# A SYSTEM OF RESIDENTIAL SPACE PLANNING
# FOR
# DWELLER PARTICIPATION

By

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B.S.A.D. Massachusetts Institute of Technology
1973

Submitted in Partial Fulfillment
of the Requirements for the
Degree of

Master of Architecture

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 1978

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ABSTRACT

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SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE MAY 1978 IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARCHITECTURE.

This thesis presents a system of residential space organization and design procedures formulated for the context of the United States. The system could be used by individuals or groups without formal architectural training to design floor and roof plans for single floor houses.

The introduction briefly discusses the circumstances which make this ability desirable. Section 1 describes the assumptions made in developing the system. Section 2 presents the system in an abbreviated form and Section 3 presents it in detail. The abreviated form was used to test the system with people unfamiliar with it. The houses they designed are presented in Section 4.

I explored only the typical American house type so that I could concentrate upon the organization and synthesis questions. This design system could be furthur developed for other contextual applications and building forms such as groups of houses, attached houses or multiple dwelling structures. The involvement of the professional designer can occur in various forms and degees to design community space, the massing and positioning of dwellings on the landscape, building construction systems and furthur elaborations and revisions of the system.

Thesis Supervisor: Eric Dluhosch
Title: Research Associate

# Acknowledgements



I GRATEFULLY ACKNOWLEDGE THE FOLLOWING PERSONS FOR THEIR CONTRIBUTIONS:

| | |
|---|---|
| Eric Dluhosch<br>Ed Allen<br>Mike Gerzso | for their support and criticisms |
| George Tremblay<br>Alison Quoyser<br>Mindy Lehrman<br>Rob Brunkan | for their participation in experimenting with the system |
| Jan Burgess | for reading and correcting my work |
| Eileen Nugent | for putting up with me |

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# INTRODUCTION

The intention of this thesis was to develop a system of residential space planning which could be used for helping people design their own homes. Although I studied only single family houses, the ideas I generated could be adapted to other, more compact forms of housing such as attached units or apartments.

There are a number of reasons for investigating ways to assist people in creating their own dwelling designs. The following are those which I consider to be the most relevant.

Each year many people have built, or build themselves, houses which they have attempted to arrange to their own specifications without the aid of an architect. To do so is a difficult, if not risky task and the cost of mistakes can be high.[1] Unless they are designers in their own right, people must rely upon magazine clippings, example house plans and tips the contractor can offer. Most publications which are aimed at helping the dweller on this design task are intended to make him into an architect for the purpose of a single home. Such expectations are too high for most people, especially when contrasted to the six years of education that an architect must have. A more useful aid would be a step by step procedure which could lead the first time designer through each phase of planning his home.

There are unquestionably numerous other people who aspire to their own house but who could not cope with the obstacles of general contractors, city officials and regulations.[2] These people must be content with houses built by the industry today: mediocre affairs designed for the nonexistent average family. This housing is produced with the same objectives as automobiles and electric toothbrushes. They are just another commodity to be sold: 'housing units' to be 'consumed' by 'consumers'. It is my contention (and many others ) that what is needed are 'homes' to be 'lived in' by 'people'. Such homes are most likely to result when the future dwellers can shape them to their individual requirements and desires.

The home can have a large psychological impact upon our lives.[3] It forms the setting for our family activities and the interaction of its members. The spaces within a home can influence what things we are able to do, how satisfactorily we can do them and if people can avoid disturbing each other. The size, quality and location of common family areas will influence what significance people place upon them and how the family may view itself as a cohesive group. The only people who can properly resolve such subtle and personal questions are the individuals who live in the dwelling.[4]

We tend to choose dwellings which reflect in some way our lifestyles and values, thus our homes become important avenues for self-expression and personal identification. We can talk to people about ourselves, but when they visit our home they will understand us in ways we could not otherwise express. It is in this manner that most houses today are so inadequate. When people must choose from a limited variety of styles papered over the same little box they can no longer discover what truely interests them.[5] In the language of a house, words are put into their mouths. Builders, at the selling end, must decorate the houses so as to catch the eye of the purchaser. Shutters are added, a dormer here and a lamppost there. The owner has bought an advertisement, an appliqué image of a house.

The house is of obvious practical importance for shelter, health and physical comfort. Every family will vary in their requirements because of the number of family members, their ages and states of health or incapacitation. Most houses seem suitable only for agile young adults. Typically the alternatives in a house are two, three or four bedrooms and a 'custom bath'. What about a guest area, a workshop or a wing for the aged parents? I suspect that one reason why middle America offers resistance to the idea of communal living is their inability to understand how people could live together in a house and not be members of the same family, i.e., they must be crazy. Some of the greatest difficulties with communes revolve around the use

of space.[6]

Homes should be changeable because people change. Not to allow alteration of one's dwelling is to guaranty an eventual misfit. People must then either contend with crowded and inconvenient conditions or move to a more appropriate dwelling. If a family size shrinks or income is reduced, both of which happen during retirement years, a small change in a dwelling's structure would allow a portion to be rented out for the extra income or security in the case of older people.[7]

Houses and even most mobile homes are tied to a particular geographical location and all the features which accompany it: neighbors, shopping, community, landscape, public services, cultural events and employment opportunities. The problem of finding an appropriate place to live is like solving an equation in which most of the variables are dependent upon the given location where one must live. People can adjust to these conditions to a certain degree by commuting to work, ignoring their neighbors or reading a good book for lack of other amusements. If people can participate in the arrangement of their home, whether it is the alteration of an existing structure or newly built, one factor in the personal housing equation is adjustable.

The cost of housing today is a major concern for most people.[8] They should be able to make the economic trade offs between what to include or exclude from their home. Rooms which were created for the hypothetical consumer may be superfluous for the real inhabitant. If space could be allocated to suit the needs of the dweller, more economical housing would result.[9]

Less pragmatic than the foregoing concerns is the question of the house as something of value beyond its price tag. We do not regard the disposable can, like we do a well crafted bowl which adds delight to our use of it beyond the contents it may hold. Much of the housing produced today is like so many disposable cans: brightly labeled containers for their contents of washing machines, color TVs and

air conditioners. Commercial, institutional, legal and other requirements determine the form of houses being produced today. The missing constituent is the individual who cares for something because he will use it and live in it. Enabling people to layout their own dwelling is one step toward re-introducing people to the home as a special place to call their own and to be proud of.

I have stated these intentions not because this thesis accomplishes them, but in order to put this work into its proper perspective. To the architect interested in beautiful and subtly pleasing designs the results will probably be disappointing. At most I have devised an elementary method for helping ing people to arrange rooms in plan. At worst the system could be used by developers to create vast tracts of houses all different in a sterile manner of geometrical permutations. As with any endevor, it is up to the people who use it to put it to good use.

By introducing people at the inception of design, it is imagined that they would continue to embellish the structure as it progressed to completion and over the years that they inhabit it. I have hinted in various parts of the thesis how this embellishment might occur, but it deserves much more work than was possible for this investigation. A plan, as every architect knows, is only the beginning of architecture, and I have only attempted to formulate a beginning.

1. For a discussion of the advantages and possible problems of people designing and building their own house see:J.F.C. Turner, Freedom to Build (Macmillan Co., New York, 1972).
In contrast to Turner, Lawrence Gavin made a brief but interesting study about the results of one architect's efforts in designing houses for others. It indicated how the architect can help people avoid some of the mistakes that Turner mentions and will add his own ideas which the dweller may appreciate. He also points to the possible friction which can occur when the dweller and the designer are different people with their separate objectives. L.D. Gavin,"Comparative Study in Perceptions of Architecture"(unpublished paper for Design Research Laboratory, College of Evironmental Design, University of California, Berkeley, 1965).
2. Ken Kern, a dedicated build-it-yourself advocate discusses the immense difficulty of building your own home or even having someone else do it to your specifications. Ken Kern, The Owner-Builder and the Code (Owner-Builder Publications, Oakhurst, California, 1976).
3. Carl Jung made public his extensive observations about the importance of the house and other artifacts as elements in our psychological existance in his classic book Man and His Symbols (Doubleday and Co., Garden City, N.Y., 1964).
Many analytical studies have been conducted which indicate how physical arrangements and the circumstances under which they are used can induce us to respond in a particular manner. David Canter and Terence Lee, Psychology and the Built Environment (John Wiley and Sons, N.Y., 1974).
Edward T. Hall The Hidden Dimension (Doubleday and Co., Garden City, N.Y., 1966).
Robert Sommer, Personal Space (Prentice Hall, Inc., Englewood Cliffs, N.J., 1969).
4. In case studies of contrasting types of families, daily activities and conversations were carefully recorded. It was indicated that there are pressures caused by the physical limitations of the dwelling and that people must change their behavior to work around them. People will also change their homes in whatever ways are available to relieve the pressures. D. Kantor and W. Lehr, Inside the Family (Harper-Row, New York, 1976).
Herbert Gans, a sociologist from the University of Pennsylvania, lived in Levittown, Pa. for the express purpose of studying how it affected the people who moved in. He concluded that "The single most important sourse of impact is undoubtedly the house, even though most of the changes it encouraged in the lives of Levittowners were intended. ... space was the most significant source of change, providing easier child-rearing, more room for family activities, and greater privacy to its members, thereby reducing family friction and increasing contentment. ... Both house and yard offered opportunities for initial fixing and furnishing, and also for more lasting decorating, hobbies, and other kinds of cultural self-expression They also had unintended effects: more family cohesion and change in spare time and spare-time activity."
Herbert J. Gans The Levittowners ("Vintage Books", Random House, Inc, New York, 1967), p. 277.
5. Clare Cooper has extended Jung's ideas with observations of how one's choice of the appearance of

their house correlates with their attitudes about their occupation, their family life and the community as a whole. Clare Cooper, "The House as Symbol of Self"(Working Paper no. 120, Institute of Urban and Regional Development, University of California, Berkeley, May 1971).

At Le Corbusier's project of single houses at Pessac, France the residents added gable roofs, made windows smaller and inserted walls to remake the houses in the image of their traditional cottages. To them, the original severely geometrical houses were "Morracan" and not French. Interestingly it was the simple shapes which allowed these alterations, but when the structure became in the way of intended alterations they were not successful. Philippe Boudon, Lived in Architecture, (MIT Press, Cambridge, Massachusetts, 1969).

6. Rosabeth Moss Kanter, Commitment and Community (Harvard University Press, Cambridge, Mass.,1972).

7. In Philadelphia a study was made of families and their reasons for moving. It was discovered that of of those which elected to move (i.e., not forced as in cases of fire or eviction), 66% stated that inadequate space was involved in their decision and 42% of those listed it as their primary complaint about their old dwelling. The study concluded that the amount of space was the most important asset about a dwelling. Its design and ability to accommodate family size and age shifts was seen to be an additional factor which influenced a family's need to move. Peter H. Rossi, Why Families Move (The Free Press, Glencoe, Illinois, 1955), p. 149, p. 177.

8. According to the general rule of thumb used by mortgage lenders, a family's gross monthly income should be at least five times the monthly payments for interest and amortization on a new house, with a down payment of 10%. In 1950 seven out of ten American families could afford the cost of a new median-priced house. In 1975 this number was four in ten. Part of this change is due to the larger house sizes being made by builders today. Gurney Breckenfeld, "Is the One-Family House Becoming a Fossil? Far From It." Fortune (April 1976), p. 84-165.

9. A favorable response was given from the tenants to an apartment building in Uppsala, Sweden which incorporated movable partitions. Most people indicated they would be willing to pay more for an apartment which could thus be adapted to their individual requirements. "Only two of the sixteen households stated that they did not feel flexibility was a significant factor in the comfort and enjoyment of the home." Bertil Olsson and Rolf Nilsson, "Flexible Apartment Units, A Study of an Experimental Housing Project in Uppsala, Sweden", The Responsive House, ed. Edward Allen (The MIT Press, Cambridge, Massachusetts, 1972), p. 212-219.

# SECTION 1

# CONCEPTS

The concepts which comprise the basis of the system were included for either of two objectives discussed below.

One objective was to be able to plan houses which would function in the way they were intended. This objective is usually accomplished by a designer who uses his experience and training to create a house plan from a list of required spaces and relationships. This system thus needed to formalize the process of design so that it could be repeated by others who had no experience or training. In doing so it was accepted that the resulting system could not possibly create as original a house as a good architect might, but it was hoped that it could do better than the typical house massed produced today and avoid the functional planning errors that non-architects would make. It was inherent that any formulated approach would produce a limited type of house because it was designed to eliminate poor houses. It was also likely that it would ignore whole categories of good solutions, particularly any with nonrectangular forms. I suggest that other house forms might be devised using similar operations but with different geometrical components.

The second objective was to make the system usable by non-architects. This task produced something of a quandry. I could not test the system with people until I had it developed, yet the system should be based upon how people might use it. I was thus forced to make several assumptions based upon my limited experience and experiments made by others with similar intentions.

Being an architecture student, people have occasionally asked me to help them with plans they have developed for themselves. What these plans typically lack is a sense of scale. For example, bathrooms are as large as living rooms and kitchens are no wider than a refridgerator, which is shown on their drawing to be six inches wide. Even when people have measured dimensions of furniture, the distances between them may be too small but more frequently they are huge.

In a short study to explore how architects design and how the methods they use distinguish a good architect from a beginner, the conclusion was that the ability to deal with graphical tools was a large factor in the success of their design efforts.[1] This would indicate that the more simply the unskilled user can put his thoughts down on paper, the more facile he will be at creating a house plan.

Most of the experiments in dweller participation attempt to make the individual into his own architect by providing him with some visual aids such as models or cutouts. These experiments have reported favorable results from first time designers who produce dwellings which are rich in personal qualities. The more successful of these experiments, resulting in less frustration for the participant, seem to be those with operations which are well defined and present a clear connection between manipulations to be performed and the spatial relationships desired. When manipulations must be performed upon parts which represent only a small and indirect element of spatial definition, such as a beam connection or other structural problem, people become distracted from their spatial planning problem.[2] The most successful attempts are those which have dealt with movable partitions and storage modules in an apartment. Here the structural question is nonexistent and every move is related directly to a spatial concern.[3]

I have assumed that a system of spatial design should deal only with manipulating spaces. There could be a very simple set of rules or boundaries which apply directly to the spaces. These rules would be devised by the architect to relate to structural or mechanical requirements, thus relieving the participant from these questions.

My observations had also indicated that, although people can understand most spatial concepts of house form, room distribution and furniture arrangements, to deal with these simultaneously and perform trade offs between various levels is a very difficult task. I suggest that it is better to

lead the decision maker through successive steps and then allow him to backtrack if necessary.

The following concepts of house organization were used in formulating the spatial planning functions of the system.

HOUSE FORM

- Placing the house depends upon site characteristics and desirable positions available for building.
- The edge of the house defines the edge of exterior spaces.
- The house shape is a major part of our understanding of it as a single entity.

GROUPING OF SPACES

- Spaces with compatible activities should be grouped together.
- Spaces with incompatible activities should be separated.

DIMENSIONS OF SPACES

- Sizes of spaces should depend upon the objects they are expected to contain and the amount of space necessary for their use.
- Sizes may also depend upon psychological or social requirements such as appropriate distances between seated people or minimum room sizes.

RECTANGULAR BASIS OF PLANNING

- Furniture and other items fit most easily into rectangular spaces.
- Rectangular spaces are easy to close pack and subdivide.
- Right angles and planes are consistent with present day construction methods.
- Employing right angles avoids useless interior acute angles.

SUN AND VENTILATION

- Distances are limited from any interior place to the exterior wall for adequate light.
- The width of any part of the dwelling should be limited for light and cross ventilation.

● No major interior space should be without windows.

DIMENSIONAL COMPATIBILITY IN PLAN

● The variation of space sizes must be controlled to prevent oddly shaped houses with many corners.

CATALOG OF GOOD IDEAS

● There should be a way to record good ideas about types of spaces and ways of arranging them so others can benefit from them.

● This catalog should be easily added to or pruned of obsolete or poor ideas.

USE OF CATALOG IDEAS

● There should be an easy way for the user to directly incorporate the good ideas from the catalog. Therefore they must be specific and concrete rather than

THE DIVISION OF SPACE

● Division of space is a task which requires careful consideration of functional and spatial relationships. It is the most logical sequence to choose where to put doors, windows and walls after spaces have been established. (Space division will usually be considered at each stage of planning, but usually in a general manner. Space division considerations may lead to reevaluation of the space layout.)

The following concepts of how people perceive design tasks were used in developing the system so that it could be usable by non-architects.

● Allow people to make choices at what ever level they choose: house form, spatial groupings or furniture layout. The system should be able to supply some average solution if the user does not care to make a decision for a particular question.

● People should be able to depart from the given alternatives if they choose to design a particular item themselves.

● The problem of determining adequate dimensions should be automatically done without requiring the

user to calculate them.

- The design task should be divided up into individual problems which have a limited dependence upon each other.
- A strategy for sequencing decisions is required which can be flexible to adjust for individual dispositions and interests while maintaining a logical order of design activities.
- The house is divided into a morphology of spaces which corresponds to common experience. It can thus be used with a minimum of translation by a user.
- This morphology is used to shorten design tasks and decrease the complexity of each step. Each level of design is only as specific as necessary, e.g., at the area level, only space types are refered to, not what is specifically in them such as refrigerators, tables, etc..

Most of the graphical notation I have used has been borrowed from the SAR methodology, although I have deviated in several places from their procedures.

The SAR methodology was created for the development of row houses in Holland. SAR divides dwelling space into two categories: 1) the "detachable unit" which is that area over which the individual has control and 2) the "support" which involves those decisions over which the community has control for everyone's mutual benefit. The goal is to construct supports and manufacture detachable units which can be manipulated by the dweller to meet his housing needs. The method relies upon explicit notation of the dimensions and positions of spaces and building elements. This notation records the dimensional requirements of activities and furniture for the determination of minimum space sizes. Linear strips of space called "zones" indicate where these spaces will tend to occur and thus are sized to accommodate the appropriate spaces.

Dwellers can participate in determining the final disposition of zones which architects will design into the support structure. The final support structure may contain many dwellings at densities of 15 to 50 people per gross acre or more.[4]

I have also taken note of Christopher Alexander's work on a language of spaces. Similar to the way words denote ideas in verbal language, "spatial patterns" represent concepts about the arrangement of space in a "pattern language". This language has a syntax for governing how patterns are organized into complete spatial forms, either rooms, buildings or cities. As with a verbal language, it is up to the user to create a complete form which makes sense. The pattern language offers only those generic arrangements of space which are useful for a particular context. This is important because it means that people are freed from generating every basic spatial arrangement that they need to use.[5]

I diverged from strict SAR methods for two reasons. The SAR methods apply most directly to row houses

and other high density housing forms. Most residential areas in the U.S. are inhabited at between 1/2 and 10 units per acre; much higher residential densities are not likely in most areas. Housing forms possible at these densities are much less restricted than the linear rowhouses assumed by SAR. Another divergence occurred in the attitude taken about the use of such a design system. With a larger range of potential design solutions available to a dweller, he must be given more help in matching his needs with a physical solution. Therefore a planning strategy for people to follow was basic to this system.

Although Alexander's patterns can be very rich and useful, one must almost be an architect or have the assistance of one to implement them. The task of actually drawing up a plan is left to the user's ingenuity.

What I have tried to do is combine the explicitness of SAR space planning with the potential richness of spatial patterns which can be filed in a library or catalog and be used in the planning system.

1. Adel Tewfik-Khalil Foz, "Some Observations on the Designer Behavior in the Parti" (unpublished Master's thesis - Architecture, Advanced Studies, Massachusets Institute of Technology, Cambridge, Mass.).
2. Jan Wampler has conducted several workshops at M.I.T. for non-architects in which various kits and design strategies were employed. I was also able to observe first year design students grapple with scaled building parts for directly designing space. I experienced this problem both as a participating student and as a teaching assistant.
3. In the Upsala apartments, tenants seemed to have little trouble understanding how to rearrange their spaces with the movable partitions. They became aware of the design of the overall structure they needed to work within and detected how it prevented many solutions. Olsson and Nilsson, The Responsive House, p. 217.
4. N.J. Habraken et al., Variations: The Systematic Design of Supports (Laboratory of Architecture and Planning, M.I.T., Cambridge, Massachusetts, 1976).
5. Christopher Alexander, et al., A Pattern Language (Oxford University Press, New York, 1977).

SECTION 2



# THE ABBREVIATED SYSTEM

Although the final system described in this thesis is not too long for someone actually interested in designing their own home, I felt that it required more attention than I could expect the casual experimenter to provide. A condensed version was created to graphically outline the system and its use. The eighteen original steps which were initially organized into a precedence network have been reduced to eight sequential steps.

The condensed version is included here to help introduce the reader to the system. It should be understood that because it is an outline many of the rules and instructions have been excluded. When it was used for testing on others I was available to answer questions and clarify rules which are presented here in section 3.

There are three basic parts to the design system: the instructions, the catalog and the display board.

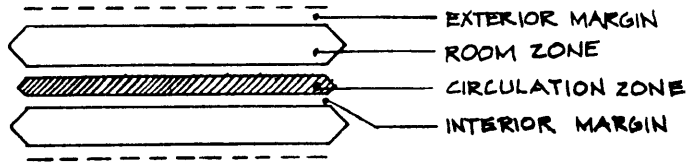
The instructions for each step inform the user about what decisions he should make at that time. These instructions are listed at the top of each step shown on the following pages.

The catalog is a collection of ideas about what might be desirable parts of a house. These are recorded as lists or charts of design options from which choices can be made by the designer during successive steps. The catalog options for each step are shown immediately below the instructions.

The display board is the two dimensional surface upon which the house plan is constructed. This could be simply a piece of paper on a drafting table, a television screen (CRT) connected to a computer or many other things. For my thesis, I used a wooden board with paper and acetate pieces to be manipulated by hand. This is described more thoroughly on page 100. In the following explanation, the display board is shown at the end of each step as it would appear after the operations have been performed.

DEFINITIONS:

Zones and Margins are bands of space with specific widths and variable lengths. They are used to indicate where rooms and objects in the house can be placed.

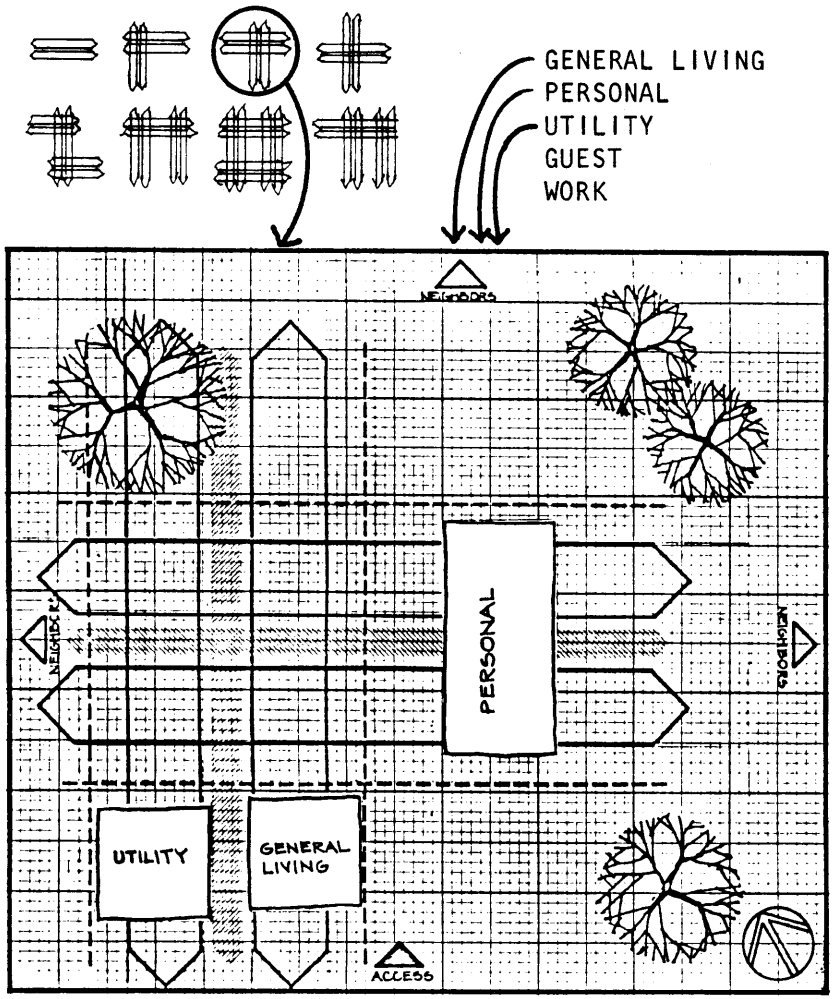



A space is a readily identifiable part of the house because of a particular activity and set of furniture it contains. examples: a kitchen space, a dining space, a sleeping space.

Areas are created from groups of spaces which are most appropriately grouped together. example: a personal area would have bedrooms, bathrooms and perhaps a study.

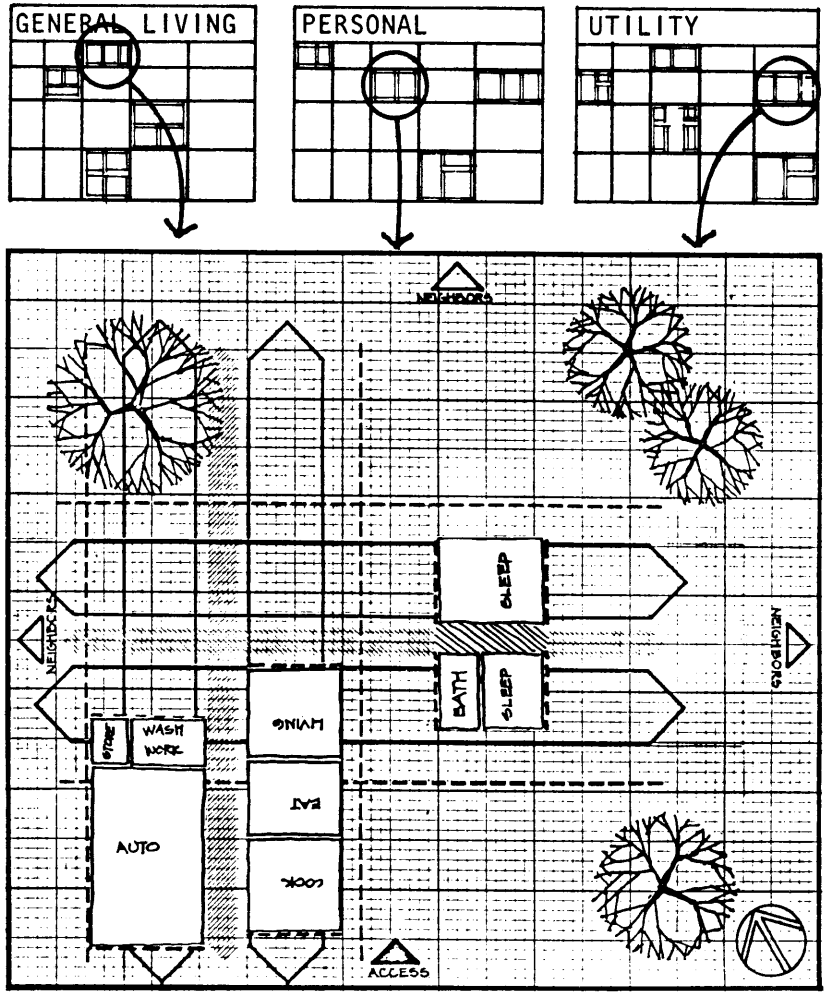
# Step 1

Choose a zone pattern and fit it onto the site. Choose at least two area types and insert them into the zone pattern by placing them over one or two room zones.



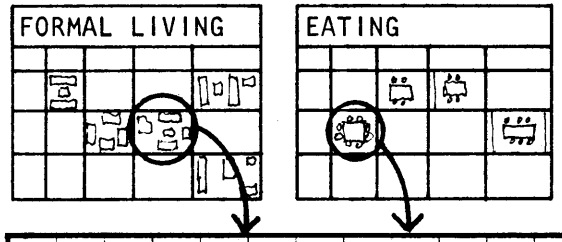

# Step 2

Examine the area layout chart for each area and choose layouts which contain the spaces you want. Substitute these layouts for the labled boxes placed in step 1.

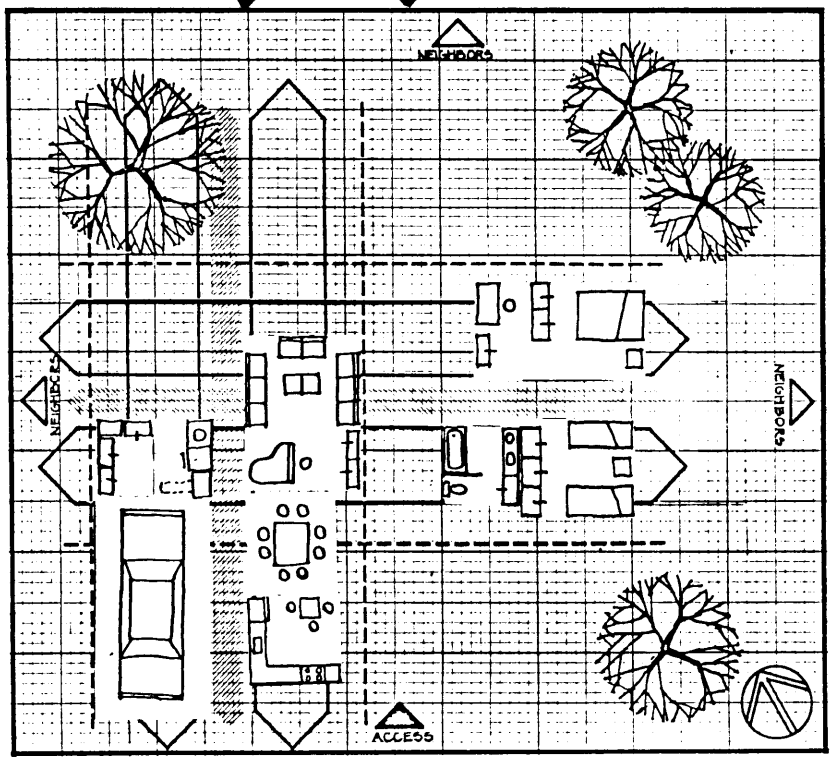


# Step 3

Examine the space layout chart for each space and choose space layouts which contain the general furniture arrangements you want. Substitute these spaces for the area layouts placed in step 2.

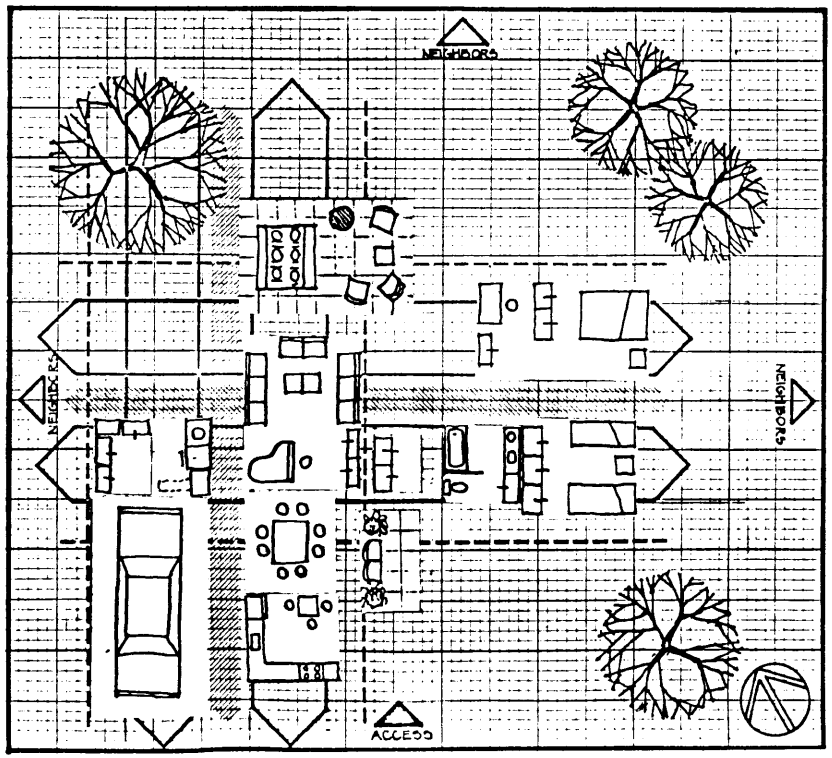



etc.
for: BATHING
COOKING
WASHING
AUTO
SLEEPING



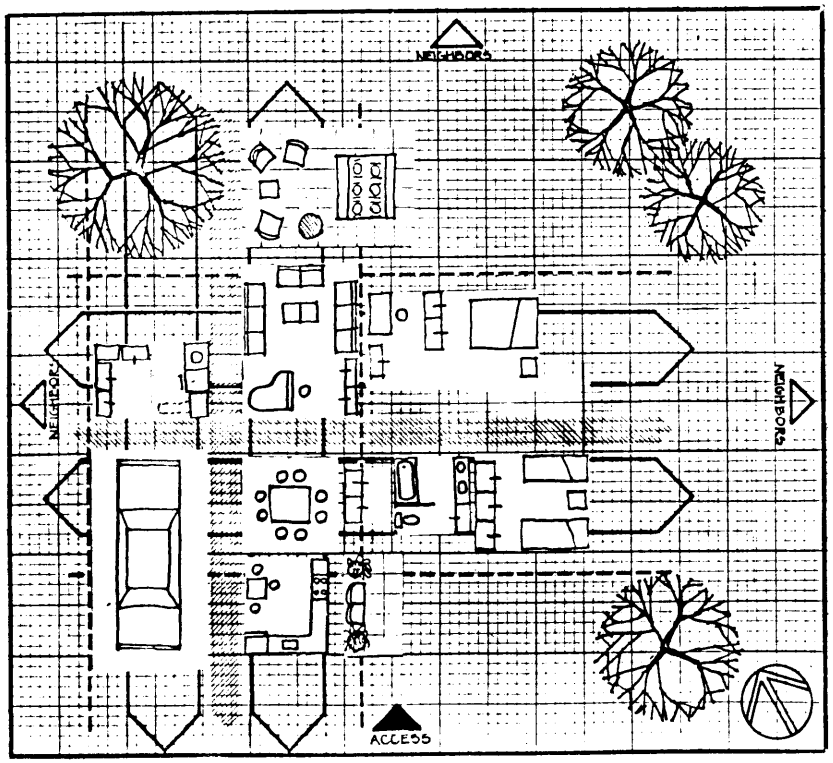

# Step 4

Put down any additional spaces which have not yet been included. Determine where your front entrance is, whether it is part of an existing space or deserves its own space. Exterior spaces should be placed next to inside spaces they will be accessible from.



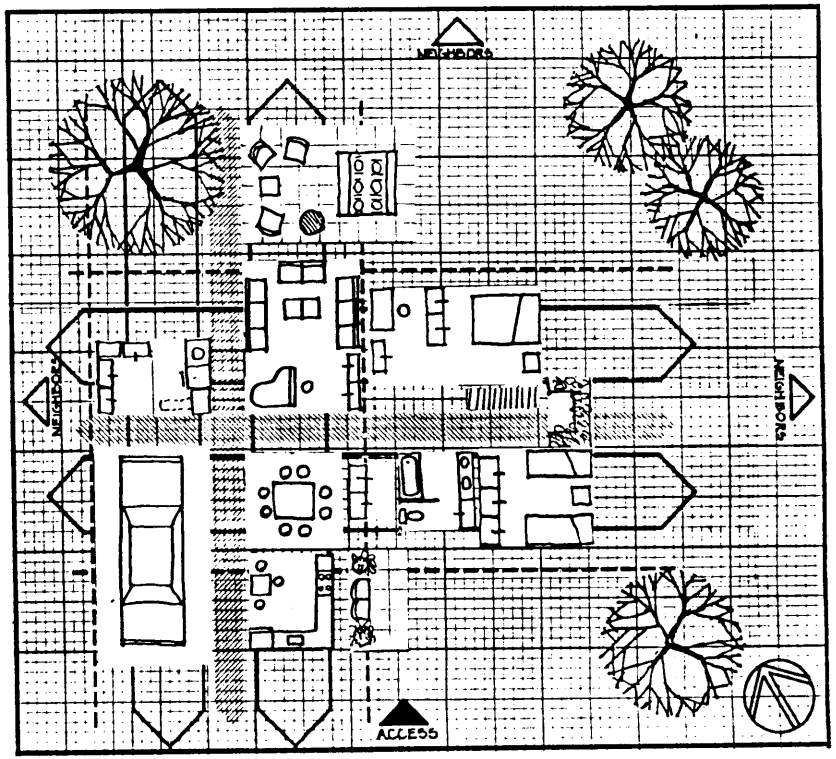
# Step 5

Adjust the house layout by moving spaces along room zones. Keep spaces from the same area together. Eliminate as much blank space in the plan as possible. Do not overlap spaces onto the circulation zone.



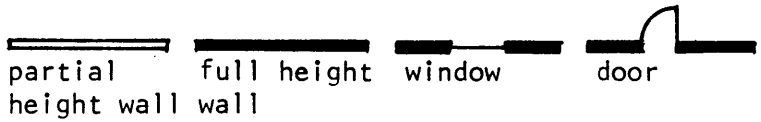

# Step 6

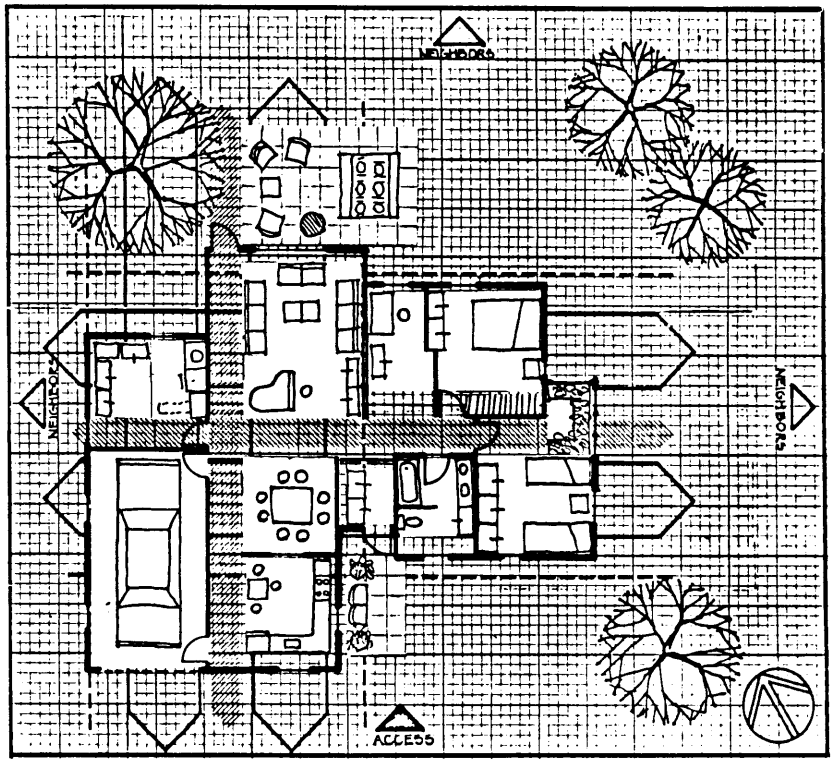
You can fill up any remaining holes in the plan with infill spaces such as storage, alcoves, small bathrooms, etc.. Margins can be made wider to accept these spaces. Bay windows and other wall projections can be put in exterior margins. The ends of circulation zones can be filled with small spaces or by expanding larger spaces.



# Step 7

Determine where interior walls and doors should be placed to separate or combine spaces. Locate exterior doors and windows with regard to sun, views and accessibility.

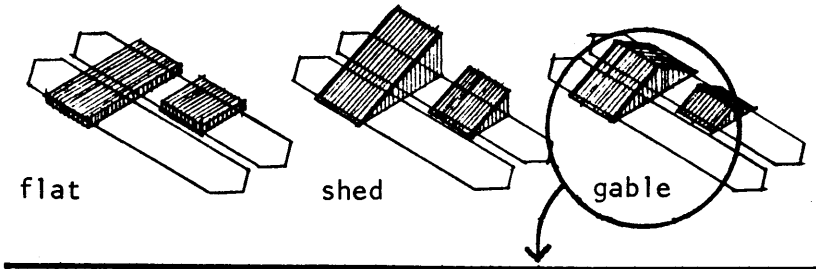


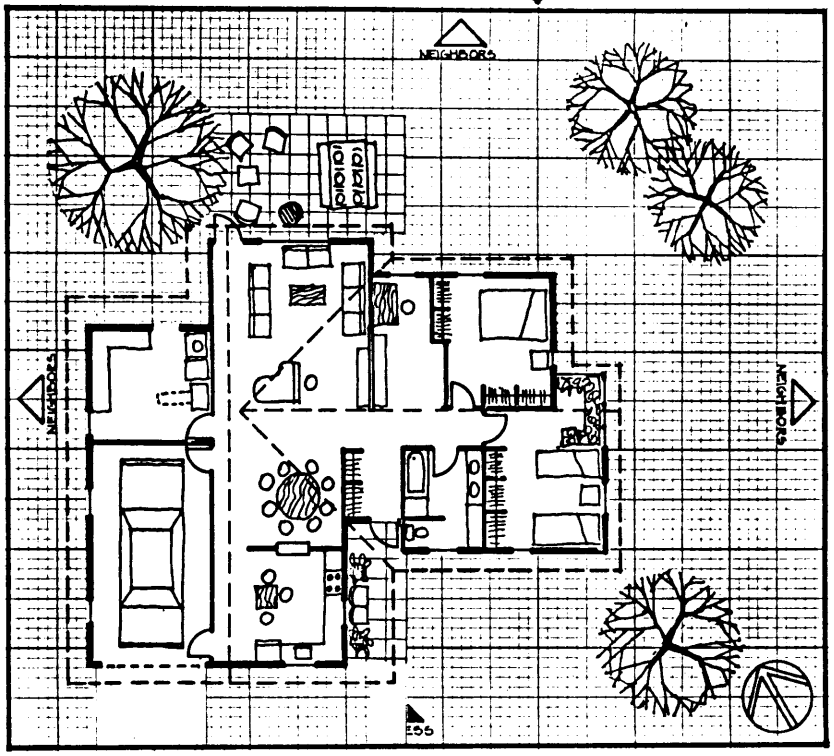




# Step 8



Determine what type of roof you would like to have over each wing of the house. Add overhangs to protect entrances or to shade windows on the south walls.



SECTION 3

# A HOUSE PLANNING SYSTEM

This section describes the design system more thoroughly than in Section 2. The format is given in a manner which assumes that the reader is using it to design his or her own house. Terminology was chosen to correspond with common parlance, but one should be aware of the distinctions between zones, areas, spaces and margins as described in the text.

Although the system is presented as if it were complete and prepared for implementation, it is essentially an experiment. My intentions were to make the work as palatable to the reader as possible because many operations are discussed in perhaps tedious detail, but which I felt was necessary for academic completeness.

In spite of painstaking effort, I have been able to produce only the bare minimum of instructions necessary to enable a person to follow through the various stages of design. What may take only a brief moment for a designer to comprehend requires many paragraphs to explain. Much of the subtle and intricate relationships and qualities which a house might have are only implied. The assumption of this system is that these qualities can be produced by the human operator if the system organizes the design problem by breaking it into individually simple problems.

Each decission could be based upon chance rather than consideration of personal desires and a plausible floor and roof plan can be achieved. When decissions are based upon a definite program and an individual projects himself into the plan as he makes decisions, the product becomes much more exciting and meaningful. Thus the system does seem to eliminate the possibility of designing unusable plans, but it requires careful work to produce a pleasant house.

Page 31 diagrams the system into 19 separate design operations. Particular operations may or may not need to follow others depending upon the aspect of design they address. These precedences are indicated as a network in which no step can be taken unless all the steps with arrows pointing to it have been completed. Thus, a person can begin to design at any of operations 1.1, 2.1, 3.1, 4.1 or 5.1 because these have no arrows leading to them. In contrast, step 1.2 must follow the completion of both 1.1 and 2.1.

The first numeral of each step decimal number indicates the morphological division of the house being dealt with. The second numeral indicates the stage in the design of that aspect.

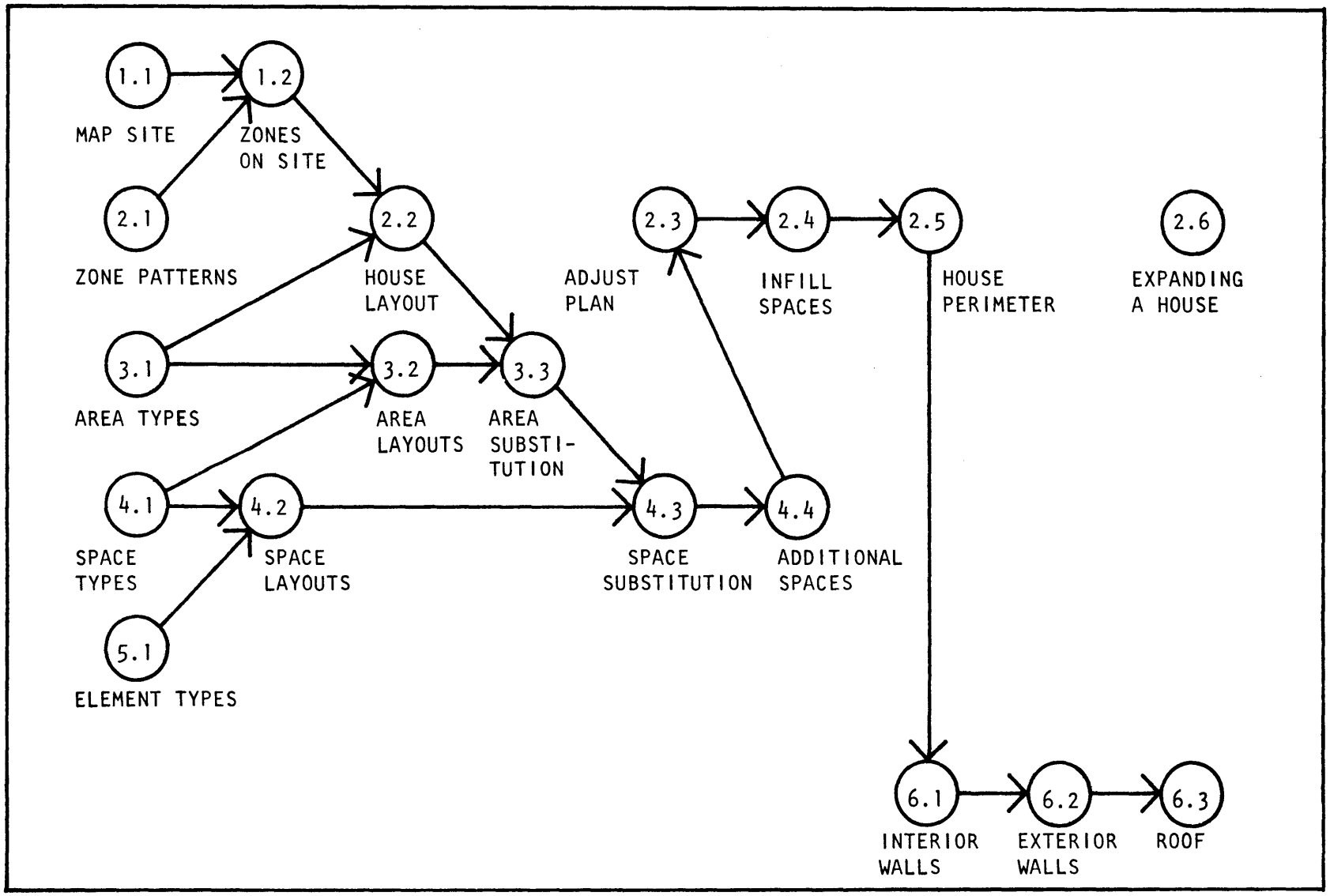
MORPHOLOGICAL DIVISIONS:

1. site
2. house
3. areas
4. spaces
5. elements (furniture, appliances, etc.)
6. physical building pieces (walls, windows, roof and doors)

Page 32 shows the sequence of operations as they are discusses in the text which is necessarily linearly sequential.

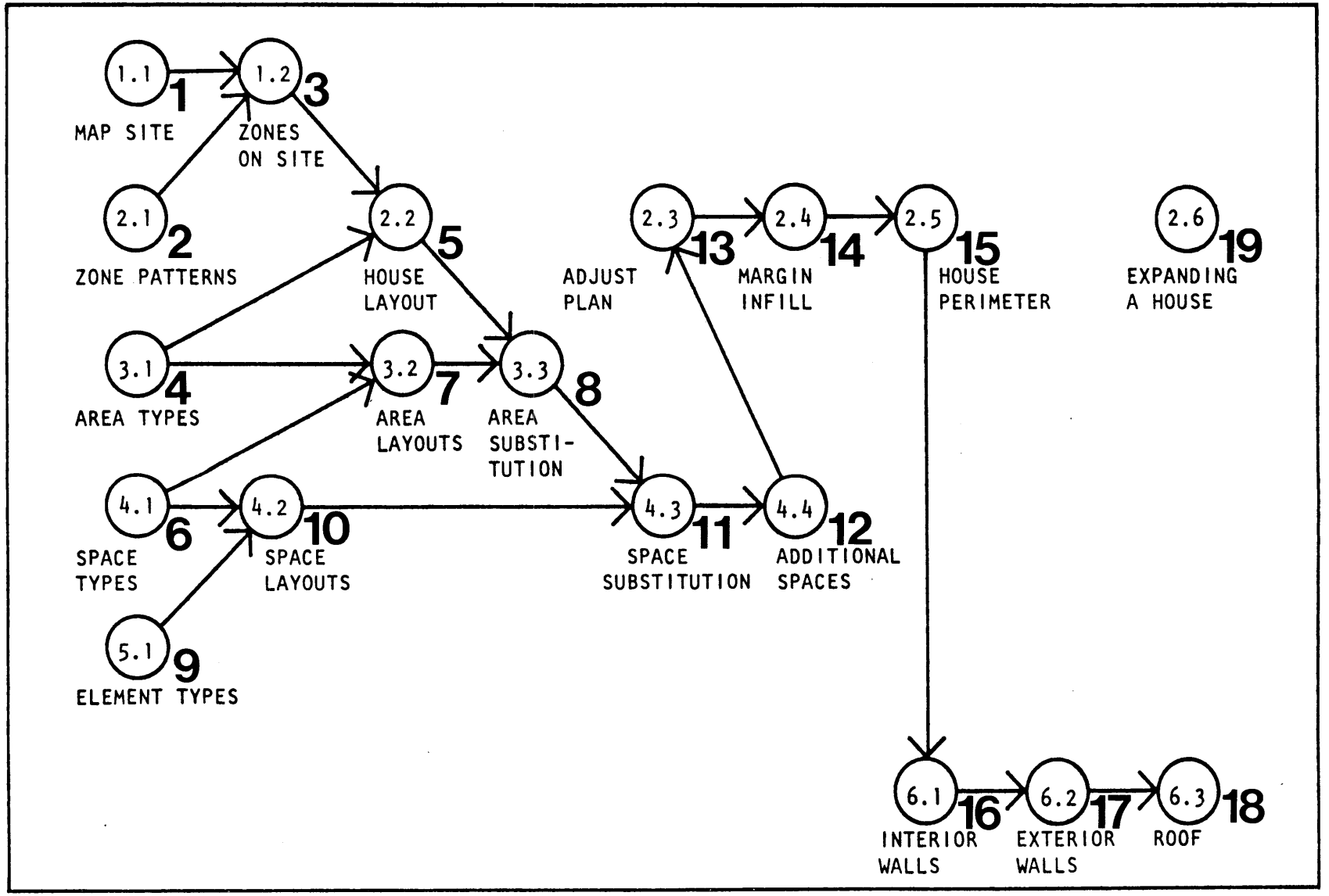
# Precedence Network for Design System





# Sequence of Design Operations Followed in Text



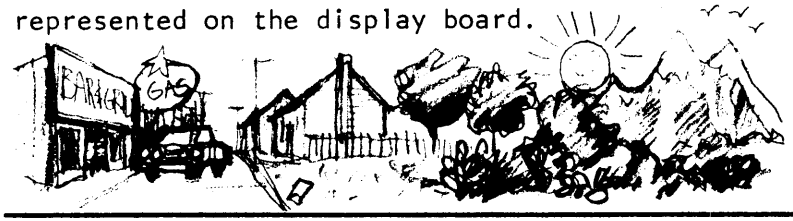


# 1.1 Map Site



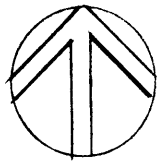
SUMMARY:

Once a site is chosen, its physical attributes are represented on the display board.



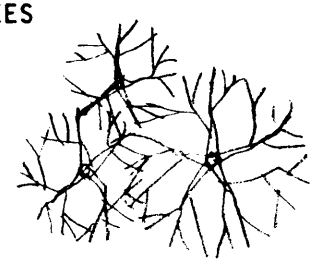

Every building site will have unique characteristics which not only make it a different problem from all other sites, but also offer the means to create a distinctive home. The first task in planning your house is to discover the important attributes of your site and to take note of them for consideration in subsequent decisions. This game enables you to account for the attributes listed below.

ORIENTATION



ACCESS FROM PUBLIC WAY


TREES

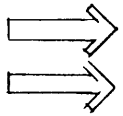


NEIGHBORS


VIEWS


SITE BOUNDARY

SUMMER WIND



WINTER WIND

TO FINISH THIS STEP:

Indicate the attributes of your site on the dispay board with the symbols provided.

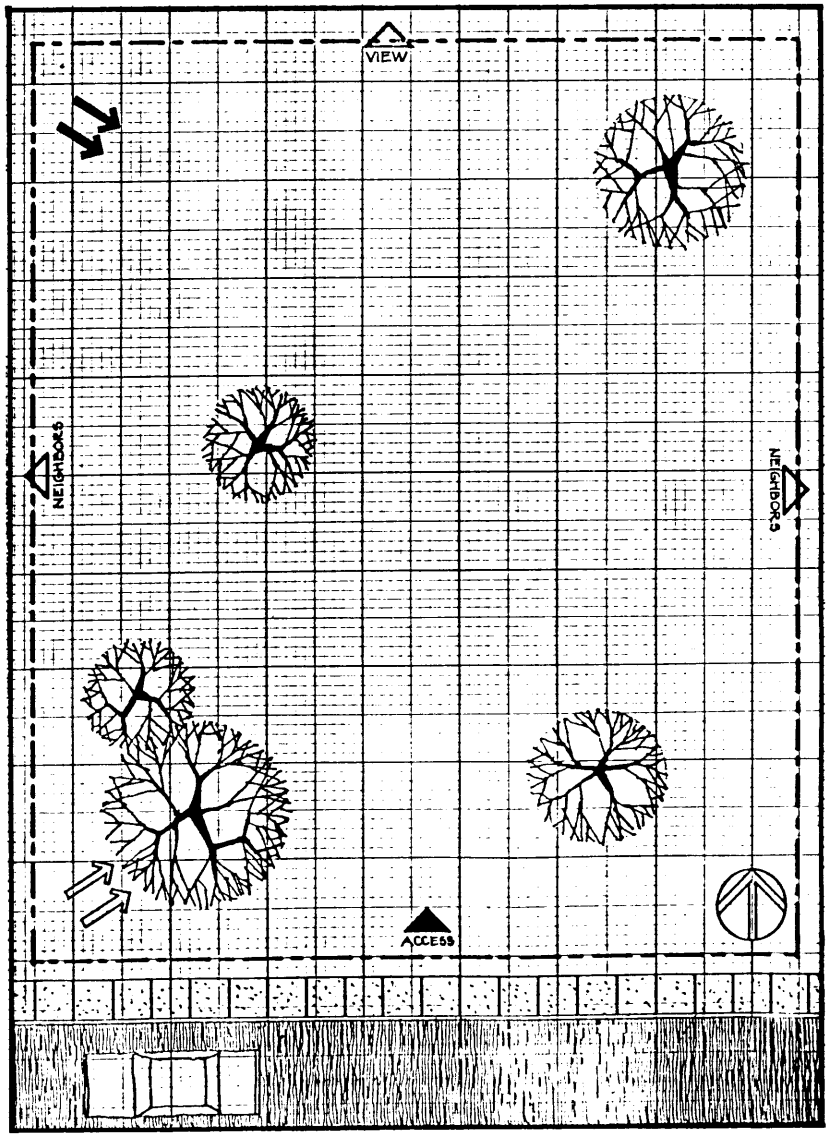
# Example



The site plan indicates the location of five trees within the site boundary. The size of this lot is 94 feet deep by 80 feet wide, a little more than 1/6 acre. This is similar to lot sizes in many developing residential areas today.

Access to the site is from the south off of the street which runs along this edge. The sidewalk and driveway must connect somewhere along this edge.

Neighbors are to the east and west which means that there are privacy problems from these directions. This may be compensated for by a good view to the north. Because the sun moves from the east to the west and generally is to the south, these sides of the house will receive the most sunshine unless shaded by trees or parts of buildings.

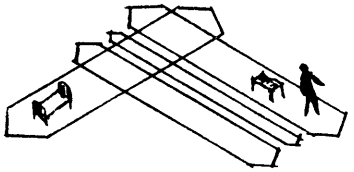


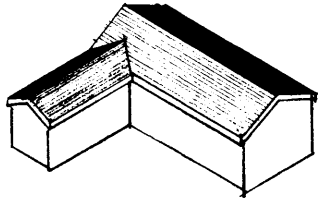
# 2.1 Zone Patterns



SUMMARY:

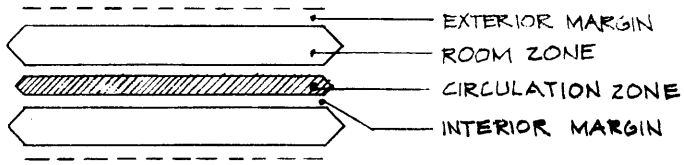
Zones are bands of space with a specific width and a variable length. They are used to indicate where rooms and objects in the house can be placed. Zones are arranged to indicate the rough shape of a house.



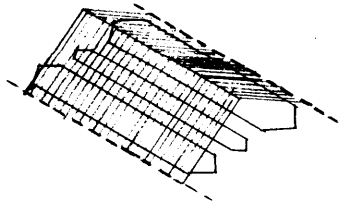


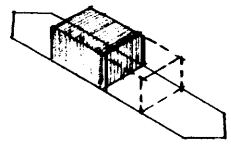
There are two types of zones and two types of margins which are spaces between zones.

- A room zone is where spaces of the house occur. These have widths which relate to minimum practical room sizes, typically 8 to 12 feet.
- A circulation zone is where circulation between spaces occur. This may be a walled in hallway or simply a path through a room where people will usually pass by and furniture should not be placed. It will have a width of 3 to 5 feet.
- An interior margin is placed between zones and is where walls, closets and alcoves may occur. It has a width of 1 to 4 feet.
- An exterior margin is placed along the outside edge of a zone and is where the exterior walls may occur which are parallel to zones. These margins may vary in width from 1 to 8 feet.




- The ridges of roofs are parallel to the zones. Their maximum span is from the outside edge of one exterior margin to the other exterior margin edge.

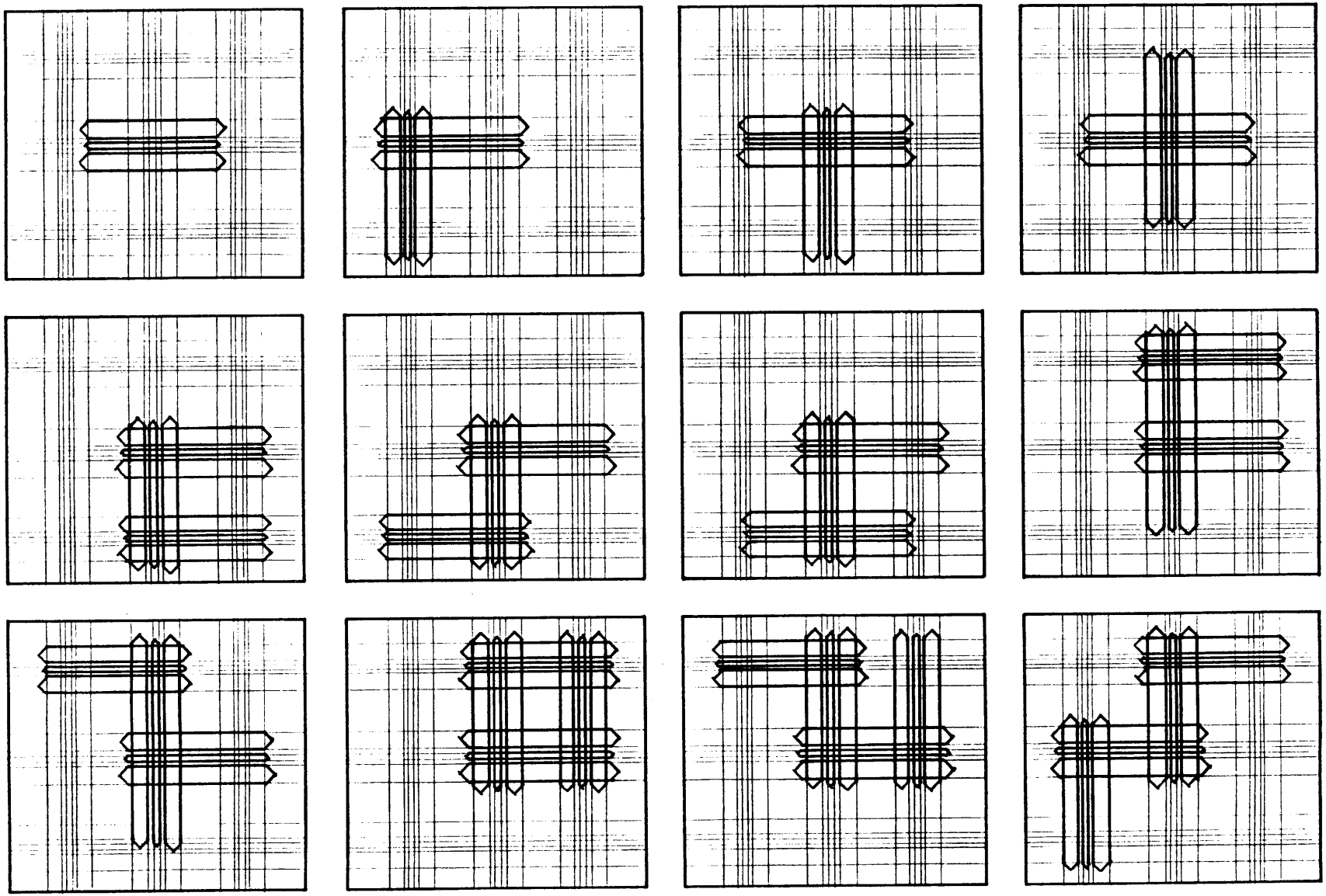


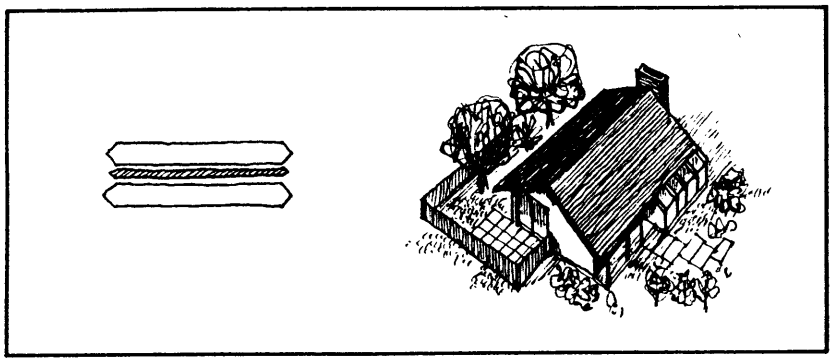


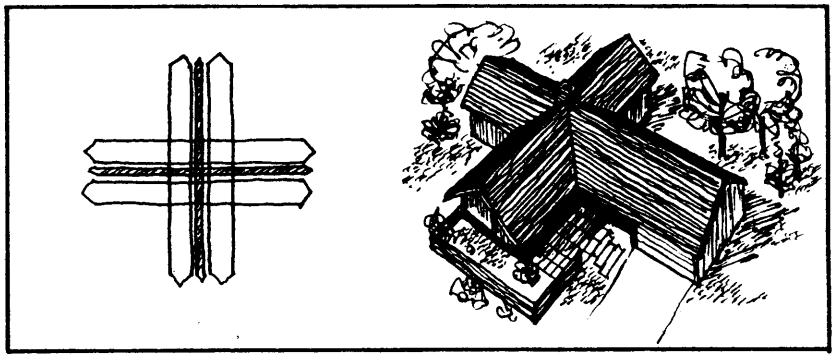
- The arrows on the zones show how their length is variable and how they may expand.

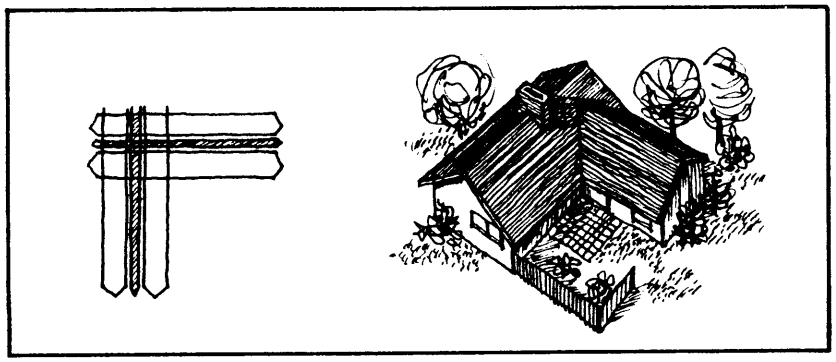
TO FINISH THIS STEP:

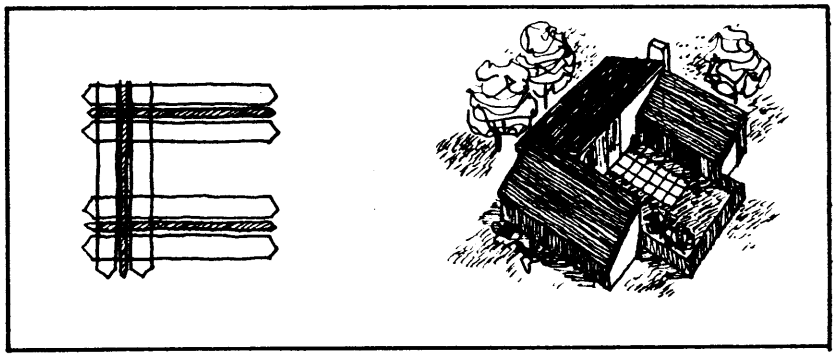
Examine the following charts and choose any zone patterns you may like. You may choose several or just one. The sketches are only examples of houses which could result from the patterns.

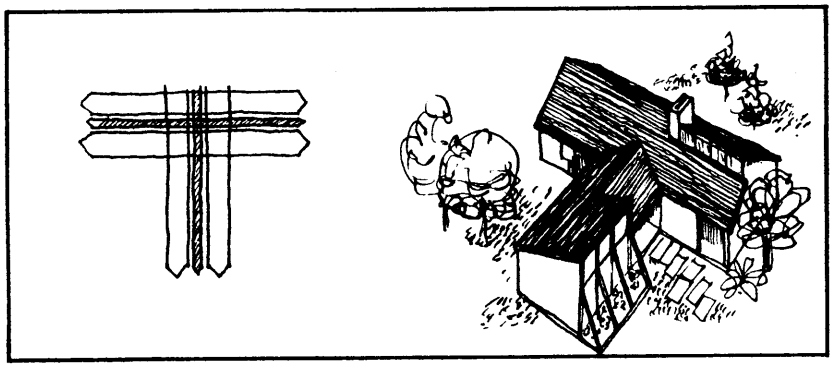


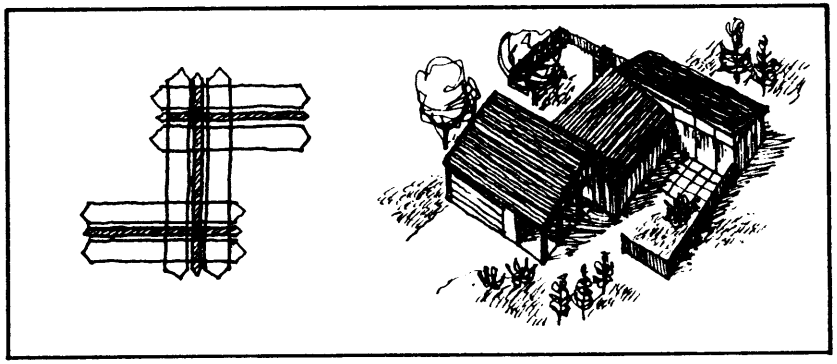


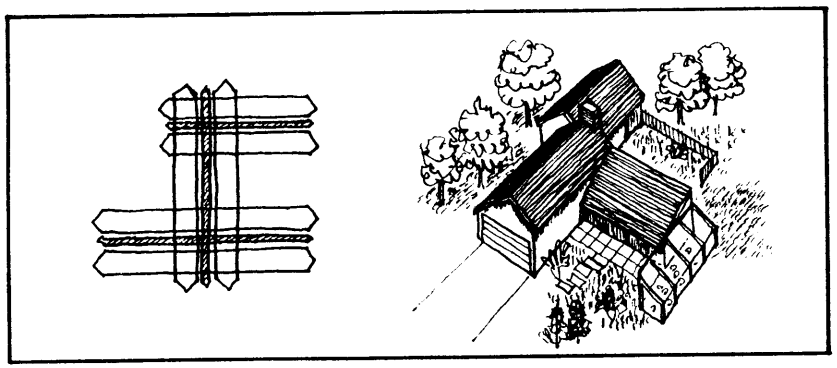


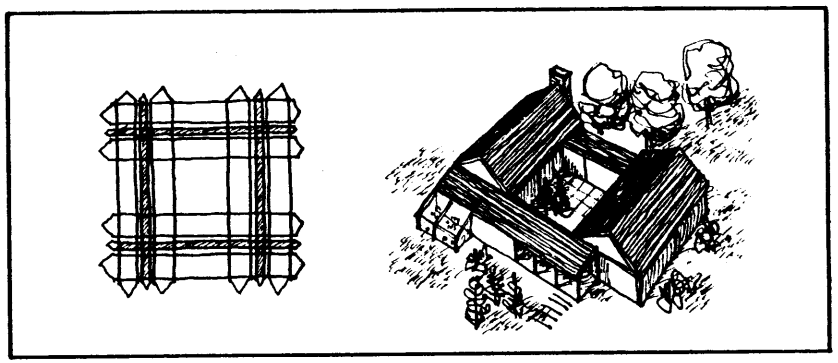


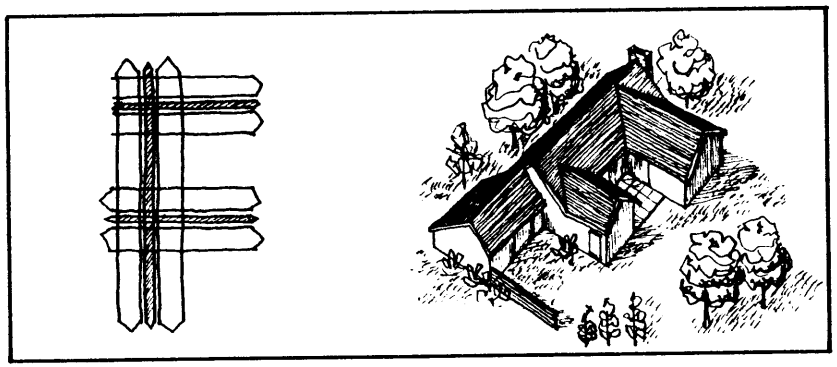


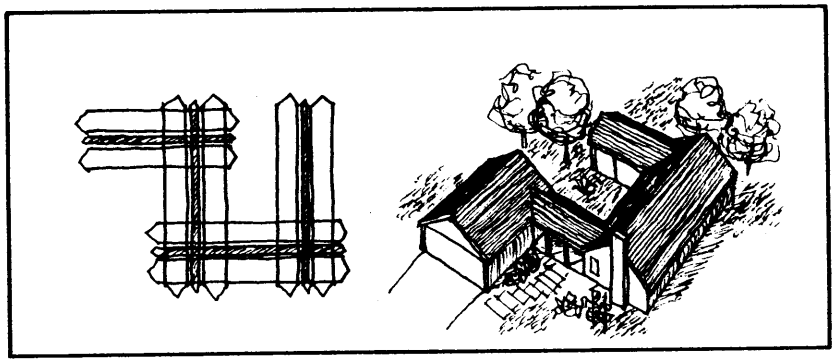


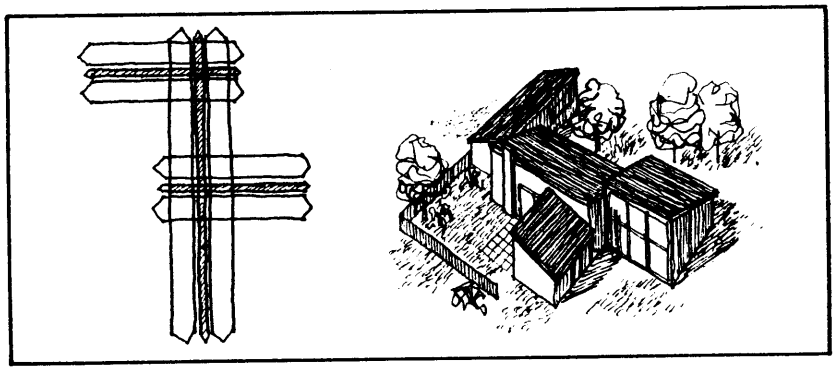


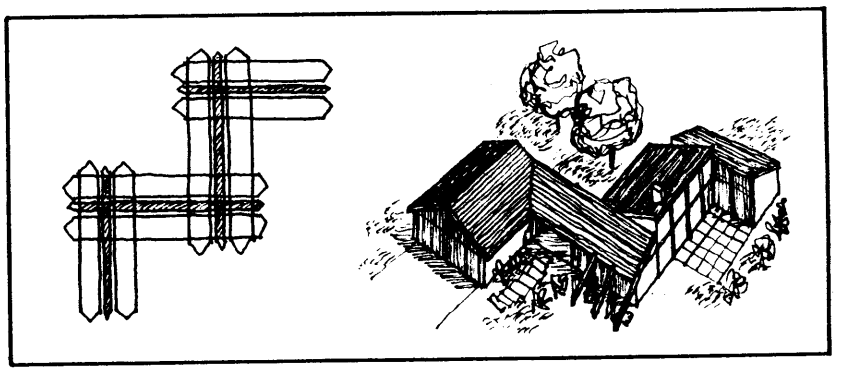












# 1.2 Zones onto Site



SUMMARY:

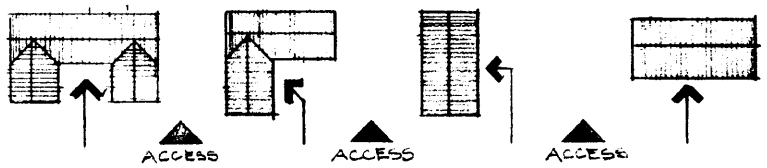
The zone patterns must be fitted onto the display board to show how the actual house will relate to the site characteristics noted in step 1.1.

During this step you may discover that some of the zone patterns you have chosen will not fit well on the site. If you chose only one pattern you may have to find a more appropriate one. You may also find that several fit equally well so that you may decide to retain more than one zone pattern at this time.

Determine the general position of the house on your site with the following in mind:

- How do people get to your house from the public way?

Would you like them to enter through a courtyard, along the side of the house or straight on?




- How does your house relate to your neighbors? Would you want to shield your yard space with a wing of the house?


- How does your house fit among the trees? Which trees are worth saving and which are not? You can use trees to reduce the sun's heat in the summer and to control the wind in your yard. Any high vegetation will provide privacy from neighbors and the public way.
- Try to orient your house with the long side facing south or southeast. This will tend to increase winter solar heat gain, especially if there are many windows on these walls. It will also tend to reduce summer heat gain if a proper overhang is provided for windows.

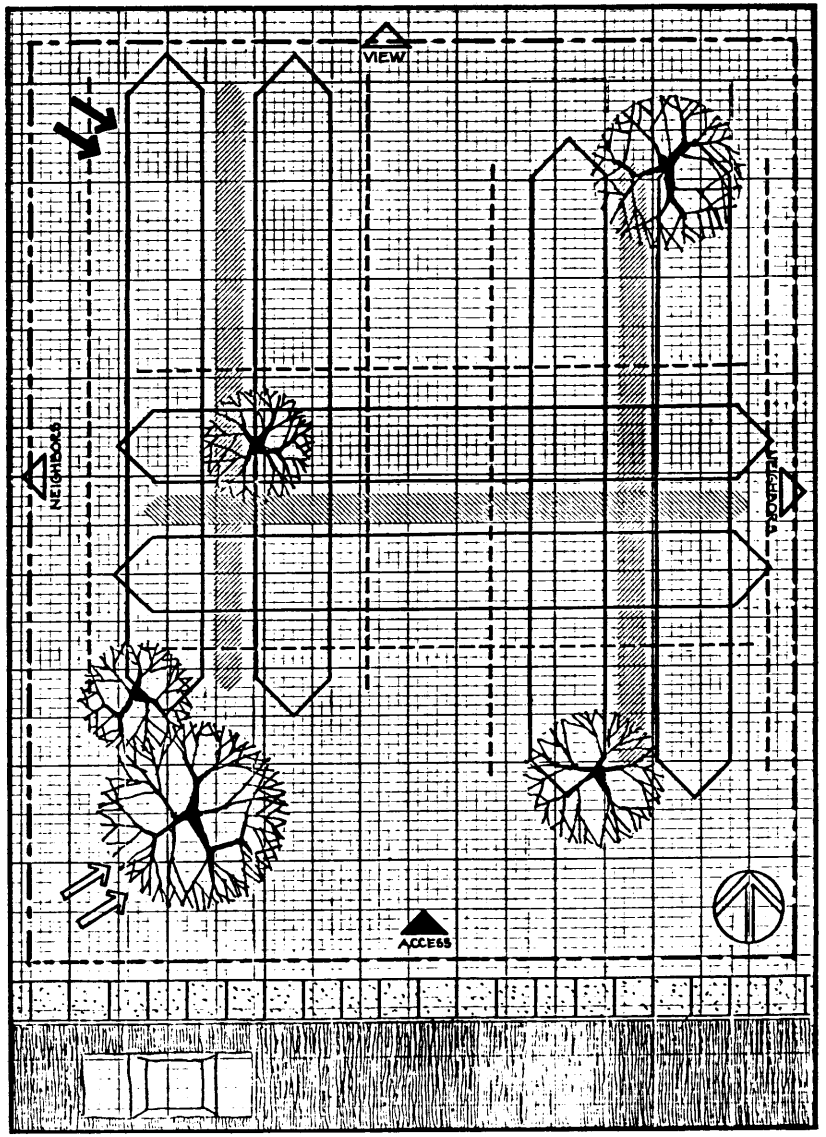
TO FINISH THIS STEP:

Place the zone pattern onto the display board in the desired orientation and position.

Each leg of the zone distribution is applied with the following widths: room zones 8 feet, circulation zones 3 feet, interior margins 1 foot and exterior margins 4 feet. The cross zones are placed along each other as desired to avoid trees and take advantage of other site conditions. The only limitation is the spacing between parallel legs. This has a minimum dimension of 12 feet for single story houses to avoid unpleasantly cramped and dark courtyards.

It is important to remember that zones are planning guides and only a portion of the area they span will become part of the house. Zones can be deleted or added at a later stage of design. The patterns and dimensions indicated are recommended starting points only.

The general path people would take when approaching the house from the street is indicated with an arrow.



# 3.1 Area Types



SUMMARY:
Certain spaces in the home are most appropriately grouped together into distinct areas. Such areas might be a personal area where one person's bedroom and study are and a general living area where the entire family can use the livingroom, dining-room and kitchen.

Spaces should be grouped together because they have mutually compatible requirements.

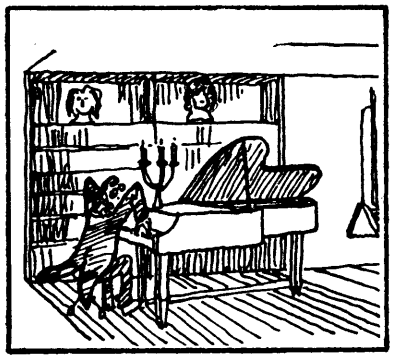
- Quiet places are necessary for sleeping and studying. These spaces should be grouped together and placed away from spaces which tend to be noisy such as kitchens, workrooms and livingrooms.
- Some spaces of the house such as music rooms, studios or bedrooms may be reserved for particular members of the family. These areas should be separated from other spaces to reduce friction between people.
- Some spaces are more likely to be shown to visitors and should be separated from more intimate family places to avoid the fear of embarrassment or intrusion.
- Some activities are messy and should be isolated from areas of the house which are desired to be kept clean and orderly.
- General living areas are for the entire family to enjoy and their centrality should be emphasized. The fireplace, kitchen or livingroom may be the most important symbol and gathering place for the family as a whole.

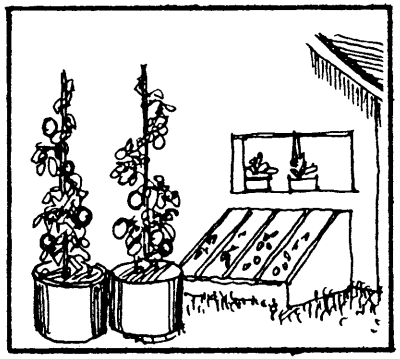
Each person or family will have different ideas about how their house should be run, what spaces are acceptable for which activities and how these spaces should be allocated into areas. The points given above are important concerns no matter how this is done in regard to particular rooms. Noise is a particularly important problem with so many electronic sources today.

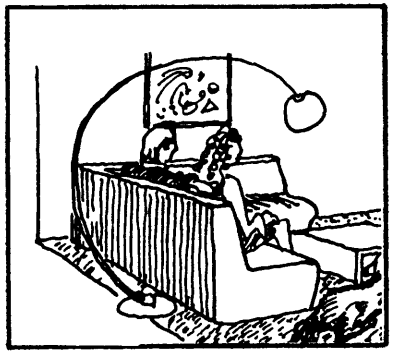
TO FINISH THIS STEP:
Examine the list of areas and suggestions of possible spaces they might contain. Select the areas you want for your house.

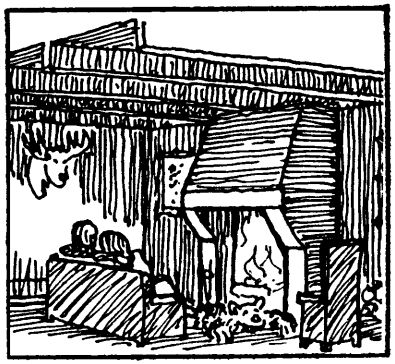
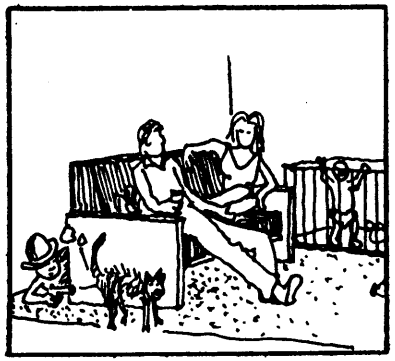
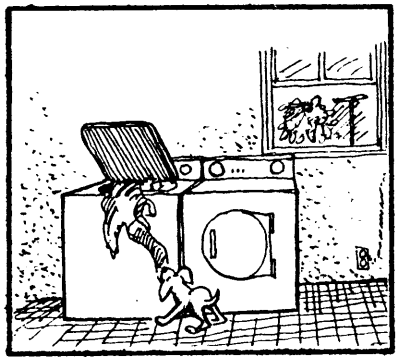
# General Living Area



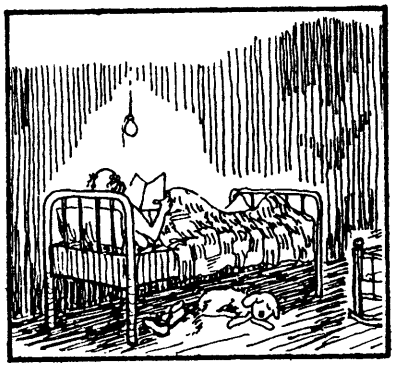



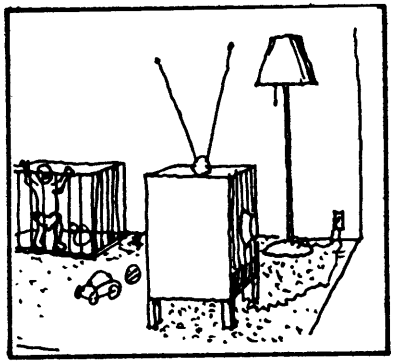


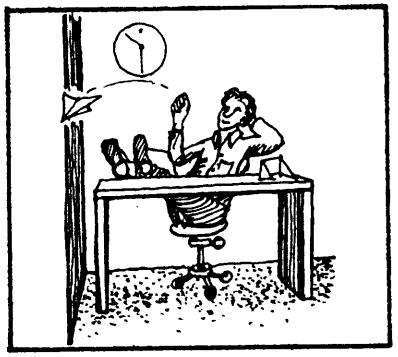


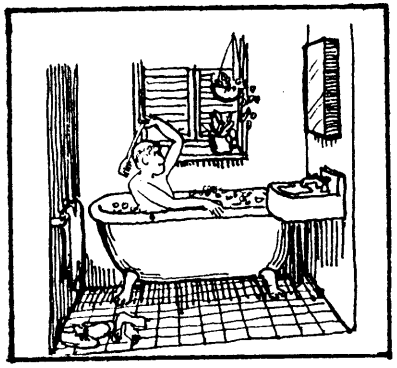




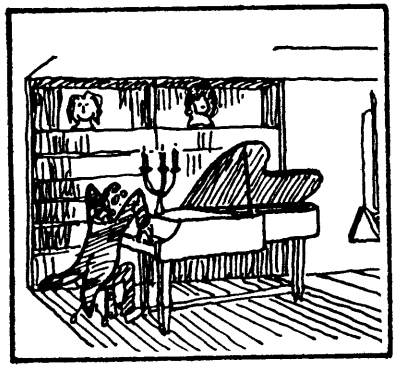
## Personal Area



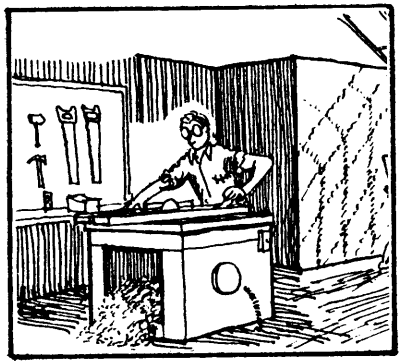


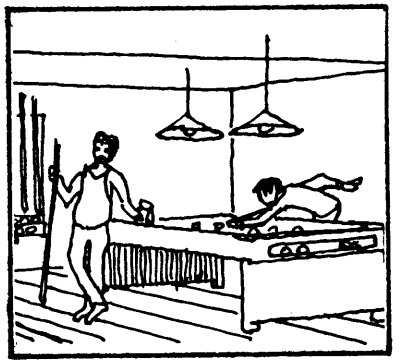


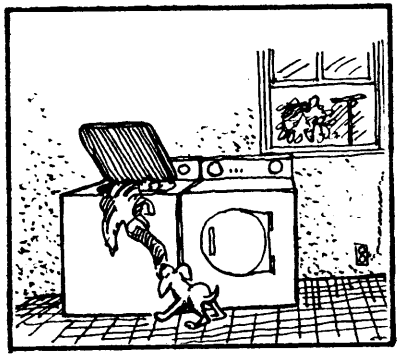


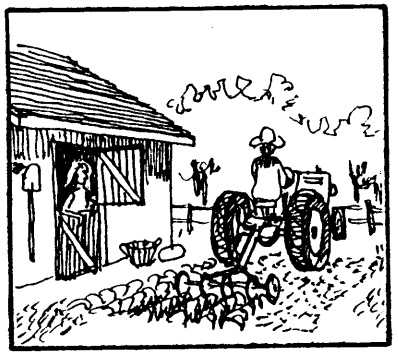


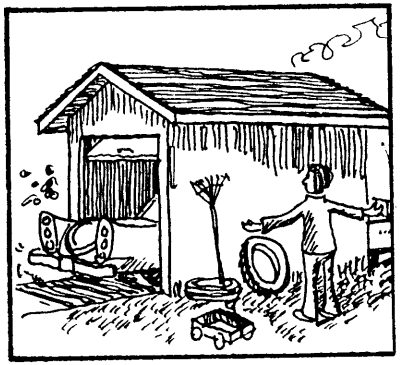
## Utility Area











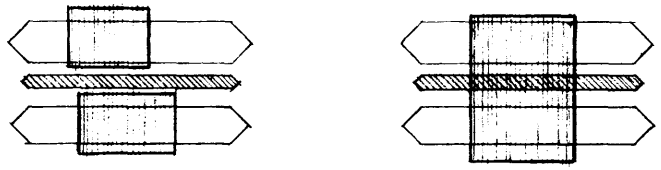
# 2.2 House Layout



SUMMARY:

The house layout represents an arrangement of areas placed along the zone patterns.

Areas are placed over the room zones. They may lie on one room zone in which case circulation may pass by the area without necessarily passing through it. The area may not have two outside walls if there is another area on the other side of the circulation zone. Areas may also lie over two room zones in which case circulation passes through the middle of this area. Thus an area would span from one side of the house to the other.



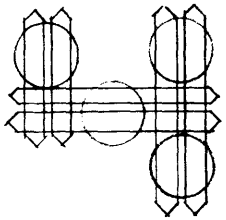
- Place areas with consideration of the public way and front yard. People will approach or pass by your house from this direction and you must imagine what part of the house should greet them. What do you want them to see and from what parts of the house do you want to see them? What things will you put in your front yard; will you do anything in it? Do you see the front of the house as only ornamental?
- What areas in the house would you rather have facing the private side of your site?
- Place areas with consideration to other areas in the house. Do you want to be able to go between them easily or should they be separated? You may want to use a common area to separate two private areas which are used by different groups in the family, such as adults and children or elderly and a young family.
- Orientation relative to the sun is important for the use of any room. As the sun moves along its daily arc from east to west, different tooms will receive more or less sunlight. This may be desirable or annoying depending upon what you want to do in a particular room.

TO FINISH THIS STEP:

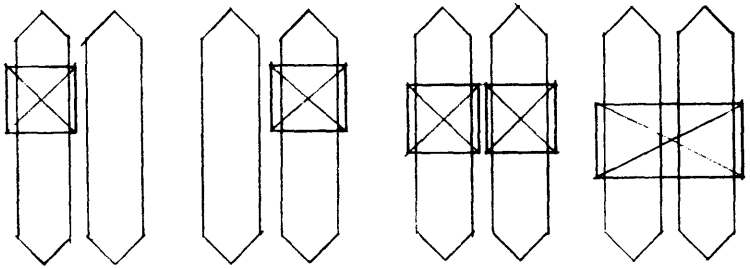
Position the area types chosen in step 3.1 over the zone pattern on the display board.

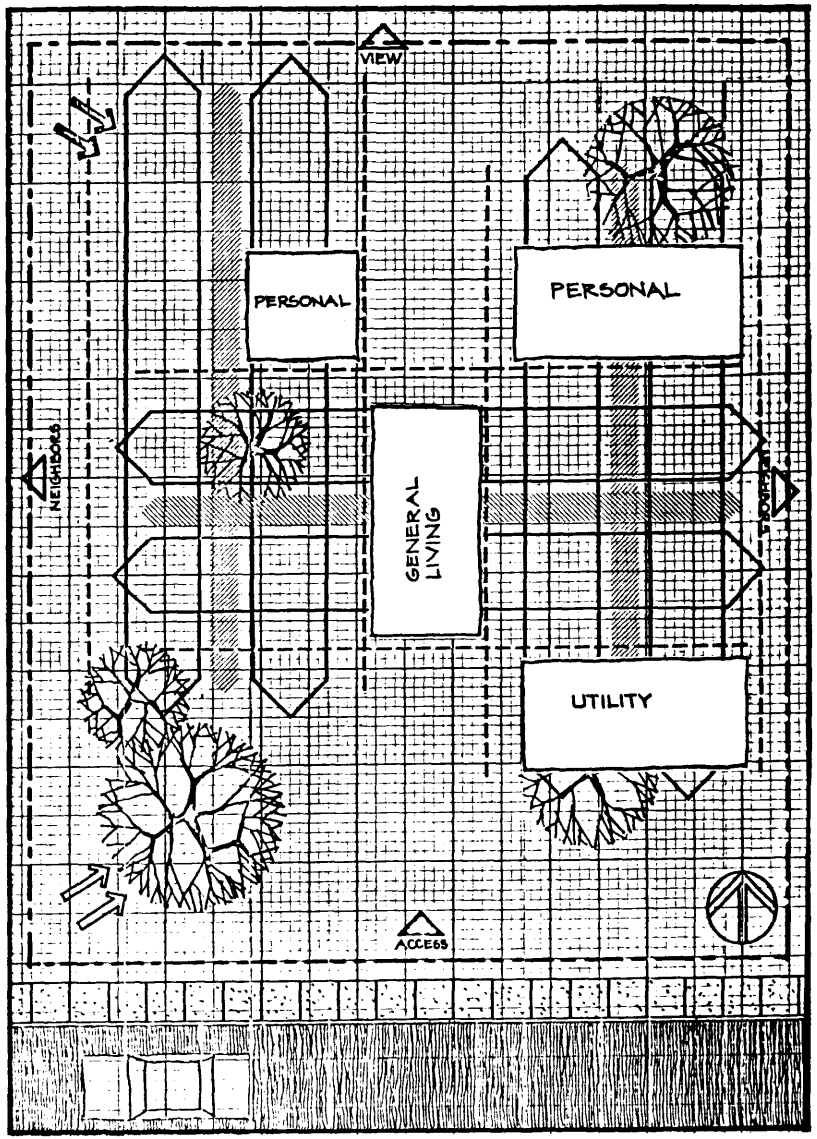
The areas are simply represented as labled rectangles. Their size has no relationship with the final house dimensions.

The purpose of this stage is to determine the rough position of areas in the overall house organization. The first question is over which leg of the zone pattern to place an area. The diagram below shows the possible positions.



The second question is on which side of the house to place the area or whether it should span across both room zones. Each position circled above could have the following conditions.





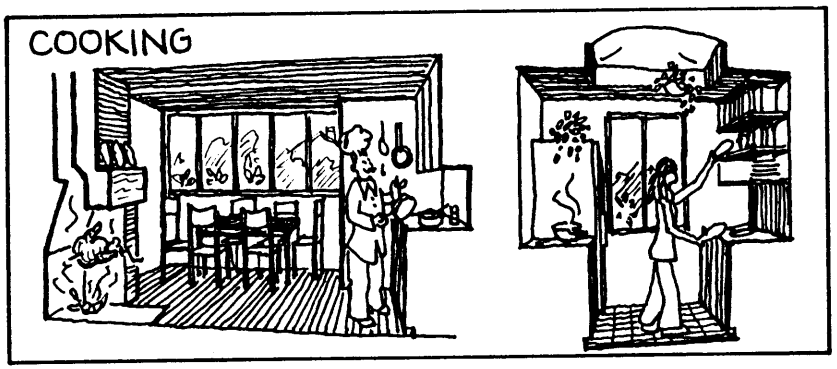
# 4.1 Space Types

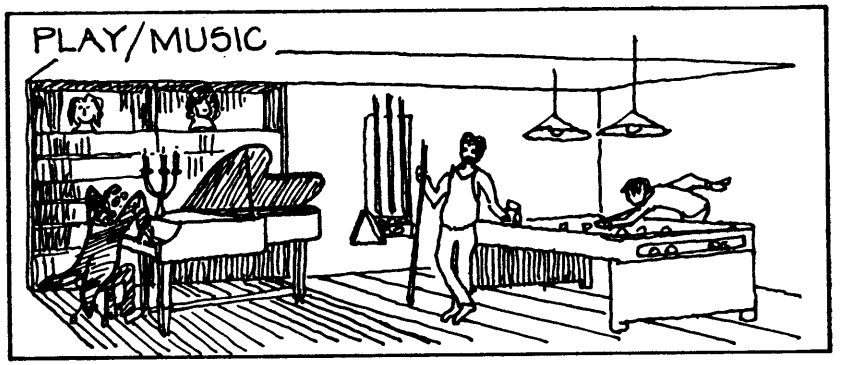


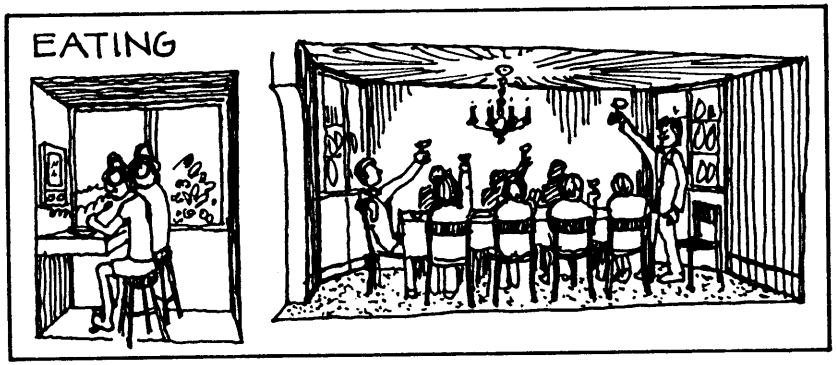
SUMMARY:
A space is a readily identifiable part of the house because of a particular activity and set of furniture it contains. For example, a kitchen is associated with the activity of cooking and contains a refrigerator, an oven and a sink.

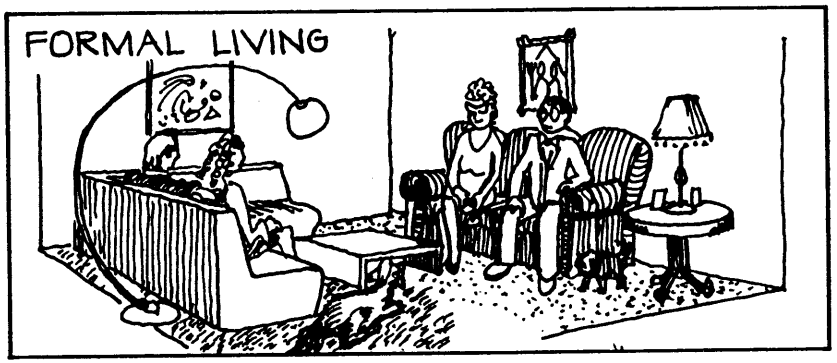
- Spaces are different than rooms. A room is a space surrounded by four walls and which must be entered through a door. Spaces are often combined into a single room as dining and living spaces are placed adjacent to each other without an intervening wall. The idea of spaces allows us to first decide on what parts of the house we want and later determine how to separate and define them.
- Try to imagine what types of things you want to be able to do in your house and what types of places you would need to accommodate them.
- What types of furniture, windows or appliances would you use?
- Can any of the spaces that you want be combined with other spaces so that the same place in your house can perform double duties? For example, a dining area could double up as a study and a bedroom might double as a play space. Not only will this enable you to have a smaller and thus less expensive house, the combination of activities may be better for you to use.
- You may discover in examining the list that spaces which you had previously thought of as combined would be more appropriately separated. Some people who have always eaten in the kitchen find that a separate dining room can make eating a more pleasurable experience.

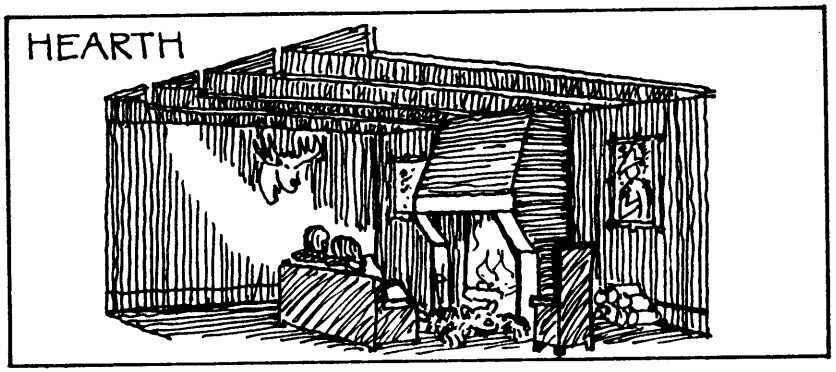
TO FINISH THIS STEP:
Look at the list of spaces and pick those which seem to be most appropriate to your lifestyle.

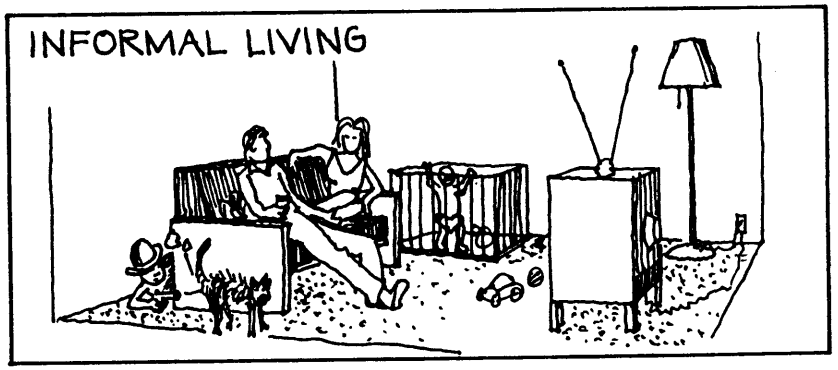

COOKING

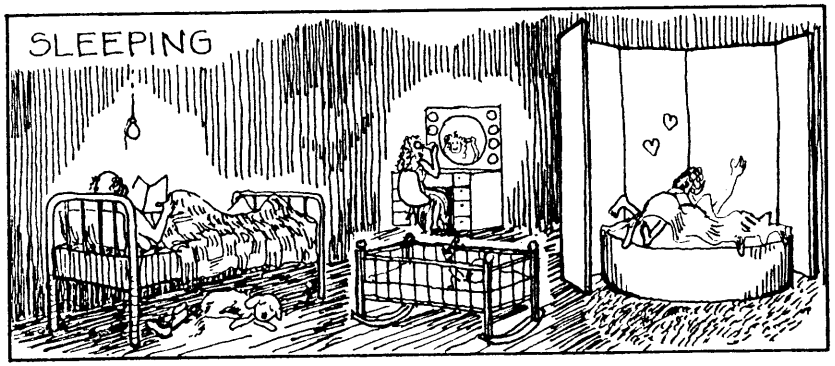

PLAY/MUSIC

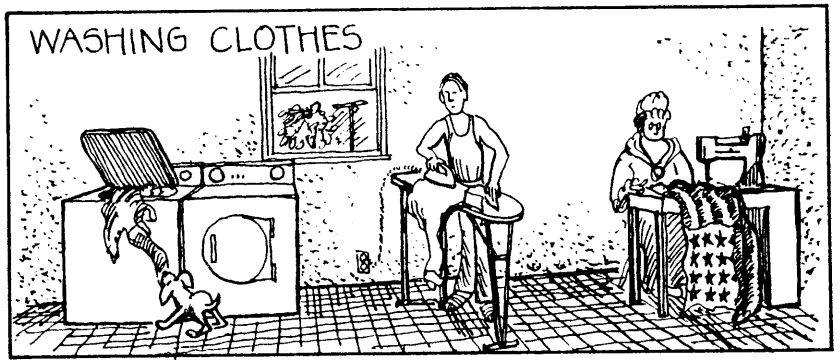

EATING

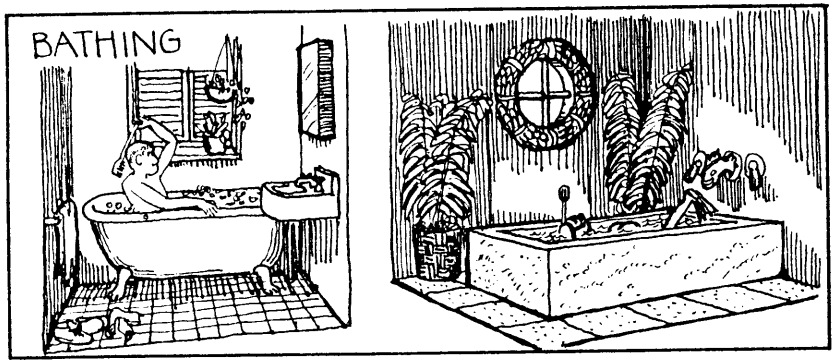

FORMAL LIVING

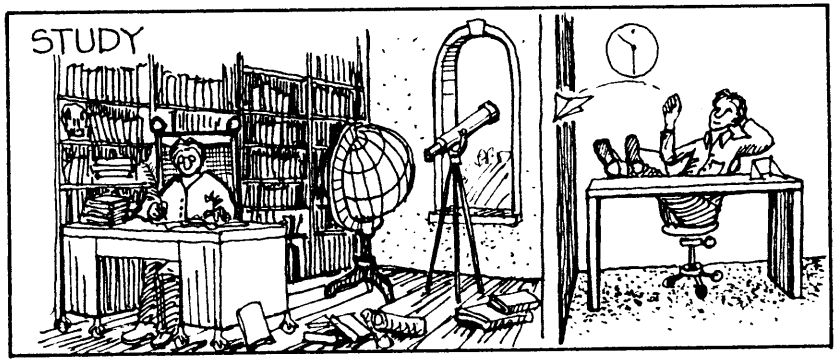

HEARTH

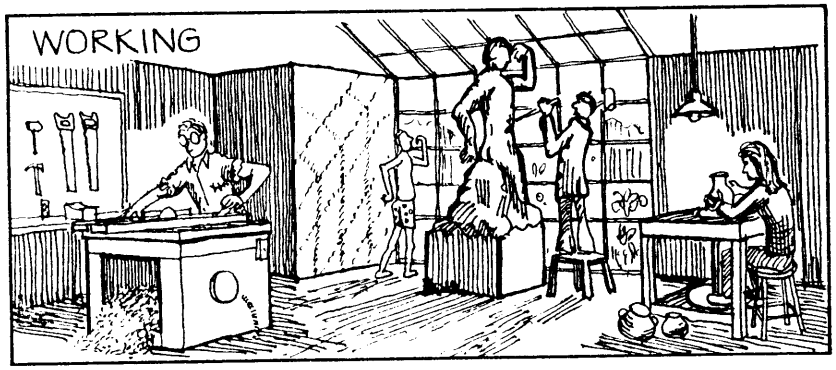

INFORMAL LIVING


SLEEPING

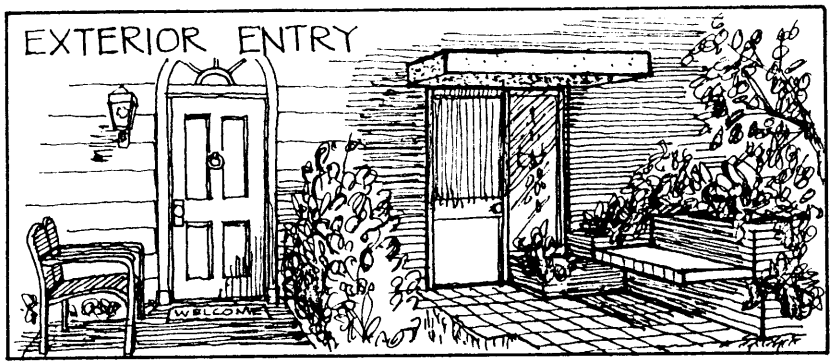

WASHING CLOTHES

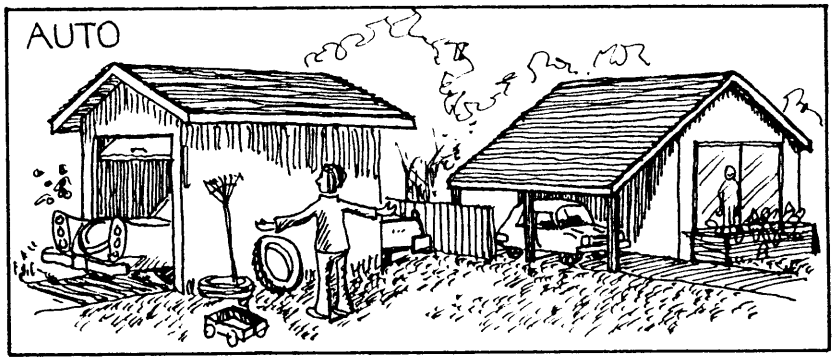

BATHING

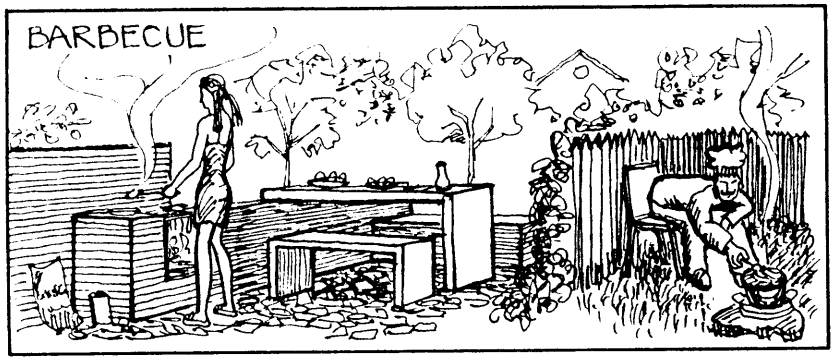

STUDY

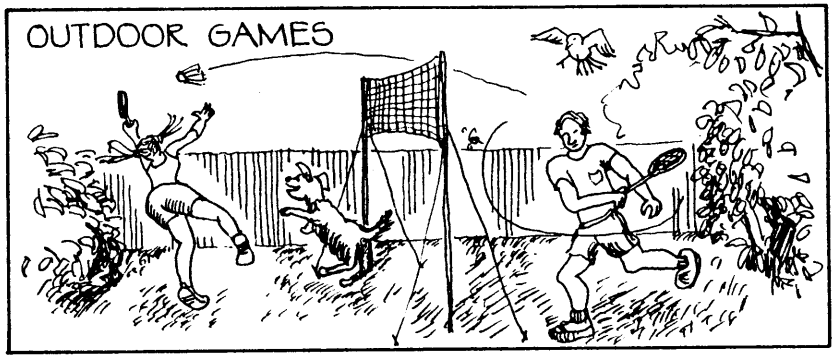

WORKING

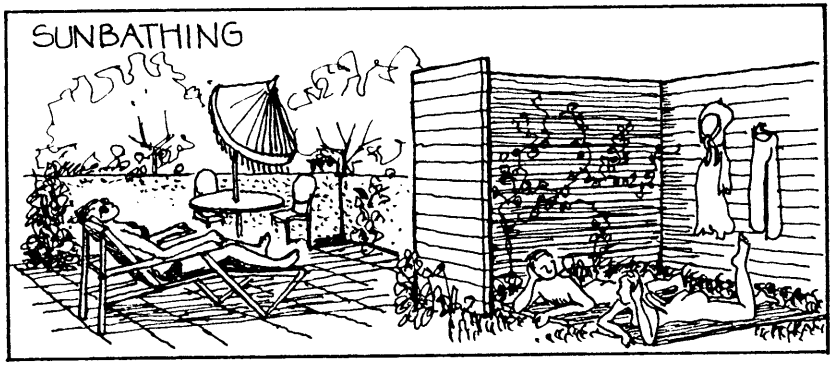

ENTRANCE

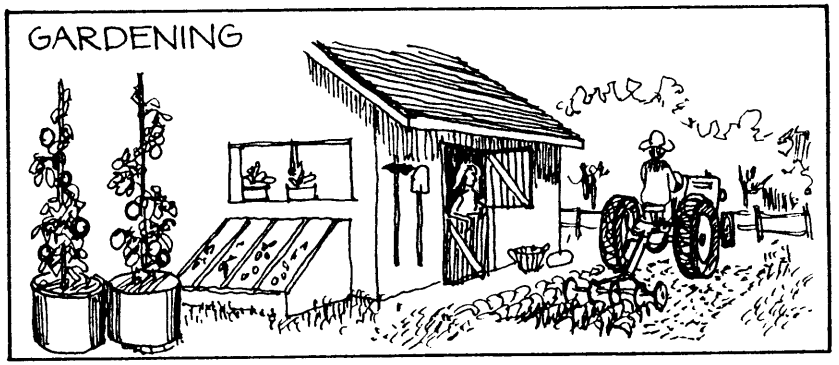

EXTERIOR ENTRY
WELCOME


AUTO


BARBECUE


OUTDOOR GAMES


SUNBATHING


GARDENING

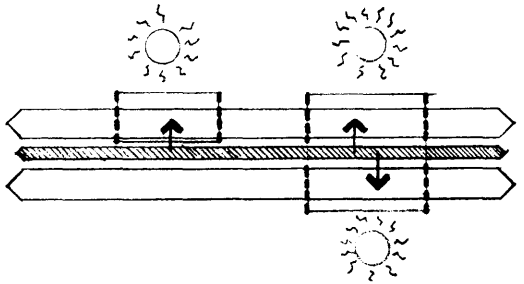
# 3.2 Area Layouts



SUMMARY:
Areas only represent ideas about how spaces might be grouped in the house. This step specifies how the areas chosen in step 3.1 are arranged out of the spaces chosen in step 4.1. It also checks that these area layouts are appropriate to the house layout.

Since you have a rough idea about how spaces are combined into areas, search the charts of each area type for patterns which contain the spaces you need.

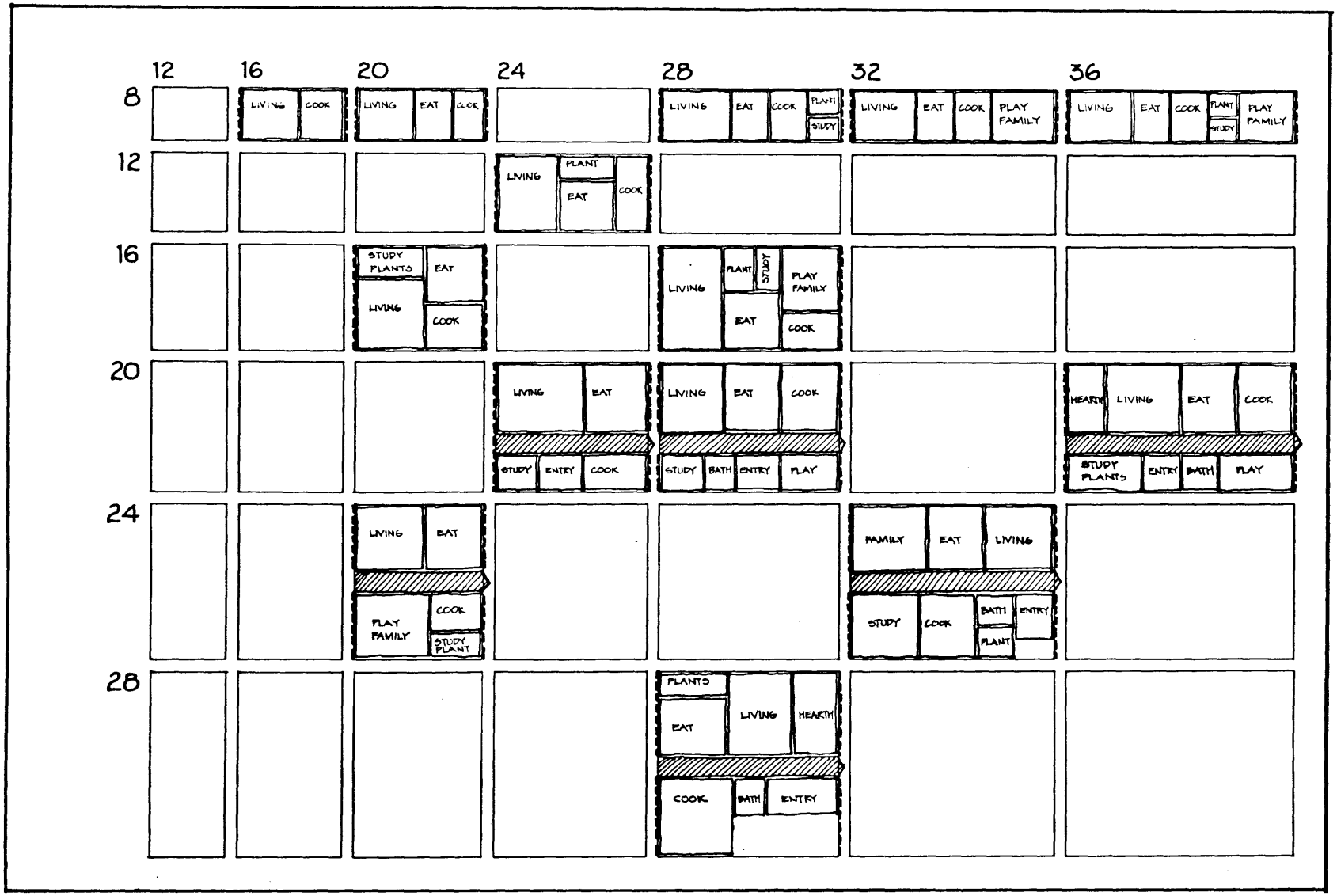
- Check the way you have distributed the areas along the zone layouts and determine which sides of the area will have windows. The direction in which windows face will affect each space because of the sunlight which may come in and the views one can see from within.
- How do the spaces relate to each other within the area? Which spaces are near which others? Which spaces are furthest apart?
- As you look at the possible area layouts you may decide to transfer some spaces from one area to another or eliminate an area by dividing its spaces among the other areas. You may also add a new area if the layouts suggest that you may be crowding too much in one area type.
- The areas are arranged on the chart with the room zones passing horizontally. The outside is assumed to be at the top of each area with circulation and access to the area from the bottom edge. The larger areas have circulation passing through the middle of each area in which case the outside is to the top and the bottom.



TO FINISH THIS STEP:
Select the desired areas which together contain all the spaces you need.

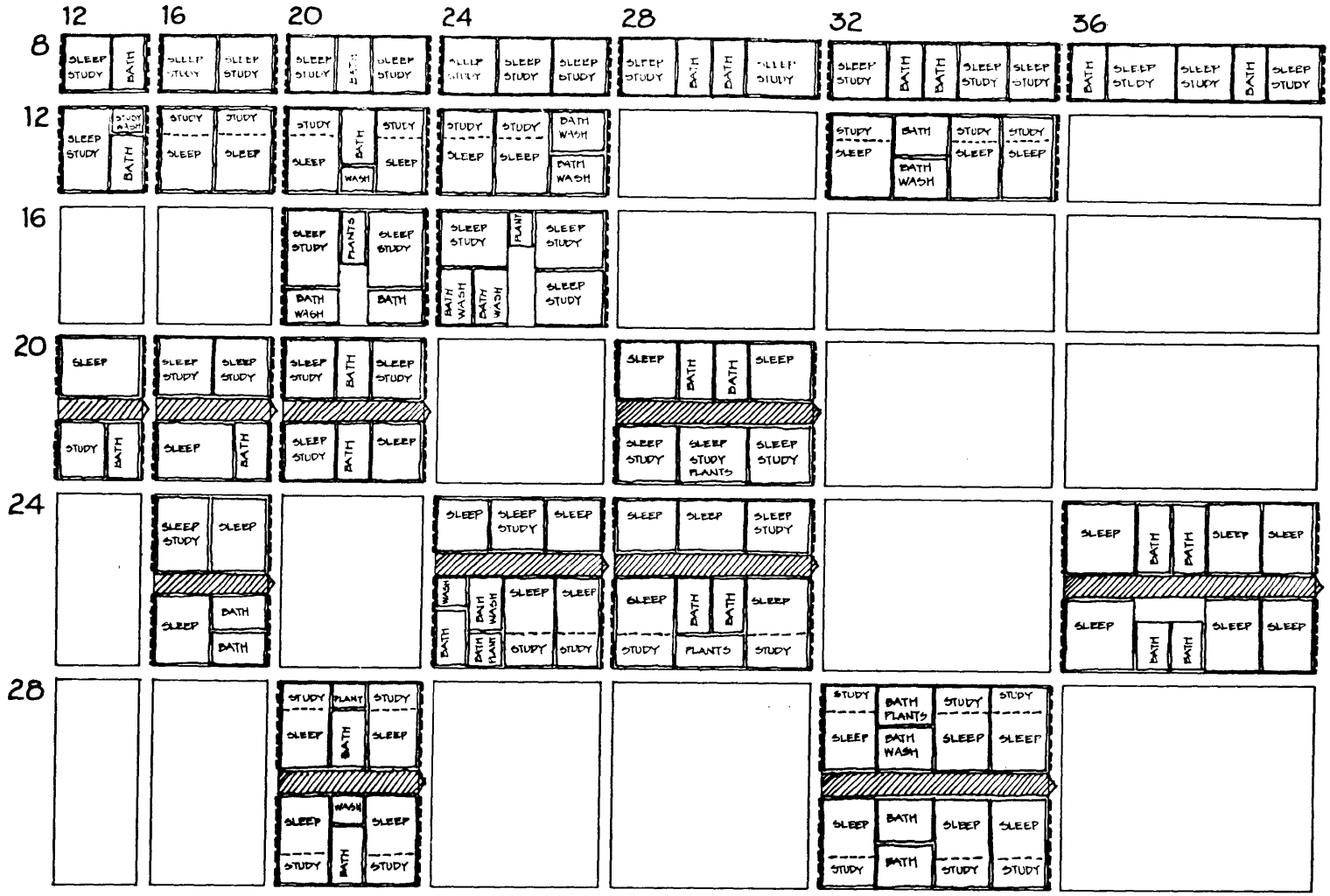
# General Living





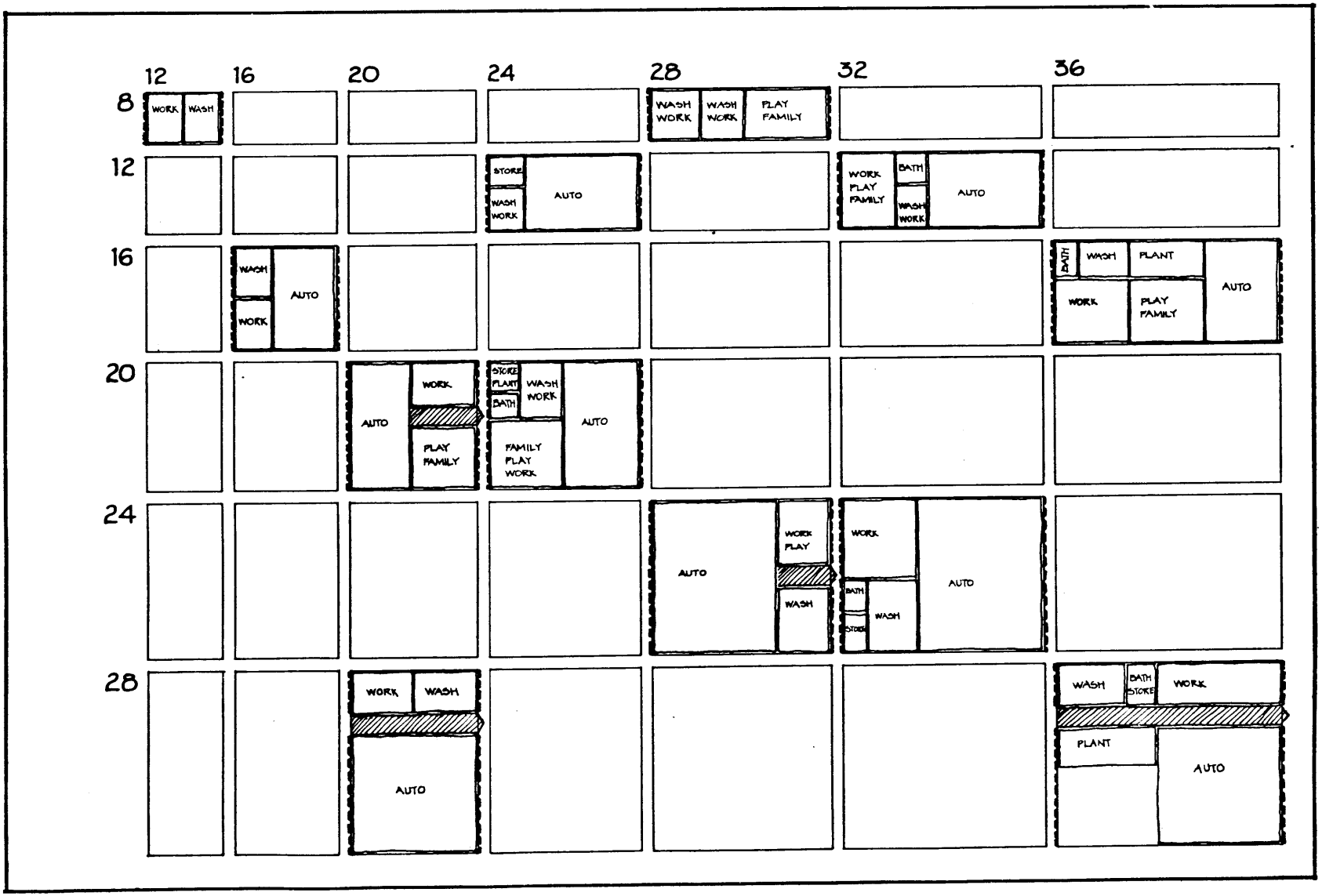
# Personal




12
16
20
24
28
32
36
8
12
16
20
24
28
SLEEP
STUDY
BATH
WASH
PLANTS
PLANT
FLANTS

# Utility




12
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24
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WORK
WASH
WASH WORK
WASH WORK
PLAY FAMILY
STORE
WASH WORK
AUTO
WORK PLAY FAMILY
BATH
WASH WORK
AUTO
BATH
WASH
PLANT
WORK
PLAY FAMILY
AUTO
WASH
WORK
AUTO
AUTO
WORK
PLAY FAMILY
STORE PLANT
BATH
WASH WORK
FAMILY PLAY WORK
AUTO
AUTO
WORK PLAY
WASH
WORK
BATH
STORE
WASH
AUTO
WORK
WASH
AUTO
WASH
BATH STORE
WORK
PLANT
AUTO

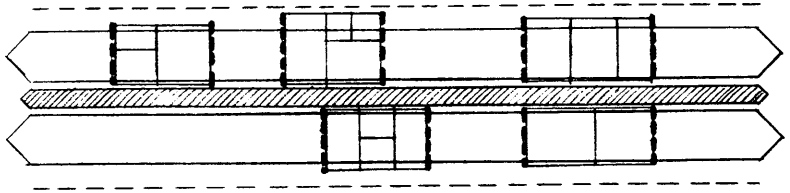
# 3.3 Area substitution into house



SUMMARY:

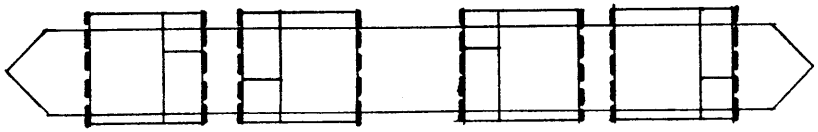
This step takes the area layouts chosen in step 3.2 and substitutes them into the house layout determined in step 2.2. You can then alter your previous decisions if that is necessary.

- Areas are placed onto the zones with the same sides parallel to the room zones as are found on the chart. This is indicated by the heavy dashed lines which run across the zones.



When you substitute the areas, you may discover that the spaces in one area may not be well placed in relation to the spaces in the other areas or the exterior.

- The areas can be rotated and flipped to create their mirror image.



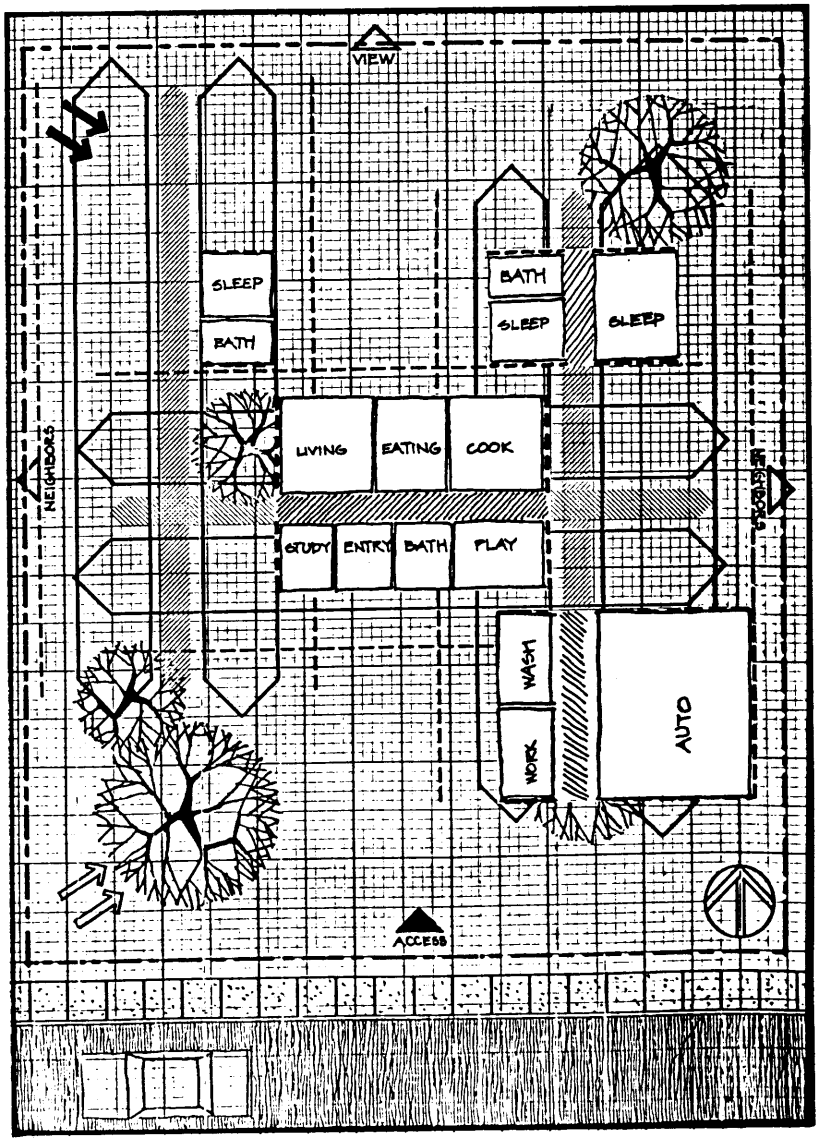
- The areas may have to be rearranged at this point, redoing some foregoing decisions.
- You may discover that you placed an area symbol spanning two room zones in step 2.2 but that you picked an area layout which spans only one zone in step 3.3 (or vice versa). In step 2.2 you were concerned with overall house layout and in step 3.2 you studied the particular area layout for its own value. You must now decide which was the more important purpose.

TO FINISH THIS STEP:

Substitute areas onto the display board. Manipulate areas by rotation and mirroring. Areas may be rearranged on the zone pattern.

Notice that the areas are all oriented with their dashed end lines running across room zones. If an area extends over the outer margin edge on one side, the room zone should be replaced with a wider one. The 8 foot zone on the far right has been replaced with a 12 foot zone to accommodate the garage ( auto space ). The reason for this is to maintain a zone width which is commensurate with what will be put into it. In latter steps this will will help maintain acceptable dimensional relationships and avoid oddly shaped house plans.

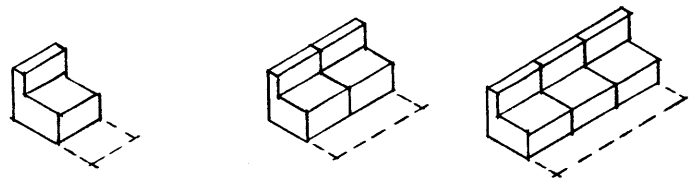
The entire zone pattern has been shifted to the left to avoid spilling over the right site boundary.



# 5.1 Element Types



Summary:
Elements are the smallest areas of space which you should consider when designing a house. They refer to the minimum space requirements of particular pieces of furniture because of their physical size and the area around them needed for their use. For example, you must have an area larger than the refrigerator itself in front just to stand and open its door.



The number of elements listed is limited to make the reading of plans easier. For example, there are two types of chair symbols, a large one for easy chairs and a smaller one for arm chairs. These symbols are adequate to represent practically every style of seating available. By placing easy chair modules side by side, two can be used to represent a 'love seat' and three will represent a large sofa.

- The typical elements are to be used in most of the later steps. For this step it is not important to list all the elements or furniture you need, but only those which seem particularly important or which might not be found in the typical house. For example: extra large dining table, sauna bath, large food freezer, grand piano.
- Other elements will occur to you as you continue with the design.
- Try to think of what furniture will go into the various spaces of the house; what things will you want to do that might need furniture or special equipment.

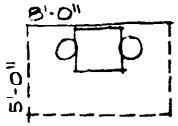
TO FINISH THIS STEP:
Look at the list of typical elements - you need not record these. List any untypical elements that you may want.

## KITCHEN

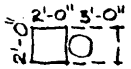
- OVENS & RANGES
- REFRIDGERATORS
- SINKS
- WASHING MACHINES


## EATING/DINING

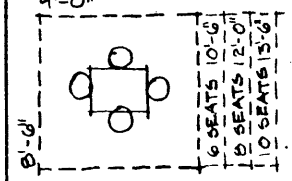
EATING ALCOVE



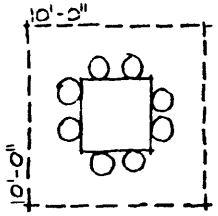

COUNTER EATING




LONG TABLE

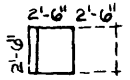



SQUARE/ROUND LARGE TABLES

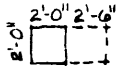



## FURNITURE

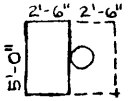
- EASY CHAIRS
- SECTION OF SOFA




- ARM CHAIR & SIDE CHAIR
- END TABLE
- SECTION OF LOW TABLE

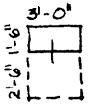



- DESK & WORK BENCH

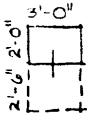



## STORAGE

- BOOK CASES
- SIDEBOARDS
- DRESSERS

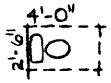



- WARDROBE
- LARGE STORAGE



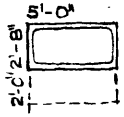

## BATHROOM

TOILET

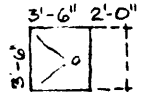



SINK


BATHTUB

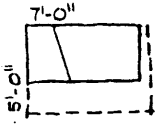



SHOWER

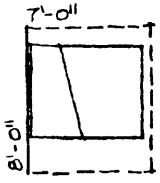



## BEDROOM

SINGLE BED

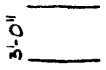



DOUBLE BED

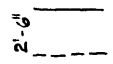



## CIRCULATION

HALLWAYS




PASSAGE




DOORS

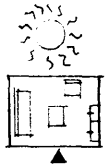
# 4.2 Space Layouts



SUMMARY:
Space layouts could be seen as the way in which you arrange your furniture. The purpose is not to design every place for every chair and table, but to make sure that you will have enough room to accommodate your needs.

The charts on the following pages show suggested space layouts for each space type. You need only look at the space types that you chose in step 4.1.

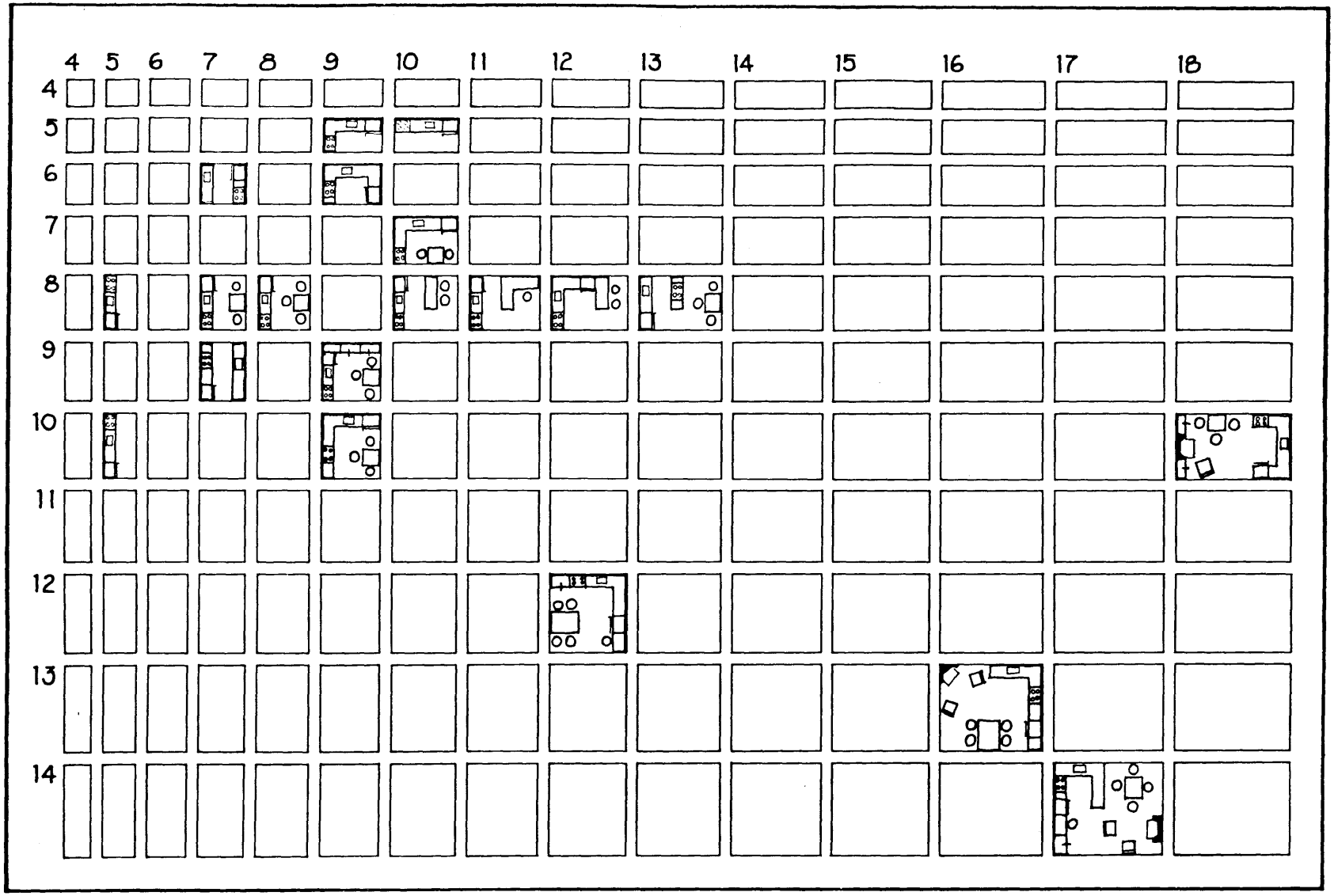
- The edges of spaces are not necessarily walls, so what occurs in one space may be affected by what is in the adjacent space. You can begin to think about this problem now, but it need not be resolved until a later step.
- It is not important to pick the best arrangement of furniture, but you should be able to pick a space which can contain all of the pieces you want.
- Note that space layouts show elements as explained in step 5.1. These may be larger or smaller than your actual pieces.
- The charts show only critical arrangements, that is, spaces which are just large enough to contain the furniture indicated. You can expand these spaces later to give you more room.
- You may choose a particular arrangement of funiture but put it in a larger space size to contain other furniture or to satisfy your desire for more space. You cannot take a pattern and fit it into a smaller space.
- When arranging spaces it is important to know which sides have windows and doors to the outside and which sides abut other spaces. The charts indicate this aspect with the convention of access to the bottom and exterior space to the top.



TO FINISH THIS STEP:
Examine the charts of spaces for spaces which will satisfy your needs. If there are any special pieces of furniture you want, try to substitute another type of element for it.

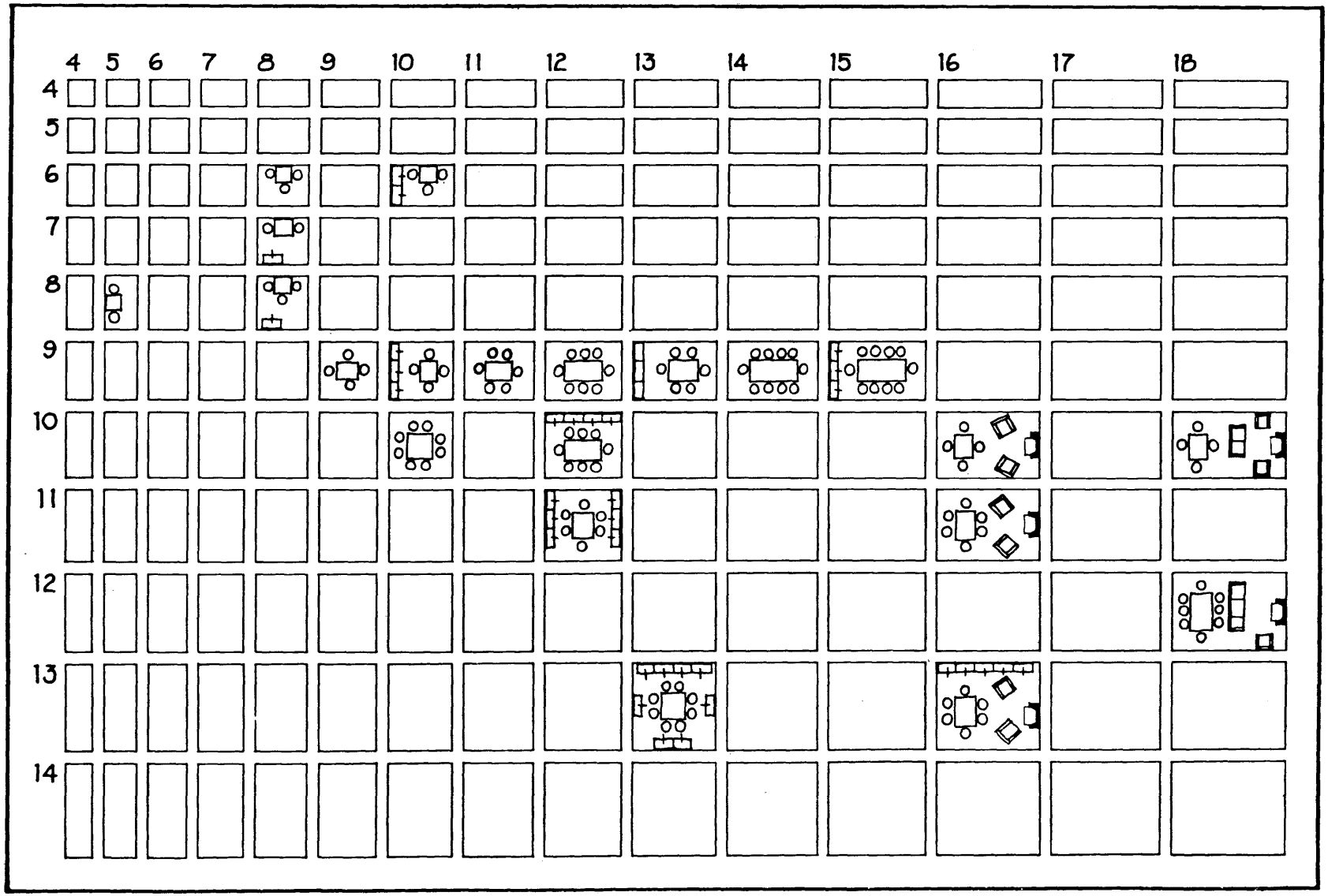
# Cooking





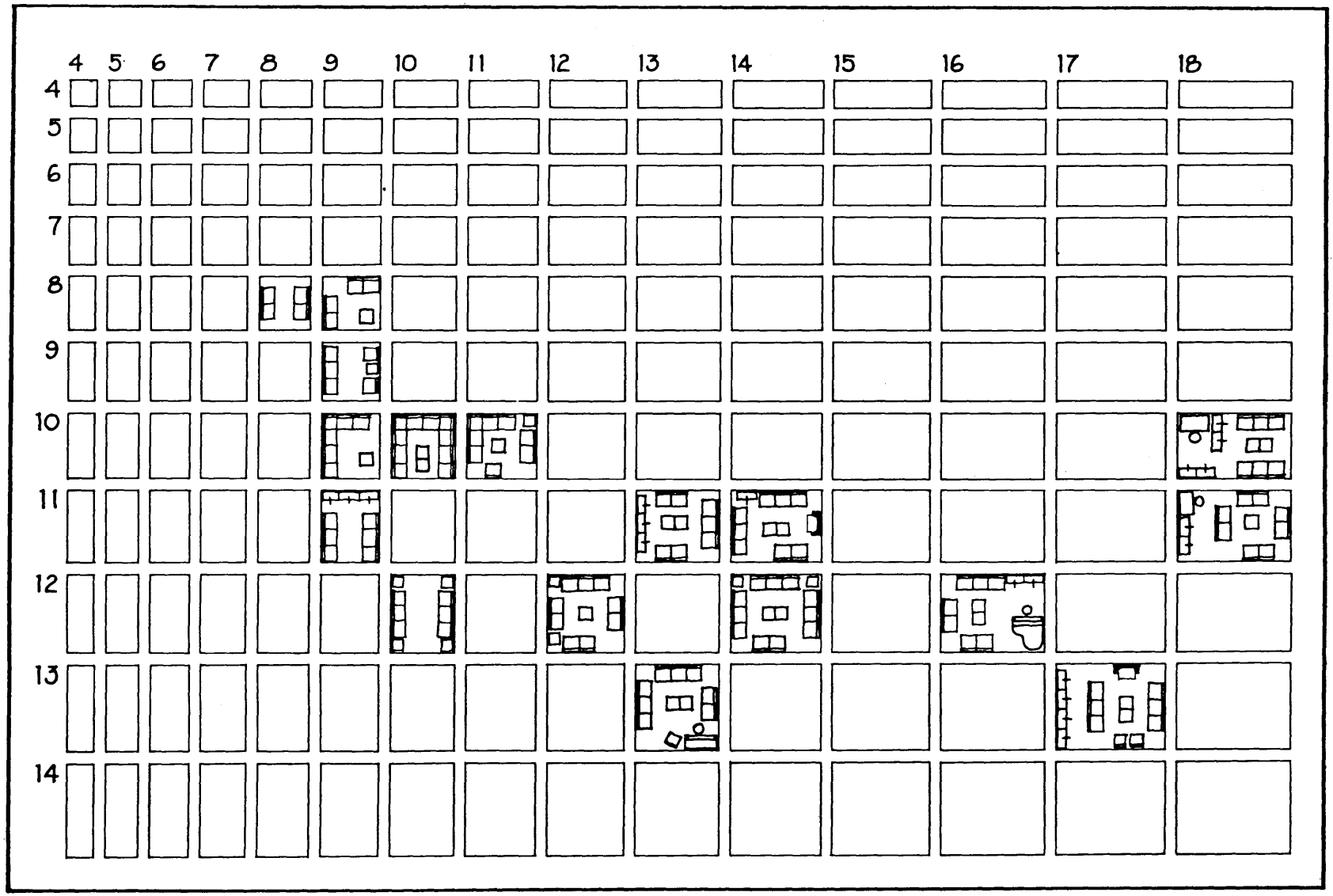
# Eating





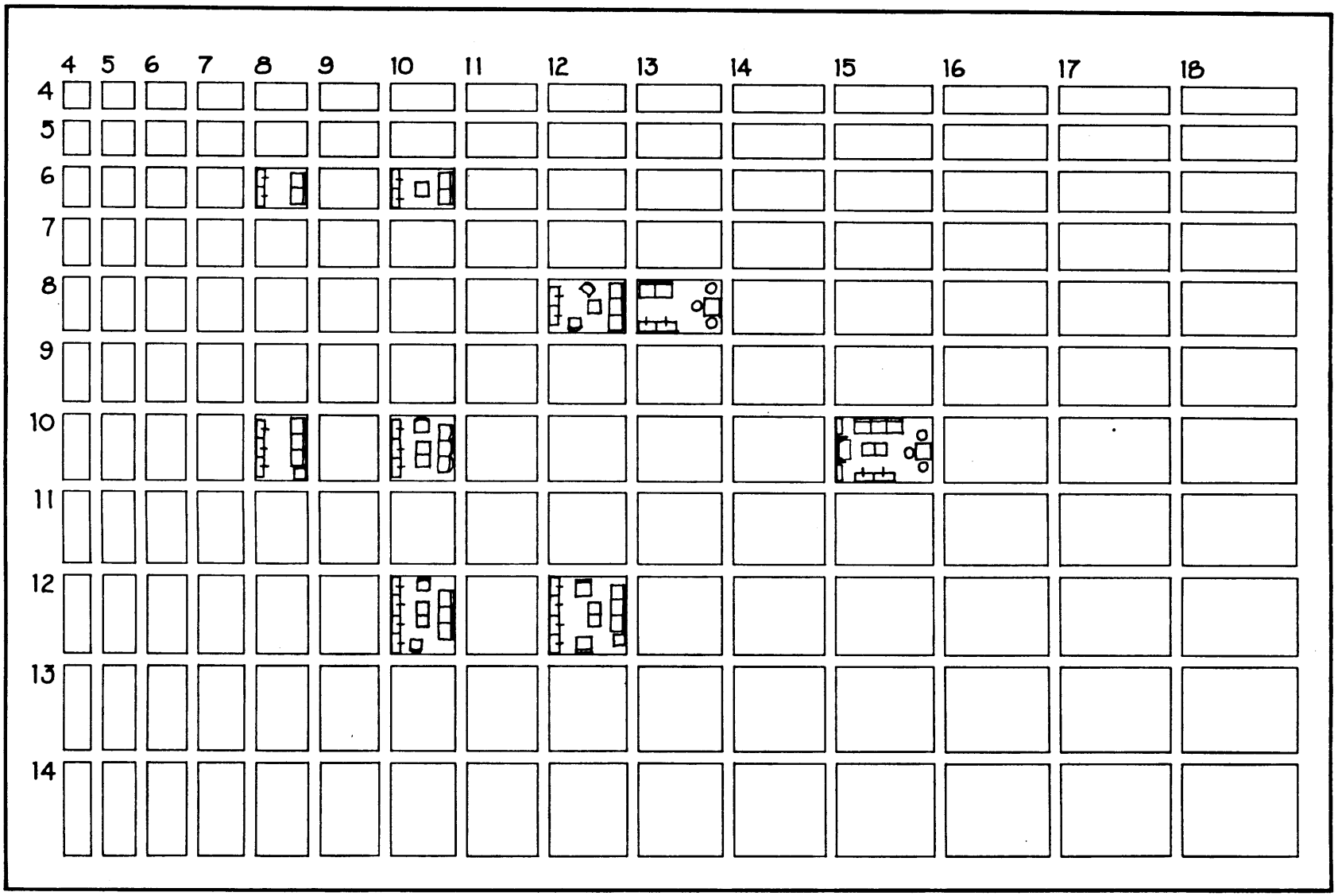
# Formal Living





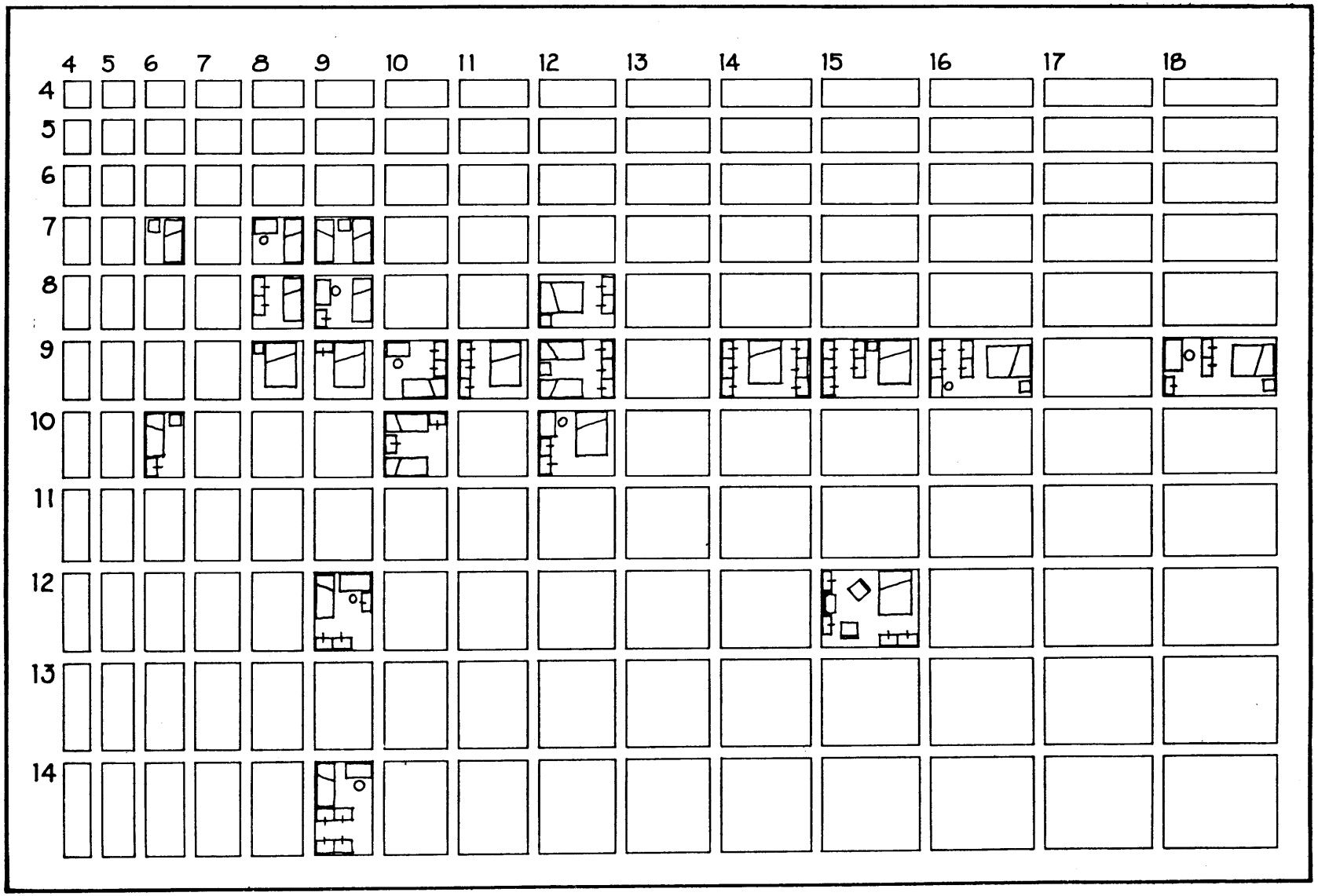
# Informal Living





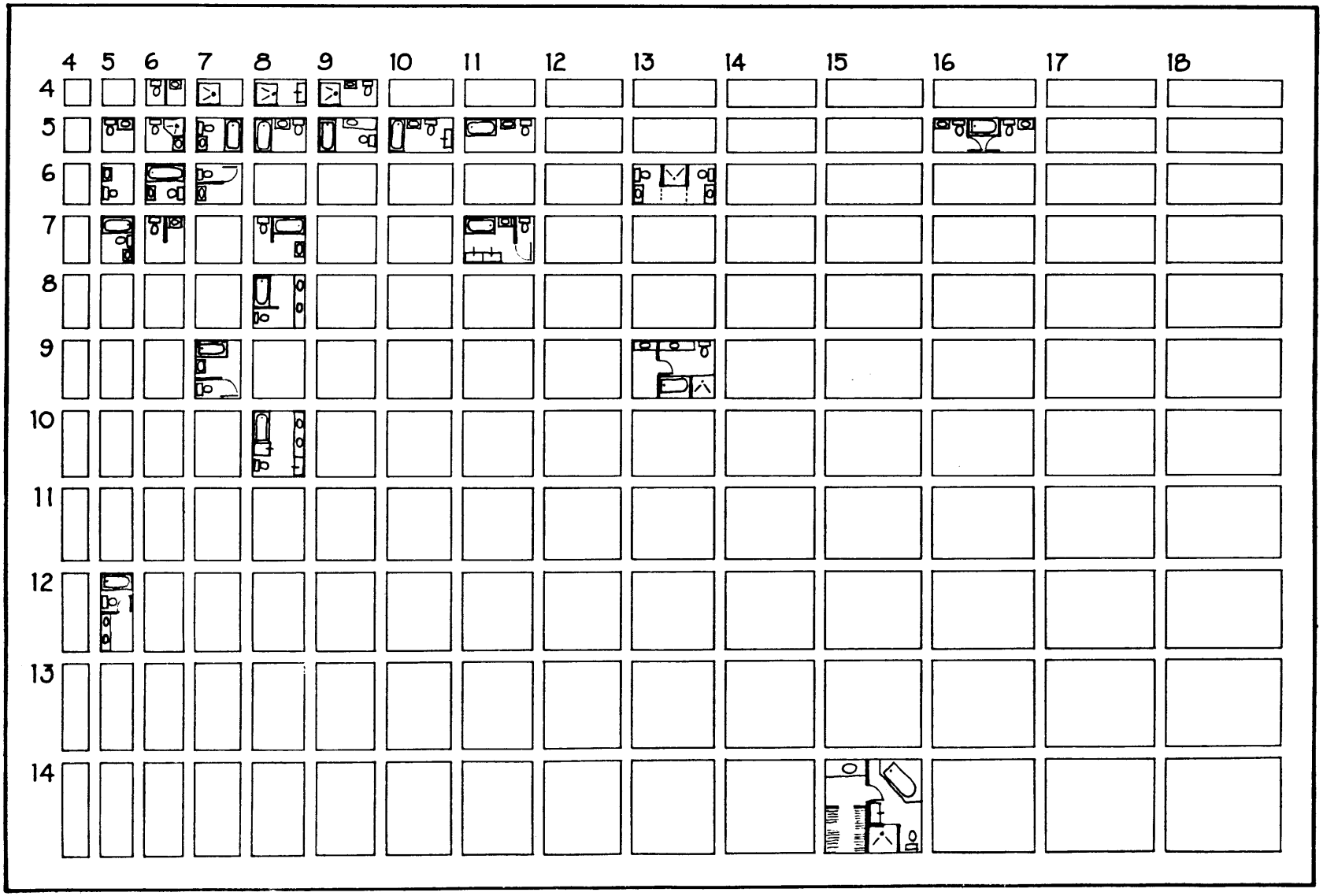
# Sleeping





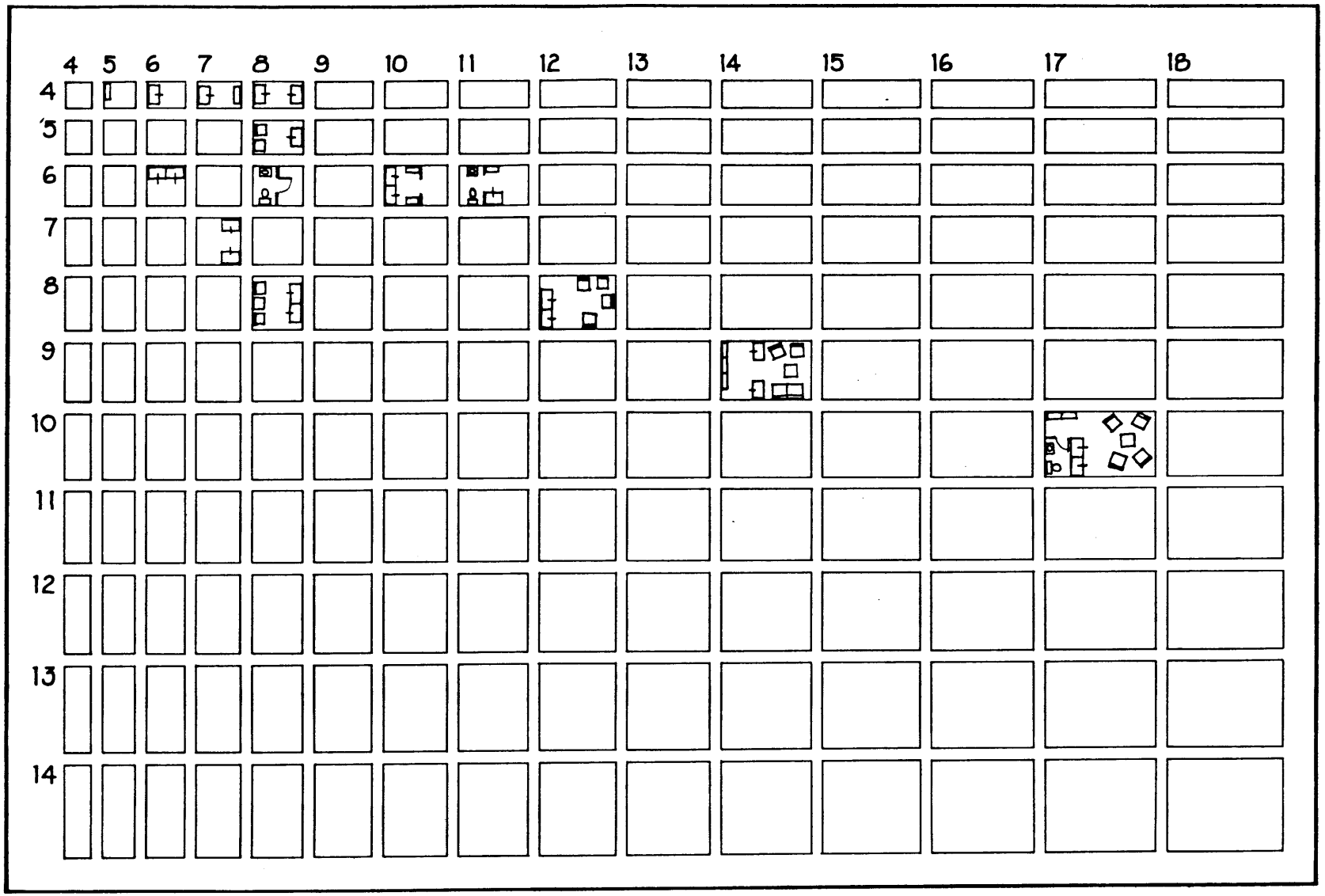
# Bathing





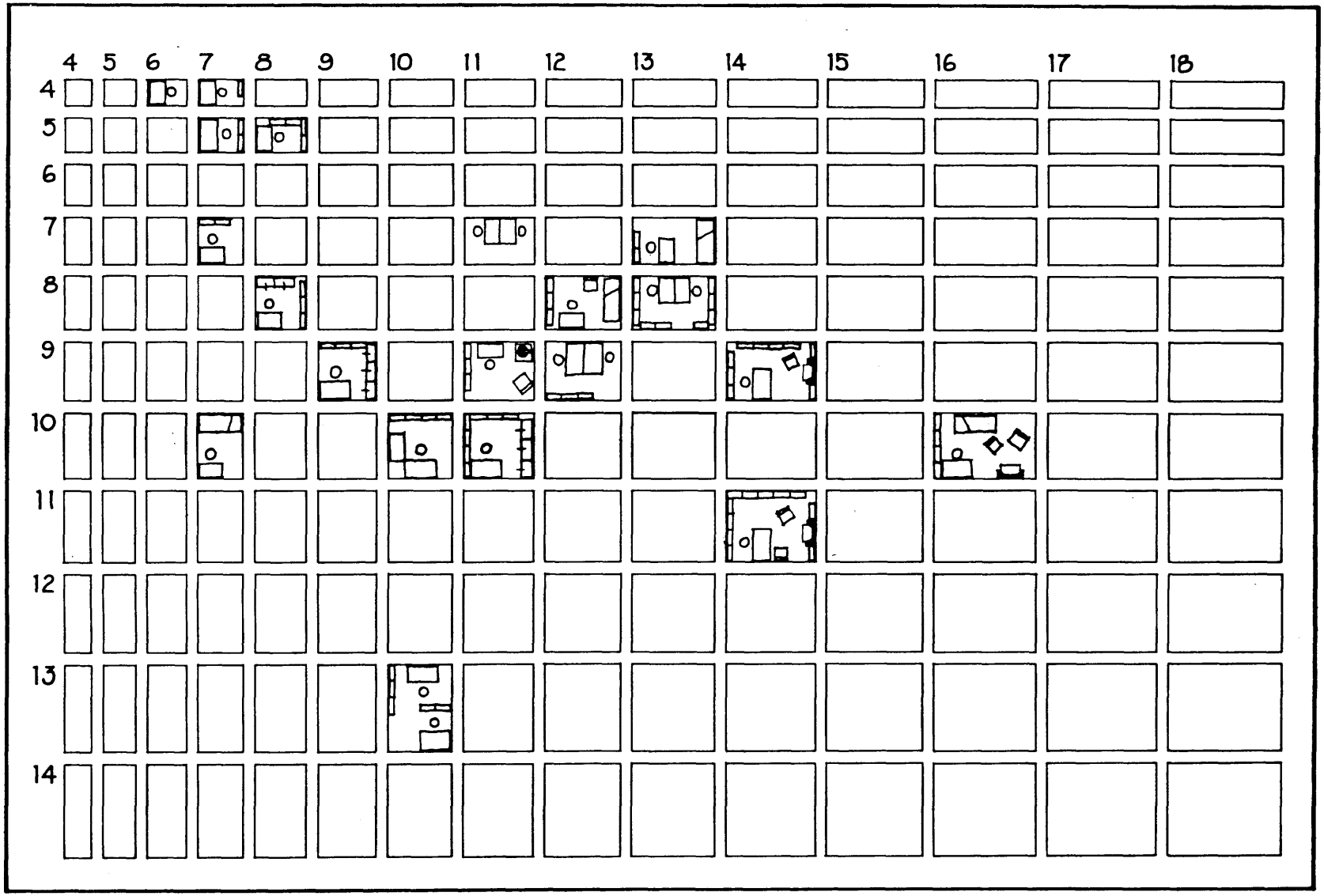
# Entrance





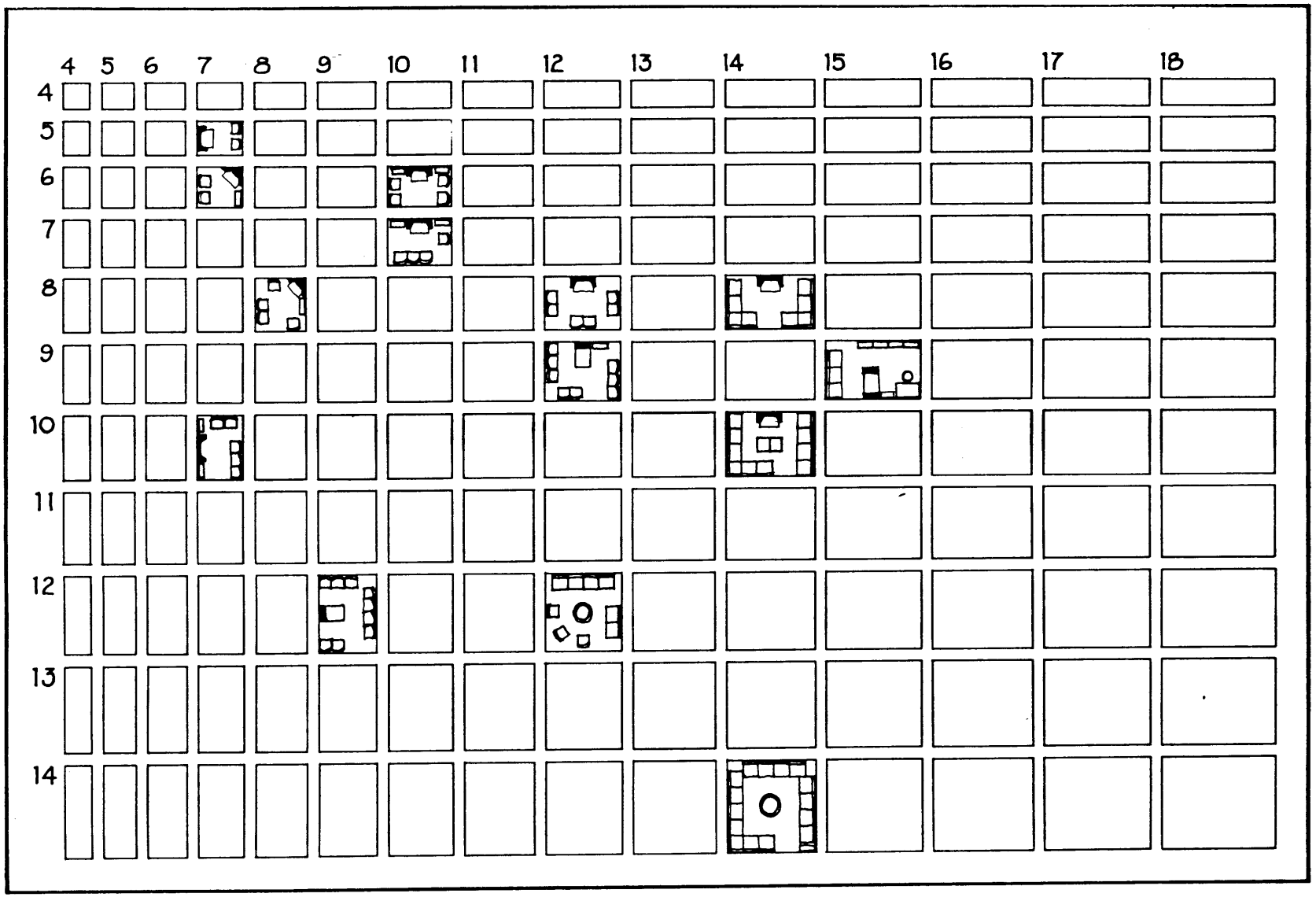
# Study





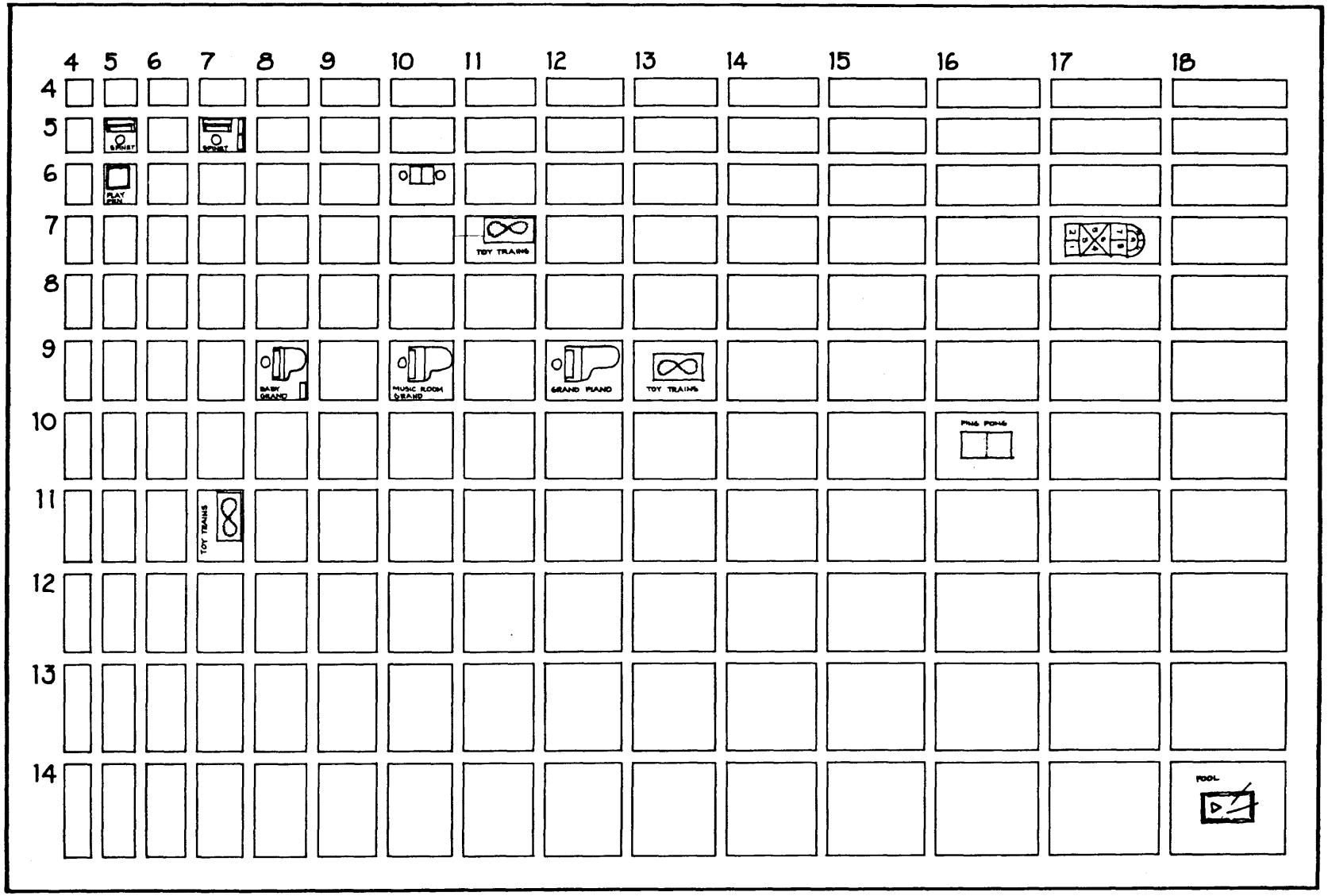
# Hearth





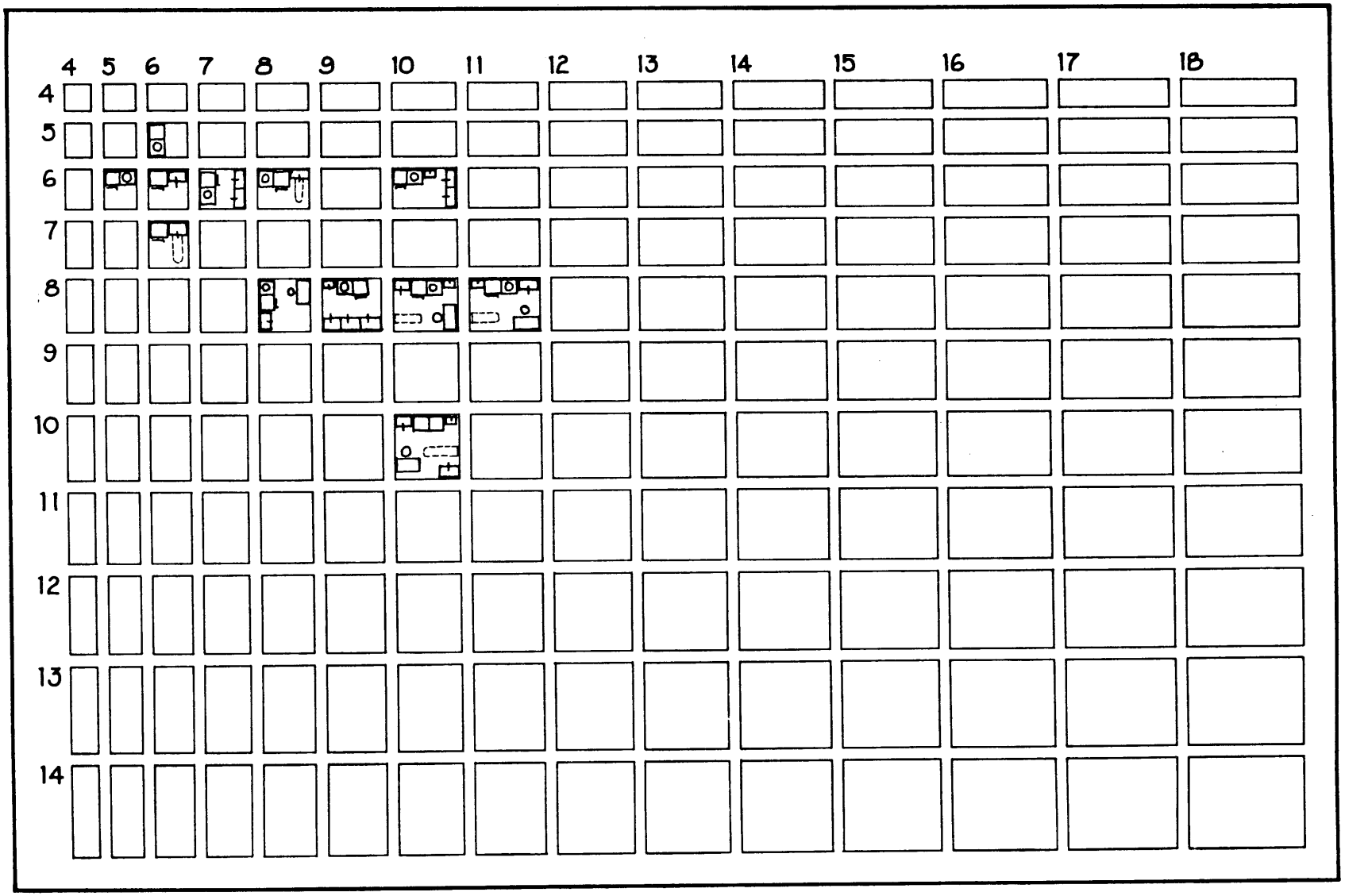
# Play/Music




4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
4
5
6
7
8
9
10
11
12
13
14
SPIRIT
SPIRIT
PLAY PEN
TOY TRAINS
BABY GRAND
MUSIC ROOM GRAND
GRAND PIANO
TOY TRAINS
PING PONG
TOY TRAINS
POOL

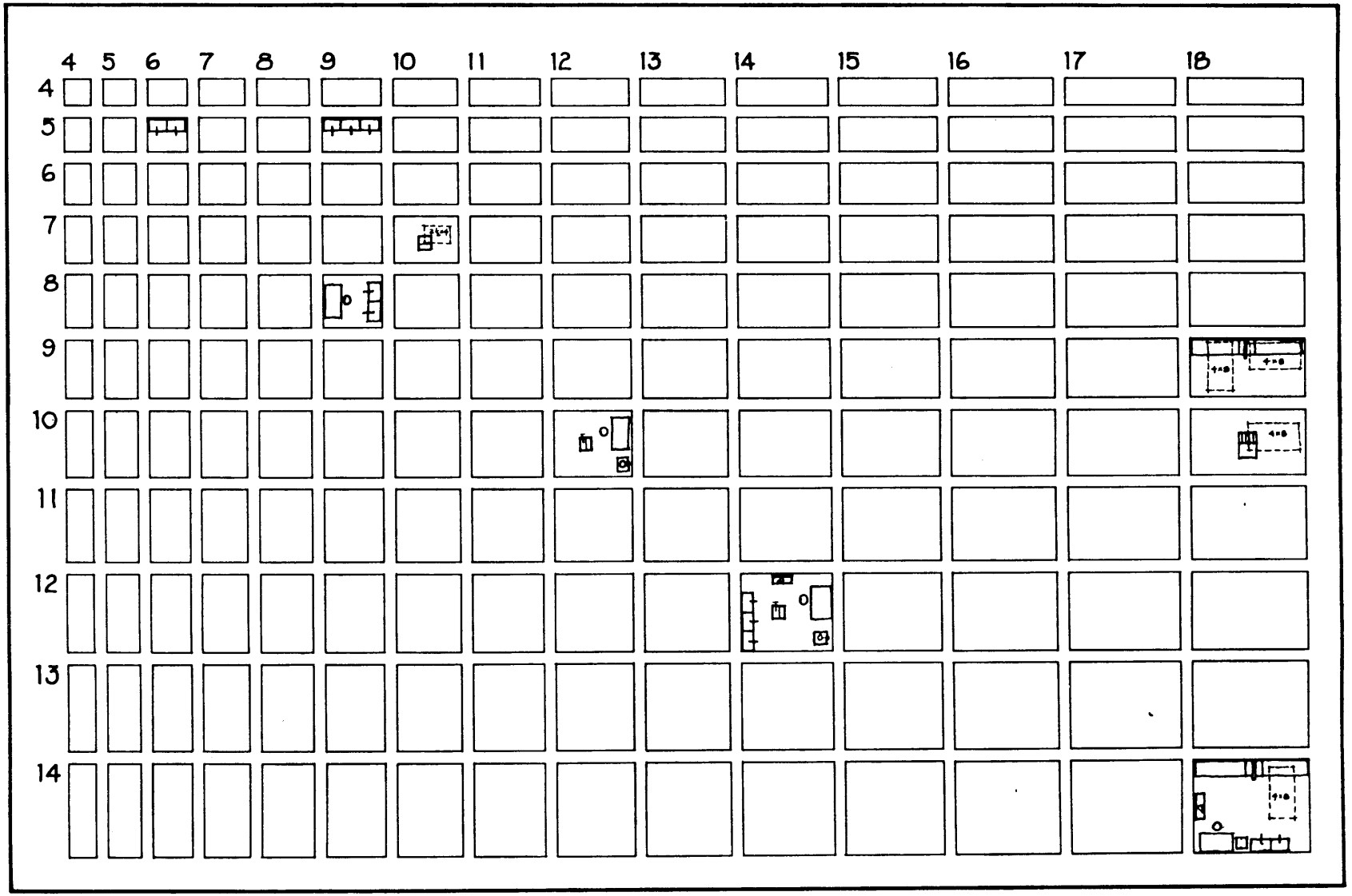
# Washing Clothes





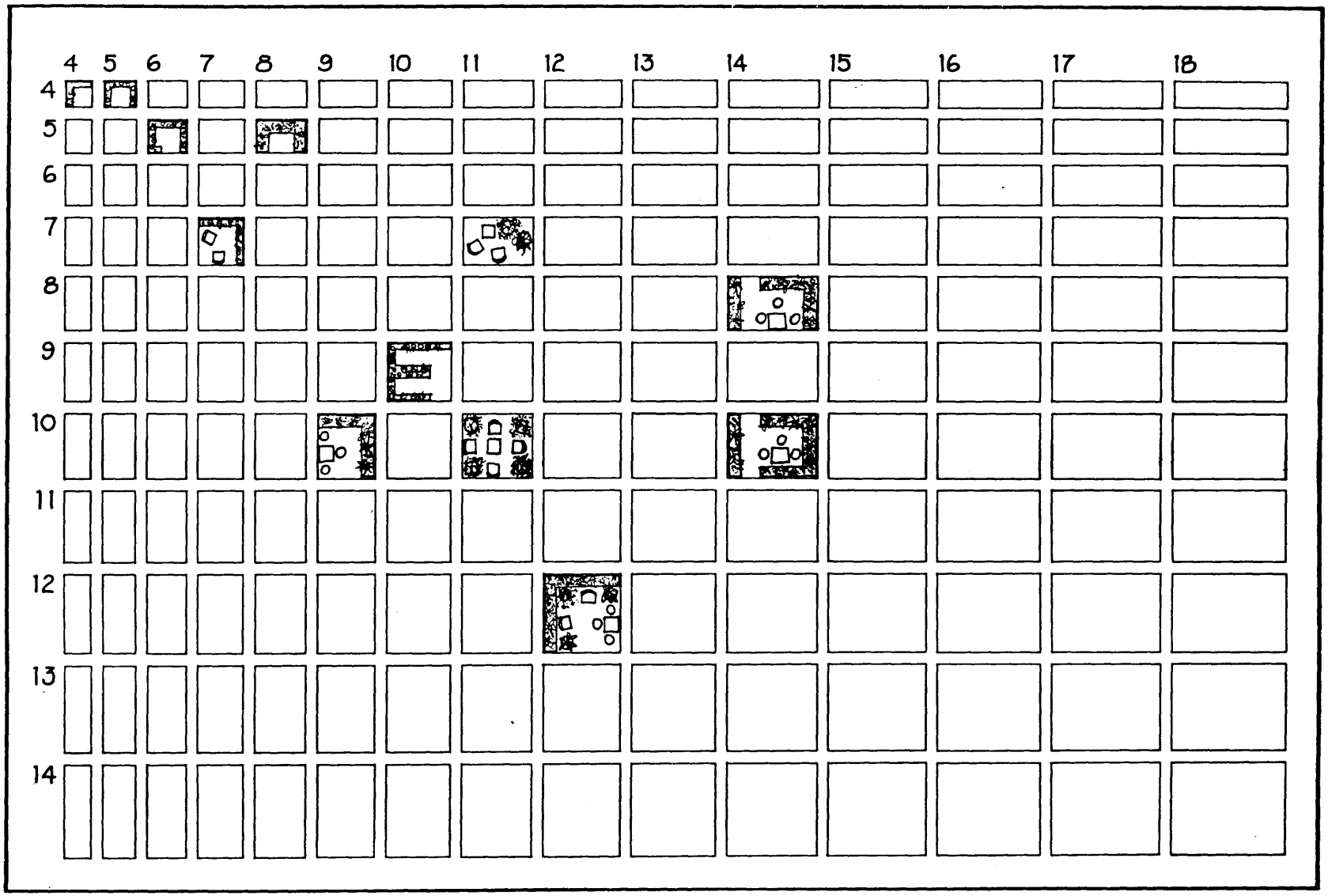
# Working





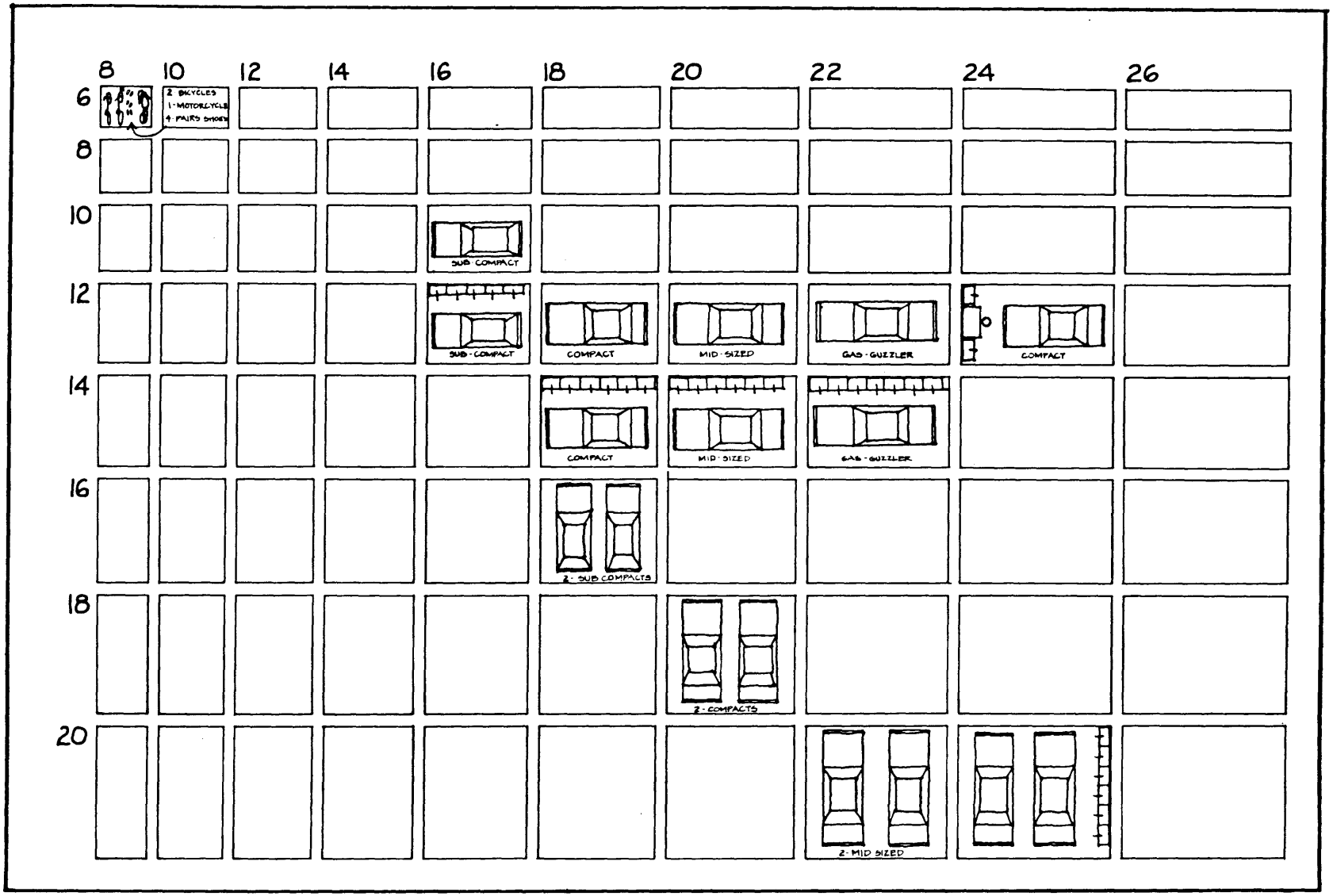
# Plants





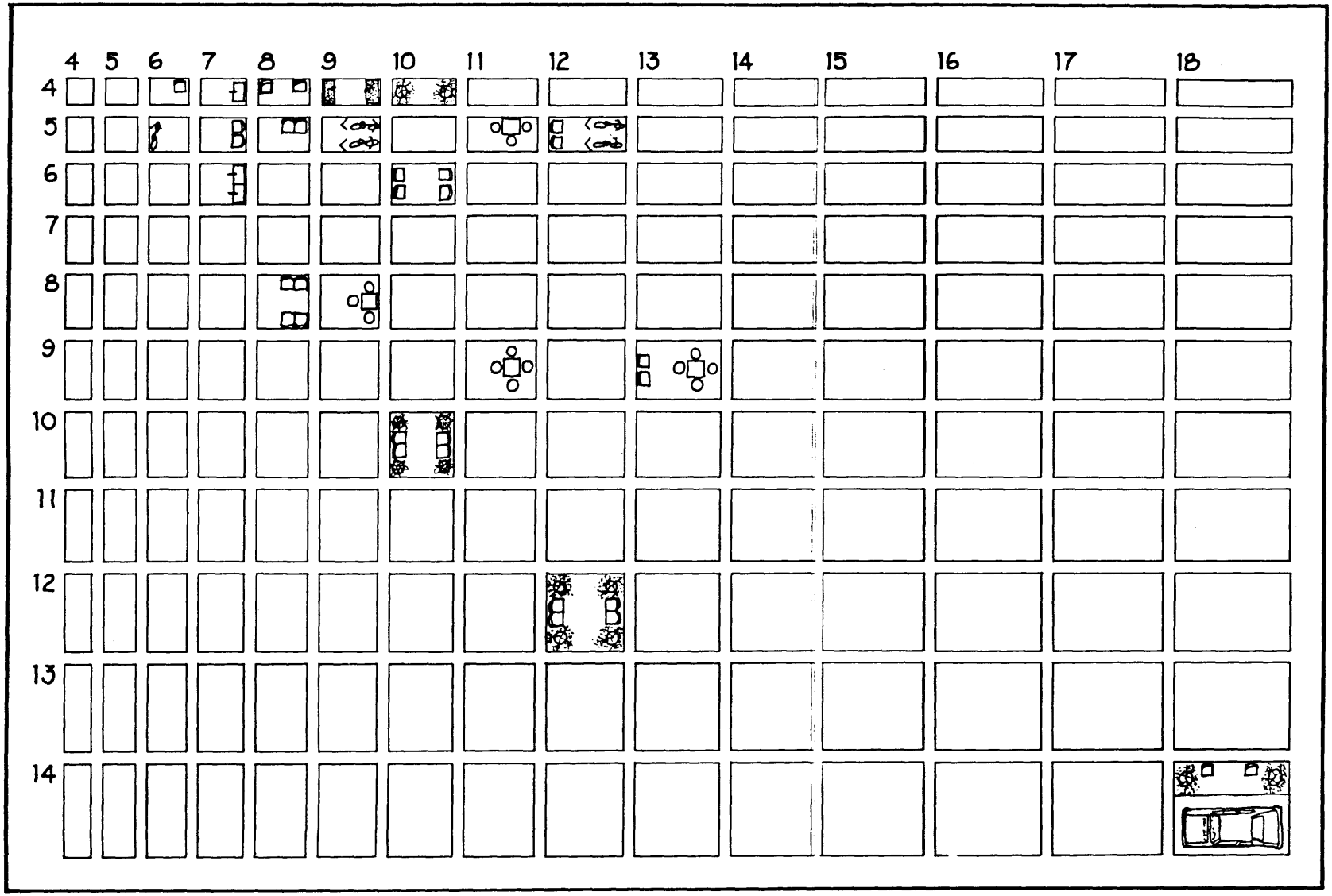
# Auto




8
10
12
14
16
18
20
22
24
26
6
8
10
12
14
16
18
20
2 BICYCLES
1 - MOTORCYCLE
4 PAIRS SHOES
SUB COMPACT
SUB-COMPACT
COMPACT
MID-SIZED
GAS-GUZZLER
COMPACT
COMPACT
MID-SIZED
GAS-GUZZLER
2 - SUB COMPACTS
2 - COMPACTS
2 - MID SIZED

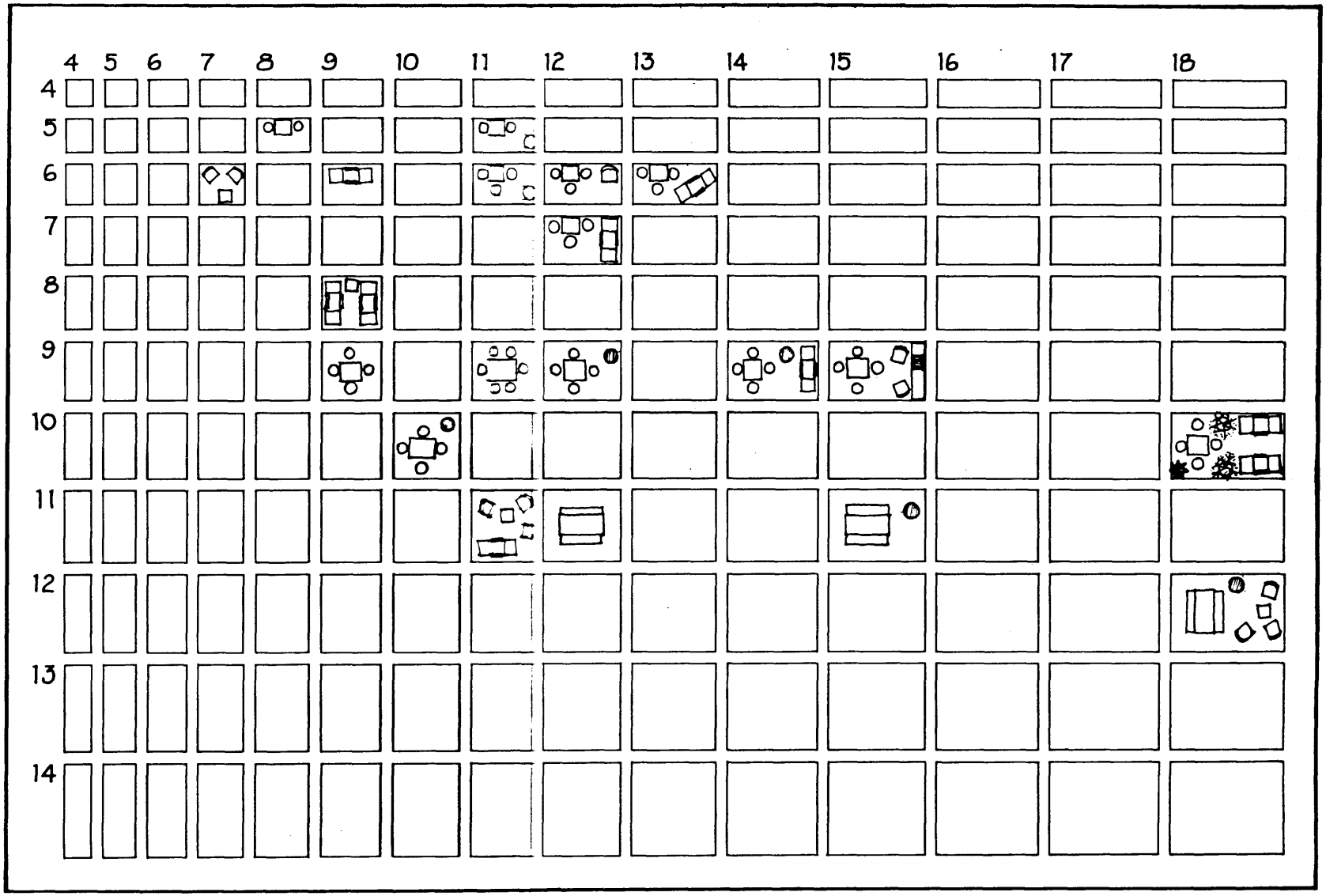
# Exterior Entry





# Barbecue/Sunbathing



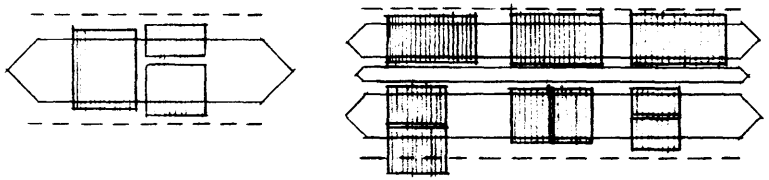


# 4.3 Space Substitution into House

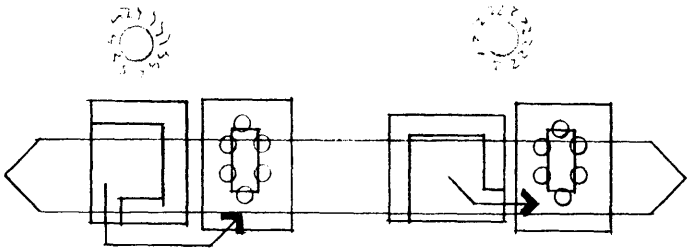


SUMMARY:
This step takes the space layouts derived in step 4.2 and substitutes them into the house. After this is done you have a rough diagram of the house layout which shows all the areas, spaces and general furniture arrangements. No interior walls have been put in and more work is required to make it a real house plan, but most of your space needs have been accounted for.

● The zones placed in step 2.1 are based upon minimum room sizes. Any spaces you place in them will probably be larger and thus their boundaries will end in the margins to either side of the zone.



● If a space extends over the outer margin you have tried to pack in too much, that is, your house is becoming too wide. Either pick a smaller space (step 4.2 ) or place the space to one side of an adjacent space, thereby rearranging the area layout.



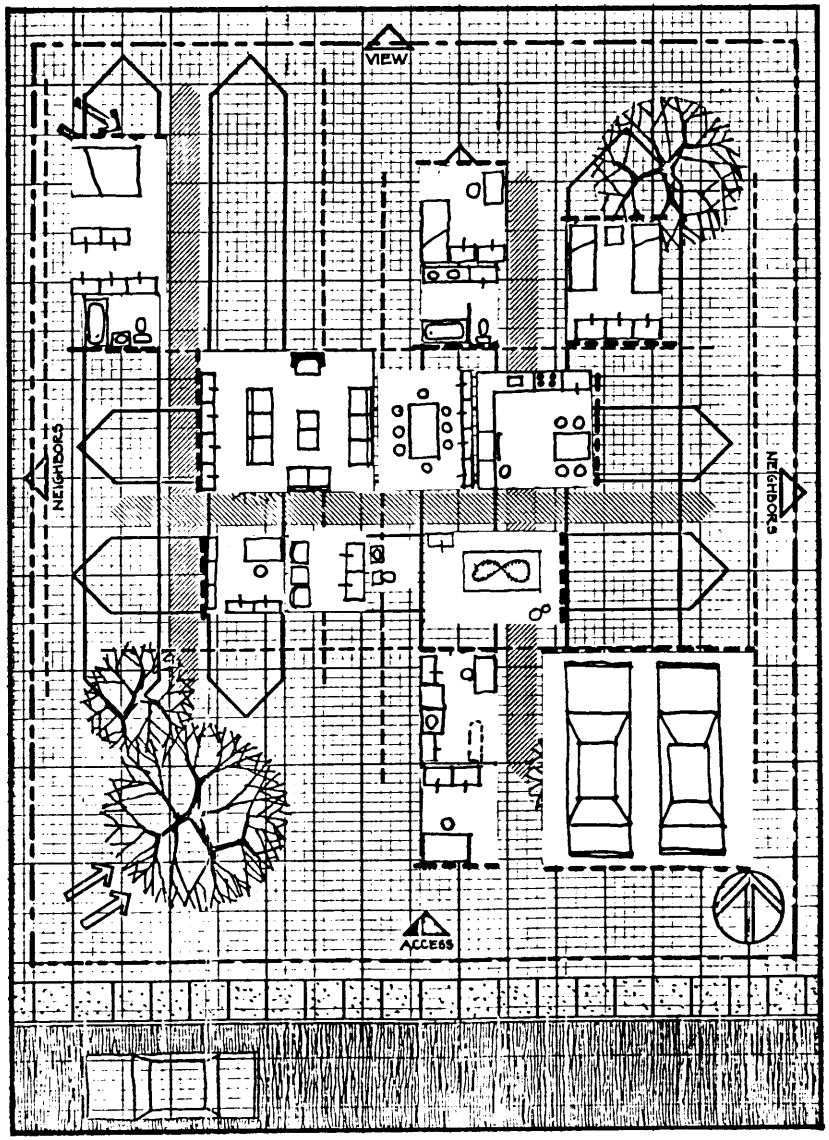
● After placing the spaces in the correct places, examine their interior layouts with respect to each other. You may wish to rotate them or make mirror images as was done with the areas when they were substituted. When doing this you will want to consider how people will pass from room to room, which side of a room has windows and which side touches the circulation path, if any.

TO FINISH THIS STEP:
Overlay spaces on the zoning pattern making sure side boundaries fall in margins. If they extend over, rearrange or choose a new space. Examine and adjust spaces to make better sense of adjacencies and overall layout.

When placing spaces you must be sure to allow sufficient clear width for people to pass between adjacent spaces or out to the circulation space. In the example this width was set at 3 feet.

If a space extends over a margin you can expand the margin width up to 8 feet. This was done for the garage space at the far right.

Spaces should not overlap the circulation zones which they are accessed from. This does not mean that your house will end up with a large amount of corridor because much of the circulation space will be combined with spaces. Because the spaces being substituted are minimum sizes for a particular activity, in any house there must be additional space allotted to movement whether this follows the circulation zones as initially laid out or not. At this stage spaces are placed only with respect to the zones they fall over; the relationships between crossing zones have not yet been resolved. In the example, spaces overlap circulation zones which cross the zones they are on.

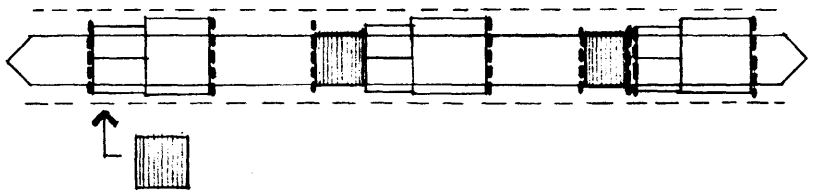


# 4.4 Additional Spaces



SUMMARY:
The purpose of using areas is to help organize your house so that it will be more than a simple collection of spaces. Now you might decide to add more spaces to the house plan beyond those explicitly laid out in the areas. In this step you can insert or substitute other spaces and add exterior spaces which are closely related to the interior spaces.

- You may exchange spaces in the plan for others. For example, you may have picked out a study space but now you realize that you would rather have a bedroom.
- You can add on additional spaces to each area. For example, you may decide that you would like an extra bedroom in the Personal Area. You may also decide that you would like to add to an area a space not usually associated with it. In this case you would be designing your own area. You might want to put an Informal Living Space in the Personal Area, an arrangement not found on the charts.
- You can also add spaces which are not associated with any particular area. These spaces would form their own areas and must span from one margin to the other across a room zone. It is important to keep spaces within areas because this is how the overall house shape and organization is maintained.



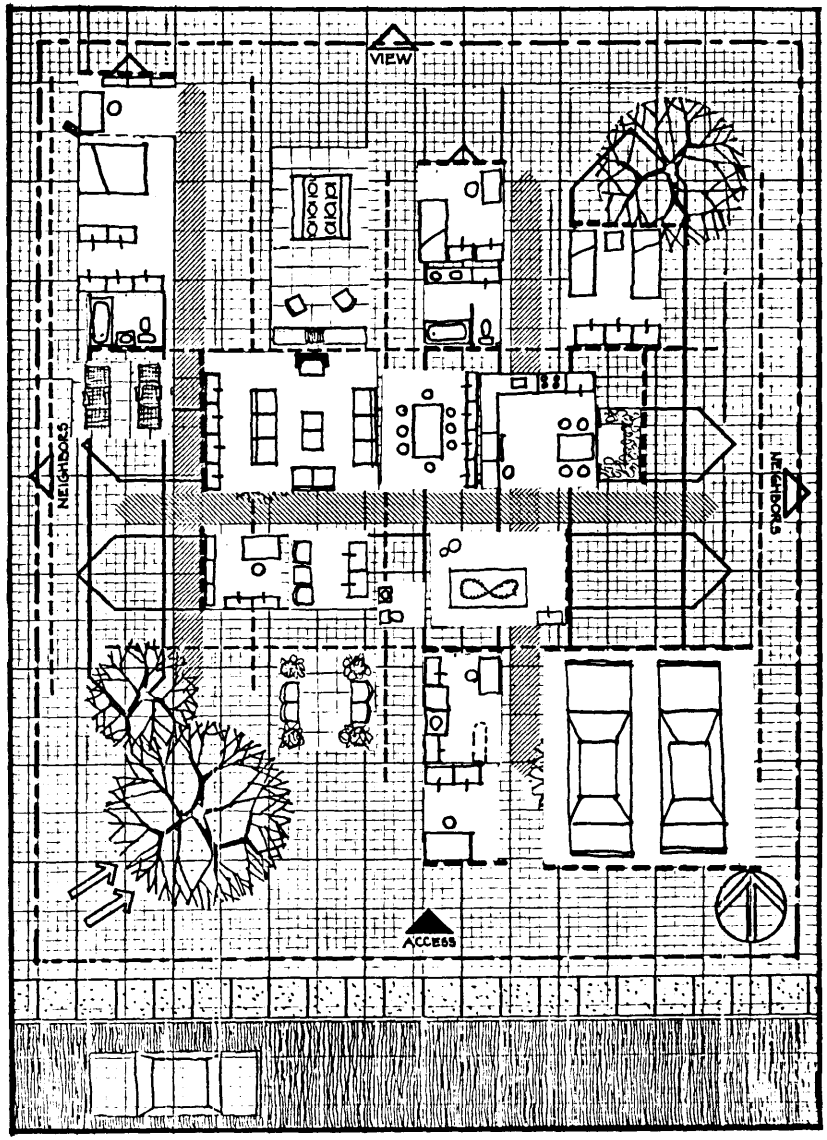
- Exterior space can be chosen from the following charts. These spaces are simply added to the exterior of the house where desired. You should consider the relationships between inside spaces and outside spaces, the site characteristics and off site influences such as neighbors and the public way.

TO FINISH THIS STEP:
Insert into the plan any additional interior spaces being sure that they are either incorporated into existing areas or form their own areas. Exterior spaces are simply added to the outside edges.

A small desk or dressing table space has been added to the north end of the west bedroom wing. A greenhouse space for plants has been added to the east end of the cooking space.

The most important additional space, if it has not been included as part of an area layout, is the entrance. This might be only a door and a closet which is part of the living space or circulation. In this case it would not require a separate space. It might also be a bit larger and fit into a vacant space in the plan, in which case it could be an infill element from step 2.7. If the entry is to be larger than 6 feet square, then you may need to add a new space in this step. In this example the entry was included in the original area. In the example given at the beginning of this work, a separate space needed to be added.

An exterior entry patio has been placed outside the entry hall mentioned above. A sunbathing porch has been placed south of the west bath. A barbeque patio has been placed north of the living space.



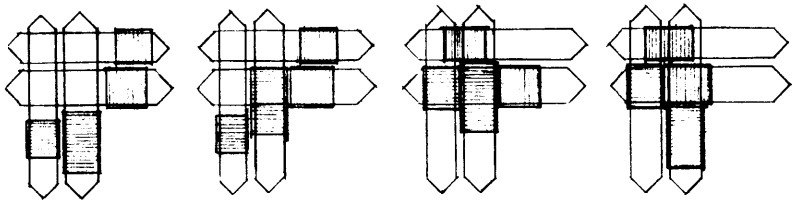
# 2.3 Adjust Plan



SUMMARY:

This step makes the house diagram more compact so that it becomes closer to representing a house plan.

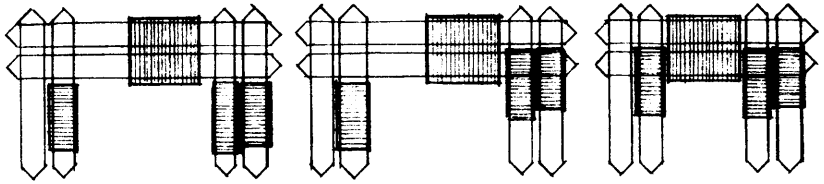
● Although we have put down separate spaces, it is important to maintain them in their area groupings. These area groups can then slide along their zones to fill in or open up space in plan.



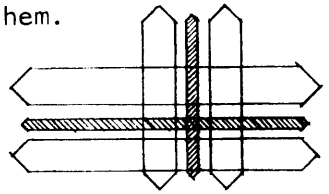
● The strategy is to move the areas together at each intersection to fill in the gaps. If your zone pattern has more than one leg, not only will the areas need to slide, but also the cross zones will move back and forth. In this manner the entire plan is consolidated.

● Even after this is done, your plan will have empty spaces inside and rough edges around its perimeter. These aspects will be dealt with later.

● The spaces cannot overlap or occupy the same area in plan.



● Check to make sure that the internal space arrangement is sensible. The circulation path should be connected from one leg to the other. This means that it is either uncovered by any space, or that if a space lies over the circulation path, it is a space through which people may pass at any time. The spaces may have to be separated to let the circulation pass between them.



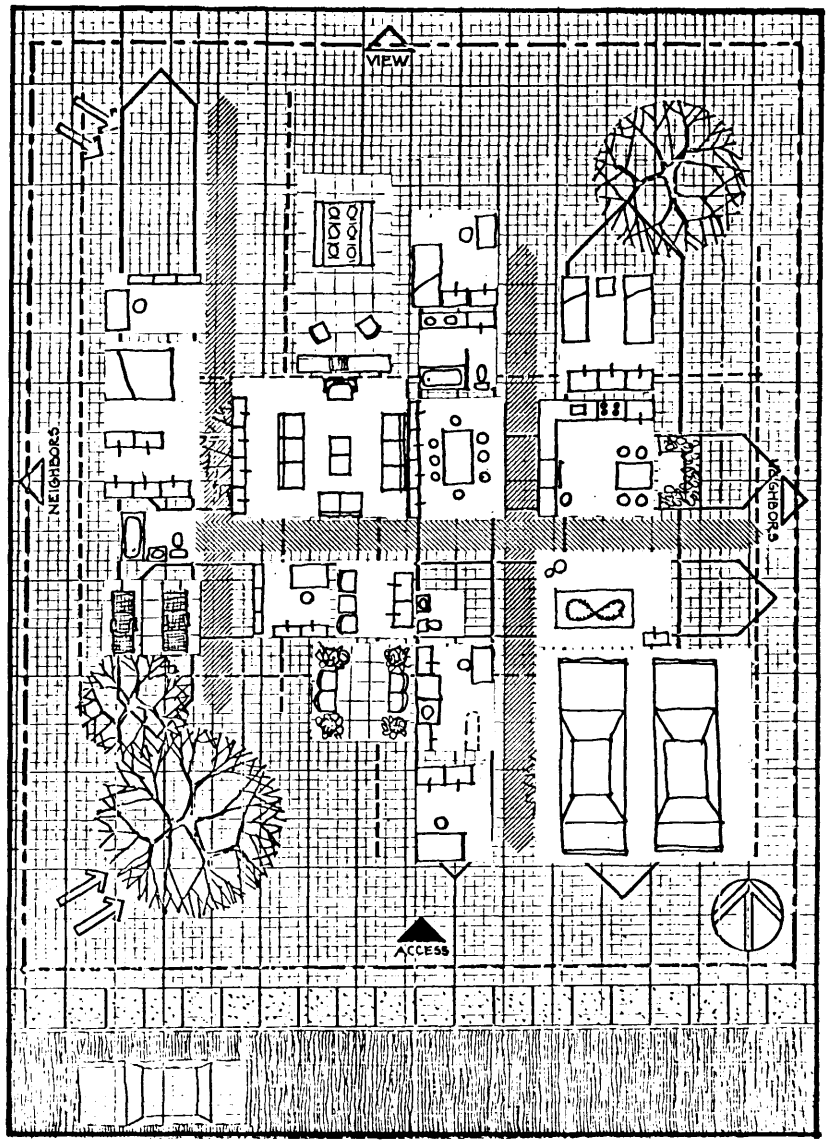
TO FINISH THIS STEP:

Slide areas around to contract the plan size. Check that the floor plan makes sense and that the circulation path is continuous.

After space substitution it may be possible to eliminate some room zones because they are not being used. An exterior margin must be maintained for the remaining zone. In the example this was done with the inside room zone on the west. The elimination of a room zone will enable the two parallel legs to move closer together (up to 12 feet).

The spaces have been moved along the room zones to achieve the present arrangement. The cooking and play spaces are now separated from the rest of the general living area by the circulation zone running north-south. The west sleeping space and bath were moved south to the edge of the east-west circulation zone. The east sleeping and bath spaces were moved as far south as they could be without overlapping the cooking and eating spaces. The auto, work and clothes washing spaces were similarly moved north. All spaces span across room zones or lie within them if they are not as wide.

All of the circulation zones are connected and uncovered by any spaces.

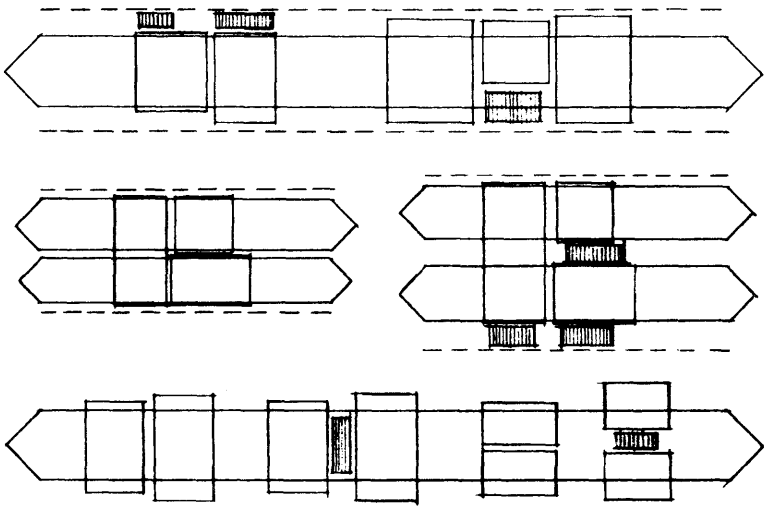


# 2.4 Infill Spaces



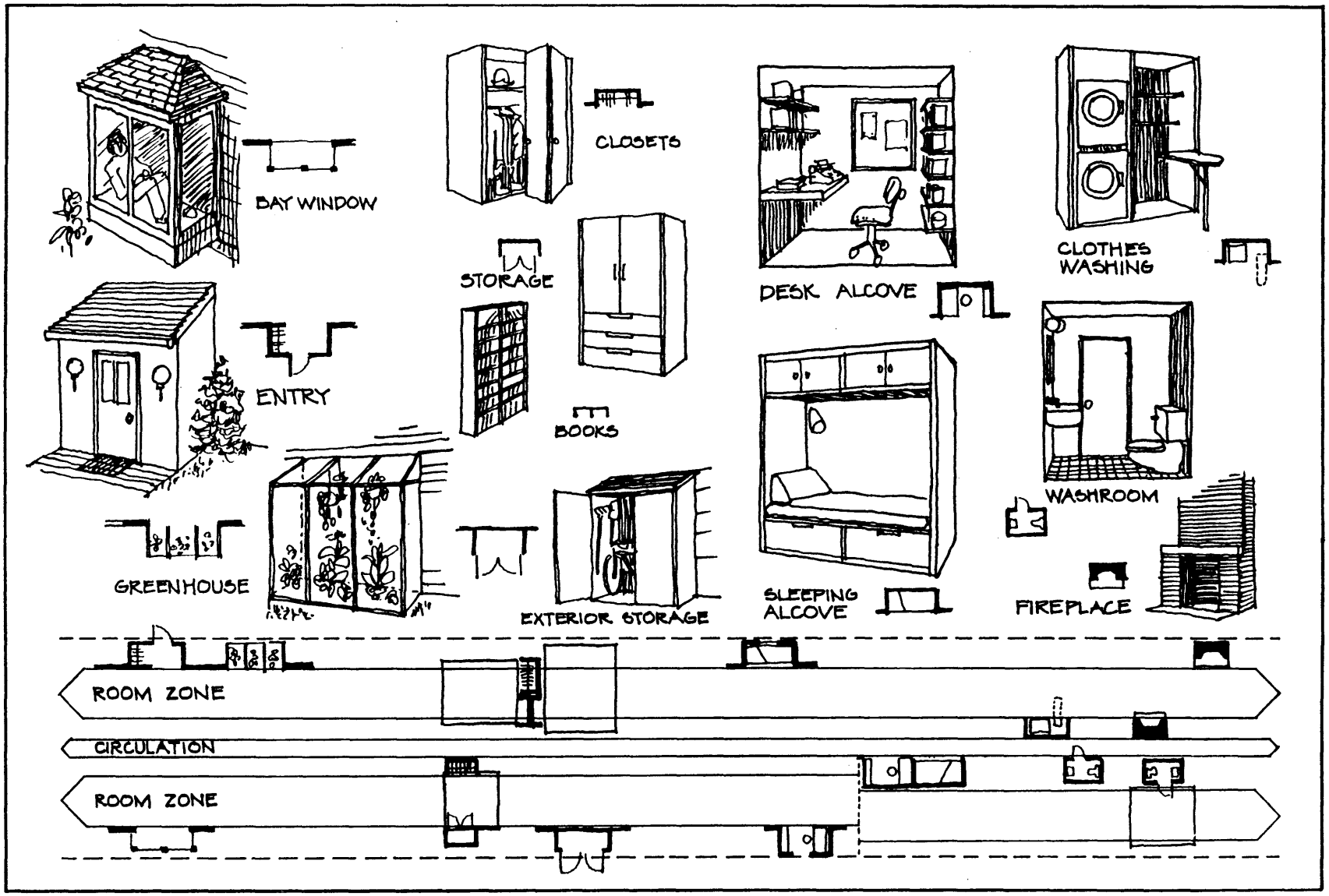
SUMMARY:
The house plan shows all of the major spaces but it does not contain a number of smaller spaces which we may take for granted, such as closets, storage space, sitting alcoves or bay windows. In this step you decide where to put these infill spaces based upon the layout of the major spaces.

- Infill spaces can be elemental spaces from step 5.1 or small spaces from step 4.1. You may also create your own infill spaces.
- Look at the list of suggested infill spaces and the way they might be inserted into the plan.
- Determine which spaces should be associated with which infill. For example, some closets will be in bedrooms and others will be accessible without having to enter a room.
- Infill spaces can also be used to fill up open areas of your plan if that would be appropriate.
- The interior margins of the zone layout can be expanded up to 4 feet so they can contain infill spaces.
- Margins can be created between spaces in a zone by spreading apart the spaces to leave a gap.



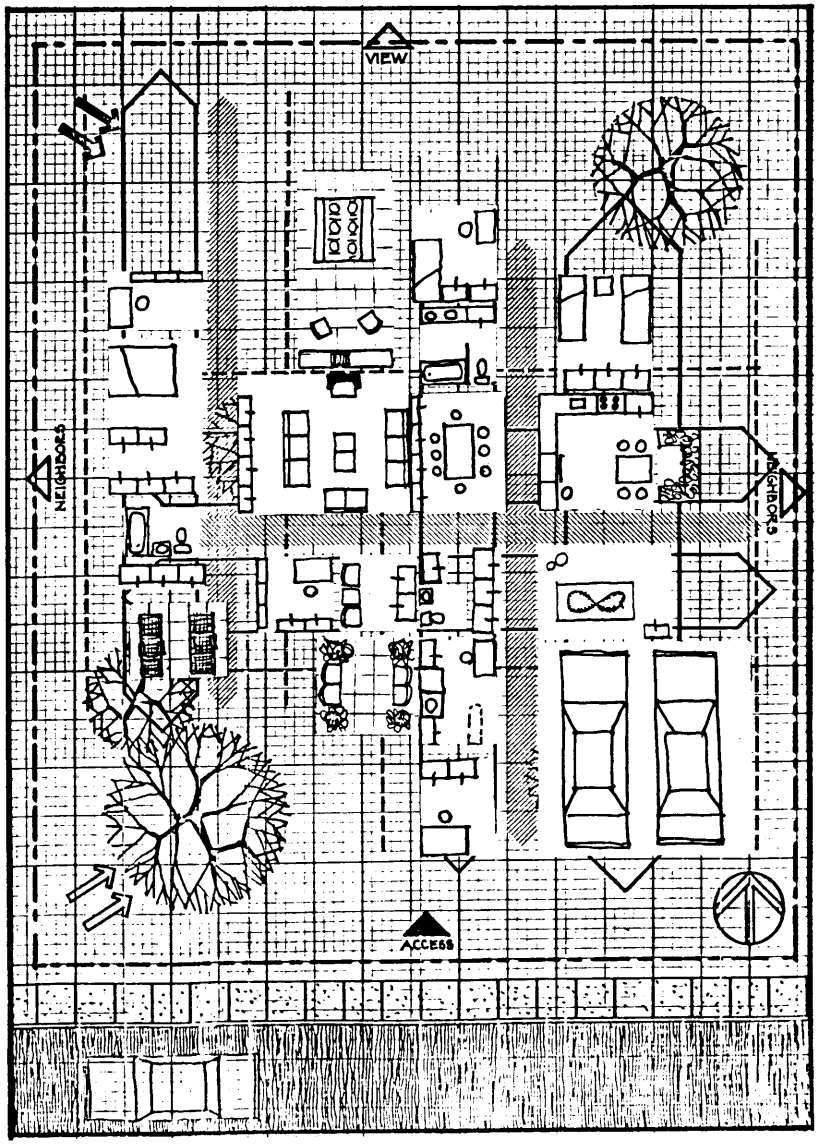
- You do not need to fill in every empty place in plan. Undesignated area can become part of one space, part of circulation space or removed to the outside.

TO FINISH THIS STEP:
Determine the infill spaces you need. Fill in any gaps in the plan first. If you need more space, you can expand margins or spread spaces apart.


BAY WINDOW
CLOSETS
STORAGE
DESK ALCOVE
CLOTHES WASHING
ENTRY
BOOKS
WASHROOM
GREENHOUSE
EXTERIOR STORAGE
SLEEPING ALCOVE
FIREPLACE
ROOM ZONE
CIRCULATION
ROOM ZONE

Infill spaces were added to the example in two places. The small washroom next to the entry could have been expanded into the gaps around it but the decision was made to fill these with storage spaces. Exterior storage was added to be accessible from the sun porch on the southwest corner of the house.

Note that no more storage was necessary for the bedrooms because it was included with the original space selection. If such space was not included or more storage was now desired, it could be added in this step.



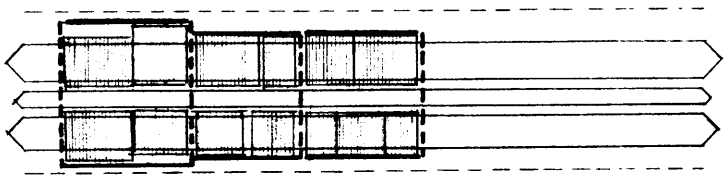
# 2.5 House Perimeter



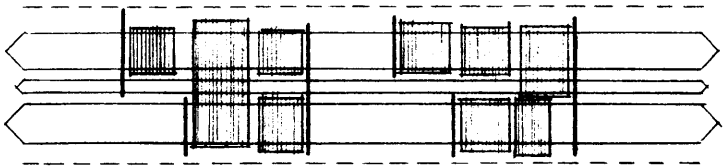
SUMMARY:
In this step the outer perimeter of the house is established.

Although we placed limits upon the possible width of the house, these do not represent the final perimeter. A line is now established which provides enough room for all the desired spaces but no more than is necessary.

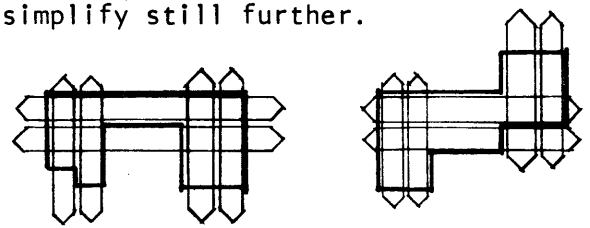
- A plan with an exterior wall having many jigs and jogs will be expensive to build. Unless a corner provides an advantage for the use of space or its enjoyment, it should be eliminated.
- Examine each zone and note where the areas end. The exterior wall along each area should be flat. This wall will be parallel to the zone and far enough out to include all the spaces in the area. This will add some space to the smaller spaces.



- If the edges of two adjacent areas are near, you may want to align them to eliminate more corners.



- The length of each zone must be determined. Draw a line from one margin to the next which gives adequate space for all the spaces in that zone. If the ends of zones fall near each other, connect them to simplify still further.



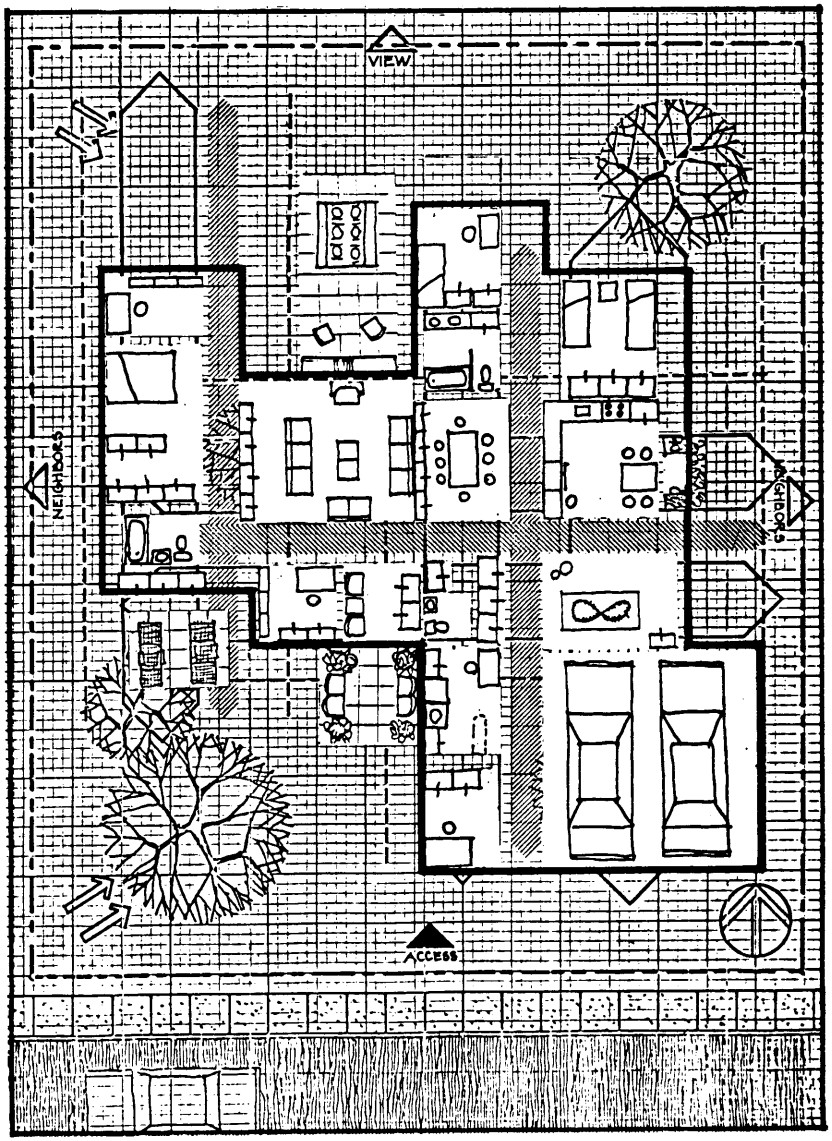
- Connect any loose ends to complete the perimeter line to enclose the house.

TO FINISH THIS STEP

Draw a boundary line outside of each area, parallel with the zones. Draw a boundary line across the end of each zone leg and enclose the plan. Simplify this perimeter line where possible.

The perimeter lines parallel to zones fall in the exterior margins. They are straight for the full length of each area, so that corners occur at the ends of areas. The perimeter line along the east edge of the sleeping and cooking spaces could have been pulled in closer to the actual space but it was decided to align it with the line along the play space for reasons of simplification and the welcome extra space. The space for plants is a greenhouse structure and can project beyond the perimeter line.

The end lines are drawn straight across room zones. There is a jog at the north end of the east personal area because these spaces were considerably different in length. A rule used for this determination was that if jogs or offsets do not need to be more than 6 feet they should be smoothed out (made straight).

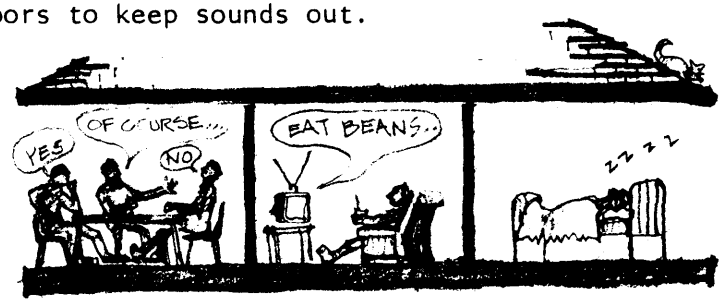


# 6.1 Interior Walls

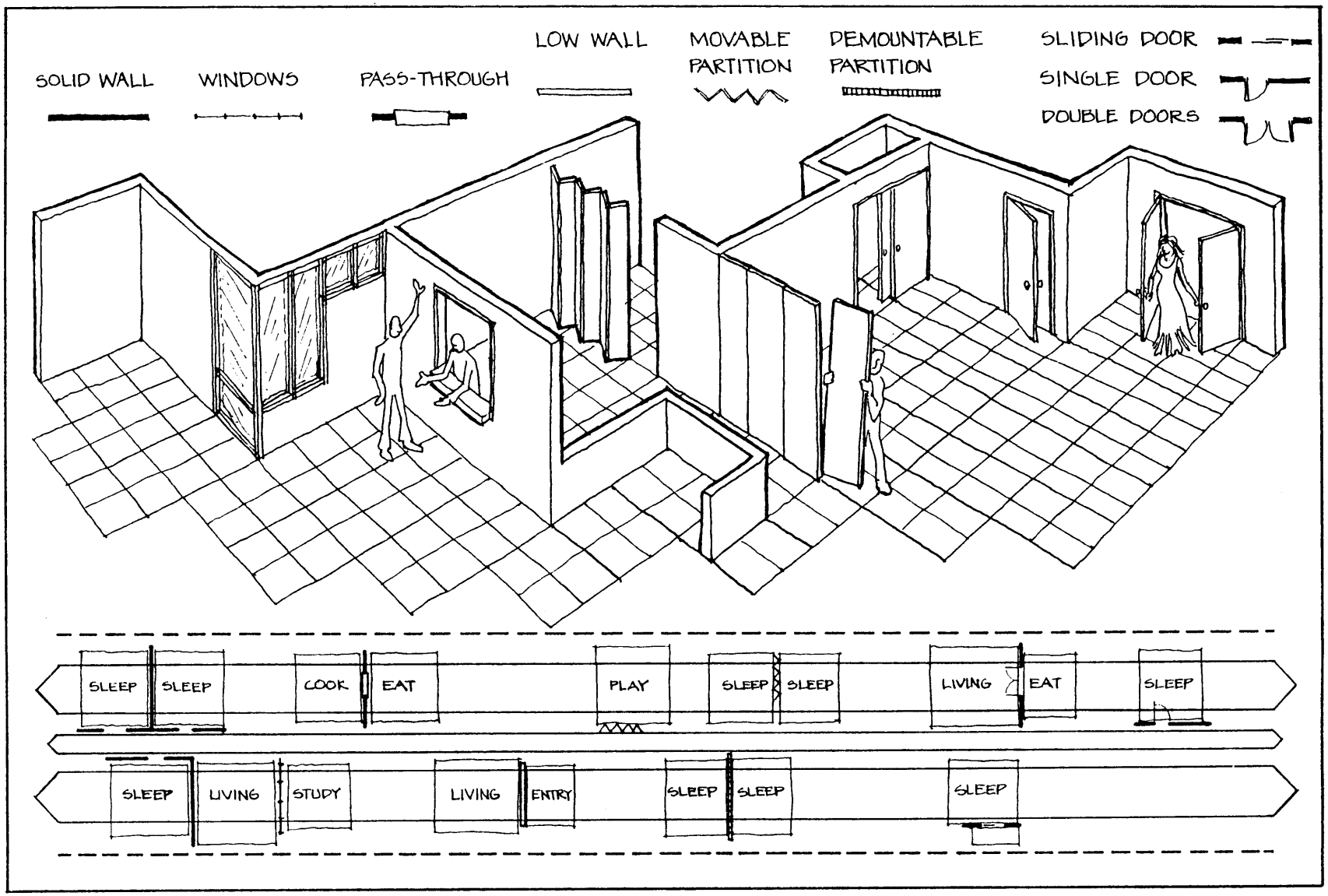


SUMMARY:
At this point all the space in the house has been allocated. It is now necessary to place walls, doors and windows into the plan to separate some spaces from others and to create distinct rooms.

- Examine the chart displaying walls, doors, windows and movable partitions. Notice how they can be used.
- Look at your plan and try to imagine who will use each space and what they might do in it.
- Some spaces will be used simultaneously with people talking and passing between them. These spaces should have no partitions. If it would be occasionally desirable to close these spaces off from each other, consider a movable partition.
- Some spaces should be easily accessible to each other but should remain distinct rooms. Kitchens and dining rooms are often like this. You may want to put up a wall with a door or perhaps a window which could be opened to pass things through from one room to the other.
- Some spaces should be completely closed from each other, such as adjoining bedrooms. Between these spaces you will want to put a solid wall. Some times you may want to separate children's rooms with a demountable partition, i.e. a wall which could be occassionally moved and is more substantial than a movable screen.
- Any spaces which are likely to produce a lot of noise, such as a workshop with power tools, must be in a room to which doors can be closed to keep the noise from disturbing the rest of the house.
- Spaces which are desired to be kept quiet, such as bedrooms and studies, must be in rooms with doors to keep sounds out.

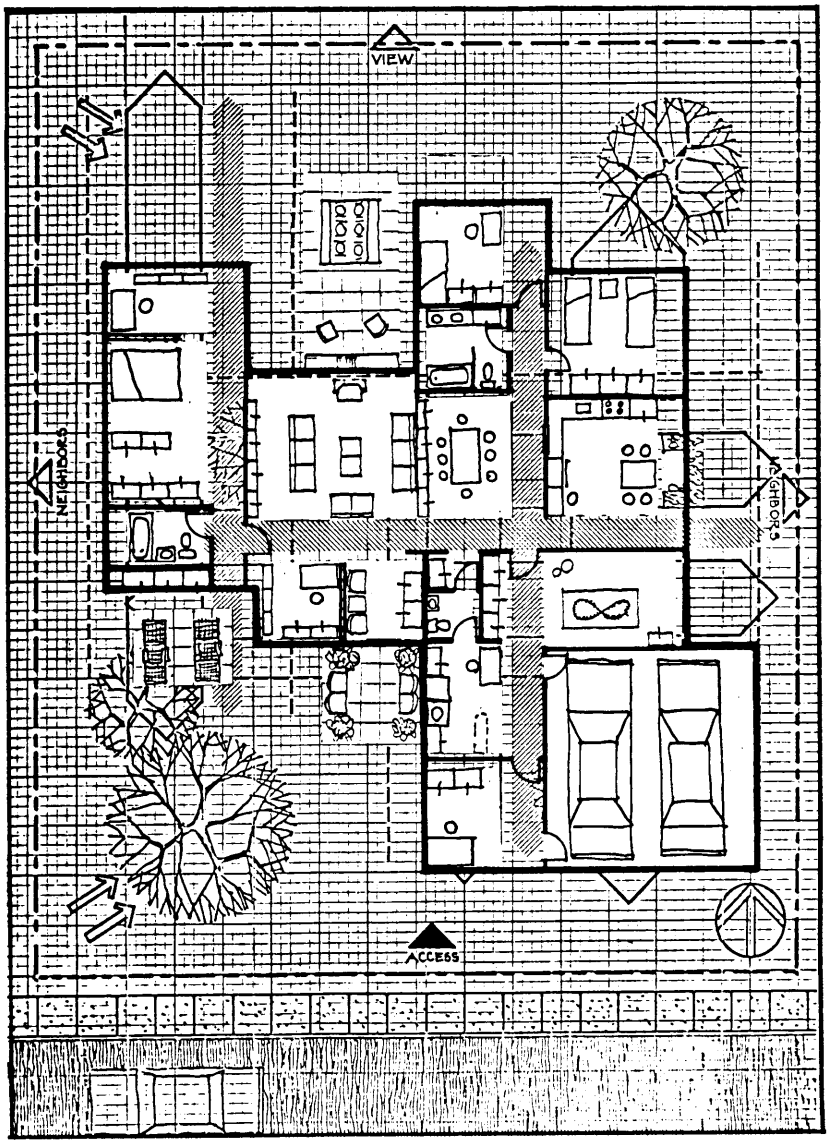



TO FINISH THIS STEP:
Indicate where interior walls should go by drawing the appropriate symbols on the house plan.


SOLID WALL
WINDOWS
PASS-THROUGH
LOW WALL
MOVABLE PARTITION
DEMOUNTABLE PARTITION
SLIDING DOOR
SINGLE DOOR
DOUBLE DOORS
SLEEP
SLEEP
COOK
EAT
PLAY
SLEEP
SLEEP
LIVING
EAT
SLEEP
SLEEP
LIVING
STUDY
LIVING
ENTRY
SLEEP
SLEEP
SLEEP

Interior walls can be placed at the edge of any space to separate it from adjacent spaces or the circulation. In the example, 2 sleeping spaces and bathing spaces have become rooms by themselves. The living, eating and entry spaces are not separated and only a waist-high partition is between the study space and the entry. The west sleeping space and study are combined, again with only a partial height wall between. The clothes washing space and play space are connected across a circulation zone.

The spaces at the ends of wings take over the circulation zones which pass by them. This occurs with the west wing which forms a 'master bedroom' suite. The northern most bedroom on the east, the kitchen and the work room have all taken the circulation zone inside their walls. The living/dining/study/entry room and the play/washing room can use the circulation zones as part of their spaces, but people must still be allowed to pass through.

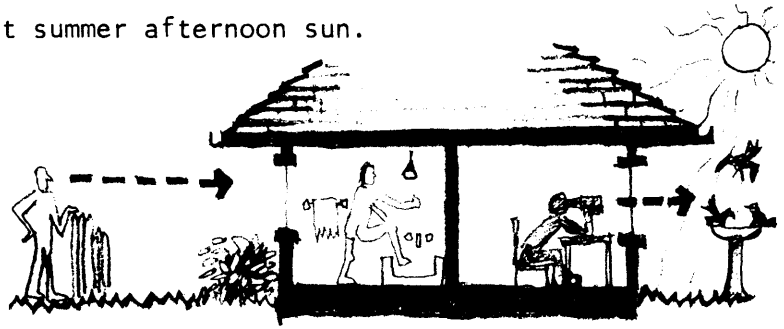


# 6.2 Exterior Walls

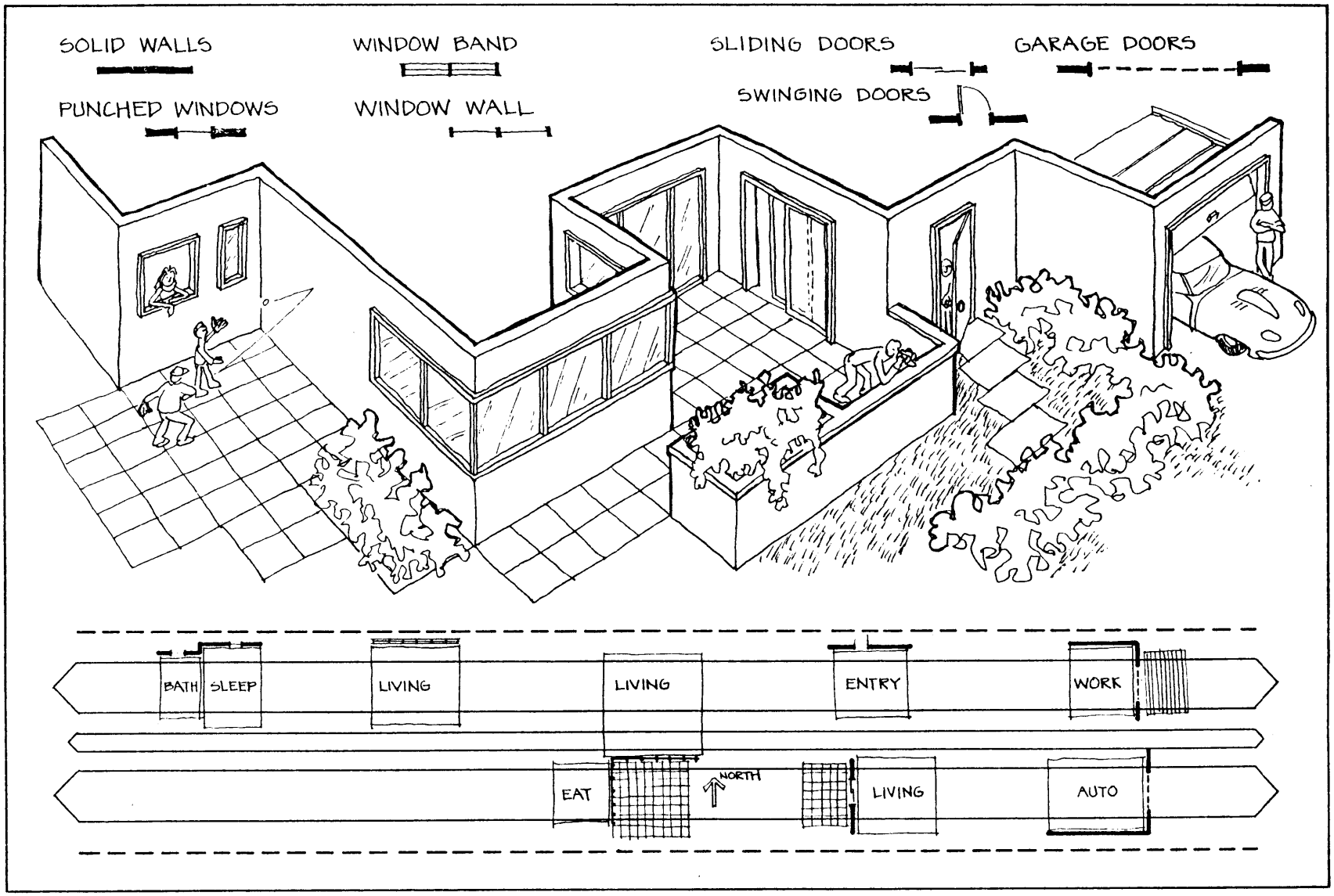


SUMMARY:
Exterior walls are important for three reasons: They affect how you use a room and the house, they are part of the exterior appearance of the house and they are important for controlling heat loss in the winter and heat gain in the summer.

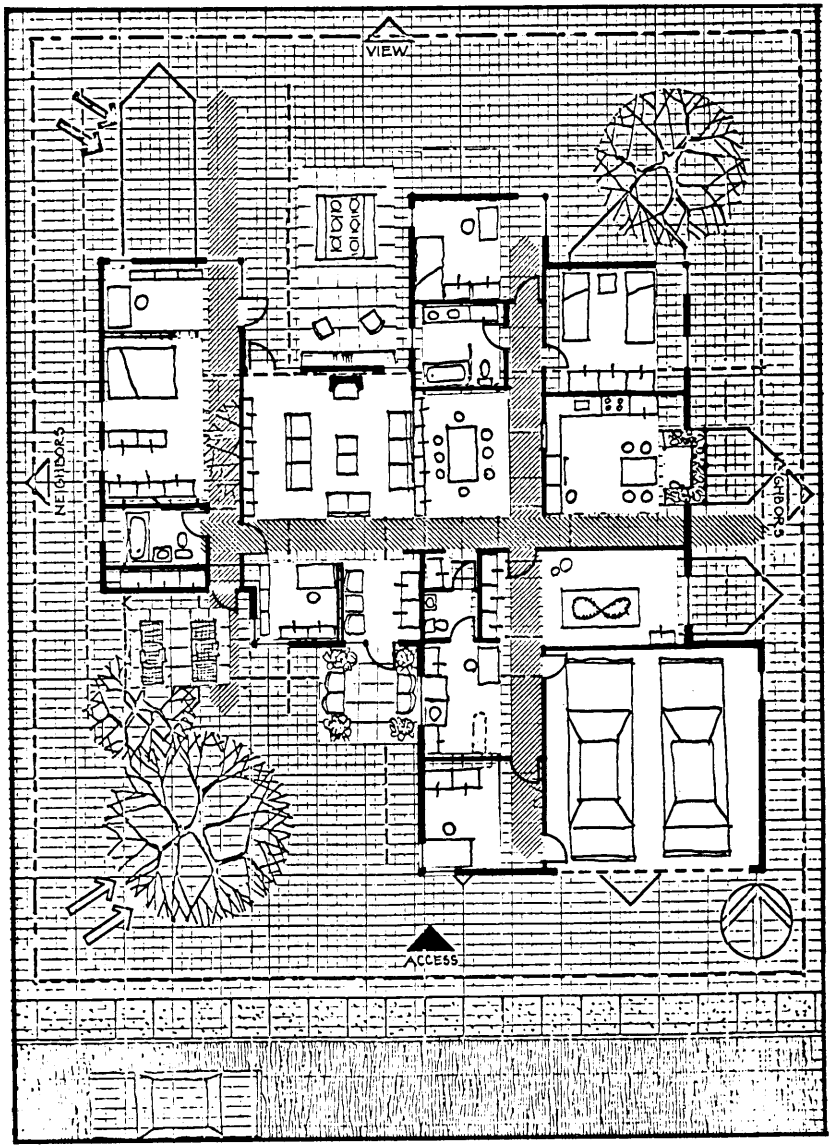
- Examine the chart which shows exterior walls, windows and doors.
- Determine which spaces you want to have doors to the outside and which spaces are satisfactory with just windows. It is usually best to put doors to the outside along circulation paths because this will cause the least disturbance of a space furniture layout.
- You must remember that wherever you put a window people can see in almost as well as you can see out. You will want to restrict the amount of window area in the direction of neighbors and where people passing by could see in.
- Windows let out much more heat than the rest of a wall. Today it is usually not a good idea to put in a window unless you really want it for light and and a view outside. Glass which begins 3 feet above the floor and ends at $6\frac{1}{2}$ feet allows as much view and light as floor to ceiling glass but about half of the heat loss.
- Windows on the south side of a house can help heat it in the winter but they must be covered at night to prevent nighttime losses. There should be a roof overhang or louvers to restrict summer heat gain.
- Windows should usually be avoided on the west side of a house unless there is some protection from the hot summer afternoon sun.



TO FINISH THIS STEP:
Indicate where exterior walls should go by drawing the appropriate symbols on the house plan.


SOLID WALLS
WINDOW BAND
SLIDING DOORS
GARAGE DOORS
PUNCHED WINDOWS
WINDOW WALL
SWINGING DOORS
BATH
SLEEP
LIVING
LIVING
ENTRY
WORK
EAT
NORTH
LIVING
AUTO

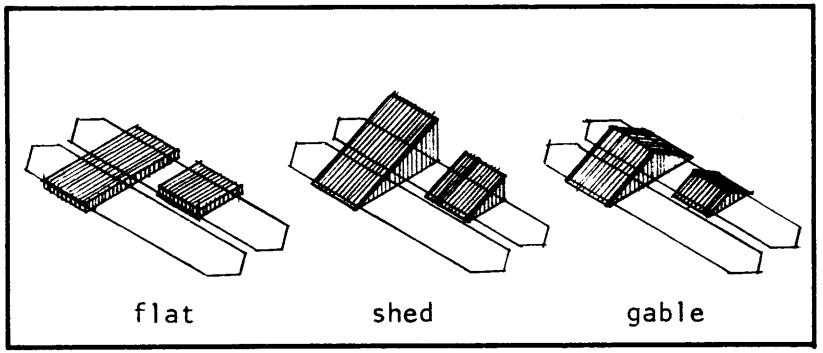
The exterior walls follow the perimeter of the house. Notice that all the exterior doors open onto planned exterior spaces. This provides a continuity between the exterior and the interior which tends to accomplish two objectives: People will be more likely to use the outdoor spaces. They will also be perceived as an extension of the inside, thereby making the interior seem more expansive. Any such physical and visual connection with the exterior must be accompanied by sufficient barriers to other people looking in or the result will be to put the interior of the house on public display. Such is the sad case of most suburban 'picture windows' which in reality turn the home into a fish bowl.



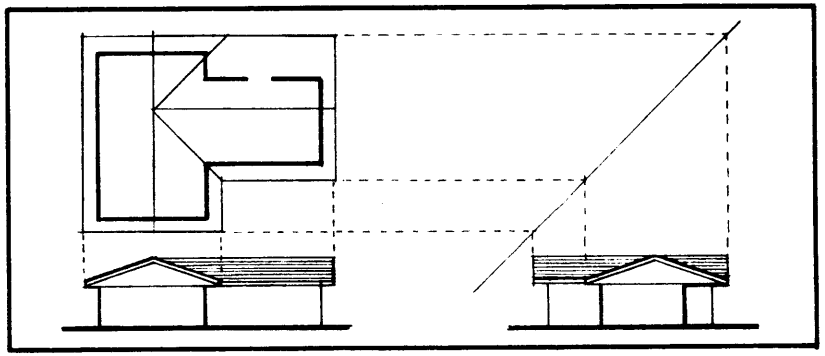
# 6.3 Roof



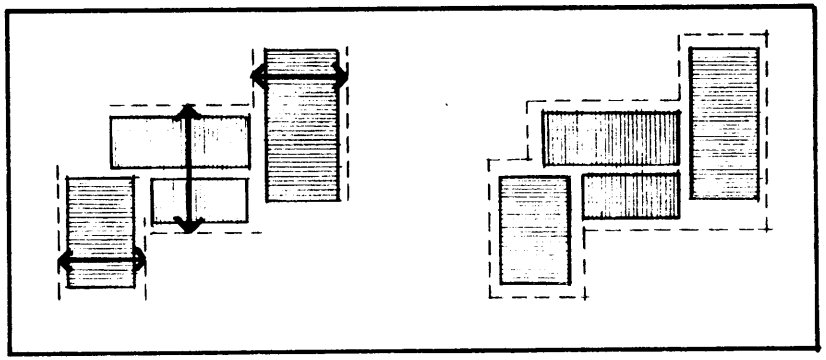
SUMMARY:
In this step you determine how to put a roof on your house based upon the plan you have chosen and your preference for various roof shapes.




- This game allows three types of roofs to be used. They can be placed over zones as shown.



- The minimum house area to be covered by the roof is the area in plan within the boundary line established in step 2.5. You will probably want some overhangs for both aesthetic reasons and practical considerations. Therefore you need to draw a roof edge line which follows the perimeter line around the house, but further out to include overhangs.

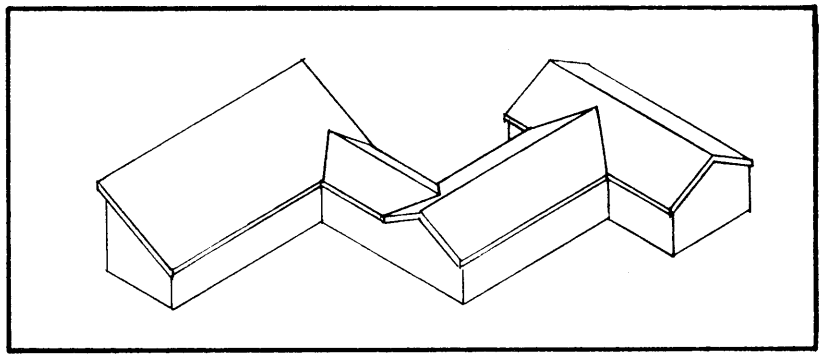


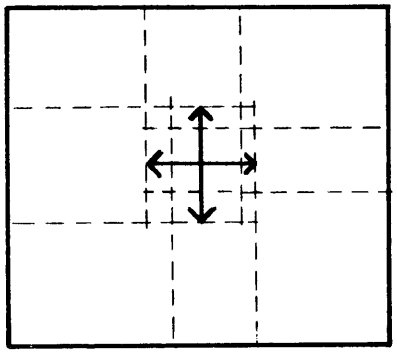
- Determine how much of an overhang you need for each area on the sides parallel to the zone leg. Draw a dashed line to indicate this. The roof of each zone leg will span between these lines.
- Determine the overhang at the end of each zone leg. This line will be the end of each roof.
- Simplify the roof shape where possible.

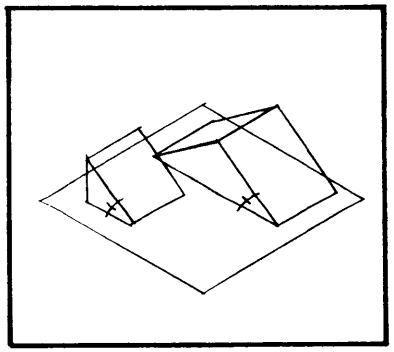
If you are satisfied with flat roofs, you can stop here. The dashed lines represent the edge of the roof.

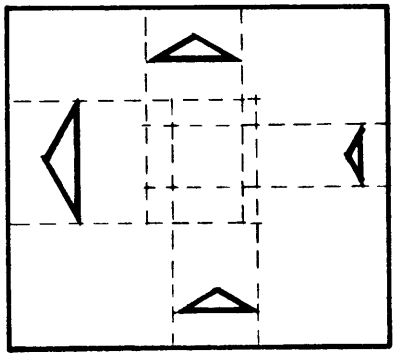
If you desire a pitched roof, you must continue below.

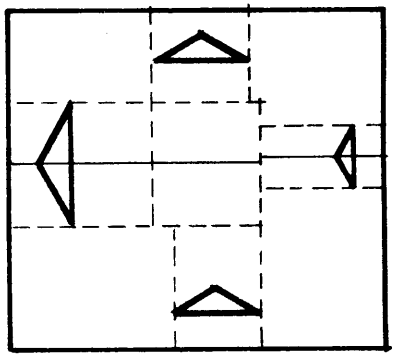
- Each intersection must be separately examined to determine how pitched roofs join each other. The intersection possibilities will influence what roof profiles are acceptable for each leg entering the intersection.
- Draw the side edges of each leg completely through the intersection. The largest rectangle they form is the 'intersection area'.
- Each slope must be the same and all roofs spring from the same plane. A zone may vary in width but it must have the same roof profile throughout.
- Choose a roof shape for each leg and draw it in section over each leg plan.
- Determine which leg has the highest ridge. Draw this ridge line in plan completely through the intersection area. If the same leg on the other side of the intersection is different, this leg will butt into the end of the high ridge.





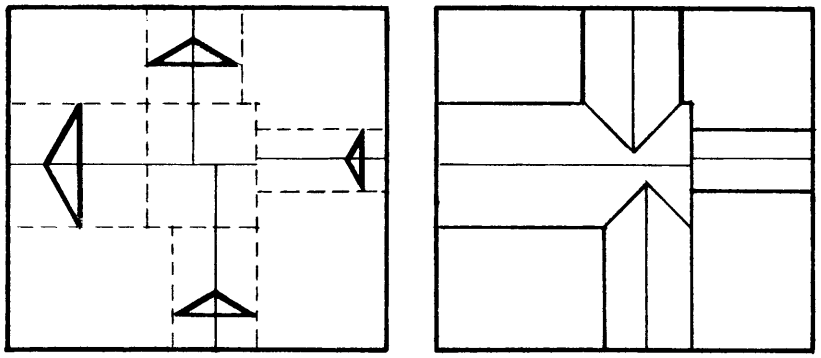




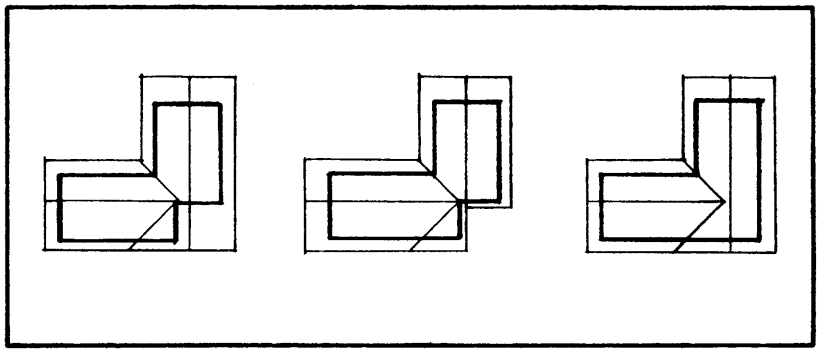


- Draw in the ridges of the legs which cross into the intersection up to the high ridge line.
- Draw in plan 45° valleys from the intersection points of the low edges of each pitched roof plane to the lower ridge line.
- This is the roof plan for this intersection.

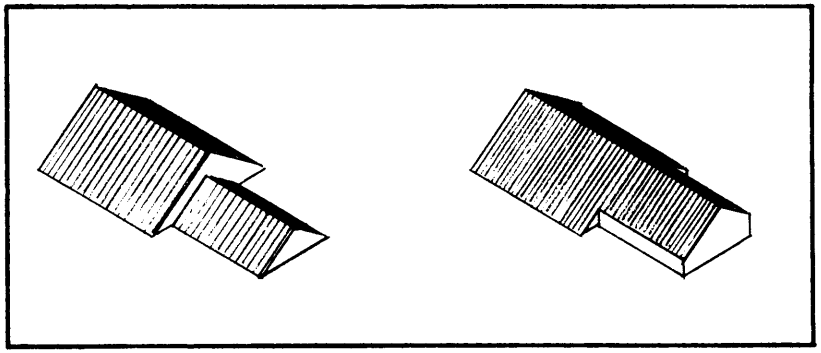
The same proceedure is repeated for the others.



- If there is a gap in any intersection, the assumptions given above will roof it over. You have several possibilities: retain the roof overhang for a porch; cut the roof back to what is necessary; enclose the gap to create more interior space.

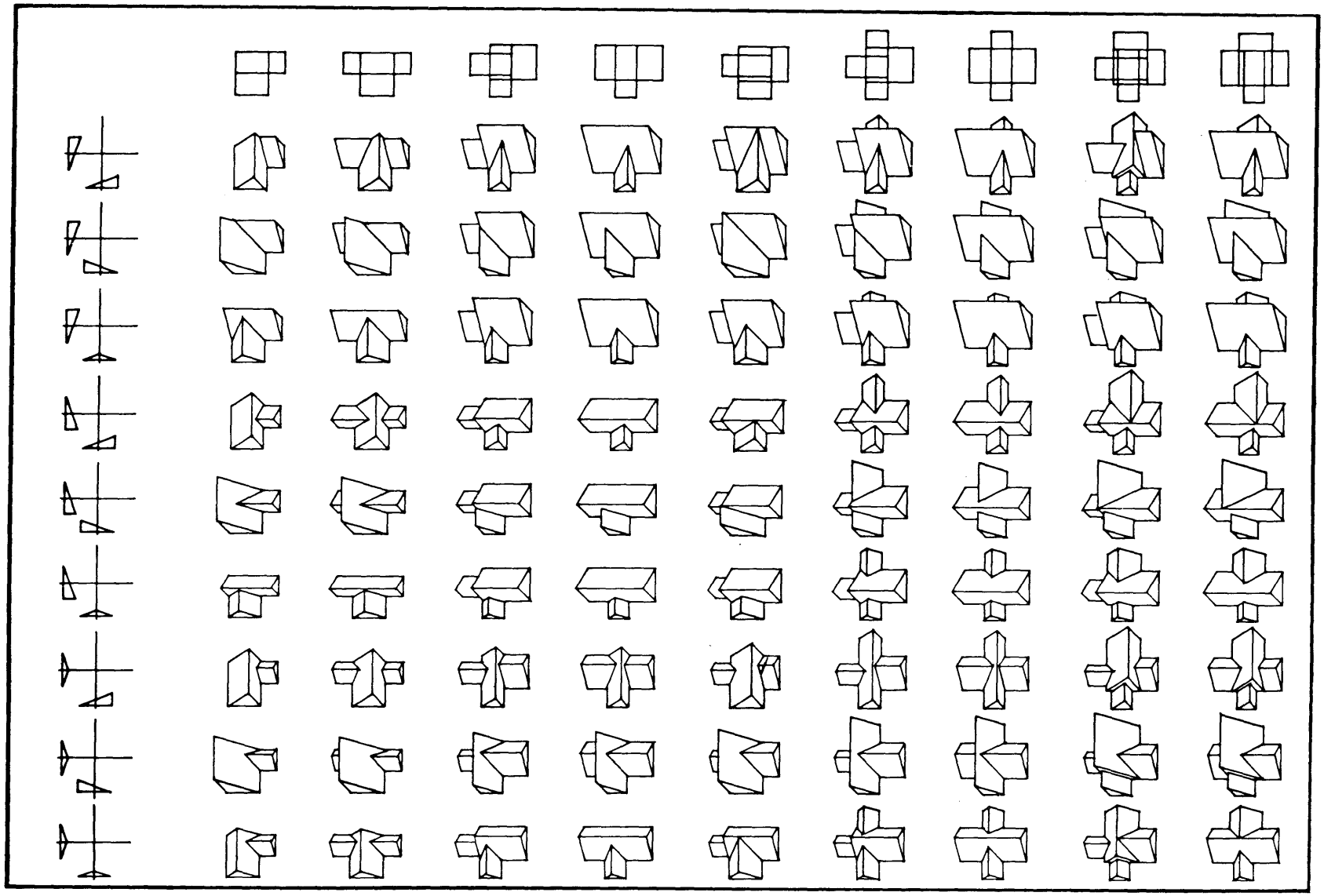


- If two areas abut each other end to end, they can take on different roof shapes, or one roof shape may extend over the other.

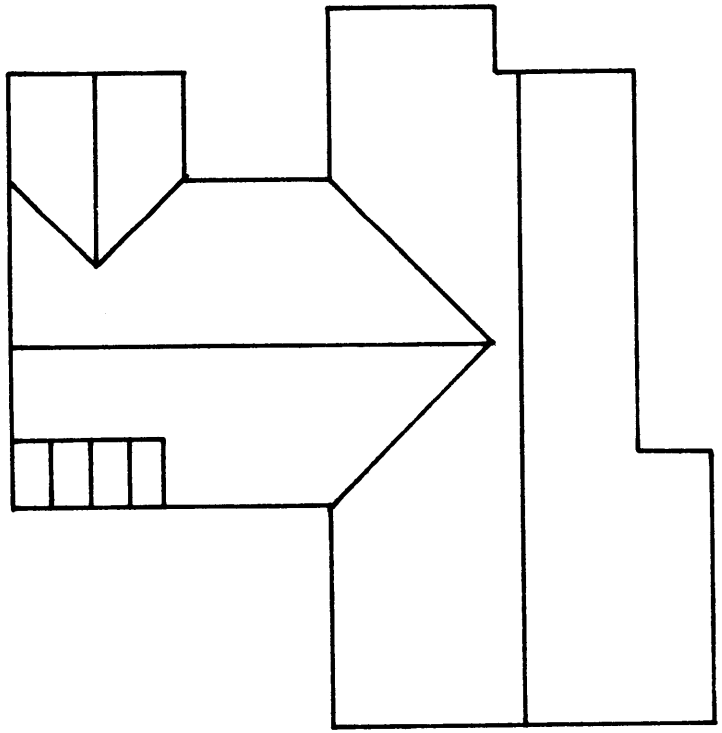


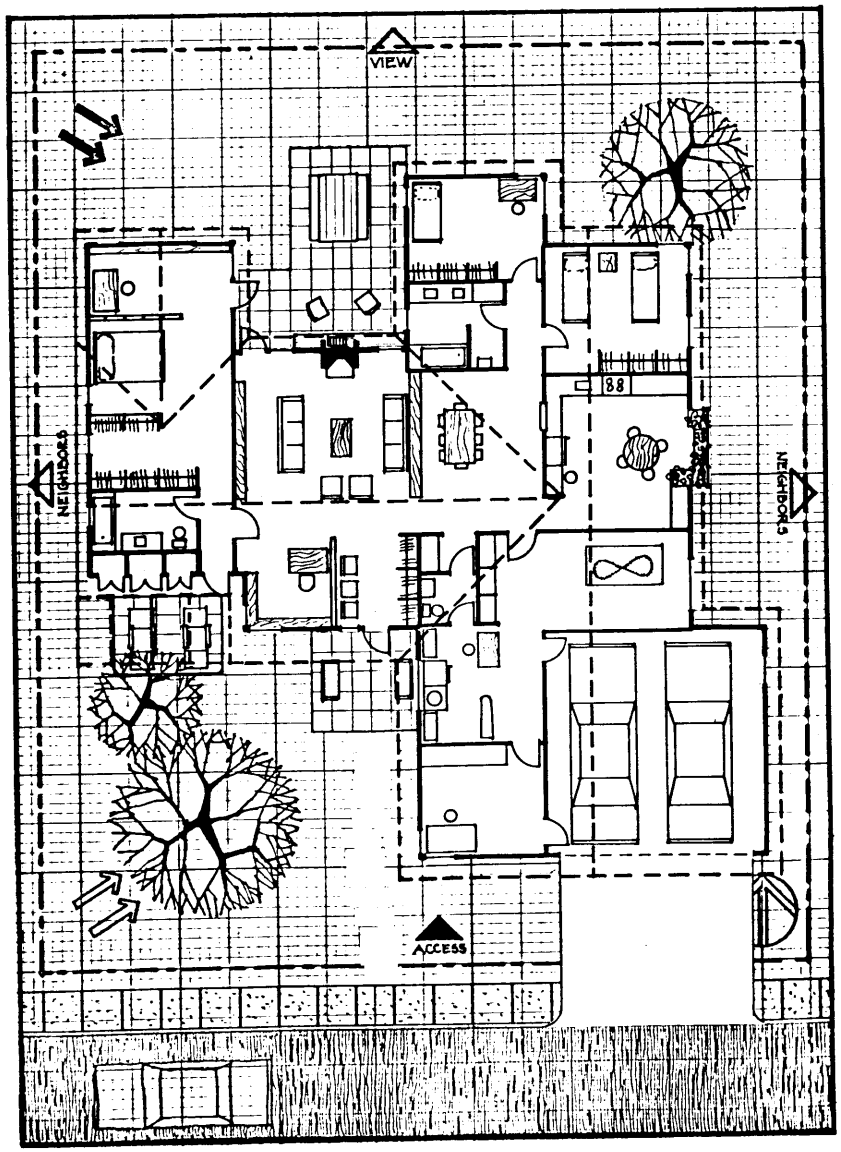
# Sloped Roofs: Intersections





The roof was laid out according to the directions given above. The highest roof was then cut away along the eastern and northern edges to more closely follow the exterior wall edge. The second highest roof was cut away over the sun porch but the framing was left for hanging plants or shades.





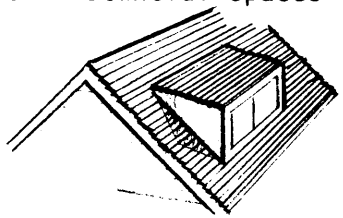
# 2.7 Expanding a House

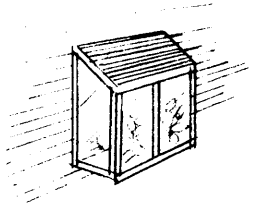


SUMMARY:
This step is useful after your house has been built and you become interested in expanding its size. Often people will start with a small house which suits their family size and budget only later to add more space. The basic house system is intended to expedite this later expansion.

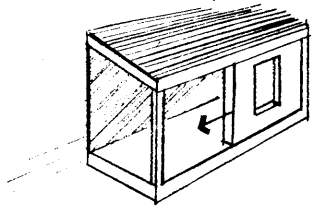
There are many reasons for expanding a house. Most of these reasons could be generalized as: needs created by an expanded family group; a desire for more comfortable and spacious living; a combination of both of the above. Typical types of expansion are: more living room space, additional family room, additional bedroom(s), exterior porches, garages, more kitchen space and more storage space.

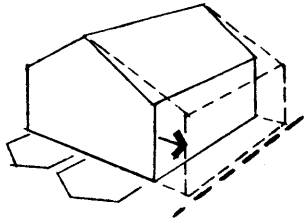
● The smallest addition is the add on element. This would be something on the scale of the margin infill spaces of step 2.4, such as bay windows, exterior storage, or a roof skylight which would add space for a loft. Such additions are characterized by a minimum affect upon the basic house structure, particularly foundations and roof. Their purpose is usually to enhance existing space use; they are not substantial spaces themselves.





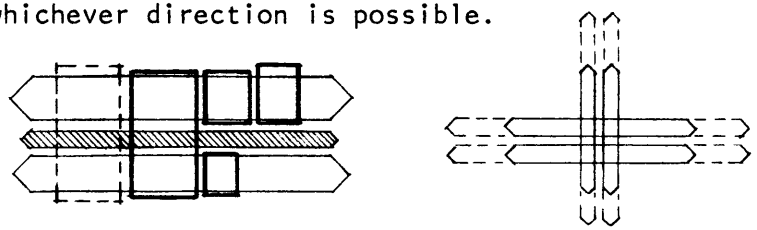
● Space expansion may also be done by transforming an exterior porch or garage into an interior room. This is perhaps the simplest and least expensive type of expansion possible. Similar types of expansion may occur downward into the basement or upward into the roof space.



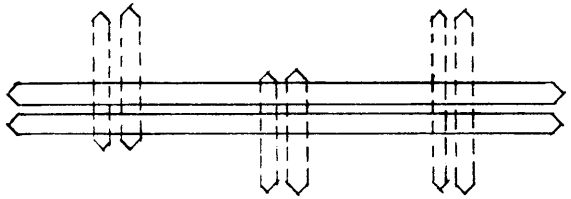


● Existing spaces can be pushed out sideways if they are not already extended to the outer margin limits. In most cases this extension would require additional foundation work and roof alterations. This means that the amount of additional space should warrant the expense. A minimum would be 6 feet out and along the entire length of an area.

● Large expansions should occur along zones. This type of expansion is unlimited and would proceed along the same lines as the design of the initial house. Circulation connectivity must be maintained which means that existing spaces in the initial house may need to be moved to allow it through to the new extention. The zones can be extended in whichever direction is possible.



● Large expansions may also be created by applying new cross zones to the existing pattern. Again, this would follow the established procedures.



● If you have pitched roofs, these must be considered when expanding space because they may control what can or can not be done. With an existing house, you must work backwards through step 6.2 to determine what spaces are allowable given the roofs which can be added to your existing structure.

SECTION 4

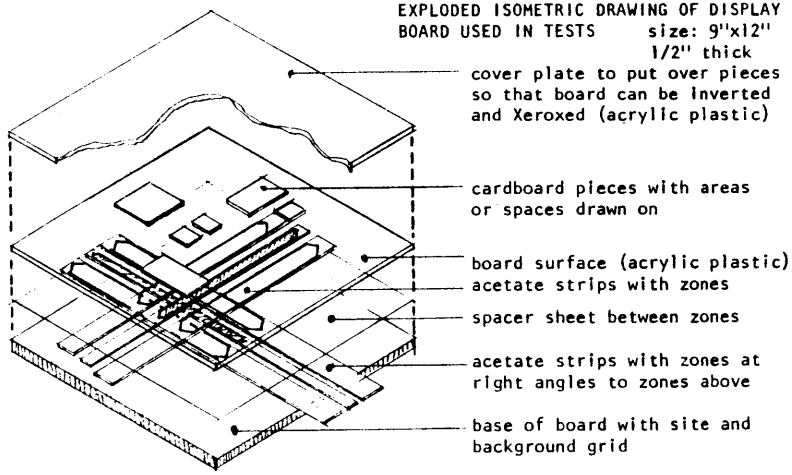
# TRIALS WITH PEOPLE

As was stated earlier, the system is complete enough so that a house can be designed by making decisions randomly within certain limits as described in section 3. During the development of the system I created approxiamately a dozen house designs which required very little time to actually make decisions; perhaps 15 minutes worth in addition to the time necessary to maipulate images on paper. The houses were all different and generally not like any I had designed without the system. Most interestingly, all seemed to be functional and several were better than many architected houses I have seen in their disposition of spaces and use of space.

Of course the ultimate goal was to test the system with other people. To enable me to do this within the time limits set for this thesis I was able to have four architecture students create their own house designs using the system. Because the system controls the design process, their individual design abilities were not tapped as might be expected, but their ability to understand graphical representation was important. I felt that this was needed to counter some of the graphical limitations of the system as I was able to develop it to this point.

I have have tried the system out on one non-architect or student who seemed to do as well or better with it than the architecture students.

Clearly a great deal of work could be done to test this system more carefully than has been possible so far, but the present section was inserted to give an indication that it is usable by some people.



# George's House



## people

- The house is designed for two couples.
- An occasional guest(s) may stay over night.

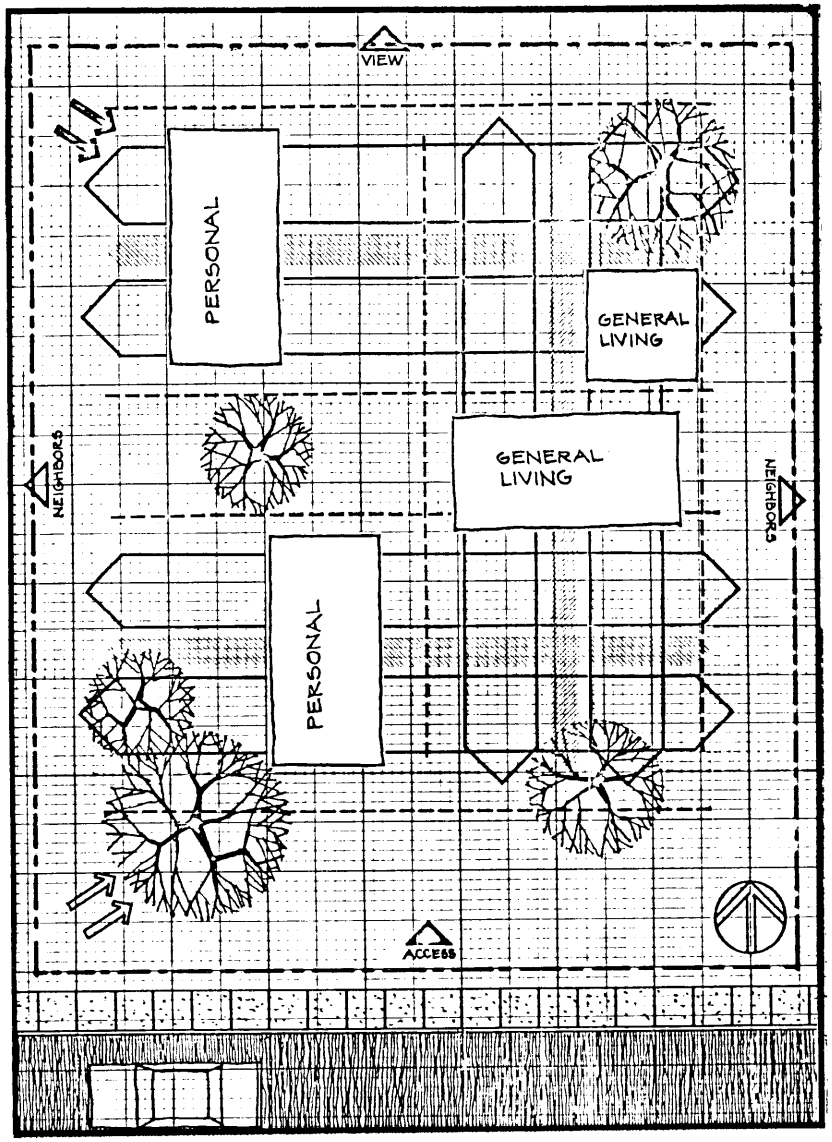
## location

- Boulder, Colorado
- Site: 3/4 acre at the edge of town

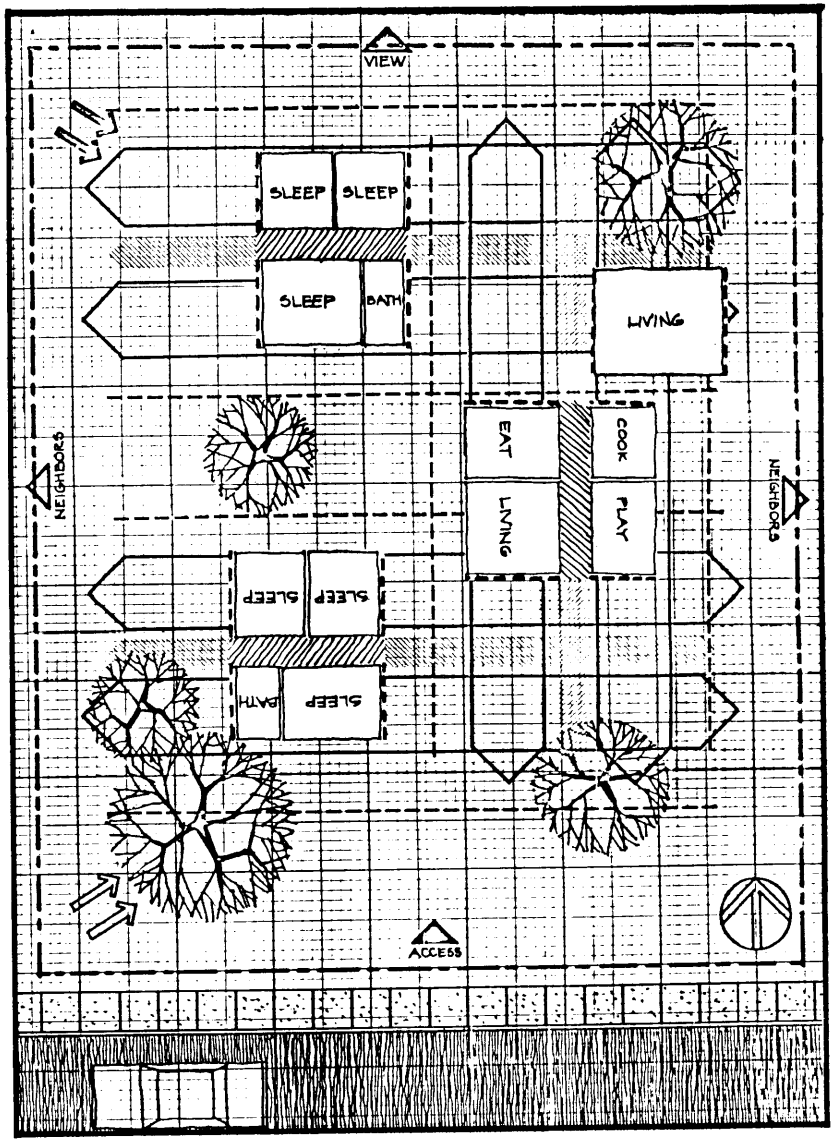
## intentions

- Both couples share common spaces for cooking, eating, formal living, T.V. and working.
- Each person has his or her own study.
- Space is needed to throw large parties.
- A good woodworking shop is needed.

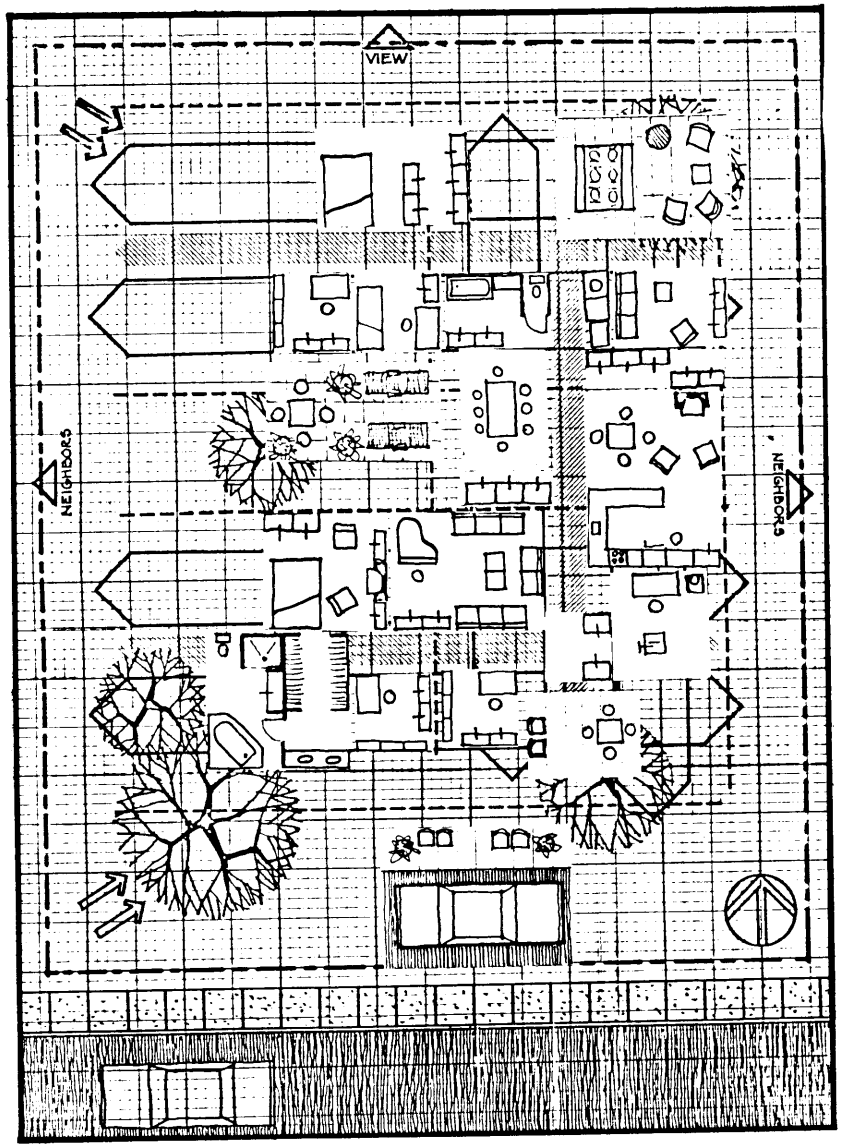
## Step 1


VIEW
PERSONAL
GENERAL LIVING
GENERAL LIVING
PERSONAL
NEIGHBORS
NEIGHBORS
ACCESS

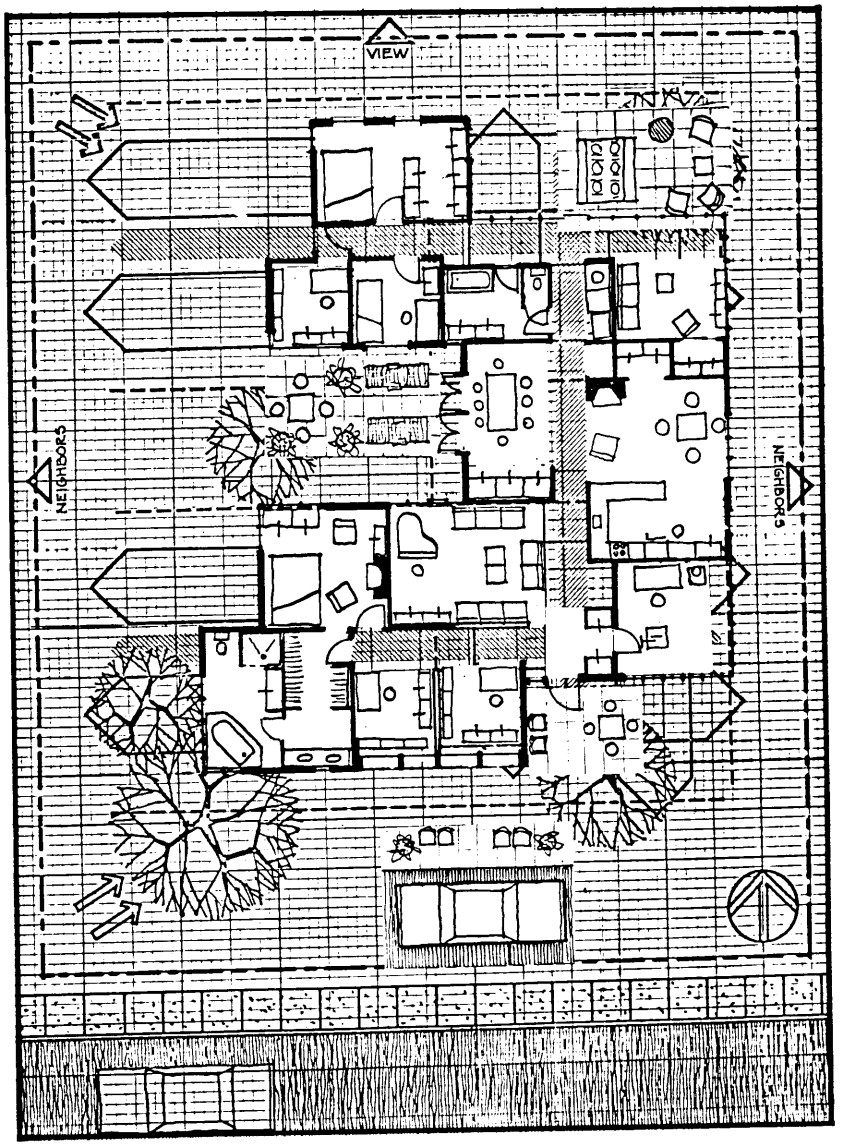
## Step 2


VIEW
SLEEP
SLEEP
SLEEP
BATH
LIVING
EAT
COOK
LIVING
PLAY
SLEEP
SLEEP
BATH
SLEEP
NEIGHBORS
NEIGHBORS
ACCESS

## Steps 3-6



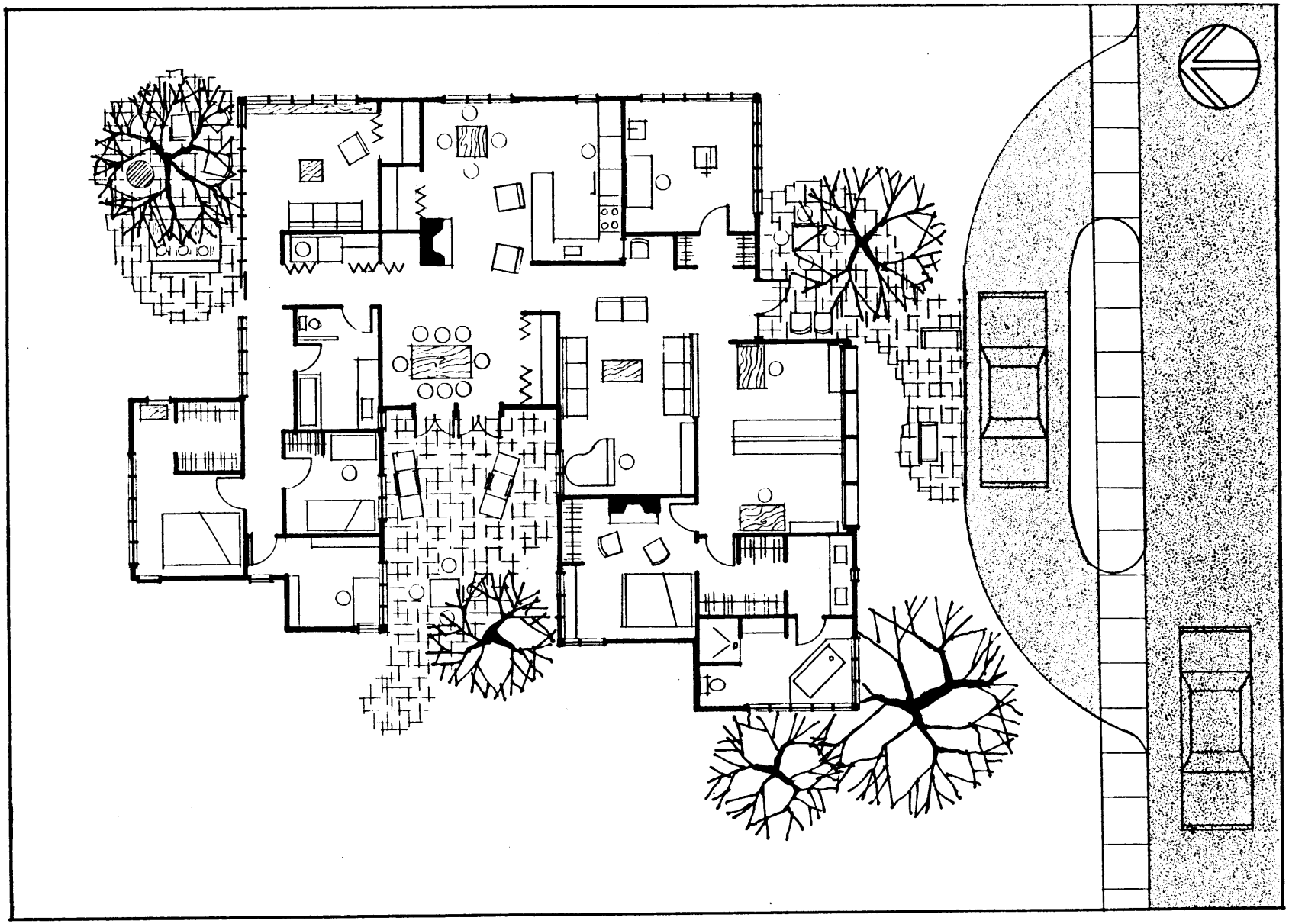

## Step 7



# Adjusted Plan

5 10 20 30 40 50

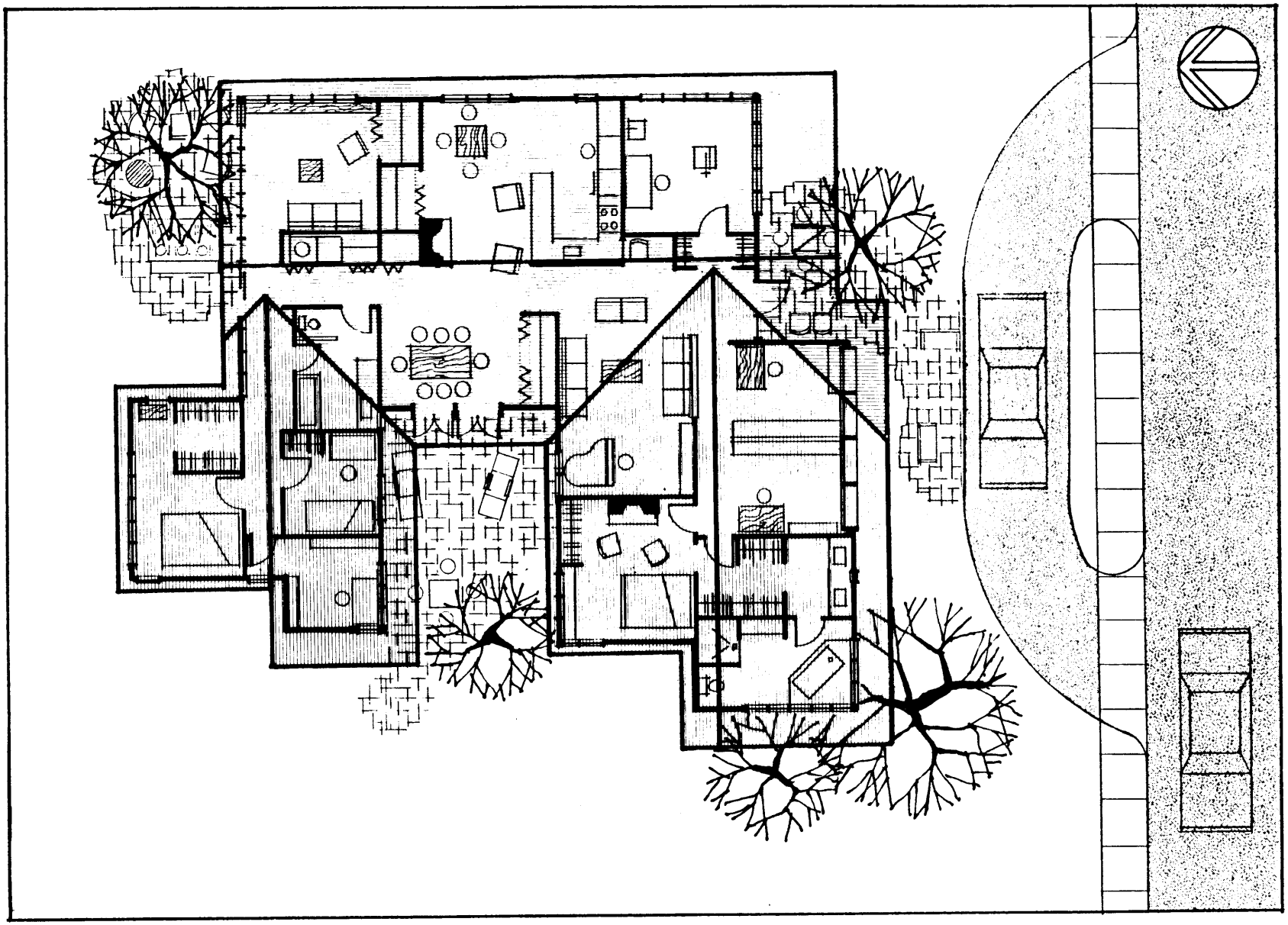


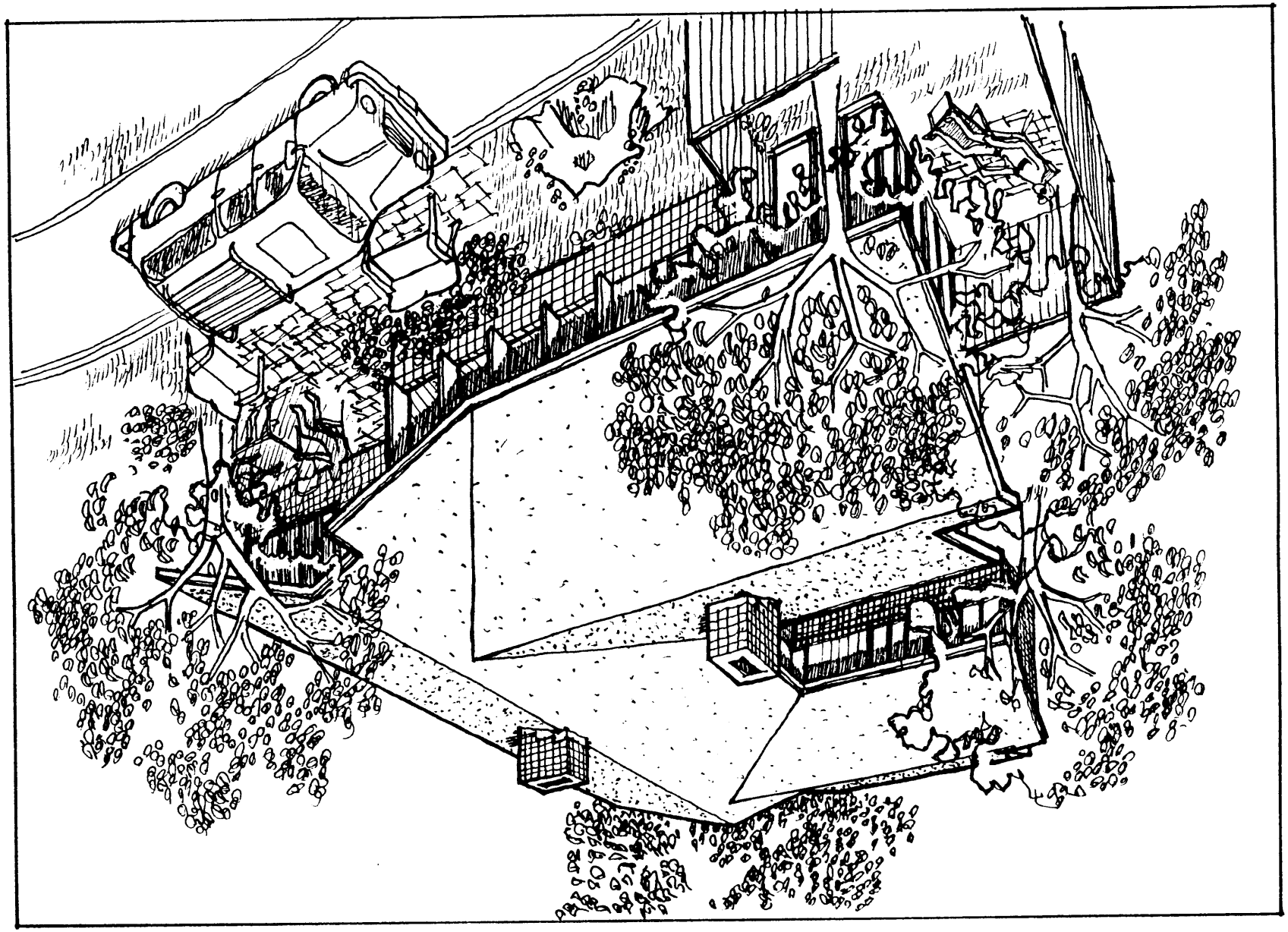


# Step 8

5 10 20 30 40 50







# Mindy's House



## people

- This house is intended for a suburban husband and wife, one son and a daughter.
- Periodically a stepson comes to stay and may choose whichever spare bedroom is available.

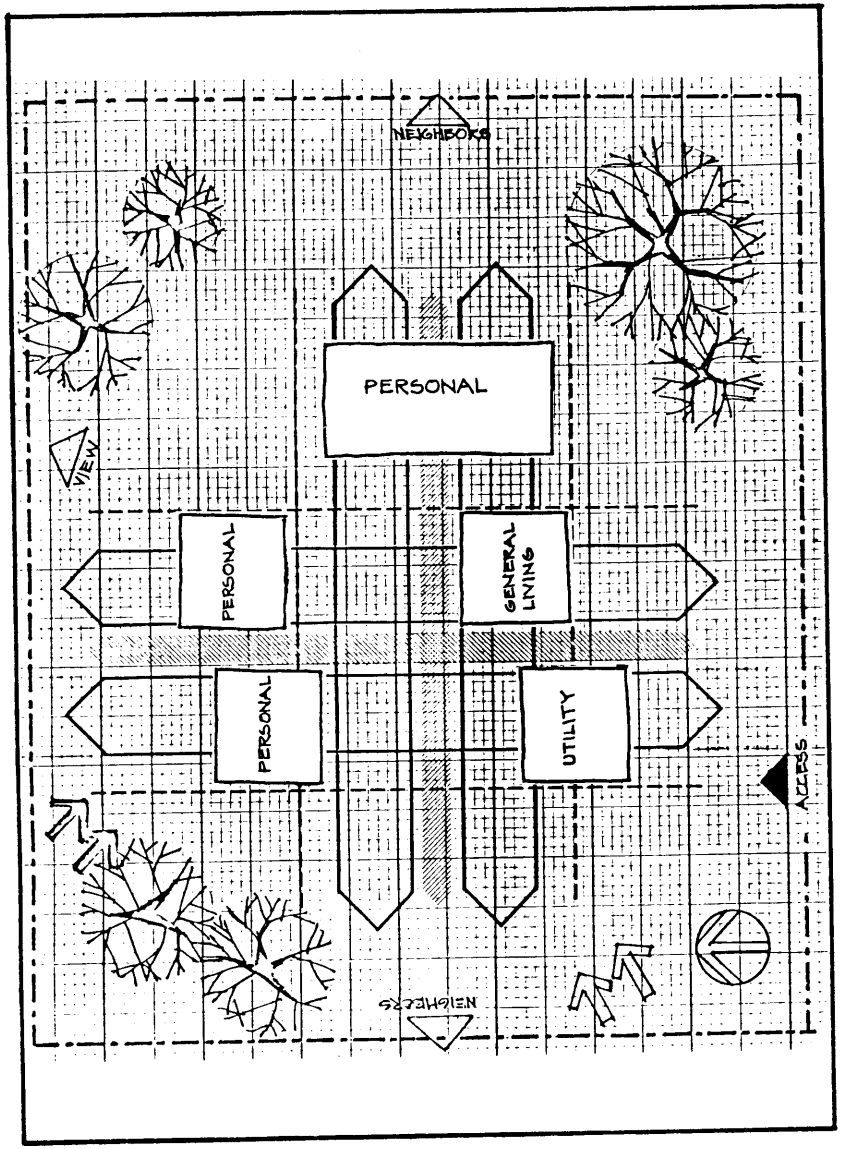
## location

- Wellesley, Massachusetts
- Site: 1/2 acre in a pleasant residential area.

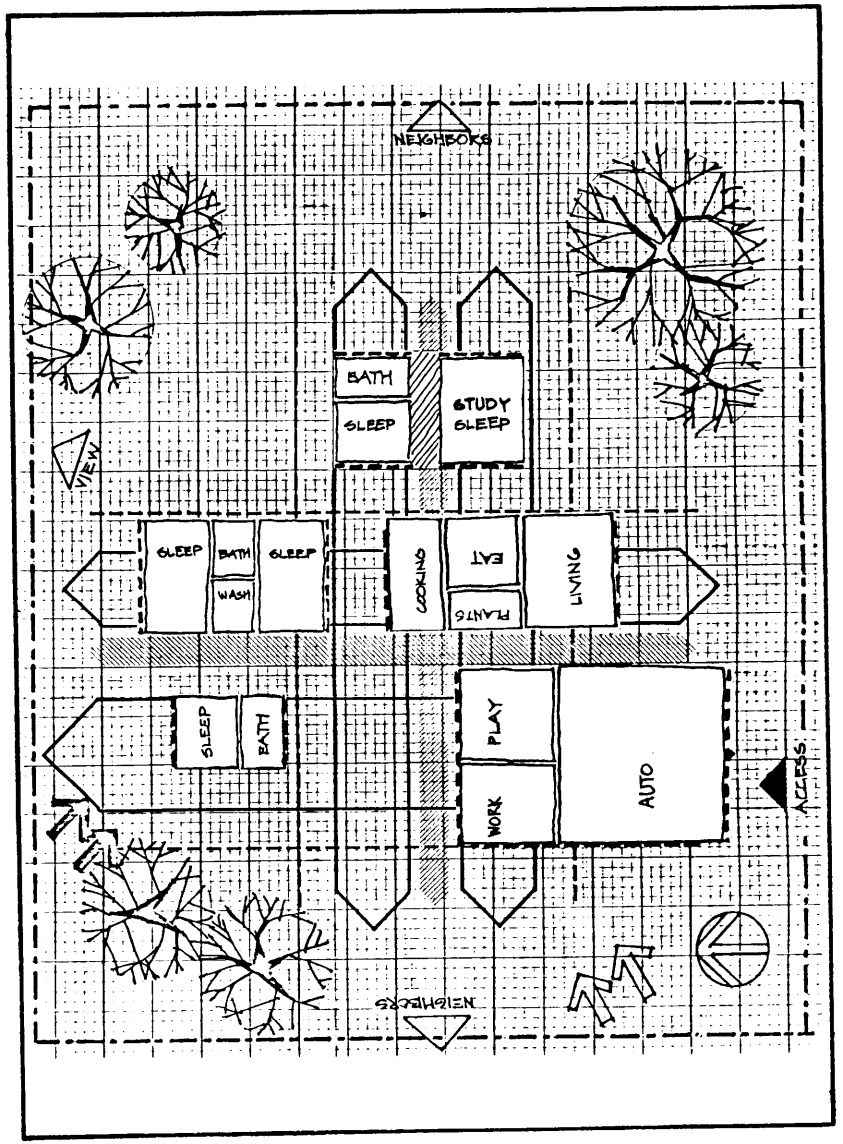
## intentions

- Provide enough space for everyone.
- Interior greenery is very important.
- Provide many exterior decks or patios to be accessible from many rooms in the house.
- Use sliding walls to open or close off some spaces when desired (like a Japanese house).

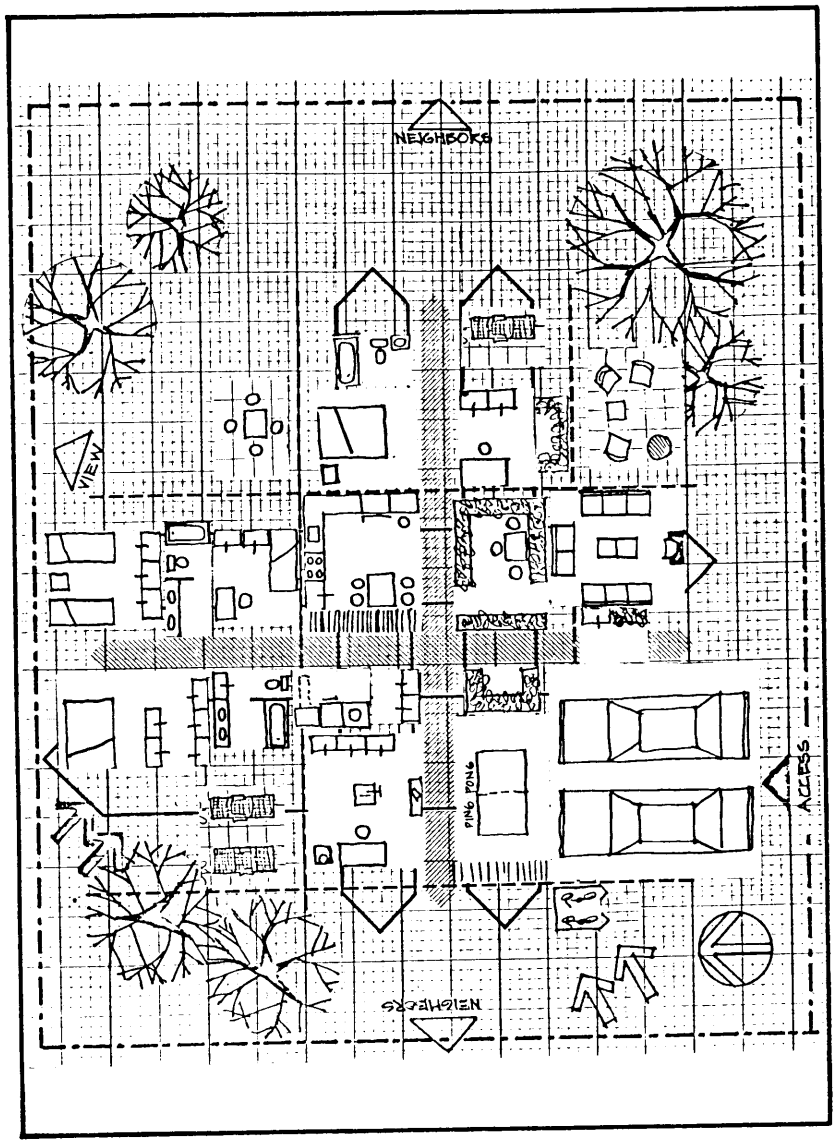
## Step 1


NEIGHBORS
PERSONAL
VIEW
PERSONAL
GENERAL LIVING
PERSONAL
UTILITY
ACCESS
NEIGHBORS

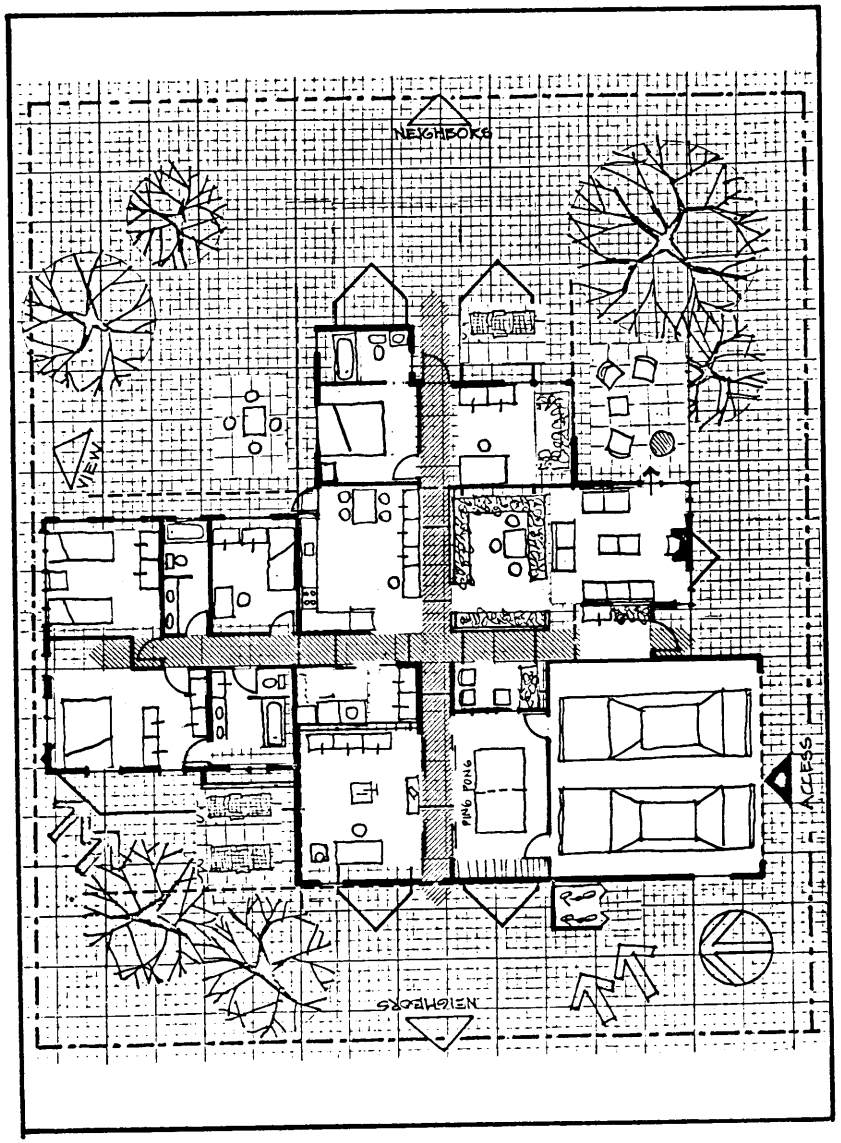
## Step 2


NEIGHBORS
BATH
SLEEP
STUDY SLEEP
VIEW
SLEEP
BATH
WASH
SLEEP
COOKING
EAT
PLANTS
LIVING
SLEEP
BATH
PLAY
WORK
AUTO
ACCESS
NEIGHBORS

## Steps 3-6



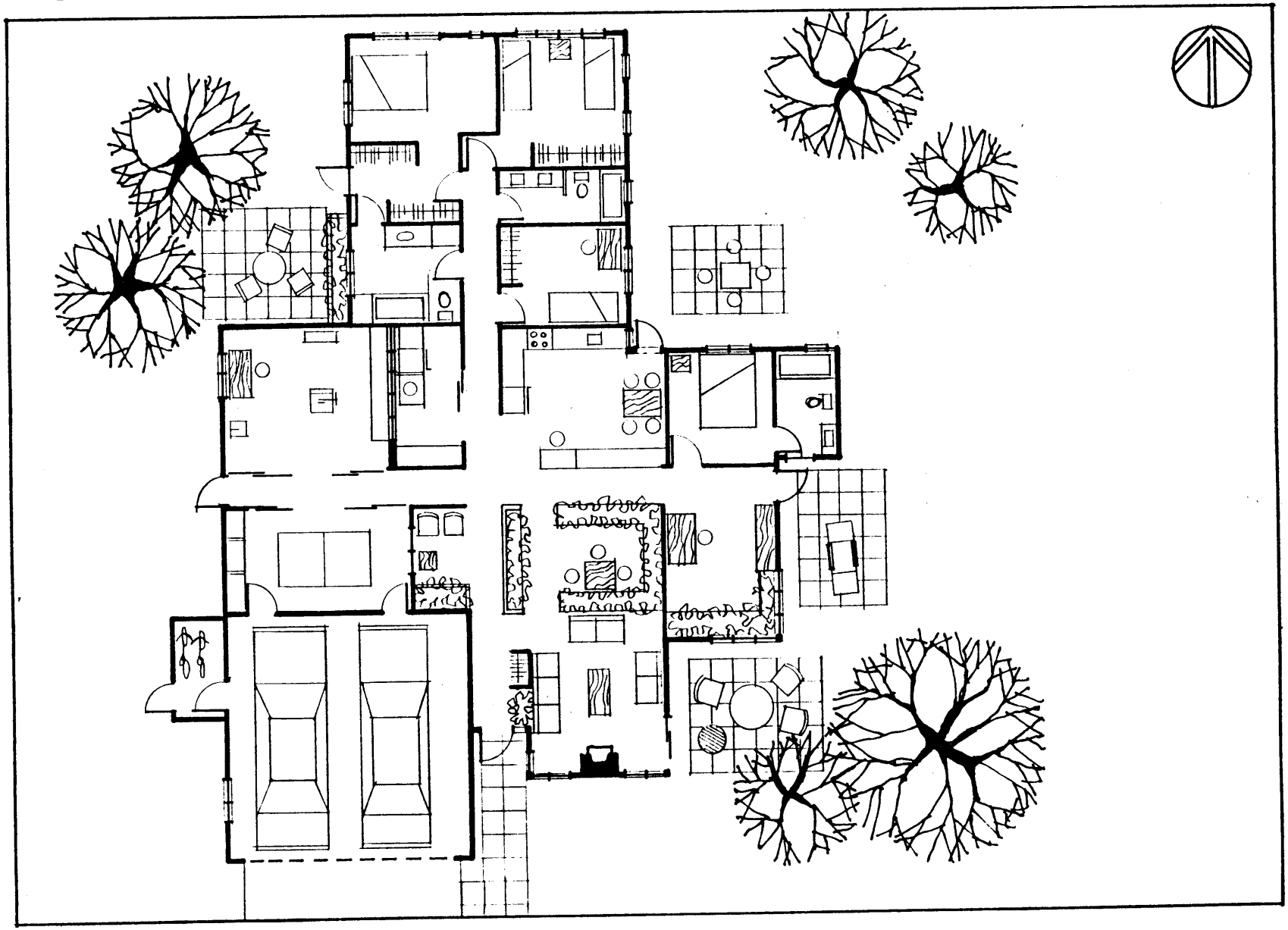

## Step 7



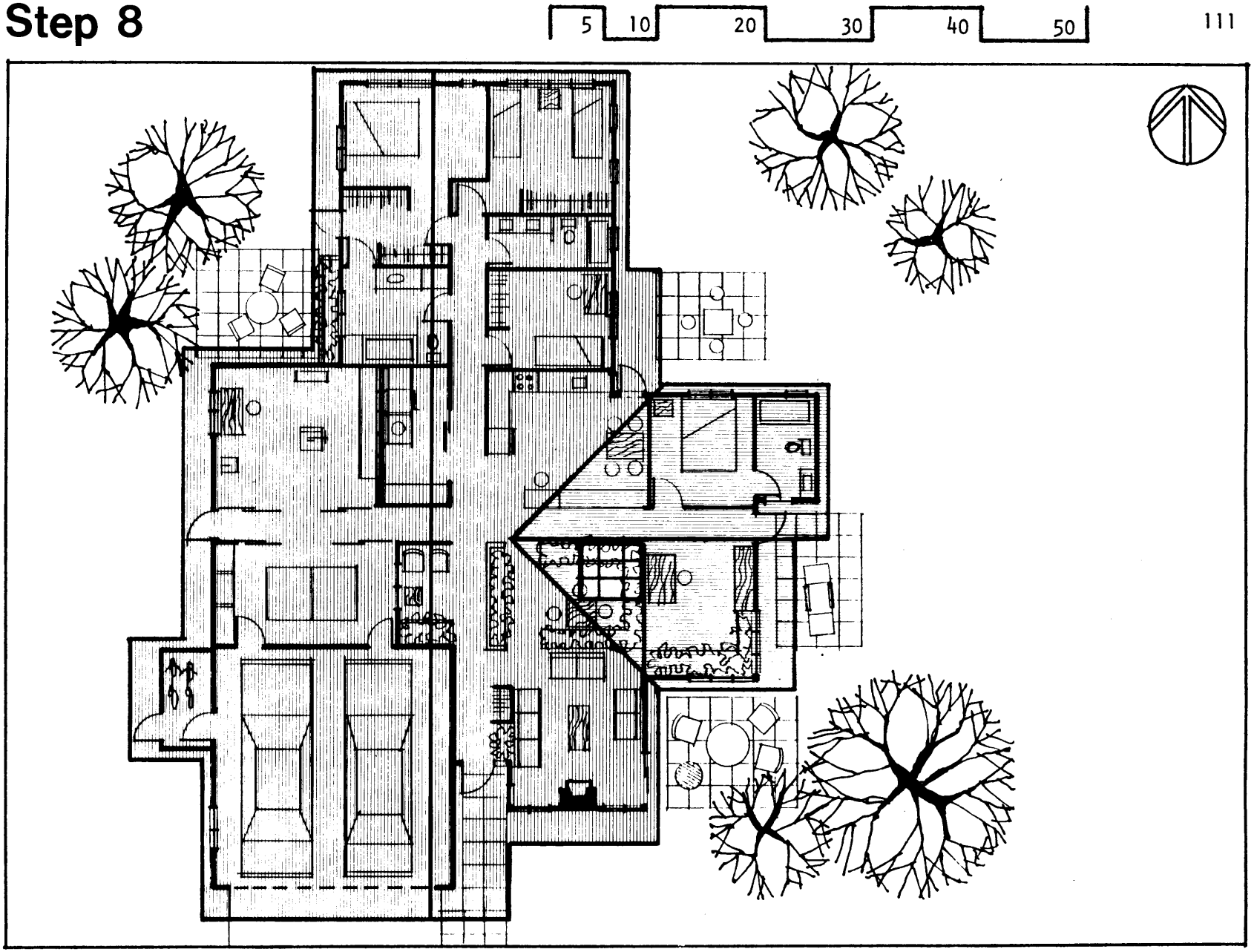
# Adjusted Plan

5 10 20 30 40 50





# Step 8



# Alison's House



## people

- Three generations live in this house: two grandparents, two parents and two children.

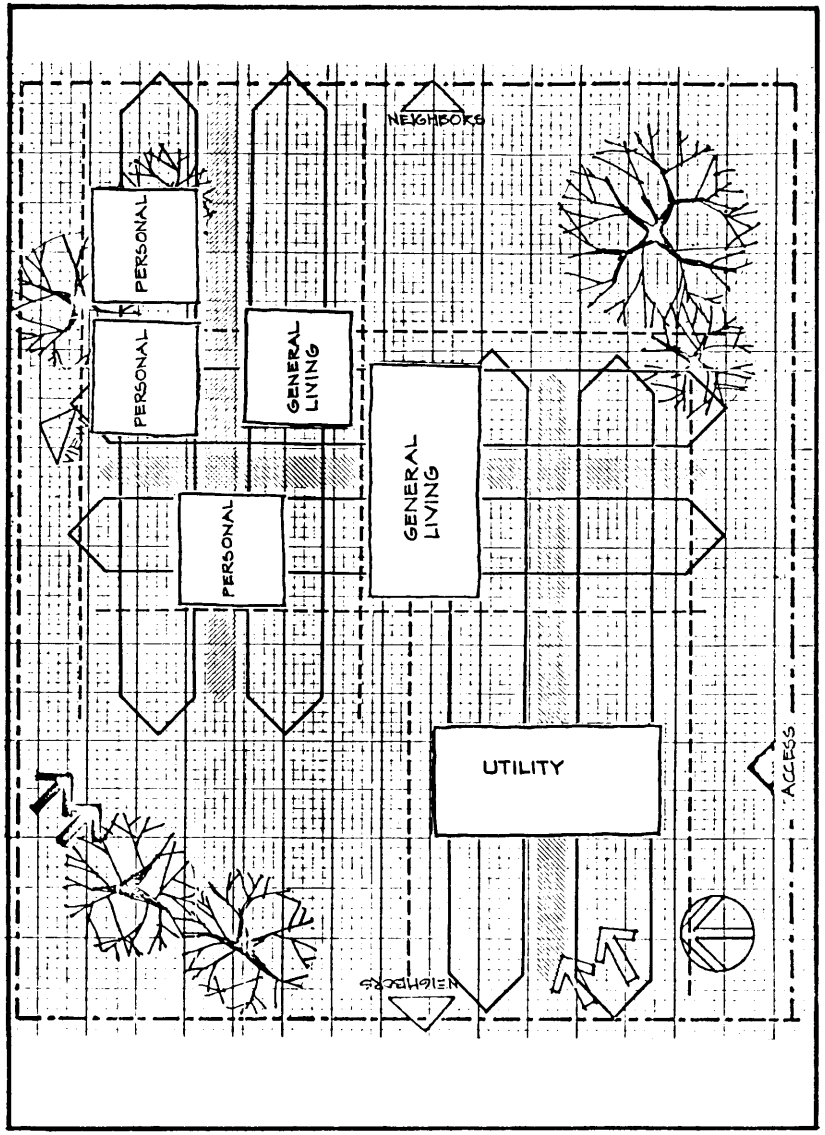
## location

- Cambridge, Massachusetts
- Site: 1/6 acre in an older residential area with similar lot sizes.

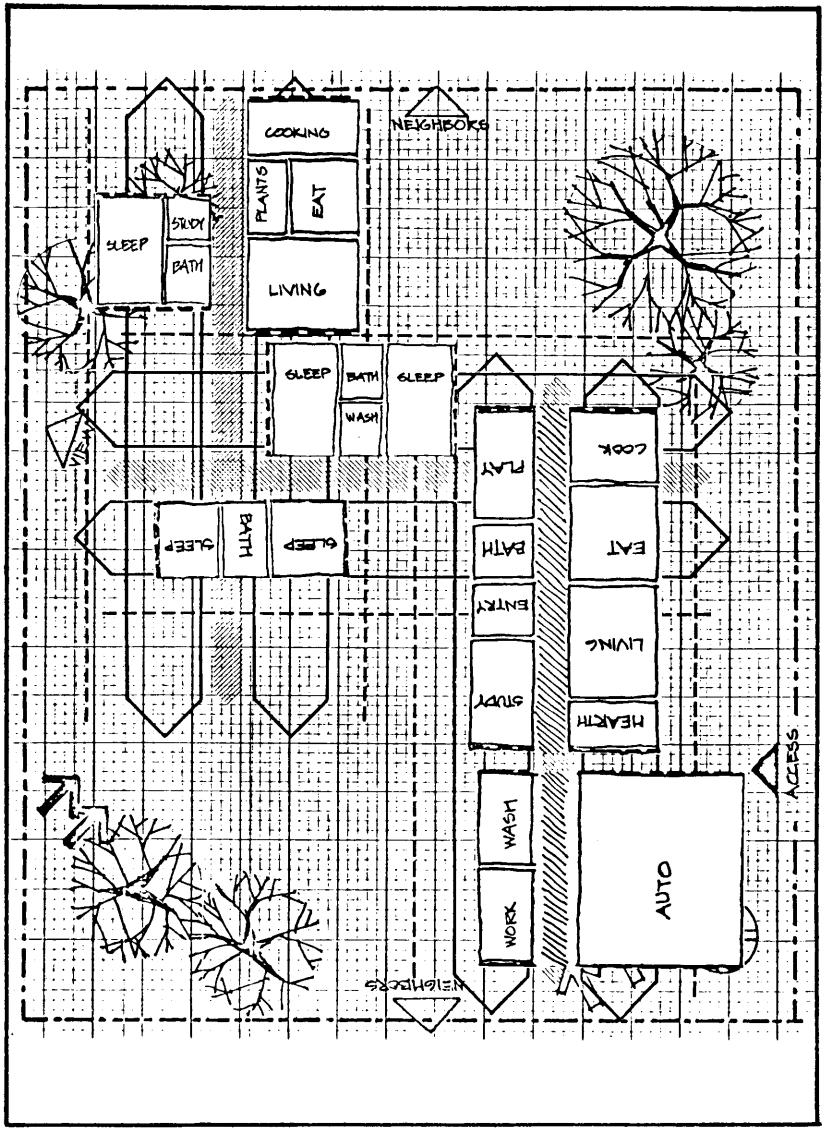
## intentions

- A separate living area was desired for the grandparents.
- An interior greenhouse marks the division between the grandparents wing and the rest of the house.

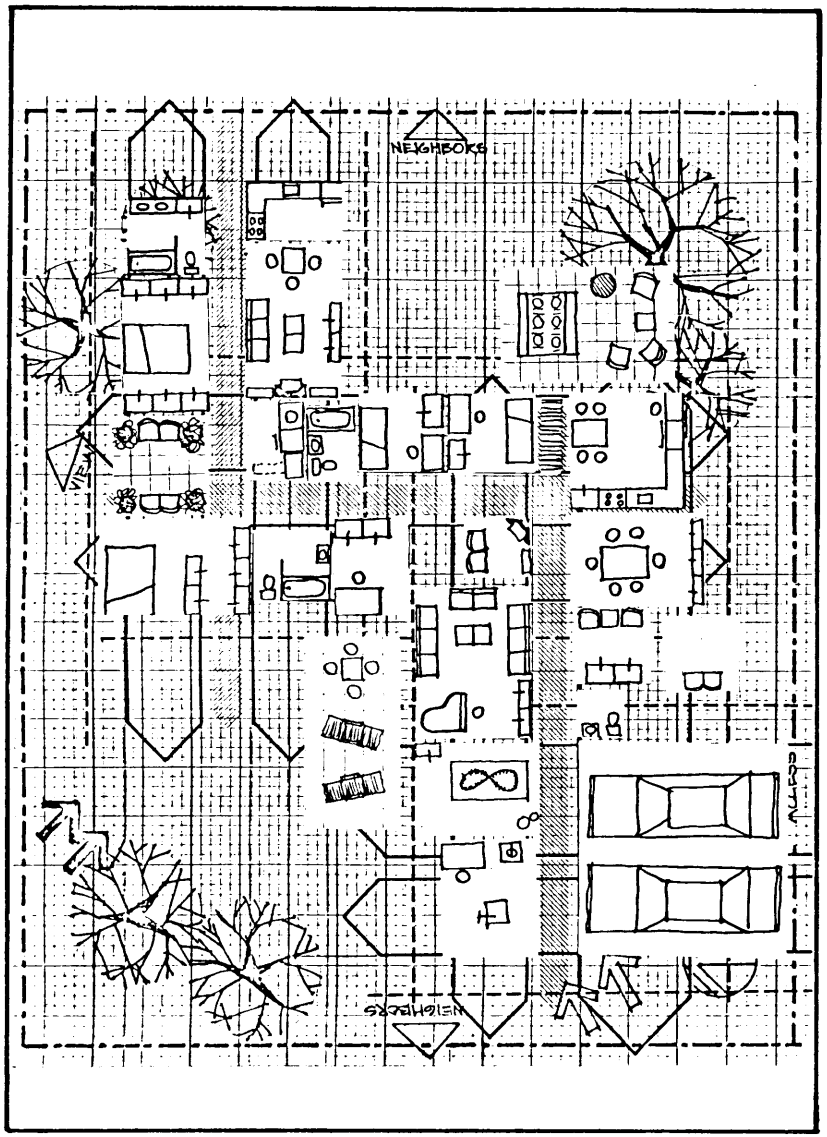
## Step 1


NEIGHBORS
PERSONAL
PERSONAL
GENERAL LIVING
GENERAL LIVING
PERSONAL
UTILITY
ACCESS
NEIGHBORS

## Step 2

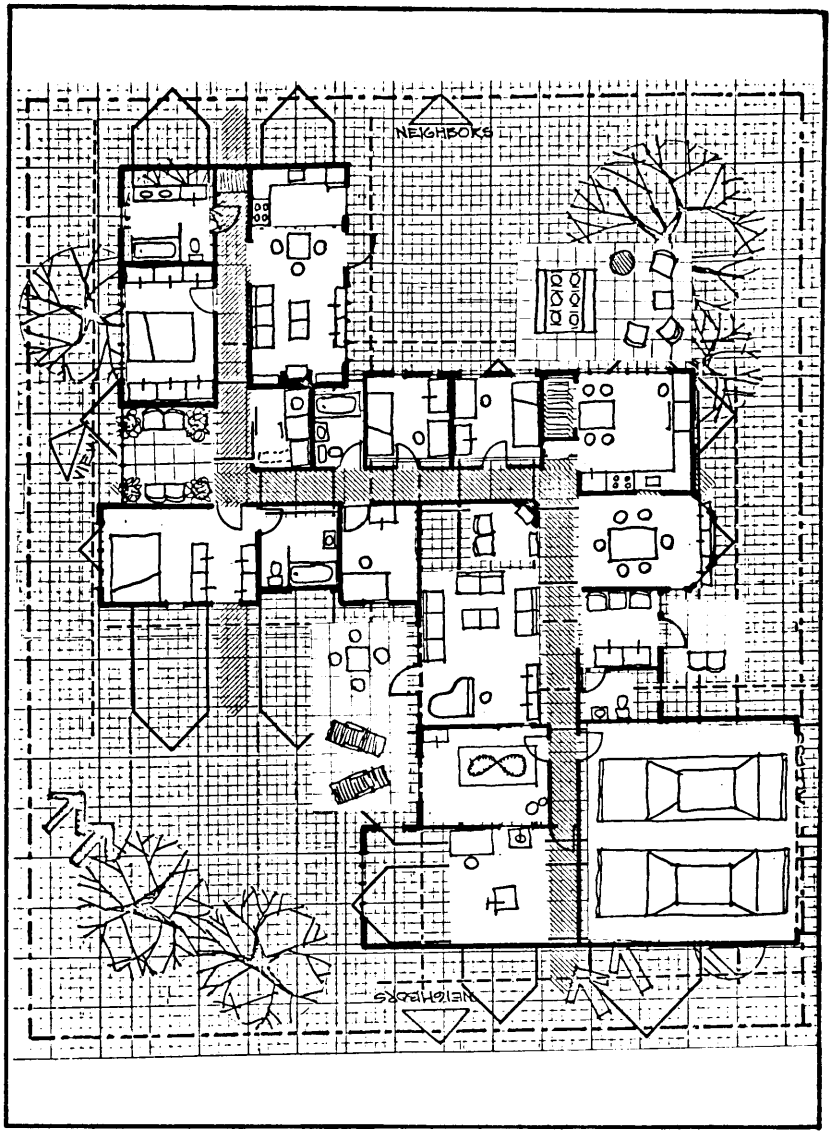

NEIGHBORS
COOKING
PLANTS
EAT
SLEEP
STUDY
BATH
LIVING
SLEEP
BATH
WASH
SLEEP
SLEEP
BATH
SLEEP
PLAY
BATH
ENTRY
STUDY
WASH
WORK
COOK
EAT
LIVING
HEARTH
AUTO
ACCESS
NEIGHBORS

# Steps 3-6




# Step 7





# Adjusted Plan

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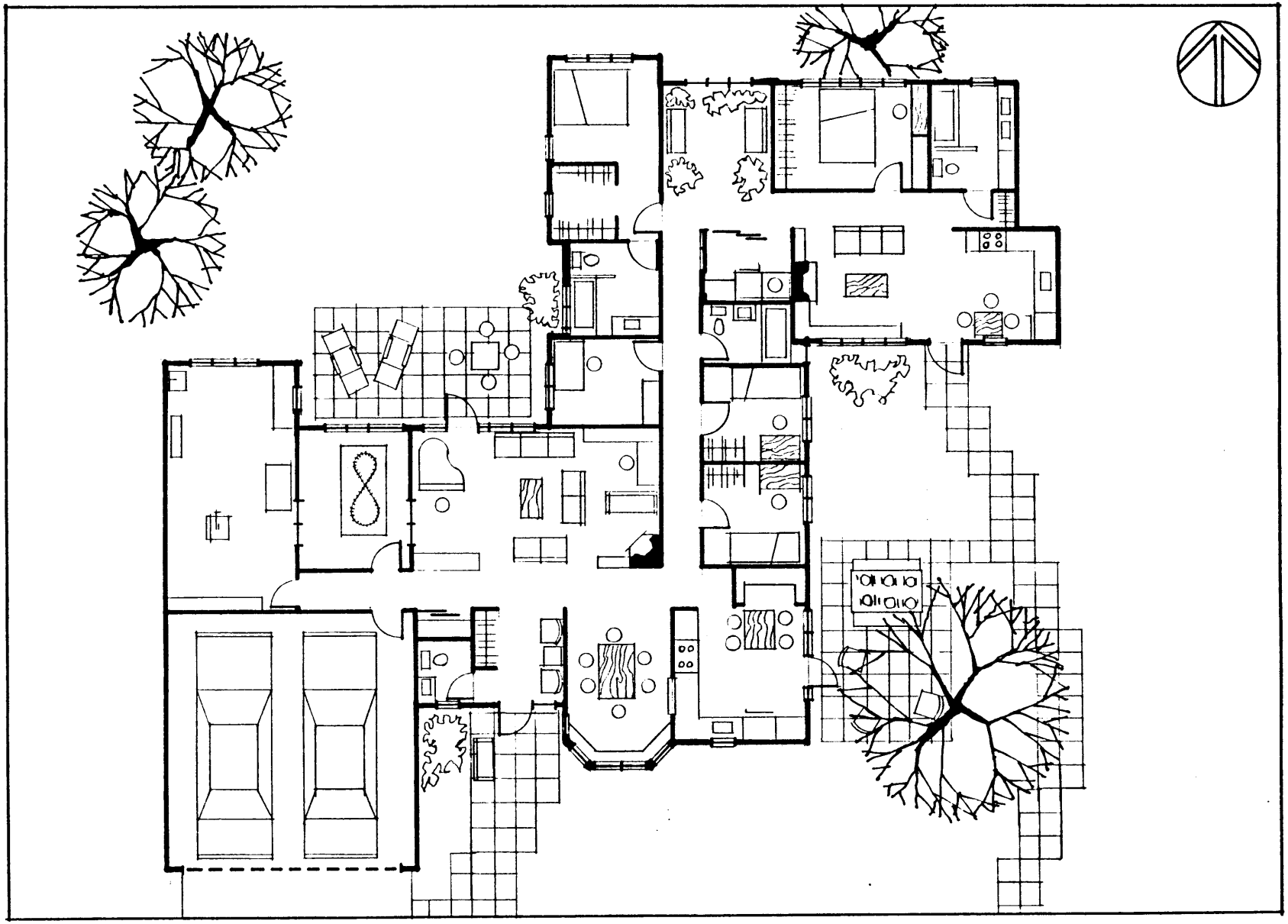
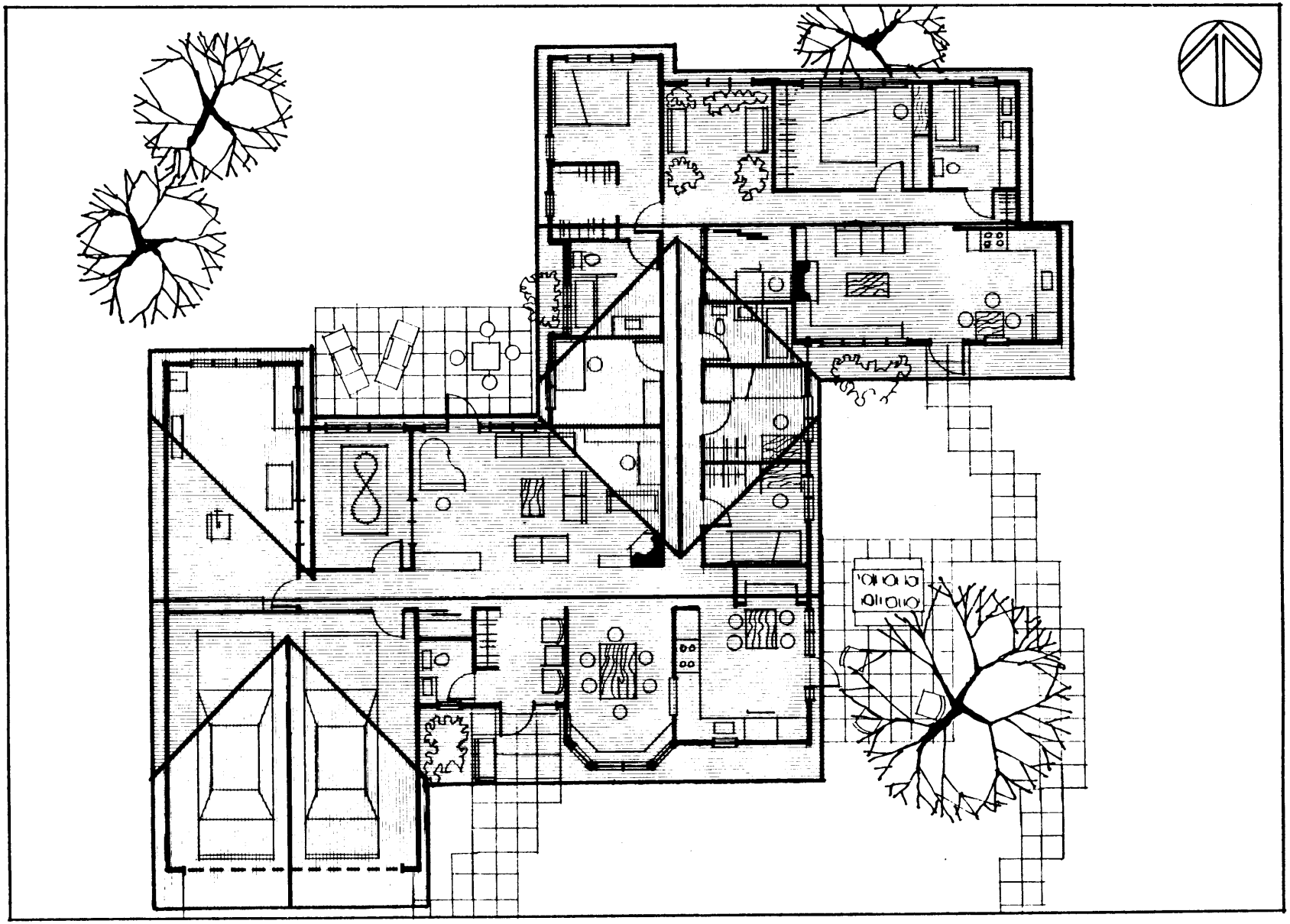


# Step 8





# Robert's House



## people

- This house is intended for a man and a woman to live in year-round.
- Occasional guests are expected, especially for the ski season.

## location

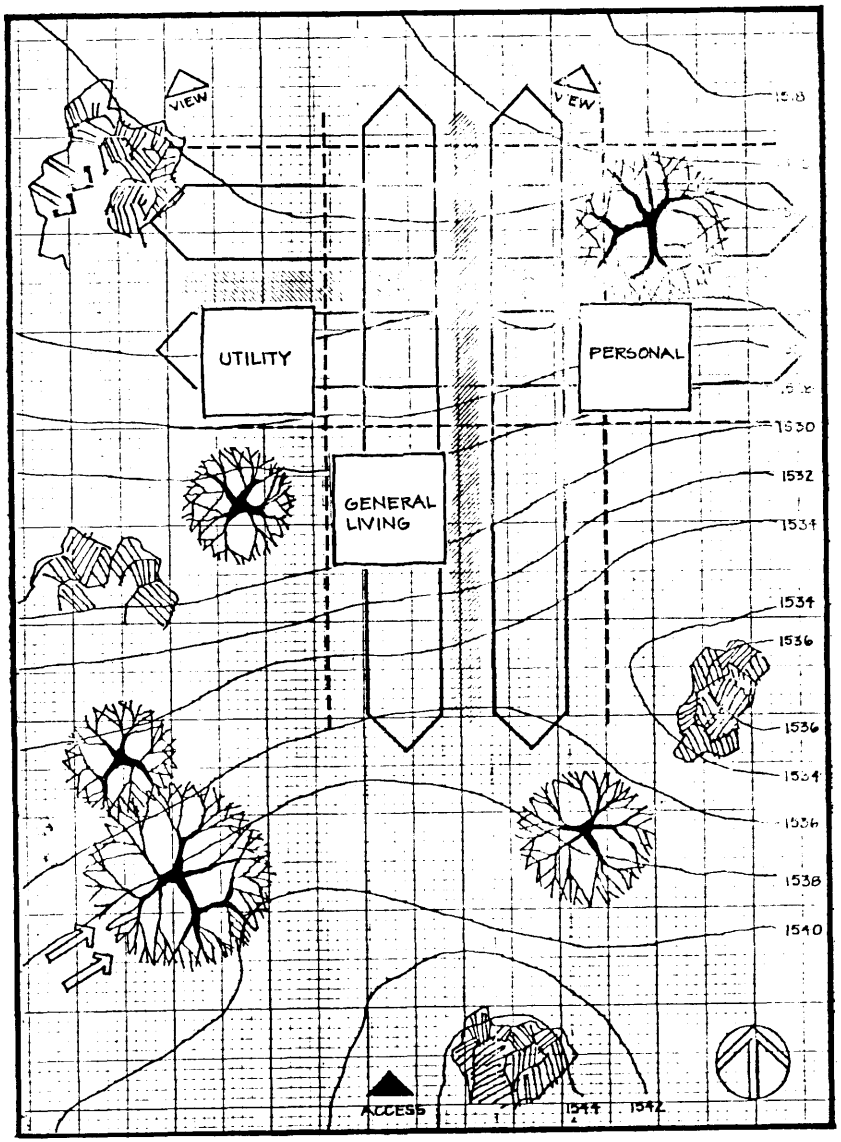
- Jackson, New Hampshire

* site: 4 acres, accessible by footpath from a nearby road.

## intentions

- The greenhouse is for solar gain and winter vegetable growing.
- Interior walls are made of rubble masonry for thermal storage.
- Most of the glass on the exterior walls is situated on the south and east and is provided with roof overhangs to control the summer sun.

## Step 1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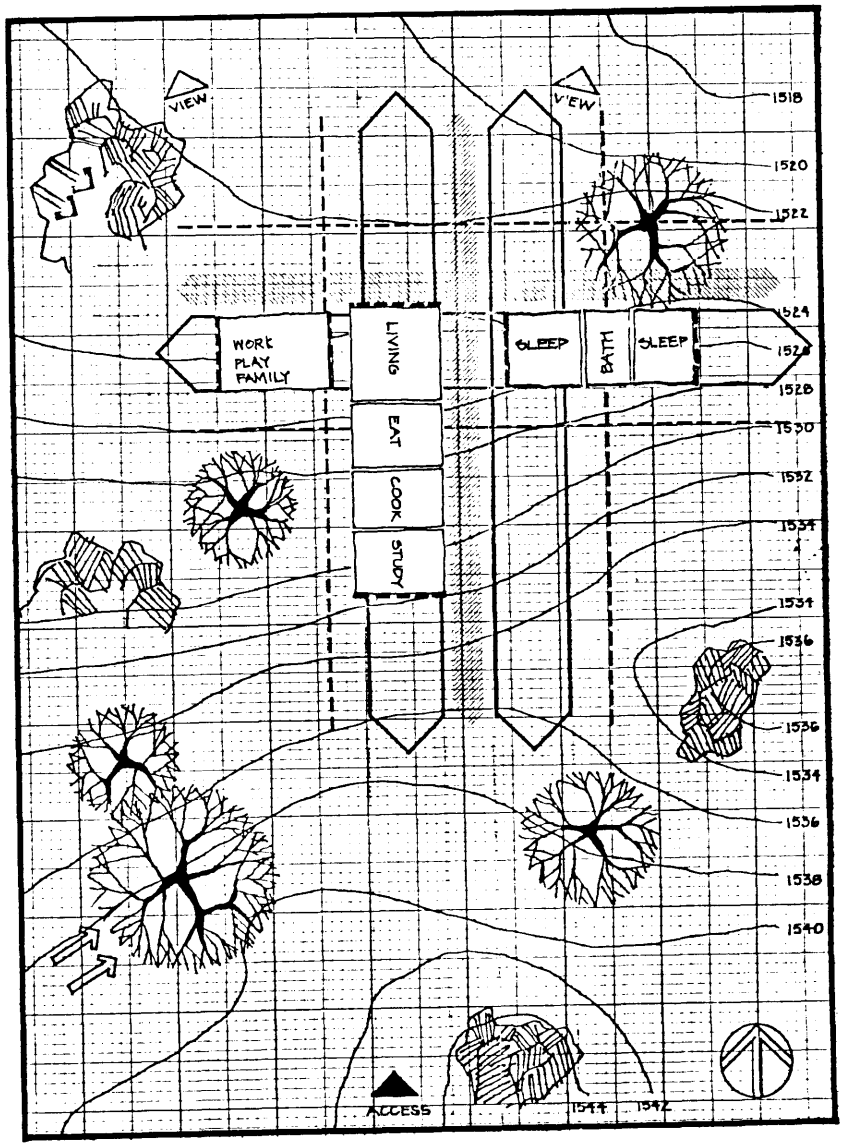
## Step 2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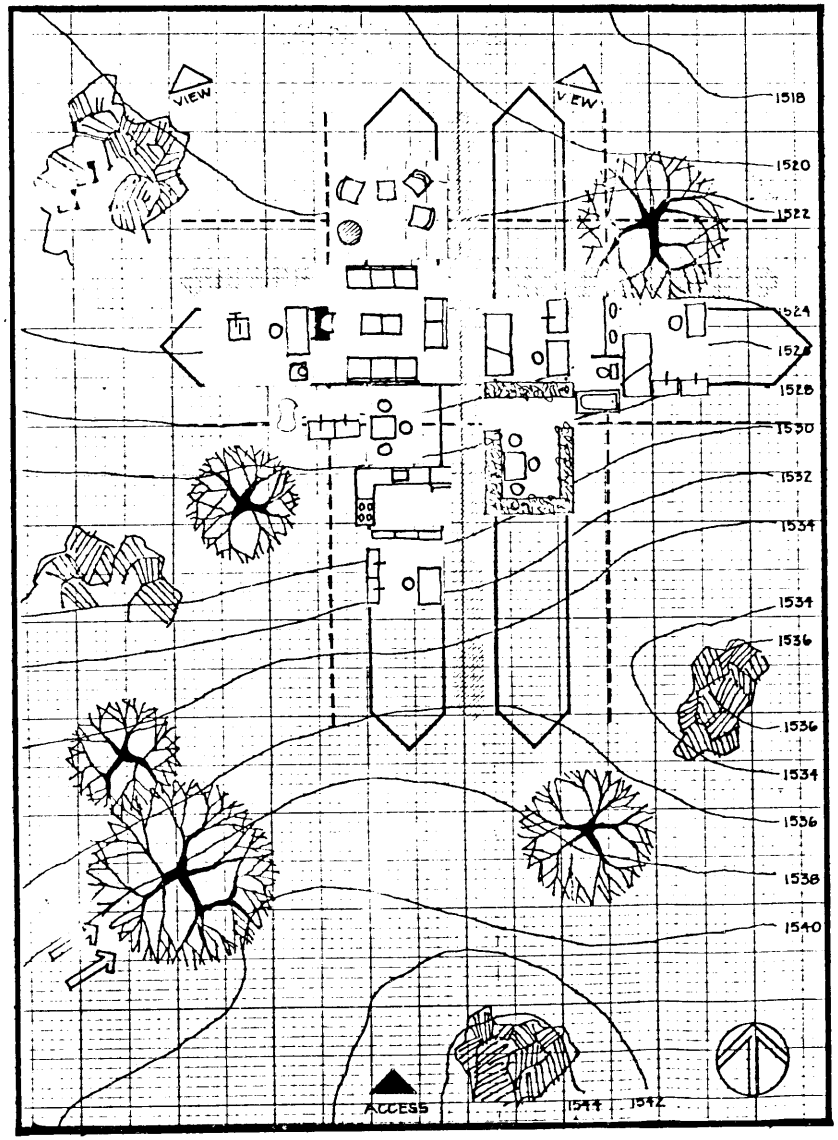
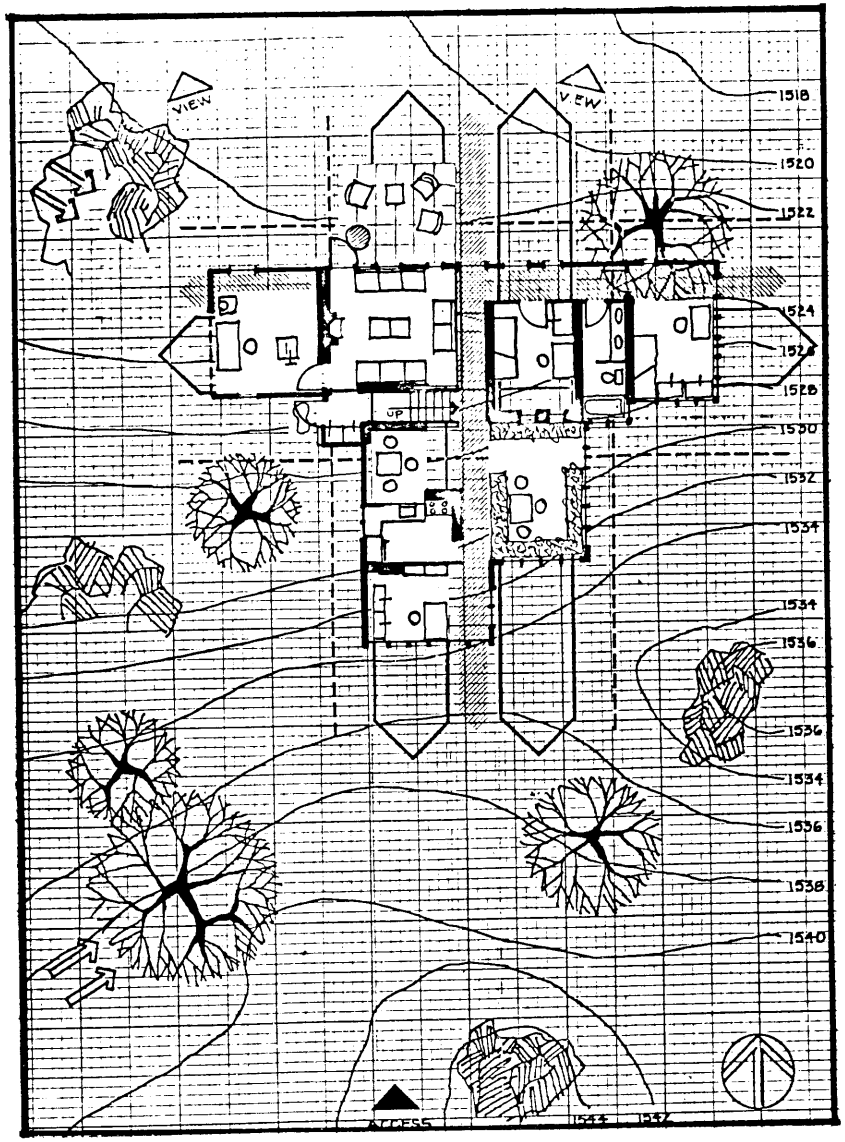
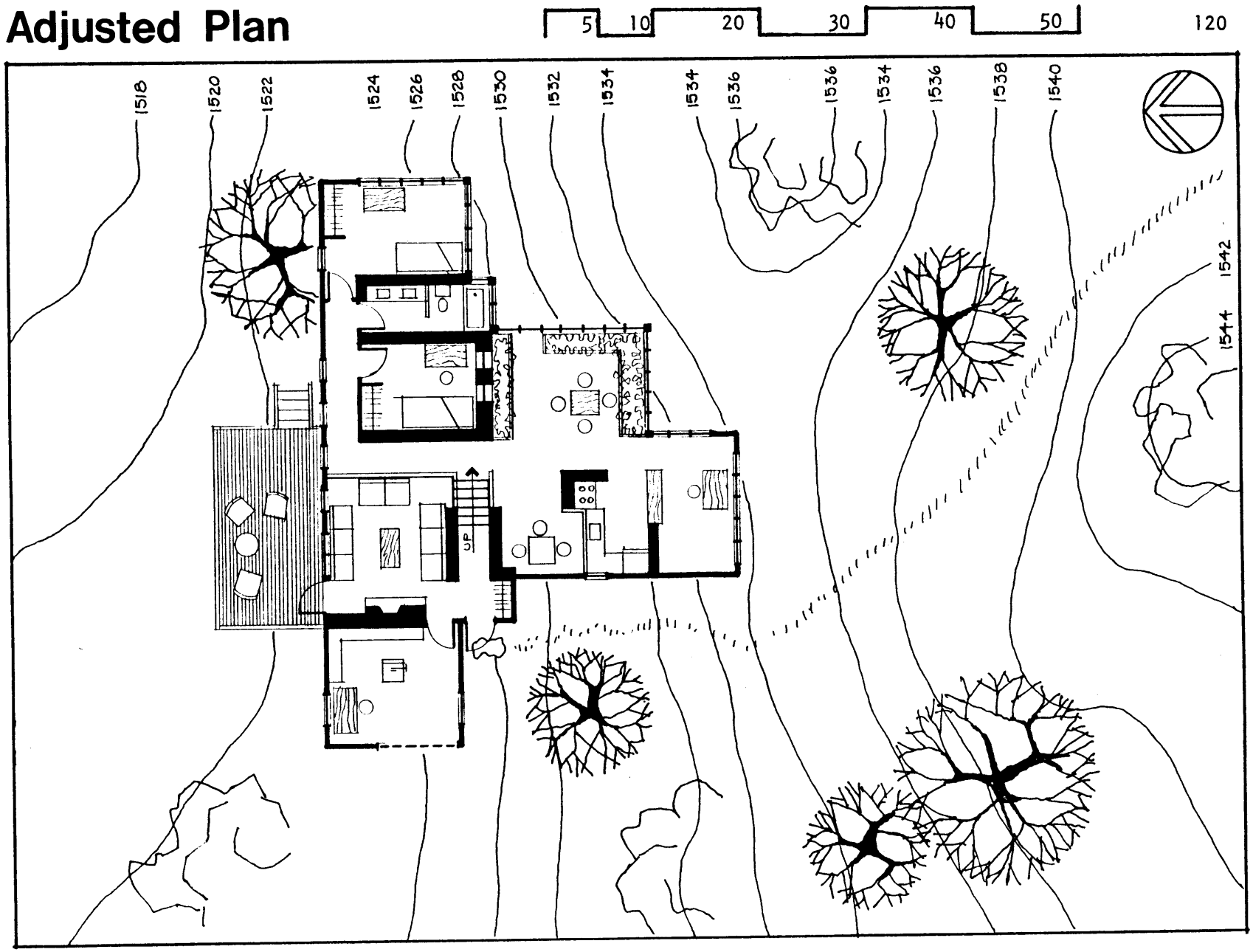
## Steps 3-6



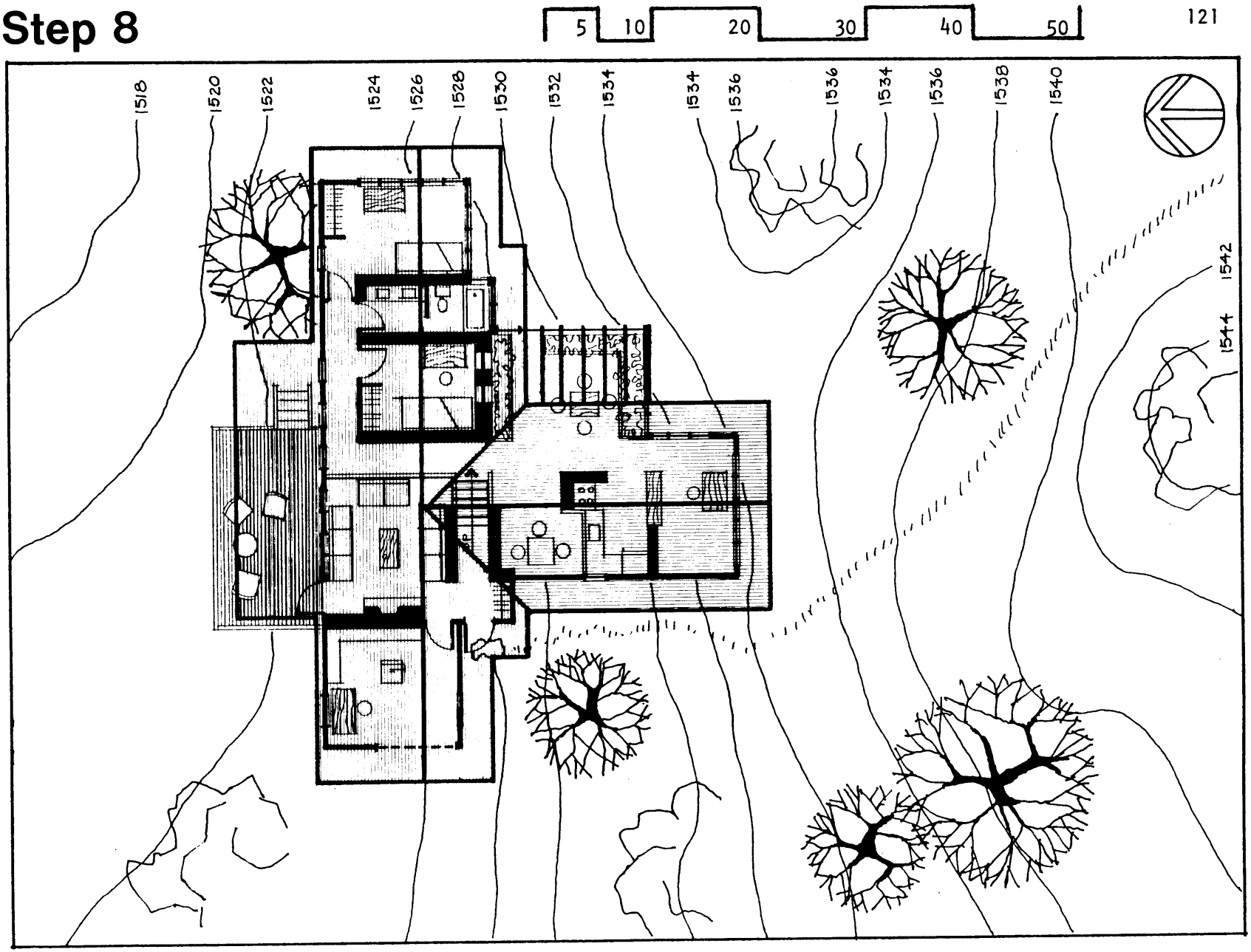

## Step 7



# Adjusted Plan



# Step 8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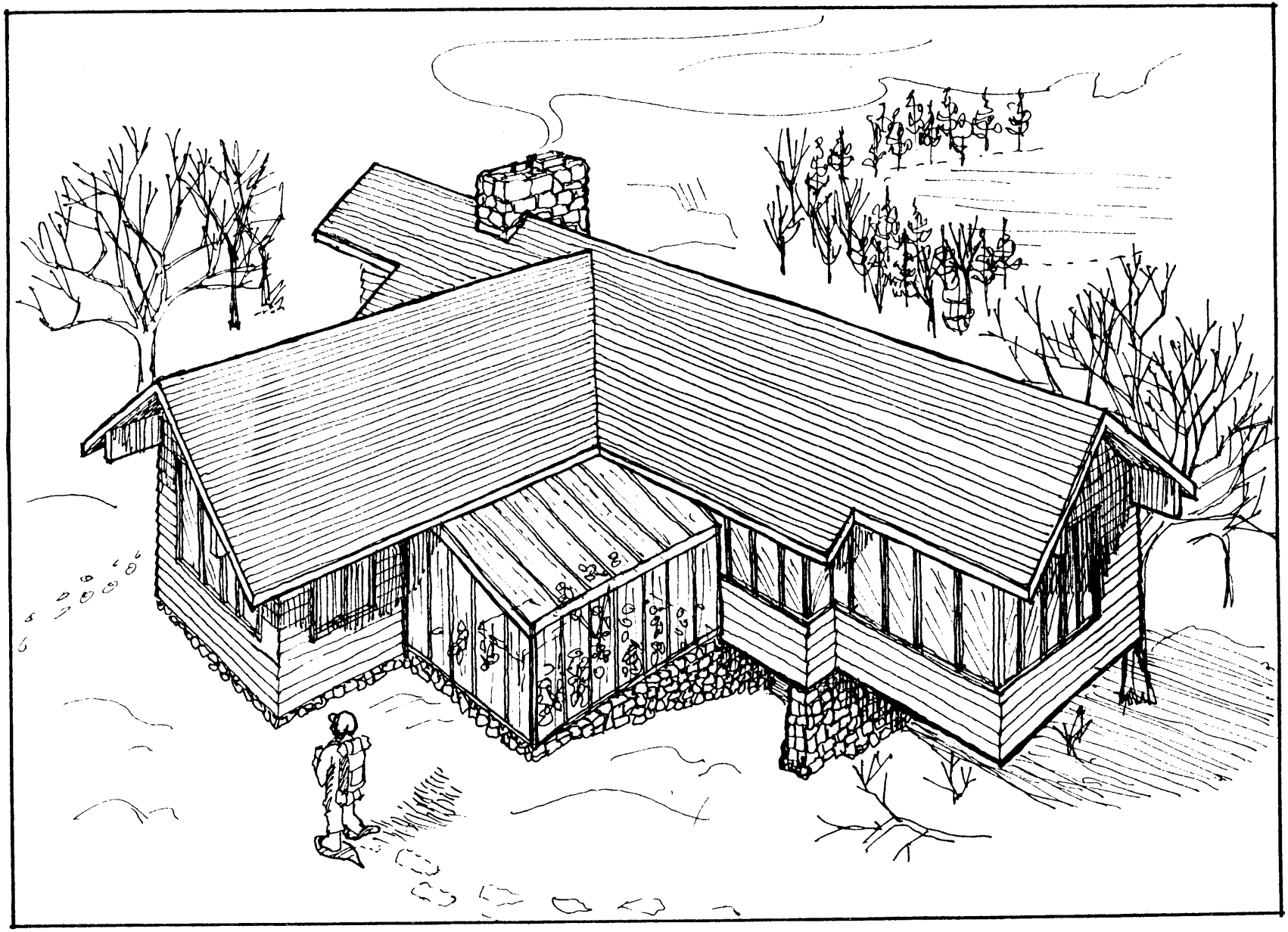

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