

HOUSES BEHIND HOUSES



TESTING THE SPATIAL POTENTIAL OF A SUBURBAN BLOCK


by Denise M. Garcia
B.A. in Art
University of Massachusetts, Boston, 1980

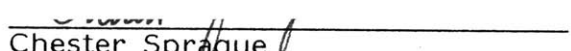
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ABSTRACT

HOUSES BEHIND HOUSES:
Testing the Spatial Potential of
a Suburban Block

Denise M. Garcia

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This thesis utilizes an approach outlined in "Consolidation: A Method for Expanding the Use of Single-Family Housing in the Suburbs" (Sprague and Vernez-Moudon, 1981). The authors suggest that existing suburban neighborhoods can be reused creatively to provide new residential units without jeopardizing the environmental qualities that make suburban living desirable.

Consolidation refers to an increase in unit density in an architectural manner.

Using the three generic forms of consolidation, increases in density are projected onto a study block in Newton, Massachusetts, and then evaluated to determine the degree of visual and physical impact to the existing neighborhood environment. Using criteria developed from observation and documentation, the most disruptive example is then redesigned, to assess the ability of the criteria to preserve the quality of the neighborhood while allowing for consolidation to occur.

Thesis Supervisor:


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Laura

and Eric.

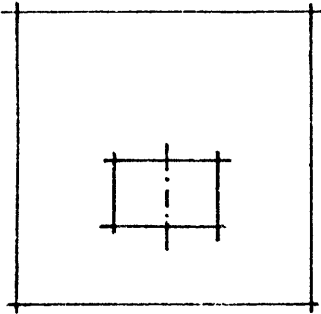
Para Papá.

INTRODUCTION

At this time, changes in economic, environmental and social conditions in the United States have resulted in specific housing needs that are not being met adequately by the current supply of residential units. The cost of new construction and investment money have made home ownership prohibitive to an increasing number of households who traditionally have had no trouble purchasing a home. Standard tract housing requires expenditures for new land, roads and utilities which add to the sale price of residential properties and use up scarce agricultural land. Furthermore, there has been a decline in the number of large, nuclear families typically interested in this form of housing and a subsequent increase in the number of smaller, varied household groups that desire cheaper, more efficient units requiring less maintenance. Consolidation addresses and solves these needs by creating more and new types of dwelling units that:

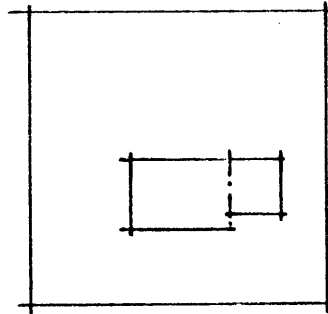
1. do not require capital for new roads, land or utilities;
2. do not use up valuable or scarce land; and
3. respond to a changing resident population.

(1)



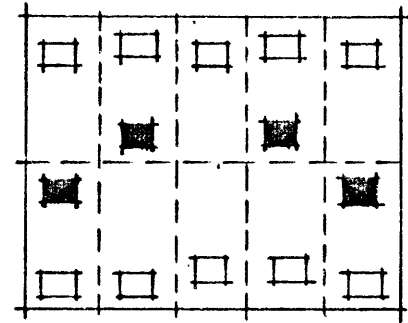
Internal
Subdivision

(2)



Addition

(3)



New Units

As mentioned, the term "consolidation" refers to unit density. It implies an increase in the number of residential units in a given area or within a given structure, although it does not necessarily imply a corresponding increase in building volume or resident population. For example, a nine-room house can be consolidated into four one-bedroom units. The original four-person household is replaced by four unrelated persons. Unit density has increased by three hundred percent, but the resident population has remained the same. In fact, of the three approaches illustrated by the authors for achieving consolidation, two involve little or no increase in unit volume.

The first two approaches involve the internal division of and/or addition to, existing dwellings and relies on the ability of suburban housing stock to be subdividable. The third approach relies on the ability of suburban lots to accommodate new dwelling units. Both scales of development are investigated in this thesis.

Precedents in consolidation already exist throughout the country, almost always stimulated by resident demand.

Many times these consolidated units appear illegally in areas zoned strictly for single-family use. Storage, office or garage space is converted into living quarters for a teenager or relative. When this member moves, the unit may then be rented. Evidence shows this form of consolidation to be popular. A report issued by the Tri-State Regional Planning Commission in New York reveals:

"...the extent of conversions is widespread and touches every type of community--large, small; suburban, exurban; old, young; wealthy and not-so-wealthy."

In fact, many cities and towns have, or are in the process of revising or amending their zoning to allow for these so-called "mother-in-law" apartments. Many communities are also allowing historically significant houses to be subdivided as a vehicle for rehabilitating and preserving the quality of their older housing stock. These large dwellings may be oversized and inefficient as single units for the majority of households purchasing homes. Subdivision may be the only way to preserve some of these "white elephants."

In general, consolidation tends to preserve the quality of existing neighborhoods by promoting the reuse and rehabilitation of existing land and housing stock. On the other hand, any increase in unit density will no doubt affect the character of single-family neighborhoods. Communities fear possible negative impacts of increased densities, including:

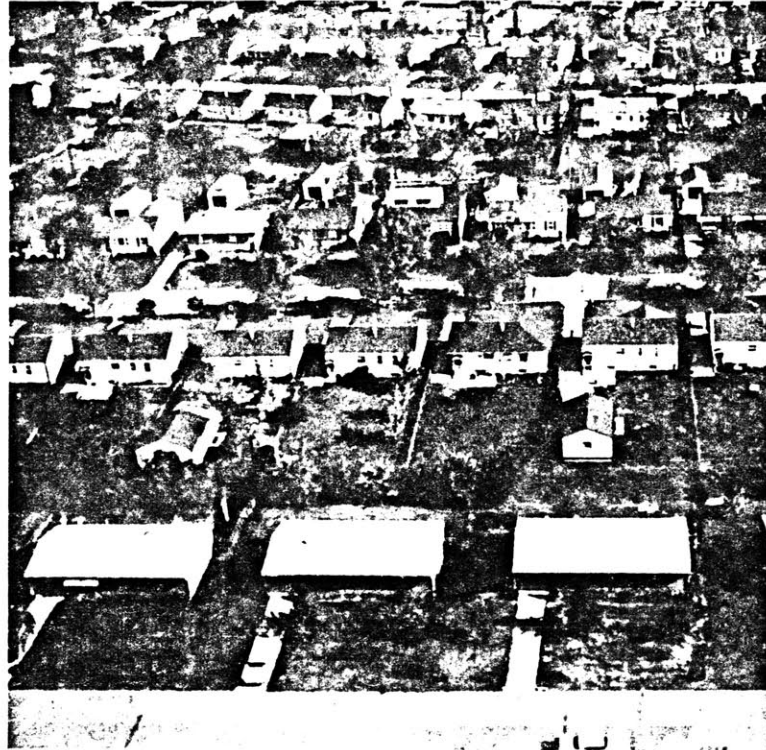
1. Changes in the physical/architectural character of the neighborhood
2. Increased traffic and parking problems
3. Building code violations
4. Absentee landlords
5. Overloaded utilities.

This thesis will address the first two concerns. Unlike the others, these are possible physical and visual manifestations of increased unit densities and, as such, are the most obvious signs of the success or failure of consolidation to preserve neighborhood character. While important, the other issues are quantitative in nature and can easily be controlled through regulation. For example,

allowing only owner-occupied properties to qualify for consolidation would reduce the likelihood of absentee landlords. Similarly, by putting a ceiling on the number of properties that are allowed to consolidate, utility capacities can be protected, especially since resident populations may not actually increase through consolidation. But how does one preserve the sense of openness, privacy and autonomy of suburban environments that seems to be at the root of their popularity? And at what point are these jeopardized by increases in density? To address these issues, the thesis exercise will:

1. Identify important environmental qualities of suburban neighborhoods in general, and the study block in particular;
2. Explore the spatial capacity for consolidation of lots and dwellings;
3. Determine the range of physical and visual expression of particular densities; and
4. Establish and test qualitative criteria that allow for consolidation to occur and preserve positive environmental qualities.

OBSERVATIONS/DOCUMENTATION



Suburban Neighborhoods

Despite criticism leveled against them, the suburbs continue to be the most desirable residential environment:

"The American housing dream for 1983 is a... single-family detached...house...sited in a half-acre lot."²

There are many reasons - sociological, economical - why this is so, but the answer lies partially in the physical environment of suburban neighborhoods, some of the features of which include:

1. A semi-rural ambiance, resulting from sparse development of formerly agricultural or wooded land.
2. Uniform scale, due to the homogenous dispersal of dwellings of similar form.
3. A sense of individualism, manifested in detached structures with clearly articulated boundaries and entries.
4. A sense of privacy achieved by generous setbacks from the street and lot lines, a distinct public/private zoning system (Figure ___) and an abundance of vegetation.





5. Distant views to and beyond adjacent properties, where vegetation and topography permit.
6. A distinct indoor/outdoor relationship that allows direct access from units to private outdoor space at grade.
7. A particular distribution of cars, usually two to three clustered on paved areas adjacent to units and within the street setback, leaving the curb and the interior of blocks relatively free of cars.
8. Abundant daylighting and ventilating of units, due to units of limited depth that allow for double orientation of most interior spaces.

It is difficult to anticipate how consolidation might affect these and other features of suburban environments. One way to begin is to look at existing examples of consolidation and observe their ability or inability to preserve these qualities.

Examples of Consolidation



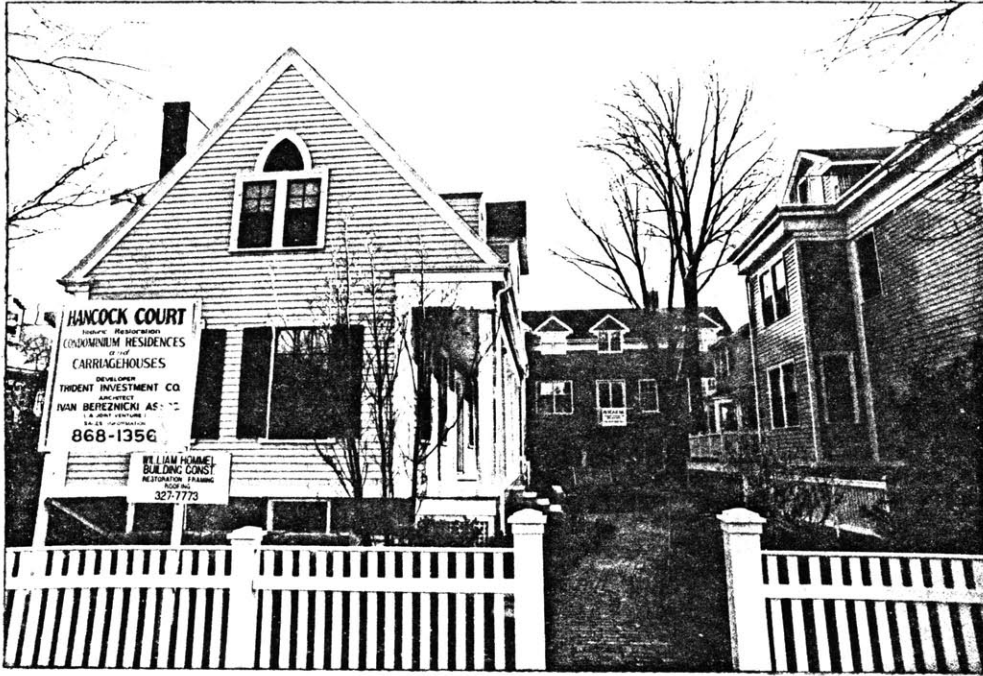
Cambridge, Ma.: A historically significant house in the process of being consolidated into several units. Little alteration of the facade is required, leaving no visible clue of an increase in unit density.



Cambridge, Ma.: The aggregation of two lots allows for consolidation in the form of four similar detached houses organized around common access. The use of gravel softens the visual impact of the accessway and parking, which can occupy a large and conspicuous portion of the lot.



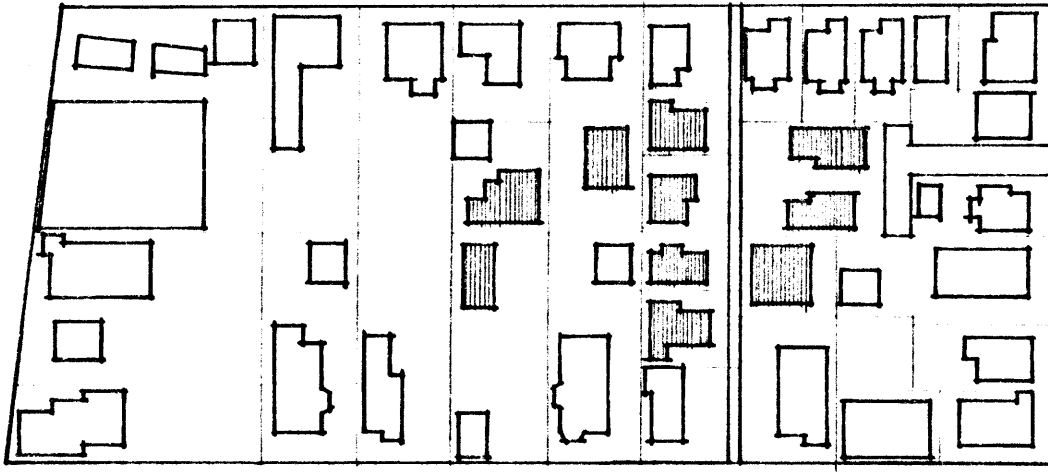
Cambridge, Ma.: A rear structure has been added to this lot. These houses are often smaller than the front structures and usually oriented to "face" the street. Boundaries between the two houses are clearly defined through the use of individual access paths and dense vegetation. The distance of the rear access path from the existing structure insures the privacy of interior spaces. Both the articulation of the facade and the materials used in the rear house complement the front structure and help to visually unify new construction with the existing fabric. The staggering of the structures provides greater backyard area for the front structure and allows the residents of the rear structure to "participate" in street activities.



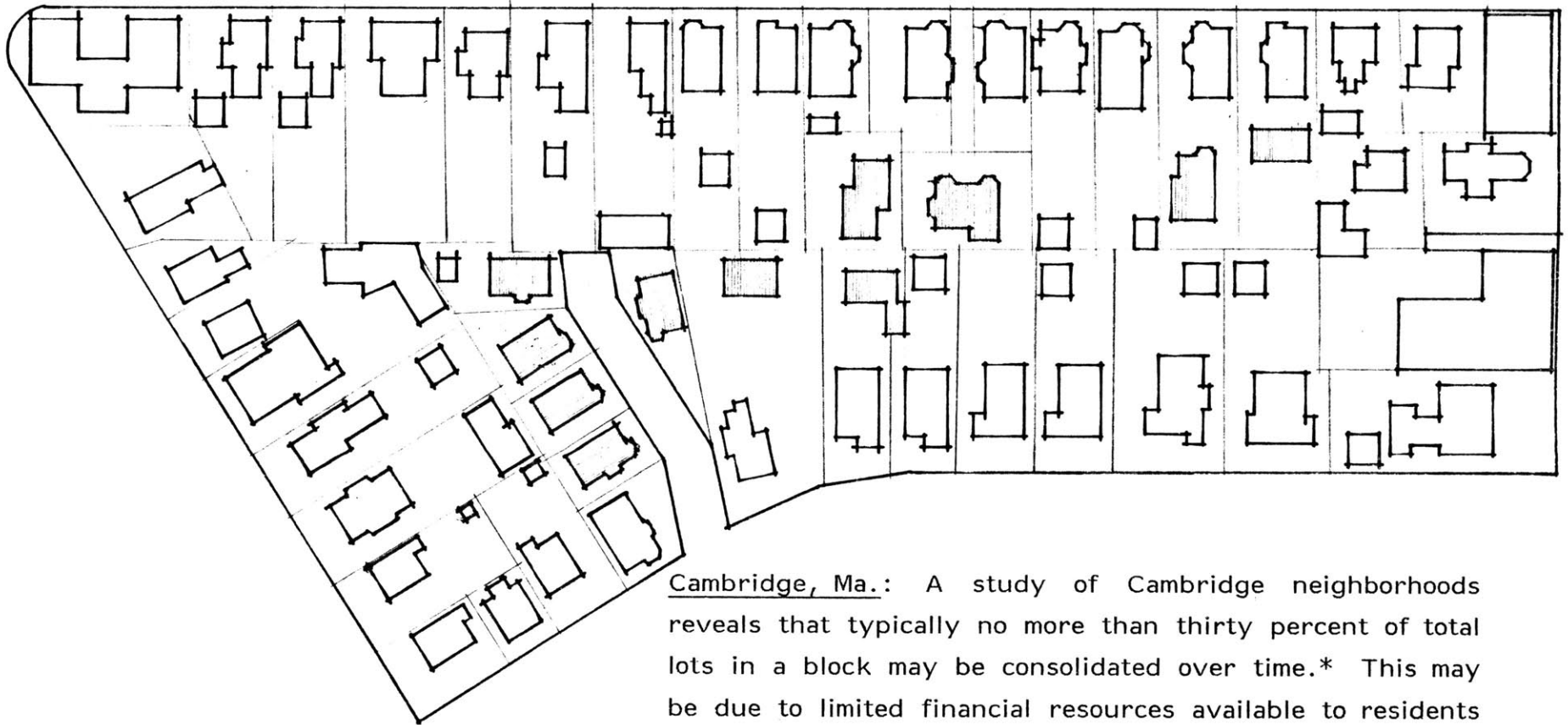
Cambridge, Ma.: Two adjacent lots are aggregated and both existing houses and lots are consolidated. Townhouse units in the rear complement the front houses in scale and materials. The articulation of the new facade includes the use of dormers and paired windows, patterns found in both existing structures.



Cambridge, Ma.: Townhouse units have been constructed behind an older, former duplex structure. In this example, the visual impact of new cars on site has been minimized through the use of internal garages in the new units.

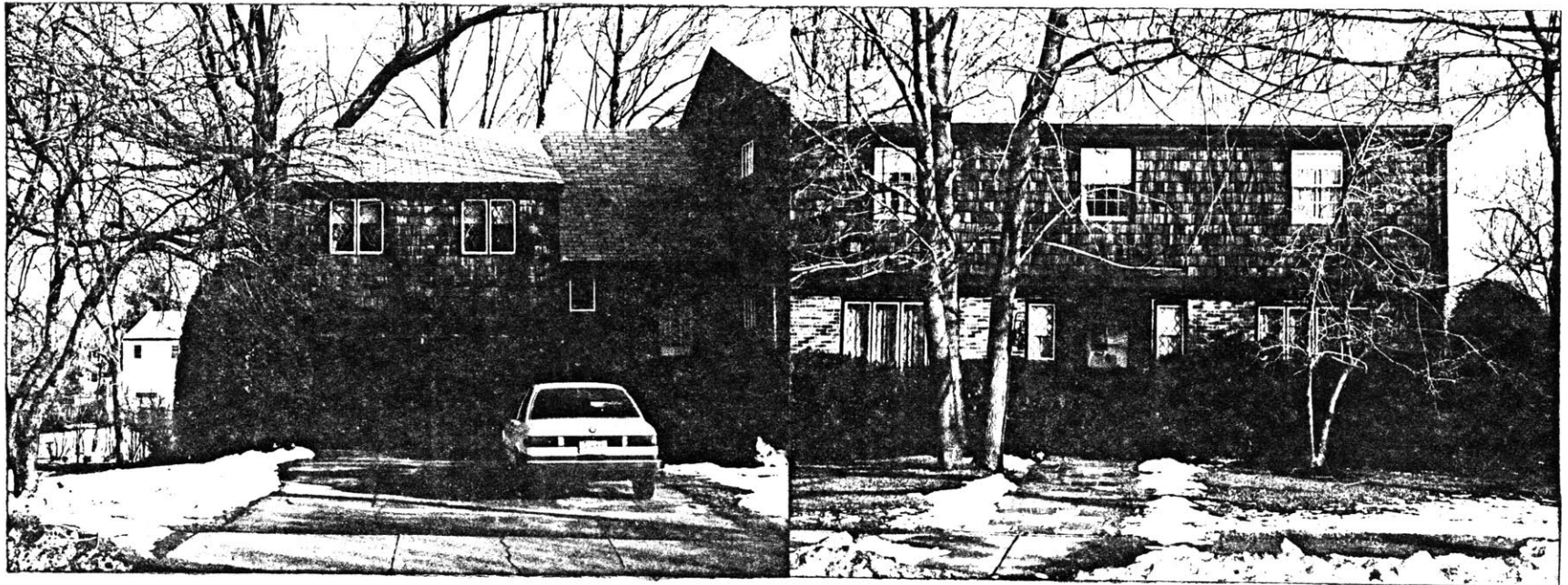


Cambridge, Ma.: Lots are aggregated through the block in this example. Seven new structures share common access - a footpath - from both sides of the block. Perpendicular development such as this is one way to consolidate narrow, deep lots.



Cambridge, Ma.: A study of Cambridge neighborhoods reveals that typically no more than thirty percent of total lots in a block may be consolidated over time.* This may be due to limited financial resources available to residents for new construction.

*Howell, Sandra and Garcia, Denise. "Houses Behind Houses: Environmental Factors Determining Satisfaction in Non-Traditional Residential Land Use." Working Draft, M.I.T. Department of Architecture, April 1983.



Newton, Ma.: A "mother-in-law" apartment built above the garage of a single-family house. The new unit utilizes the second entry, located next to the driveway. This form of consolidation is widespread in many single-family neighborhoods. The illegal status of these units may be the reason they tend to be visually unobtrusive.

the Site





Olmsted plan for Riverside, Illinois.



An example of F.H.A. neighborhood planning strategies of the 1930-40's.

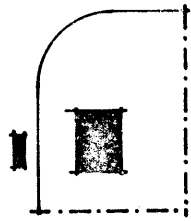
The site was chosen for a number of physical features and demographic qualities. Originally meadowland, the general area known as South Newton began to be developed after World War II into single-family properties. The study area itself was developed in the early 1950's by several builder/developers who bought the land and erected "spec" houses which were subsequently sold.

The block consists of eleven properties with an average area of 17,000 ft.² This generous spatial layout, coupled with an average unit size of 2,100 ft.², insures the possibility of consolidation in its three generic forms. A relatively flat topography and modern infrastructure allow for the ease of typical residential construction and utility hook-ups.

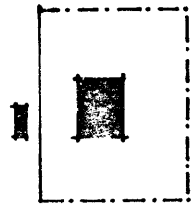
In form, both the block and the houses represent types common to post-war developments, which constitute the bulk of present-day housing stock.³ The curvilinear block derives from Olmsted's plan for Riverside, Illinois and was promoted in FHA neighborhood planning strategies of the 30's and 40's. These strategies remained essentially unchanged after World War II and heavily influenced the form of post-war residential developments.



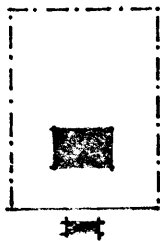
Three types of lots on the block.



1. corner lot



2. side lot



3. inner lot

Lots:

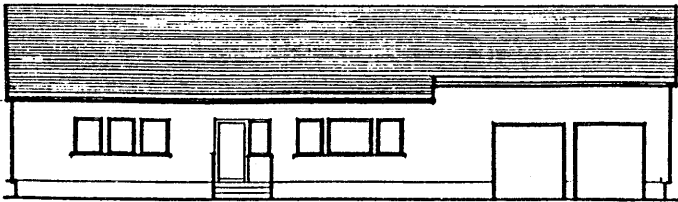
The eleven lots in the study block range in total square footage from approximately 13,000 ft.² to approximately 19,000 ft.² or roughly one-third to one-half acre, medium in size for the Northeast.⁴

The lots fall roughly into three categories that have implications for the development of new units: (1) corner lots, of which there are four; (2) side lots, located on the shorter side of blocks and oriented parallel to the length of the block; and (3) inner lots, located between corner lots and oriented perpendicular to the length of the lot. Obviously, total square footage will determine the extent to which a lot can accommodate new units, but beyond this, the depth/width relationship, street setback, location and orientation of the unit on the lot, may affect the extent to which new construction can be accommodated, particularly on corner and side lots.

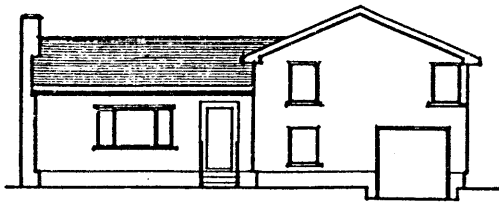
1.



2.



3.



Housing Stock:

There are three types of houses on the study block. These are:

1. A two-story "Colonial" with an attached one- or two-car garage
2. A one-story "Ranch" with an internal two-car garage
3. A split-level "Ranch" with an internal one-car garage

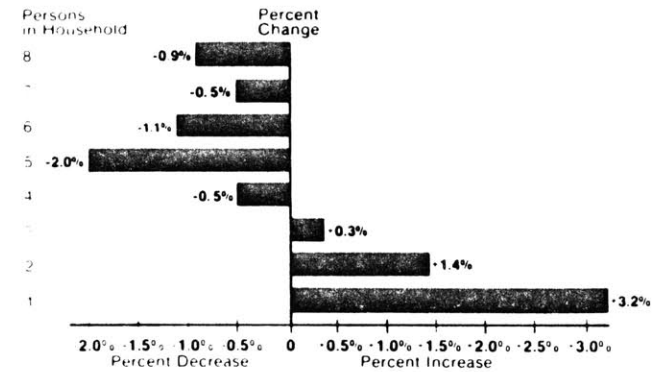
The three types belong to a seven-member group of built-for-sale houses that characterize nearly all post-war construction in the country.⁵ Although regional or local variations do exist, these are sufficiently minimal to allow the labeling of the eleven study examples as "typical."

Demographics:

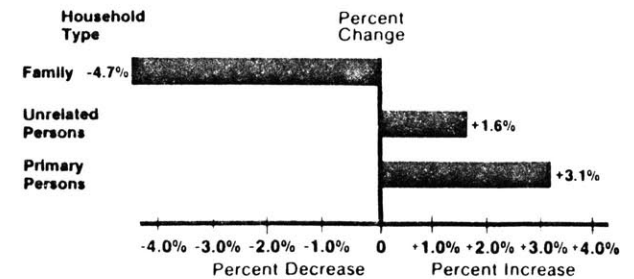
The extent to which consolidation does and will occur depends not only on the physical capacity of the community, but on the nature of the resident population as well. Sprague and Vernez-Mondon identify the "ideal" population characteristics for consolidation as:

1. An increasing elderly population. This would imply both a greater turnover in ownership by "overhoused" or financially restricted residents (i.e., those on fixed incomes) who would be looking to sell their single-family properties, as well as an increase in demand for smaller, more efficient units, preferably rentals.
2. An increase in smaller and varied household groups. This would create a demand for non-traditional housing units as well as increase the amount of developable interior space in larger single-family properties.
3. An increase in housing stock in need of repair. This would facilitate the reorganization of larger single-family properties.

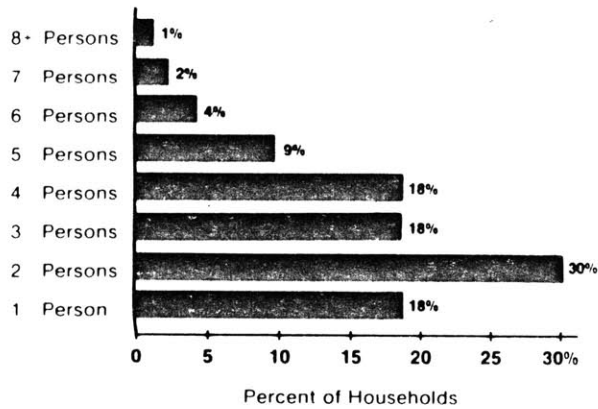
CHANGE IN HOUSEHOLD SIZE DISTRIBUTION: 1976 TO 1980



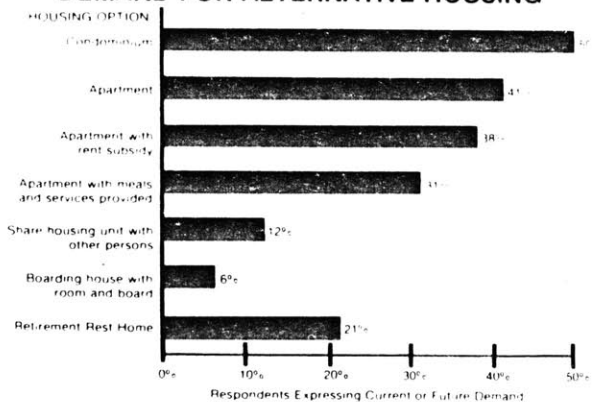
CHANGE IN HOUSEHOLD TYPE DISTRIBUTION: 1976 TO 1980



HOUSEHOLD SIZE DISTRIBUTION BY PERCENT



DEMAND FOR ALTERNATIVE HOUSING



Population profiles for the city of Newton in general and the study area in particular reveal an increase in both the elderly population and number of smaller and/or unrelated households.⁶ Not surprisingly, there has been a corresponding demand for alternative housing in the city by residents fifty-five years or older (i.e., "empty-nesters" and elderly).⁷

Although housing stock in the area is of recent vintage (mid-1950's), and not generally in need of repair, the original owners may now be of an age requiring different housing needs. Consolidation is a reasonable vehicle for these residents to either adapt their single-family properties to changing needs or locate alternative housing that satisfies these needs. Likewise, it would allow a new generation of young families to supplement stiff mortgage payments with additional income.

Clearly there are both physical opportunities and demographic indications supporting change in current housing form in Newton.

METHODOLOGY

Structure

The thesis exploration tests the spatial capacity for consolidation of the eleven lots and dwellings by projecting increases in density onto them. In order to give structural clarity to the exercise, existing zoning regulations are used. Utilizing zoning regulations facilitates the development of a methodology that incorporates quantitative and qualitative criteria simultaneously. As a design tool, zoning permits site-specific work to be potentially generic by virtue of its standardized format. Finally, zoning is the vehicle by which consolidation will be attained in communities whose residents are demanding changes in current municipal housing policies.

Newton has five major residential zoning designations with density requirements ranging from one unit per 15,000 ft.² ("A") to one unit per 3,000 ft.². The most common designation is "B," which requires a density of one unit per 10,000 ft.² and under which the study block falls. The five zoning designations and corresponding densities are:

1. "A": one single-family unit per 15,000 ft.²
2. "B": one single-family unit per 10,000 ft.²
3. "C": one single-family unit per 7,000 ft.²

Process

4. "D₁": one two-family unit per 7,000 ft.²
5. "D₂": one townhouse unit per 3,000 ft.², with a minimum lot area of 24,000 ft.²

	Minimum new construction	Maximum new construction
B → C	✓	✓
B → D ₁	✓	✓
B → D ₂	✓	✓

PROCESS:

A blanket change in zoning status (and thus density) is proposed for the study block. In this case, since the block is currently zoned "B," three of the five designations are involved: C, D₁, and D₂. For each of the three zoning designations - C₁, D₁ and D₂ - required setbacks are diagrammed to show non-buildable areas. The corresponding buildable areas are analyzed to determine likely locations for new access, parking and units. Using the three generic forms of consolidation, site designs are generated to illustrate the ways in which the required unit density can be achieved, without lot subdivision.[#] To do this, two site plans are derived for each zoning change: one that maximizes new construction (i.e., new units) while attempting to maintain the single-family character of the existing houses, and another that minimizes new construction and thus maximizes the internal division of the

existing houses. This method accomplishes two things: first, it determines the spatial capacity of both lots and houses, and the impact of new paving (on-site) and cars (on- and off-site) and second, the method also simulates and evaluates the impact of different developmental approaches by the two groups interested in consolidation: resident owners and developers.

Minimizing New Construction:

In order to determine the threshold for minimum new construction, a ceiling on the number of subdividable units is reached through an analysis of the three types of houses on the block. The analysis of each dwelling identifies opportunities and constraints for consolidation by identifying features - both physical and spatial - that may encourage or inhibit internal division, including:

1. location of bearing walls
2. interior zoning
3. circulation
4. entry conditions

5. location of wet walls (plumbing)
6. type and location of windows and doors

Information derived from the analysis is used to diagram the range of subdivision possible within the given shell, and the maximum internal subdivision for each dwelling type is illustrated in unit plans. The design solutions are guided by a set of usability standards and consolidation criteria:

1. Keep demolition to a minimum;
2. Maintain patterns of use whenever possible;
3. Maintain existing primary entrance and foyer spaces;
4. Provide the following minimum areas and dimensions in new units:

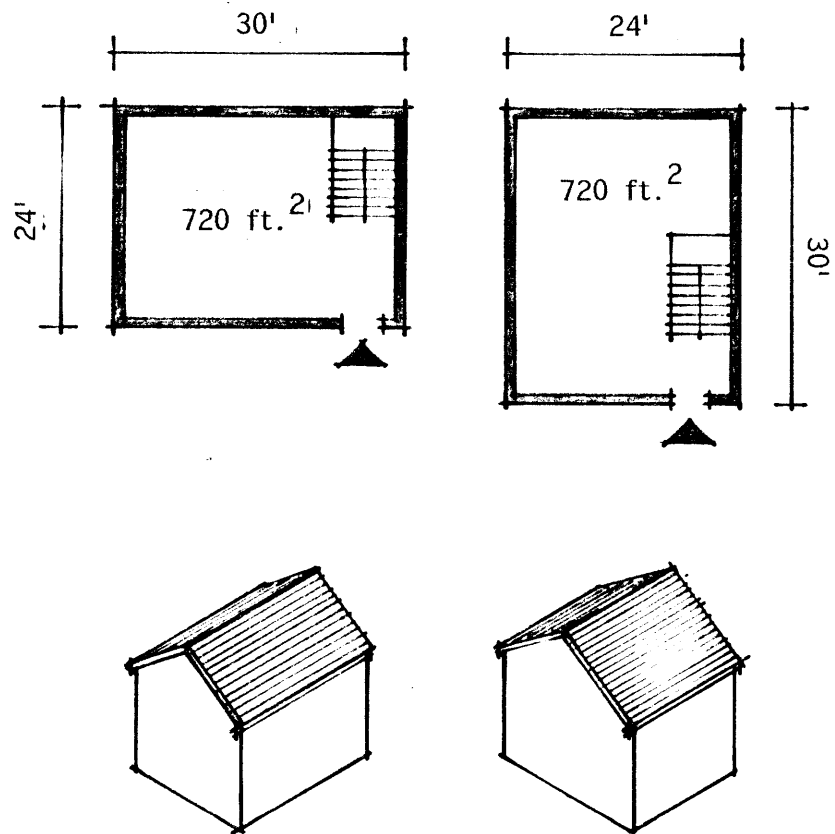
Living	120 ft. ²	10' - 0"
Dining	40 ft. ²	6' - 6"
Living/Dining	160 ft. ²	10' - 0"
Kitchen	40 ft. ²	5' - 0"
Kitchen/Dining	60 ft. ²	6' - 6"
Bedroom	90 ft. ²	9' - 0"
Bath	40 ft. ²	5' - 0"

When a limit is reached in the number of units that can be yielded by the dwelling, additional volume is utilized - where lot width allows - to create more units. For the sake of the thesis exercise, consolidation in the form of additions is illustrated on site designs and elevations only. The amount and form of this consolidation varies depending on dwelling type, orientation and the amount of available buildable area on each lot. Obviously, there are unlimited possibilities that can be derived from these variables. However, given the clear front/back relationship of existing units to the street and the aim of consolidation to preserve and perpetuate neighborhood patterns, the following guidelines direct the addition of new volume to existing structures:

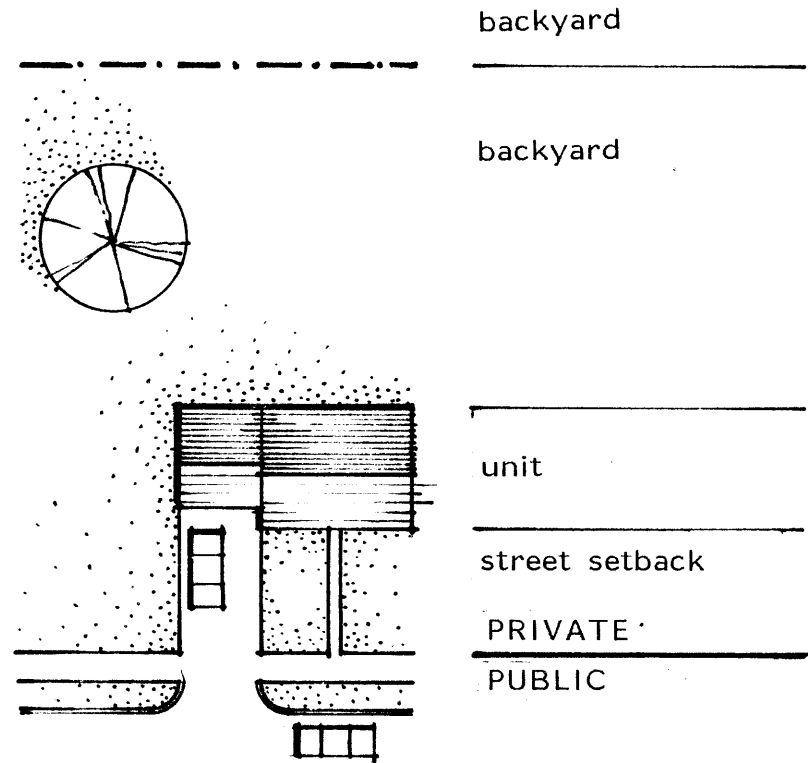
1. After the threshold on the number of units derived from the given shell is reached, additional volume can be utilized.
2. New volume must be added horizontally and parallel to the facade of existing dwelling.
3. A shift in roof and/or wall plane should distinguish the new volume from the original structure; however, not so that the new volume protrudes beyond the facade of the original structure.

-
4. The overall length of the structure should not exceed seventy-five feet, the local maximum.
 5. When the maximum length is reached, volume can be added vertically to the existing structure to within the thirty-foot restriction imposed by zoning.
 6. Any new entrances must "face" the street.
 7. One curbside parking space is allotted each new unit; no new paving can be introduced.

1. New Units:



2. Public/Private Zoning:



Maximizing New Construction:

In solving for maximum new construction, a set of standards for new construction is used to guide the design solutions. The standards are based on zoning requirements, current housing literature and local patterns.

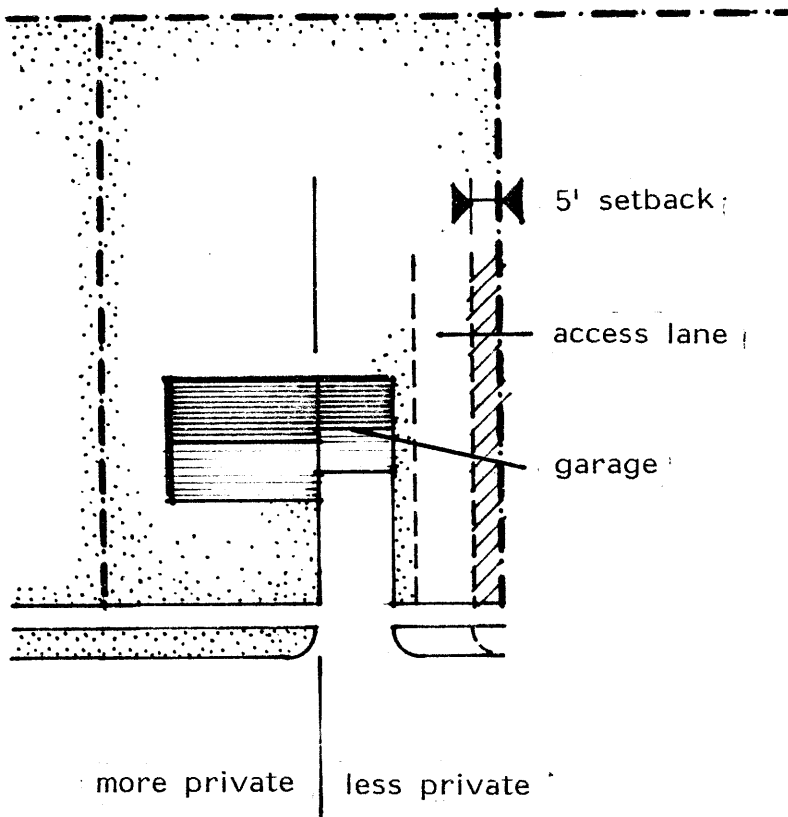
1. New Units:

- a. Size - new units have a 24' x 30' footprint (720 ft.²) which, when given a height restriction of 2½ stories, yields a unit of 1,440 ft.² (2 x 720 ft.²). Recent housing literature reveals a trend toward downsized units with an average 1,600 ft.² and 6.9 rooms, including three bedrooms.⁸
- b. Roof Form - Roofs on new units are pitched, with ridge lines parallel to the length and/or facade of the dwelling, to complement local patterns.

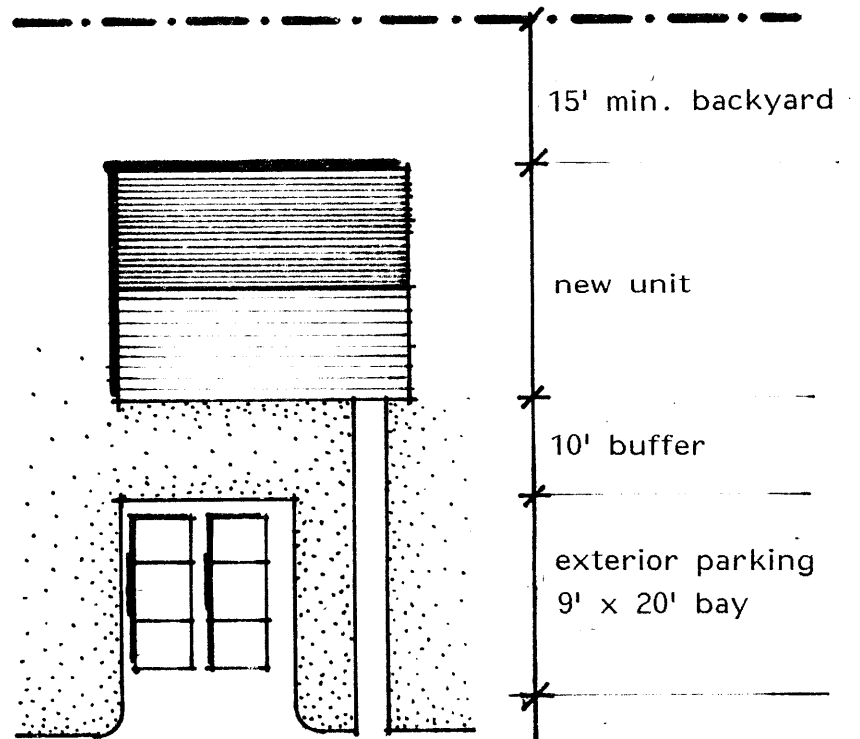
2. Public/Private Zoning:

All suburban neighborhoods contain a distinct public/private system defined by a series of zones. This system is maintained in the public/private zoning of new units.

3. New Access:



4. Parking:



3. New Access:

Access to new units occurs where side lot dimensions allow the width of the access lane plus a five-foot lot line setback to be accommodated, but ideally on the least private side of the existing house (i.e., the garage), where possible visual and acoustical intrusion of new cars and residents is minimized.

4. Parking:

a. Location - All parking for new units is assumed to be exterior, in order to test the potential of lots to accommodate new paving and so the spatial balance between required parking and new units can be determined.

b. Size - Bay size is determined by local zoning and other codes: 9' x 20'.

c. Number - The number of parking spaces per unit is set by specific zoning designations, but never exceeds one and one-quarter spaces per unit for new units and one space per unit for subdivided units.

5. Setbacks:

New units have a ten-foot buffer between parking and entry, and a minimum backyard depth of fifteen feet, both requirements of local zoning.

Evaluation:

All eight design solutions are tested for the degree to which they are able to preserve essential neighborhood qualities. Evaluative criteria are based on the information generated by the analysis of suburban neighborhoods in general and the study block in particular. One site design is selected for redesign and reevaluation: the densest and/or most disruptive, i.e., the one with the lowest score. The redesign will attempt to improve areas with low ratings and determine to what extent solving for the criteria improves the design.

From these results, the evaluative criteria can themselves be evaluated to determine:

1. Which environmental qualities seem to be most sensitive to increased unit density and thus inhibit certain forms of consolidation;
2. To what degree the criteria guarantee the maintenance of positive environmental qualities;
3. Which criteria should be questioned and should others not considered be included?

Summary of Newton Zoning

	Residence A	Residence B	Residence C	Residence D ₁	Residence D ₂
Density	1u/15,000 ft. ²	1u/10,000 ft. ²	1u/7,000 ft. ²	2u/7,000 ft. ²	1u/3,000 ft. ²
Minimum lot area	15,000 ft. ²	10,000 ft. ²	7,000 ft. ²	7,000 ft. ²	24,000 ft. ²
Minimum lot width	100 ft.	80 ft.	70 ft.	70 ft.	70 ft.
Street setback	25 ft.	25 ft.	25 ft.	25 ft.	20 ft.
Side lotline setback	25' agg. (12' 6" min.)	20' agg. (7' 6" min.)	17' 6" agg. (7' 6" min.)	17' 6" agg. (7' 6" min.)	30' agg. (15' min.)
Backyard depth	Lot depth/4' min.	15' min.	15' min.	15' min.	15' min.
Lot coverage (inc. parking)	30% max.	30% max.	30% max.	30% max.	65% max.
Height of buildings	3 stories 30'	3 stories 30'	3 stories 30'	3 stories 30'	3 stories 30'
Parking required	1/unit (3 max.)	1/unit (3 max.)	1/unit (3 max.)	1/unit (3 max.)	1½/unit
Access width	12' min. 20' max.	12' min. 20' max.	12' min. 20' max.	12' min. 20' max.	12' min. 20' max.

A summary of residential zoning for the City of Newton reveals little variety in unit densities and other requirements for the four major designations: A, B, C and D. Given the minimum lot area required under "A" - 15,000 ft.² - the maximum number of units allowed by a change in zoning would be four, under the designation "D" (2 units/7,000 ft.²). Because this limits the range of the thesis exercise, a recently introduced variance labeled "D₂" is included. This variance applies to the construction of P.U.D.'s (planned unit developments) in residential areas of the city currently zoned "D," and allows for a unit density of 1/3,000 ft.² However, a minimum lot area of 24,000 ft.² is required. To achieve this on the site, two lots are joined either side to side or back to back.

The site diagrams on the following pages describe the impact of each zoning change on the number of units and cars on the block.

Impact of Zoning Changes



1. B-- C: 1 unit/7,000 ft.²

This change results in a density increase of nearly 100 percent.² Ten of the eleven lots have 14,000 ft.² or more, allowing for one new unit each. A total of twenty-one units and twenty-six cars are now on the site.

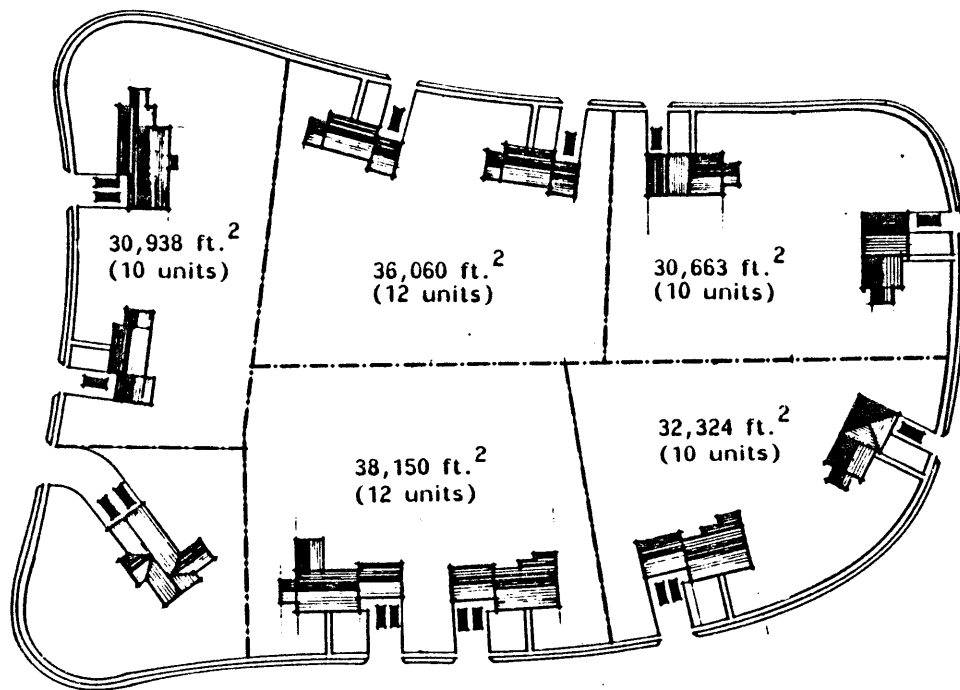
	New	Existing	Total
units	10	11	21
cars	10	16	26

2. B-- D: 2 units/7,000 ft.²

Unit density increases under this designation by nearly 300 percent. Ten of the eleven lots are allowed three new units each and the eleventh is allowed two. A total of forty-two units and forty-seven cars are now on the site.



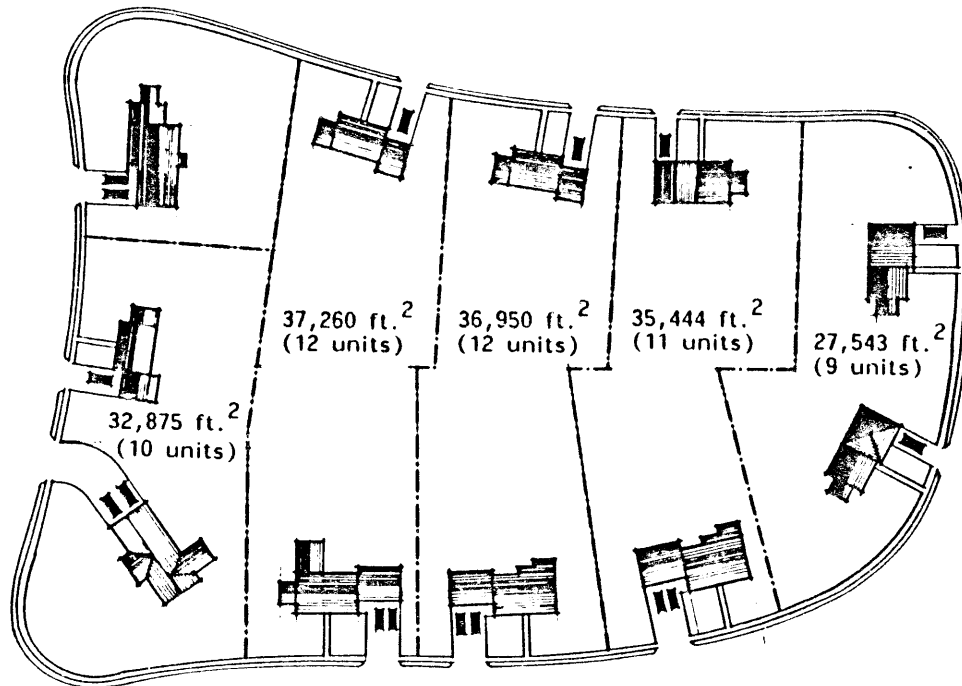
	New	Existing	Total
units	31	11	42
cars	31	16	47



3. B-- D₂: 1 unit/3,000 ft.² (side-to-side aggregation)

This diagram illustrates one of four possible ways of aggregating adjacent lots in order to meet the minimum lot area of 24,000 ft.² It represents the worst case for possible physical and visual congestion of new construction since the new aggregated lots are not staggered but directly aligned. Ten of eleven lots are paired. Given the allowable density and a parking requirement of 1.25 cars per unit, a total of fifty-five units and seventy-one cars is on the site, an increase of 500 percent in the number of units and 450 percent in the number of cars.

	New	Existing	Total
units	44	11	55
cars	55	16	71



4. B-- D₂: 1 unit/7,000 ft.² (back-to-back aggregation)

Required lot area is achieved by aggregating lots back to back. The five new aggregated lots are collectively allowed forty-three new units. The total number of units is fifty-four and cars, seventy; increases of 490 percent and 440 percent respectively.

	New	Existing	Total
units	43	11	54
cars	54	16	70

DESIGN EXPLORATIONS

Analysis of Housing Stock: Potential for Subdivision

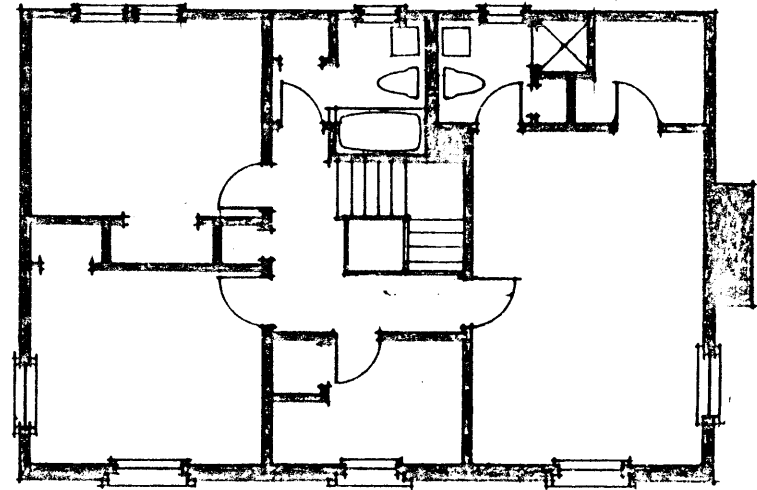
The housing stock analysis tests the spatial and physical capacities of the three particular suburban structures found on the block. The goal is to set a range for consolidation by establishing a ceiling on the number of separate units that can be derived from the given shell. For this reason, the ultimate unit mix is not considered, nor are cost implications. Dividing a three-bedroom, single-family dwelling into four studio apartments may not be feasible or desirable in Newton at this time. The suitability of schemes varies, depending on location, resident needs, financial resources available, etc. However, setting the physical/spatial parameters for internal subdivision identifies the boundaries within which "appropriate" solutions may fall.

For the purposes of the thesis exercise, establishing the range of consolidation possible within a given shell provides a means for expressing allowable densities when minimizing on-site construction.

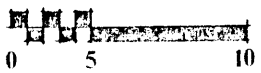
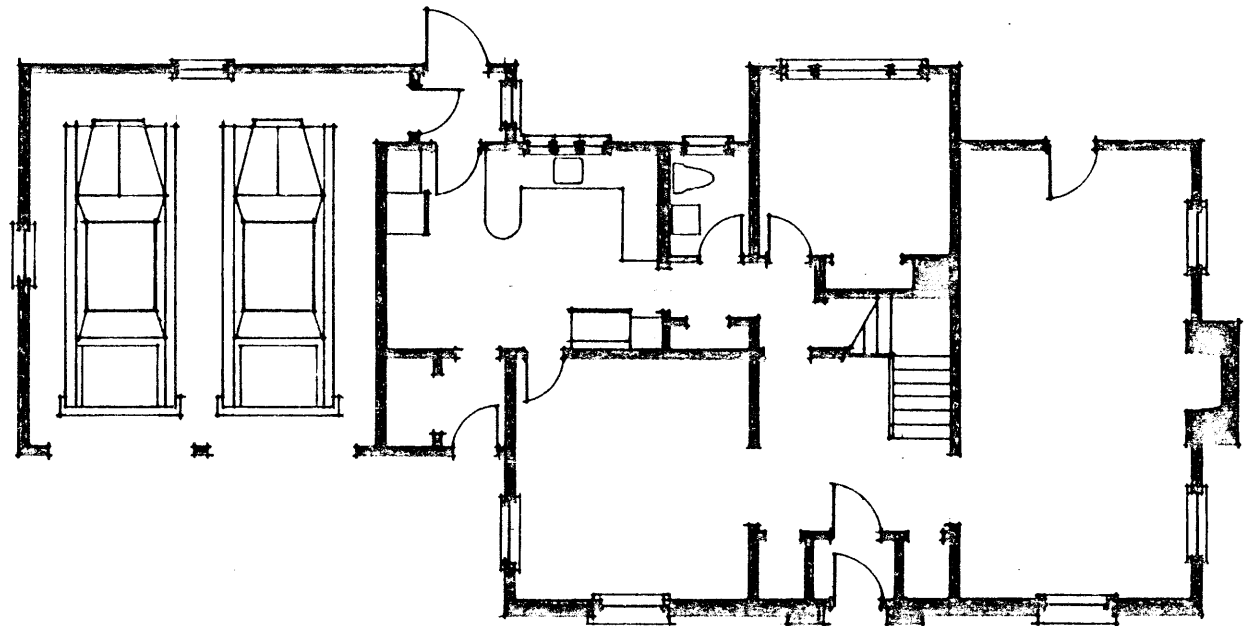
1.

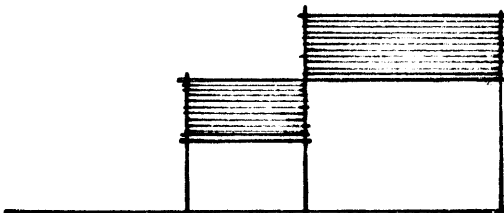
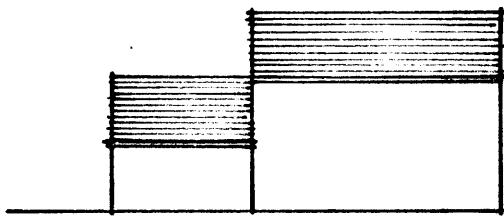
2-STORY "COLONIAL": EXISTING CONDITIONS

SECOND FLOOR



1ST FLOOR

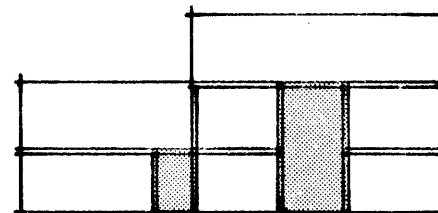
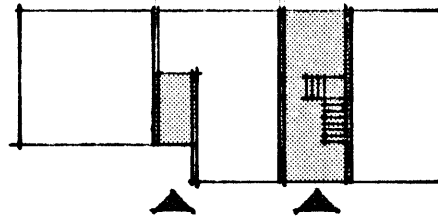




a. Volume/Area

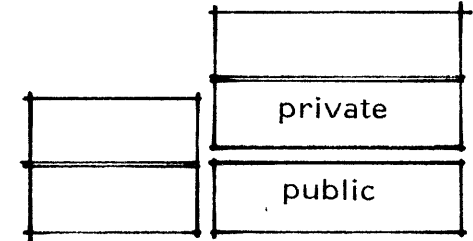
One version of the two-story "Colonial" on the block has a 38' x 26' footprint with an attached 26' x 22' single-story volume used as car storage. Total area is 2,300 ft.² in the two-story volume and 572 ft.² in the single-story volume.

The second version of the two-story "Colonial" has a footprint measuring 30' x 22' with an attached one-story volume also used as car storage. Total area is 1,320 ft.² in the two-story volume and 300 ft.² in the one-story volume.



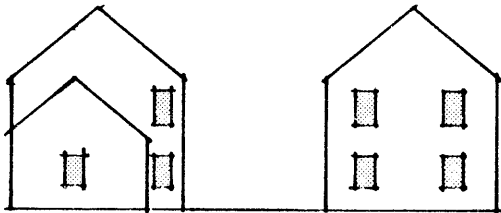
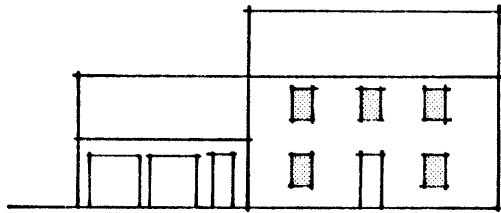
b. Entry/Circulation

There are two entries on the facade. The formal is located at the center of the two-story volume and opens onto a generous foyer space that contains stairs to the upper floor. The other entrance is located at the junction of the two volumes. Entries and circulation are bound by major bearing walls and, together with floors, these tend to divide the structure into five distinct areas.



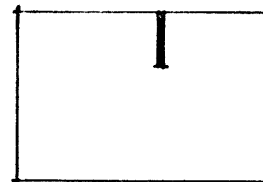
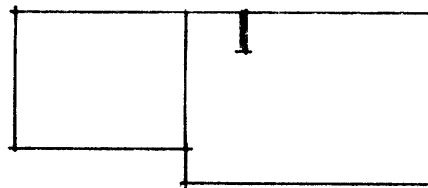
c. Interior Zoning

Interior zoning is achieved by vertical separation: public uses on the ground floor and private uses on the upper floor.



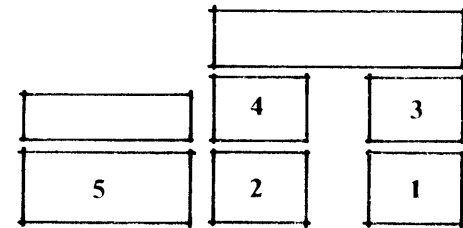
d. Windows

Windows are uniform for all interior spaces, unlike other dwellings on the block. They consist of a single 3' x 4' glazed opening, used for living, dining, kitchen, bedrooms and bathrooms.



e. Wet Walls

Wet walls are not centrally located or aligned vertically, both of which inhibit subdivision of this type. However, given the symmetrical interior organization, these can be reorganized to facilitate maximum subdivision.



Conclusions:

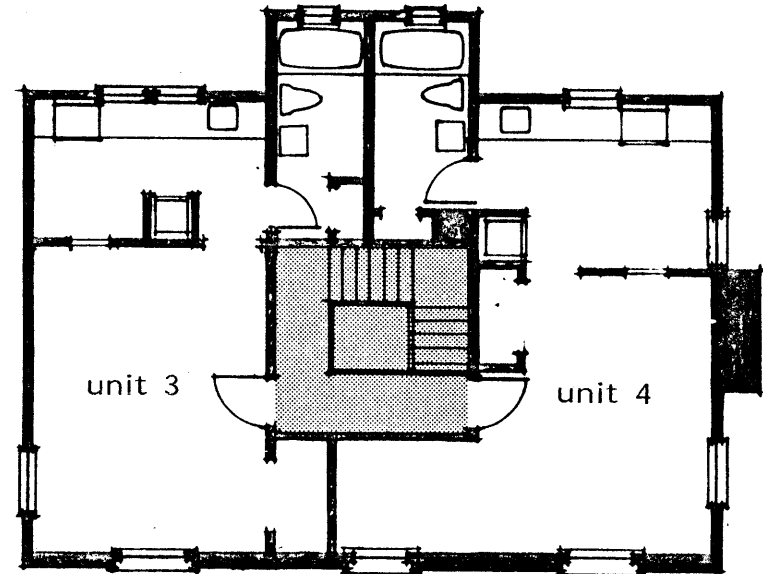
The structure can be divided into five units - four in the two-story volume and one in the one-story volume. Although having flats on the ground floor disrupts the pattern of interior zoning by locating sleeping areas on the ground level, it complements patterns for other dwellings on the block, namely the two examples of the one-story "Ranch." Furthermore, locating sleeping areas on the ground floor does not conflict with the window type/use pattern.

2-STORY "COLONIAL": MAXIMUM CONSOLIDATION

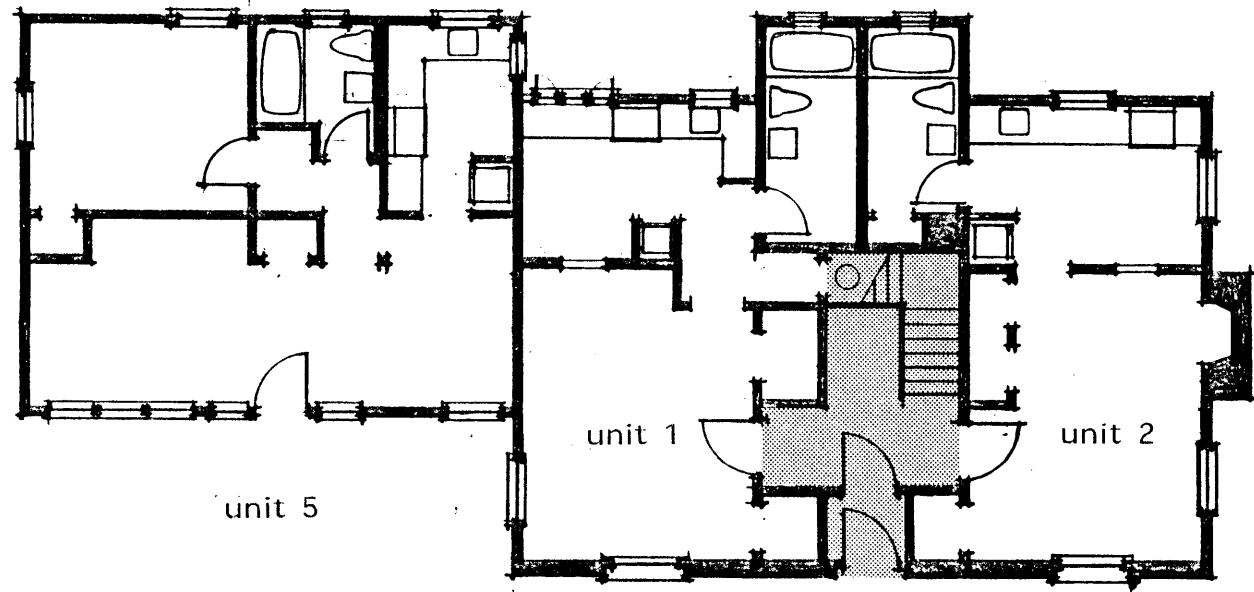
All four units in the two-story volume share the main entry and foyer space, which must be enclosed on both floors by adding several small partition walls. The fifth unit can utilize either the secondary entrance or either of the two doors in the garage as entry.

Wet walls are reorganized to line up vertically as well as to service both kitchens and bathrooms more efficiently in each unit.

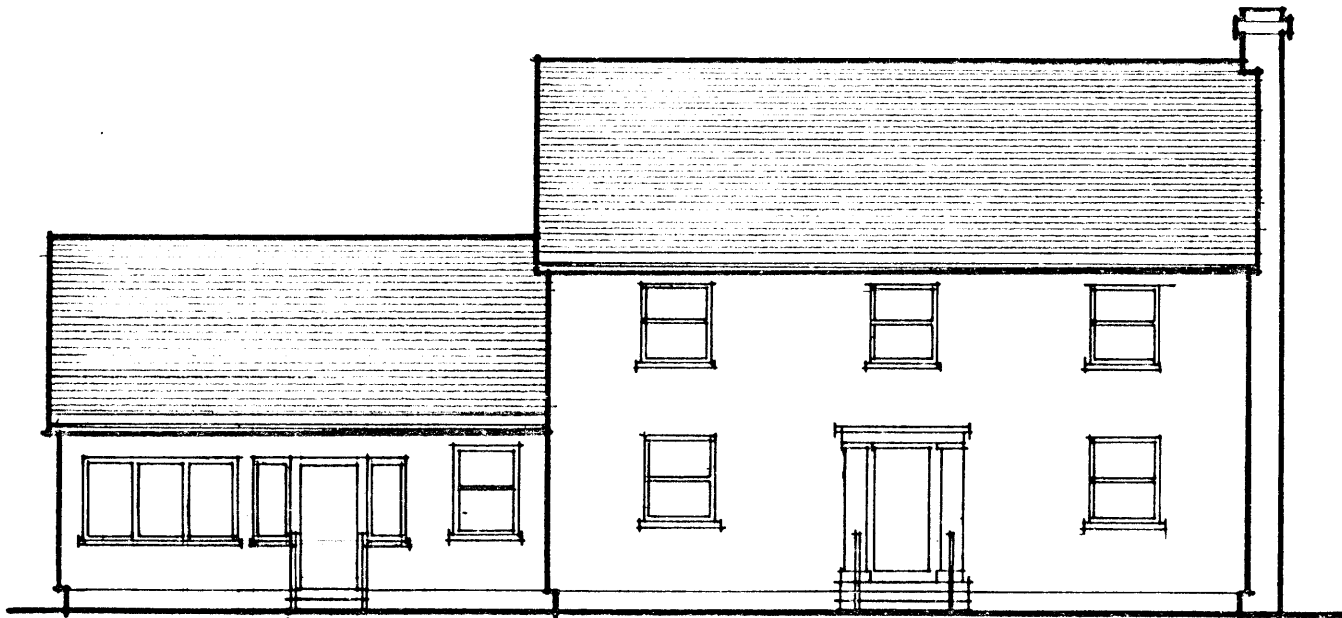
SECOND FLOOR



1ST FLOOR



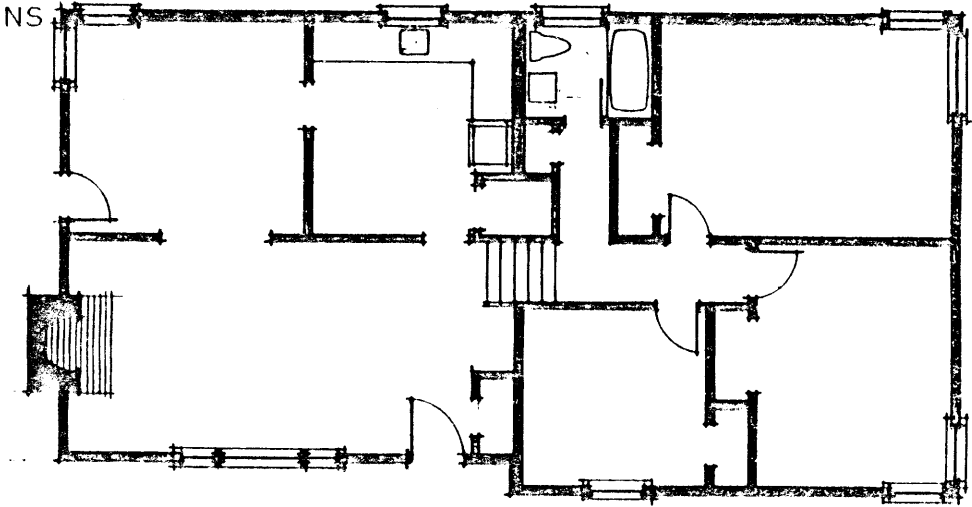
ELEVATION



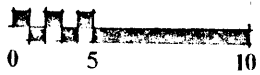
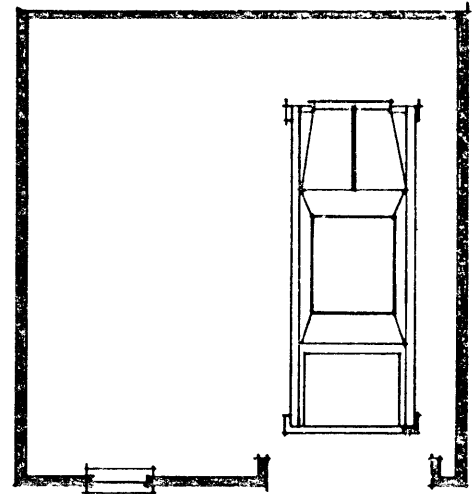
2.

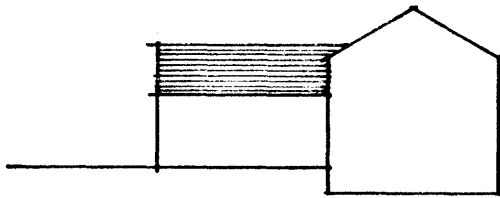
SPLIT-LEVEL "RANCH": EXISTING CONDITIONS

SECOND FLOOR



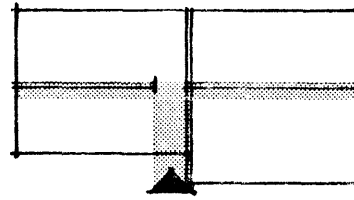
1ST FLOOR





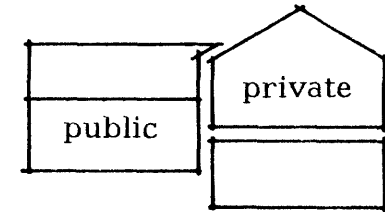
a. Volume/Area

This dwelling type has two major volumes: a two-story volume containing car storage below and bedrooms above, and an attached one-story volume containing living, dining and kitchen areas. The one-story volume is half a level above and below the other floors - hence the name "split level" - and has a total area of 500 ft.² (24' x 22'). Total area in the two-story volume is 1,350 ft.² (26' x 26'); 676 ft.² per floor.



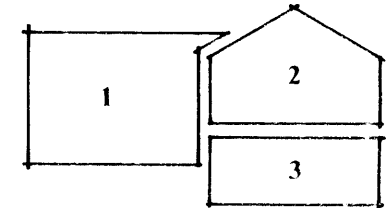
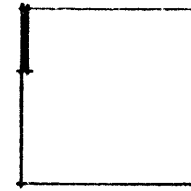
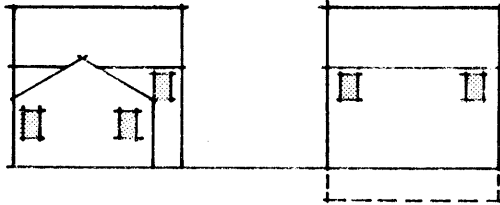
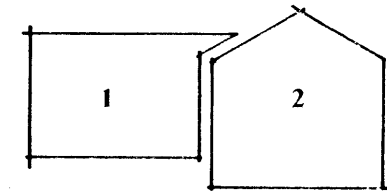
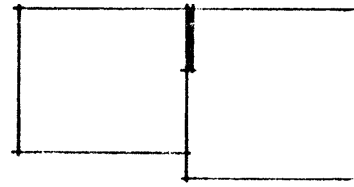
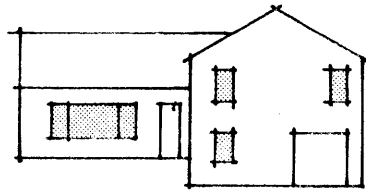
b. Entry/Circulation

Unlike the two-story "Colonial," this dwelling type has only one entry on the facade, located at the junction of the two volumes. It opens directly onto a living area; there is no foyer or other "transitional" zone. Primary interior circulation takes the form of a zone that runs along the interior longitudinal bearing wall located at the center of the structure.



c. Interior Zoning

Interior zoning is achieved by half-level changes between three major uses: utilitarian (garage, storage), public (living, dining, and kitchen) and private (bathroom and bedrooms).



d. Windows

The dwelling contains two types of windows used for all interior spaces. A single 3' x 4' glazed opening is used in all areas except the living area: dining, kitchen, bedrooms and storage. A triple-pane 16' x 4' opening is used in the living area and, coupled with its proximity to the entry, discourages less public use of this space.

e. Wet Walls

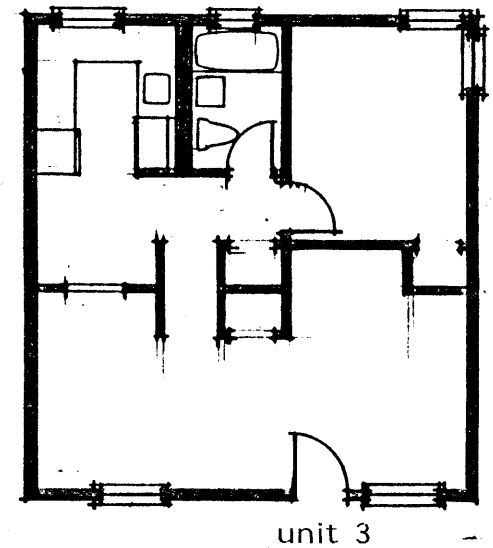
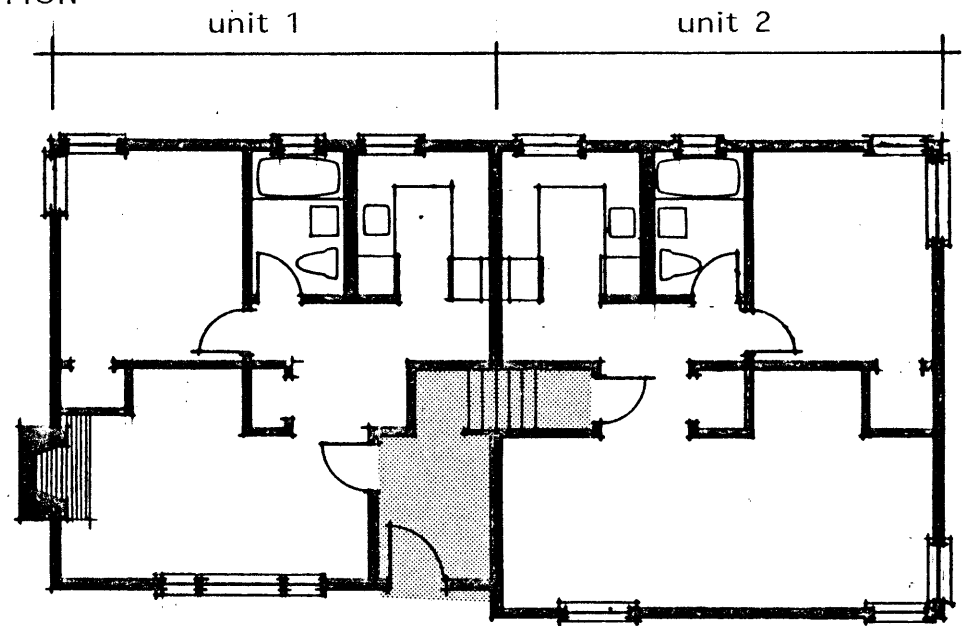
A single wet wall is located in the interior bearing wall separating the two volumes and services areas on either side at all three levels.

Conclusions:

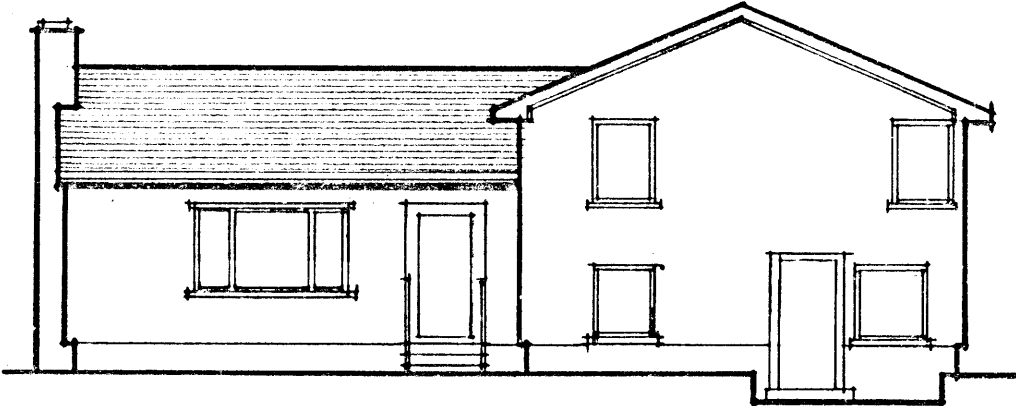
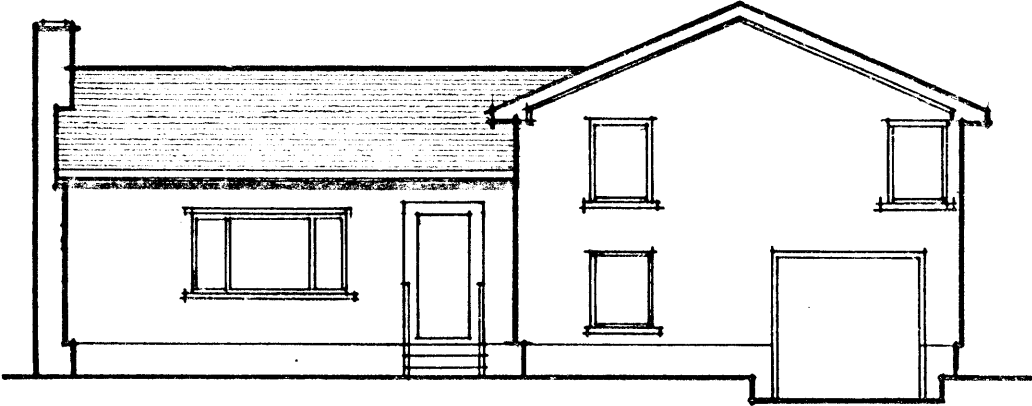
The structure is easily consolidated into two distinct volumes along bearing walls. Furthermore, the two-story volume can be divided into two flats, creating a maximum of three units derived from the given shell.

SPLIT-LEVEL "RANCH": MAXIMUM CONSOLIDATION

Given the single entry, the two upper units require the partitioning of a foyer space from which to access units, making the stairs to the upper unit semi-public. The lower unit has a private entry that utilizes the original garage opening. New windows need to be provided for the lower unit on the side and/or rear elevation. Wet walls need to be reorganized for greater efficiency. One wall services the units within the two-story volume, while a second services the third unit.

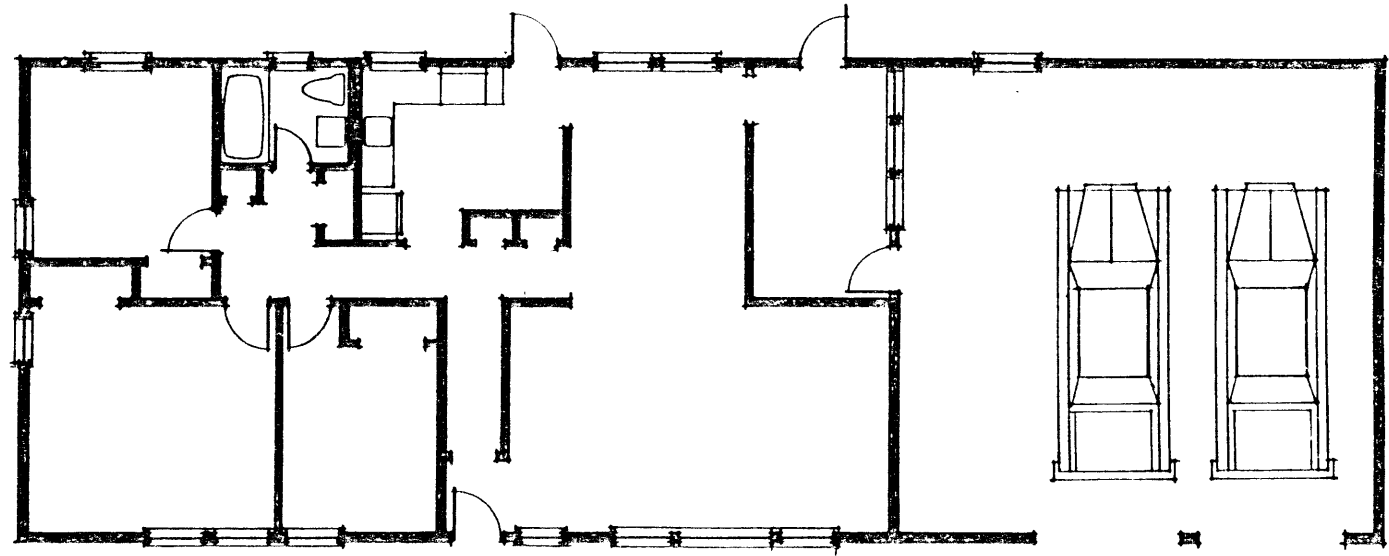


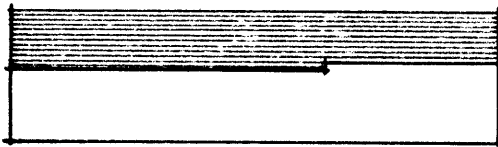
ELEVATION



3.

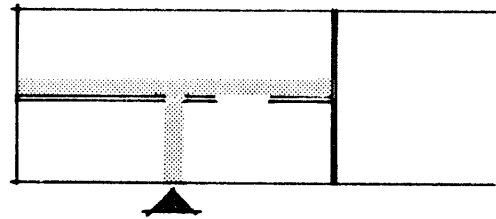
1-STORY "RANCH": EXISTING CONDITIONS





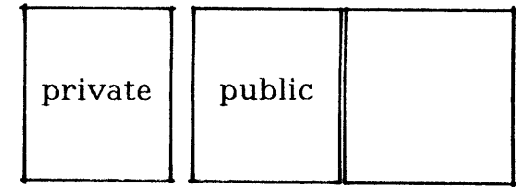
a. Volume/Area

The dwelling consists of a single-story rectangular volume with a 75' x 26' footprint and a total area of 1,950 ft.², 676 ft.² of which is a two-car garage.



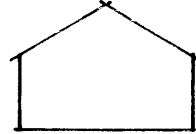
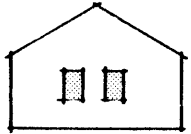
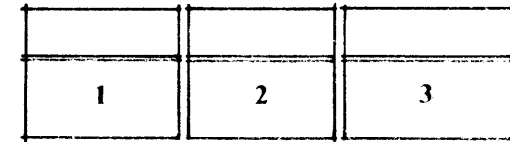
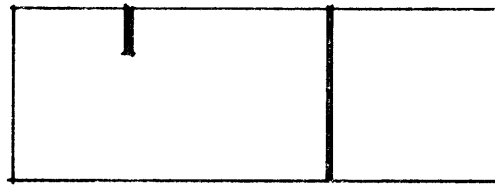
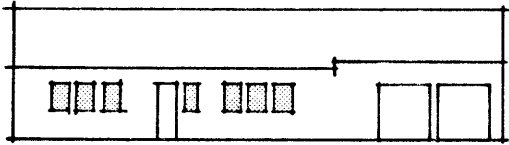
b. Entry/Circulation

There is one entry at the center of the structure that opens onto a small area containing a vestibule, and short corridor. Primary circulation runs longitudinally along the interior bearing wall.



c. Interior Zoning

Separation between public and private areas is achieved through the placement of the entry space at the center of the structure. This effectively divides the interior into two roughly equal areas with bedrooms and bath in one and living and dining area in the other.



d. Windows

Window size is uniform and consists of a 3' x 4' opening which is used both singularly and grouped in all areas.

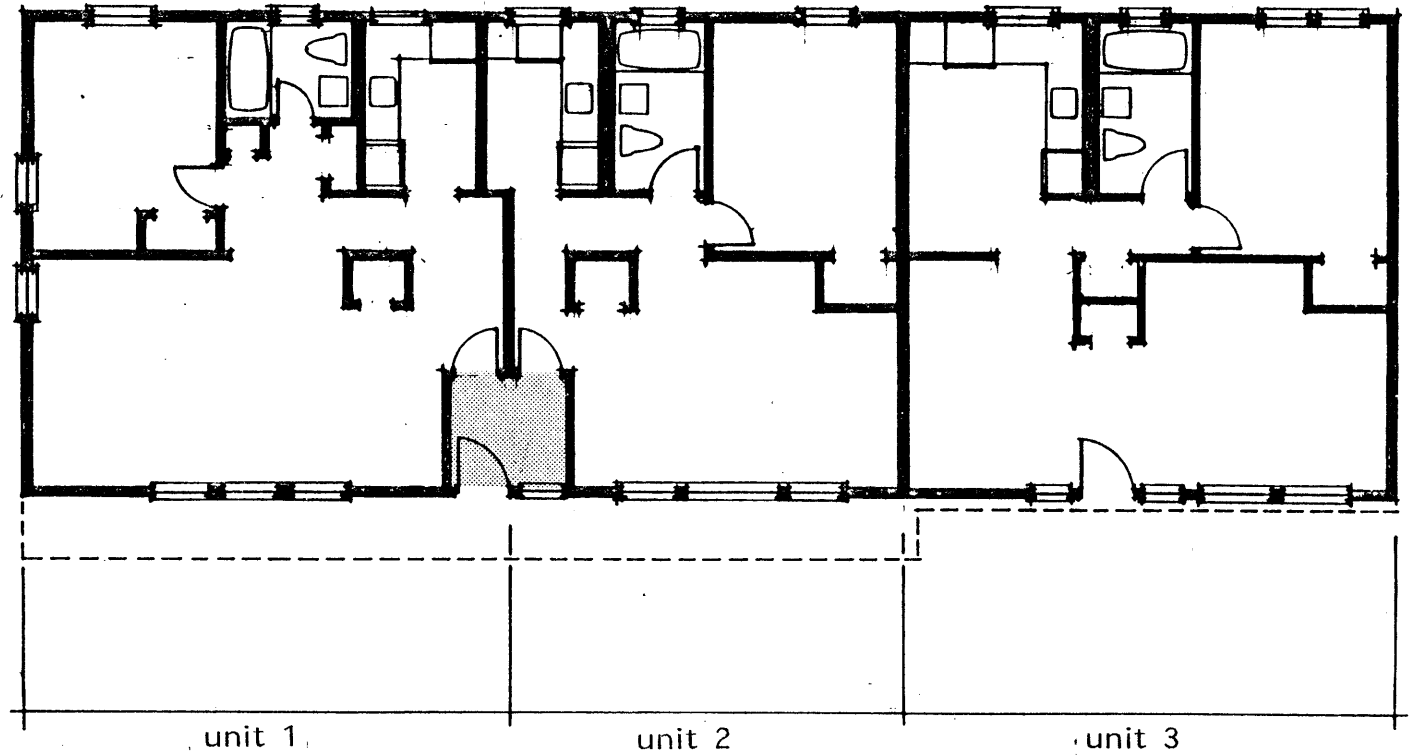
e. Wet Walls

A single wet wall is located off-center from the entry zone dividing the dwelling, and services the kitchen and bath.

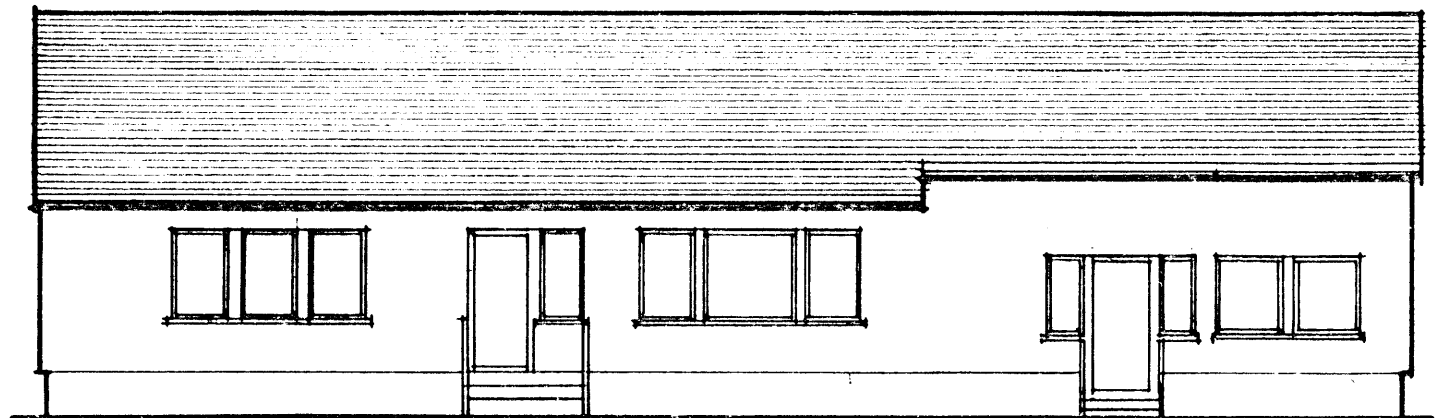
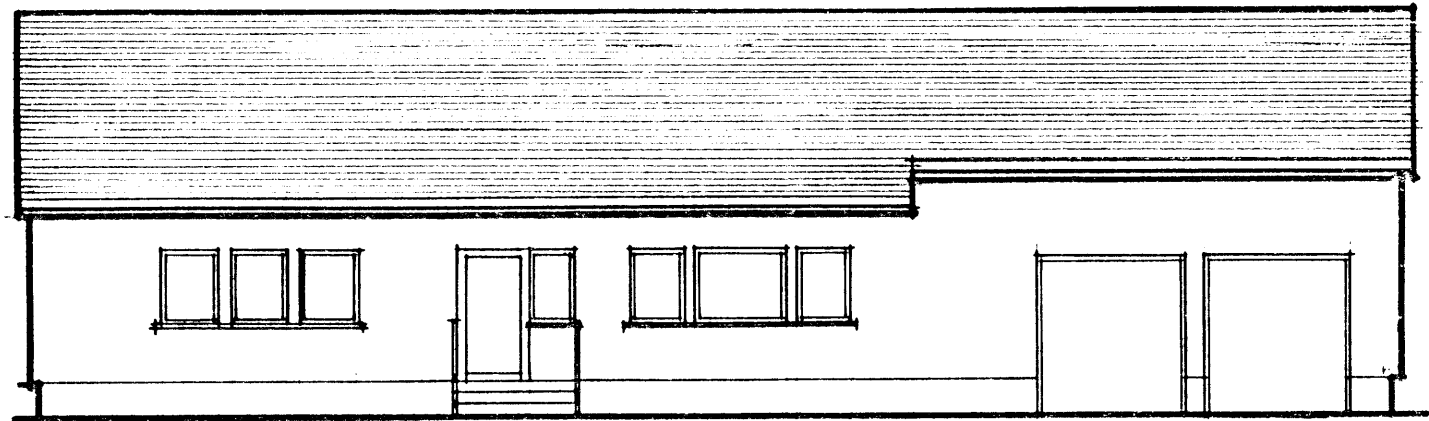
Conclusions:

The structure can be consolidated into three distinct volumes along its length using the perpendicular bearing wall between garage and living area, and the entry zone as boundaries.

1-STORY "RANCH": MAXIMUM CONSOLIDATION



ELEVATION



Analysis of Lots: Buildable and Non-Buildable Areas

Corner Lots:

Unlike inner or side lots, dwellings on corner lots are oriented either diagonally across, or with their length parallel to the longer dimension of the lot. This offers limited opportunity for consolidation in the form of new detached dwellings, even when two corner lots are aggregated. Parallel and diagonal orientation leave little and/or awkwardly shaped buildable area behind existing houses for new cars and units, even when total lot area is comparable to inner lots. For all four corner lots, on average, only thirty-two percent of available area is buildable, compared to forty-four percent for inner lots. However, corner lots have relatively larger side yards, providing greater opportunity than other lots for consolidation through the use of additions. Furthermore, having two sides of the lot exposed to the street creates more curbside parking space for new units in the existing structures.

Side Lots:

Side lots are really inner lots in the sense that they have only one side exposed to the street. Unlike inner

lots, however, they usually have greater depth than width and thus offer more opportunity for consolidation through additions than for consolidation through new detached units. Aggregating corner and side lots does not seem to increase the ability to accommodate new detached dwellings as both usually have similarly shallow depths, ranging from 100' to 130'.

Inner Lots:

Inner lots offer the greatest potential for accommodating new detached dwellings, due to generous depths, in this case ranging from 150' to 180'. Removing area for street, rear yard and rear lot line setbacks still leaves 65' to 90' in depth for new construction.

A generous lot depth usually implies a comparatively narrow width and consequently limited opportunity for other forms of consolidation, particularly those utilizing additional volume. This situation may be further aggravated by the placement of structures on the lot. Typically, suburban houses are centered on the lot, creating similarly-sized side yards. Given side lot line setbacks, the resulting buildable areas on either side may be too narrow for either additional volume or access to new units behind.

Side-to-Side Lot Aggregation:

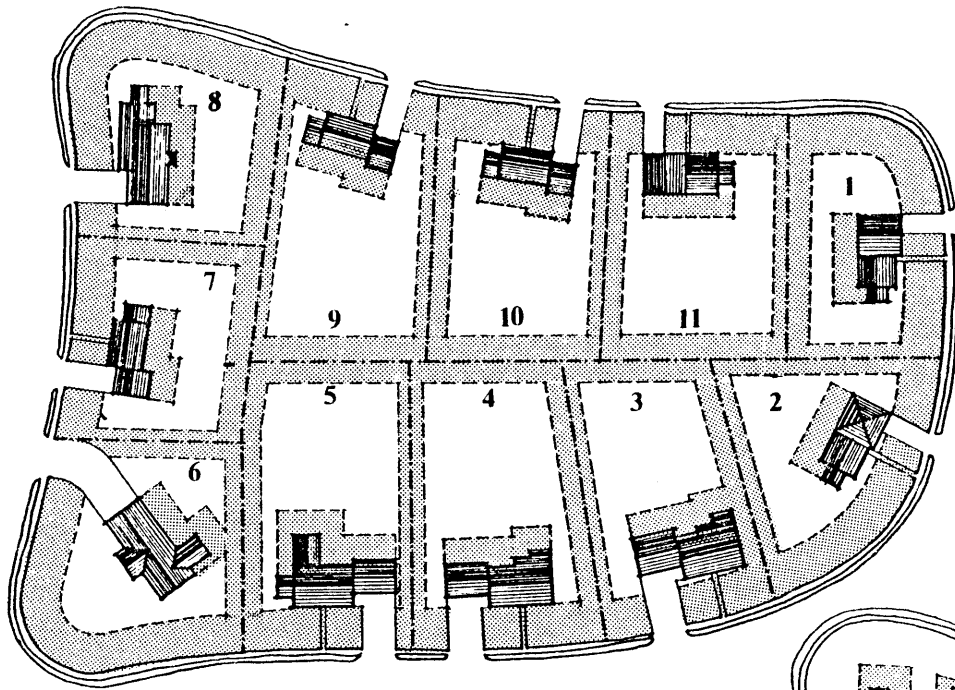
Pairing up of adjacent lots eliminates one lot line that separates side yard from side yard. In addition to producing greater total buildable area for new units, it provides more space between existing structures since two side lot lines setbacks are subsequently removed. This additional area offers greater freedom in the location of accessways to new units and helps insure the maintenance of interior privacy of existing dwellings as well. For example, if the existing structures are oriented so that the garage of one is adjacent to the living area of the other, the new driveway may be located alongside the garage, leaving a generous setback from the other structure.

Back-to-Back Lot Aggregation:


Pairing up lots through the block eliminates the rear lot line separating backyard from backyard. However, since on inner lots width is substantially less than depth, this organization results in less new buildable area than side-to-side aggregation of lots. In addition, two points of access are required to reach new units. It is interesting to note that the staggering of lots greatly reduces the


amount of buildable area by creating more setback area along lot lines.

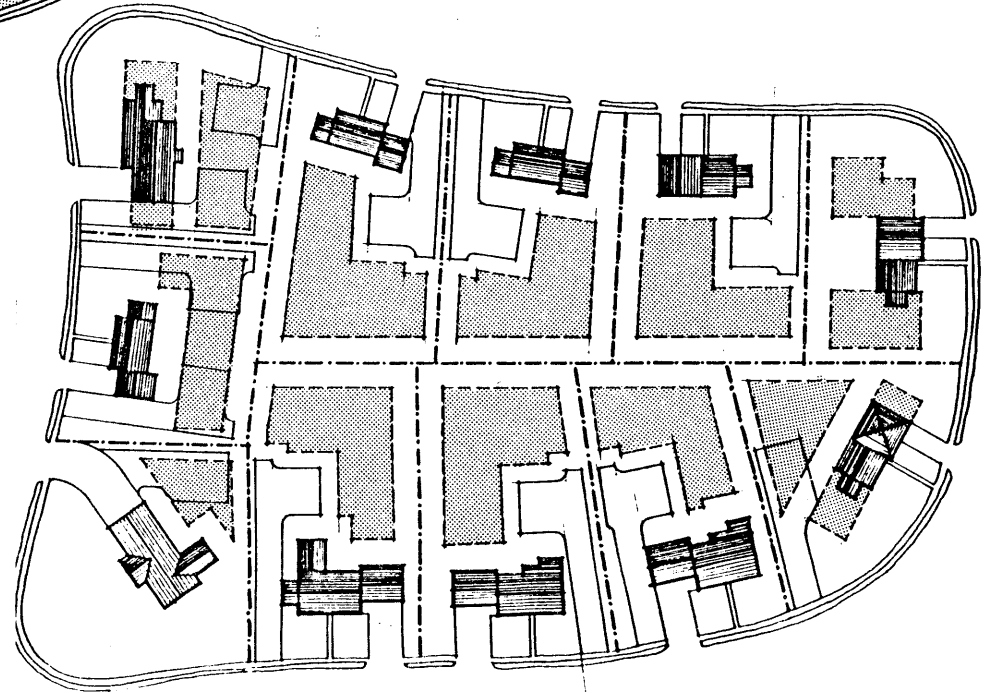
The chart on the following page lists the amount of buildable area for both single and aggregated lots.



B → C
 B → D₁

 non-buildable areas:
 required setbacks

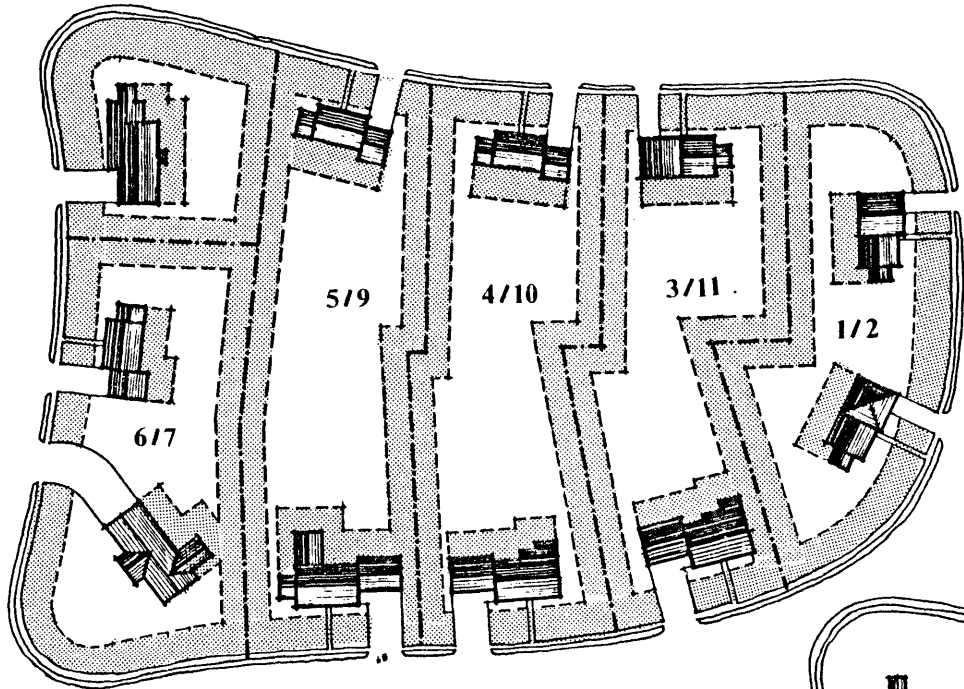
 buildable areas: new units



Single-Lot Aggregation

c = corner lot
 i = inner lot
 s = side lot

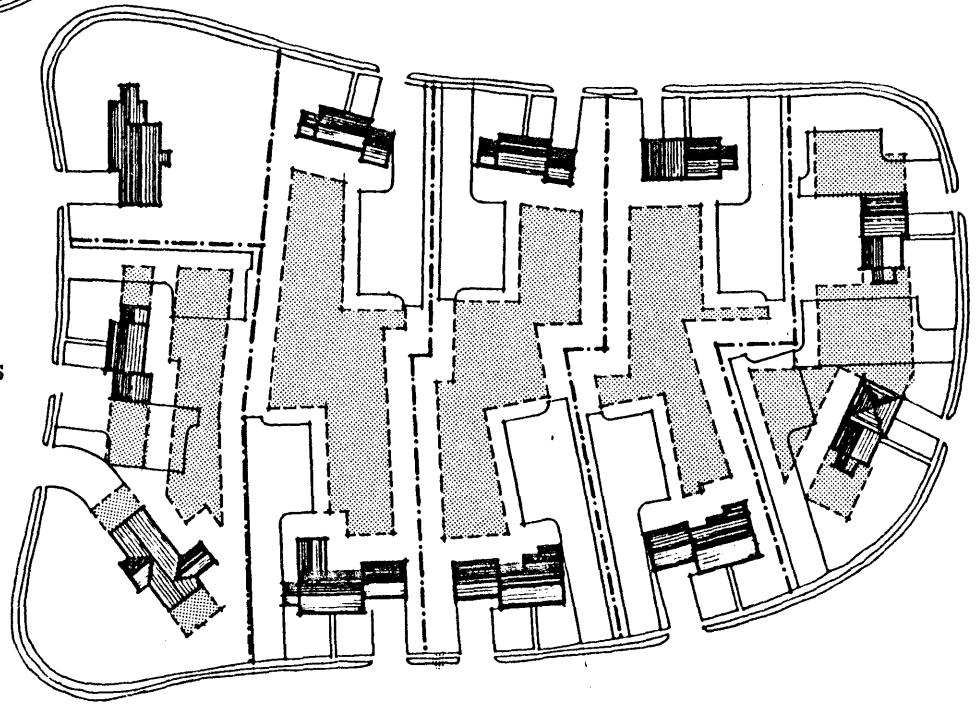
<u>Lot #</u>	<u>Type</u>	<u>Total Area</u>	<u>Total Build-able Area</u>	<u>(% of Total Area)</u>	<u>Area for New Construction</u>	<u>(% of Total Buildable Area)</u>
1	c	13,413 ft. ²	3,800 ft. ²	28%	1,700 ft. ²	45%
2	c	14,130 ft. ²	4,490 ft. ²	31%	2,800 ft. ²	62%
3	i	16,194 ft. ²	6,675 ft. ²	36%	5,400 ft. ²	82%
4	i	19,350 ft. ²	8,800 ft. ²	45%	7,200 ft. ²	82%
5	i	18,800 ft. ²	7,750 ft. ²	41%	7,325 ft. ²	95%
6	c	17,875 ft. ²	5,875 ft. ²	33%	1,550 ft. ²	26%
7	s	15,000 ft. ²	5,550 ft. ²	37%	3,450 ft. ²	62%
8	c	15,938 ft. ²	5,975 ft. ²	37%	3,275 ft. ²	55%
9	i	18,460 ft. ²	8,850 ft. ²	48%	7,900 ft. ²	90%
10	i	17,600 ft. ²	8,300 ft. ²	47%	6,925 ft. ²	83%
11	i	17,250 ft. ²	7,875 ft. ²	46%	7,125 ft. ²	90%

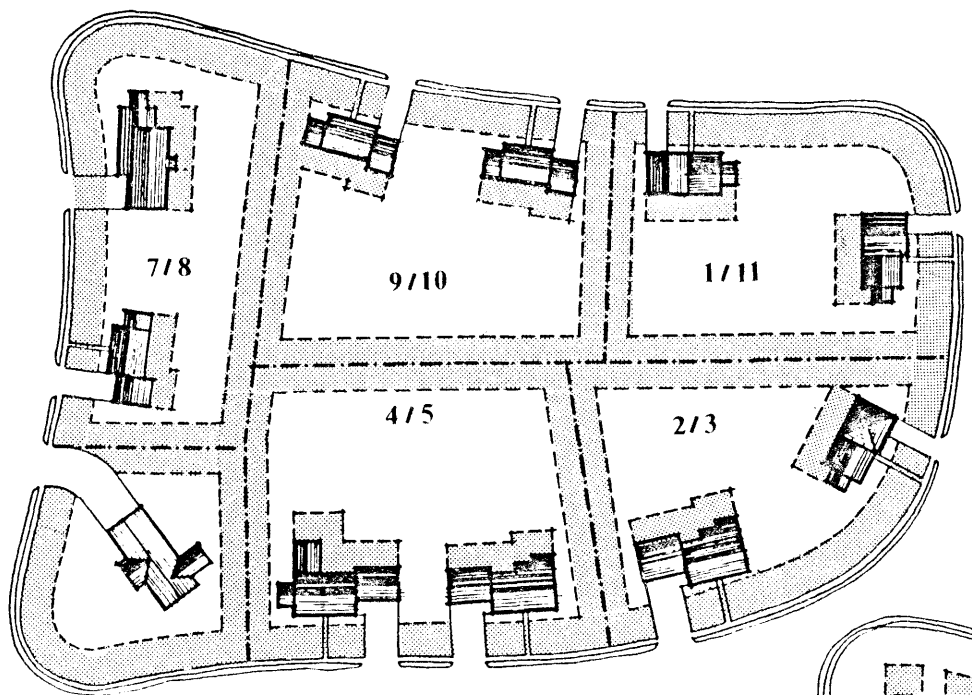


B → D₂ (back-to-back lot aggregation)


■ non-buildable areas:
required setbacks


■ buildable areas: new units

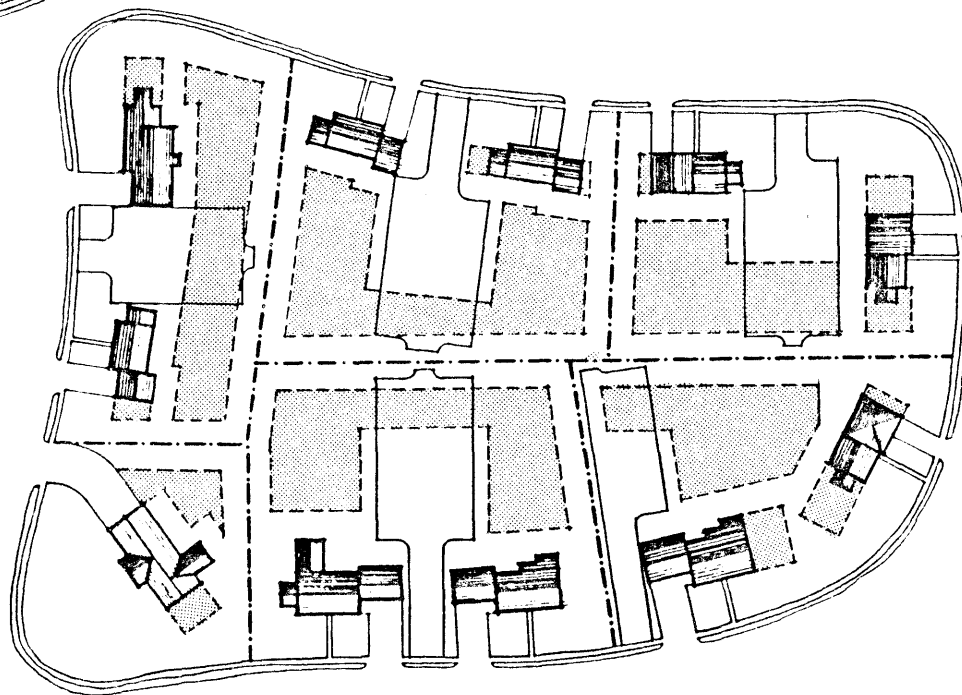




B → D₂ (side-to-side lot aggregation)

 non-buildable areas.
required setbacks

 buildable areas: new units



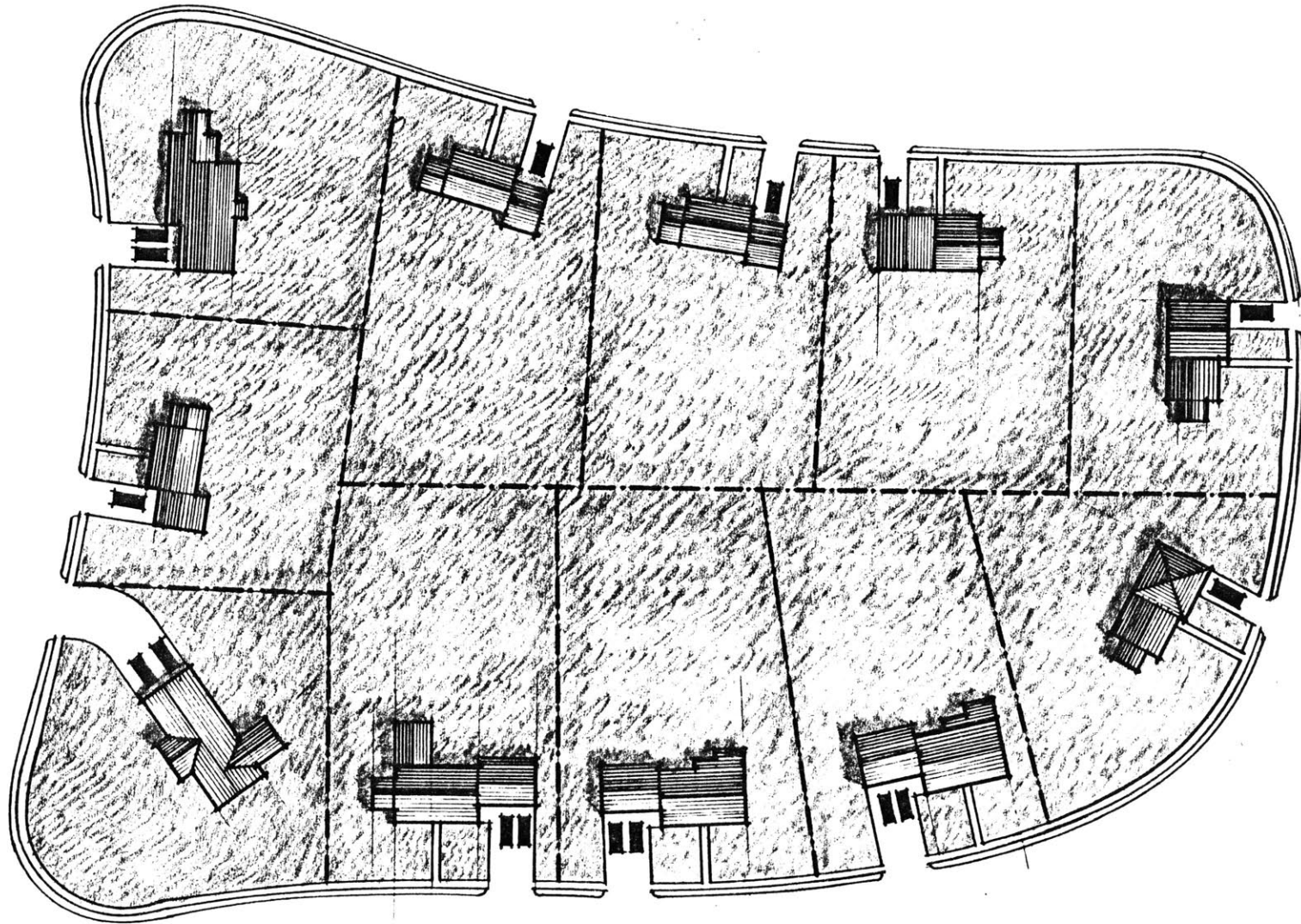
Double-Lot Aggregation

(a) <u>Side-to-Side</u>	<u>Total Area</u>	<u>Total Build-able Area</u>	<u>(% of Total Area)</u>	<u>Area for New Detached Units</u>	<u>(% of Total Buildable Area)</u>
1/11	30,665 ft. ²	14,800 ft. ²	46%	6,687 ft. ²	45%
2/3	32,324 ft. ²	12,788 ft. ²	40%	6,075 ft. ²	48%
4/5	38,150 ft. ²	18,150 ft. ²	48%	9,675 ft. ²	53%
7/8	30,398 ft. ²	11,000 ft. ²	36%	7,450 ft. ²	68%
9/10	36,060 ft. ²	18,175 ft. ²	50%	10,000 ft. ²	55%
 (b) <u>Back-to-Back</u>					
1/2	27,543 ft. ²	9,562 ft. ²	35%	6,800 ft. ²	71%
3/11	35,444 ft. ²	13,188 ft. ²	37%	6,688 ft. ²	51%
4/10	36,950 ft. ²	15,765 ft. ²	42%	9,025 ft. ²	57%
5/9	37,260 ft. ²	14,550 ft. ²	39%	9,150 ft. ²	62%
6/7	32,875 ft. ²	13,362 ft. ²	41%	4,962.5 ft. ²	37%

Site Designs

The following site designs illustrate the testing of buildable areas on the block. Minimum new construction is shown on the left-hand page and maximum new construction is shown on the right-hand page. For the sake of the thesis exercise, only one elevation is shown for each site design, that of Wendell Street. From observation, this street tends to be the most heavily used of the three that bound the block. As a result, the visual impact of new units may be most perceptible along this side. The existing conditions are shown first in plan and elevation to allow for comparison.

EXISTING CONDITIONS





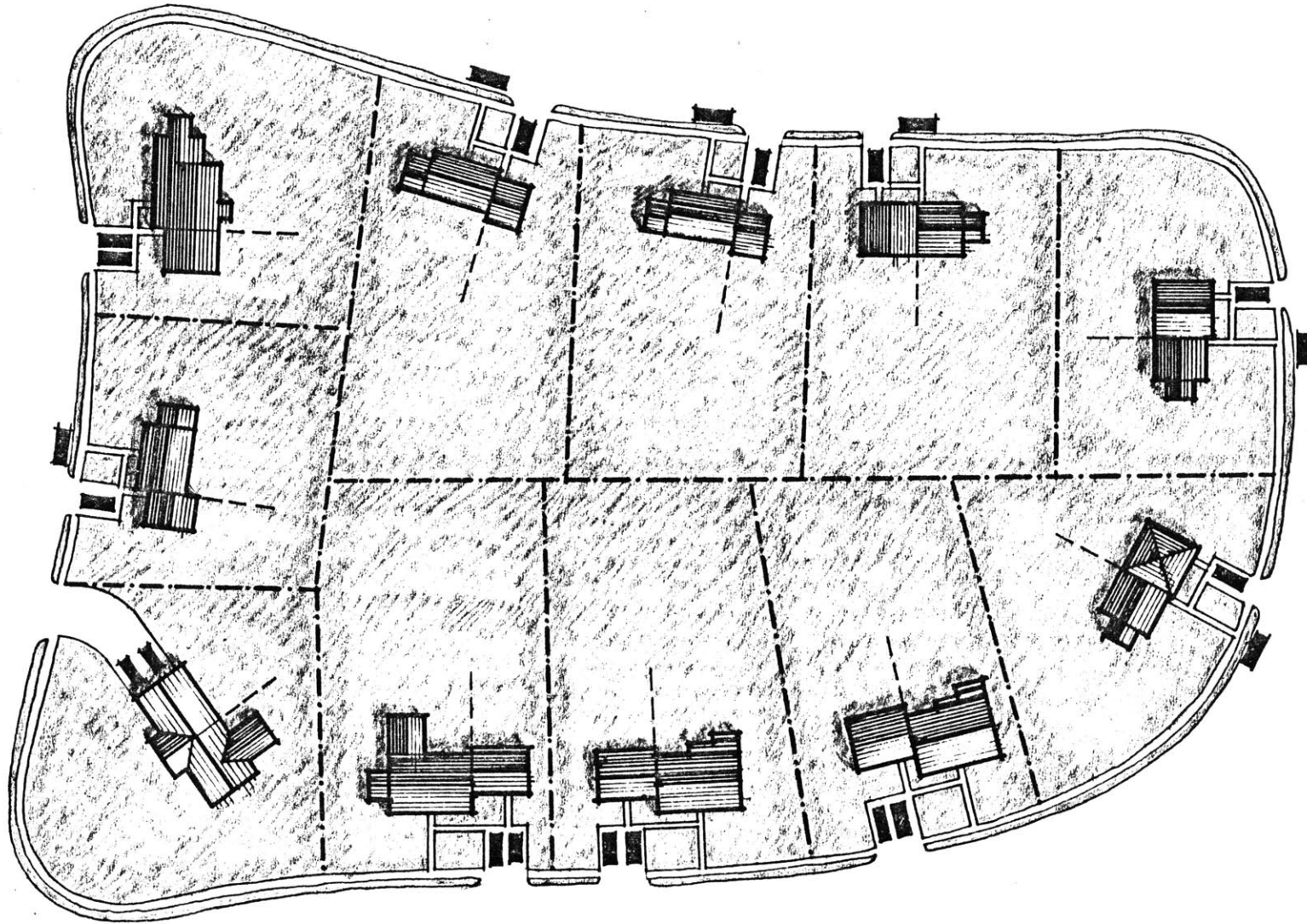
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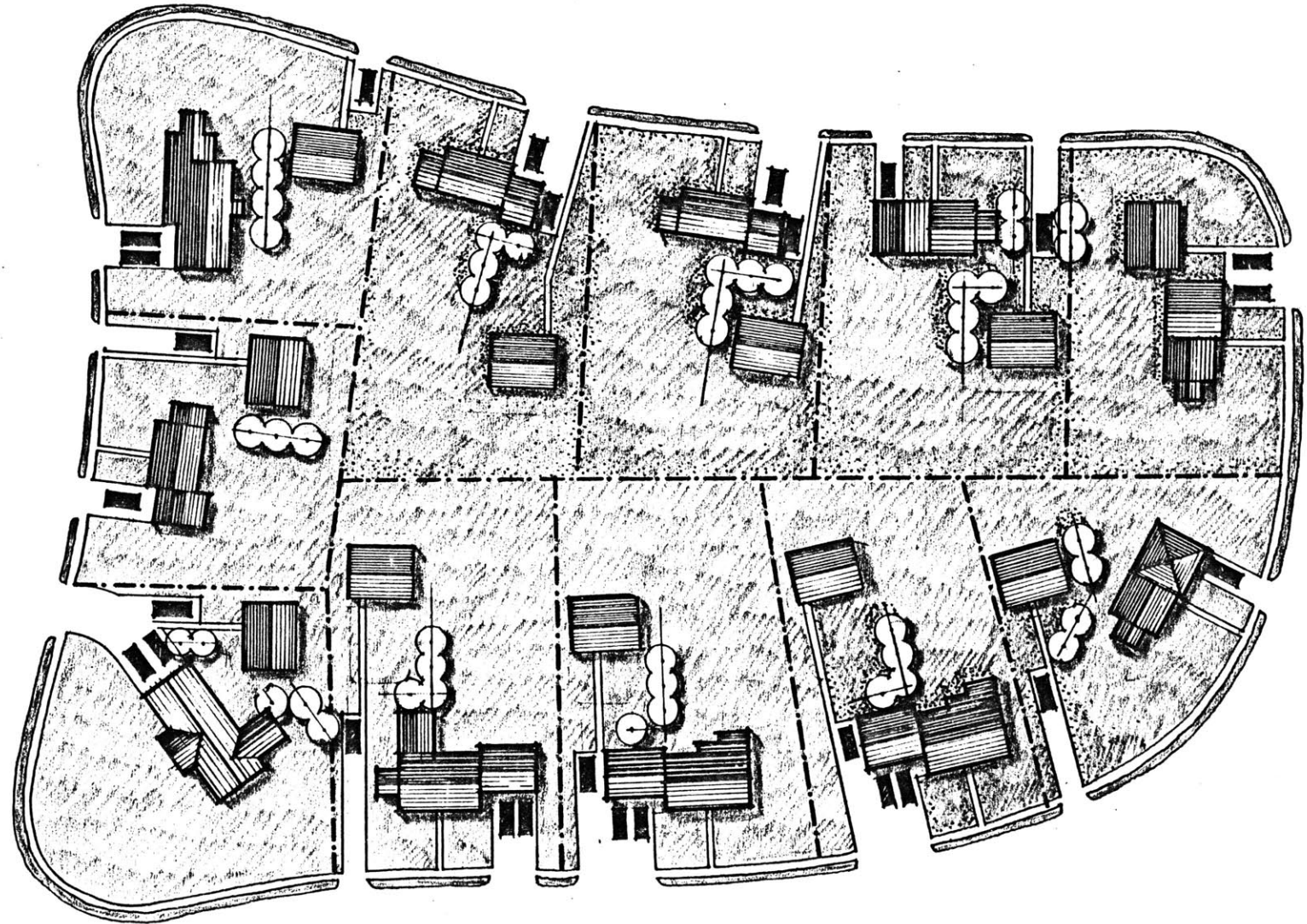
B → C

MINIMUM NEW CONSTRUCTION



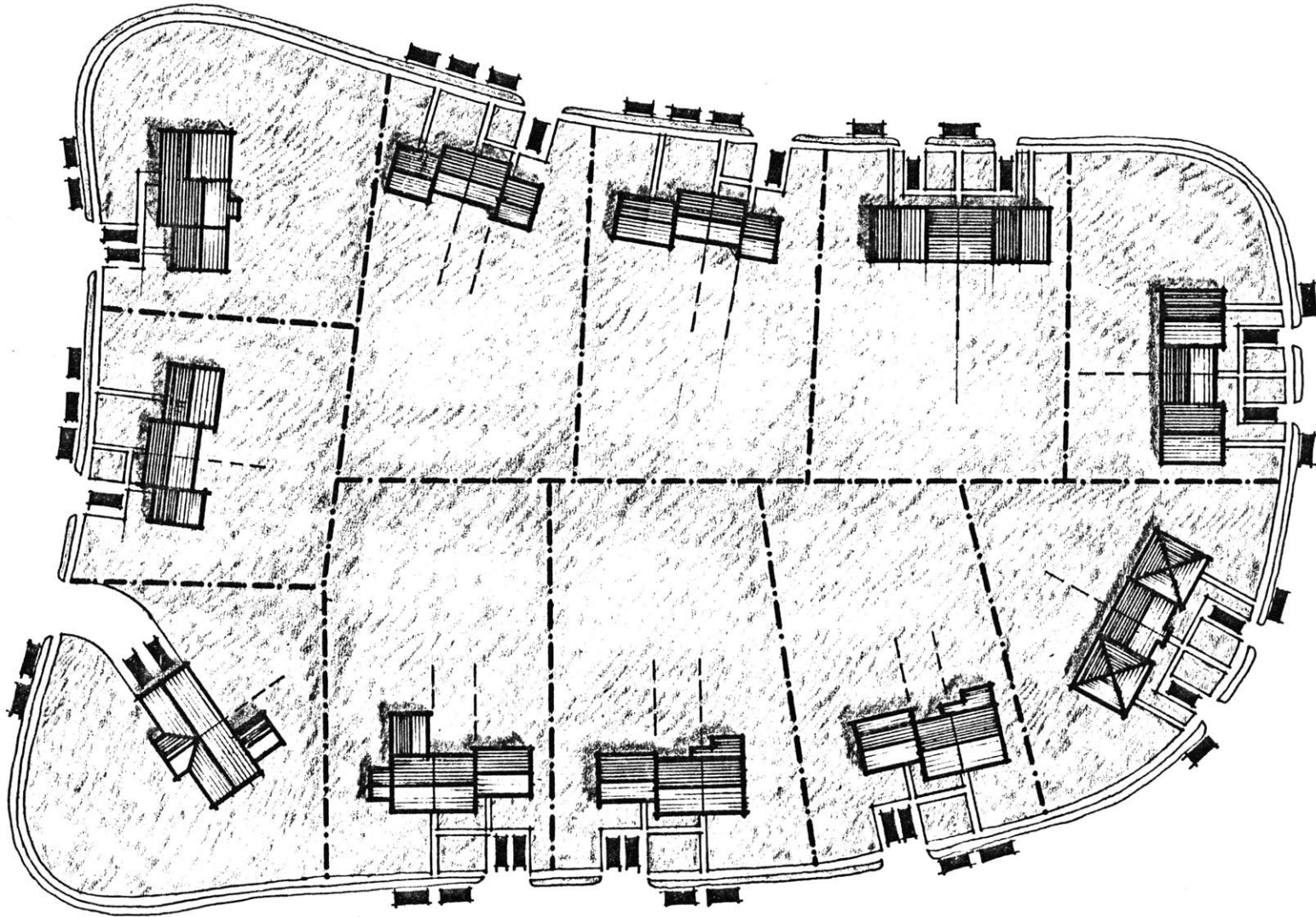
B → C

MAXIMUM NEW CONSTRUCTION



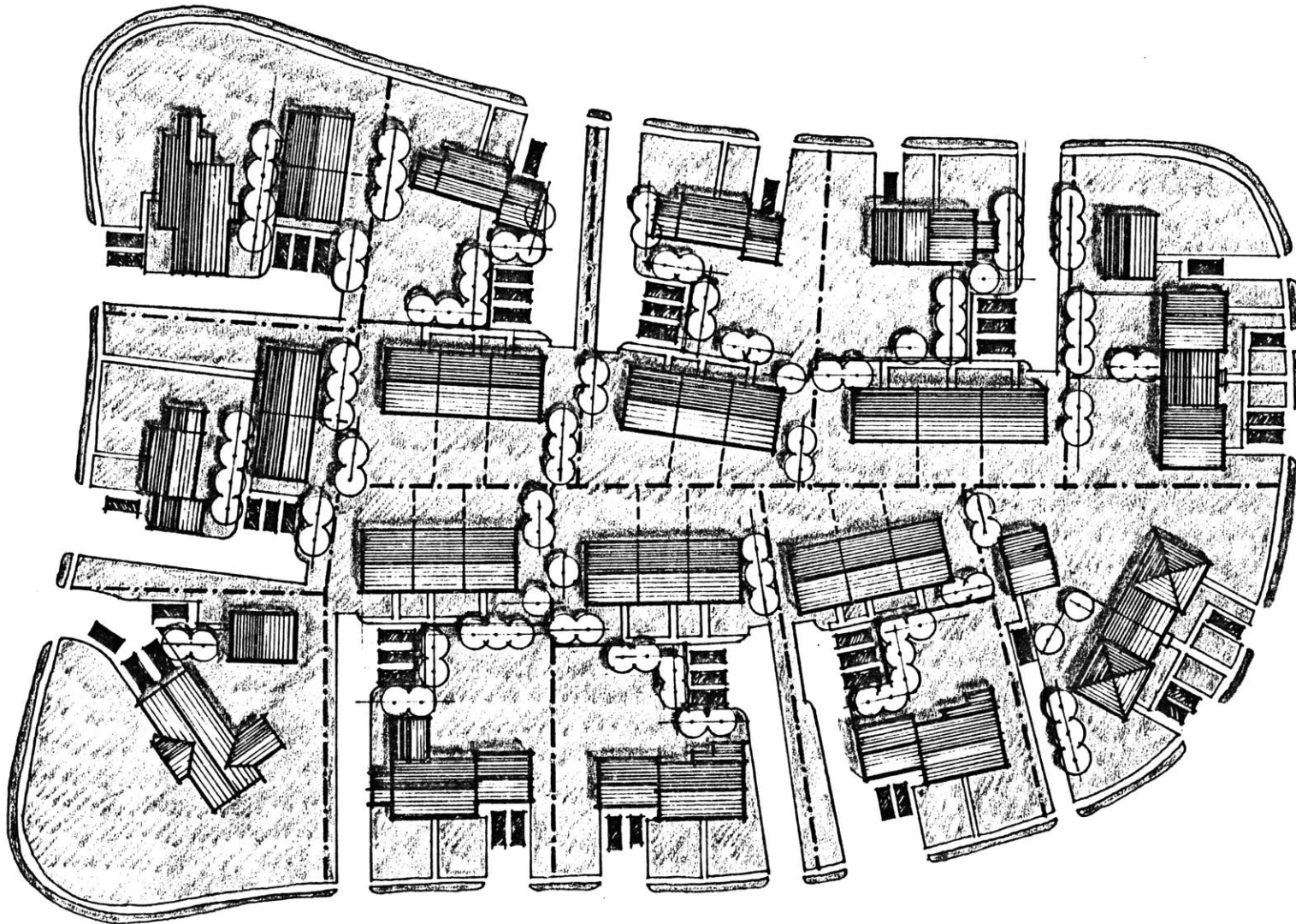
B. → D₁

MINIMUM NEW CONSTRUCTION



B → D₁

MAXIMUM NEW CONSTRUCTION



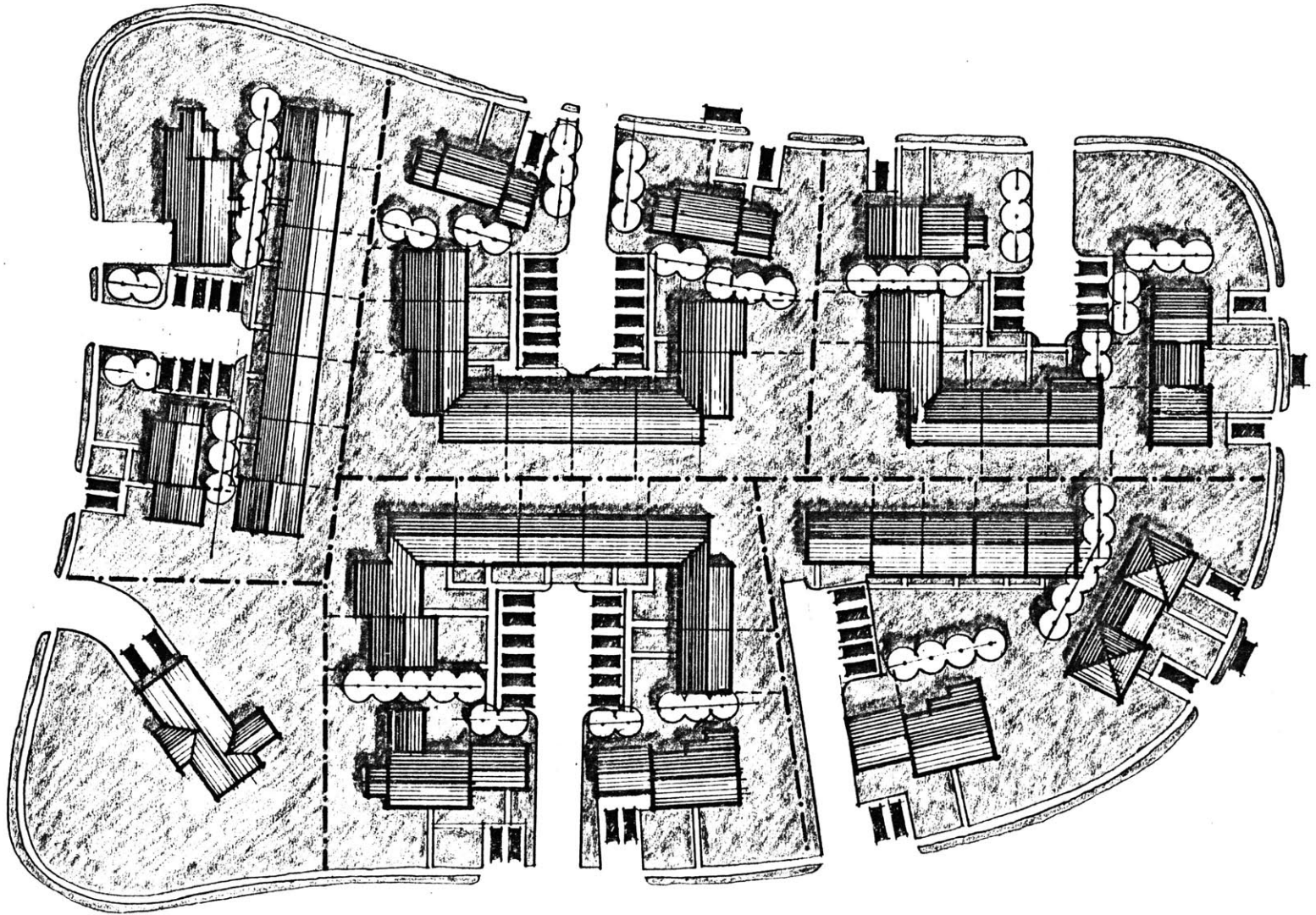
B → D₂

MINIMUM NEW CONSTRUCTION (side-to-side lot aggregation)



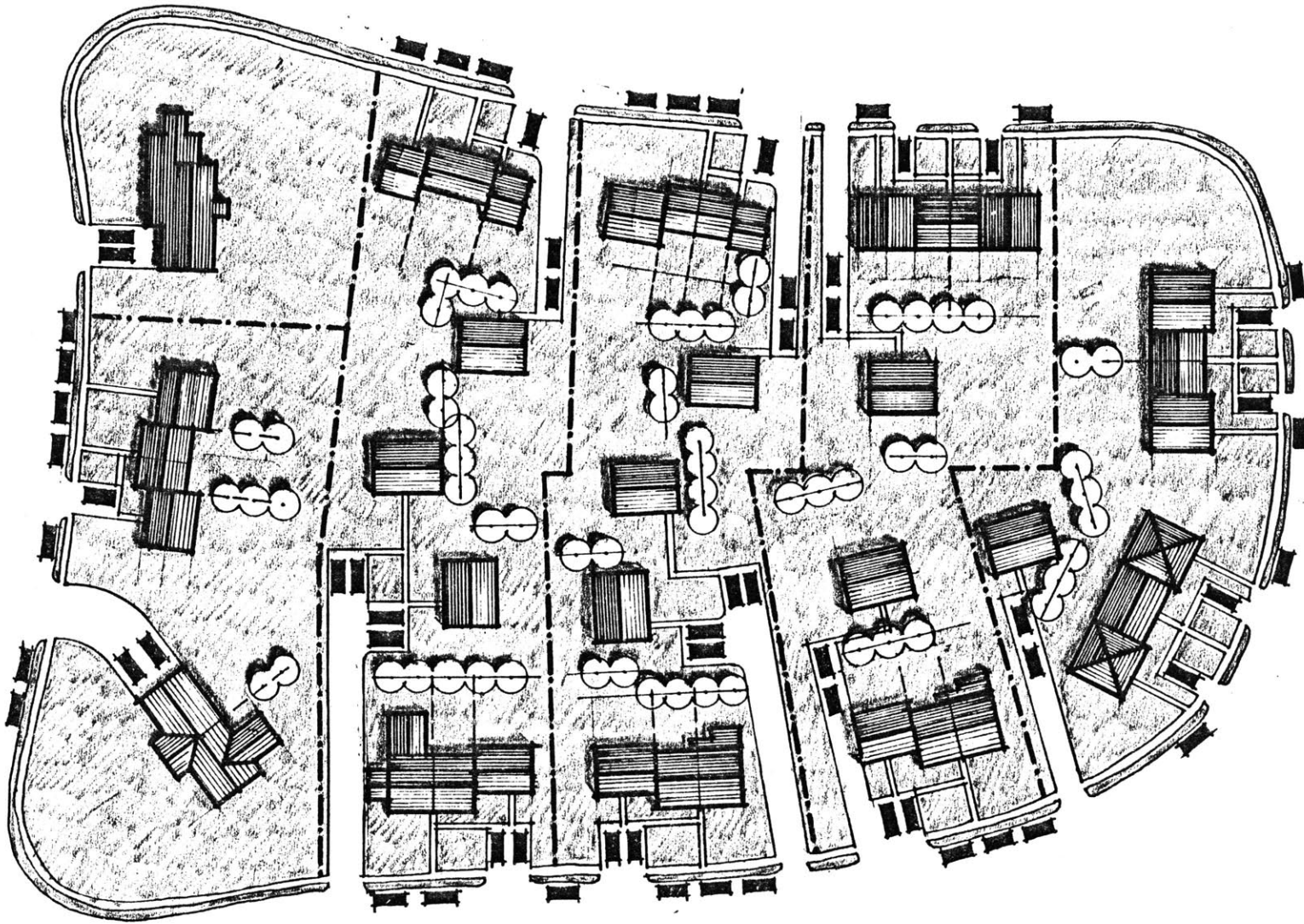
B → D₂

MAXIMUM NEW CONSTRUCTION (side-to-side lot aggregation)



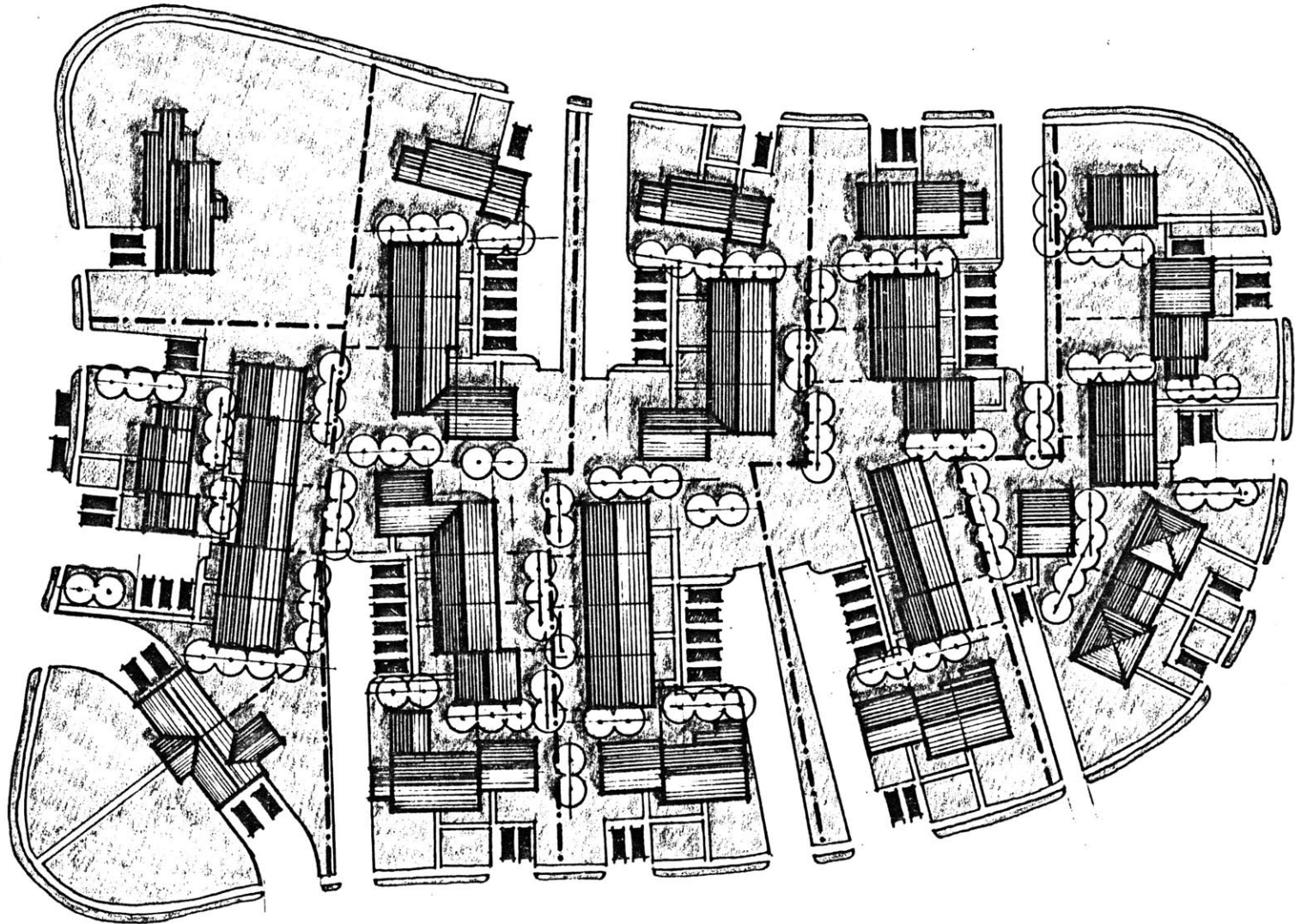
B → D₂

MINIMUM NEW CONSTRUCTION (back-to-back lot aggregation)



B → D₂

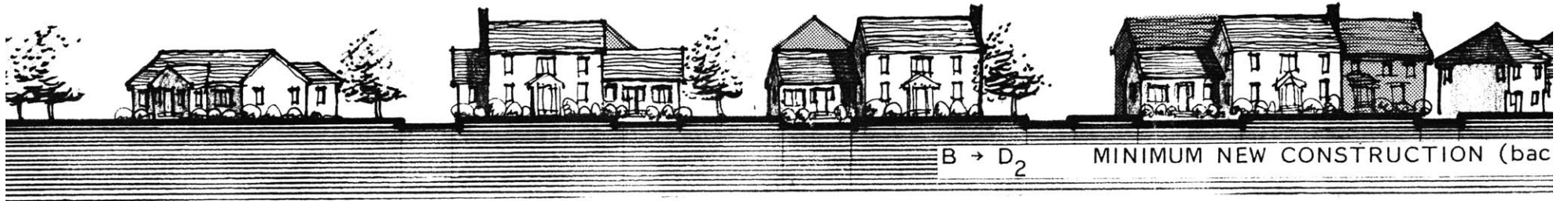
MAXIMUM NEW CONSTRUCTION (back-to-back lot aggregation)











EVALUATIONS

Using information gathered from the documentation and analysis of suburban neighborhoods and the site, as well as my own assumptions, criteria were developed and used to evaluate the ability of each design solution to preserve essential environmental qualities. The list of issues from which the criteria is derived includes:

1. Massing of new units;
2. The number of new cars on the site;
3. The distribution of new cars and paving;
4. The amount and privacy of outdoor space for existing dwellings;
5. The nature of views through the block;
6. Daylighting and energy efficiency of new units; and
7. The public/private zoning between the new development and the existing fabric.

Twenty individual standards were developed from this list:

Massing of New Units

1. The height of new units should not exceed that of the existing (front) house.

-
2. The length of new structures should not exceed 75' - the maximum local length.
 3. Each new unit should be individually articulated through a break in height and/or shift in the wall plane. The shift must be visually significant, i.e., no less than 5'-0".
 4. Each new unit must have an individual private entry.

Cars on the Site

5. The maximum number of new cars on-site is thirty-two - twice the existing number.
6. The maximum number of cars on a single lot equals the existing number plus twice the existing number.
7. The maximum number of new cars on the street is sixteen. No more than two new cars can be parked within each lot frontage.

Parking

8. New driveways should not be wider than 17'6", the maximum local width.
9. On-site parking must be organized in clusters of two bays to complement local patterns.

-
10. A minimum of 5'-0" strip of planting must separate each cluster.

Curb Cuts

11. No single new curb cut should exceed 20', the maximum local length.
12. The total curb cut/curb value should not be greater than 20% (the existing value is 14%).

Outdoor Space

13. Existing (front) structures must have at least the footprint area of the house (including garage) in backyard space.
14. The minimum depth of private outdoor areas of existing structures must equal the depth of the structure.

Solar Orientation of New Units

15. New units on the south side of the block must be set back at least a distance from the front structure equal to the height of the front structure. New units on the north side must be set back from the front structures a distance equal to their own height.

-
16. New units should be oriented with their length along the east/west axis.

View

17. Sixty percent of the perpendicular views between houses should be maintained through the block.
18. If this is not possible, sixty percent of the perpendicular view can be through to the rear lot line, but must terminate in large vegetation (i.e., trees).

Public/Private Zoning

19. New units should be oriented back to back, with private outdoor areas between units.
20. A front/back relation between new units that overlap existing structures should be avoided, unless new units are at least 60' away. A side/back relation is acceptable.

The eight design solutions are evaluated by determining what percentage of consolidation fails to meet the qualitative standards. The percentage failure is graded in the following way:

0% failure	5
1% - 25 % failure	4
26% - 50% failure	3
51% - 75% failure	2
76% - 100% failure	1

Given the twenty standards, a perfect score is 100. The results of the qualitative evaluation are summarized in the table on the following page.

Tally

		Single-lot development				Double-lot development			
		B → C		B → D ₁		B → D ₂ ¹		B → D ₂ ²	
		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<u>Massing</u>	1	○	◐	○	◐	○	◐	○	◐
	2	○	○	◐	◐	◐	◐	◐	◐
	3	○	○	◐	◐	◐	◐	◐	◐
	4	○	○	◐	◐	◐	◐	◐	◐
<u>Cars</u>	5	○	○	○	○	○	◐	○	◐
	6	○	○	○	○	◐	◐	○	◐
	7	○	○	◐	○	○	○	◐	○
<u>Parking/Paving</u>	8	○	○	○	○	○	○	○	○
	9	○	○	○	◐	○	◐	○	◐
	10	○	○	○	◐	○	◐	○	◐
<u>Outdoor Space</u>	11	○	○	○	○	○	◐	○	◐
	12	○	○	○	○	○	○	○	○
<u>Solar Orientation</u>	13	○	○	○	○	○	◐	○	◐
	14	○	○	○	◐	◐	◐	○	◐
<u>Curb Cuts</u>	15	○	◐	○	◐	◐	◐	◐	◐
	16	○	○	○	◐	○	○	○	◐
<u>Views</u>	17	○	○	○	○	◐	◐	○	◐
	18	○	○	○	○	◐	◐	○	◐
<u>Public/Private Zoning</u>	19	○	○	○	○	◐	◐	○	◐
	20	○	○	○	○	○	◐	○	◐
Final Score:		100	97	88	83	81	59	88	66

Results

Results:

1. Minimizing new construction is clearly less disruptive than maximizing new construction for all densities, except in the area of new cars on the street, where these schemes fail completely. One solution for this would be to park additional cars on site, behind the structure.
2. The criteria for massing of consolidation is most restrictive to schemes involving minimum construction (i.e., maximum internal subdivision) and should be questioned in this application.
3. On single lots, the threshold for the impact of new structures seems to be three units (D_1 maximum) as this requires different patterns for massing, parking and paving.
4. The schemes in which two lots are aggregated tend to produce larger building volumes and greater paved areas.
5. Of the two aggregation approaches, the one involving adjacent lots is more disruptive to existing views and in the amount and distribution of new cars and paving. This is due to the fact that this organization requires

common access and orients new structures with their length to the street.

6. Aggregating lots back to back is less disruptive with regard to these issues since two points of access are required and new structures are oriented with their short side to the street.
7. On back-to-back aggregation of lots, staggered lot lines can produce more positive massing patterns for new construction, since shorter building lengths are required.

Of all schemes, the most disruptive seems to be "D₂ maximum" in which adjacent lots are aggregated. This scheme scored lowest in the following areas:

Massing: New structures greatly exceed the maximum local length of 75', and individual units are generally not physically articulated.

Cars: The number of cars (on site) per lot exceeds the required amount.

Parking/Paving: On-site cars are not parked in clusters of two, nor are the clusters separated by planting.

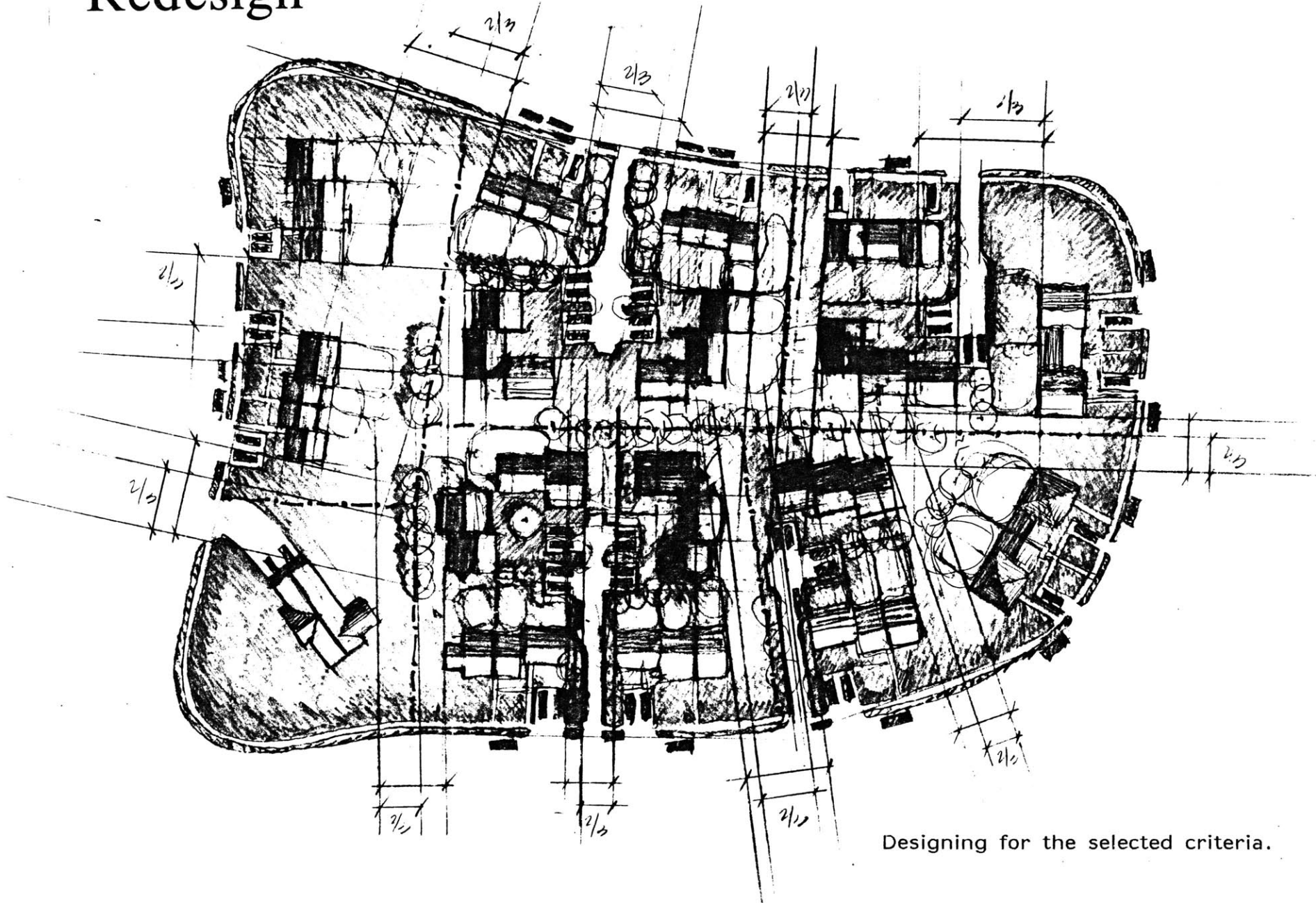
Outdoor Space: Existing houses have less than the recommended amount of outdoor space.

Views: Views between existing structures are generally closed by new structures.

Public/Private Zoning: In one case in particular, new units face directly onto the private outdoor areas of existing houses.

Using all the criteria, but giving priority to those issues above, the scheme was redesigned to improve its score. On the following pages are the original site design and the new site designs. Included is a preliminary sketch illustrating the application of the criteria on the selected areas requiring improvement. The new scheme is evaluated and the results compared to those for the original.









































Redesign



Designing for the selected criteria.



Evaluation: Improved Scheme

		Before	After
<u>Massing</u>	1		
	2		
	3		
	4		
<u>Cars</u>	5		
	6		
	7		
<u>Parking/Paving</u>	8		
	9		
	10		
<u>Outdoor Space</u>	11		
	12		
<u>Solar Orientation</u>	13		
	14		
<u>Curb Cuts</u>	15		
	16		
<u>Views</u>	17		
	18		
<u>Public/Private Zoning</u>	19		
	20		
Final Score:		59	89

Evaluation of Criteria

Evaluation of Criteria:

Based on the redesign of the most disruptive scheme, an assessment of the criteria can be made. As a design tool, the set of standards is successful in allowing a range of consolidation to occur on the block, given the change in allowable density. The redesigned scheme includes all three generic forms of consolidation: internal subdivision, additions and new units, in configurations that seem reasonable in terms of economic feasibility (new units are attached, paving is relatively contained, etc.). As a vehicle for insuring the maintenance of positive environmental qualities, the set of standards is also successful, as evidenced by the results of the reevaluation. The most potentially restrictive criteria appear to be the requirement for unobstructed views and the ceiling on new curb cuts. The first, in particular, should be questioned in light of existing examples of consolidation. At issue is the way in which new construction is to be integrated into the neighborhood fabric. While the sense of openness of suburban neighborhoods is important, there are undoubtedly other ways to achieve the perception of spaciousness and still allow for consolidation. Vegetation and other forms of screening play an important role in this.

Although new construction may be the most visually conspicuous sign of consolidation and thus potentially the most disruptive to the neighborhood, existing examples show that with careful articulation of volume and facades, new construction can complement and even enrich the architectural character of suburban environments. Less solvable is the problem of new cars on site. In addition to being visually obtrusive, cars introduce problems of noise and pollution. Unfortunately, since low-density neighborhoods seldom have efficient public transportation, consolidation of these environments will probably mean additional cars. However, as mentioned before, an increase in unit density may not necessarily imply a corresponding increase in resident population; the impact of new cars on site may be less significant than anticipated for higher densities.

It should be noted that the site designs and elevations illustrate participation of all lots on the block at once. In fact, existing examples reveal that there may be a possible ceiling of 30% in the number of lots that actually consolidate over time.* In this sense, the diagrams shown are not realistic and represent one particular expression of a concept.

CONCLUSIONS

The design exploration has illustrated the inherent flexibility of one "typical" suburban block. Establishing the spatial capacity for consolidation is the first step of a large process that will determine all the implications of increased residential densities in suburban neighborhoods. Clearly there are a number of other issues not addressed in this thesis exercise that need to be considered in future work, including:

- the public costs of consolidation, i.e., the impact on municipal services;
- land value and property tax implications;
- development and construction feasibility;
- possible alternative ownership scenarios, such as pooling of land, etc.

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 7. Ibid., p. 69.
 8. Professional Builder, editors. "What 1983 Buyers Want in Housing," pp. 64-65.

*Subdivision of lots requires the addition of front and rear setbacks for the new, rear property. As a result, the spatial capacity of lots cannot be fully tested as much potential buildable area becomes non-buildable.