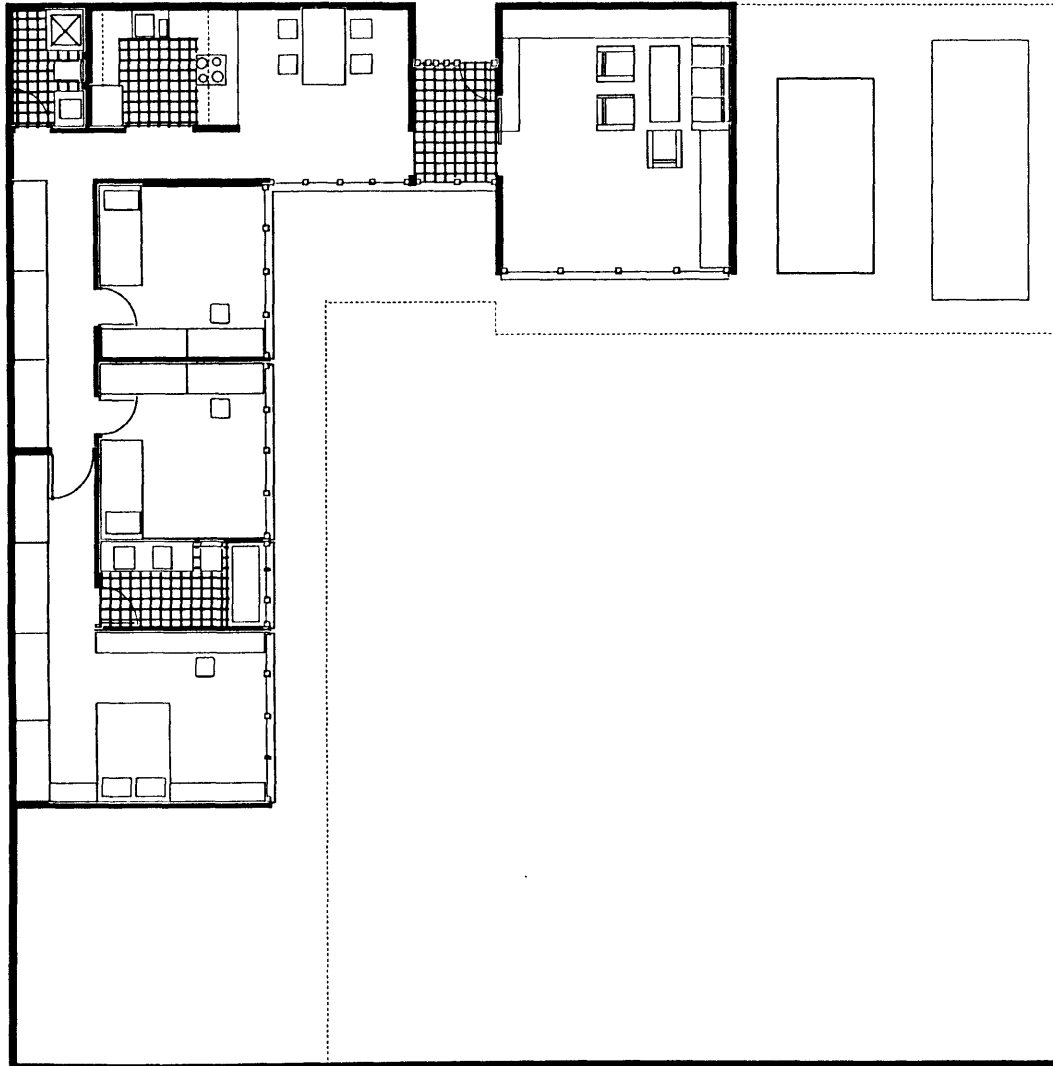


Type	Five-B
Site	2,500 s.f.
Unit	1,220 s.f.
yard	1,280 s.f.

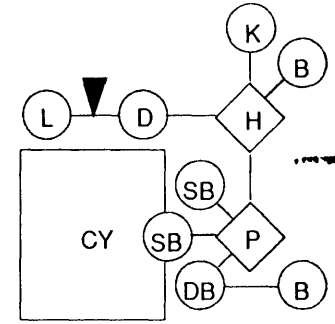
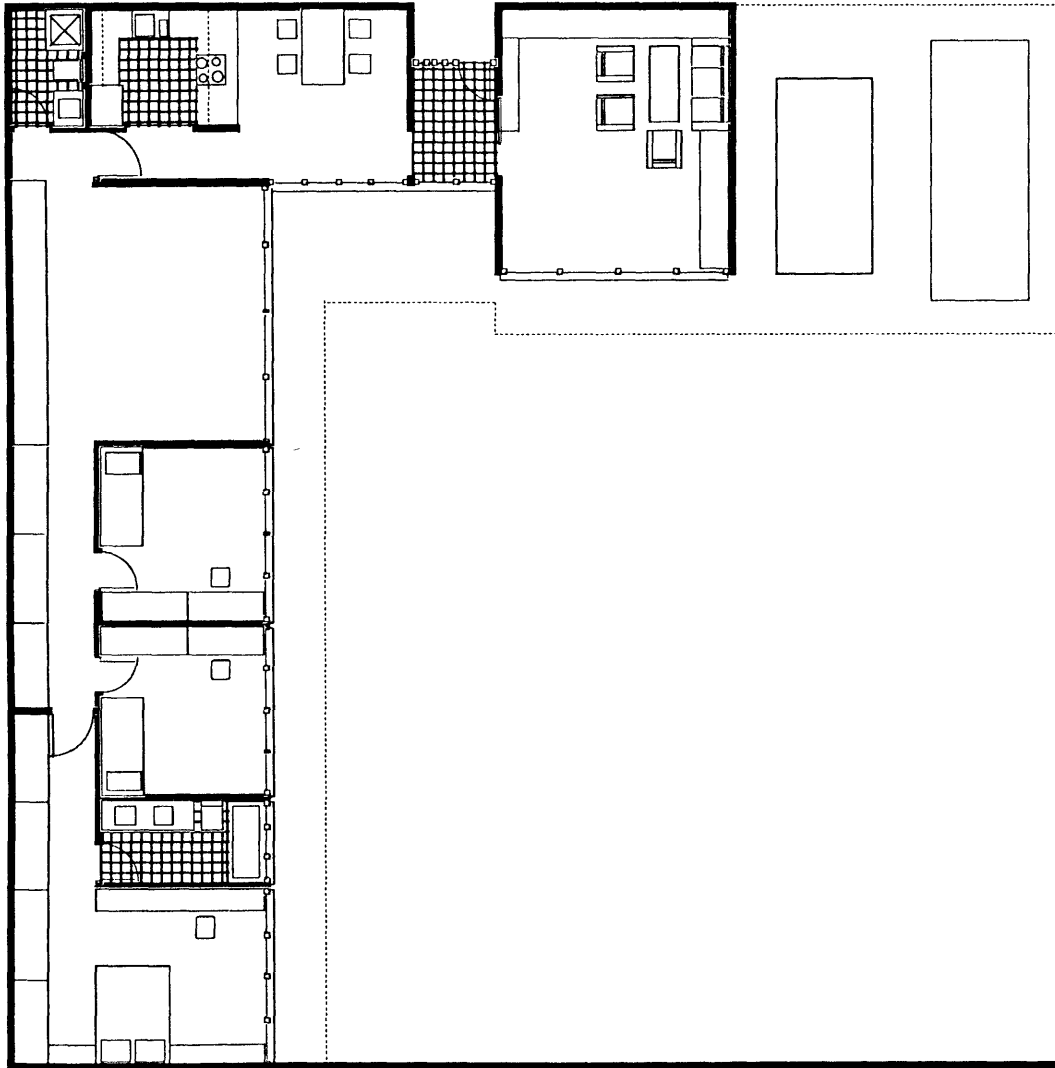


Type Five-C	
Site	2,500 s.f.
Unit	1,220 s.f.
yard	1,280 s.f.

figure15



Type	Four-Large
Site	5,200 s.f.
Unit	1,396 s.f.
yard	3,804 s.f.



Type	Four-Large
Site	5,200 s.f.
Unit	1,708 s.f.
yard	3,492 s.f.

Facade

The street facade of the detached house looks across the semi-public front yard to the public way, is meant to see and be seen by passers-by. Traditionally the living and dining rooms are located on this elevation, and the facade and associated window treatment are formal in their detailing. In contrast the conventional courtyard house facade has been a blank wall with a door. This is to insure the privacy of the dwelling, particularly in existing (European) applications where the courtyard house has been clustered on narrow maze-like public access walkways.

The courtyard house in an American context can have a modified design which incorporates a windowed facade that faces on to the street in a manner similar to the detached house's. The primary orientation of the building toward the private courtyard will continue, but a secondary orientation toward the street can easily be added — especially in conjunction with the use of a front yard or forecourt semi-public zone.

Parking

Most Americans depend on their cars daily for transportation. Easy access to the car is important. If an attached garage is not provided, most people would

like to be able to see their car from a front window. A conventional detached house incorporates an attached garage. Attached garages can be included in courtyard applications on eighth acre sites. (See figure 15). On a sixteenth of an acre site, attached garages cannot be incorporated. However, on-site collective parking which can be viewed from the house is possible. See figure twelve and eight unit site designs.

Grouping

In a high-density application of the courtyard house, four clustering arrangements are illustrated. Three are in-fill applications in a typical American city block of: twelve units per acre, 10 units per acre, and eight units per acre. The fourth takes the existing four units per acre plus communal land siting arrangement of Jorn Utzon designs at Helsingfors and Fredensborge, Denmark and modifies the interior design to satisfy American requirements.

The first in-fill site design replaces eight single-family detached houses on eighth acre lots with twelve clustered L-shaped courtyard houses on sixteenth of an acre (50' + x 50' +) lots in a matrix clustering. This is shown as a mid-block retrofit. The front yard setback of twenty feet common for the rest of the street is retained in this cluster design. The front facades of

four of the new courtyard houses are aligned with those of existing houses to maintain and define the streetscape. Access to the rest of the courtyard houses located behind the street front units is via a shared semi-public forecourt, also used for parking. A hierarchy of semi-public to more private spaces would be enhanced by the addition of a fence (transparent wall) in line with the street facades. (See figure 16)

The second in-fill site design replaces six single-family detached houses on eighth acre lots with eight clustered L-shaped courtyard houses. The density is equivalent to 10 units per acre, with lot sizes of a sixteenth acre. Two center eighth acre lots are left open for parking and communal play. As with the previous example, the front yard setback of twenty feet common for the rest of the dwellings on the street is retained. Again, four of the courtyard houses face the public street. Access to the other four courtyard houses located behind the streetfront units is by way of one through-block shared semi-private forecourt. Parking for all units is at either end of the forecourt. One benefit of this design is the provision of semi-private exterior space for communal play activities in addition to individual, private courtyards. This play space can be viewed by any of the dwellings.

The third in-fill design is for an eight-unit development. The site design replaces eight single-family detached houses on eighth acre lots with eight L-shaped courtyard houses. The lot is a conventional narrow and deep configuration of roughly 60 x 100 feet. Once more a twenty-foot front yard setback is utilized and all of the new dwellings front facades line up with those of existing houses. In addition, these homes have attached garages.

The fourth design is a layout modification of Jorn Utzon designs at Helsingfors and Fredensborge. The modification replaces the existing unit plans with larger variations of the basic courtyard houses developed for this study. This site layout uses staggered, wide-shallow eighth acre lots of 72' + x 72' +. All houses border on an access road and have front yard setbacks of somewhat less than twenty feet. This configuration uses a high rear wall to enclose the individual courtyards. Some of these unit plans reduce the height of this wall to a three-foot high property demarcation fence. This opens the courtyard into a large commonly owned natural landscape, allowing for privacy with expanded view. While this arrangement reduces the absolute privacy of the courtyard and dwelling, the relative privacy of the individual unit still exceeds that of a detached house. This grouping arrangement has parallel siting

applications in any conservation area or waterfront location.

EXPANSION POTENTIAL

As stated above, a desired design feature of the house is an ability to relatively easily expand the floor area. This flexibility will enable a home to serve a household's needs as its lifestyle changes over time. A basic requirement to expansion potential is a lot of sufficient size. Thus a minimally sized lot of a sixteenth of an acre would not permit addition of rooms to the basic design, although room expansion would be possible by encroaching on to the courtyard. On a sufficiently large lot, either wing of the L-shaped house can be expanded without complicating circulation flows. (See figure).

Groupings

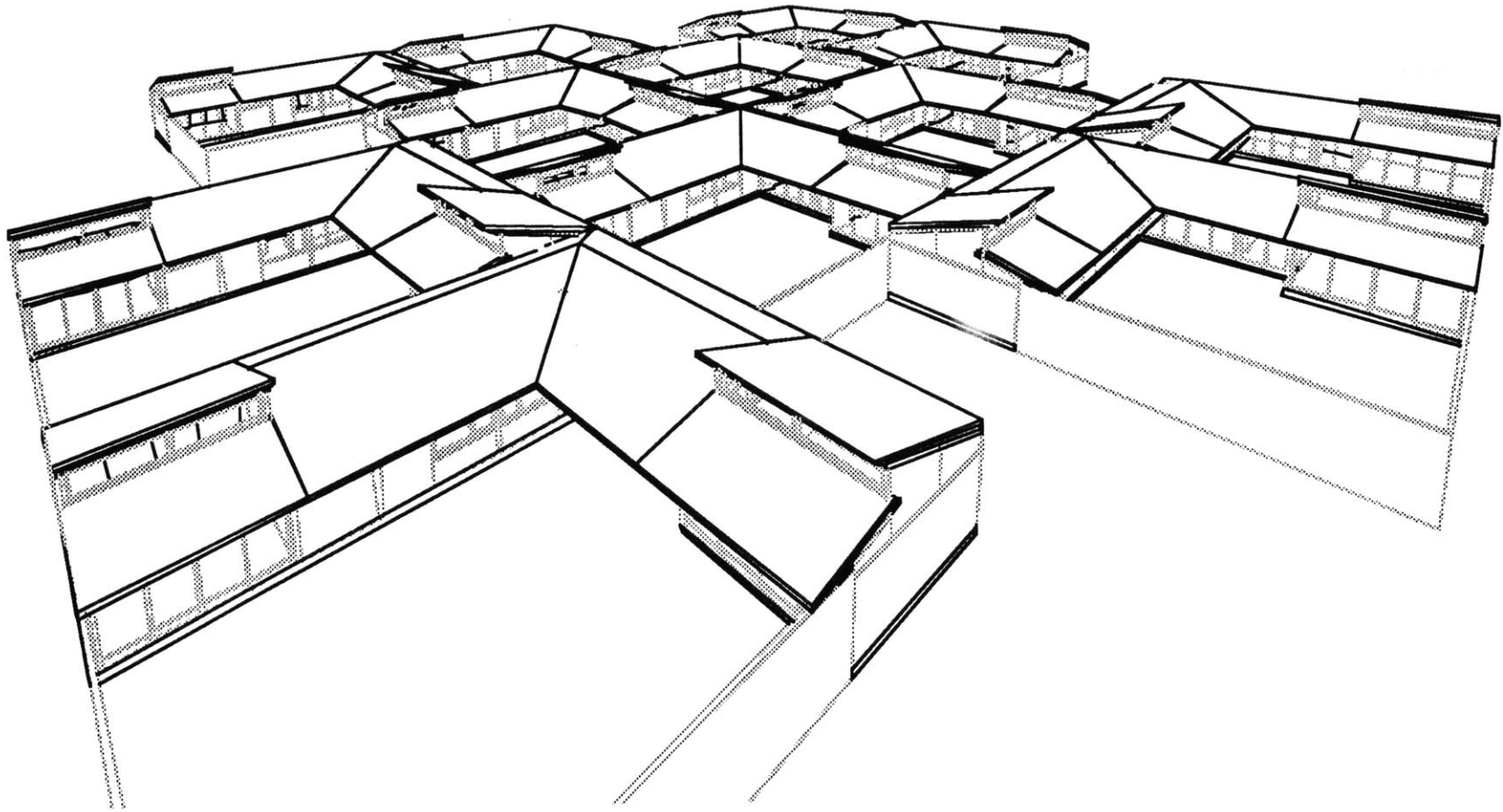


figure 16

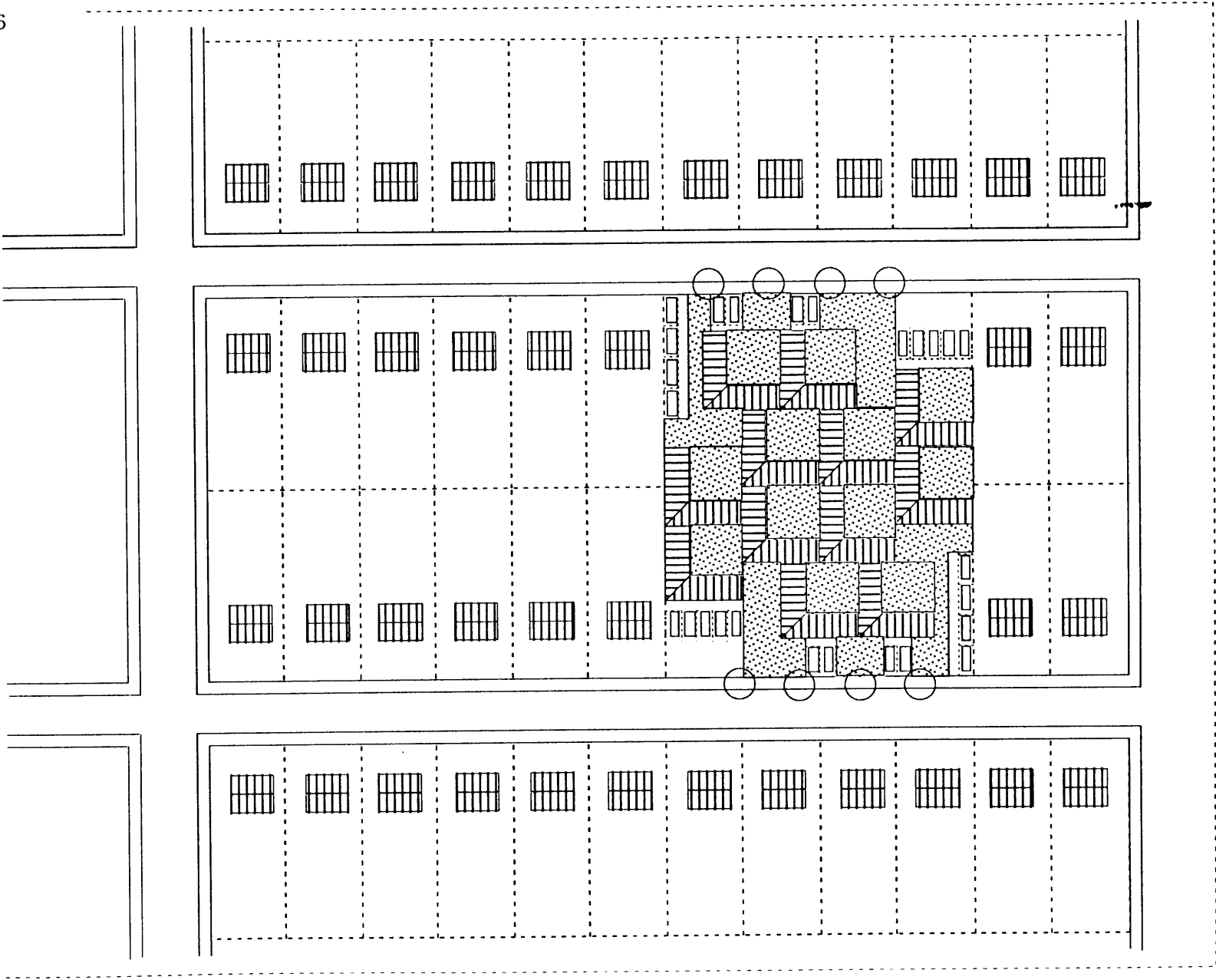


figure 17

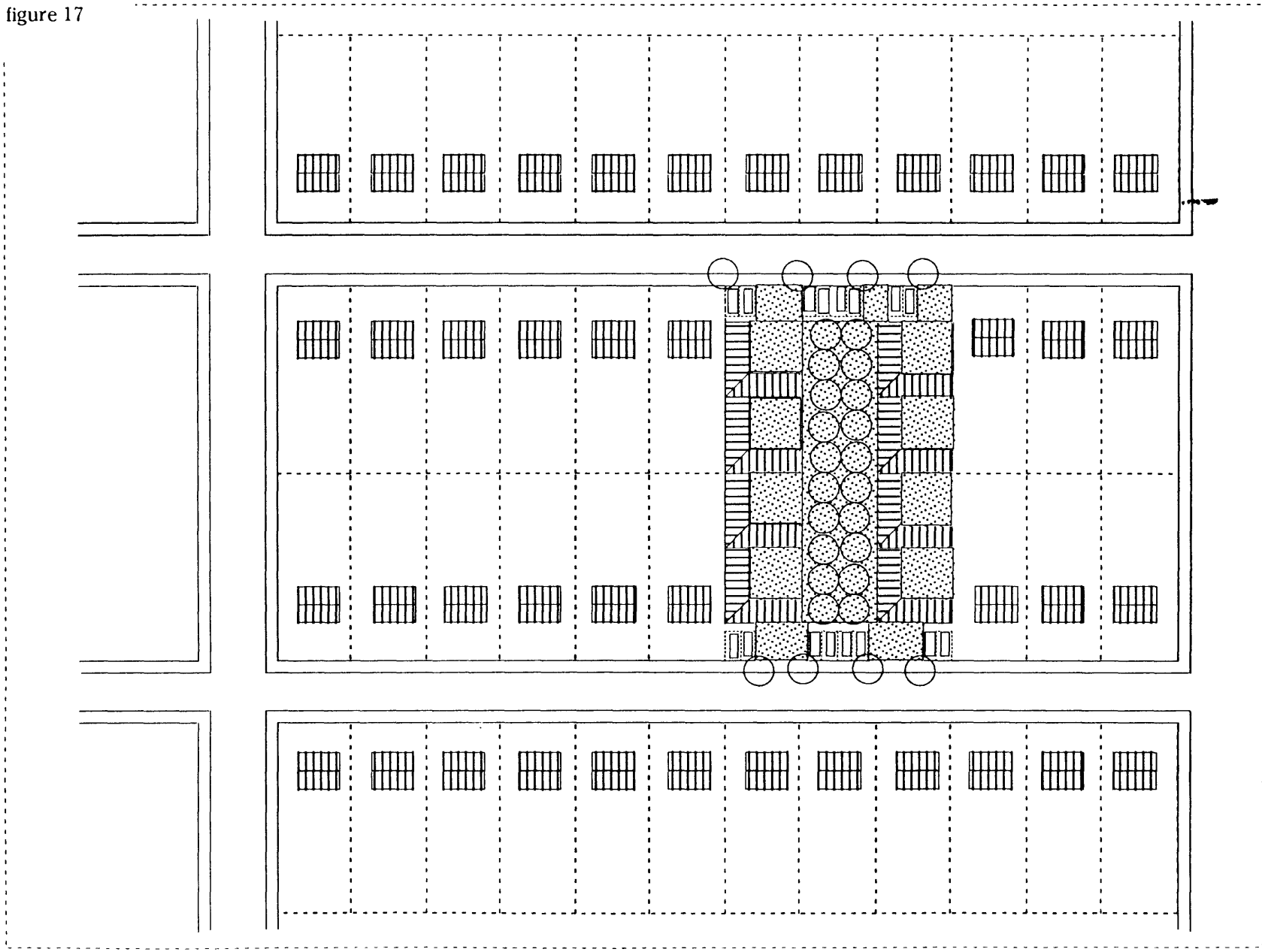


figure 18

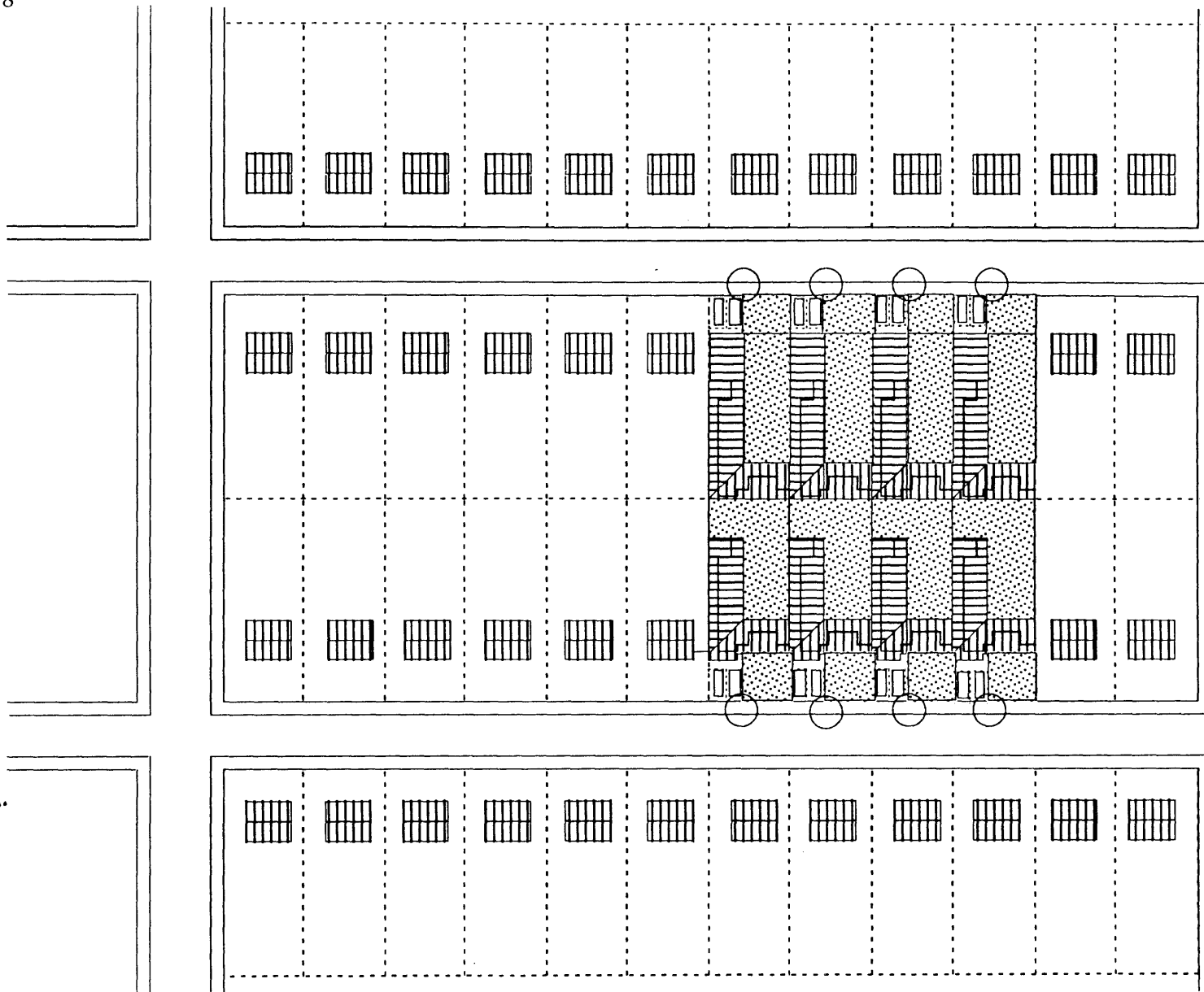
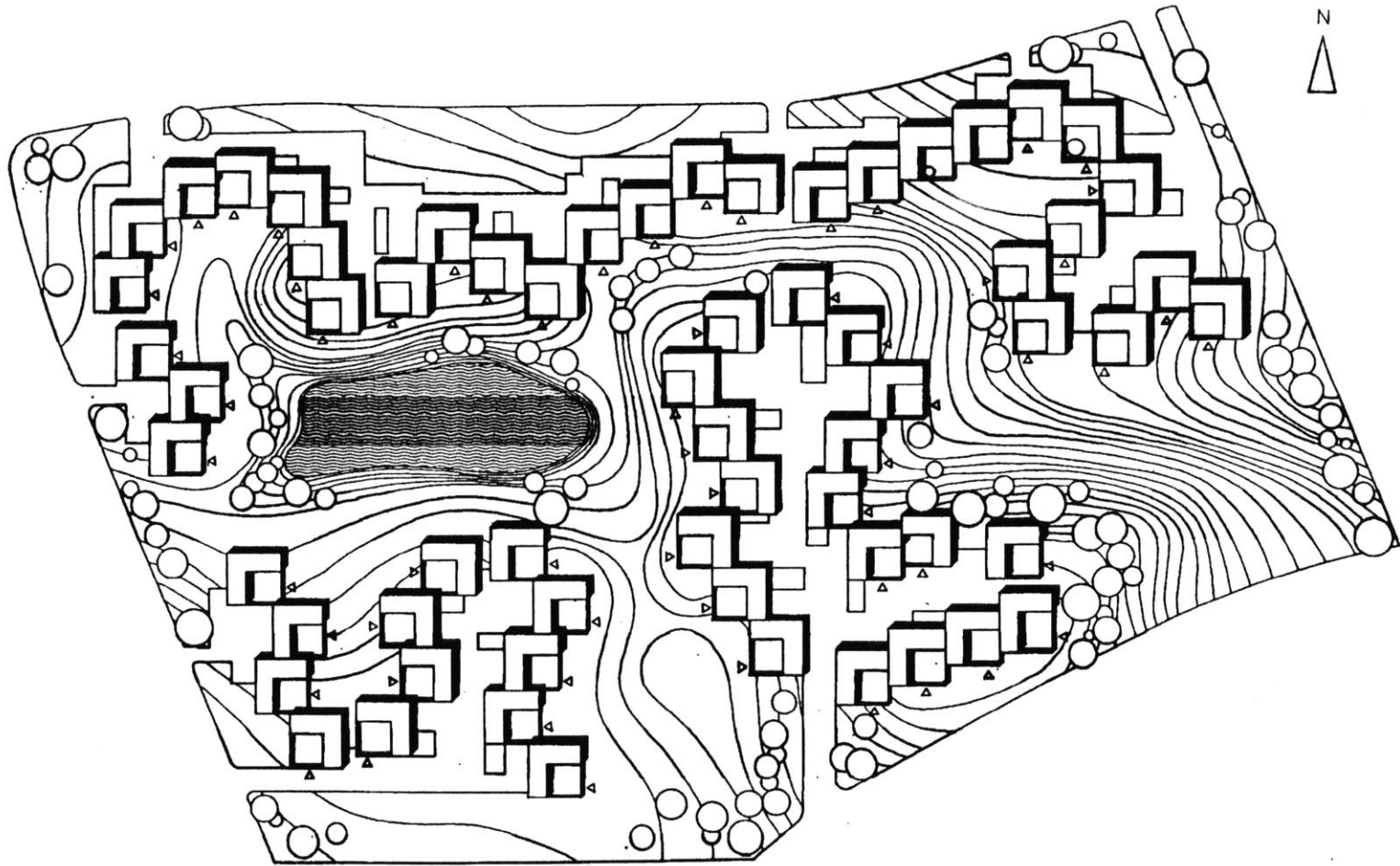


figure 19



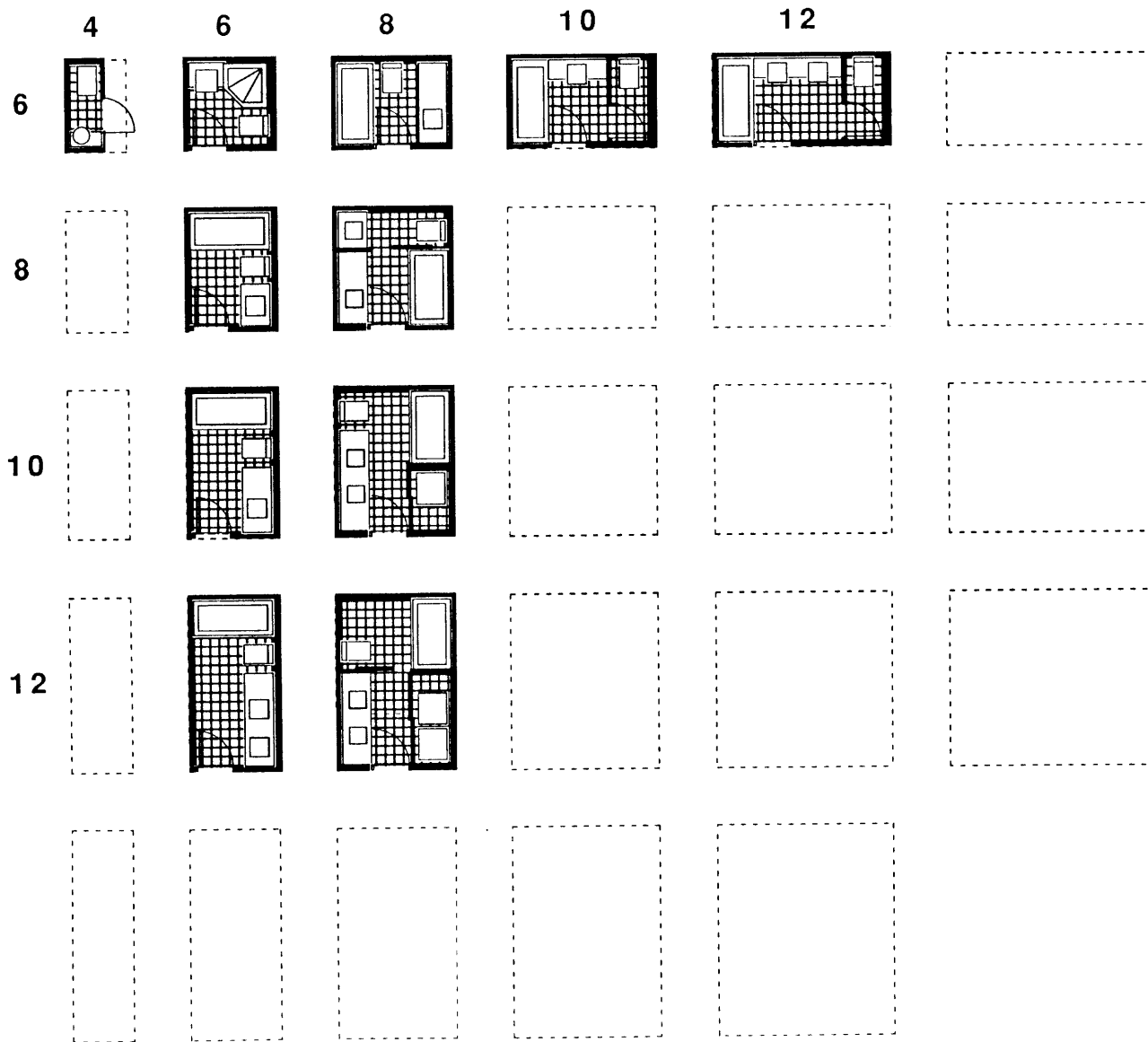
TECHNICAL APPENDIX

Room Size and Square Footage

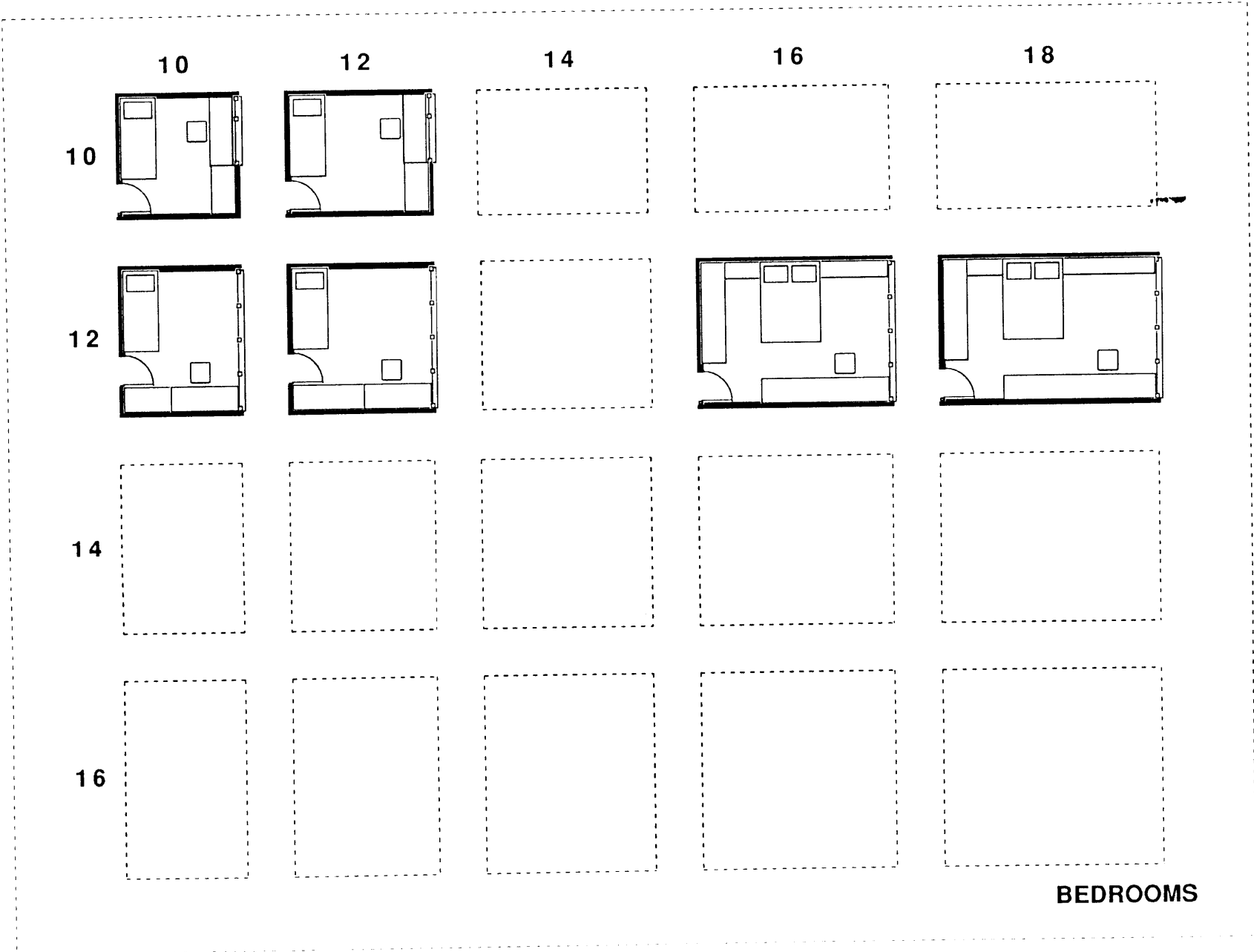
By reviewing home builder's journals the following room sizes and total square footages were found to reoccur in designs for the starter home and move-up markets.

	First House Market	Move-Up Market
Entry	6'-0"x 8'-0", 48 s.f.	6'-0"x 8'-0", 48 s.f.
Living Room	16'-0"x16'-0", 256 s.f.	16'-0"x18'-0", 288 s.f.
Dining Room	12'-0"x12'-0", 144 s.f.	12'-0"x12'-0", 144 s.f.
Kitchen	8'-0"x10'-0", 80 s.f.	8'-0"x10'-0", 80 s.f.
Bath	6'-0"x 8'-0", 48 s.f.	6'-0"x 8'-0", 48 s.f.
Master Bath	6'-0"x10'-0", 60 s.f.	6'-0"x10'-0", 60 s.f.
Master Bed Room	12'-0"x16'-0", 192 s.f.	12'-0"x18'-0", 216 s.f.
Child's Bed Room	10'-0"x10'-0", 100 s.f.	12'-0"x12'-0", 144 s.f.
Child's Bed Room	10'-0"x10'-0", 100 s.f.	12'-0"x12'-0", 144 s.f.
Family Room	Not Applicable	16'-0"x16'-0", 256 s.f.
Half Bath	Not Applicable	6'-0"x 6'-0", 36 s.f.
Guest Room/Study	Not Applicable	12'-0"x16'-0", 192 s.f.
20% Circulation	212 s.f.	331 s.f.
Total Space	1,272 s.f.	1,987 s.f.
(4-person household)	(318 s.f./person)	(497 s.f./person)

The following figures show possible room layouts.



BATHROOMS



BEDROOMS

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8

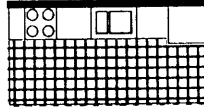
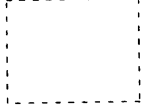
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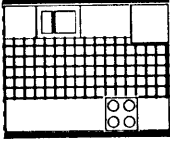
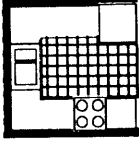
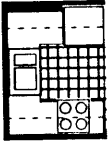
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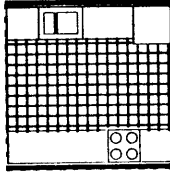
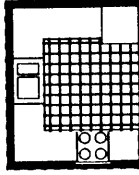
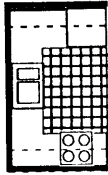
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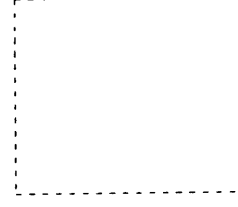
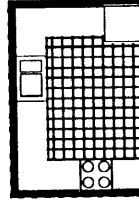
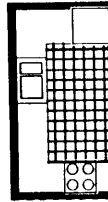
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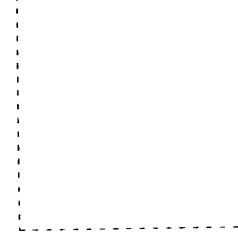
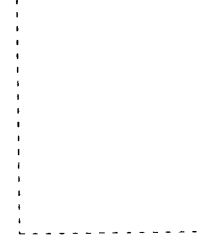
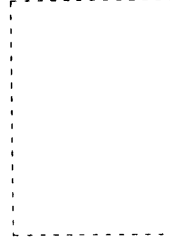
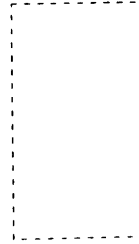
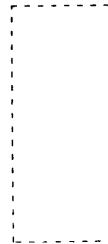
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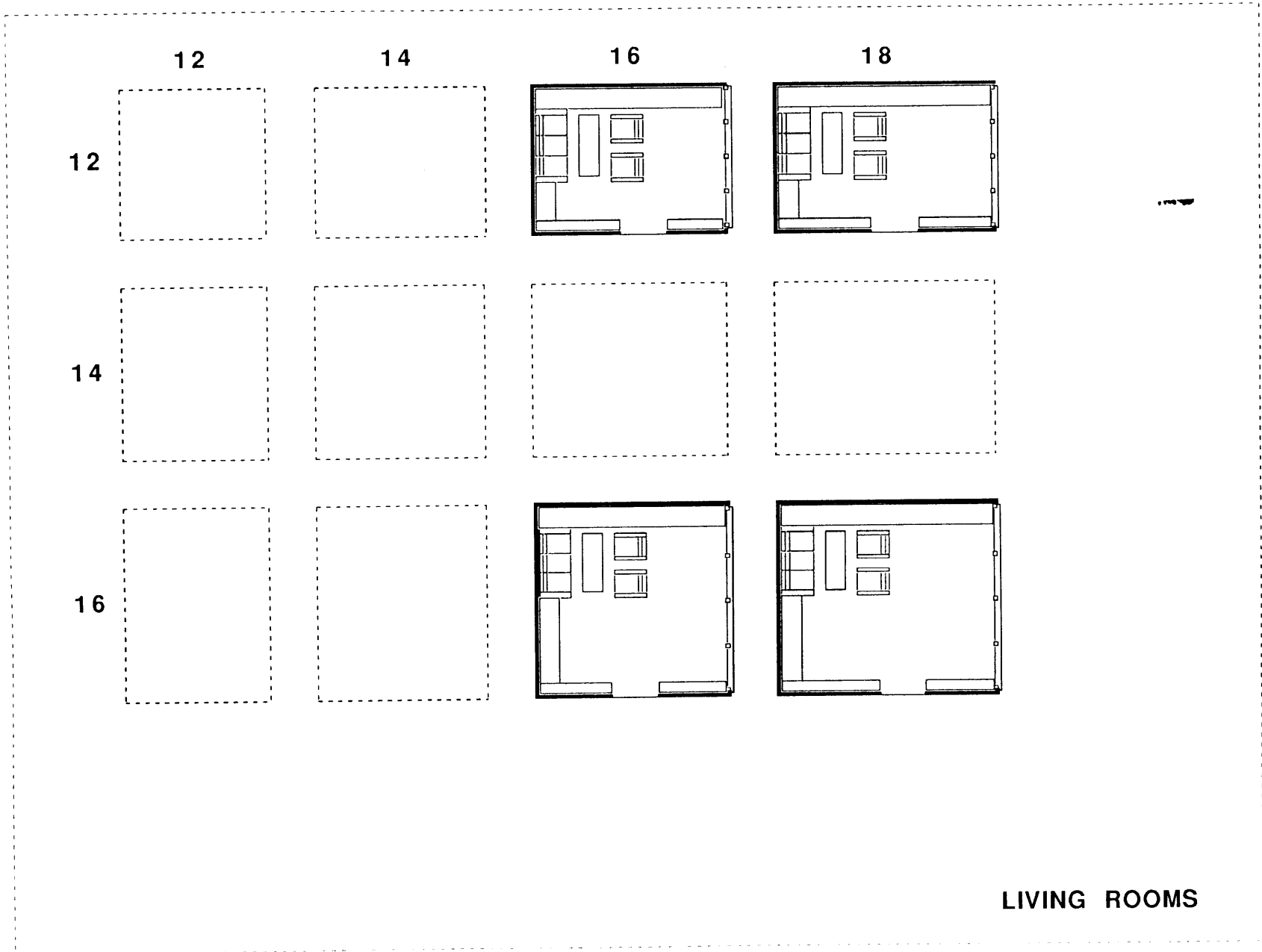
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14



KITCHENS



LIVING ROOMS

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