

---

## Chapter 4: Inductive Analysis

---

Previous chapters have shown the many different measures of density and indicated a lack of common accord on what to call the various measures. This divergence is further aggravated by the difficulty in mentally conceptualizing the areal measure of the denominator in the density equation - the acre or hectare. Ask the question "how big is an acre?" or "how many acres is this particular plot of land?" and the answers are as numerous as the respondents.

The inductive section of this study sets out to present an array of visual images of various densities to help people to conceptualize the physical ramifications of specific densities within the range of one unit per acre to approximately 170 units per acre.

Each case study, set out in Appendix A, shows a housing pattern: a particular dwelling type organized on a site, conforming to a set of site dimensions and constraints. Each such pattern is il-

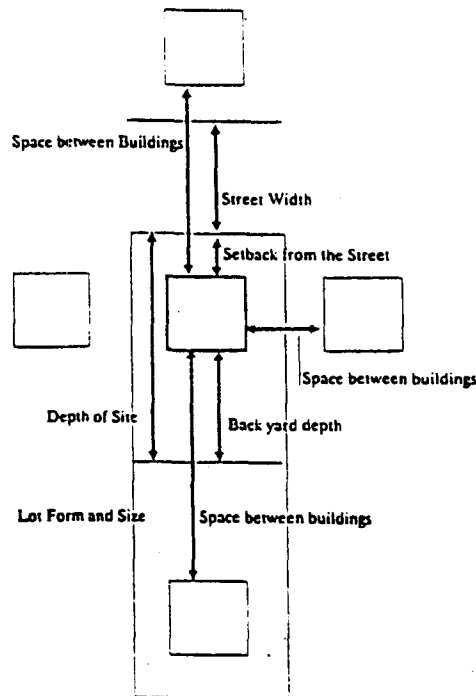


Figure 4-1: Physical Variables.

lustrated by plan and axonometric layouts of the abstracted conditions.

In putting these patterns together the complexity of the interplay of the many dimensional variables that affect housing density became quickly apparent. Some of these have been discussed in Chapter 3 and illustrated in Figure 3-1. (For convenience this Figure is repeated in Figure 4-1.)

The dimensional variables identified in Figure 4-1 represent design factors that can vary in a residential environment to produce a particular pattern of development and, in turn, have an impact on urban form. While some of these variables affect housing density, some do not and it is important to differentiate between these two categories, particularly with regard to their impact on the urban form. Table 4-1 shows these two categories.

Key Density Factors:	Other Critical Design Factors:
Dwelling Type	Access
Lot Size	Daylighting/Sunlighting
Block Variables	Privacy
Building Size	The Nature of the Street
	Orientation
	Relationship to Parking

Table 4-1: Critical Design Factors.

**Dwelling type:**

Within each of the four dwelling types used in this study are a number of variables that are typical to each type. These variables have their own particular set of demands on the site and on the arrangement of the units on the site and consequently affect the density of particular layouts in subtle ways. The variables used in this study are summarized below.

*Single family detached housing.*

The single family detached housing case studies illustrate a variety of floor plan characteristics. Clearly the number of variations in plan and organization are considerable. Within the scope of this study we have illustrated three single family detached house plans that typically appear in new housing developments:

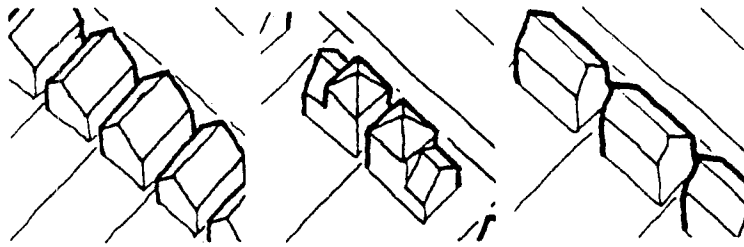


Figure 4-2: Single Family Detached Housing Types.

the one-level "bungalow", the "split level", and the two storey "colonial". (Figure 4-2)

The densities illustrated range from a low of one unit/acre (NDD) to a high of 10.6 units /acre (NDD). The low end of this scale, the one acre lot, represents typical suburban development in many parts of the country. Less prevalent but still obvious in many parts are densities lower than this but at anything less than one unit/acre the overall character of development has clearly switched from urban to rural - in fact this may also be true at one unit/acre. The upper end of the scale, about 10 units/acre represents the density found in more urban developments that employ single family housing. The overall environmental character at this density is now shaped by the relationships that exist between the housing units and each of the lot variables set out in Figure 4-1 becomes significant in determining that character.

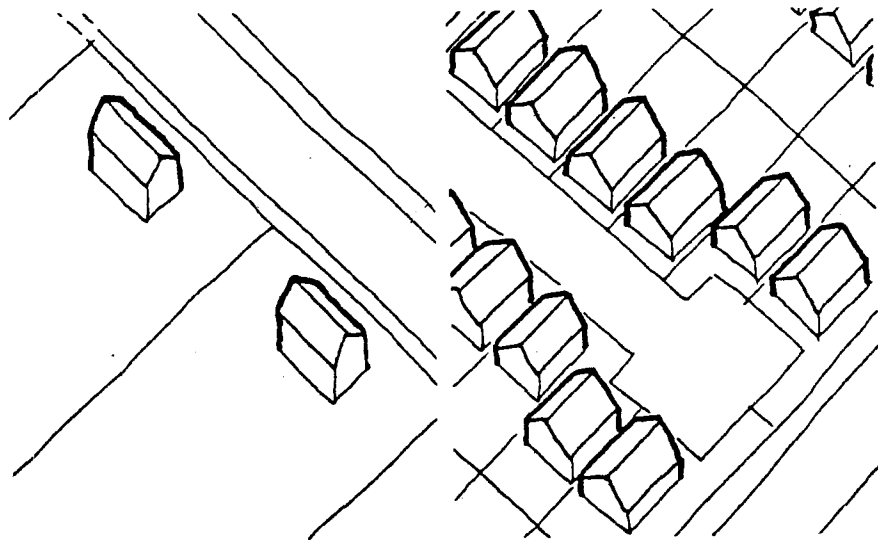


Figure 4-3: Single Family Detached Housing: The Density Range

### *Row Housing*

The range of density within the row housing type is principally controlled by the width of the lot. We have chosen an extremely narrow lot by American standards of 12 feet as the narrowest lot and have increased this to 18 feet, 20 feet, and 25 feet. Two and three storey units are illustrated in a variety of configurations. (Figure 4-4)



Figure 4-4: Row Housing Types.

Densities range from a low of 12.5 units/acre (NDD) to a high of 57 units/acre (NDD) (Figure 4-5). The character of the urban form can be more significantly manipulated and controlled at these higher densities and the consolidation of the individual dwelling unit into a large building unit adds to the control of the housing environment available to the designer. This is true for both the design of the private space within the block and the design of the public zone, the street side of the units. As is noted later the relationship between the housing unit and the parking arrangements becomes a critical element of the site design and the integration of landscape into the design can be a prime factor in determining the overall character of the housing environment. The case studies explore a number of alternative layouts that illustrate some of the many possible configurations.

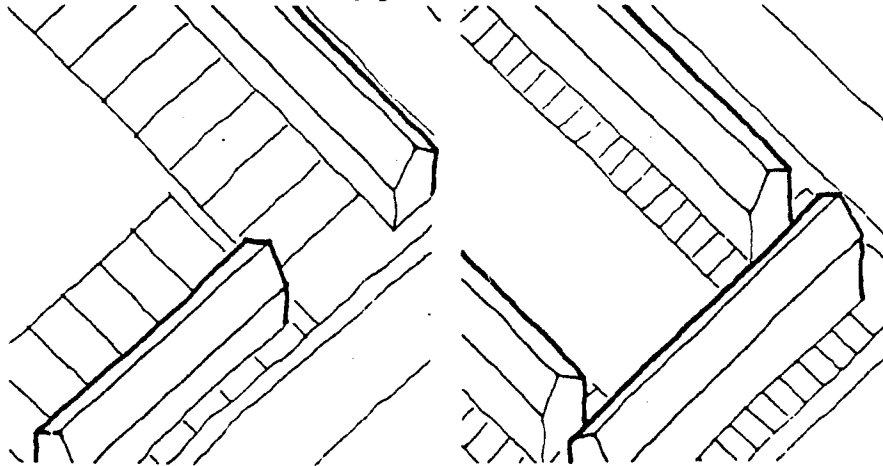


Figure 4-5: Row Housing: The Density Range.

*Low-rise "Garden" Apartments.*

With single family and row house dwelling units the key variable that affected density was the lot size. With garden apartments this is clearly not the case as the lot as an identifiable element has disappeared from the layout. Other site factors now take over as the significant lot variables with the dwelling type, the site organization, and the relationship to parking being among the most important. The dwelling types that we have represented are three and four storey buildings with double- and single- loaded corridor plan arrangements or with single or multiple cores (Figure 4-6).

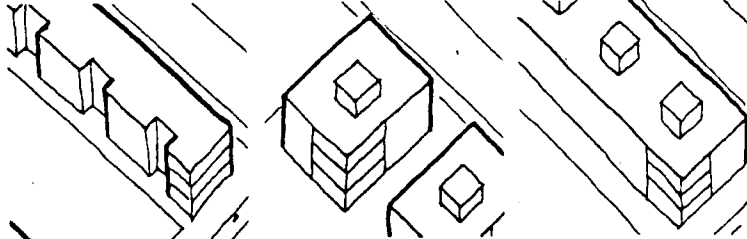


Figure 4-6: Low-rise "Garden" Apartments Types.

The density range illustrated is from a low of 12.6 units/acre (NDD) to a high of 45.5 units/ acre (NDD) (Figure 4-7). As with the row housing type, the character of the urban form can be manipulated and controlled at these higher densities to create both an "internal" private environment and an "external" public environment with both landscaping and parking playing key roles in determining the particular urban character of the urban environment. Discussed later is the issue of the orientation of the individual units within each building block which, while not affecting density, is often ignored in apartment layout.

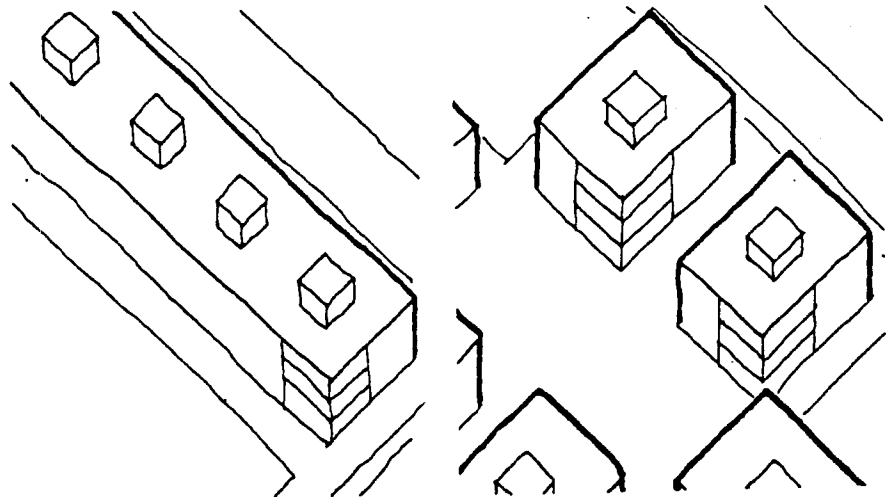


Figure 4-7: Low-rise "Garden" Apartments: The Density Range.

*High-rise Apartments.* As with the low-rise apartment dwelling types, the high-rise dwelling types that we have represented are buildings with double- and single- loaded corridor plan arrangements or with single or multiple cores. The height of the buildings range from 7 to 30 storeys. (Figure 4-8). Also included with this group are a number of schemes that combine both high-rise and low-rise buildings to create a variety of opportunities within the site. Problems of overlooking, referred to later in this chapter, take on a particular significance with this complex arrangement.

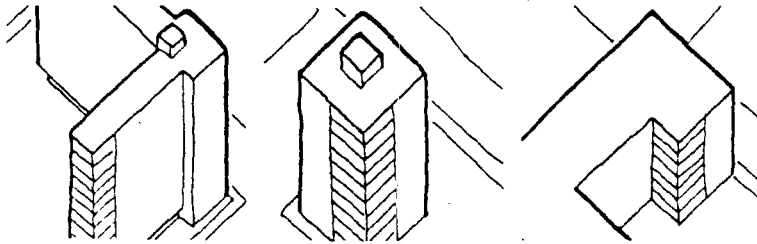


Figure 4-8: High-rise Apartment Types.

#### *High-rise Apartments.*

High-rise apartment developments are illustrated with a density range from as low as 15 units/acre (NDD) to a high of 171 units/acre (NDD) (Figure 4-9). At these high levels other design determinants become key factors with perhaps parking being the most significant one. Above about 150 units per acre and with the liberal requirement of one car parking space per unit, one acre of parking must be created. For high densities to be maintained this parking must be in a structured facility either above or below ground. Either way the parking and its access both to the street and to the dwelling unit become key factors in design.

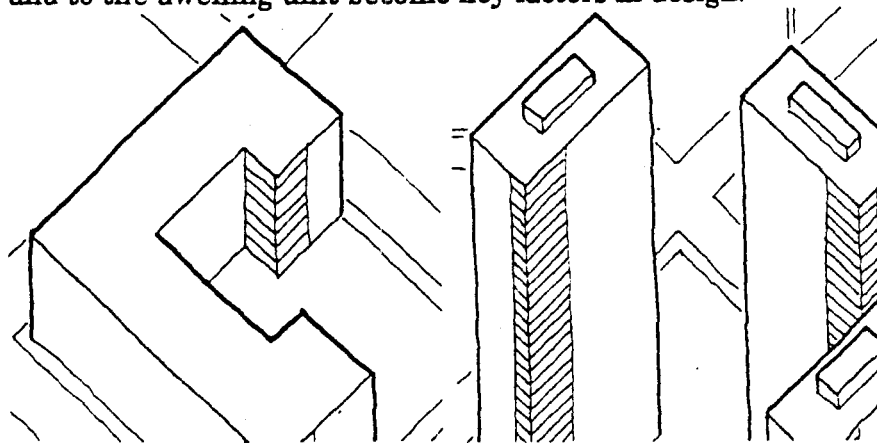


Figure 4-9: High-rise Apartments: The Density Range.

### Lot Size:

The lots on which these buildings are sited can vary through a considerable range though the method of describing the unit in relation to the lot size changes with the type of unit. Clearly there is a direct relationship between the size of the lot and the number of units able to be accommodated in an acre. Yet, while the lot size is usually thought of in terms of area, it is equally important to understand the impact on urban form of the relationship between the site depth and the site width - short, wide lots are a very different proposition than long, narrow lots although they can produce the same density.

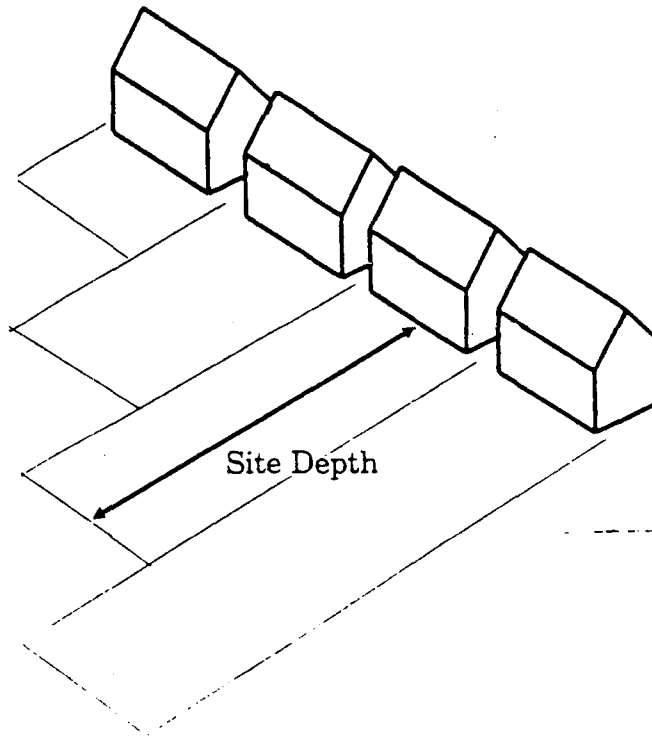


Figure 4-10: Lot Size.

### Block variables:

All of the block diagrams are illustrated as if they were regular rectilinear blocks although this is not always true of the photographic illustrations that accompany the diagrams. This is an abstraction for calculation purposes and each of the patterns could be illustrated by a curvilinear pattern substituted for the rectilinear pattern. The road pattern also has a decisive effect on the development potential of the site determining the shape and

character of the individual plots, the ease of development, and, in concert with the contours of the site, the ease of building in relation to the road. Again the density measures would remain constant but the urban form would be different and in some cases the impact of the change would be considerable.

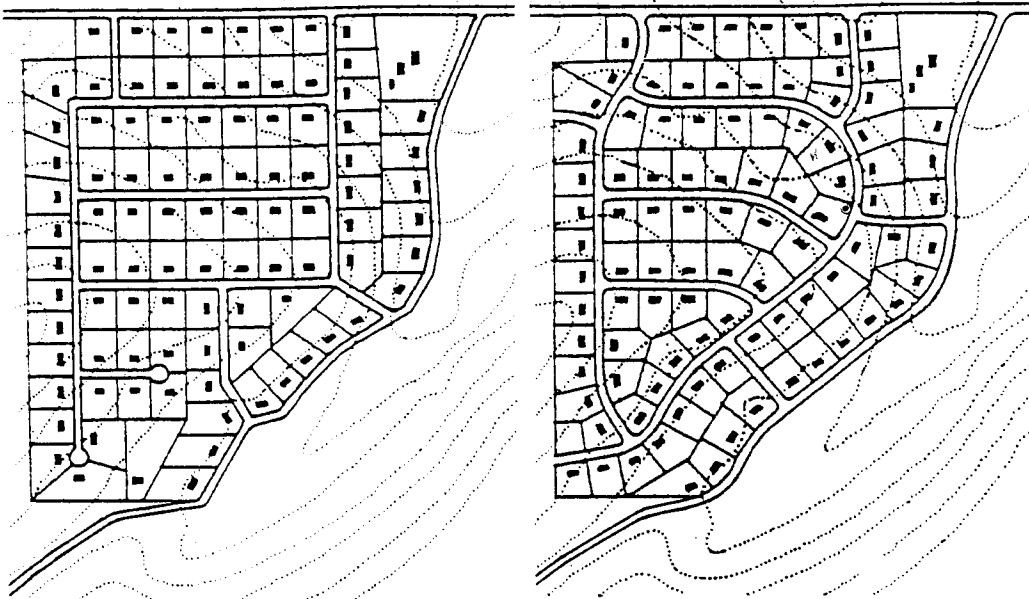


Figure 4-11: Block Variables (Tunnard, 1963).

#### Figure 4-11

##### **Building size:**

There is an assumed relationship between building size and the lot size. This is a natural assumption with minimum lot dimensions that add on front yard, side yard, and back yard requirements to the unit size to obtain the lot size. Here the relationship with density is direct.

Different attitudes to the site dimensions as they relate to the house size can produce considerably different urban form conditions without changing the density. This is perhaps best illustrated in relation to the front yard or setback dimension. A change of setback with the building dimension and the lot size remaining the same can produce a considerably different urban environment with no impact on the density measure.

The extension of this thinking can have an even greater impact on urban form. In a study carried out in England, the following sequence of logic is outlined - less set back requirement can result



in smaller lots which means more houses on the site (and hence a higher density) which, in turn, produces a greater return to the builder (Essex County Council, 1973). The use of this option then gives the planning authority greater leverage with the developer to demand higher standards of finishes and detailing in the urban realm. Clearly this kind of thinking produces a significant relationship between setback, density, and urban form.

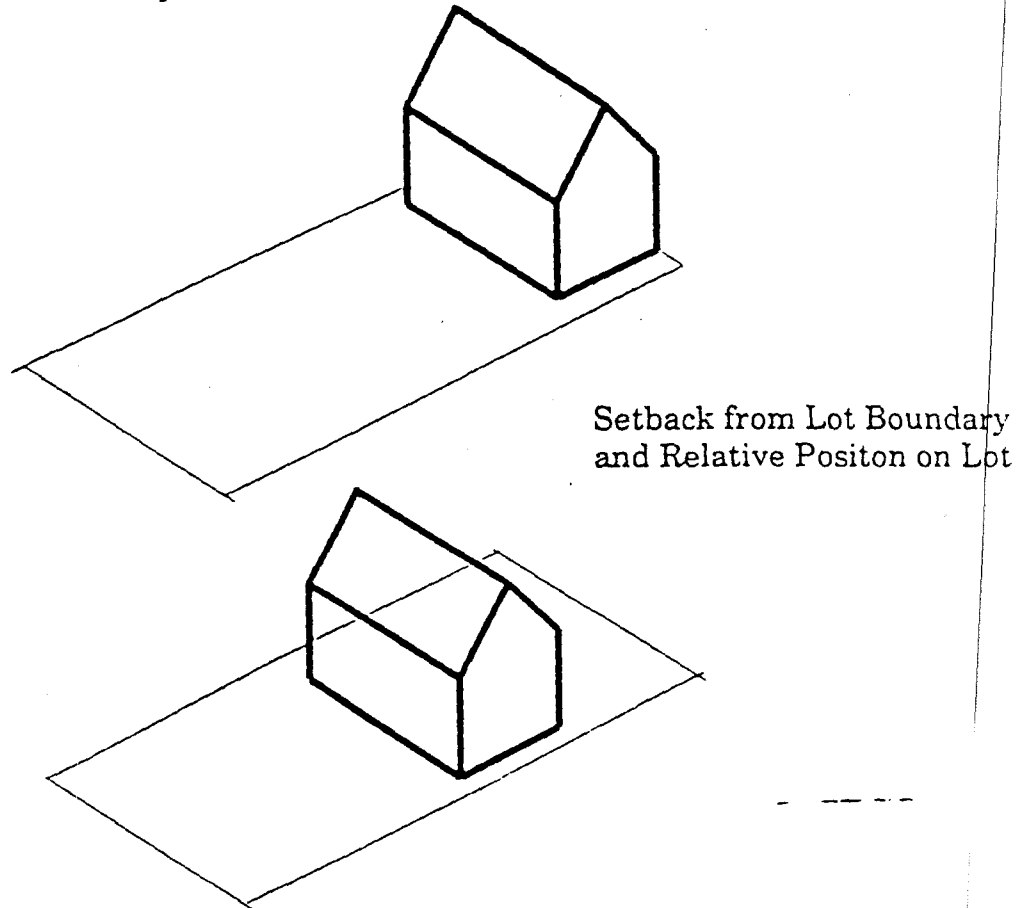


Figure 4:12: Variation in Setback from the Street.

**Other urban form issues:**

Other consideration of housing layout must include the needs for access, adequate daylighting and sunlighting, and privacy, both visual and auditory.

Housing design standards have tended to incorporate these requirements into two prime concerns that can be defined as: a) the problems of accessibility, and b) the problem of achieving a physically satisfactory environment for people within their own site.

These standards have proven to be particularly ineffective in shaping the urban form, particularly as they have affected the issues of privacy and of the nature of the street. In relation to these issues, any inter-relationship between density and urban form is a secondary consideration.

*Privacy:*

The private yard is an important use of the ground in a family housing site (Lynch and Hack, 1984). The responses to achieving privacy within the building lot can be categorized into three groups:

- a). The enclosure within the building lot of part of the site to ensure privacy from the street. This can be achieved by the use of the building itself as a screen or by using other physical devices (fences, planting, etc.) to obtain privacy (Figure 4-13).

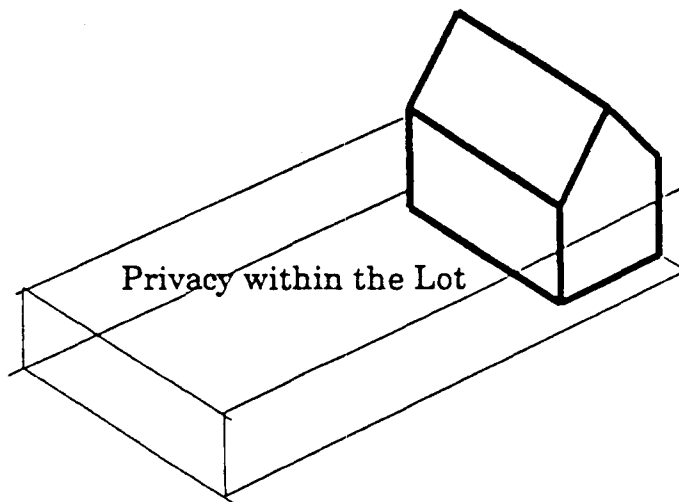
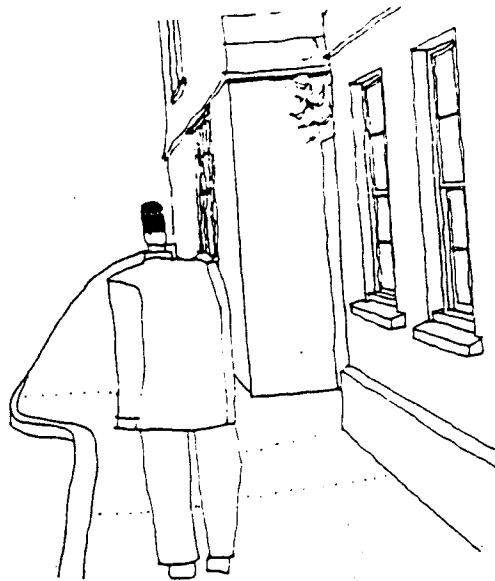
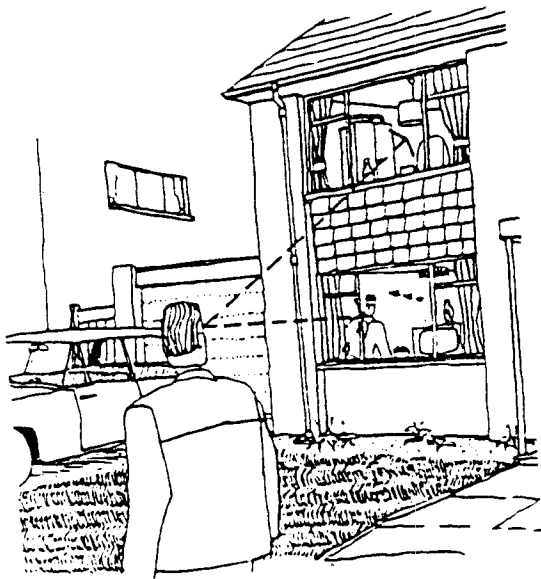


Figure 4-13: Privacy within the Building Lot.

- b). A relationship between the organization and design of the housing unit and the public zone of the street to ensure privacy within the house. This can take several forms - increase the distance, organize the unit in a suitable way to avoid problems, or provide barriers. The logic of the same study referred to above is interesting in this regard. (Figure 4-14)



2.13 a Public and private zones

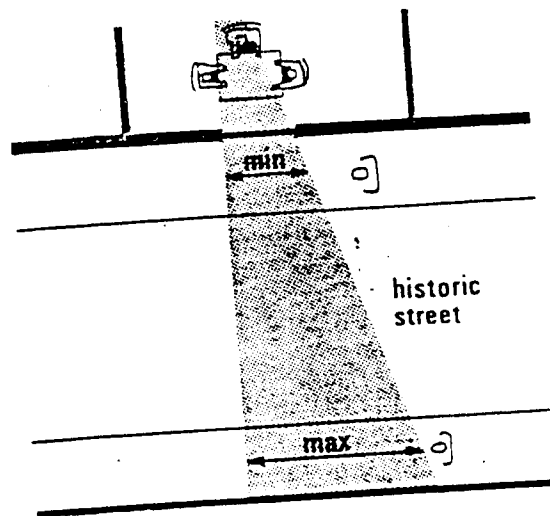
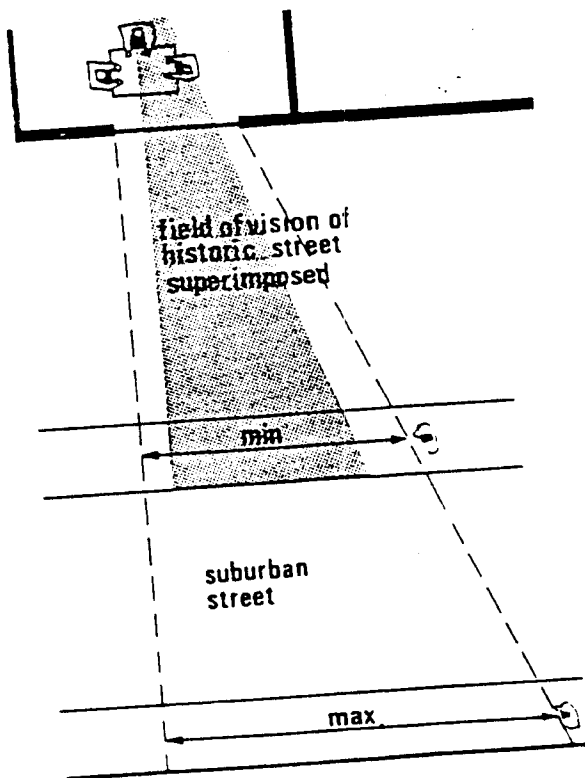
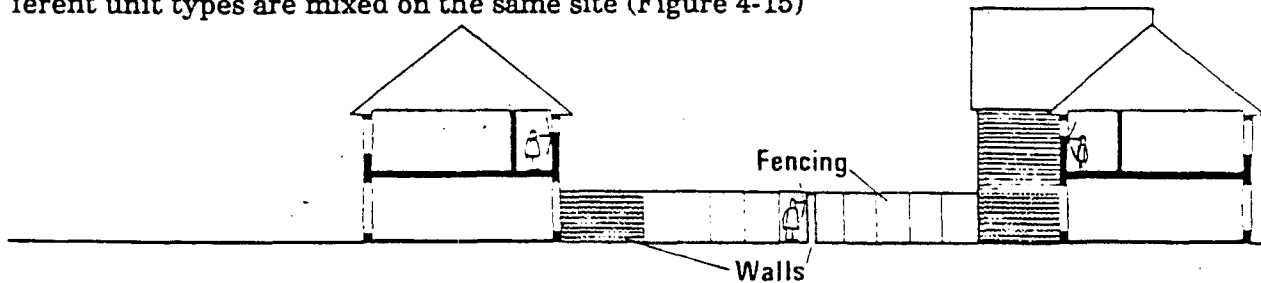


Figure 4-14: Privacy from the Street (Essex C.C., 1973).

c). Organization of the relationship between adjacent units, both back to back and side to side, to ensure a privacy from overlooking from neighboring units. This is particularly difficult when different unit types are mixed on the same site (Figure 4-15)



Garden privacy by design

Overlooking from surrounding gardens and ground floor windows can be effectively prevented by above eye-level screens  
 Overlooking from upper floor windows, with conventional cill levels, will still occur unless the view from them is very oblique, they are sufficiently remote, or screened by buildings or trees. Fig 2 21 b



Screen planting effectively blocks first floor overlooking

Private zone

Figure 4-15: Privacy from Overlooking (Essex C.C., 1973).

### *The Nature of the Street:*

Of particular significance to the question of urban form is the relationship that exists between the housing units and the public zone - the street. The public street is a significant component of urban form - a community space under public control. At the lower density scale, the space between the units both along the street and across the street greatly affects the overall urban character and form of the residential neighborhood. Gordon Cullen's (1962) treatise of *Townscape* and Ian Nairn's (1964) critique of suburban layout have had little effect in bringing about a change to the urban form of housing developments. Most continue to perpetuate the barren prairie approach.

At higher densities, buildings are often designed as object buildings with little consideration for the design of the space between buildings, the relationship that determines the quality of the urban form. Parking and access needs further complicate the problem at the higher density scale and poor relationships between parking areas and buildings contribute to the further reduction of the quality of the urban environment.

The relationships that shape the street, the proportions that are achieved, and the resulting sense of enclosure or openness are critical components of urban form (Figure 4-16). Consideration of the nature of the street obviously affect, or are affected by, density concerns but at a secondary level. The two factors are seldom considered together.

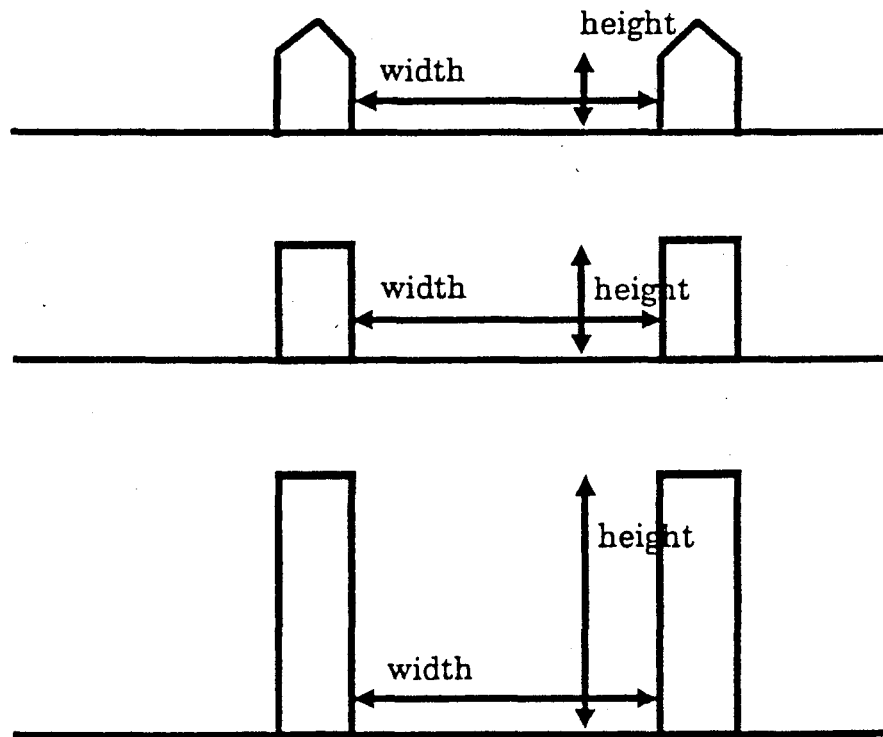


Figure 4-16: Street Proportions.

*Orientation:*

Two further issues need to be touched upon. The patterns illustrated in Appendix A do not include any consideration of orientation. As is often true with built projects, individual housing units are freely rotated through 360 degrees with little regard to the energy or lighting needs of the unit. Similarly, individual

units in the multi-unit complexes are simply related to the outside wall with no regard to orientation. Orientation is more of a problem as density increases and units have fewer open sides. Conventional wisdom is that the best orientation for double-loaded corridor buildings is with the corridor oriented north/south to afford east or west facing apartments - but examples that pay little heed to such guidelines are numerous, and the virtue of west facing units that potentially suffer from heat and glare still remains an open question (Figure 4-17)

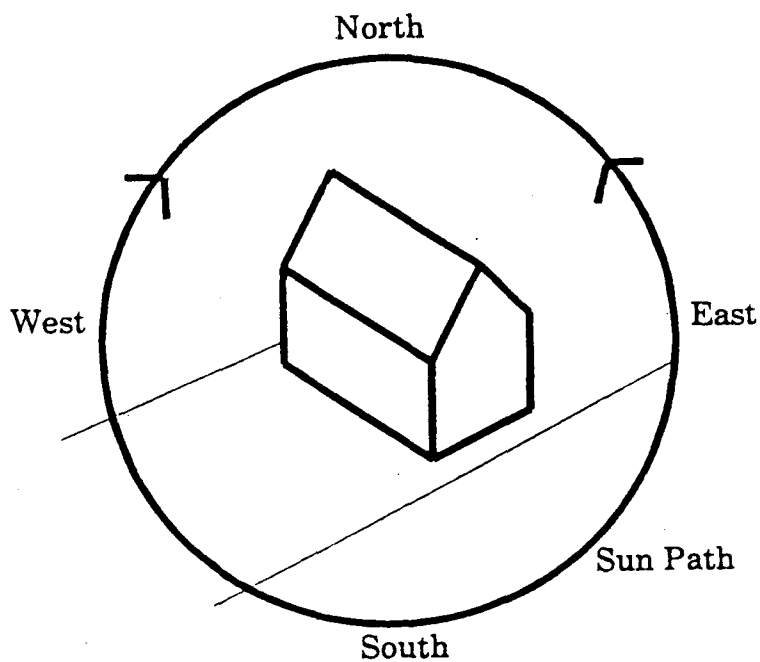


Figure 4-17: Orientation Considerations.

Orientation per se has little effect on density. Consideration of housing layout and urban form that responds to orientation as a critical issue will have an affect on density.

#### *Parking*

The final issue that needs to be discussed concerns the issue of parking and the relationship that exists between parking and the housing unit (Figure 4-19).

At low densities this is not generally considered a problem with the access provided to a point immediately adjacent to the house. At higher densities such an arrangement is not so feasible and alternative organizational arrangements have to be made. Choices must be made between surface parking, underground parking,

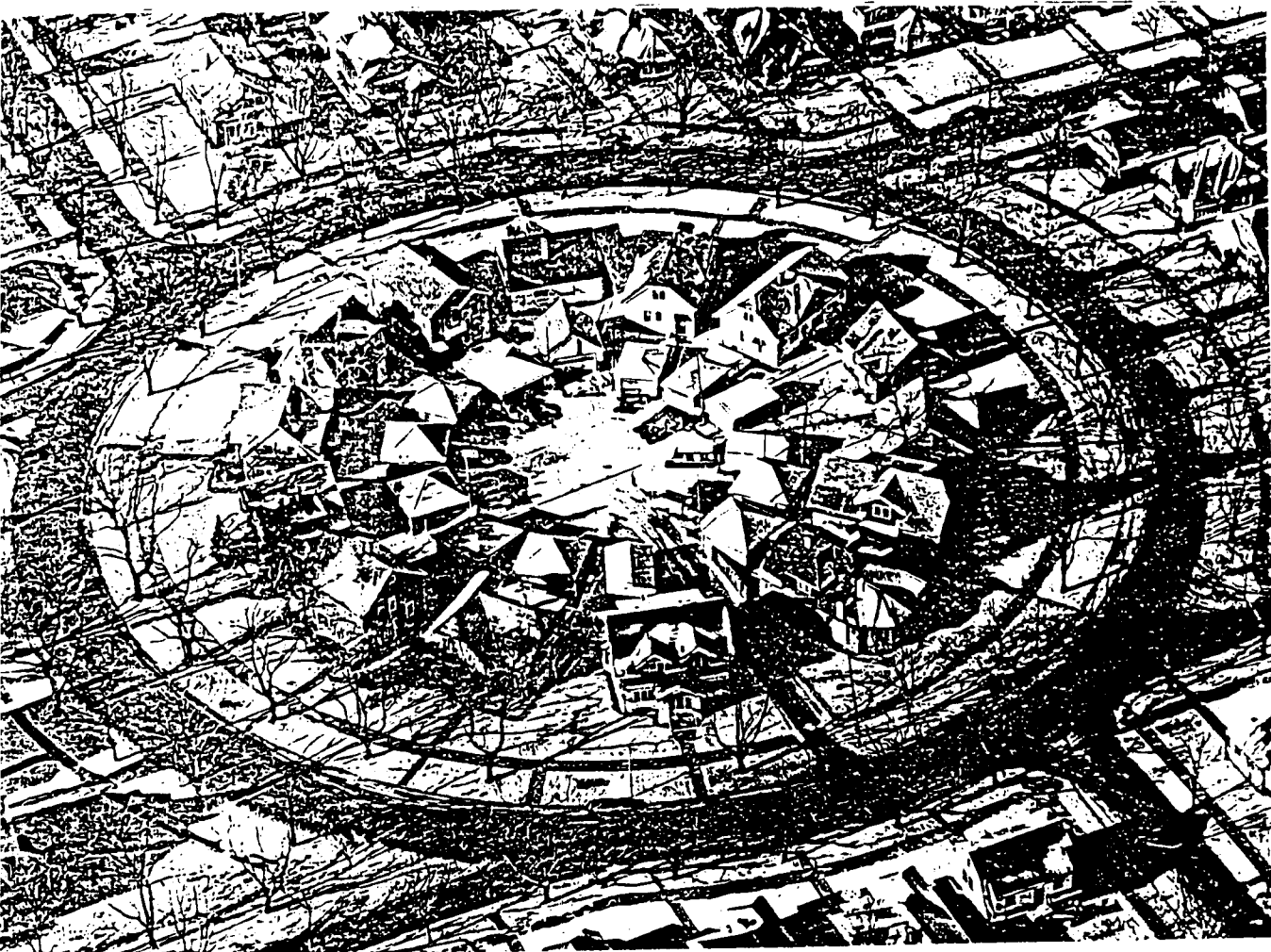


Figure 4-18: Housing Oriented to All Points of the Compass.

and structured parking; between large parking areas and a number of smaller parking areas; and between covered or uncovered parking. At the same time decisions need to be made about the relationship between car parking areas and other landscaped spaces, and about the ratio of housing units to parking spaces. These decisions hinge upon a complex set of relationships that exist between issues of access, cost, image, urban form, and, of course, ultimately, density. The patterns illustrated have attempted to incorporate parking requirements into the layout although this has often been at the expense of land for other uses such as play space or passive landscaped areas.

Such considerations will further moderate the densities achieved in any particular development. What we present is a range of 99 patterns from a density of one unit per acre to the highest of 171

units per acre. Of course, any pattern can be built at lower densities than those shown, although it may be difficult to economically justify much lower figures. In between the extremes thresholds of different housing types can be seen, areas of overlap between similar densities with different housing types can be found, and the image of density measures can be discovered.

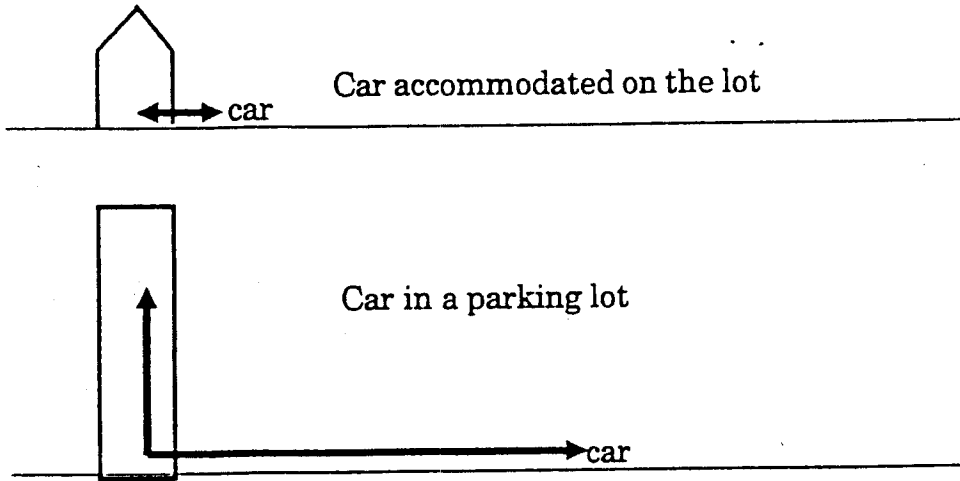


Figure 4-19: Relation of Parking to the Dwelling Unit.