

SOLAR ROW HOUSES
Between the Earth and Sky

by
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Institute and State University in partial fulfillment of the
requirements for the degree of

MASTER OF ARCHITECTURE

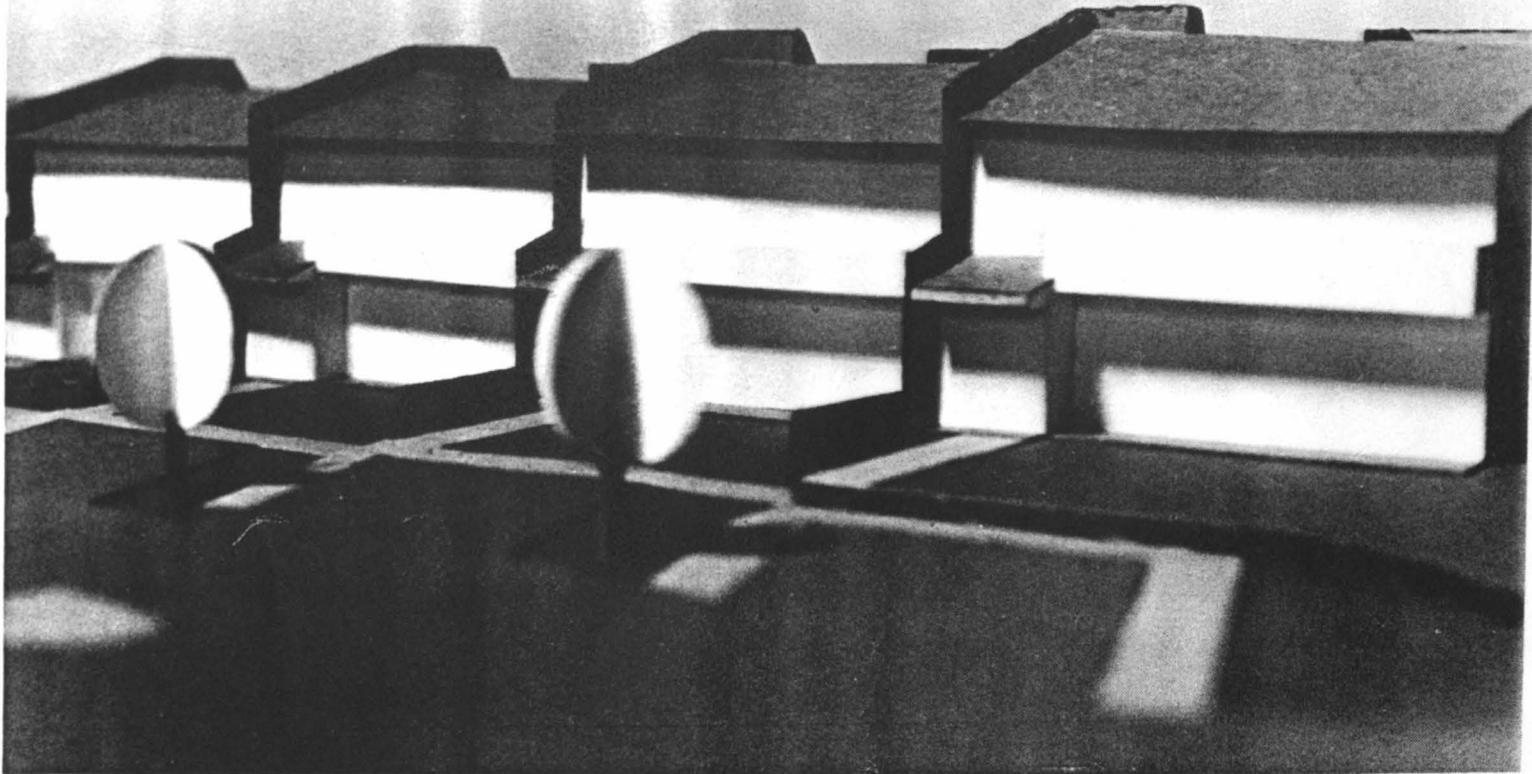
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July 1991
Blacksburg, Virginia



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Robert W. Jensen

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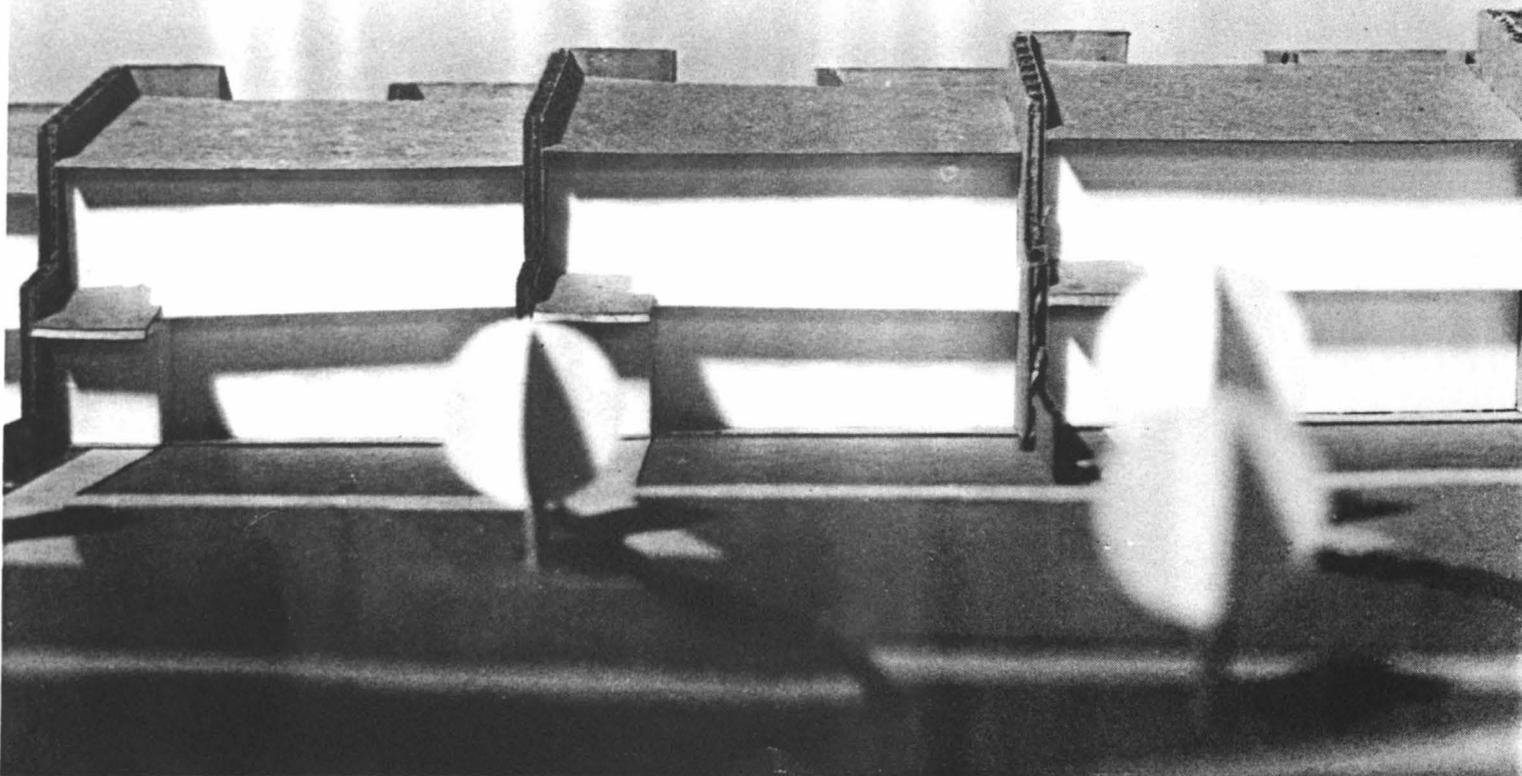
College of Architecture and Urban Studies

(ABSTRACT)

In the past 30 years the size of new houses has varied considerably with a general trend to larger houses. These larger houses use more materials in their construction and consume more energy to heat and cool than a more compact house would. Meanwhile, the amount of resources that are available have not increased, and the environmental condition of the planet has become more and more tenuous.

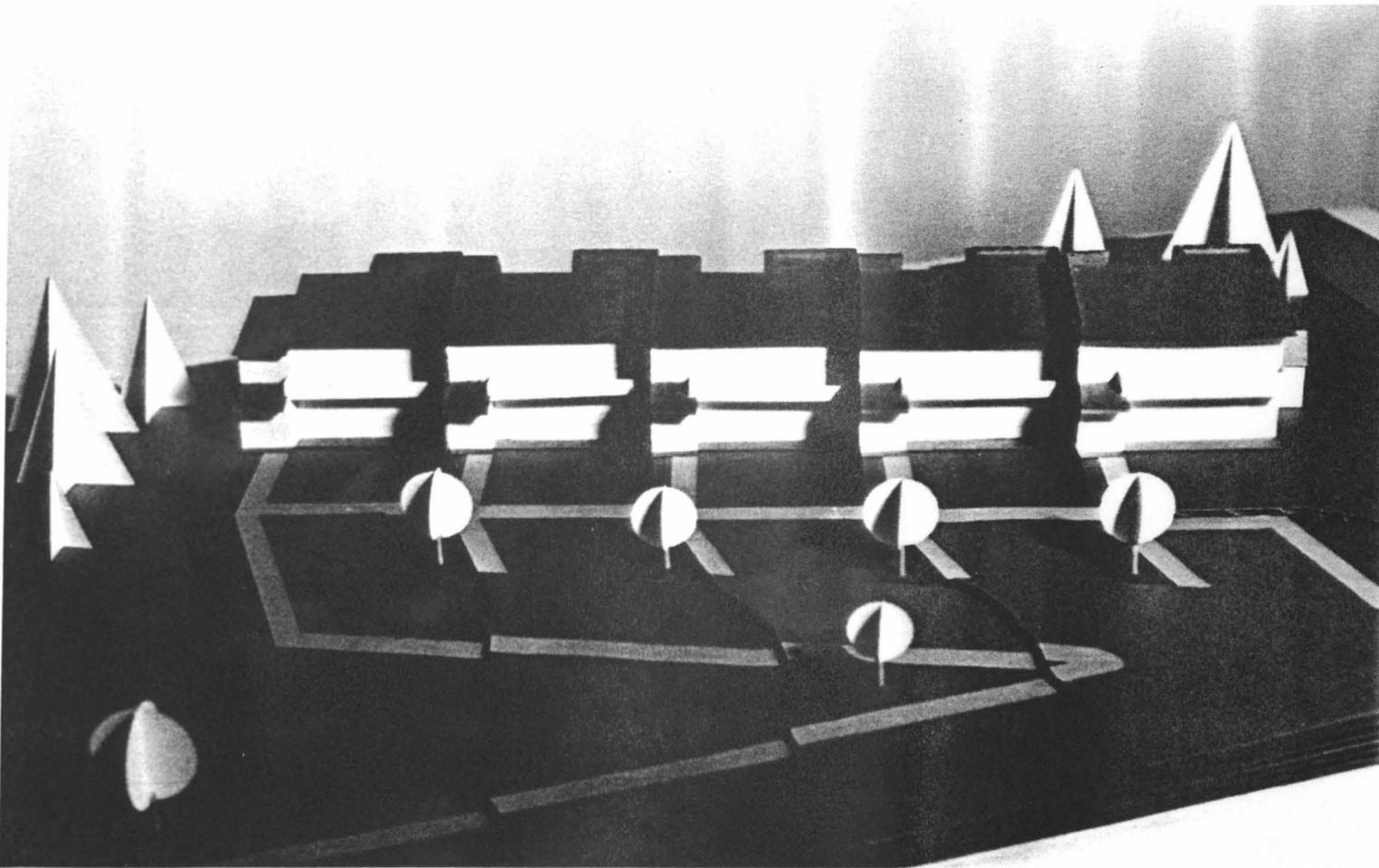
To end this trend of larger houses that make inefficient use of natural resources, architects need to design houses that are smaller and use energy more efficiently. By building houses more in tune with the natural rhythms of the sun and seasons the home becomes more energy efficient and can take better advantage of the natural energy supply available from the sun. Such a house will have less of an impact on the environment and keep the residents in touch with natural cycle of life.

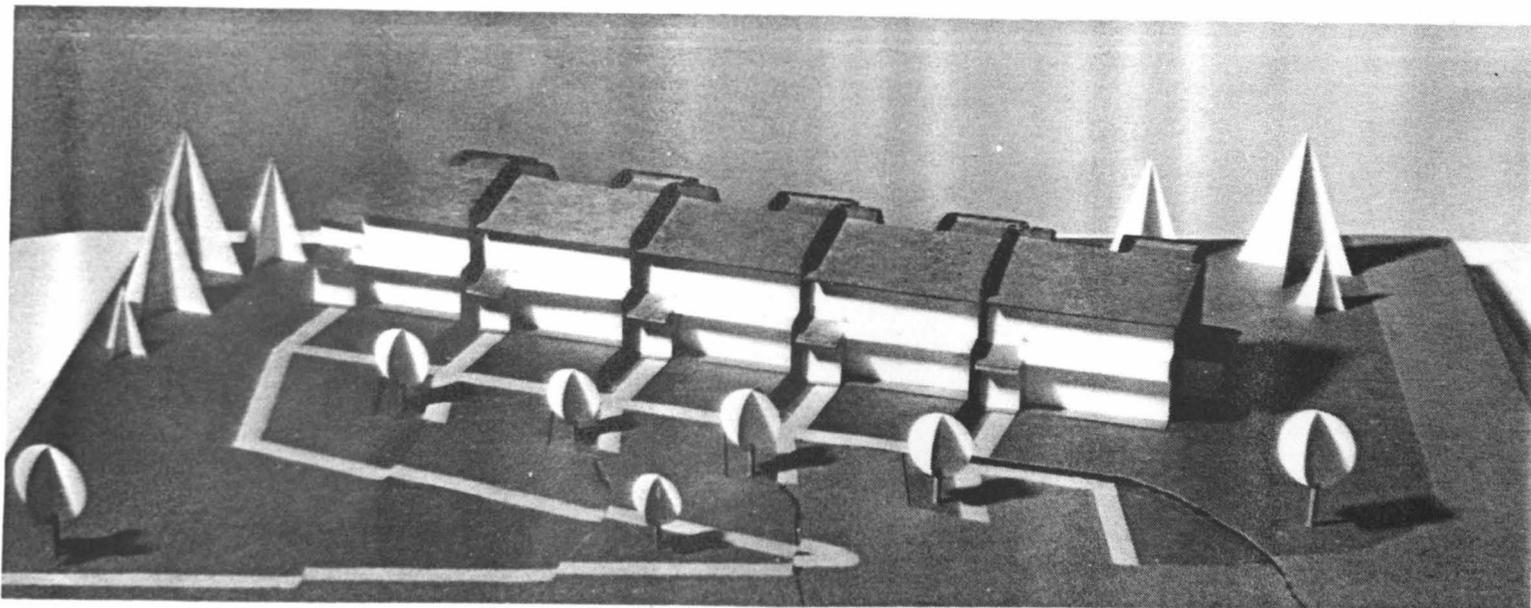
With this project I have addressed these issues and have designed a row of houses that provide a meaningful place to live that is also in tune with the environment. As with any project, I have found the answers to many questions and I have also discovered new ideas to develop further.



I wish to thank my committee chairman, Dr. Dennis Kilper for all the help he has given me. Thanks also to Professors Scott Poole and Robert Schubert for their assistance, and to Sal

I am also grateful to my mother for her faith in me and to my father, who was a great influence in my life. To my wife, I am extremely grateful for all the help and support she has given me, for without her I could not have done this.





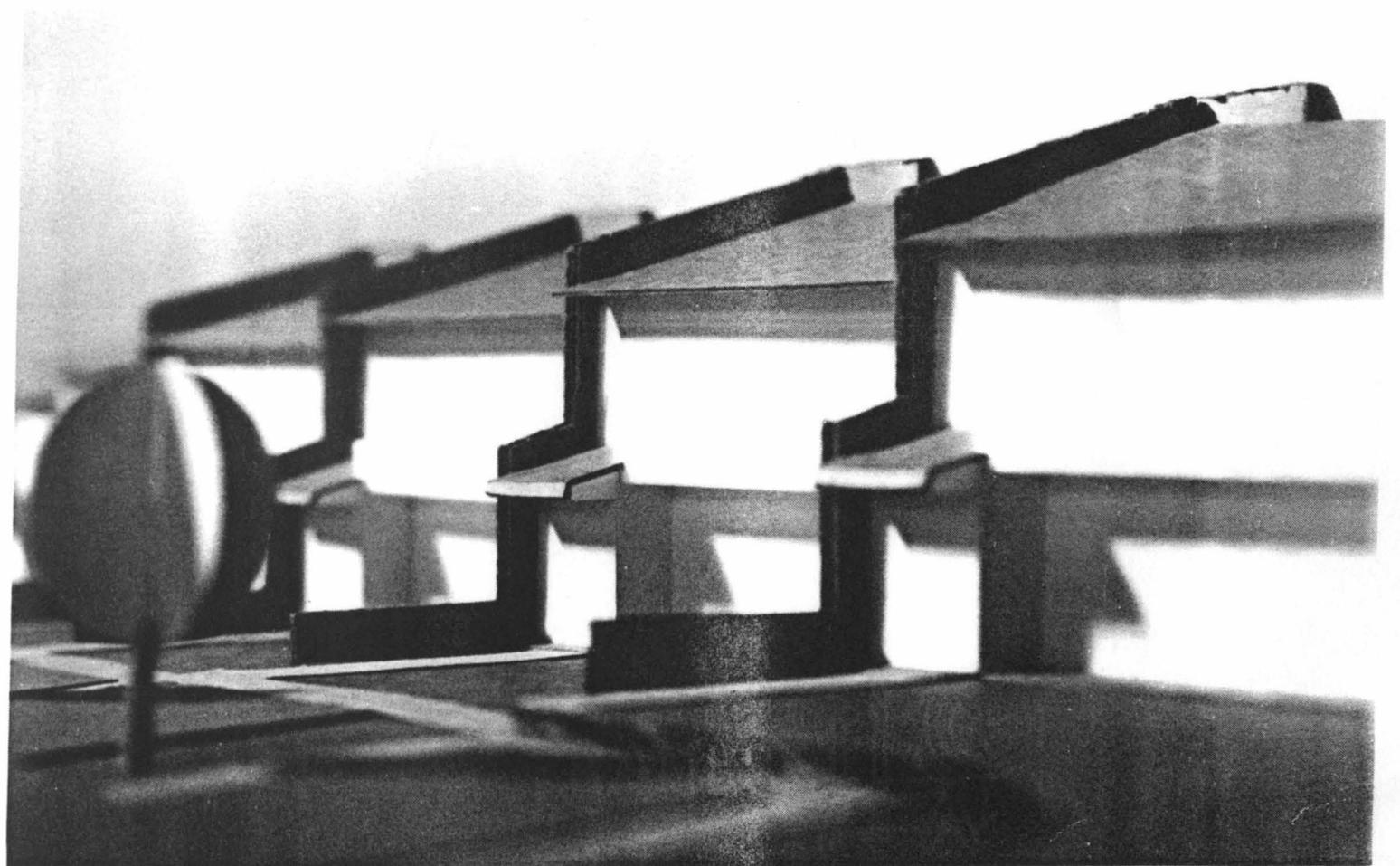
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The home of the American dream has traditionally been a single-family detached house with ample yard space for scenic vistas in all directions. This dream has its roots in the historical expansion across the woods and plains of this country where there has always been room for everyone to have their own piece of land. Frank Lloyd Wright's plan for Broadacre City is the most extensive architectural plan to embody this idea. Since that time we have become more aware of the environmental impact that such a plan and its accompanying energy demand would have on the land.

The combination of land scarcity and restrictive zoning has placed a premium on land and has inflated values in many areas where demand is high. Unexpectedly, in the 1970s, we seem no longer to have enough to realize the American dream of a lot and a home for every middle class family.

One reaction of the single-family homebuilder is to move further out into the countryside where land is cheaper and zoning less restrictive to provide housing affordable to the middle of the market. The environmental damage and public cost incurred by the resultant construction of roads, bridges, sewer and water systems, shopping centers and schools has been decried by many. (Nolan and Dickinson, 1990)

With row houses land use is reduced by the elimination of the side yard. This reduces construction costs by using a shared wall, which in turn reduces heat loss. The resulting higher density of land use then reduces the needed infrastructure and lessens the environmental impact.



In the search for a housing style for the future of the United States it is important to be aware of what has gone before. A knowledge of the evolution of the house in America, even if it is not drawn on directly, is necessary to understand what is thought of as a house in this society. The roots of American housing go back mainly to European soils, which, in turn, grew from Roman, Greek and Mesopotamian cultures.

The Sumerian city of Ur is an excellent example of what occurred in most cities during the early period of urbanization. One of the first events in the life of the city was the construction of a wall to enclose the city for protection from invaders. Then, as stated by Spiro Kostof,

Once walled, the land became precious, and the high value of private property kept public space to a minimum. The houses were grouped into congested blocks, where party walls were common. (Kostof, 1985)(fig. 1)

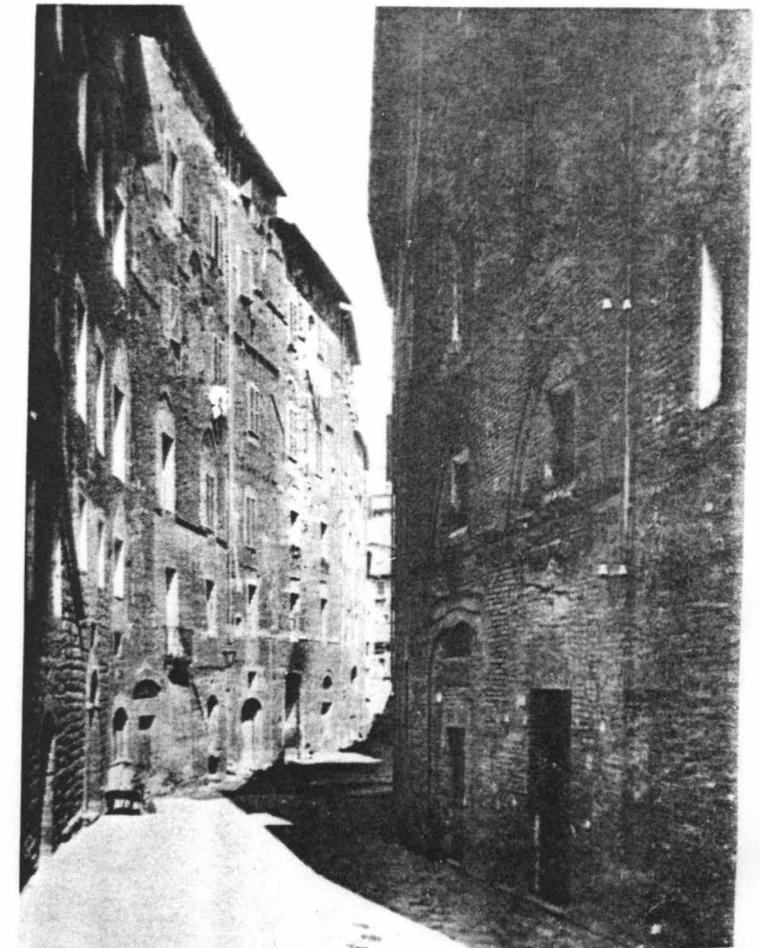
The common wall not only reduces the space needed for house construction, but also reduces the need for building materials.

Both Greek and Roman houses were turned inward, as were those of Mesopotamia, offering little more than a blank wall to the street. They were courtyard houses, with the main design emphasis being concentrated on the inner courtyard. With the center of the home being open, the exterior walls had no need for openings other than the entrances, allowing for the use of a common wall. By Medieval times houses had acquired some decoration on the outside. They had also continued to grow up since they could not spread out.(fig. 2)



Fig. 1

Fig. 2



The construction of the row house reached its zenith in England, where by the early twentieth century it was the predominant housing type.

The vast majority of English houses were built in one sort of row or another, houses of all sizes and in all price ranges. (Muthesius, 1982)

The row house at its simplest form was a small modest home where the poor working family lived. Homes were often joined on three sides with the front opening onto a street too small for a horse and carriage. On the other end of the scale the row houses became quite impressive, with rows approaching the grandeur of the country estates belonging to the wealthy.

A row has an architectural unity which provides a heightened social image and which speaks of a special achievement on the part of those who planned and built it and those who bought or rented it. (Muthesius, 1982)

In the United States there were very few row houses before 1900, and those were only in the larger cities.

By the early decades of the nineteenth century, they had shaped many square miles of Philadelphia, with a peculiarly intimate and loving scale (Scully, 1988).

Row houses were also common in Baltimore (fig.3), New York (fig. 4), and other larger eastern cities. However, they seemed to have little impact on the average American house.

Modern housing is the result of an evolutionary process which is based on tradition and historical precedence. Although there have always been row houses in the United States, the popular ideal has long been the country house such as Mt. Vernon or Monticello. There is still the desire for the agrarian home in the country, but the costs of transportation and land have begun to rule out this possibility for many home buyers.

Modern row houses do not have the plain, unadorned front facade of the houses common to Baltimore or Philadelphia. They are now more articulated, with style and detail rivalling the homes of the suburbs. Row houses are becoming more popular in the United States now because of their lower initial cost, and also because their lower maintenance requirements fit in better with current lifestyles of society.



Fig. 3

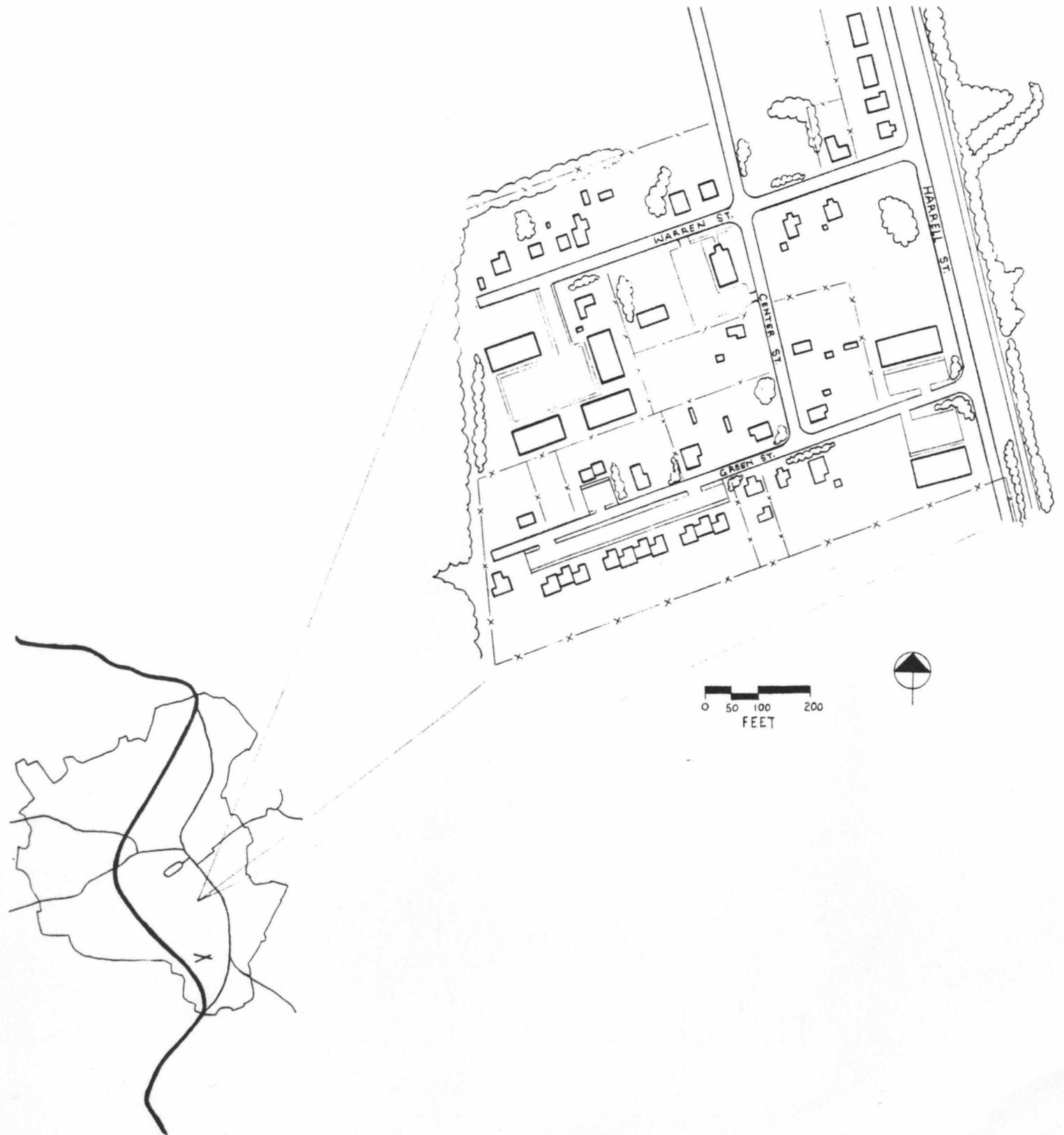


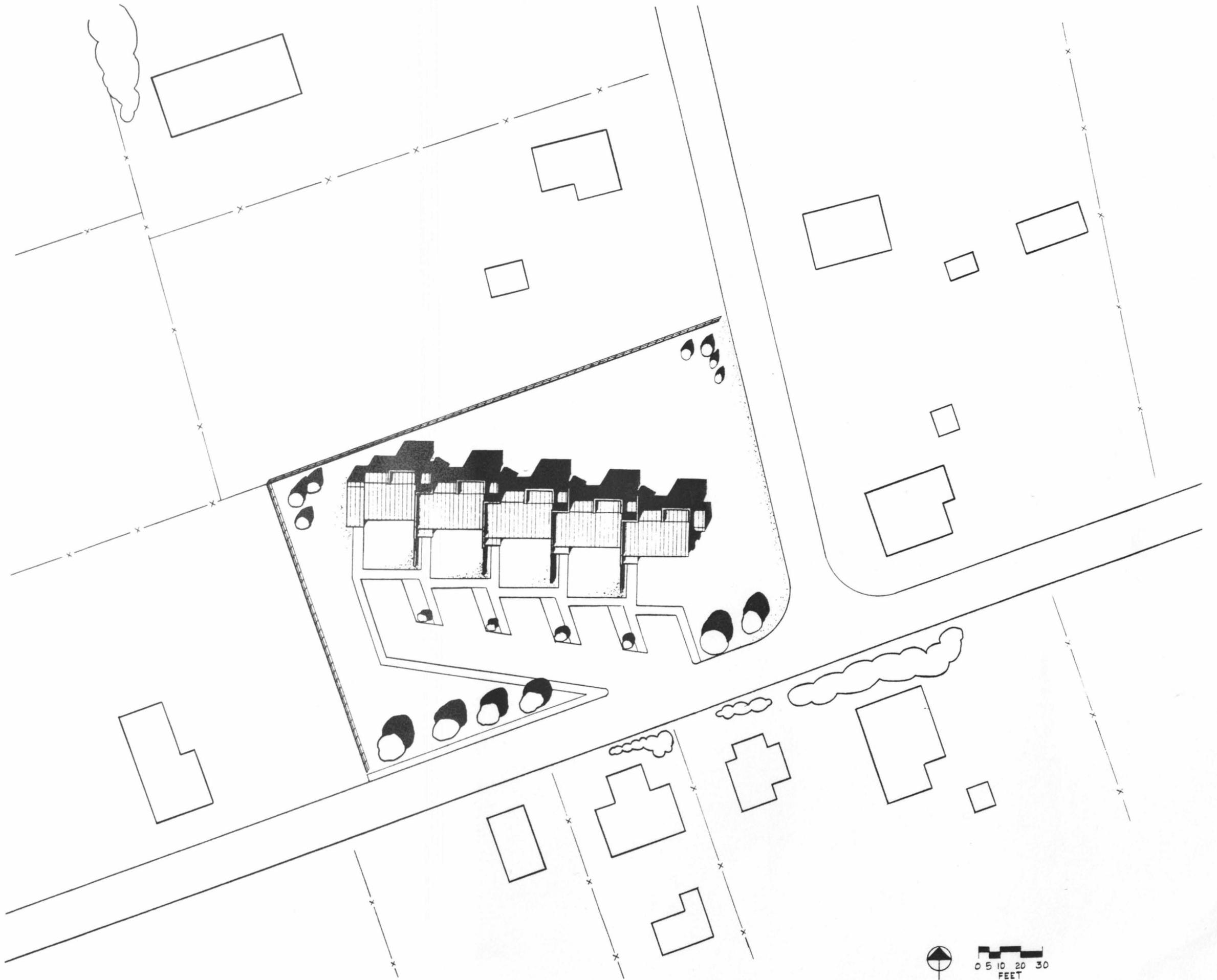
Fig. 4

The Site

The site for this project is located in Blacksburg, Virginia in a neighborhood a few blocks south of the Virginia Tech campus. To the east is a jogging path, to the west is a wooded area and to the south are the maintenance shops for the campus. Most of the houses in the area are older and of stud wall construction. There are some newer structures in the neighborhood, mostly apartment buildings, with some row houses across the street.

The lot is on the northwest corner of the intersection of Green Street and Center Street. There is a gentle slope to the northwest, away from the intersection. The lot is currently occupied by two houses.



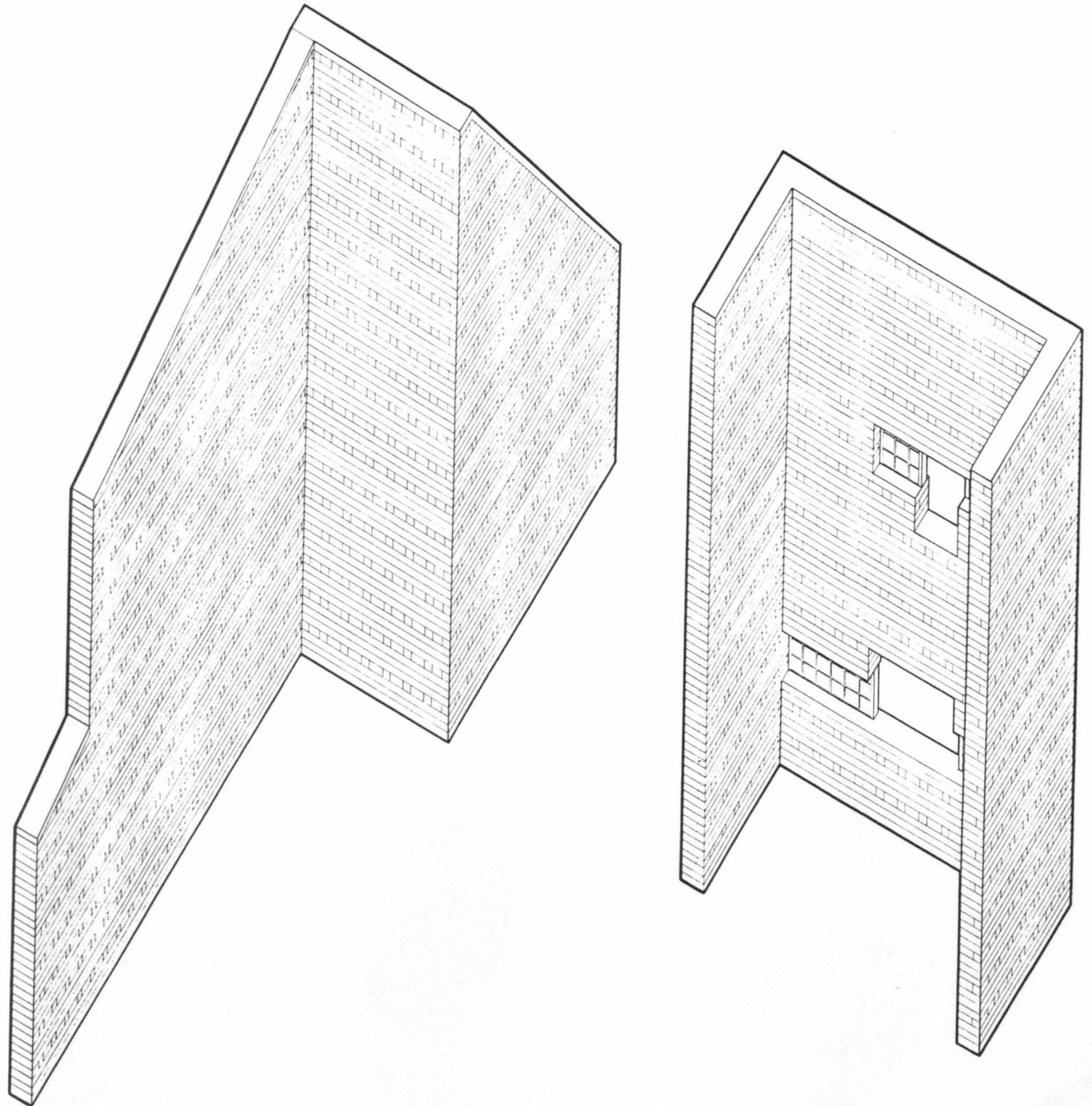


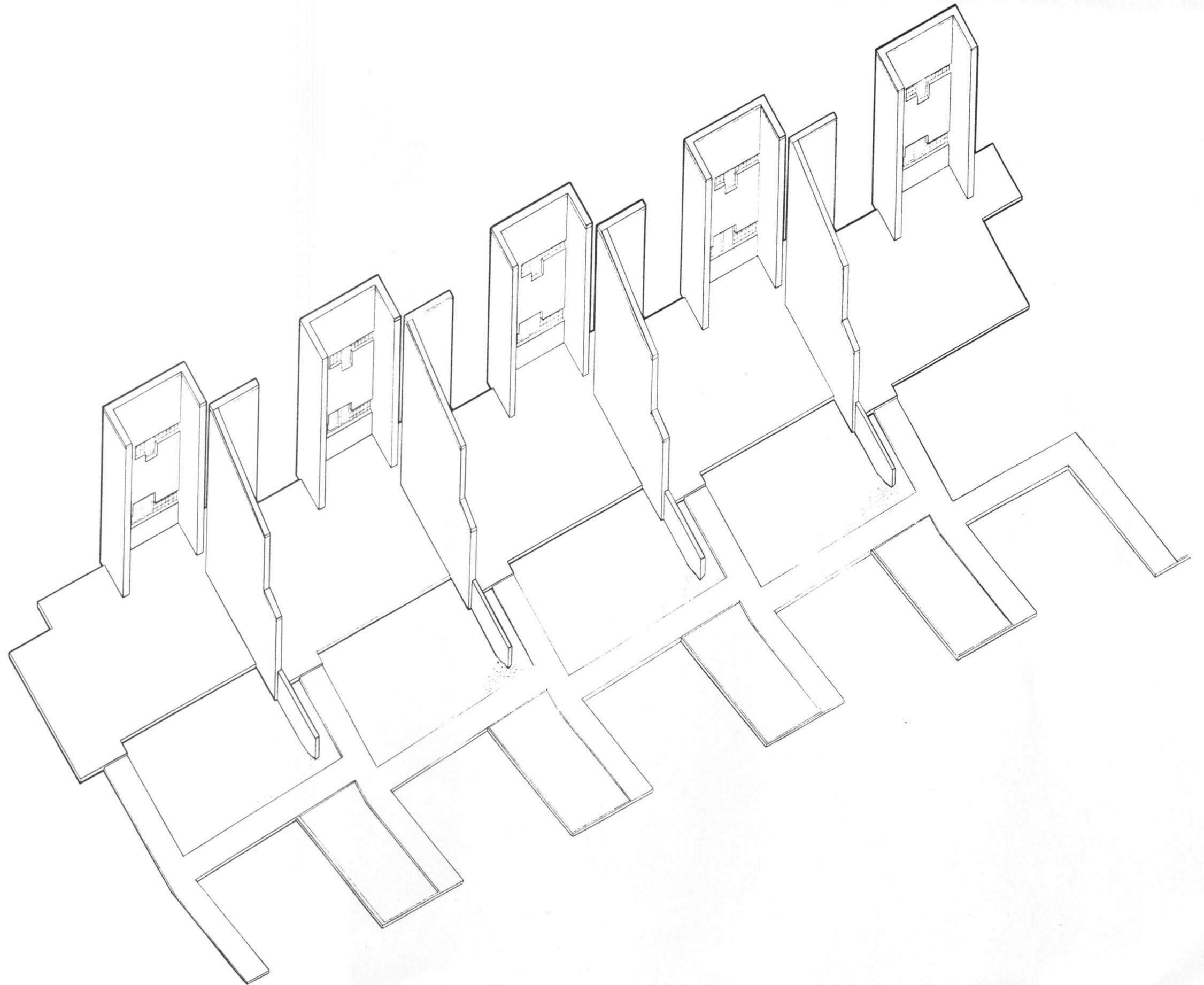
With the elimination of the side yard the land that separated the houses must be replaced to provide a psychological distance between neighbors. A wall constructed of masonry gives the necessary psychological separation and also provides a structural separation. Since it is formed out of the earth, the wall can stand in for the open land that it is replacing. When the wall is extended beyond the enclosed limits of the house it then gives a visual separation between the units. The directional emphasis created by the wall can then compensate for the loss of vista to the sides.

The brick wall is a symbol of the permanence of the site and contrasts with the stud wall infill and glazing of the walls within the units. The brick wall that surrounds the service core offers a high level of protection necessary for this private area. Also, on the first floor, the kitchen is within this core to offer the stability and center of life in the house that has in the past been supplied by the hearth, which is also of the earth.

The wall is a cavity wall construction using a utility size brick to give a greater scale than that of a standard brick. An English Garden Wall bond is used, which uses three Running bond courses with a Flemish Header course, adding another level to the scale of the wall.

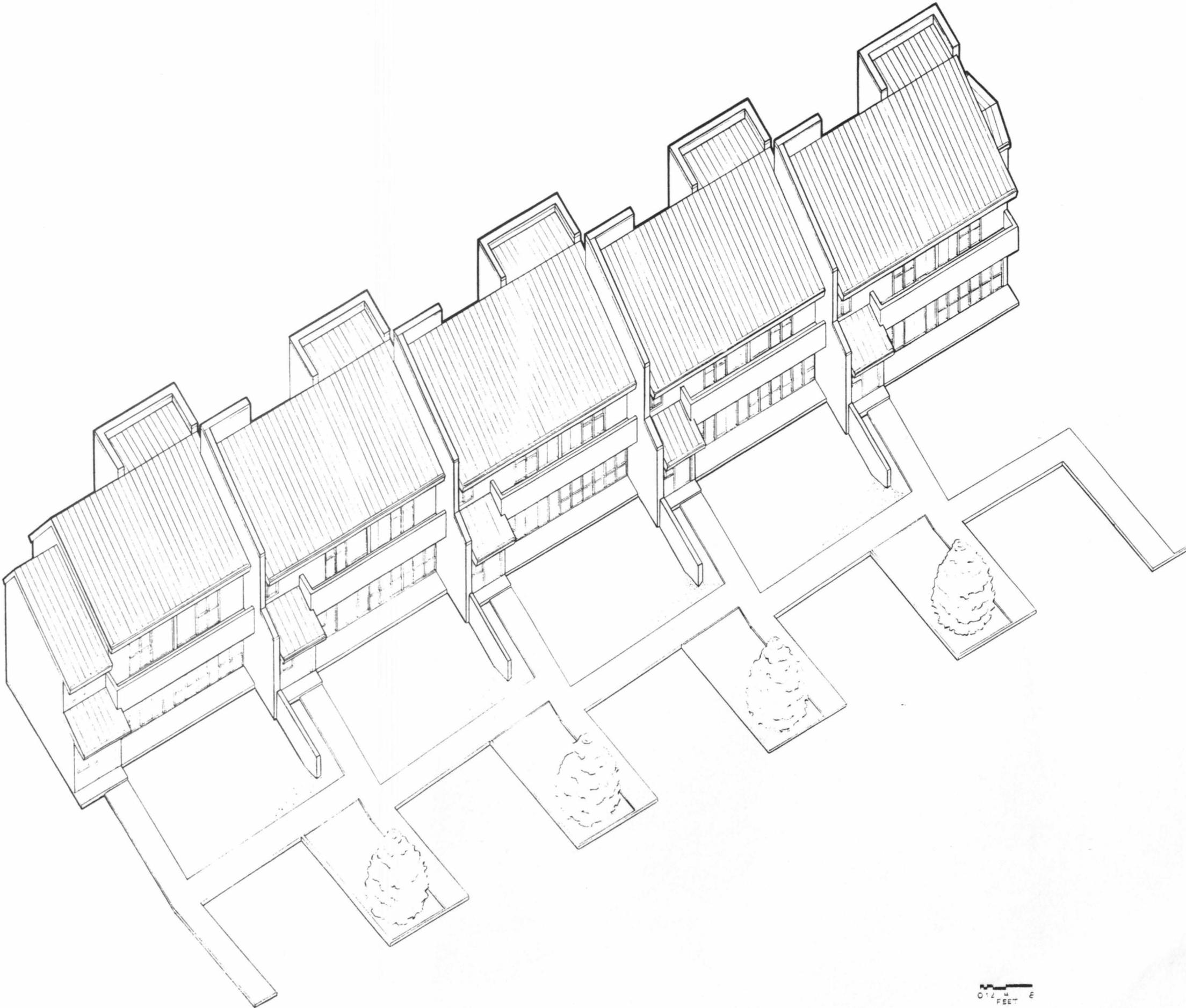
There are two purposes for the jog, or bend, in the wall. While the wall separates the units, the jog ties them together. When a person comes through the front door there is a choice of whether to go up the stairs, between two walls, or to go forward into the open space beside the stairway. Now the second function of the jog becomes apparent: the wall forces a change in direction into the living space where the brick wall on the other side of the room can be seen. Caught between these two massive walls, a person's consciousness is then drawn to the open wall facing south and the freedom of the outside.





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The Building

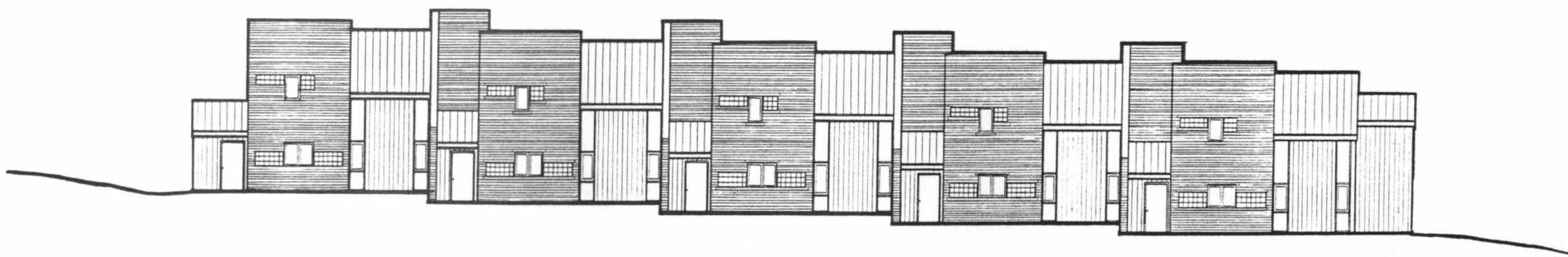


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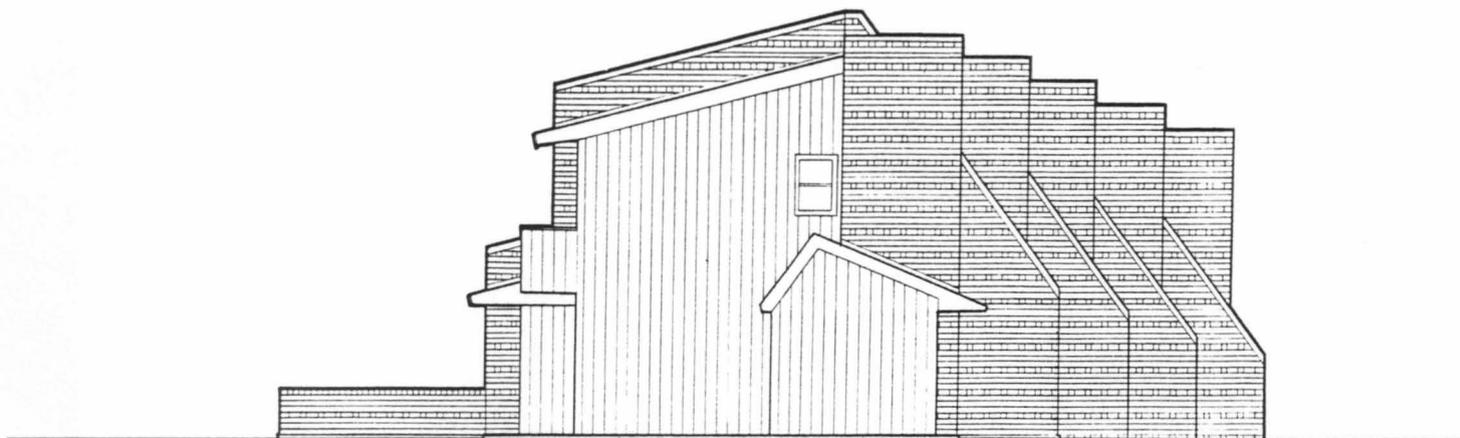
South Elevation



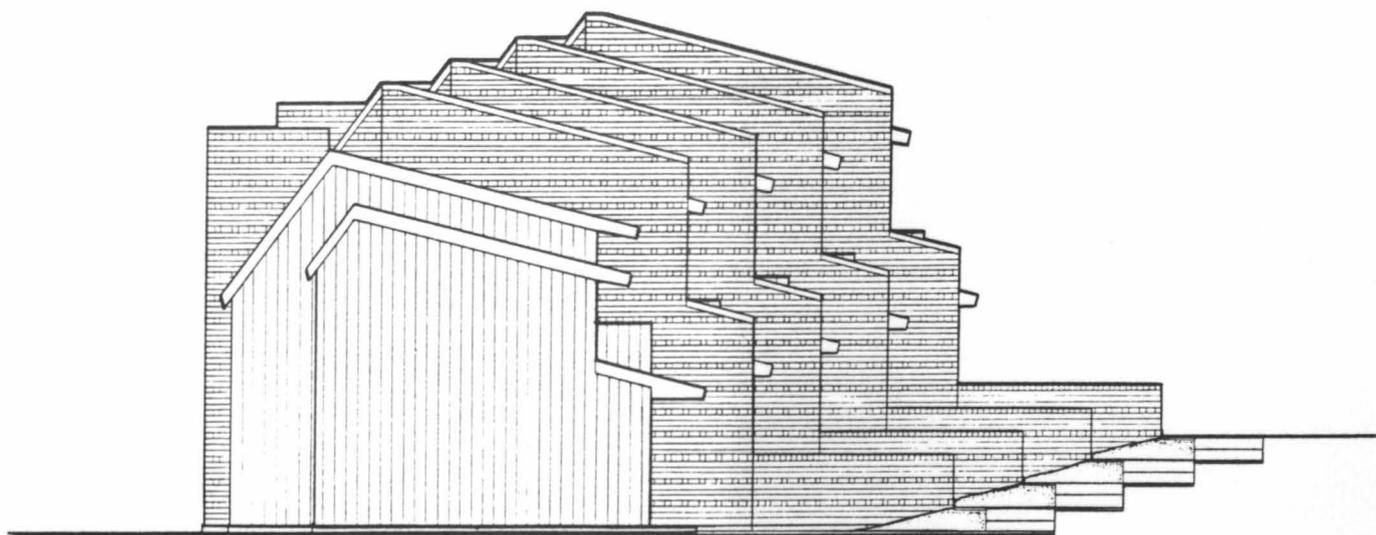


North Elevation



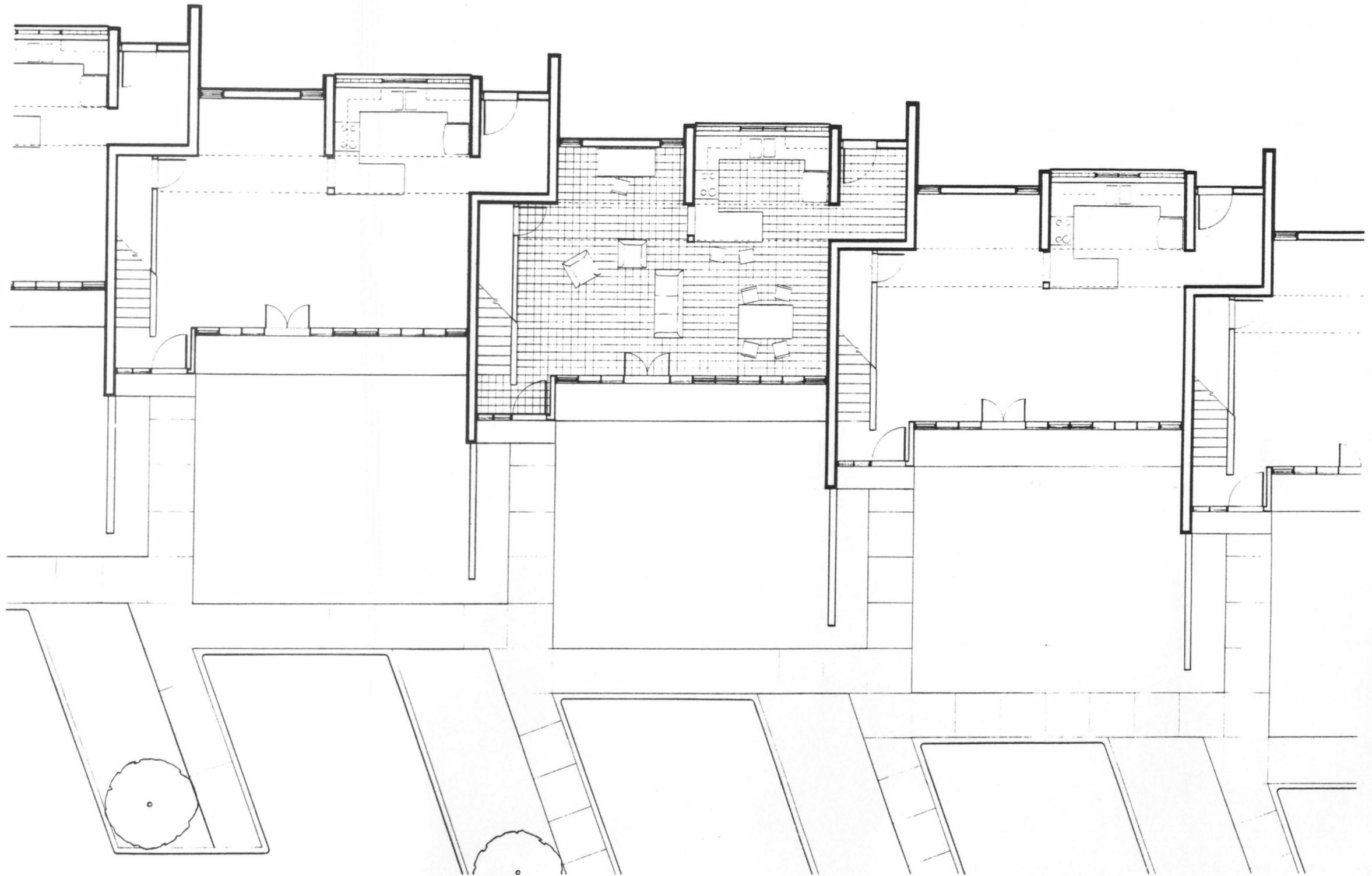


East Elevation



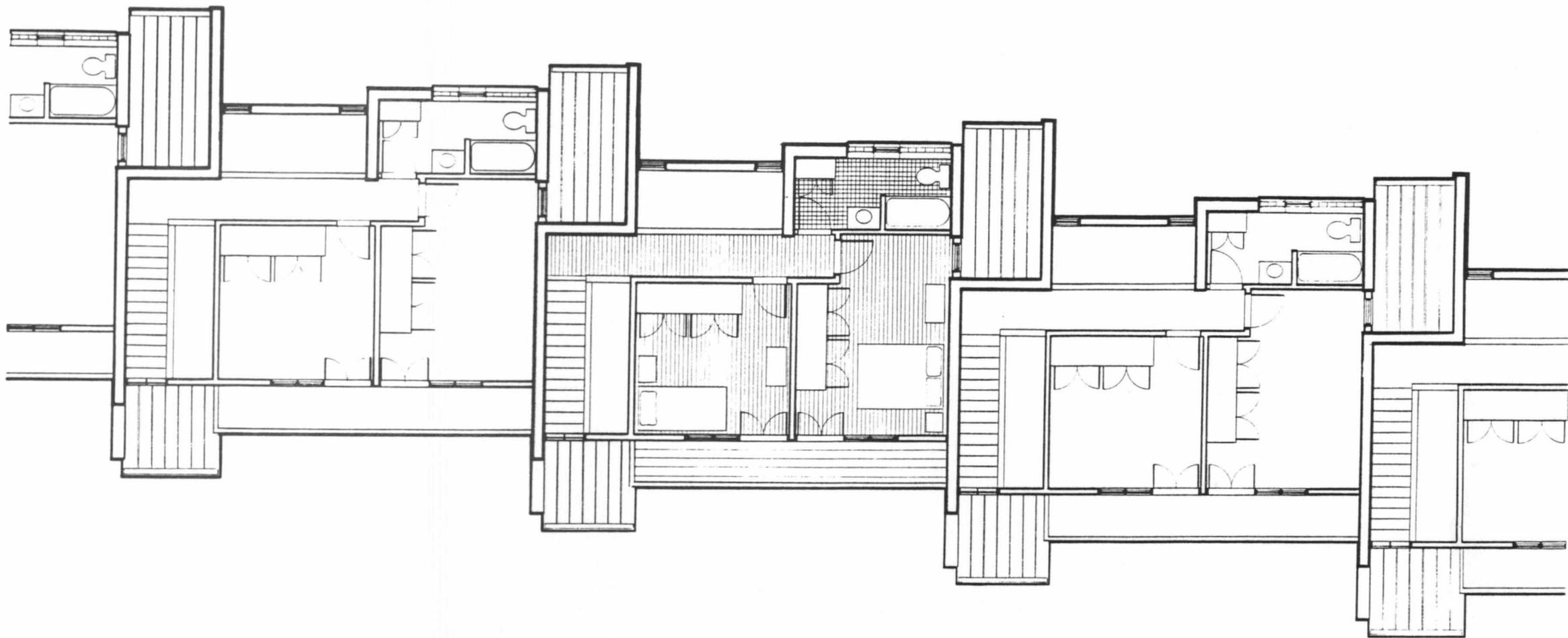
West Elevation



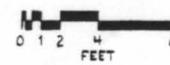


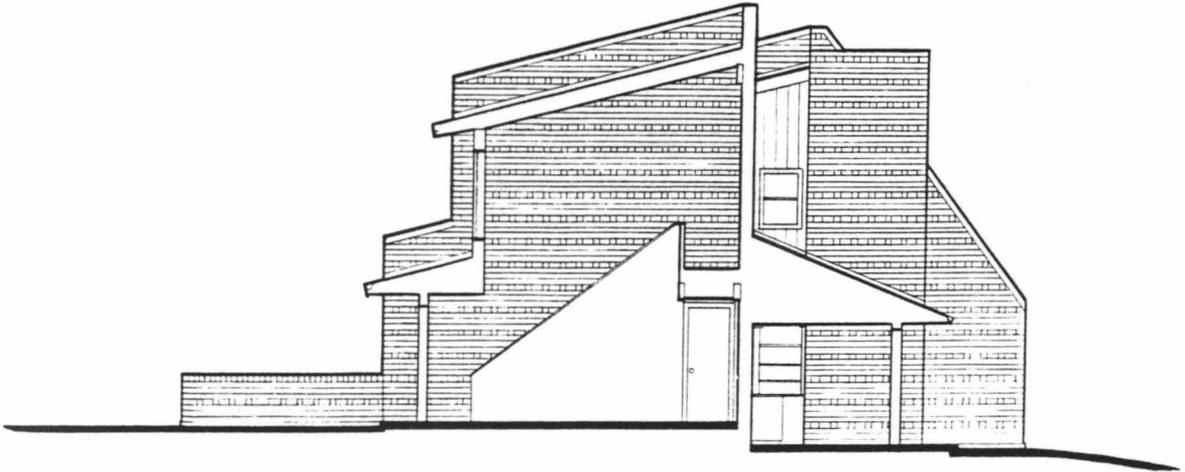
First Floor Plan



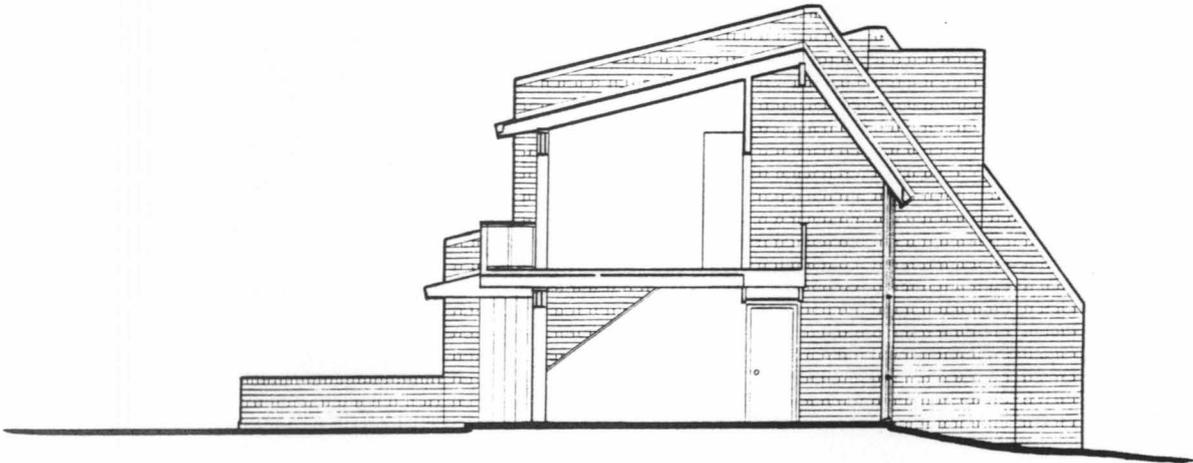


Second Floor Plan





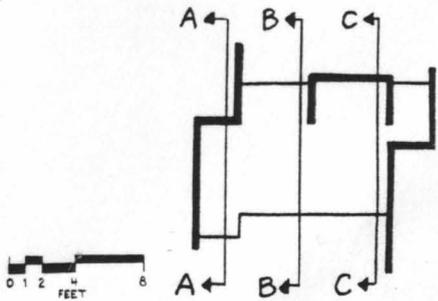
Section A-A

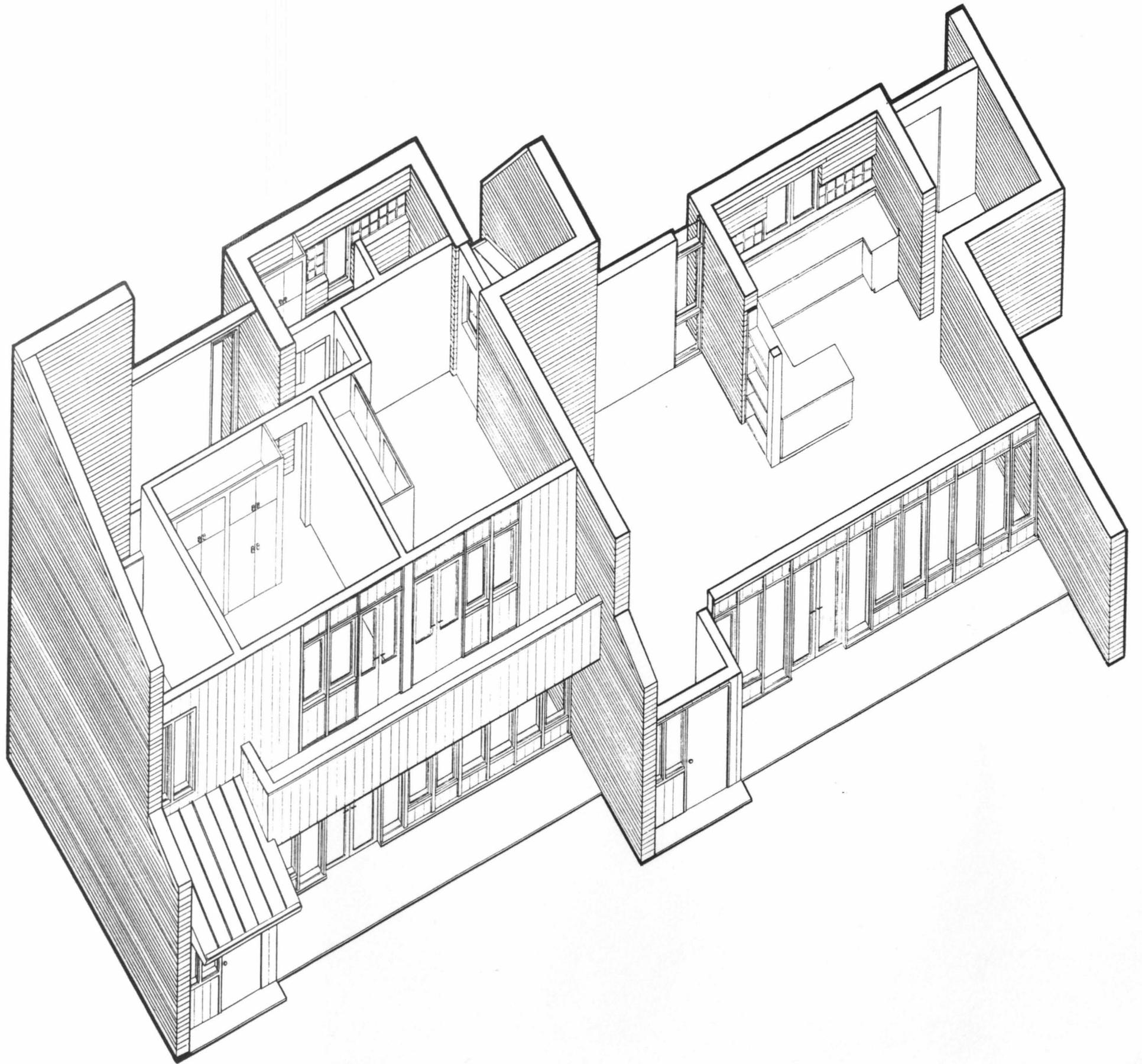


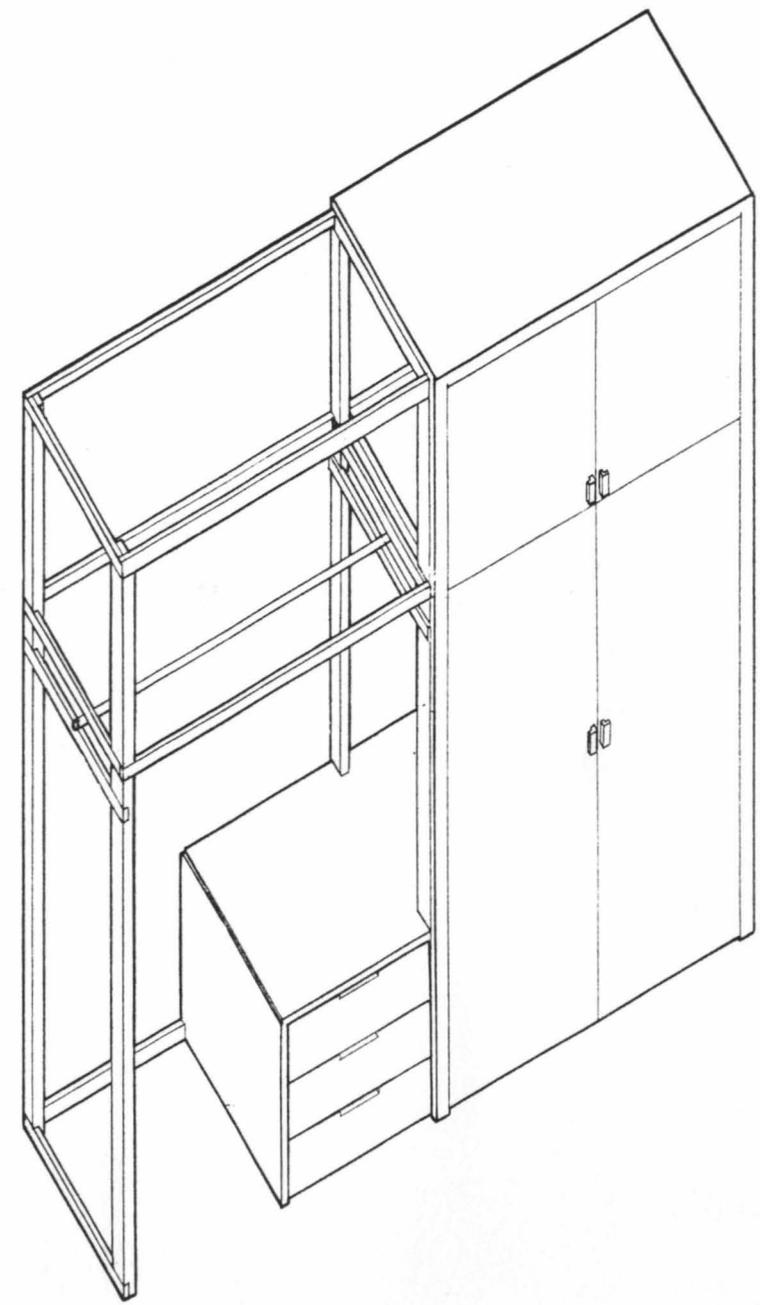
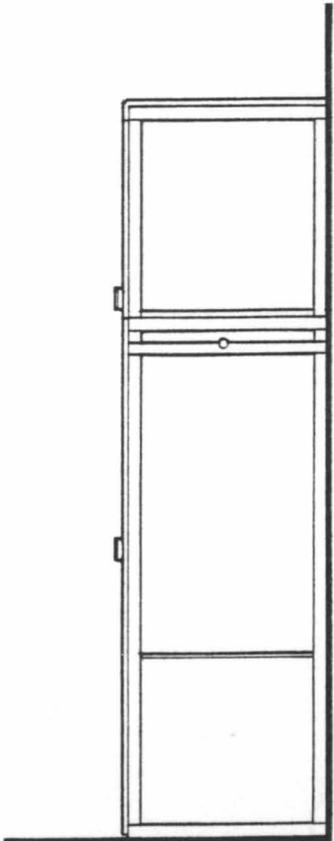
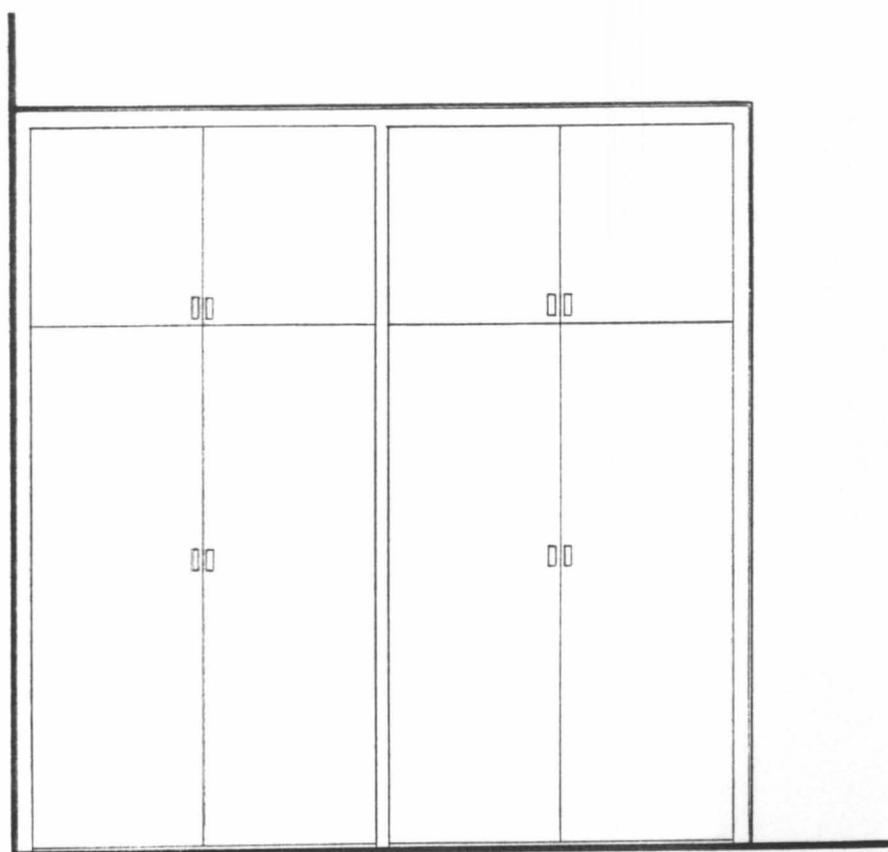
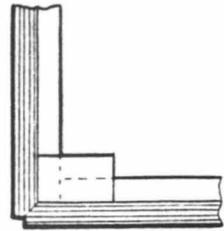
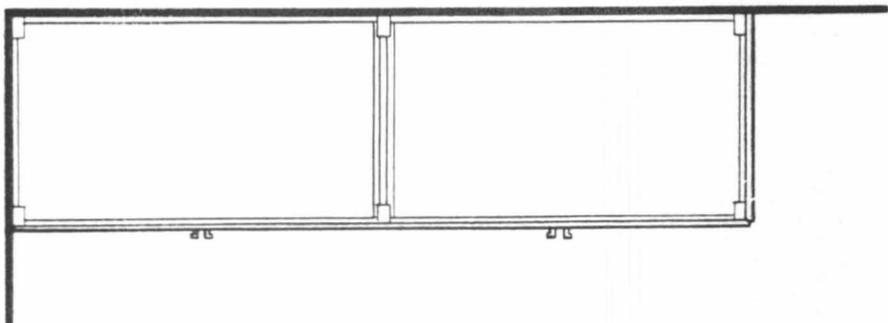
Section B-B



Section C-C







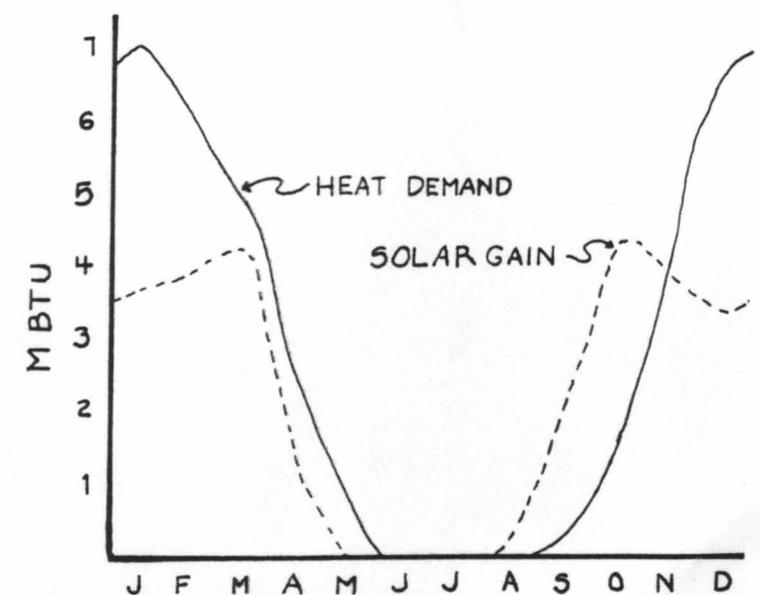
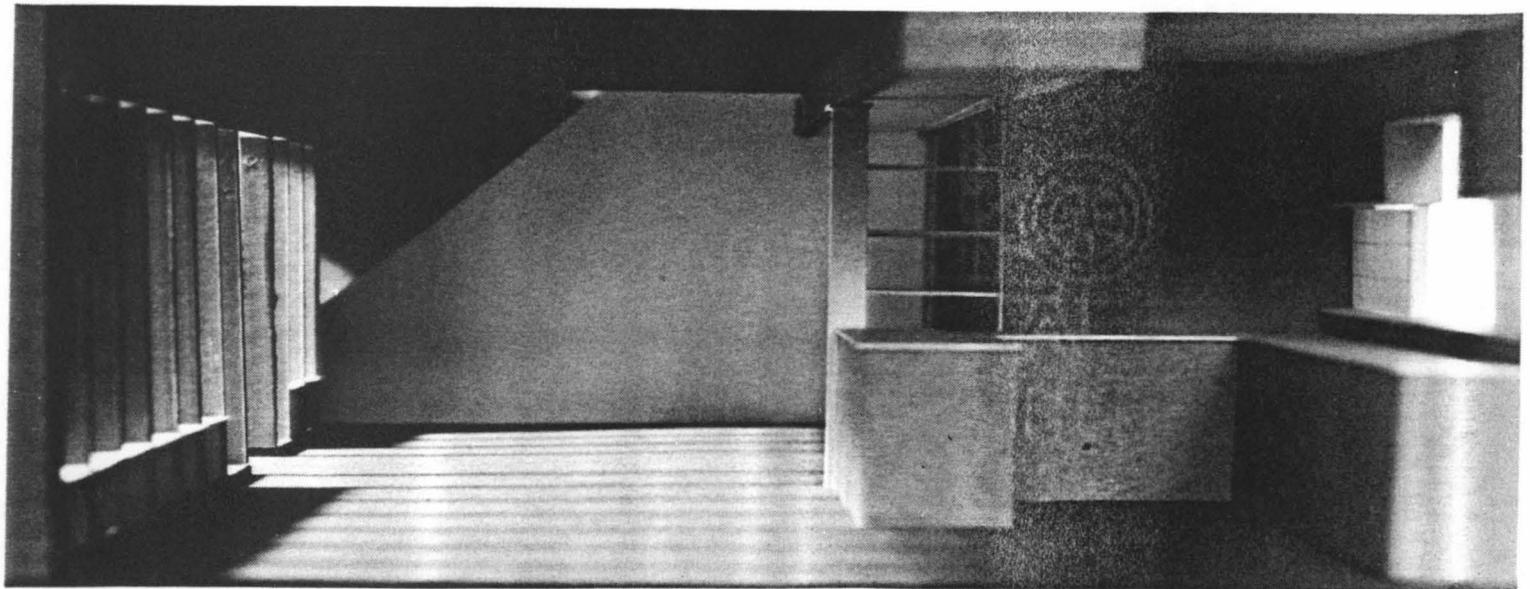
Closets

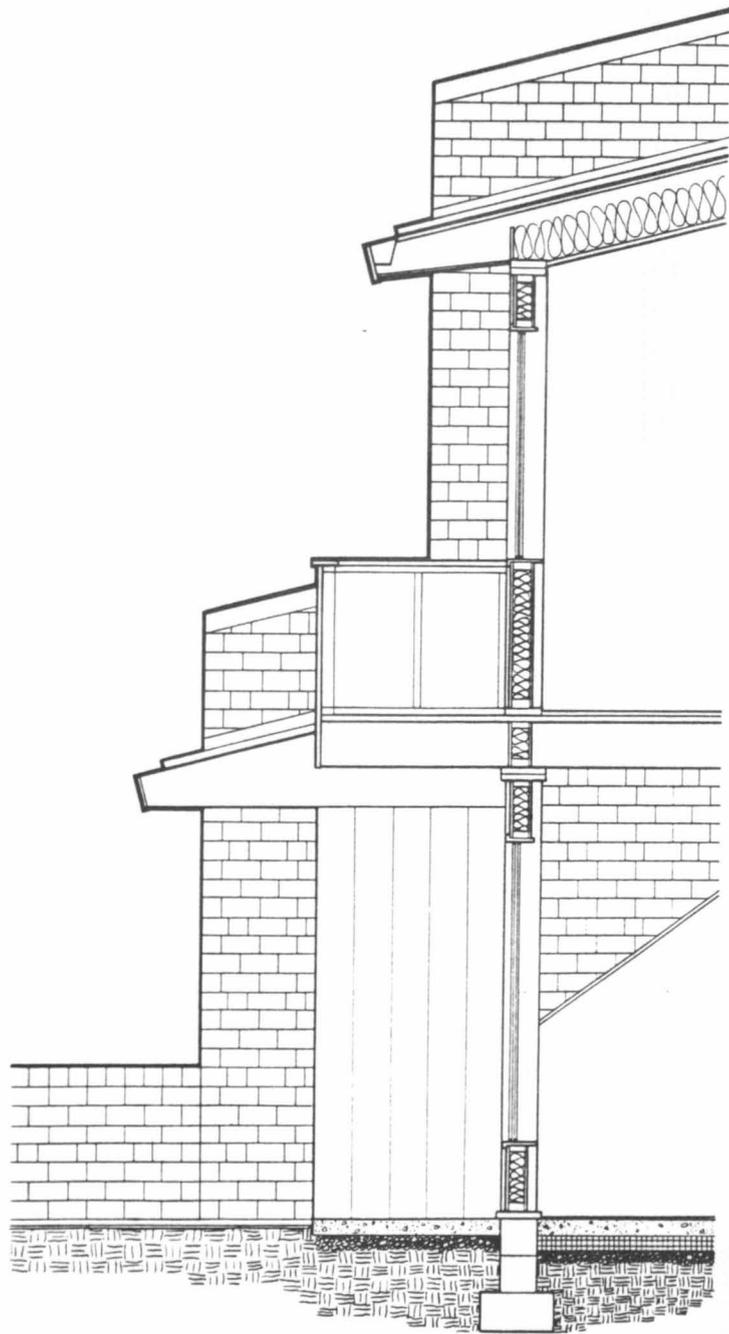
From the beginning the use of solar energy has been an intrinsic part of this project. Although it is very important it was not intended to be used as a tool to generate a design. However, the passive solar requirements were used to modify the design after other criteria had been satisfied.

The building was designed to have a low energy demand for both summer cooling and winter heating. The roof overhang and the balcony act as shades to control summer heat gain. Most of the windows are operable to admit any breeze to help cool the space. The elimination of windows on the east and west also reduce heat gain during the summer.

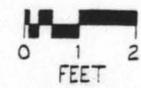
To maximize heat gain during the winter the building is oriented with an east-west axis to give a maximum amount of wall a southern exposure. This south wall has a large amount of glazing to admit the winter sunshine. The floor on the first floor is a concrete slab with a quarry tile covering which acts as a heat sink, absorbing the solar energy as it enters the space and releasing it after the sun goes down. The stepping back of the units minimize the shadows falling on the south wall in the afternoon, which helps to increase the solar gain in the winter. Solar gain is dependent on the glazing area, window overhangs, the position of the sun and the amount of global radiation incident upon the site.

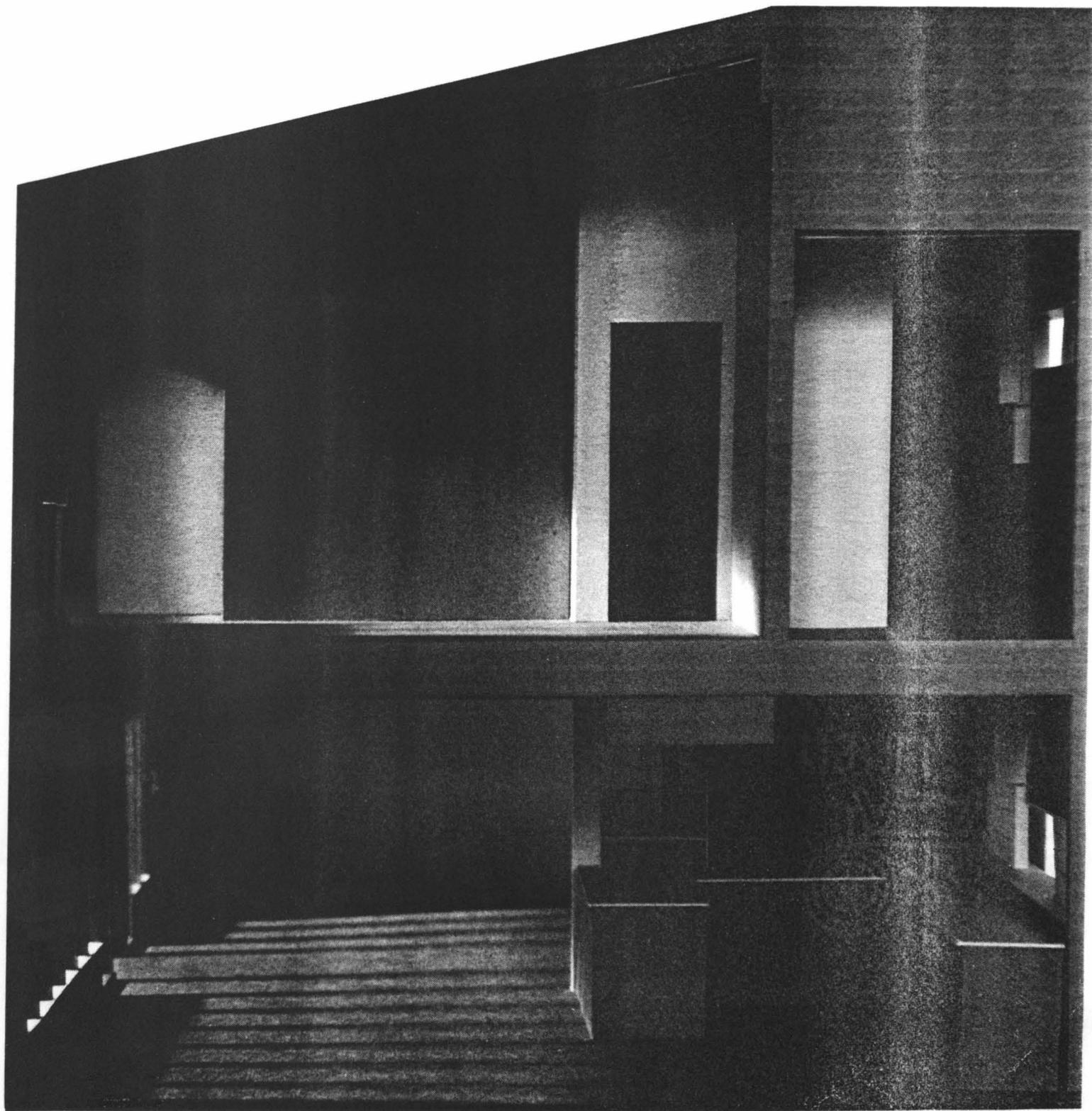
The R values for the building components range from an R-32 for the ceiling to an R-13 for the south wall where there is no glazing. The north stud wall and the brick wall both have an R value of 21. When the heat loss for the building is computed the building loss coefficient (BLC) is 7911 Btu/°F-day. With an annual average of 4301 degree days this gives an annual heating demand of 34MBtu's. Over half of this amount, when monthly percentages are averaged, can be gained through solar means, with many months obtaining all the heat naturally, as shown in the graph.

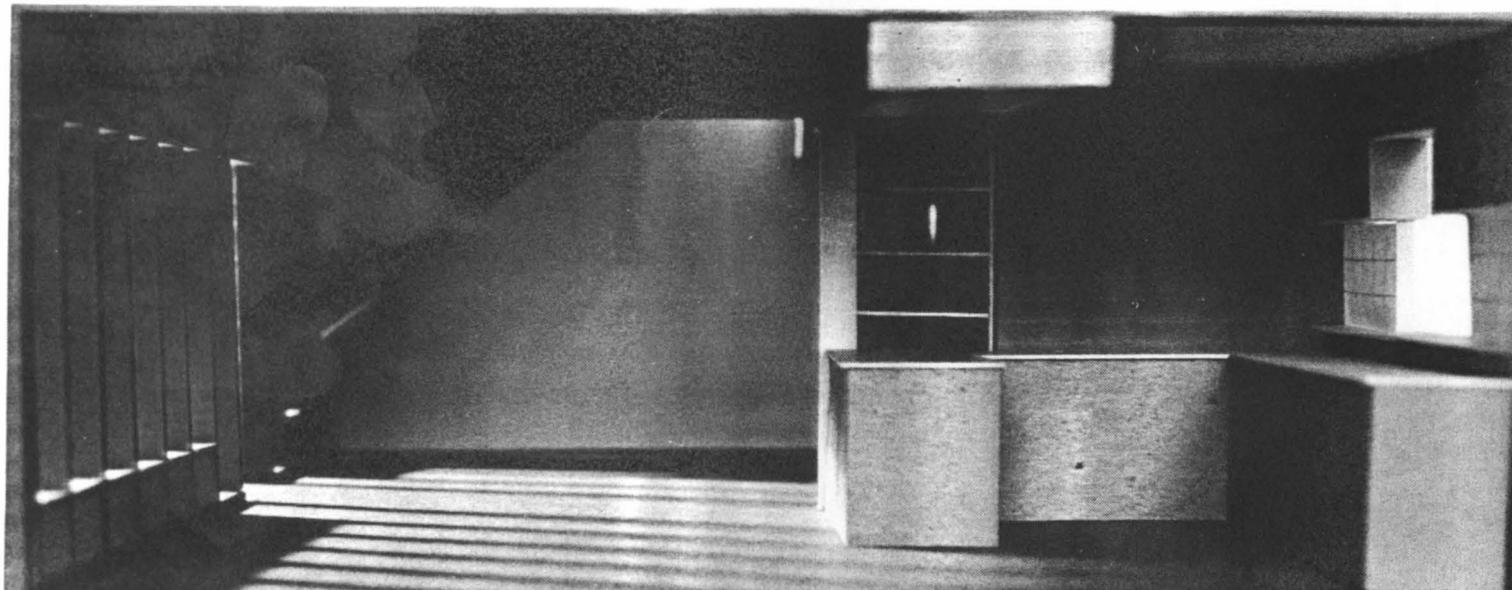




South Wall







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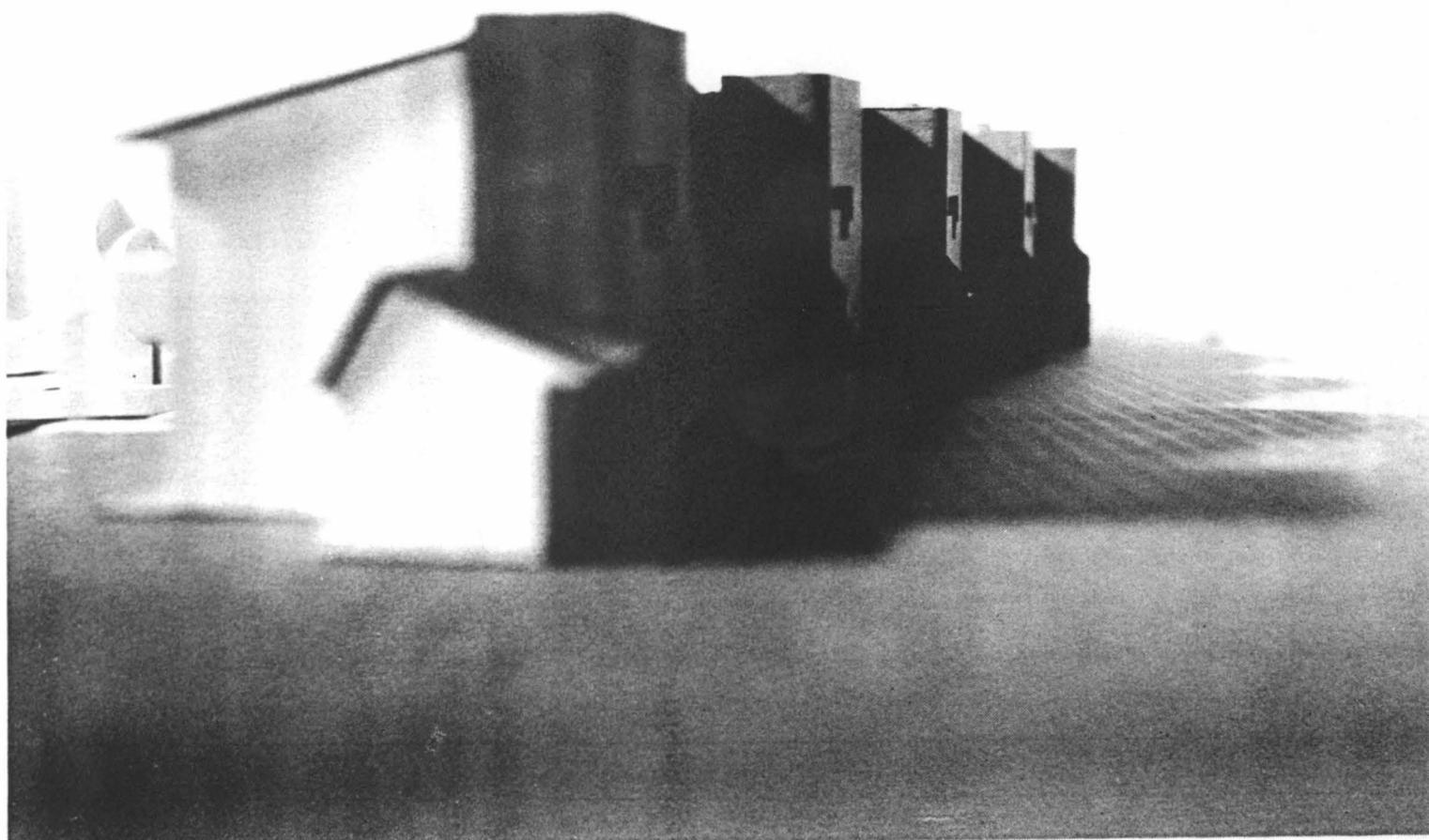
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Fig. 1 and Fig. 2; Kostof, 1985
Fig. 3 and Fig. 4; Scully, 1988



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