PERFORMANCE STANDARDS
FOR RESIDENTIAL ZONING AND SUBDIVISION CONTROLS

by K. IZUMI

submitted in partial fulfilment of the requirements for the degree of MASTER IN CITY PLANNING (MCP)

author's signature

certified by
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January 12 1952
Title: PERFORMANCE STANDARDS FOR RESIDENTIAL ZONING AND SUBDIVISION CONTROLS.

Author: K. IZUMI.

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The results of residential development under present zoning and subdivision regulations leave much to be desired. A more elastic type of control is thought to be in order. The thesis attempts to show that the "performance approach" will fulfill this need.

The prime concern is the single-family detached dwelling unit, its yard and street access. Site conditions, social policy, personal desires, technology and the "way of life" are discussed as factors from which a point of departure for further analysis is found. This is the assumption of the A.P.H.A. Standards for Healthful Housing as embodying the provisions of the social policy. These requirements are then augmented and modified by the requirements of the other factors mentioned. Various proposals as to the type of provisions for adequate space for the dwelling, the outdoor requirements and the street access are put forth and discussed. These proposed type provisions are then subjected to a comparison with present regulations. This phase is graphically illustrated.

Advantages accruing from the proposals are noted followed by a discussion of the new background data required to fully benefit from the new type of regulations. A methodology for the gathering and dissemination of this information is suggested. Other present and future considerations such as future technology, the "new" forms of housing are discussed briefly.

It is tentatively concluded that the new type of provisions as proposed do not assure good design anymore than the present; but that strict adherence to the provisions would not result in any poorer designs; nor would it "cost" anymore in its application. The significant result is that it would not prohibit good designs in contrast to present regulations. Finally recommendations are made as follows:

1. Integration of zoning and subdivision controls or at least a better co-ordination between the two.
2. A more detailed and precise type of specification, stating the performance requirement of each provision.
3. Performance type building codes should be adopted and zoning and subdivision controls complement these or vice versa. In any case the controls should recognize technological developments.
January 12, 1952.

Professor Frederick J. Adams, Head
Department of City and Regional Planning,
Massachusetts Institute of Technology,
Cambridge, Massachusetts.

Dear Prof. Adams:

In partial fulfilment of the requirements
for the degree of Master in City Planning (MCP),
I submit this thesis entitled:

PERFORMANCE STANDARDS FOR RESIDENTIAL
ZONING AND SUBDIVISION CONTROLS.

Respectfully,

Kiyoshi IZUMI.
ACKNOWLEDGEMENTS

The author wishes to express his sincerest appreciation to:

The Royal Architectural Institute of Canada, College of Fellows, for the scholarship which enabled the continuation of formal studies and hence undertake this thesis.

Professor Burnham Kelly, Department of City and Regional Planning, M. I. T., for his constructive and enlightening criticisms throughout the course of this thesis.

The several who contributed their valuable time and money to assure my stay in the United States.

My wife, for her indulgence.
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Considering the circumstances of evolution, most zoning and subdivision regulations are a reasonable and fair attempt to deal with a complex problem. But, the results of residential development under present controls leave much to be desired. It is probably impossible to prohibit "bad" design or to pass a fiat that a certain design must be followed. However, it is desirable and highly possible that what controls we have could be more "positive" in effect to encourage and facilitate good imaginative design.

Further, this new approach to controls, with the necessary flexibility is a must if we are to take advantage of the past, present and future technological developments; to keep up with and give expression to the ever-changing and improving "way of life"; and to maintain as much as possible the individual's freedom of choice and expression, above all in his own home. Then and only then, will we be able to reap the profits of the cost-cutting devices offered by technology; to give expression and spread the benefits of the good features of the diverse "way of life" so far
limited to the select few; and to make available the variety of lots and dwellings to the mass.

To help accomplish these ends, first, the controls should not place limitations on good design as do the present regulations. While establishing a minimum, they should not prohibit the "maximum". Second, the provisions need to be couched in terms, quite definite but also "suggestive". For example, instead of a specification for a roadway reading, "required a 20' width pavement", it could be stated in this fashion, "required two moving lanes of 10' width each". While just as if not more specific, the latter conveys another message. "Two moving lanes" says quite definitely that they are not for parking and implies need for providing additional space for this purpose. Admittedly, should off-street parking be desired, this should be stated but it is obvious that the direct reference to performance is precise and more positive as a means to stimulate and encourage thinking of better designs.
INTENT AND SCOPE OF THESIS

INTENT

The intent of this thesis is to show that the "performance approach" in evolving zoning and subdivision regulations will help to fulfill the need discussed in the foregoing.

In the course of the following, many "value" judgments are made which warrant more thorough research and discussion but for reasons of limitations of time and research facilities, these are not undertaken. For illustrative purposes only, many of the figures proposed and used, particularly those relative to spatial requirements are comparable to those of prevailing practice. This is to facilitate the illustrative comparison contained later and should not be assumed that they are the standards advocated.

In several instances the reader will differ with respect to the use of a particular "Standard" but where these seem significant, they are noted and briefly discussed.

SCOPE

To illustrate this "approach" in reasonable detail, the portion that the thesis covers is the physical design of that type of residential area usually classified as "A", "RI", "RAI" and so on signifying the "highest" form of dwelling
areas. These are the areas limited to the so-called one-family detached houses. Since design restrictions become more real as the lots get smaller, about 7,000 square feet and under, specific interest is shown in this type of lots.

Since the basic element of any residential district is the individual unit composed of the dwelling, its yard and access street, the requirements of this "unit" should be paramount in establishing any regulations to control its design. Therefore the analysis is centered on this unit, basing any proposals or recommendations for controls mainly from this point of view. As a matter of fact, some factors important to the unit effect the larger residential area directly and vice versa. Where these occur, they are discussed with necessary qualifications.
THE PRESENT SITUATION

The major drawbacks of present regulations are mostly due to the assumption that the same regulation will have the same effect on every parcel of land with which it deals. This has lead to the resolution of control measures to exact spatial dimensions. Also, for reasons of administration, this was thought to be the best. But, a recent survey shows that 62 out of 68 cities have had to grant variances to these rigid requirements. It should be obvious that a 30 foot set back requirement on a 100 foot depth lot has not the same effect as the same setback on a 150 or even a 110 foot depth lot. Similarly, a side yard aggregate width requirement of 12 feet on a 50 foot width lot presents difficulties infinitely greater than the same restriction on a 70 or even a 55 foot lot. The cumulative effect has a discouraging effect on the designer and the result, to say the least.

THE PERFORMANCE APPROACH

This approach is not unlike the method used by the up-to-date specifications of many engineering societies and institutes. For example, the specifications for designing a typical floor are usually stated as follows:

1. Live load requirement in lbs. per square foot,
2. Fire resistance rating in degrees per hour,
3. Sound insulation rating in decibels, and so on.

With these, the designer is free to choose the type of material, the method of construction, the design formulas and so on. Hence, he is able to evolve any span or bay system, thickness of floor, finish etc. to suit his design so long as he fulfills the basic performance requirements of supporting the live load, resisting fire for the required number of hours, providing the proper amount of sound insulation etc.

1. The manuals and handbooks of the American Institute of Steel Construction (AISC), the American Welding Society (AWS), the American Society for Testing Materials (ASTM), the American Concrete Institute (ACI), the British National Research Board are a few.
This is comparable to specifying the number of moving lanes, parking facilities required, pedestrian ways, buffer and planting strips etc. for the design of the street right of way instead of stating the exact width for the street and pavement. With the former, the designer has some freedom to decide what combination will best suit his design.

It is indicative of the validity of this approach to note that Mamaroneck, Westchester County, New York, has legally adopted a "performance type" building code for one and two-family dwellings. This is in direct contrast to most existing building codes which set up rigid specifications. For example, these may require walls to be of a certain thickness even though a lighter construction may prove to be just as if not more effective to adequately support the weight or to provide the necessary insulation.


2. The BOCA (Building Officials Conference of America), NAHB (National Association of Home Builders) have published a basic building code and a plumbing code of the performance type respectively. The National Board of Fire Underwriters, the American Institute of Architects, American Public Health Association have also made contributions.
THE FACTORS TO BE CONSIDERED

The difficulty in evolving this type of specification for zoning and subdivision controls lies in the proper segregation of factors, to gather together under a specification all those elements with a common denominator. However for ease of analysis, the factors to be considered are cast as shown in the diagram opposite. They are placed in order of their relative capacity (number of ways) to influence the physical design of the "unit". The social policy is singular, that is to say, society agrees usually to a standard or a group of standards, so it is assumed that the social policy makes a "singular" impact. On the other hand, since there is no agreement in the same sense, technology's influence on design vary as to what and how much is used. Similarly the "way of life" has diverse influences, varying as to the habits, customs, social status and so on of the party concerned.

Site conditions are next in this hierarchy, the various elements changing from lot to lot, region to region, placing to another degree its demand on physical design. Finally, as the manifestations of the personal desires are infinite in number and least accountable, it is placed at the bottom.

A study of this hierarchy shows that as we progress from the top down, we need greater flexibility in our controls. In other words, the certainty of the grounds for
control decrease and hence a wider latitude is necessary. The point of departure for further analysis suggests itself, the social policy which has the least diversification. Hence the analysis proceeds as follows. A desired set of provisions, reflecting the social policy is assumed. Next, these are augmented by the demands of technology and the "way of life". Then the site conditions are taken into account and finally the requirements of the personal desires noted. From the results of the demands of each on the physical design of the dwelling unit, its yards and street access, suggestions are made as to the type of provisions which will best accomplish the desired ends.

THE SOCIAL POLICY

Any social policy is derivative of the economic, political, technological and myriad elements which form the social "climate" of the time. However, the "timeless" considerations are put forth in the constitutional basis for the police power which states that regulations must be "to secure the health, safety, morals, comfort, convenience and general welfare of the community." 1

PHYSICAL DESIGN STANDARDS
for
Lot Dwelling Access

SOCIAL POLICY
Provisions of the police power as expressed for example in the standards of bodies such as the American Public Health Assoc.

TECHNOLOGY
Household Equipment
Building Materials and Methods
Architectural Detailing
Others

WAY OF LIFE
Social Progress
Customs and Fashions

SITE CONDITIONS
Topographical
Vegetation
Soil
Contours etc.
Climatological
Sun
Wind
Rainfall
Snowfall etc.
Views

PERSONAL DESIRES
Availability of choice
Freedom to develop site
At any given time these are expressed by minimum space and other standards for housing evolved by various governmental agencies. In general the standards recommended by non-governmental agencies tend to be more generous. For this thesis, the provisions as set forth by the American Public Health Association, Committee on the Hygiene of Housing are assumed to reflect the social policy. These are published as "Standards for Healthful Housing", in three volumes titled:

PLANNING THE NEIGHBORHOOD (1948),
PLANNING THE HOME FOR OCCUPANCY (1950),
CONSTRUCTION AND EQUIPMENT OF THE HOME (1951).  

The following are the various considerations culled from their text,

For the Dwelling Unit

1. A dwelling unit for each family in any residential area based on social and psychological needs.

2. Adequate dwelling space:

   For one person ............... 400 square feet.
   For two persons ........... 750 square feet.
   For three persons .......... 1,000 square feet.
   For four persons .......... 1,150 square feet.
   For five persons ........... 1,400 square feet.
   For six persons ............ 1,550 square feet.

3. Provision for household activities, personal and family.

4. Provision for suitable conditions of temperature.

1. Public Administration Service, 1313 East Sixtieth St.,
   Chicago 37, Illinois.
and light:

Winter heating,
Summer cooling,
Ventilation,
Daylight.

5. Provision for sanitation and health.

6. Provision for privacy and personal satisfaction.

For the Lot

1. Protection against noise, odor and invasion of privacy.

2. Provision of natural illumination.

3. Provision of cross and through ventilation.

4. Provision of adequate egress, access to street, access to rear of lot.

5. Provision of optimum size and use of lot for:

   Outdoor living space,
   Play space for pre-school children,
   Space for drying and airing of clothes, etc.,
   Space for off-street parking.

6. Provision for other facilities on the lot:

   Garage or car-port,
   Porch and/or garden shelter,
   Storage shed,
   Workshop,
   Incinerator,
   Garbage can shelter.

7. Provision for adequate relationship to adjacent lots and dwelling units.

8. Provision for proper ground drainage.

For the Access Street

1. Access street, easement or other public way for:
a. Public utilities:

Sewerage lines,
Water supply,
Gas lines,
Power lines.

b. Public service:

Street cleaning,
Snow removal
Garbage collection,
Access for ambulance, fire fighting apparatus and other emergency services,
Access for delivery of mail, fuel etc.

c. Automobile and other vehicles:

Adequate space for movement,
Parking facilities.

d. Pedestrian ways:

Sidewalks and crosswalks.

e. Others:

Planting,
Street lights,
Hydrants,
Mail boxes, etc.

Many of the above items requiring space are automatically provided for when adequate space is apportioned for the lot and street. The important space provisions are the space standards for the dwelling unit starting from 400 sq. ft. for one person to 1,550 sq. ft. for 6 persons. The space required for other structural elements on the lot will be fairly constant.

For one garage or carport, 250\textsuperscript{1} sq. ft. is needed, for two 400 sq. ft. In addition another 150 sq. ft. should take care of the other items, making totals of 400 to 550

\textsuperscript{1} The variable here is dependent upon many factors of a regional, cultural and other bases. For example, the availability of good public transit, for, educational,
shopping, recreational etc. etc. facilities will effect the number of cars the family will have. The fact that in the Los Angeles area ratio of cars to people is about 1 to 2 and the average in other cities, (Winnipeg, Canada) is about 1 to 8 must be taken into account when establishing any lot space standards. The use of 400 for two cars above is purely for convenience and should not be construed to mean that the thesis recommends this space allocation. Even the possibility that cars will be smaller or larger cannot be ignored.

sq. ft. which need to be added to the space required for the main dwelling unit.

The space requirements for outdoor living facilities and other purposes are highly conjectural. The author makes a value judgment and suggests the relation to be twice the floor area of the total building space for purposes of illustration. This makes the total lot area requirement, three times the total building space. (This is an estimate made from a perusal of published designs, which are thought to have an optimum relationship of open to closed space.

The following table then shows the minimum lot areas evolved for the various space standards for the dwelling unit. The maximum requirements of 550 sq. ft. for other building space requirements is used in all cases.

<table>
<thead>
<tr>
<th>Number of Persons</th>
<th>Space Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>One person</td>
<td>(400 plus 550)</td>
</tr>
<tr>
<td>Two persons</td>
<td>(750 plus 550)</td>
</tr>
<tr>
<td>Three persons</td>
<td>(1,000 plus 550)</td>
</tr>
<tr>
<td>Four persons</td>
<td>(1,150 plus 550)</td>
</tr>
<tr>
<td>Five persons</td>
<td>(1,400 plus 550)</td>
</tr>
<tr>
<td>Six persons</td>
<td>(1,550 plus 550)</td>
</tr>
<tr>
<td>Over six persons</td>
<td></td>
</tr>
</tbody>
</table>

(The space provisions for the street access will be assessed in a later section, along with those required by the other factors still to be reviewed.)
Technology provides better and an increasing variety of material and methods to help achieve the optimum physical environment. Through technology, natural features and requirements are enhanced, changed, even completely displaced, like substituting the ultra-violet lamp for daylight as a disinfecting factor.

The following is a list of the more common technological improvements evident today. For convenience, they are listed under four headings, household equipment, building materials and methods and architectural detailing and "others". Each item listed is followed by a comment of its effect on the physical design of the "unit". It is noted that there are many new advancements whose impacts are yet to be assessed. Some of the more obvious are discussed in the latter part of this thesis.

Household Equipment

1. Better heating and cooking facilities:
   Less fire hazards,
   Elimination of need for basement "furnace rooms",
   New fuels eliminate large storage facilities,
   The kitchen can be more compact.

2. Forced ventilation and air-conditioning:
   Less dependency on windows and other openings for air,
   Less space needed for required volume of air or "air change effect".

3. Refrigeration:
Elimination of cold storage cellars,
Less kitchen space needed for cooking and storage
through use of compact "prepared" food stuffs.

4. Better artificial illumination:
Less dependency on natural light.

5. Ultra-violet lamps:
Less need for daylight as a factor for disinfecting of rooms etc.

6. Laundry equipment, automatic dryers:
Less space needed for this facility,
Less or no space required for outdoor drying.

7. Garbage disposal and incinerators:
Less garbage and trash removal service,
Less need for provision of facilities for storage.

Building Materials and Methods

1. Reinforced concrete;
Permits slab on ground construction, facilitating the spreading out of the dwelling.
Concrete as a fire resistant material displaces space as a fire protection measure.

2. Insulation:
Permits closer Juxtapositioning of units since there would be no need for space as an insulation factor for noise and heat.

3. Fire-resistant building materials:
Permits closer relationship of units.

4. Roofing material:
The use of flat roofs cuts down the height and the bulk of the building.

5. Post and lintel construction with fill-in walls:
Permits flexible construction, allowing the adding or subtracting of floor area.

**Architectural Detailing**

1. Use of large areas of glass for visual integration of outdoor and indoor living space requires better use of site conditions, i.e. more freedom in placing the dwelling unit in relation to lot etc.

2. Clerestory, strip windows, louvres for light and ventilation:
   
   Permits closer building relationship for light and privacy.

3. Skylight and forced vents:
   
   Permits planning and use of interior rooms.

4. Built-in features:
   
   Cuts down on storage space and other space requirements in general.

5. Coupled with the development of many wall and other building materials, in general architectural detailing of walls, partitions, stairs etc. have tended to cut down actual construction volume.

**Others**

1. The automobile:

   Need for immediate access, shelter for vehicle as close to the dwelling unit as possible requires close relationship of dwelling unit to street.

2. Radiant heating:

   Used integrally with paving construction eliminates the hazard and inconvenience of ice and snow permitting use of steeper grades and requires less space for snow piling or removal.
We might summarize the effects of technology as being two. First, the space standards for the dwelling may be modified by the many facilities which help to cut down or substitute certain space requirements. Second, the cumulative effect of technology is greater flexibility of construction which permits a greater variety in the final form of the building. This means that the site or lot should be of such size and shape to accommodate the maximum variety of plan forms. This suggests the need for greater flexibility of controls so that the "tailoring" of the site conditions to the dwelling unit or vice versa can be accomplished.

WAY OF LIFE

In many cases the trend towards ever-increasing community activities indicate less use of the "home" as a place to "live". It is just a place to "bunk" for many. On the other hand, other factors point just as significantly to the contrary and the tendency is to fulfill the "English adage", "that home is the man's castle", providing the setting for all but a few of man's activities. But, between these two tendencies, certain phenomena can be observed which have a decided and measurable effect on the physical design of the dwelling unit and its environs. In general these factors express the need for greater efficiency in the design of the dwelling and its site. The following are the most conspicuous of trends and their influence on the physical design.
Social Reform

Very few are now in a position to afford full time household help. Only the select few have governesses to look after their children. Many of the household duties have been "commercialized" and are completely eliminated in other instances. The effect on the physical design of the unit are as follows:

1. More compact plans. (multiple use of space)
2. All ground level construction to facilitate household duties and supervision of pre-school children.
3. Increasing use of mechanical equipment which has the effects listed under the section discussing technology. In general space saving devices and easy maintenance equipment is used.
4. Greater use of prepared food and other commercialized services, again eliminating need for large storage space and space for work.

Since the "elevation" of service to a higher social status, if you will, the trend has been to eliminate the back door and use the front door for this facility. Hence, the need for easier access to the dwelling unit from the street front for deliveries and service calls require some new thought on the design of the dwelling unit, and as a corollary of the street.

Customs and Fashions

The trend has been towards "informal" living habits.
The "techniques" of entertaining, resulting from the decreasing use of help has eliminated "parlour" rooms, the large hall space. The general tendency has been towards the multiple use and integration of various rooms. The most common being the combining of the living and dining rooms. The popularity of outdoor living and the trend towards the integration of outdoor and indoor living space visually and physically has the following effects:

1. Ground level construction.

2. Use of large areas of glass making orientation to sun an important feature.

3. Wind direction and views become very important considerations.

4. The preservation and exploitation of minute natural features.

Again, the demand here is greater freedom to choose and develop the site and dwelling unit as one wishes. The major concern here is how the other elements such as lot space requirements and right-of-way provisions are regulated.

SITE CONDITIONS

"No two building lots are orientated identically with respect to any other lot or to all lots, nor with respect to the wind and sun",\(^1\) states Ratcliff in discussing

urban land economics. In many respects, this uniqueness of land is more important in the considerations of the residential lot than in the highly commercialized urban lot of the financial or retail trade areas. To a much greater degree than in commercial buildings, the added value of the residential building is dependent on the many seemingly intangible relationships of the dwelling unit to its site. The orientation to wind and sun, the relationship of trees and other vegetation, the view and many other "natural" features of the site need individual attention if the best "use" is to be made of the lot. Hence, any controls must recognize the fact that no two lots are the same. This demands a maximum of flexibility in the controls.

PERSONAL DESIRES

Admittedly, there is available the variety of lots and the freedom to develop these lots but only for the select few and at a certain sacrifice of social integration. It should be possible, within greater limits, to make available this variety and the freedom to develop one's lot as one wishes for practically all "grades" of home-owners. Then, with respect to this development of the site, the contradictory and unpredictability of individual preferences is illustrated by the use of plate glass. It was not long ago that the intent of the "picture window" was for the
visual appreciation of the outside from within along with the desire for more sunlight in the room. Today, this picture window may appear on the north facade of the dwelling and the view is towards the inside from the outside. This also illustrates the sophistry in the employment of privacy. Suffice to say the controls must respect individual prerogatives as much as possible. Actually this has so many intangible relationships with any physical design concepts that we cannot specifically make provisions for it. Again, the need is flexibility of controls to take care of any reasonable demands of the individual.

**SUMMARY OF INFLUENCES**

In the following, the influence of the various factors discussed are listed in a chart form under several headings which are self-explanatory. By no means comprehensive, it nevertheless serves to indicate the variety of influences that need to be considered. While some factors demand more space others tend to require less space and even displace space. Plate I which follows the chart, graphically illustrates the general trend in the development of the dwelling unit, its yards and street access.
### FACTORS RELATED TO DWELLING UNIT THAT:

<table>
<thead>
<tr>
<th>DECREASE TOTAL FLOOR AREA</th>
<th>DECREASE BUILDING VOLUME</th>
<th>INCREASE BUILDING COVERAGE</th>
<th>ELIMINATE OR DISPLACE PROTECTIVE SPACE REQUIREMENTS</th>
<th>AFFECT SITE REQUIREMENTS IN OTHER WAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Integration of various rooms.</td>
<td>1. Flat roof construction.</td>
<td>1. All ground floor construction for reasons of: safety, convenience, easy maintenance etc.</td>
<td>1. Fire-resistant building materials &amp; automatic fire fighting apparatus require less or no &quot;side yard&quot; requirements.</td>
<td>1. Automatic dryers, garbage disposal units, incinerators require less outdoor space for clothes drying, garbage cans, trash storage.</td>
</tr>
<tr>
<td>2. Elimination of large halls, stairways etc., more compact planning.</td>
<td>2. Forced type heating system, refrigeration, eliminating basement furnace rooms, fuel storage bins and cold storage cellars.</td>
<td>2. Trends towards integration of outdoor and indoor areas.</td>
<td>2. Artificial illumination eliminates need of daylight for lighting purposes.</td>
<td>2. Trend towards elimination of rear alleys requires both service and frontal entrance facilities on front of house (or vice versa) demands greater width of lot.</td>
</tr>
<tr>
<td>3. New household equipment, e.g. refrigerators, gas and electric range, washing machines etc.</td>
<td>3. Air-conditioning and forced air equipment requires less room volumes for air-change construction.</td>
<td>3. Reinforced concrete facilitating ground level construction.</td>
<td>3. Ultra-violet ray lamps eliminates necessity of daylight as a disinfecting factor.</td>
<td>3. Trend towards placing of living areas towards rear of lots require proper orientation.</td>
</tr>
<tr>
<td>4. Built-in fixtures &amp; storage facilities.</td>
<td>4. New building materials cut down construction volume, i.e. space taken up by structural and other materials.</td>
<td>4. Forced heating systems permit spreading out of construction.</td>
<td>4. Clerestories, louveres, skylights, forced vents require less or no exposed wall space for light or air.</td>
<td>4. Increasing dependency on automobiles require new relationship of street access to dwelling unit.</td>
</tr>
<tr>
<td>5. Use of multi-purpose and &quot;put-away&quot; furnitures.</td>
<td>5. Garage, carport, breezeway and other facilities.</td>
<td>5. Garage, carport, breezeway and other facilities.</td>
<td>Better noise insulation permit abutting of buildings</td>
<td></td>
</tr>
</tbody>
</table>

### FACTORS RELATED TO SITE THAT REQUIRE NEW APPROACH:

<table>
<thead>
<tr>
<th>STREET DESIGN THAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Increasing use of motor vehicles require: free and clear roadways, parking facilities.</td>
</tr>
<tr>
<td>2. Utilities.</td>
</tr>
<tr>
<td>3. Street landscaping.</td>
</tr>
<tr>
<td>4. Increasing dependency on automobiles require new relationship of street access to dwelling unit.</td>
</tr>
</tbody>
</table>
PLATE I

GENERAL TRENDS OF DEVELOPMENT OF TYPICAL DWELLING UNIT, LOT AND STREET ACCESS

PAST

PRESENT

PROPOSED
SUMMARY OF TRENDS OF DEVELOPMENT OF THE UNIT FROM THE FOREGOING ANALYSIS (See Plate 1)

1. The dwelling unit covers a larger ground area but with less bulk, i.e. cubage contents.

2. The front street now serves for both "formal" and service calls. Further the increasing use of the automobile requires more service, i.e. snow removal, maintenance etc. besides parking facilities close to the dwelling unit.

3. The "new" uses of the site require greater flexibility in the placing of lot lines, relationship of site to access street.

4. Many technological improvements and developments in household equipment, building materials, methods of construction, architectural detailing substitute and in some cases completely displace space requirements.
Recapitulating, the community's interest can be broadly stated in two categories.

1. The physical provision of adequate space for building and access.

2. The provision of maximum freedom in the choice and development of the lot, dwelling and access street.

The problem is also twofold. The first is, how many types of specifications and the second is, in what terms. The minima resort to spatial dimensions is desirable but unfortunately, there seems to be no substitute for space standards that will convey the desired "qualitative" provisions while assuring provision of adequate absolute space.

In view of the above, the following attempts to evolve a method of specification that will assure the provision of adequate space and the other materials requirements while maintaining that freedom so essential for the designer and the individual.

PROVISION FOR SPACE

In a previous section (Social Policy) using the APHA
space standards for the dwelling units, basic space standards for the lot was developed. The table is reproduced below.

<table>
<thead>
<tr>
<th>Number of Persons</th>
<th>Minimum Space (sq. ft.)</th>
<th>Maximum Space (sq. ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 person</td>
<td>(400 plus 550)</td>
<td>2,850</td>
</tr>
<tr>
<td>2 persons</td>
<td>(750 plus 550)</td>
<td>3,900</td>
</tr>
<tr>
<td>3 persons</td>
<td>(1,000 plus 550)</td>
<td>4,650</td>
</tr>
<tr>
<td>4 persons</td>
<td>(1,150 plus 550)</td>
<td>5,100</td>
</tr>
<tr>
<td>5 persons</td>
<td>(1,400 plus 550)</td>
<td>5,850</td>
</tr>
<tr>
<td>6 persons</td>
<td>(1,550 plus 550)</td>
<td>6,300</td>
</tr>
<tr>
<td>Over 6 persons</td>
<td></td>
<td>6,500</td>
</tr>
</tbody>
</table>

Obviously this variety of space standards cannot be used in any one subdivision without actual knowledge of the future occupants' requirements. And since this is improbable in most cases the most "flexible" median must be found. An insistence on the maximum as a minimum will be wasteful but provisions for this maximum must also be made. Many families desire more space than others in the way of dwelling space while others desire less space for outdoor activities. This thesis suggests 4,500 square feet as an absolute minimum. (This again is a value judgment based on the author's limited experience, and is used here for a specific reason which will be apparent in the later section showing a comparison of the proposed provisions with present regulations).

This minimum must then be modified by several considerations relative to the locality and the larger residential areas. They are as follows:

1. A more detailed population analysis as regards to median family size, ratio of cars to people (see footnote on page 12) etc. for the locality, may suggest a larger minimum.
2. The type of utilities available or intended, such as whether they are piped water and sewerage system or independent well water supply and septic tank system will dictate another minimum subject to soil, drainage and other factors.

3. The topographical and climatological conditions will have their influence on the minimum size of lots. Soil and drainage conditions have been mentioned. Contours, vegetation and other features will affect the amount of buildable area available.

4. The relationship to the rest of the area, as to the proposed plan of development, particularly any density policy will have its effects on the minimum for any given area.

The last brings us to the next desired provision, that of the availability of a variety of lot sizes and types or shapes in any one area. This means that the density established by the minimum must be modified to allow for the variety since any variation from the minimum will require additional area. The suggestion is that the overall density requirement be expressed in terms of dwelling units per gross acre in relation to the minimum lot area specification. For example, "6 dwelling units per acre, minimum lot area 4500 square feet". Such a combination will permit a variety of lot sizes in an area, with the smallest being the minimum.

1. Gross acre as used here includes streets, alleys, easements, and other access ways, but not parks, playground or totlots etc.
The added provision of the minimum number of lots per unit area, may be desired. For example 12 lots per every two acres for the 6 dwelling units per acre will assure, more or less an equitable distribution. In other words, this will prevent the crowding of all the minimum size lots in one section and the larger in another in a large 50 acre development. In the case mentioned, we are assured of 12 lots of various sizes distributed in every two acres. (See Plate V)

A fifth basis may be added to the group of four listed as considerations at the beginning of the section, as an essential consideration for density provisions. This is the consideration of other services as distinct from utilities such as schools, transportation, parks and playgrounds and other communal facilities etc.

The suggested definition of the dwelling unit is a "residential building on a surveyed lot registered for this purpose." This does not limit the number of families or groups of persons living in a dwelling unit. If limitations of density in the real sense, i.e. the number of persons per unit area is desirable, a floor area per person as recommended by A.P.H.A. can be incorporated coupled with the desired Floor Area Ratio which will be discussed in the following sections.
OTHER PROVISIONS FOR THE LOT

A minimum width for the lot may be incorporated as a measure of expedience. The recommended minimum is 40 feet clear for building purposes. Any other space requirements such as access to rear of lot should be added to this. The 40 foot suggestion is another tentative value judgment based on the perusal of the better dwelling plans published in various architectural magazines. For reasons illustrated in Plate XI, the minimum lot width should not be a frontage requirement. Rather it could be the width required at a point one third of the distance from the street or frontage.

The three-dimensional aspect of the lot must now be considered. The provision of light and air and other elements dependent upon the vertical projection of area will require maximum flexibility in the control measures, if imaginary lines of restrictions are not to become real obstacles.

The Floor Area Ratio (FAR): the total floor area of all stories used for residential purposes (including garage, sheltered car-port, garden houses, enclosed porches, tool sheds etc.) divided by the area of the residential land, to control density with an additional index of floor area per person is recommended by both the American Public Health Association and the Harrison, Ballard and Allen...
BUILDABLE AREA ON LOT - MINIMUM BUILDING FRONTAGE FOR SIDE & REAR LOT LINES - FLOOR AREA RATIO (FAR)

CONSTRUCTION 'VOLUME' FOR ONE STOREY = 10'

CONSTRUCTION 'VOLUME' FOR OVER ONE STOREY

'FRONTAGE' OF BUILDING ON NORTH LOT LINES AWAY FROM NOON SUN LIMITED TO 20'-0'

'FRONTAGE' ON SOUTH LOT LINES FACING NOON SUN LIMITED TO 30'-0'

TOTAL BUILDING FLOOR AREA RATIO OF LOT.

PERMITTED FLOOR AREA IN ONE STOREY

SAME FLOOR AREA IN TWO STOREYS

SAME FLOOR AREA IN THREE STOREYS

SHOWING VARYING PROPORTION OF BUILDING MASS & AS OBSTRUCTION TO LIGHT & AIR

SHOWING INCREASING SPACE REQUIRED FOR VERTICAL CIRCULATION CUTTING DOWN ON USABLE LIVING SPACE AUTOMATICALLY LIMITING HEIGHT OF BUILDING
report for the rezoning of New York.\textsuperscript{1} As a result of this type of control of building bulk, it is illustrated that both light and air is automatically provided for without any further rear, front or side yard requirements.

But, we have seen that with the use of technological facilities, natural space requirements can be decreased or in cases completely displaced. Therefore the FAR is suggested here as a measure to control only the relationship of building to open area or to put it in design terms, mass to space. Further no restrictions as to placing this mass is suggested except for the minimum frontage of building over one storey or 10 feet on any rear or side lot as illustrated in Plate II for the following reasons.

1. The possibility of any residential building over 3 stories is remote because:
   a. With FAR restriction on the typical A residential area, the amount of usable floor area per storey decreases too rapidly with every additional one. (See Plate II) The amount of space taken up by vertical circulation will actually eliminate all floor space when carried to its maximum.

\textsuperscript{1} A.P.H.A. Standards for Healthful Living, "Planning the Neighborhood" (Public Administration Service, Chicago, Illinois, 1943) p.40. and Harrison, Ballard and Allen, "Plan for Rezoning the City of New York" (City Planning Commission, New York, 1950) p.45.
2. With FAR if the owner still wishes to build up, the proportions of the "tower" residence is such that it is no more a major obstruction to light and air than the average sized tree.

3. The fact that his neighbor can also build as he desires will persuade the home owner to place his own dwelling so as to protect his own access to light and air, should he have window adjacent to his neighbors.

The suggested provision of the limitation on the building frontage on the rear and side lot lines need not be included but this may be desirable where the FAR specification is large. In this case, this "frontage" could be a percentage of the lot width but 30 feet is recommended for frontage on the south side and 20 feet on the north. (See Plate II)

The FAR is directly related to lot area and density, the index becoming smaller as the density decreases. Consideration may be given to the open space of the street in any calculation. For the example illustrating this provision in the comparative analysis, the FAR index suggested is .4 which is comparable to the building area permitted in present regulations for a 6000 square foot lot.

Since the practice has been to eliminate the rear alley, an essential provision for reasons of safety is an access to all parts of the lot without the necessity of going through the building. If an alley or an unobstructed easement is provided from the ends of the block, building in a solid row
WIDTH  \( y \) = \( \sin 75^\circ \times z \)  
= 0.96593 \times z

LOSS IN WIDTH = VEISED SINE 15° \times z  
= 0.03407 \times z

EXAMPLE: 60' FRONTAGE LOT  
WIDTH  \( y \) = 0.96593 \times 60 = 57.96'

LOSS IN W = 0.03407 \times 60 = 2.04'
is permitted. The width of this clear access should be determined by local considerations and recommendations of the fire department, ambulance corp, police etc. but a 8 foot clear passage will permit adequate access for the stretcher bearers, pulmotors, an iron lung etc. This provision is over and above the minimum building lot width.

As a measure to facilitate the provision of the variety of lot sizes and shapes, instead of the usual 90 degree requirement, a minimum re-entrant angle of 75 degrees between lot lines is suggested. This will also facilitate orientation of the lot to the elements and to take advantage of any topographical nature of the area when other limitations are imposed. For example, where the grade of a street on a sloping site cannot be changed and the utility lines placed in the street, conditions arise where the lots on one side of the street cannot be served adequately by the utility line because of the difference in elevation. The deviation of the lot line from the normal helps to avoid this difficulty as illustrated in Plate VII.

The actual loss in buildable lot width is clearly shown in Plate III opposite this page.

PROVISIONS FOR THE ACCESS STREET

The remaining consideration is the access street. The
basic function of the street as a means for access for pedestrians and vehicles and a place for laying of utility lines have not changed but with the advent of the automobile, the spatial requirements have been greatly modified. The trend has been to use the front street for service since the trend towards elimination of the rear alley. The suggested type of provision is to stipulate the desired functions based on the desired features. The provisions would be as follows:

1. The number of moving lanes desired based on probable number and type and desired speed of vehicles using the street. The thesis suggested a minimum of two moving lanes of 9 ft. width which is recommended for the desired maximum of 20 mph in residential areas. Where a short loop street is used, probably one lane with a solid shoulder in one direction will suffice.

2. Parking requirements will cause the greatest variation in the design of the right-of-way. The usual 30 foot pavement requirement provided street parking supplied by the community. The proposal is that the community assume responsibility for one space per dwelling unit and any additional requirement be the responsibility of the home owner. Further it is suggested that while the community assumes full responsibility for repairs and service of
the moving lanes, the responsibility of repairs and service of
the parking bays be divided. The home owners should assume
the responsibility of keeping the parking space clean and
free of snow. Only off-street parking will permit this type
of arrangement but since there is no restriction as to the
exact width of the right of way, various designs are possible,
permitting the placing of the parking facilities appropriately
near the street yet convenient to the dwelling. A few
possibilities are shown in Plate VIII, IX and X.

3. The common practice has been to place sewerage and water
mains under the hard surfaced roadway, as a result of
inadequate right of way width. This has made subsequent
maintenance and repair expensive and a hazard to traffic.
The right of way should provide a separate strip coupled
with another function such as space for snow piling etc.
for this need.

It is suggested that the community assume the cost of
supplying utility lines, water and sewerage up to within 5 feet of the dwelling or to the point where most
building codes require the change of tile to cast iron
pipes in the case of the sewerage line. This is recom-
mended as an incentive for builders and home owners to
place their dwelling units with more concern for design.
Though it may seem a trivial item, the fact that in many cases the monotonous alignment of buildings on too many streets is due to the reluctance of the builders to assume the small additional cost of supplying the extra lengths of utility lines if the building is set back beyond that required. As a matter of fact, they are justified since in most cases the set back is excessive. With the proposed provisions the small extra cost to the community would be offset by the savings made in paving width, easier maintenance and access of lines. In any case the added value, aesthetic if you will, should justify the community absorbing the relatively small cost.

4. Provision for snow removal or piling. The space requirements for this provision will depend upon the local snow fall data, method and type of snow removal equipment etc. Where radiant heating coils are used, this provision will not be necessary.

5. Provision for pedestrian sidewalks. The number and type will depend on the general density of the area. For the typical area of 5 or more lots per acre, possibly two will be desirable but the designer should be free to place these anywhere on the right of way to suit his design.
as long as there is no danger to the pedestrian from traffic and the sidewalk are convenient as accesses to the street and dwelling. A minimum buffer strip of say 5 feet between the sidewalk and the right of way line (now the building line also) may be incorporated for building convenience. i.e. placing of footings, sewerage connections etc.

6. Provisions for planting, street illumination etc.
This provision will depend upon the overall policy of the community to perform the functions of "civic" gardener. The street light system should be planned with the tree planting since it is obvious that improper placing of lights or careless planting of trees will negate the value of street illumination. Much of course will depend upon existant vegetation and soil condition. The width of the planting strip should be geared to the type of trees intended or permitted to be planted.

SUMMARY OF PROVISIONS AND COMPARABLE EXISTING REGULATIONS
The foregoing provisions are summarized under two categories, the lot and street access, but are numbered consecutively for convenience and to suggest that these should be treated in entirely and not separately as is the case with present day zoning and subdivision regulations.
The present regulations that these would displace are noted immediately after each provision.

For the Lot

Provision 1:

a. Overall density in terms of dwelling units per gross acre,
b. Minimum lot area,
c. Minimum buildable lot width,
d. Number of lots per unit area,

instead of the single minimum size lot, frontage and proportion of lot.

Provision 2:

a. Floor Area Ratio (FAR),
b. Minimum "frontage" of building over one storey of 10 feet on any side or rear lot lines, the allowable depending upon orientation,

instead of the side, rear and front yard set back requirements.

Provision 3:

a. Minimum re-entrant angle of 75 degrees for lot lines,

instead of the 90 degrees required in present regulations.

Provision 4:

a. A free and clear access to all parts of the lot other than through the building. Width determined by local requirements and is over and above the minimum lot width of provision 1 c.

There is no counterpart in the present regulations to this provision unless the side yard requirement is construed as accomplishing this purpose.
For the Street Access

Provision 5:

a. Number of moving lanes,
b. Number and type of parking space facilities,
c. Number, width and type of pedestrian walkways,
d. Buffer strip requirement between sidewalk and building line,
e. Space for snow piling,
f. Specifications for placing of utility lines,

instead of the regulation specifying the exact widths of roadway and right of way.

Several basic differences are noted. First of course, is that the proposed type of provisions is more detailed. This is in accordance with the principle of the performance type standards where a specification is limited to its own particular concern. Provision 5 is the best illustration. Second, no minimum lot frontage on the street is required. A nominal width of 20 feet may be specified which will assure access by truck or car but it is felt that there is no need for this since the value of the lot from any point of view, depends upon the provision of so obvious an element. (The resultant flexibility of this provision if illustrated in Plate XI). Then, the building line and the street right of way now coincide. This coincidence is deliberate for several reasons. (Many of the advantages are illustrated in Plates VIII, IX and X.)

1. With the excessive set back requirements and conditions.
of the present regulations, the owner of the lot need not own his front yard since the community in effect takes over the use for all practical purposes and yet does not use it. The illustration shows how advantageously this area can be used. (See also No. 4 below in this connection).

2. With the proposed provision or even with present regulations, building up to the property line does not "crowd" the street, and space between opposing lines of buildings are more than adequate for light and air.

3. The excessive set-back as a means to establish or help establish the desired "character" of the residential area is not as valid as it seems. There are other elements more effective and of real significance that "stamp" the character and assure the integrity of the residential district. These are the proper relationship of mass to open space, of trees, of other forms of vegetation, the street design making utmost use of topographical features; in short the design aspect which or may not depend on a front yard set back.

4. From the illustrations, it is fairly obvious that the provision of off-street parking between the sidewalk and roadway is not only aesthetically satisfying but is more functional than providing it on the lot. It is further suggested that the placing of the side-
walk in this position is much more residential in character resulting from the proper segregation of the automobile towards the roadway and the intimacy gained from being able to walk close to the homes, away from traffic. Also clearing the street and providing off-street parking in this manner, greatly facilitates street cleaning and snow removal.

5. While it is a basic premise of good planning to provide flexibility, the main idea of planning is to secure that stability which arises from permanence of use. Any one street may have an excessive set-back imposed for reasons of probability of future requirements but surely not all the residential streets need be designed for the same reason. Only when that permanence is established through good design can the stability of "character", of the value of the residential area remain for both real estate and taxation purposes.
A graphic comparison of the design possibilities of the present and the proposed type of provisions follows to further clarify the foregoing analysis and the subsequent provisions. The comparison takes the form of listing the common disadvantages of the present regulations and shows how the proposed type provides the necessary flexibility to overcome these difficulties. For ease of presentation and clarity each provision is illustrated and compared separately or grouped together where the specific advantages accrues from a combination of provisions.

To make the comparison, a typical "A" residential district is chosen requiring 6,000 square feet for the lot area, a frontage of 50 feet, a street width of 50 feet with a roadway requirement of 30 feet. The zoning regulations\(^1\) further stipulate side, back and front yard set backs, height and other restrictions. The comparable set of provisions

\(^1\) The actual set of regulations used are those put forth by the National Research Council of Canada in their "Model Zoning Bylaw", Ottawa, 1939.
visions of the proposed type is evolved as shown in the following discussion and illustration.

The density of the assumed type of area is approximately 6 per gross acre. (including street space. See Plates IV and V). The minimum lot size proposed under the proposed provisions (as discussed on page 24) is 4,500 square feet with a minimum lot width of 40 feet plus the free and clear access space of 5 feet. As the illustration will show, this is about twice the building area though the entire lot area is not to be used for building. The other corresponding provisions are quite clearly shown in the following page and Plate IV graphically illustrates the results of the present and proposed type of regulations.
COMPARISON OF PLAN RESULTS OF PRESENT AND PROPOSED TYPE OF PROVISIONS

PRESENT

BUILDING LINE SET-BACK 25' FROM R.O.W.
RIGHT OF WAY LINE
BUFFER STRIP
3 - 10' WIDE LANES

PROPOSED

VARIABLE LOT DEPTH

BUILDABLE AREA
2,660 SQ. FT.
44.3% OF LOT

BUILDABLE AREA
ENTIRE LOT AREA

2 MOVING LANES
SPACE FOR OFF-STREET PARKING
BUFFER STRIP
RIGHT OF WAY COINCIDE WITH BUILDING LINE

PLATE IV
COMPARATIVE SPECIFICATIONS OF PRESENT AND PROPOSED TYPE
FOR ZONING AND SUBDIVISION CONTROLS

Present
Density ...................... 6 lots per gross acre.
Minimum lot size ............ 6,000 square feet.
Minimum frontage .......... 50 feet.
Height restriction ......... 35 feet.
Building coverage .......... 33% for main building,
                          8% for accessory buildings.
                           Total 41%
Front yard setback ........ 25 feet.
Rear yard setback ........... 25% of lot depth or 25 feet.
Side yard .................. 3 feet minimum or aggregate
                          of 12 feet.
Buildable area on 50 by 120 ft. lot is area 38 by 70 ft.
                          2,660 square feet.
Lot lines to be at 90 degrees to street line.
Street width ............... 50 feet
Paving width ............... 30 feet
Sidewalks ................... 2 at 5 feet.
Utilities buried in centre of street.

Proposed
Density ...................... 6 lots per gross acre.
Minimum lot size ............ 4,500 square feet.
Number of lots required ...... 12 per 2 gross acres.
Minimum re-entrant angle for lot lines ... 75 degrees.
Floor area ratio of .45 which means an area of 2,025 sq. ft.
Access, free and clear to rear of lot ... 5 feet width.
Street provisions:
1. 2 moving lanes of 9 ft. width each.
2. 2 sidewalks of 5 foot widths.
3. One off-street parking per dwelling unit.
4. Strip for snow piling 16 cubic feet per lin. ft.
   of street.
5. Utilities to be placed as desired.
COMPARISON OF DESIGN POSSIBILITIES UNDER PRESENT REGULATIONS AND PROPOSED PROVISION 1.
DRAWBACKS OF PRESENT REGULATIONS AND COMPARATIVE

ADVANTAGES OF PROPOSED PROVISION I.

Present

1. Even though the general character of the land may be the same, the rigid lot size specification will not permit parcelling of land to exploit minute natural features of the land such as trees, rock outcroppings, and other small scale promontories, valleys etc.

2. Monotonous alignment of building is further accentuated by the fact that the alternate open space and building mass tend to be the same. (See page 33). The width remaining for building purposes after space is taken for side yard requirements from the average size lot, is cramped. Therefore full use must be made which results in the repetition of the same size space between all buildings on the same size lots.

3. The needed variety of choice of type, size and form of lots in the same area is not available.

Proposed

1. The flexibility through availability of various lot sizes permit greater facility in exploiting minute natural features of the site. The lot can be "tailored" to site conditions.

2. With a variety of lot sizes, even though the same mass or width of building is used, variations are possible since the remaining open spaces will differ. If the open space is kept constant the mass must vary. Further the incentive provided in the proposed provision V (See page 32) where the community assumes the cost of supplying utilities up to 5 feet of the building, conformity to the building line for economic reasons is not necessary.

3. The desired variety of lot sizes, types and forms is made available on a relatively small scale.
COMPARISON OF DESIGN POSSIBILITIES UNDER PRESENT REGULATIONS AND PROPOSED PROVISIONS I & II
DRAWBACKS OF PRESENT REGULATIONS AND COMPARATIVE ADVANTAGES OF PROPOSED PROVISIONS I AND II.

Present

1. With excessive set backs provision of garage or sheltered car port consumes much area, discouraging or prohibiting any advantageous use of lot for other purposes.

2. Side yard requirements forces the dwelling unit into a narrow building area, resulting in cramped designs, necessitating recourse to many alternatives such as narrower hallways and doorways, shallower closets, shorter kitchen counters and the like to retain a workable plan.

3. Many small pockets of lot space, difficult to utilize, cutting down excessively on the available space of the narrow lot results from side yard regulations.

4. Integration of outdoor and indoor living space is made difficult since consolidation of space is impossible.

Proposed

1. Provision of garage or carport, convenient to both street and dwelling is possible with very little encroachment on valuable lot space.

2. Provides more building space, permitting "uncramped" planning of dwelling, facilitating evolving the "informal" plan so desired for the "new type" of living.

3. All open space may be consolidated in any one area for the desired use.

4. Greater opportunity is provided for the exploitation of the natural assets of the site permitting the best outdoor-indoor relationship desired.
PLATE VII

COMPARISON OF DESIGN POSSIBILITIES UNDER PRESENT REGULATIONS AND PROPOSED PROVISION III & V

PRESENT

PROPOSED
DRAWBACKS OF PRESENT REGULATIONS AND COMPARATIVE ADVANTAGES OF PROPOSED PROVISIONS III AND V.

Present

1. To serve lot with sewerage system on the low side of the street, excessive depth of main is required at the street center.

2. Utility lines must be buried under hard pavement.

3. Depending upon slope of ground and soil condition, ground drainage runs into adjacent lot or may not be easily trapped and drained since difference in elevation of trap to storm sewer may be too excessive.

4. Orientation to sun, wind and view may be hampered through the necessity of lot lines conforming to the 90 degree requirement. The street line may have to be in that position for other unavoidable reasons.

 Proposed

1. Where lot frontage is narrow, angling of lot lines coupled with the greater latitude in placing utility lines in the right of way as provided permits taking advantage of slope of land requiring less depth for the main.

2. Utility lines may be placed under "softer" surfacing making access for repair and maintenance less expensive, and hazardous to traffic conditions.

3. With judicious placing of lot lines, ground drainage can be confined or controlled and drained in its own lot space.

4. Angling of lot lines permits some flexibility for orientation purposes.
This design takes the same situation as the above but the street is designed under the proposed type provisions.
DRAWBACKS OF PRESENT REGULATIONS AND COMPARATIVE ADVANTAGES OF PROPOSED PROVISION V

Present

1. More paved surface is installed than is actually necessary.
2. Not enough space is available for snow piling.
3. With street parking, snow removal and street cleaning is made very difficult, if not impossible.
4. Besides interference with traffic, provision of street parking is very expensive.
5. Tree planting is almost impossible since adequate ground space is not available on the right of way.
6. Generally, the present street is aesthetically unsatisfying as a result of the above.

Proposed

1. No more paving than necessary need be provided.
2. Sufficient space for snow piling is provided.
3. With no street parking, snow plowing and street cleaning is greatly facilitated.
4. Adequate space for off-street parking is provided on the right of way, convenient to both road and dwelling without interfering with either pedestrian or traffic. Gravel parking bays can be provided much cheaper.
5. The greater latitude permitted in placing the paved roadway allows mass tree planting helping to create a park-like atmosphere.
6. Variation in roadway alignment is possible to lend variety and to control speed of traffic.

Continued next page.
OTHER STREET DESIGN POSSIBILITIES WITH PROPOSED TYPE PROVISIONS
PLATE X

OTHER DESIGN POSSIBILITIES
Advantages of provision V continued.

7. Additional parking space may be had at a very small cost by providing individually or communally gravelled parking courts or the right of way. These can be very easily landscaped and maintained.

Note: The distance between buildings on the opposing side of the streets are less than that required under present regulations.

Plate XI on the following page illustrates a possibility in subdivision design using land more efficiently. This type of development is not possible under present regulations where minimum lot frontages are imposed rigorously. This particular design recognizes the need for providing access to fit the needs of the dwelling rather than fitting the dwelling to the access street. The street is minimum and is strictly for movement of traffic. Parking facilities are provided in the common motor court which gives direct access to the four lots served. This court may also be minimum, i.e., restricted as a large "driveway" or may be larger to provide for additional parking. In this connection periodic excessive parking requirements, can be taken care of by use of the buffer strip on the street right of way which will be a minimum of 10 ft. in width. A portion of this strip near the
PLATE XI

NEW SUBDIVISION POSSIBILITIES
approach to the court may be gravelled for this purpose. Each owner can still provide additional parking facilities on his own lot if he pleases.

The community could assume the responsibility of maintenance and repair of the court while the servicing, i.e. cleaning and snow removal be the responsibility of the owners. An arrangement might be made with the community whereby even this can be taken over by the community. But with this type of design the recommendation is the use of radiant heating to keep the court free of ice and snow. Since the street is completely free of any parking, the cleaning and snow plowing will be greatly facilitated.
OTHER RAMIFICATIONS OF PRESENT AND PROPOSED TYPE PROVISIONS.

Drawbacks of Present Regulation Stating Minimum Floor Area Requirements

To be able to afford the floor space, to live in the desired area, many deserving home owners are forced to forego other amenities and even necessities. Some of these are external to the "home" but many are distinct features of the dwelling that help directly to make it a more livable place. Such items are a fireplace, built-in features, better insulation, glazing, finishing and the many technological paraphernalia discussed previously.

The minimum 1200 square feet does not necessarily mean a healthier, safer, more comfortable or convenient etc. etc. home, than a 1,000 square foot home. Obviously there is a limit beyond which this argument is no longer valid and is not intended as an argument against space in low cost houses. On the contrary, we must do everything we can to increase space standards but the fact remains that the substitution of any one of the items mentioned for the extra 100 square feet of floor space, at this level, in terms of livability may make all the difference in the world. Then, take the case of the rich man who needs only a small home, a 600 square foot efficiency unit that has incorporated all the latest technological household gadgets. It is not justifiable to prohibit the building of such a home solely on the grounds
that he has not provided the minimum floor area.

There is no substitute for this regulation in the proposed provisions. The real need is for an adequate performance code which takes into consideration the design for livability aspects of the home. However, if the minimum floor area specification is justified on the basis that this is to maintain a certain "character" in the area and thus assure the stable physical base for tax assessment and real estate values, the contention is that the new provisions could be just as effective in maintaining character. Usually the "inappropriate" design stems from the fact that the desired type and size of site is not available. These sites could be provided on a greater scale if the necessary flexibility is contained in the controls. The proposed provisions are an attempt to approximate fundamental design principles as near as possible to guide the subdivider to evolve a plan so that, in the words of Charles Diggs, "the street system and the lot layout are such to facilitate and render almost automatic the appropriate use of the various portions of the subdivision or the community".2

Beyond this, no amount of justifiable controls could assure the desired "character", in the opinion of this thesis.


Drawbacks of Present Regulations Segregating Types of Dwelling

Another common ordinance is concerning "use" in the residential area, which segregates dwelling types into one, two, three or more family type units. This is to control density, to establish the types of "residential character", single family, duplex, row-house etc. and to maintain values in accordance with these characteristics. However, insistence on the single-family unit in the area under concern, prohibits or at least discourages the carrying out of some very basic tenets of family and social responsibilities. For example, much is made of the problem of housing the aged, and the cyclical expanding and contracting phenomenom of the family during its life span. A floor space requirement discussed before, prohibits such "luxury" as raising one's family in that area by the very type of people most desirable who cannot or do not want a large house initially. It should be possible to build units to accommodate this cyclical change in family space requirements and to allow the young couple to help finance their home by being able to build a "multi-purpose" home, renting space as not needed to the other young couples or to the aged, before and after their family raising period. This means no rigid specifications as to type, number of families per dwelling unit should be imposed.

The issue is how dependent is the maintenance of
character and property value on the fact that a single type of dwelling exists in a certain district. The fact that residential real estate values are built on this premise may be valid but very unfortunate. The argument here is that the true values are as put forth in the considerations of site conditions, "the seemingly intangible relationships of the dwelling unit to its lot". (See page 20) In other words, it does not matter whether there is a duplex sitting next to a group of single-family units. The important point is the design of these units in themselves and in relationship to each other.

The proposed type of provision would allow building right up to the lot lines, which means that two units can be combined. But this "duplex" occupies two lots. The density remains the same as far as the number of units in the area is concerned. Then the proposed type of provisions do not specify the number of families per unit. Rather the recommendation is to state a minimum floor area per person as a supplement to the Floor Area Ratio to control actual density. Though this is still not right (since some families can and prefer to live in quarters that seem cramped to others), with this type of provision, the afore-mentioned young couple and the aged can be accomodated. So long as the FAR is not exceeded and the minimum floor area per person is maintained, the couple is free to build a "con-
vertible" unit as discussed above. Again the basic need is for a performance type building or other code which takes into consideration the design for livability features of the home.
REQUIRED NEW BACKGROUND DATA

To fully benefit from the proposed type of provisions new data besides a new attitude towards existing data are required.

LOCAL LEVEL

The use of the following data has been discussed during the course of the above analysis. This data should be available from local engineers, surveyors, meteorologists etc. If a planning agency exists, these data should be available already compiled.

1. Demographic
2. Topographic
   - Soil condition
   - Vegetation
   - Drainage
   - Contours
3. Climatological
   - Wind
   - Sun
   - Snowfall
   - Rainfall
4. Other site features
   - Views
Then the customs, habits and fashions, etc., the general social background is most essential as material to establish physical design standards for the area. For example, mention has been made as to the provision of outdoor space for living purposes. Apart from the climatological restrictions, local customs and habits as to how this area is used for outdoor living purposes will have great influence on the space requirements of the lot area.

**REGIONAL AND/OR NATIONAL LEVEL(S)**

Specifically, much research is needed in the realm of lot space standards. The thesis recommended a minimum 40 foot lot width and a lot area three times the total building area. This was primarily for the purpose to make a fair comparison with the present type regulations. But the basis for such minimum provisions need factual background as to efficient plan forms of dwelling under varying site and other conditions, etc.

Other data that should be collected are of the same type but much of it is "informed" opinions. In this connection, much has been done by committees and organizations such as the A.P.H.A. who have compiled architectural, engineering and other technological information as related to the design of dwellings and passed "informed" opinions. Other organizations such as the Bureau of Standards, the American Standards Association, the American Society for
Testing Materials and so on have much data on the engineering aspects with "informed" opinions. These need to be compiled in form useful for purposes of evolving zoning and subdivision controls.

In the field of manufactured goods, the Consumers Union performs one of the most valuable informations services we have. They frankly assess and rate competitive products solely on their relative merits based on performance. A similar qualifying bureau need to be set up for the evaluation of good residential design. Architects, planners, builders, social workers, etc. must cooperate for the proper evaluation of design but each could pass informed opinions on many available examples strictly from their particular point of view. From these, a central bureau might classify and extract the essential data. A rough outline for a "page" of the handbook on design would have the following parts.

1. Background data as to location, size of development, cost and various conditions pertinent to the design.

2. Enough graphic illustrations, composed of plans sections and photographs to show the various features of the design.

3. A brief outline as to why the particular solution.

4. A critical assessment of important facets of the design. The last is the most important item as this information will be the basis on which value judgments will be made at the local level.
OTHER PRESENT AND FUTURE CONSIDERATIONS

FUTURE TECHNOLOGY

Many aspects of future technology are still very much in the conjectural stage. Atomic power has now been harnessed. If this form of energy becomes available on the large and cheap scale predicted, many new concepts of the residential area will develop. Snow and ice problems would no longer exist. Control of micro-climates may be a possibility. New methods of transportation will probably make the street obsolete. The future residential area may be completely independent of the land.

Highly conjectural, but at a "lower" level, there are already a large number of fairly well developed facilities which were thought to be impossible just yesterday that now need to be considered. Radiant heating of streets is gaining popularity in the large urban areas, eliminating the problem of ice and snow. The fuller type house will demand a new subdivision concept. This circular house, completely transparent, will require new attitudes towards the definition of what is indoors and what is out. Completely self-contained packages water and sewerage disposal systems,
chemically operated are being investigated. This development will completely release us from the tentacles of the piped systems. Self-generated power units are already in vogue even in areas where transmitted power is available for reasons of increased independence. The helicopter, the new "flying tubes" with airfoil designs based on the principle of the venturi tubes, which permit hovering, are already being manufactured; supplies limited only because of the present war emergency. These and others will make new demands on the use of the residential lots, hangars instead of garages and a roof top landing platform instead of the sun deck and so on.

The demands of technology are usually accompanied by an additional freedom if we can assimilate them properly. A flexible framework is essential.

SOME OTHER IMMEDIATE CONSIDERATIONS

There are many immediate situations that are becoming increasingly perplexing. These are as yet to be fully accepted as problems related to residential zoning and subdivision controls but they will need the proper attention if they are to be solved.

It is probable that in the future, for that matter today, we wish to assimilate public housing, veterans housing, defense housing etc. etc. into the fabric of the community. To socially and economically integrate these into a homo-
geneous residential pattern will make their demands on zoning or a new form of controls. To facilitate slum clearance and rehabilitation, temporary housing is needed for the "evicted". Only a proper zoning technique, based on performance standards will facilitate the fulfilling of such humane desires democratically.

Mass-housing, though nothing new, is beginning to provide more and more of the housing units. The completely pre-fabricated house presents its own peculiar problems. Basically they are two forms of standardization used. In the first case, the standardization is carried to the extent that the entire house is of a standard size, plan and form. The second standardizes only units or sections of the house. The second case will demand the optimum lot size and shape to permit as many variations as possible on that lot. The first presents another problem. The possibility arises that a variety of types and sizes is not available in any one area by the very nature of the product. Its bulk, distribution of producers, etc. may make it impractical to gather a variety at any one point. If only to assure that the endless monotony of the standardized unit will not be further accentuated by endless repetition, zoning and subdivision controls should have some measures to help the "uneducated" site planner, the small-scale speculator builder and the layman, in making an aesthetic decision if you
will. It is not too difficult to imagine the probable character of any area without this proper guidance. Aesthetic does have an economic value.

Another trend in "homes" is the increasing use of trailers. It is estimated that there are over 500,000\(^1\) permanent trailer homes, housing some 1,500,000 persons in the United States. However temporary this may be, these "residents" should be entitled to the benefits of any good residential area. Though the present number of "mobile" homes is largely due to the war emergency and actually affect only a few "defense" areas, there is no assurance that a large number of these homes will not remain. We are concerned now with the tremendous increase in the mobility of the people,\(^2\) and it is possible that we will be confronted with the problem of the "mobile homes" on a still larger scale.


2. The previous discussion on floor area and use restrictions shows that zoning restrictions does contribute to this problem of increased mobility of the people. The family is forced to move around to find suitable accommodations at every stage of the family cycle.
CONCLUSION

The thesis has followed through the steps of the performance approach to establish residential zoning and subdivision controls. Throughout the analysis, the main concern was to provide flexibility in the provisions, to adjust automatically as it were, to the unique conditions of the site, of technology, of social policies and above all the demands of the individual's idiosyncracies.

An attempt has been made to show in the graphic comparison that the application of the new type of provisions need not cost anymore. In fact, in many instances, the precision type of specification has indicated areas in which savings can be made. Such items were paving cost, installation of utility lines, servicing of streets and so on. Depending on one's point of view, any economic advantage or disadvantage is believed to be a matter of shifting of responsibility from the community to the individual.

Admittedly, the proposed provisions do not guarantee good design any more than the present regulations. Nor would the strict application of the provisions result in poorer designs. BUT, under the proposed type provisions,
as far as can be shown, the designer has much more freedom, so essential if we are to enjoy better residential areas. Any limitations still apparent (and there are many) are mainly due to the inability to extract the essential elements to control. For example, the resort to specific spatial dimension to assure certain space requirements of lot size, width, lot lines indicate this drawback.

Many shortcomings of the thesis are apparent which in most cases can be eliminated. Certain views are comparatively speaking subjective in nature. For example, many would object to the substitution of mechanical ventilation for natural, the indices used for outdoor space, etc. Also there is too much reliance on the graphic illustrations to prove a point. This in itself is not a major fault but the illustrations themselves leave much to be desired. Reference to actual designs would be better to illustrate these points.

In any case certain recommendations are in order besides those already mentioned in the previous section. These are listed in order of their immediate applicability.

1. Integration of zoning and subdivision controls or at least a better coordination between the two is needed. This is best illustrated in the design of that area between the building lines or the right of way. The requirements of the street, the lot and dwelling must be considered together.

2. The provisions of the street and lot requirements should be more detailed and precise and not the reduced aver-
age of all conditions, related or not. Only then can the designer be free to use his imagination to design better residential areas. In this connection, the language used could be more connotative as illustrated in the introduction.

3. Performance type building codes should be adopted and zoning and subdivision controls complement these. In any case, technological developments should be recognized.

FINIS.
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