THE UNIVERSITY OF MANITOBA

THE SHAPE OF ACTIVITIES

by

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THE SHAPE OF ACTIVITIES

THESIS OUTLINE

The study looks at the process by which man shapes his environment, and is in turn shaped by it. Subsequent to this investigation, and to an examination of the context of design today, a design approach is outlined. The approach is based upon the various activities performed within buildings, housing is used as a vehicle for the study.

It is proposed that the physical form of most building types should to some extent respond to the spatial and symbolic criteria emanating from the behaviour of the users. It is further contended that by studying the behaviour, (comprising both motor activity and psychological response), of users of buildings of a similar type, criteria can be established which result in spatial requirements which lead to such 'form.'

In an attempt to establish such criteria, a survey was conducted of residents of different types of dwellings. Whilst the object was to determine the type of activities performed and the relative importance of each, the method for obtaining information and methods of analysis were of equal interest. In effect the study was a trial run for testing 'time budgets' as a method for recording activities, and the timing and location of them.

Likewise a technique was tested for establishing criteria by which the symbolic or affective dimensions, atmosphere, visual

character etc. of buildings and dwellings in particular, can be judged.

The significance of such means for shaping the built environment depends upon an understanding of the manner in which such an environment affects human behaviour. In fact it is necessary to ask - 'to what degree does the built environment influence behaviour, if at all? And also, is information gathered from one environment, influenced too much by that environment for it to be valid for predicting patterns of use in another similar setting?

Methods are proposed which attempt to answer these questions. Comparisons are made between the activities performed within the four dwelling types surveyed, and particular physical characteristics of rooms are correlated with the degree to which they are used. For instance if dwellings have larger dining rooms will people make extra use of them or will they eat in the kitchen anyway? Many such questions, relating to the optimum use of space within dwellings, could be answered by the methods proposed.

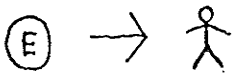
It is concluded that within the context of housing, 'behaviour' is influenced by the nature of the physical environment.

It is further shown that activities are a valid unit for evaluating and measuring the use made of space within buildings.

THE INTERFACE BETWEEN PHYSICAL FORM AND HUMAN BEHAVIOUR

Human behaviour is in its broadest sense 'the engagement in a complex interchange with the environment, in the course of which all living organisms modify, or are modified by what they encounter.'

1 Man shapes his environment 

2 The environment shapes man 

1 Man physically shapes, or modifies his environment to achieve certain goals. Such goals comprise the emotional and physical needs that the human organism values. The designer needs information about the nature of these values, and about methods for expressing them in the built environment.

2 The physical environment shapes man, i.e., the case for physical determinism. It is generally believed by the architectural profession, that the manner in which space is structured will to some degree determine the behaviour of the users of such space. Is this true, and if so to what extent?

Meaning in Architecture

The interface between the physical environment and human behaviour is one aspect of the complex interchange.* However the modification of the environment by man and the modification of man by his environment cannot be seen directly

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*between environmental systems

in causal terms, these processes are performed through the intermediary process of culturization. For men are social animals, reared within systems which precondition them to see the world in particular ways. Cultural behaviour is the result of inumerable previous encounters with the environment, which have created patterns of response found to be satisfactory and therefore integrated within the culture. Architecture is the image of a culture: a physically present human environment that expresses the characteristic rhythmic functional patterns which constitute a culture.

Built form embodies the ideas, values and beliefs of different generations, it exists as a symbolic code which conveys meanings, ranging from the very objective, non-discursive symbols such as traffic lights or signs which direct people, to highly subjective discursive symbols which may convey different meanings to different people, and have no immediate effect on behaviour. Any built environment is therefore alive with symbols which trigger memories and comparisons of other places, within the eyes of a beholder.

Within any cultural environment there are many social groupings, all of which are likely to have variations in the values and beliefs that they hold, consequently physical forms will have different meanings to them. At the individual level meaning

will of course vary greatly between persons so that personal symbols can rarely be designed for unless within the context of a close client/architect relationship. This is partly due to the fact that existing terminologies are inadequate for expressing non-discursive symbols. The question to be asked is therefore this: are there tools available which will enable architects to discover more about the symbolic meaning of physical forms?

The attempt has been made to show how behaviour is not simply a response to stimuli arising in the physical and social environments, but that it is a response to a situation as it is 'perceived,' and that perception is an infinitely variable process, each individual perceiving slightly differently. Any tools must therefore be capable of encompassing complex systems consisting of many variables.

THE CONTEXT OF DESIGN TODAY

In recent years there has been a growing awareness of the inadequacy of purely intuitive methods for designing increasingly complex buildings. Gerald Davis, a building programmer has said that, "the complexity of a building grows and, as we become more and more aware of the extent to which apparently random, unimportant factors can seriously affect human activity, the need for new tools becomes clear."*

We are in fact becoming aware of the built environment as a group of systems which are constantly changing, responding to the demands of business corporations, of transport and other municipal authorities. The scale of these bodies and the influence that they have, is so great that by comparison the needs of individuals and small communities, has little effect upon environmental systems, both urban and rural. The natural processes by which man responded to, and in turn influenced his environment, are no longer viable. It is not possible for an intuitive vernacular form of building to emerge in the existing social and economic situation. As a consequence of this, the affective and symbolic aspects of buildings are not being fully considered.

N. J. Habraken, in his book 'The supports and the People,' explains at length that it is the process by which housing environments are built that prevents individuals influencing or shaping, their environment. The housing project totally denies the participation of the future dweller, in its design,

*The Independent Building Program Consultant - Building Research April/June, 1969

conception and incapacity to adapt to changing needs. As Habraken emphasizes, it is the process by which one human being decides upon the characteristics of the habitation of another, that unless carried out on an individual basis, with a one to one relationship between architect and client, robs the dweller of the opportunity to choose.

It is only through a process of individual choice that the myriad variables of the system can be brought into a relationship such as that which Habraken describes as the 'Natural Relationship.' It is a process similar to that generating vernacular architecture, in which existing buildings can be modified and new ones incorporate those changes found desirable.

But whilst Habraken proposes a radical solution, comprising a structural framework incorporating services, into which industrialized components chosen by the occupant can be installed, such a solution is not feasible, perhaps not acceptable, in North America where the political machinery necessary to sponsor such a comprehensive undertaking does not exist. If it is inevitable that the majority of housing will continue to be <u>designed for</u> people, it is imperative that there is a real choice available. Not just a choice between brown paint or white, but a choice more closely related to living patterns. To make such a choice possible it is firstly imperative to have information of such living patterns. An interim definition for the purposes of the present study is that a living pattern consists of the day to day activities of all

the individuals comprising a family.

The thesis has as its concern the belief that the design process today, especially in the sphere of housing, does not operate on a small enough scale, in terms not of industrialized components as such, but the manner in which such parts are put together. The relationships between them could be made sufficiently diverse to meet the varied requirements of many living patterns at an individual scale, allowing for much greater choice than at present.

CHAPTER TWO

DESIGN APPROACH

DESIGN APPROACH

Arising from the discussion of the design process today is the belief that there is a need for more information. For information about how people use space, for instance the degree to which the location of people's activities are determined by the size of a room, the view from it, or perhaps its proximity to other rooms. Information is also needed about the symbolic meaning that built environment has for people, for the kind of space that make people feel secure or insecure, relaxed or on edge.

Running parallel to this need for information is the necessity for methods which will enable designers to make use of ever increasing quantities and varieties of knowledge.

It is the intention to outline an approach towards design which will have as its main objectives:

> 'the identification of requirements for physical support and servicing which will lead to a structuring of space which is
> 1) functionally appropriate and
> 2) symbolically meaningful, to the users.'

Functionally Appropriate Space

To design spaces which are functionally appropriate, architects often try to determine the requirements or 'needs' of the <u>organization</u> commissioning the building. For example,

in the design of an industrial complex, careful consideration is given to the physical processes which are to be carried out. For most industrial corporations, economy of means and the most efficient use of labour are the goals which 'building' must meet. Whilst not denying that it is important for a building to function appropriately at this level (of the organization), the design approach outlined will consider functional appropriateness at the level of the 'users' to be of prime consideration.

The term 'functional appropriateness' can obviously mean different things depending upon its context. To the users of the built environment, it means that all those activities which constitute the purposes for which the building is used, can be accomplished with the utmost facility.

A criteria often used to develop the programme for the design of a building is a 'need.' The clarification of such a unit is inextricably bound up with values, it is therefore proposed that an 'activity' is a more useful concept than need, because an activity has physical indicators, most of which can be described and measured. For instance, the 'needs' of office workers are almost as vast (and as personal) as the sum of all the individuals working in the offices - but the activities that they perform as 'office workers' are limited, they are predictable and can be planned for, and for these reasons activities will be used as the units determining spatial criteria.

Activities

A minimum definition of an activity would be 'exertion of energy,' but within the present context an activity is seen as 'physical manifestation of motivation towards some goal.' The objective of the design approach is to provide the optimal environmental conditions for reaching the said goal.

Activity Requirements

Activities can be viewed as behaviour which makes demands upon the supporting environment. For the purposes of the present study, these demands will be called activity requirements - these activity requirements give rise to physical indicators of form. Activity requirements will be classified into three major categories -

1. requirements for topographic space
2. requirements for sensory space
3. requirements for spatial relationships

Activity Requirements - Physical Indicators

1. topographic space → area
2. sensory space → boundaries
3. relationships → organization or structural pattern

1. Topographic Space

The shape and size of requirements for space are determined by -

a) the nature of the activities to be performed, and

b) characteristics of the performers - age, size, physiological condition, and cultural attitudes towards space.

For most activities space allowances above minimum required physiologically are necessary, for all individuals are surrounded by a personal 'bubble' of space which surrounds them wherever they go. In effect, it is like an invisible boundary giving protection from an overabundance of stimuli which would result from too close contact with other human beings. This 'bubble' expands and contracts according to both the mood of the individual and the social situation that he is in. For instance, within the family closer distances would be maintained between family members than between strangers to the dwelling. Spatial requirements for an activity such as chatting would necessarily depend not only on the numbers of people involved, but also on the relationships between them. These 'social distances' are culturally determined and so vary.

Another aspect affecting the areas required is the amount and size of furniture that occupants desire in their home.

Requirements

To be able to predict adequate dimensions and shape for the creation of satisfactory 'areas' it is necessary to know:

1. what activities are going to be performed
2. the social relationships of participants in activities

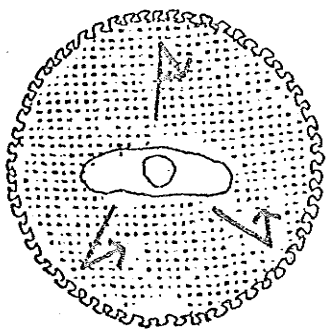
3. how many people will be involved
4. the dimensions of any necessary furniture, equipment or services.

2. Sensory Space

Human beings become aware of themselves as individuals because their senses inform them that some matter is constantly with them, whilst other things appear and disappear. The baby first differentiates between what is me and not me, and becomes aware of himself as an entity, at least in part, through a process of orientating himself in space. Though Western cultures do not consciously develop the spatial orientation of man in his environment as a symbolic process, unconsciously we build patterns of response to sensory input which become symbolically meaningful. A young child can become familiar with spaces of certain proportions, rooms which seem much higher than he is but which are not very much wider because he can easily touch the walls with his outstretched hands. Unconsciously this pattern of orientation will be stored and when the individual meets different spaces it will be used as a standard against which new experiences are compared. If a new environment is similar to the original pattern, it is likely to induce feelings of security, friendliness, etc., feelings which are likely to be intensified if the original pattern was emotionally invested. Sensory space is a product of perception which is intricately bound up with culture and previous experience, and of instinctive responses of which amazingly little is known.

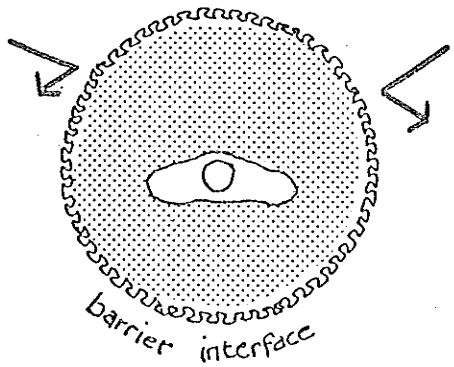
Within the immediate context 'sensory space' will refer only to levels of sensory stimulation - a relative measure of sights, sounds and textures. 'Sensory space' is both active and passive depending upon whether the actor himself is creating the sensory environment, i.e. being active, or if in terms of the present terminology he is being passive and requires a certain kind of sensory environment to facilitate completion of particular activities. For example, an active sensory environment might be where children are playing, their motion, noise and use of physical objects invests the surrounding space with particular sensory qualities. The problem arising is one of containing an active sensory space so that it does not conflict with passive areas. On the other hand a passive environment for sleeping or studying requires that selected stimuli arising in the environment are kept out. The problem posed is to keep out all, or selective stimuli, from the sensory space.

active



stimuli must be kept in

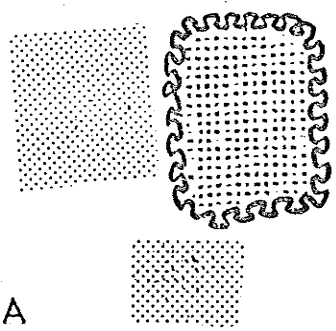
passive



stimuli to be kept out

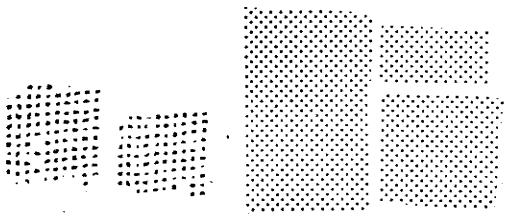
The problems posed by active and passive sensory spaces are usually solved in one of two ways -

A. BY CONSTRUCTING BOUNDARIES around certain spaces and therefore isolating them to differing degrees



A

B. BY TOPOGRAPHIC PLANNING so that spaces of a similar nature are in spatial proximity to each other



B

CONSTRUCTION OF BOUNDARIES

A. Boundaries - physical elements that define and enclose 'areas.'

The particular characteristics of boundaries of interest are their qualities as barriers, barriers both to exclude visual, accoustic and tactile stimuli from passive areas, and to contain such stimuli within active areas. The boundaries in a house determine the degree to which areas in a house are separated or contiguous to each other, and consequently the degree of privacy provided by each space. The nature of boundaries enclosing a space, and the effectiveness of them as visual, acoustic and tactile barriers will determine the 'sensory stimulation levels' within it. In recent years less use has been made of 'boundaries,' in many houses today the

bathrooms are the only totally enclosed spaces.

B. TOPOGRAPHIC PLANNING - The behavioural consequences of 'open or topographic planning' are open to question because of the corresponding loss of privacy and lack of differentiation in the sensory stimulation levels between spaces.

Privacy means different things to different people, and different types of privacy are desired by the same people for various activities. Such differences cannot be considered in the design of mass housing with the existing programming techniques. The lowest common denominators among the requirements of prospective residents have to be used as design criteria, i.e. only those solutions which are bland enough to be innoffensive to all tastes are incorporated. As a result, no one particular group of families finds the accommodation particularly unsuitable but at the same time, no one group finds it definitely satisfactory. In the private sector of the housing market, such considerations have not been considered vital because there is an element of freedom of choice. But in much mass housing, in particular public housing, this choice does not often exist. Consequently there is a need for methods enabling different degrees of privacy and different arrangements of sensory space to be designed for. There is also a need to determine the degree to which families differ, and how. For example, it is assumed that some families will pursue very individual activities which require many spaces with high levels of acoustic and visual privacy, whilst

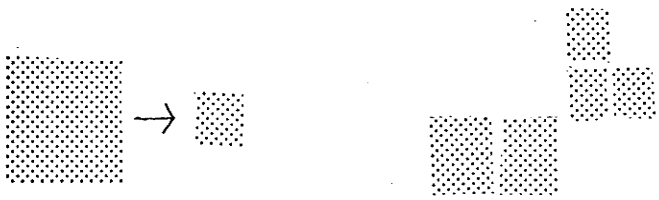
others perform mainly communal activities requiring little individual privacy - in which case open or topographic planning will be suitable.

It is hypothesized that the kinds of activities that a family pursues, will to a significant extent, determine their requirements for sensory space and should therefore influence their choice of house plan.

To decide the types of sensory space suitable for different families, it is necessary to know the nature of the activities performed by all its members - and whether these are individual or communal pursuits.

It is suggested that knowledge of these activities could lead to models of 'house' which differ markedly in their disposition of space, from the models currently in use.

RELATIONSHIPS



It is of limited use to have knowledge of the optimum size and shape of space required for the performance of certain activities, or to know the types of sensory space that are desirable, if these separate and sometimes disparate requirements cannot be organized into a whole. In fact the major concern is for such a whole - 'the shape of activities' must

comprise the totality of all the activity requirements, plus the relationships between them. It is believed that it is the relationships between the activities pursued by individuals within a setting that leads to methods for structuring each design situation.

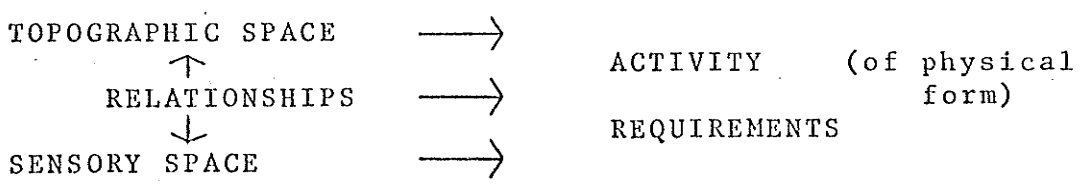
The types of Relationships

Two major types of activities arise from activity patterns:

1. Those relating directly to the organization of physical space - to topographic and sensory space.
2. Those relating to the relative importance of each activity to the total activity pattern.

The latter type of relationship gives rise to a hierarchy of activities based upon the concept of 'value,' the relative importance of each activity. Such a hierarchy can be used for organizing many conflicting requirements by indicating which activity requirements should be met first. The concept will be further explained following discussion of the first type of relationship.

1. Relationships relating directly to physical space - to topographic and sensory space.



Sequential Relationships

Topographic areas will be placed in proximal relationship to each other if the activities pursued within them have a sequential relationship. Such an idea is familiar to architects as 'the flow diagram' for example:

sleep ---→ hygiene ---→ dress

Sequential relationships usually indicate functional connections, for instance activities performed in a dining space will frequently follow or precede those performed in the kitchen, as food preparation is functionally related to eating.

Sensory Relationships

Sensory spaces can be placed in a proximal relation to each other if the activities pursued within them are of the same type - i.e. passive or active. For instance, those spaces which are the setting for activities requiring similar degrees of visual, acoustic or tactile privacy can be grouped, whilst those spaces which are required to be connected to allow for easy human contact can also be related. Whilst relationships based upon sensory perception of space can be very personal, varying greatly between individuals, research conducted by Robert Summer has shown some characteristics of space which are widely perceived. He proposes a classification of space which distinguishes between space that brings people together - sociopetal space, and settings that keep people apart - sociofugal space.

It is contended that there exist great similarities in the ways that many families organize the activities that constitute their living pattern. With greater information about such patterns, whether they can be classified into extrovert and introvert categories corresponding to 'open planning' or 'closed planning,' families would be able to choose a dwelling which suits their way of life to an increased degree.

Characteristic Relationships

The third type of relationship which will effect both topographic and sensory space is based upon the connection between particular activities and certain categories of persons, and could be called 'characteristic' relationships. For example the activities of young children and the mother will be closely related, whereas older children will engage in more individual pursuits, and participate in activities with children of a similar age. Similarly the settings for many adult activities can be grouped to give privacy etc.

It is hypothesized that the links connecting human activities into a continuous behaviour stream, should be reflected to some extent in the linkage of the physical spaces which are the settings for activities. The relationships between activities, as outlined above, can be used to organize spaces topographically, and to indicate the nature and position of the boundaries and links required.

Preliminary research is undertaken in the present study of the sequential relationships between activities, but further

research will be needed in this topic, and into the subject of sensory and characteristic relationships, before such relationships become more than an intuitive way of organizing space.

It is proposed that the categories outlined can be used to diagram requirements and so allow design problems to be better understood.

THE VALUE OF ACTIVITIES

In any design situation it is impossible to satisfy all demands, not only would they be too expensive in terms of money and land use, but some would directly contradict others.

To make decisions, the designer needs some recourse to information other than that supplied by his own intuition; he needs to have requirements in some order of priority so that major demands can be met first, and the others in a descending scale of importance.

For a building to have functionally appropriate spaces, each part or room, should have a spatial value proportional to some extent to the degree to which it is used. For example within the context of housing, many families may desire to play table tennis in their home; however, in buildings without basements, it is unlikely that the activity would be pursued frequently enough to justify allocation of the relatively large proportion of space required; on the other hand, an activity such as sleeping, which requires almost as much space (because of

culturally conditioned need for beds as we know them), is allocated the space because the activity occurs frequently, and because sleep is an activity basic to the behaviour of every individual.

A hierarchy of activities can be achieved by assigning a value to each. This value of activities is based upon the relationship of each activity to the totality of activities pursued within the environment under consideration. The activity value is basically determined by three criteria:

1. its importance for the functioning of the whole;
2. the frequency of its occurrence and its duration;
3. the number of people performing it.

1. An activity's importance for the functioning of the whole:

Activities can be divided into two major categories -

a) essential, and

b) discretionary.

Essential Activities - those activities that contribute directly to the functioning of the organization requiring a building. In practice it is usually quite easy to identify essential or primary activity. For example, in an industrial situation, activities such as processing of material would be essential, whilst personal cleansing or maintenance of the workshops would be secondary. The methods for determining what activities were essential to the functioning of the whole organization would depend upon the type of organization

under consideration. Within a housing context it would be generally safe to say that universality of activities would be a fair measure - i.e., if all families pursued an activity, it could be called essential, or primary.

Discretionary activities would be those not occurring in every family. There is no static dividing line between the two as some activities essential to one family may not be to another.

Objective - to determine which activities are essential and which are discretionary; and whether these groupings change with dwelling type. If this were the case, one could be assured that the physical environment had either deterred or encouraged certain actions.

2. Frequency of occurrence and duration of activities

An activity may have value because it happens either more frequently or for a longer time period. However, the total time that it occurs will be of help in determining value - it is therefore intended to construct a frequency/duration scale of activities which would give a mean of activities from every family. It would also be useful to know how much deviation there is from the mean.

3. The number of people performing the activity

If every member of a family performed the activity it would have a higher value than an activity pursued by one person unless that one activity scored highly in either of the other two categories. For example, food preparation is an activity

in which it is usual for only one person to participate and yet such an activity would rank very high on the 'Importance' scale and also on the 'Frequency/duration' scale.

Objective

a) To determine the importance of activities (if activities are essential or discretionary) to be established as the degree to which they are 'universal' among families.
b) To establish the 'Frequency/duration' scale of activities
c) To establish the number-people scale of activities.

Conclusions to Design Approach

Arising from the discussion of the interface between physical form and human behaviour, and from the discussion of the manner in which the human environment is formed today, is the belief that a more fundamental look should be taken at the needs of human beings for built environment.

An approach towards design is proposed which would enable a fundamental analysis of space, and its appropriateness for activities, to be undertaken. Basic elements of the built environment are identified which could be used as units for the specification of environmental qualities. Topographic space to be described in terms of size and shape, sensory space in terms of active or passive sensory stimulation levels, requiring open or closed boundaries, and relationships in terms of 'sequential,' 'sensory' or 'characteristic' relationships.

The starting point of the method is of course, the human activity, and the first objective of the present study is to investigate methods for determining what these activities are, and the characteristics of activity patterns that are pertinent to the design approach.

The approach requires that all the activities that are likely to be performed by the behavioural group under consideration are known, and that the requirements for physical support and servicing are known. Also that the 'meaning' of both the activity and the physical forms of the proposed building to the users, must be understood by the designer. Most importantly the 'value' of each activity, the part it plays in various behavioural patterns must be understood. The value of each activity can then be weighed against its physical requirements and a decision made about the feasibility of providing for each activity, in terms of each, or all of its activity requirements.

CHAPTER THREE

OBJECTIVES

3(1) Information and Methods relating to the Design Approach

information required

intentions

3(2) The Study of Meaning

methods for its investigation

comparison of meaningfulness to residents of different house types

3(3) Investigation of an Activity Modelling Technique

investigation of the effects of particular environments upon activities of users

OBJECTIVES

1st OBJECTIVE

An 'approach towards design,' or method by which the needs of human beings for built environment could be identified in formal terms, has been proposed. The first objective of the present study is investigate methods for obtaining the information necessary to such a design approach. 'Activities' are the basic constituents, and information must be obtained which will lead to 'activity requirements,' which can be translated into physical form.

The information required is as follows:

A) POPULATION CHARACTERISTICS: age, sex, family size and composition.

Cultural attitudes and personal values would to some extent influence the activity pattern of a family, consequently the population studied is to be as homogenous as possible. (Figure 1a)

B) REQUIREMENTS FOR TOPOGRAPHIC SPACE leads to need for information about the type of activities performed, and the number of actors.

C) REQUIREMENTS FOR SENSORY SPACE leads to need for information about activities that occur simultaneously and might have conflicting requirements.

D) REQUIREMENTS FOR RELATIONSHIPS leads to a need for information about

1) the sequence in which activities occur,
2) the actor category most often performing each activity.

E) To determine the VALUE OF ACTIVITIES it is necessary to know:

1) which activities occur in every household - are essential or discretionary.
2) which activities happen most frequently, which are of longest duration.
3) which activities are performed by a solitary actor, and which are performed by numbers of people.

It has been illustrated in the chapter on the Design Approach, that the information noted above would be essential to the operation of design methods based upon activities. But such information could also be very helpful to other related design methods - for instance knowledge about which activities are pursued for the greatest length of time, could lead to changes in the proportions of space within a house.

For example, kitchens could be made larger in many dwellings if it was shown that food preparation and related functions had the greatest 'value' of all the activities performed within a house. Another application of such knowledge might be in the comparison of the activity patterns, and the

related spatial needs, of sub-groups within the population, whether regional, class or ethnic differences lead to variations.

Intentions

A small survey was undertaken, the intentions of which were:

1 to test the data collecting method

2 to obtain sufficient information to be able to determine the significance of 'activities' as a subject for theoretical research or immediate practical application, i.e. the feasibility of the design method, and/or simulation techniques. It was believed that the following information should be sufficient for judgements to be made about activity studies:

   a) Population characteristics - family size and composition

   b) the activities performed

   c) sequential relationships between activities

   d) the value of activities;
      which activities are essential/discretionary
      which activities are of greatest magnitude
      which activities are performed by the most people

3 to provide evidence towards the 'case for design,' by illustrating the effects, if any, that the spatial organization of a dwelling has upon the activities of its occupants. Such a proposition forms the basis of the third objective and as such will be elaborated upon at greater length.

2nd OBJECTIVE

The second objective is to study 'meaning' in residential building.

The starting point for the study is the belief that functional convenience alone will not make a building a psychological success, but that buildings must be meaningful to their users. A 'psychological success' is taken to mean that a building satisfies its occupants on a subjective and an emotional level.

The thesis is that to be meaningful a building must contain symbols. Von Bertanfly* has defined non-discursive symbols as 'conveying values, felt and acted upon - that is emotions and motivations.'

Architects have in the past relied on personal intuition and cultural awareness, which, fed by a close working relationship with the client who was often the eventual user, helped create buildings that were symbolically meaningful. But today the situation is different, clients want the best economic return and rarely consider the affects that a building has upon its users. Only in instances when the prestige of an organization has to be expressed, or a group of people has to be impressed, is much thought given to the symbolism of a building or

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*in 'Psychology and the Symbol,' edited by Joseph R. Royce.

environment. The users of most buildings today are an anonymous group of people whose wishes cannot be known, and cannot therefore be considered.

Consequently it is necessary to have tools which will enable architects, and all those concerned with planning urban environments, to know and appreciate what makes physical form meaningful to different groups of people.

Verbal descriptions of buildings by their users are useful indicators of emotional satisfaction, if they can be measured. A psychologist who has investigated methods for measuring meaning, David Cantor, has written that,

> "a common assumption in the study of person perception is that judgements of people may be usefully considered to exist along a number of independent dimensions. If the perception of buildings is considered as similar to the perception of people, it is important to find the main underlying dimensions along which buildings are judged to exist."≠

Cantor, among others, has used the semantic differential technique for measuring these dimensions.

The 'semantic differential' is a technique developed by Osgood. Suci and Tannenbaum, to measure connotive meaning.* The method

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*the Measurement of Meaning by Osgood, Suci and Tannenbaum

≠An intergroup comparison of Connotative Dimensions in Architecture, - Environment and Behaviour, June 1969

utilizes a number of scales consisting of polar adjectives such as "good - bad," "beautiful - ugly," to differentiate the meaning of concepts.

A basic assumption of the semantic differential technique is that a battery of intercorrelated variables has common factors running through it, and that the scores of an individual can be represented more economically in terms of these 'factors.' The general factors will consist of those concepts or variables, such as sad, welcoming, peaceful etc. which are consistently used in the same way by members of a respondent group. For example if houses rated 'peaceful' were consistently rated 'unfussy,' these two scales would be highly correlated. If several such scales were highly correlated, factor analysis would group them around a common factor or 'dimension.'

3rd OBJECTIVE

The third objective is to investigate the manner, and the degree to which, a particular built environment influences or shapes the activities of the users of that environment.

The ultimate aim of the study as a whole is to determine methods which would lead to the design and creation of buildings which are more appropriate to the behaviour of the users of buildings.

Such an approach pre-supposes that buildings do shape

behaviour, and that an architect when designing, does through the medium of a building, impose his own value system upon the users. In fact the proposition that design is valuable because it will have an influence upon the life of the occupants of a building, is basic to the credo of all architects. There is, however, very little scientific evidence to either support or refute such a proposition. Some studies have been carried out to determine if friendship patterns are influenced to any extent by physical features of the environment, such as the position of the entrances to dwellings. Michelson, in his book 'Man and his urban environment,' reviews several studies, and concludes that when certain conditions were met, notably that the population studied were homogenous, physical form is likely to have an influence on friendship patterns.

The supposition that the behaviour of man is shaped by the environment is seen to be very basic to the theme of the design approach outlined, - in fact to the very concept of design. It seems necessary to try to establish the extent to which correlations between physical form and behaviour can be found, and to examine the conditions within the social and physical environment which are necessary for relationships to be established.

It is intended to study human activities performed within a limited number of physical settings. One of the purposes of such a study will be to gather evidence about activities

performed within four house types, so that comparisons can be made between the average of the activities of the four groups. If activity patterns of residents of one of the four groups, for instance apartment dwellers, are found to have greater similarities within the group than do the activity patterns of dwellers in the other types of housing, such results could be attributed to the following factors:

1. either the physical form of the dwelling has influenced activities or
2. characteristics of the people living in that type of dwelling have led to particular behaviour patterns, or
3. both the aforementioned factors have been of influence.

It must be borne in mind that particular elements of each dwelling type attract certain kinds of families, so that by a process of choice a degree of categorization takes place.

If either distinct activity patterns are detected which differ for each house type, or evidence is found of different lifestyles made manifest in 'active' or 'passive' activity patterns, then the study could be used as a framework for further enquiry.

Intentions

It is necessary to investigate the effect of the built environment, specifically of different types and forms of

housing, for two reasons.

The first is that increased knowledge of the effects of particular spatial arrangements upon users will enable architects and planners to design buildings which are more appropriate to a way of life, and buildings which use the spatial resources available more economically.

The second reason is to determine the validity of the data relating to activities: is such data influenced too greatly by the existing environment to be of use for predicting activity requirements in similar but not identical situations? These concerns can be put in the form of a postulate which it is intended to test.

Postulate

The physical form of dwellings will effect the 'patterns of use' of them.

The constituent elements of this physical form are:

1. Topographic space - shape and size of areas
2. Sensory space - boundary condition, open - closed
3. Relationships - specifically spatial proximity between locations.

Variations in these elements will effect the use made of locations directly, manifest in the pattern of activities, and indirectly through the perception of the space and the meaning of the resultant images to the user.

The postulate will be tested by comparing the 'patterns of use' in the four dwelling types.

A pattern of use comprises:

1. The magnitude of different activities for an average family
2. The amount of use of each location
3. The location of particular activities
4. The amount of use of locations by various family members (person categories).

It was not possible to test the indirect effects, the meaning of each location or room, to its user until preliminary work on a measuring technique (the semantic differential, see chapter 4) was complete.

The physical form, with constituent elements as outlined, of the living, dining and kitchen areas of the four dwelling types, will be visually described together with data on the amount of use made of these locations.

Inferences can then be drawn about the effects that <u>particular</u> arrangements of space have upon the location of activities.

CHAPTER FOUR

MEANING IN RESIDENTIAL BUILDING

MEANING IN RESIDENTIAL BUILDING

As stated in the 'design approach' it is contended that a major requirement of the built environment is to be symbolically meaningful.

The problem is to find ways to establish the content of 'meaningfulness' to residents of different types of housing. In an attempt to describe residents' feeling about their dwelling, and to find out if there are any differences in this regard according to housing type, a 'semantic differential' scale was administered.

The semantic differential technique developed by Osgood, Suci and Tannenbaum, is a method for measuring connotive meaning. It utilizes a number of scales consisting of polar adjectives such as: 'beautiful - ugly,' 'happy - sad,' to differentiate the meaning of concepts. Judging every concept on several scales ensures a more accurate description, as differences in the meanings attributed to individual words are minimized. The technique has been used by several researchers to establish meaningfulness in terms of factors or dimensions, studies pertinent to the present enquiry will be reviewed.

Previous studies

David Cantor used architectural students to judge plans and elevations of twenty house designs. Thirty, third and fourth year students judged two black and white slides of each of

twenty buildings. The slides were of plans and elevations of houses designed by other students in the school.

Each building was rated on forty-five, seven point bi-polar adjectival scales. Many of the adjectives are similar to those used in the present study which are shown in Table 2 - 1, adjectives additional to those used are as follows:

characterful	- characterless
good	- bad
sophisticated	- unsophisticated
subtle	- unsubtle
expected	- unexpected
barren	- fruitful
dignified	- undignified
clear	- obscure
confident	- hesitant
hard	- soft
masculine	- feminine
informal	- formal
sympathetic	- unsympathetic
light	- dark
dangerous	- safe
opaque	- transparent

The adjectives were selected from recordings made of architects' discussions.

The method of analysis was to correlate each scale with every other and to analyse the resulting matrix by the method of

principal component analysis. The factor loadings produced were rotated to a varimax solution. Seven of the latent roots of the correlation matrix were greater than unity and were therefore extracted as factors.

The most significant were 'character,' in which evaluative scales such as 'pleasant - unpleasant,' and activity scales such as 'lively - calm,' were highly loaded.

The second factor was 'coherence,' loading such scales as 'stable - unstable' and 'harmonious - discordant.' The third factor was 'friendliness,' with scales such as 'welcoming - unwelcoming,' 'neighbourly - un-neighbourly.' He also measured the reactions of non-architectural students to drawings of room interiors, and found that the importance of the major factors changed: with non-architects the 'friendliness' dimension was the major factor, 'coherence' the second and an 'activity' factor was third and subsidiary to the other two.

Hershberger, in a study comparing the differences between architects and non-architects, also found that the dimensions by which buildings were judged varied. His 'organization' dimension corresponds to the 'coherence' factor of Cantor's, the other dimensions however appear to be different, they are a space evaluation factor and a potency factor, compared to 'character' and 'friendliness.'

There seems to be four major variables which could account for these differences:

1. type of building
2. method of presentation of material
3. cultural and social differences amongst subjects
4. composition of scales and method of factor extraction.

The scale

The scale items were first selected to describe the physical forms of the exterior, the entrance, and the interior layout of the dwelling. The selection of the items was guided by previous research done by Canter (1968, 1969), Hershberger (1969) and others. Seventy-eight items were first pre-tested. The pilot study questionnaire was administered to a sample of fifteen respondents living in three types of buildings (dwellings), in order to maximize, using impressionistic criteria, their heterogeneity. Respondents emphasized adjectives which were expressive of the affective dimensions, so influencing the final thirty-one item scale, which is shown on Table 2 - 2.

Method and procedure

Each of the sixty respondents was asked to consider the physical form of their dwelling, and as far as was possible to disregard the furniture and decorations. Respondents were requested to put a check mark in one of the seven slots, the one that was felt to be most appropriate to describe his or her feeling.

Residents of four types of dwelling were tested, these are: type A - apartments (24 cases), type B1 - 3 bedroom townhouses (14 cases), type B2 - 4 bedroom townhouses (11 cases), and type C - detached single family houses (11 cases).

Questionnaires were personally delivered to random respondents, this factor probably helped to bring about the relatively high return of over 50%. (The original apartment sample however, was so unresponsive that a further survey had to be conducted, 17 of the 24 cases are from the second survey).

Due to the limited number of observations reported in the analysis it was necessary to reduce the number of items on the scale to 18, before attempting to analyse the responses in order to find the underlying dimensions. The problem related to the number of variables versus the number of observations, a matter which has not been observed, however, by many investigators who attempted to use the factor analysis technique in order to describe the connotative dimensions in architecture. Canter (1968), for example, has factor analyzed a forty-five semantic differential scale while his observations were only thirty-one. Although statisticians have provided no well-defined rules for guidance in this matter, it is generally agreed that, as a rule of thumb, one ought to have at least three to four times as many observations as variables (Rummel, 1970: 220). What this means is that if one uses items which pertain to meanings or concepts in architecture, one will not generally be able to use any

number of items which can be obtained, but will have to select a sample from among a set of adjectives. Accordingly, a smaller set of the most meaningful items was finally administered to sixty respondents. The original scale of 31 items, and the final scale consisting of 18 items are shown in the appendix.

Analysis of data

In order to arrive at possible dimensionality of judgements pertaining to housing characteristics, a principal component analysis was used. Three factors, with their associated eigenvalues greater than unity were retained for purposes of rotation. The rotation method used was the varimax criterion. The extracted factors are shown in Table 2B.

Identification of factors

Three common factors together accounting for 71% of the total variance were obtained.

The first factor, by far the largest accounted for 58% of the variance. It related both to the mood of the individual with adjectives such as cheerful, elating and personal, and to the social atmosphere. Adjectives such as hospitable, sociable and welcoming, pertain not only to the manner in which the dwelling affects the mood of the individual, but to the manner in which the individual perceives the family and visitors to be affected.

FIGURE 2A

THREE DIMENSIONS OF MEANING

VARIMAX ROTATED FACTOR MATRIX -

for all sixty samples'

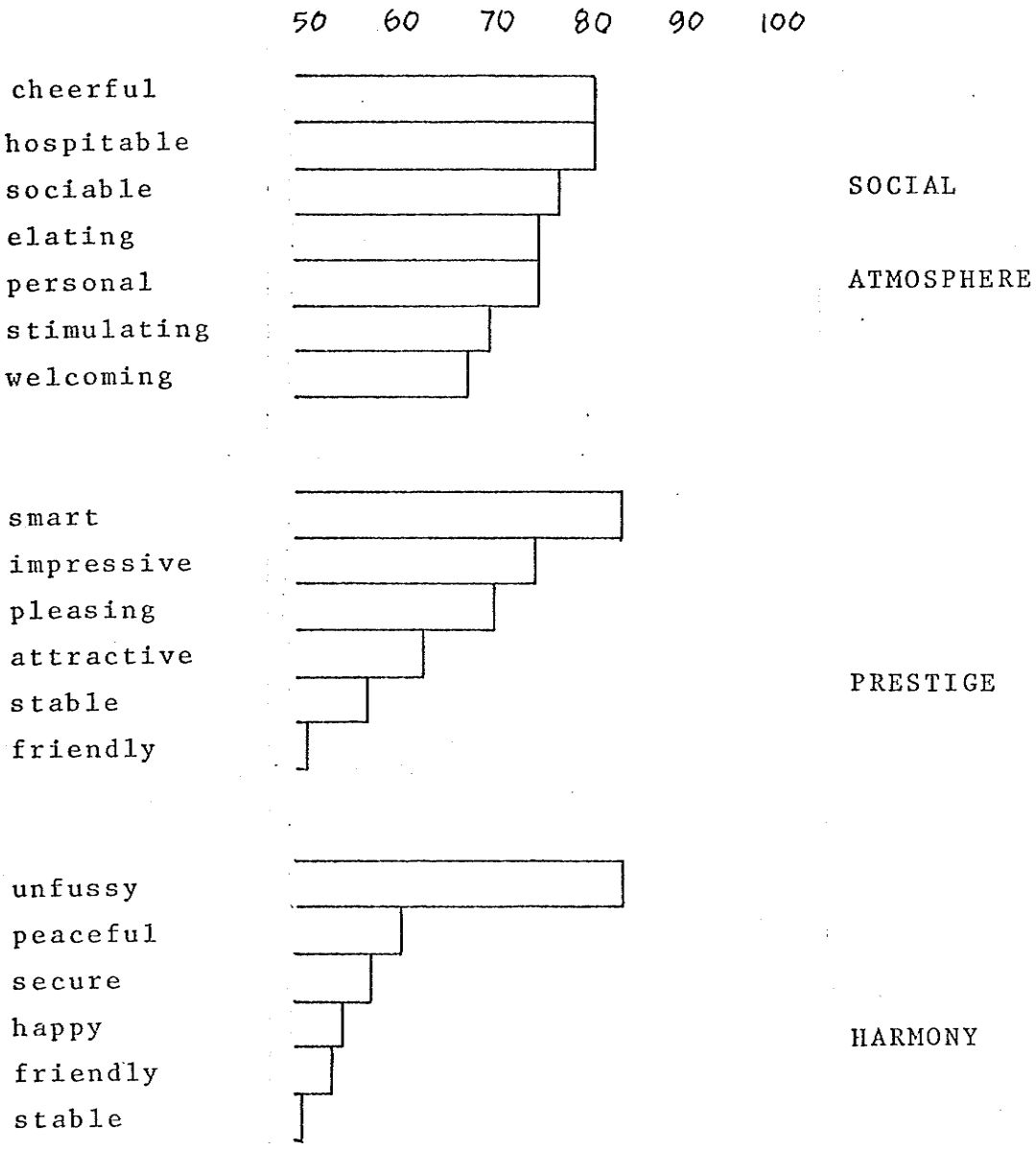

Figure 2 B

Factor Loadings of three factors (orthagonal rotation)

Scale items	Factor I Atmosphere	Factor 2 Prestige	Factor 3 Harmony
1 smart	0.324	(0.858)	0.085
2 impressive	0.417	(0.760)	0.006
3 pleasing	0.388	(0.771)	0.304
4 welcoming	(0.684)	0.321	0.289
5 elating	(0.772)	0.303	0.066
6 stimulating	(0.710)	0.447	0.220
7 lively	0.450	0.467	0.419
8 attractive	0.314	(0.643)	0.479
9 friendly	0.472	(0.512)	(0.545)
10 secure	0.303	0.397	(0.583)
11 happy	0.462	0.398	(0.553)
12 stable	0.259	(0.584)	0.507
13 hospitable	(0.819)	0.289	0.261
14 peaceful	0.324	0.238	(0.616)
15 cheerful	(0.819)	0.254	0.256
16 fussy	0.326	0.074	(0.846)
17 sociable	(0.785)	0.343	0.120
18 personal	(0.770)	0.229	0.262
% variance explained	58.4%	7.7%	5.8%

This is therefore not a very clear dimension, but puts the emphasis on the friendliness and receptiveness of the dwelling generally.

The second factor accounting for only 7.7% of the variance, related to 'prestige.' Scales such as dull - smart, unimpressive - impressive, ranked the highest. Adjectives such as pleasing and attractive also ranked high, showing that smartness and impressiveness were considered to be both pleasing and attractive.

The third factor - 'harmony' was composed of the scales fussy - unfussy, turbulent - peaceful, and insecure- secure, it accounts for only 5.8% of the total variance. The harmony factor pertains most closely to the physical organization or design of the dwellings, its relative unimportance could be seen to indicate indifference to the aesthetic qualities of the housing environment.

Comparison between factors in the present study and those established by Cantor for room interiors.

Present study	Cantor's study
1 Social atmosphere (cheerfulness/hospitality)	1 friendliness
2 Prestige	2 coherence
3 Harmony	3 activity (lively)

Comparison of the factors extracted in the present study to those established by Cantor, indicates that a friendliness or

mood dimension is of major significance to non-architects when judging the interiors of buildings, (whereas Hershberger has indicated that 'character' is more important to architects). It also appears that when evaluating a building that is also a dwelling a different dimension is introduced - 'prestige.' All other studies conducted have been of other building types, it therefore seems that prestige is a factor particular to dwelling, presumably because possession is involved and a house is felt to reflect the status of its occupants. This point will be discussed further when a comparison is made between factor scores of each type of dwelling.

The 'harmony' factor in the present study is comparable to the 'coherence' factor which was present in both studies by Cantor. The difference in the percentage of the total variance, 5.8% compared to 17% and 20% for the 'coherence' factor, is accounted for by the order of the factor in the matrix, 'harmony' is the third factor whereas 'coherence' was the second in both instances. This discrepancy will also be partly due to the small number of items in the present study which are concerned with harmony or physical coherence.

However the conditions of the experiments may partly account for the differences. In Cantor's second study respondents were unfamiliar with the rooms they had to evaluate, and therefore had no emotional ties with them. It is possible that as a consequence respondents reacted more objectively,

especially as they were made aware that the experiment was of an architectural nature.

COMPARISON OF MEANINGFULNESS ON THREE FACTORS BETWEEN HOUSE TYPES

An attempt was made to factor analyse the data from each of the four dwelling types separately, in order that comparisons could be made between the factors extracted, and the scores on these factors. However, the number of cases was too small, types B2 and C consisted of only eleven cases respectively, for extraction of a sufficient number of factors. In order that comparisons could be made it was found to be necessary to build a composite index based upon coefficients.

'To obtain factor scores, each variable is weighted proportionately to its involvement in a factor: the more involved a variable the higher the weight. Variables not at all related to a factor would be weighted near zero. To determine the score for a case on a factor, the case's data on each variable is multiplied by the factor weight for that variable. The sum of these, weight times data products for all the variables, yields the factor score. This weighted summation will give cases high scores if their values are high on the variables involved in a factor.'*

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*Rummel page 150

Using these factor scores a composite index was built which provides a basis for comparison of the scores for each case on every factor.

For example, the score on Factor 1 is

Factor score = Factor coefficient $(x_1 - \bar{x}_1) / SDx_1 +$

Factor coefficient $(x_2 - \bar{x}_2) / SDx_2 + \ldots.$

where x_n is the row score on each item and $\bar{x}$ is the mean of each item, and SDx is the standard deviation of each item. Figure 2C (1-6) shows the scores on each factor for cases in each of the four dwelling types.

Discussion:

Factor 1 - 'social atmosphere'

In figures 2C (1), 2C (2), it can be seen that there was a much larger proportion of low scores for the apartment dwellers compared to residents of other house types except B2 - the large townhouses. As this factor accounts for the greatest variance and is indicative of the general mood and degree of satisfaction of residents, it is important to understand why residents of one type of rented accommodation, B1 small townhouses, should be comparatively happier and more satisfied than the residents of the other two - apartments and large townhouses.

This pattern is consistent for the other factors also, apartment dwellers score lowest on the first and second factors, but are slightly higher than the 2 group on Factor 3. The

B1 group is uniformly higher than group A and B2 on all factors. As was to be expected the highest scores on Factor 1 were recorded by residents of the detached houses, however the difference between them and the B1 townhouses was surprisingly small.

Factor 2 - 'prestige'

Surprisingly the B1 group, small townhouses, scored higher than the C group, detached dwellings. Obviously variables other than the housing type per se, have an influence. The townhouses are situated adjacent to the apartments, as a consequence they might be considered smart and impressive by comparison. The same influence could have been expected to have effected the scores of the residents of the larger townhouses, but as rents in these were significantly higher, the residents were generally professional people who might have felt that the close proximity of the lower rental apartments and townhouses detracted from the impressiveness of their own dwellings. It must be noted, however, that scores were clustered around the medium range, there were fewer low scores than in the detached houses.

Factor 3 - 'harmony'

Scores for the B1 group were notably homogenous on this factor, 11 cases from 14 ranked as medium scores.

In contrast scores for the B2 group were divergent - only three of the eleven cases ranked as medium.

The detached dwellings were seen as the most harmonious, with only one low score. It would be interesting to find out if this was a consequence of the symetrical double fronted plan, see figure 1 , or a consequence of owner occupation.

CONCLUSIONS

The usefulness of the study lies in the testing of the semantic differential technique as a measuring tool, as much as in the results themselves. However, bearing in mind the preliminary nature of the study and the limited size of the sample, size, the results were encouraging. The factors extracted indicate that dwellings are judged rather differently from other building types - with the notable inclusion of a 'prestige' factor. However a friendliness or mood dimension is common to different kinds of building interiors. The study also reinforces Hershberger's hypothesis that 'character,' 'harmony,' and other dimensions related to the physical organization of space, are less significant to laymen than are 'mood' dimensions.

More studies are needed, based upon larger and more diverse samples, before definite conclusions can be reached about the practical significance of knowledge of the factors by which dwellings are objectively and subjectively evaluated. It is foreseen that the technique can be adapted to determine not only which values different groups of people desire in their home, but can also establish which physical forms are expressive of these values. The semantic differential can

therefore become a tool which can be used to predict desirable affective and symbolic environments, and also to evaluate the success of such environments.

FIGURE 2C

COMPARISON BETWEEN HOUSETYPES ON THREE FACTORS

- COMPOSITE INDEX OF FACTOR SCORES

Mean score for Dwelling Type A, B1, B2, C

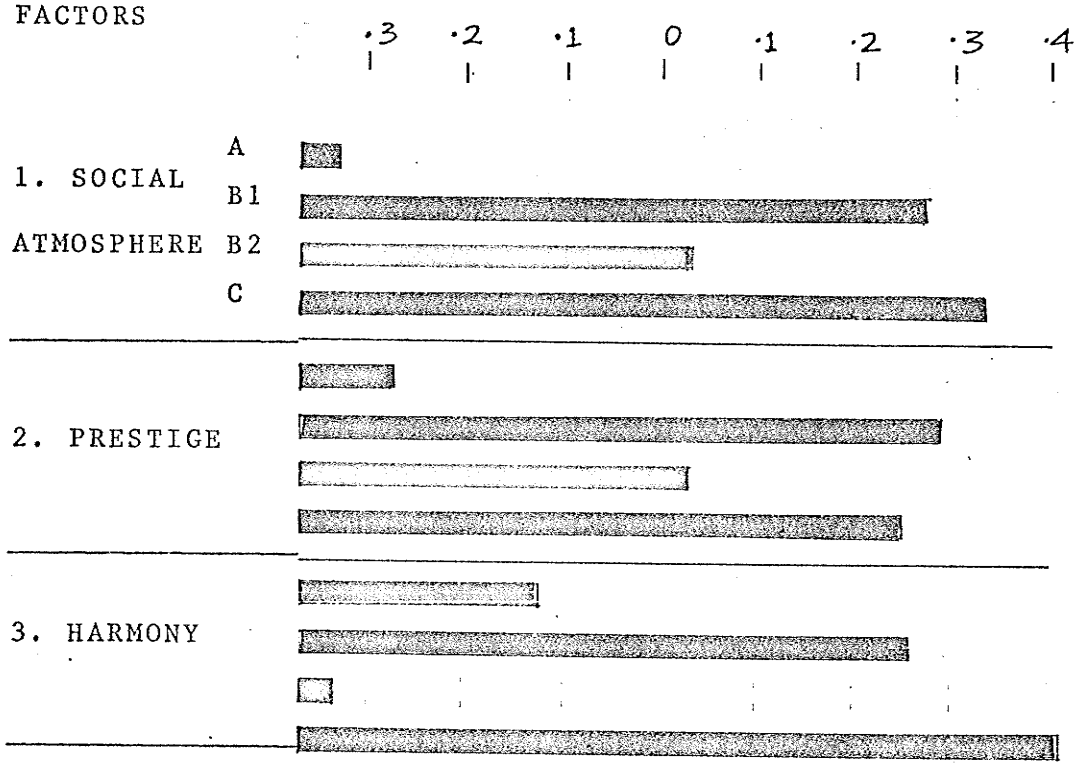

FIGURE 2D(1)
COMPARISON BETWEEN HOUSE TYPES ON THREE FACTORS

Figures from a composite index based on factor scores.

FACTOR 1 'Social Atmosphere'

Type A - Apartments		Type C - Detached dwellings	
-0.947		-0.523	low scores
-1.618			
-0.735			
-0.745	low scores	+0.074	
-0.703		+0.453	
-1.295		-0.296	
-0.528		+0.350	medium scores
-2.910		+0.075	
+0.244		+1.028	
-0.440		+0.817	
-0.393		+0.606	high scores
-0.319		+0.529	
-0.407	medium scores	+0.629	
+0.126			
-0.160			
+0.283			
-0.383			
+0.415			
+0.151			
+0.359			
-0.153			
+1.618			
+0.629	high scores		
+0.549			

FIGURE 2D(2)

FACTOR 1 'Social Atmosphere'

Type B1 - Townhouses		Type B2 - Townhouses
-0.620	low scores	-0.707
		-0.737
		-0.853
-0.029	medium scores	-0.020
-0.022		-0.065
-0.475		-0.305
-0.177		-0.051
+0.467		
+0.116		
+0.374		
+0.002		
+0.684	high scores	+1.086
+0.884		+0.801
+1.150		+0.521
+0.689		
+0.681		

FIGURE 2D(3)

FACTOR 2 'Prestige'

Type A - Apartments		Type C - Detached dwellings
-1.878		-1.188
-2.350		-2.268
-1.610		-0.507
-1.224		
-0.719	low scores	
-1.311		
-1.911		
-1.917		
-0.762		
-0.612		
-0.866		
+0.586		+0.181
+0.193		-0.178
-0.106		+0.348
-0.045		+0.309
+0.226	medium scores	
-0.384		
-0.409		
+0.452		
+1.943		+2.111
+2.144		+1.191
+1.032	high scores	+1.253
+1.342		+1.477
+0.959		

FIGURE 2D(4)

FACTOR 2 'Prestige'

Type B1 - Townhouses		Type B2 - Townhouses
-1.595		-1.252
-1.367	low	-1.976
-1.027		
+0.167		+0.001
+0.258		+0.023
+0.271		+0.168
+0.359		-0.270
		+0.489
+0.996		+0.673
+0.788		+0.785
+0.958		+1.018
+0.967	high	+0.627
+0.600		
+1.309		
+1.396		

FIGURE 2D(5)

FACTOR 3 - 'Harmony'

Type A - Apartments		Type C - Detached dwellings
-1.755		-0.514
-0.584		
-1.975	low scores	
-1.059		
-0.504		
-0.571		
-0.327		+0.458
+0.183		-0.063
-0.463		+0.484
-0.441		+0.466
+0.359		-0.235
+0.407	medium scores	+0.240
+0.549		+0.497
-0.020		
-0.382		
-0.407		
-0.127		
+0.573		+1.135
+1.780		+1.022
+0.944		+0.995
+0.630		
+0.604		
+1.040		
+2.644		

FIGURE 2D(6)

FACTOR 3 - 'Harmony'

Type B1 - Townhouses		Type B2 - Townhouses
-0.752		-0.775
-0.892	low	-1.267
-0.595		-1.086
		-0.679
		-1.800
-0.203		+0.345
-0.012		-0.421
+0.410		+0.183
+0.100		
-0.272		
-0.189	medium	
+0.172		
-0.270		
+0.245		
+0.468		
+0.116		
		+0.562
	high	+0.548
		+0.709

FIGURE 2D(7)
COMPARISON BETWEEN HOUSETYPES ON THREE FACTORS

Maximum and minimum scores and mean, on each factor for each housetype

FACTOR 1 - Social Atmosphere

Dwelling Type	Maximum highest	Minimum lowest	Mean
A	+1.618	-2.910	-0.331
B1.	+1.150	-0.620	+0.266
B2	+1.086	-0.853	+0.021
C	+1.028	-0.523	+0.338

FACTOR 2 - Prestige

A	+2.144	-2.350	-0.282
B1	+1.396	-1.595	+0.292
B2	+1.018	-1.976	+0.026
C	+2.111	-2.268	+0.248

FACTOR 3 - Harmony

A	+2.644	-1.975	-0.121
B1	+0.468	-0.892	+0.250
B2	+0.709	-1.800	-0.334
C	+1.135	-0.514	+0.408

CHAPTER FIVE

ACTIVITY MODELLING

CONTENTS

ACTIVITY MODELLING

A. Review of existing methods

In the past vernacular building forms evolved slowly by processes of modification. Each building could be added to or changed until it corresponded to the needs of its occupants, any significant developments would then be incorporated in new buildings, a process analogous to the development of the Volkswagen beetle. But today the scale of the building operation (referred to in Chapter 1) prevents traditional means of communication between designer and user, from operating.

What then are the methods available to the present-day architect by which he can establish the nature of relationships which will lead to physical form?

At the very least, an architect relies on his own experience of previous similar situations, basing his opinions solely on his personal value system. In the design of a house, the very most that an architect will usually do is spend a few days living with the client and his family in order to be able to judge the ebb and flow of their lives, to find out where the boundaries should be, which spaces should be closely linked and which only partially. Such investigations are felt to be necessary when an individual client is involved, for by such means the basic structure of the life of a particular family within a setting can be determined. As this basic structure has always to be studied within an existing setting, the

question arises of the degree to which this behaviour has been influenced by its setting, and the validity of such a model as a 'true' representation of the life of a family. The answer is that the architect uses his previous knowledge of comparable situations to indicate to him where the setting might have had particular influence.

In recent attempts at more objective research several approaches have been tried.

'Game theory' provides a means of representing the actions of the individual and his attempts to make optimum decisions in a situation where he has only imperfect knowledge of the world. It has been used by Marble (1967) to investigate the travel behaviour of individuals between shopping and the home. However, such a technique will not be of great use in the simulation of activities within the home, because as well as being impossible to predict 'all the possible plays,' it would be an inappropriate method for investigation of such a personal activity as dwelling. Such an approach is based on the concept of rationality of behaviour, the decision to proceed in a certain direction, being the outcome of a rational approach leading to an optimum decision based upon the probabilities of the outcomes of all the possible 'plays' open.

Simulation techniques

'Stochastic methods attempt, given the probability of a person visiting this or that facility, or spending so much time in

one activity and so much in another, to reproduce a possible and likely pattern for his day: how he spends his time between different activities, the sequences in which he engages in those activities, and the place he chooses for them. We will not know whether a particular individual might be in this or that facility at a given time; but we will be able to attach a probability to there being a total of 100 people in a particular facility at a point in time. It is this overall picture which the simulation is intended to build up.'

Stochastic methods have been used to represent activities at very different scales. At a city scale, techniques have been used by Donnelly, Chapin and Weiss (1964), Marble (1964) and (1967) and others. At the scale of the individual building similar methods have been used in a pioneer study of circulation in hospitals (Souder et al. 1964).

Work by Hemmens (1966) on the linkages between different elements of the urban structure would appear at first sight to be similar to the problem of representing activities within the home. Hemmens represents the number of trips from a 'trip purpose origin' to a 'trip purpose destination' as a matrix. From this a second matrix of 'linkage co-efficients,' or transition probabilities, is derived giving the probability of a trip P_{ij} from location i to location j. This stochastic matrix is then used to estimate the probable number of trips of different types.

Similar methods have been used in the study of activity patterns within hospitals by Souder et al. They found that routine activities and the patterns of circulation exhibit certain similarities, independent of the particular location of the different elements of a hospital. The existence of these similarities and the independence of activities and location is essential if the simulation of activities in hypothetical hospitals is to be achieved.

Whether such methods will be of use for simulating activities in dwellings depends on the degree to which it is found that similar routines operate in various house types. It must be made clear that when referring to routines the time element is not a critical factor as it would be in hospitals and other large institutional buildings, more critical is the frequency with which activities happen. The emphasis is on time only to establish sequential relationships between activities and people, and to isolate critical situations which arise from different kinds of activities happening simultaneously, and so making conflicting demands upon a dwelling.

Negroponte has written that,

> "The simulation of activities can benefit the architect in two ways. If the designer does not fully understand the behavioural aspects of an event, he can play with rules and regulations, searching for recognizable activity

> patterns. In other words from empirical knowledge of a set of actions and reactions for specific environments, a designer could inductively compose postulates or algorithms applicable in other contexts.
>
> The second design application, pretesting, assumes the rules are correct. Whether empirical or experimental, simulations are no better than their underlying rules, whether the rules are provided by the man or by the machine. ... Someday designers will be able to subject their projects to the simulations of an entire day or week or year of such events as use patterns and fast time changes in activity locations."[1]

Although the simulation of activity patterns is not the immediate purpose of the present study, it is surmised that many of the techniques used for gathering information relating to the design approach outlined, notably for determining the sequences in which activities occur, could also be used for simulation models.

Some of the techniques outlined are likely to be of use for constructing activity models for dwelling, however, they presuppose knowledge of the pertinent activity patterns. In

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[1] Negroponte in 'The architecture machine.'

many ways it is more difficult to obtain information about human activity in a residential setting than in any other. The reasons for this are of course the intrusion into the very private realm of a home.

B. Proposed Method for gathering information

A problem posed by the small scale of residential activity models is that of acquiring information which is reasonably accurate. The presence of observers within dwelling units, would at least in the short term, lead to changes in behaviour on the part of the occupants. Normal time and motion study techniques are not therefore appropriate, the only methods which seem feasible are time budgets, questionnaires and maps which the respondents complete themselves.

Visual methods were considered whereby the respondent positioned symbols representing activities, and numbers referring to the sequence of the activities, on maps, so giving the location of actions. However, means could not be found of simplifying the process sufficiently to ensure a good response.

Time budgets were chosen as they were the simplest method for gathering all the relevant information, and the easiest for the respondents to use.

They consisted of charts divided into 15 minute intervals, each family member was asked to fill in the activity that they were pursuing at the appropriate time, and to also denote the location of that activity by means of a letter. It was felt that more accurate information would be obtained if the respondents were free to describe activities in their own words, rather than predetermining the categories, although the latter course would have made the data easier to process.

It will be possible, however, to use the categories arrived at through this initial study, in a form which can be used directly by computers.

A sample of the questionnaire used is shown in the appendix, Table 2 .

C. The Survey

Selection of the sample:

The location of the study was a new suburb, Fort Richmond, located adjacent to the University of Manitoba, at which many of the residents were either employed or studied. It was decided to collect information from three housing types - apartments, townhouses and single family detached houses. The original intention was to use two different floor plans for each type, so that inter-type comparisons could be made which were not influenced by a single floor plan. For this reason a housing development was selected which offered both three and four bedroom townhouses, and two bedroom apartments with a variety of floor plans. Single family detached dwellings situated nearby were to complete the sample.

Variations in family composition were expected, the only condition for inclusion in the study was that a family should have children. However, respondents were visited during the afternoons, which generally precluded working wives from the study.

No information about occupations, working hours or income was obtained although wide differences existed in the living costs in the dwelling types. The detached single family homes were distinguished by the fact that they were owner occupied whereas the townhouses and apartments were rented.

Most of the other variables likely to affect the pattern of activities, applied uniformly across the sample group. Respondents were asked to record activities for a weekday, the time of year was constant for the total sample, mid-winter, end of december to the beginning of january, when the greatest amount of time is likely to be spent inside the home.

Questionnaires:

Originally fifty-one questionnaires were delivered personally, residents were asked to complete them within a few days, when they would be collected. The response from residents of the apartments and B2 townhouses was so low that a further study had to be conducted in another residential development, Baylor Place. This time the response was very positive, the response from the various dwelling types is shown in the following table.

Dwelling type	Nos. questionnaires	Returns
Apartments A	18	6
Apartments (Baylor)	21	17
Townhouses B1	18	14
Townhouses B2	9	4
Townhouses (Baylor) B2	11	7
Detached Houses C	14	11

Some questionnaires were incompletely recorded, in others the household did not contain children (in apartments only), and for these reasons the original number of time budgets were reduced to a total of forty-seven -

	dwelling type
11 apartments (Baylor)	A
14 three-bedroom townhouses	B1
11 four-bedroom townhouses	B2
11 detached single family houses	C
Floor plans of each type are shown	1 below.

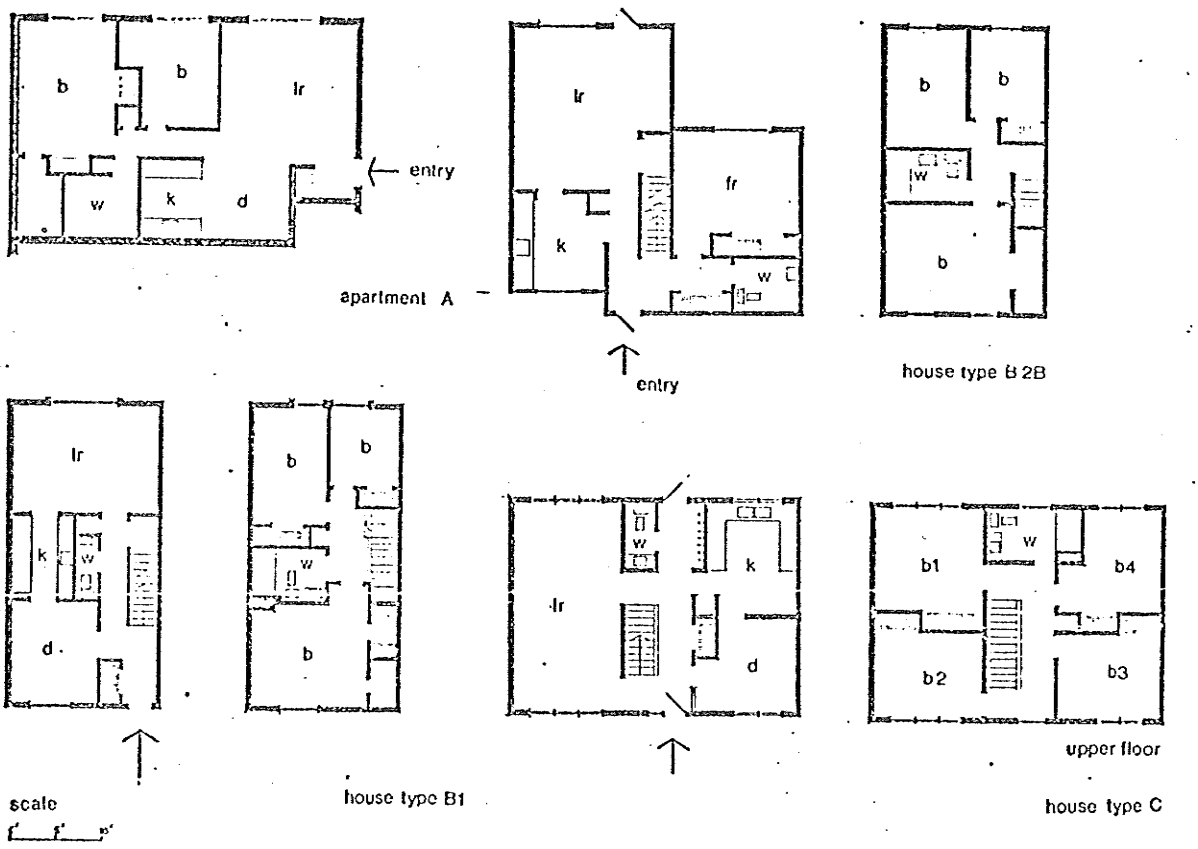


Figure 1 - Floor plans of dwellings

D. Data Processing

The objectives were:

1. To order and classify the information in such a way that it was reduced to its basic dimensions without losing any meaning.
2. To structure the data so that it could be stored in a manner which allowed for easy retrieval of information. It was proposed that further use would be made of the data after the immediate objectives had been met.

In the activity study data was collected relevant to the following variables:

1. People
2. Activities
3. Locations (by room and by house type)
4. Time

The survey covered 47 families, approximately 200 people; this number multiplied by the number of variables indicates the size of the processing problem.

1. People

The variety of cultural, social and psychological influences effecting behaviour is infinite. However, the three major factors which influence the activity pattern of individuals within a family are: age, sex and marital status. In social institutions other than the family, other factors will be of

greater significance, but within most families roles are determined by age and sex. The role that an individual assumes will greatly effect the type of activities that he or she performs within the dwelling.

All respondents have therefore been classified into the following categories:

P1 - husband

P2 - wife

P4 - infant up to 18 months of age

P5 - child below school age

P6 - male child 6 - 12 years

P7 - female child 6 - 12 years

P8 - male teenager

P9 - female teenager

Note: it was later decided that for the information presented two major child categories would be sufficient, these were:

P4 - pre-school children, P6 - school-age children.

It was found to be impossible to find families with similar size and composition, therefore the only condition for inclusion in the study was that each family should have children.

2. Activities

Activity categories were not pre-determined, but from all the activities reported by respondents 22 major classifications emerged. The author personally categorized activities

reported to ensure a uniform classification.

The twenty-two categories and the abbreviations used in processing are as follows:

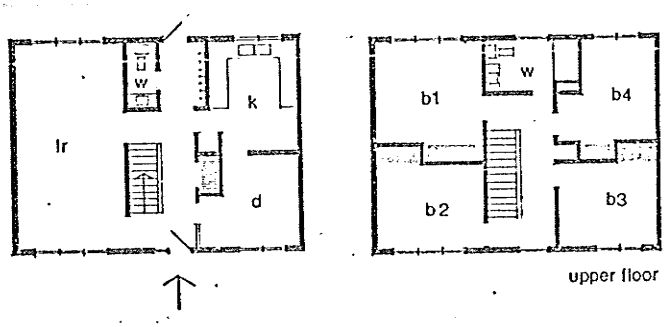
ACTIVITY CLASSIFICATION

category	abbreviation	major category
sleep/rest	sleep	
personal hygiene	hygie	
dressing/grooming	dress	
infant care	icare	infant care
food preparation	foodp	
house cleaning	clean	housework
laundry	laund	
ironing	irong	
family meal	fmeal	
light meal	lmeal	meals
drinks/snack	snack	
relaxation	relax	relax
sewing	sewng	
quiet hobbies	quiet	quiet
active/noisy hobbies	activ	
television viewing	teeve	television
entertaining (casual)	centg	
entertaining (formal)	fentg	social activity
telephone	phone	
study/homework	study	study

3. Locations

The physical substance of an environment consists of relatively permanent and static structural features such as walls, roofs and floors, which act as barriers against visual, acoustic and tactile stimuli. An environment consists also of relatively impermanent and mobile elements such as furniture, equipment and services such as lighting, the effects of which can be changed instantly. It was not possible to include these impermanent variables in the study but as by their very nature they are changeable, the effects of them are considered less significant than the effects of the permanent, static boundaries. Such boundaries in most instances demarcate rooms. Room locations were marked on the plans used in the survey by the following notation:

Living room	LR
Kitchen	K
Dining space	DR
Bedrooms	B1-4
Bedroom/ Family room	FR
Washrooms	W1-2
Basement	Ba



Respondents were asked to note the location of every activity that they recorded.

Each dwelling type was notated in the following manner:

Apartments - A, Small townhouses - B1, Four bedroom townhouses - B2, Single family detached houses - C.

4. Time

The time-budget questionnaire divided time into 15 minute periods, and respondents were asked to record the activities of every member of the family for every 15 minute interval that they were inside the dwelling. The study was concerned with the time period from 6.30 a.m. until midnight (later if respondents not sleeping), the night time hours were not thought to be sufficiently relevant to the concern of the study to be recorded.

Time was the variable by which the activities were ordered, and was used as a unit of measurement.

Units

On the time charts respondents were asked to record activities for every fifteen minutes - this fifteen minute time period was established as a UNIT OF USE.

A UNIT OF USE is related to the performance of an activity for a time period of fifteen minutes - it measures 'quantity' of activity expressed in time.

A sum of such units can comprise:

a. an activity performed by one person which lasts a long time, i.e. many fifteen minute units, or
b. a single activity lasting only fifteen minutes; (one unit) which is performed by many people, or
c. any combination of the two, a. and b.

Quantity of activity is determined by both the number of people performing an activity, and by the duration of the activity in time. The 'unit of use' measures this quantity and does not distinguish between the two components. For example figure 3A shows the average 'magnitude' of each activity in each dwelling type (in 'units of use' divided by four - i.e. hours) it illustrates quantity of action, it does not show whether one person watches television for eight hours or if four people watch for two hours. What is significant is the relative value of that activity to other activities and to the total pattern of activities. The concern throughout is not for absolute measurements but for relative values.

Processing of data

The large quantity of data necessitated the use of an electronic computer. If this had been realised earlier a certain

amount of translation could have been avoided, and in future studies the activity classifications determined could be used on specially designed computer cards. On such cards the respondent can check the relevant activity and location for each time slot. These cards could then be fed directly into the computer.

Data was punched onto cards in the following categories:

dwelling type:	time:	location:	person category:	activity:
A1	1700	LR	P1	relax

The card format allowed for relatively easy retrieval of information concerning any combination of variables with simple counting, or more lengthy linking programmes.

E Analysis of Data

1. INFORMATION RELATING TO THE DESIGN APPROACH - THE SHAPING OF THE BUILT ENVIRONMENT

a) Population characteristics:

It was not feasible to obtain a statistically valid sample, and so the population characteristics are not of general significance, but apply only to the present study. The details of family size and composition are however of considerable importance for accurate comprehension of the data, particularly where comparisons are made between the (activities of) the average family for each dwelling type. Individual residents of apartments might spend as great a proportion of their day watching television in the living room as do residents of the large townhouses, but because the family size is larger in the latter, and the figures given (units of use or hours), relate to the complete family, the total amount of television watching will be greater, although not necessarily for individuals.

Figure 1A refers to the total population, and average family size for the four dwelling types. It can be seen that there is considerable variation, apartment dwellers having the smallest families, and residents of the four bedroom townhouses the largest.

Figure 1A also shows the family composition of the sample households. The four bedroom townhouses have by far the

largest number of school age children but very few pre-school children - whereas both the apartments and three bedroom townhouses have few school age children but comparatively more pre-schoolchildren. This fact can be expected to influence the nature of the activities performed within the various house types.

It is perhaps surprising that the dwellings with the largest floor area, the detached houses (C), have a smaller average family size, and a smaller total population than the large townhouses (B2).

The table below gives the amount of use, (average per household) in 'units of use,' made of each dwelling type by each person category:

P1 - husband, P2 - wife, P4 - pre-school child, P5 - school age child.

	P1	P2	P4	P5
A	30.5	59.0	38.5	6.0
B1	34.0	55.0	69.0	19.0
B2	22.5	63.3	32.9	86.3
C	26.5	58.3	39.0	33.4

The wives, as could be expected, spent a far greater amount of time in the home than did husbands.

The greatest difference was in the B2 type where wives spent three times as much time in the home as did husbands. Most

noticeable, however, is the difference in the units of use for children because of the variation in the total number in each age category.

b) Information concerning requirements for topographic space - the nature of the activities performed:

A total of 57 activities were reported, covering a wide range. The response was relatively uninhibited, many respondents took the trouble to differentiate activities to a greater level of detail than was necessary for the present study. Time budgets proved successful in elucidating information, although the 15 minute time interval seemed to deter respondents from recording many activities which, although of short duration are not insignificant. But if the time interval is shortened the task of reporting is likely to become too onerous, an average of 10-15 minutes was taken to complete the time budget as it was.

A full list of all activities reported is shown in figure 1B.

FIGURE 1B

List of Activities from Richmond Village Survey.

household duties	personal care	relaxation	care of children	sleeping
cooking	shower	playing	dress ch.	
clearing table	dressing	eating	feed baby	
cleaning	bath	drinking coffee	amuse ch.	
making beds	makeup	resting	bath baby	
laundry	shave	reading		
vacuuming	change clothes	relaxing		
baking		watching tv		
loading dishw.		listen to music		
cleaning		storytelling		
tidying		studying		
sorting clothes		jumping		
housework		bridge		
serving food		teach piano		
wash dishes		listen to radio		
ironing		table tennis		
dusting		run around		
		physical exercises		
		singing		
		practice		
		potter around	relaxation(contd.)	
		talk on phone	knitting	
		chat with friends	painting	
		talk with husband	play piano	
			writing	
			finishing furniture	

c) Information relating to requirements for relationships

Sequential relationships between activities

It was indicated in the section on the 'design approach' that sequential relationships between activities usually indicate functional connections. These sequences can therefore be translated into the 'flow' diagram familiar to architects.

Figure 1C(1) illustrates the sequences which occur more than twelve times among the total number of households in each dwelling type. Because there are fourteen households of the B1 type, and only eleven of the other three, the total number of sequences is slightly higher for the B1 type.

The only sequences occurring daily in the households comprising each type are:

sleep -- hygiene
meals -- child play
child play -- meals
food prep. -- meals

Note: the preceding activity is always shown to the left of following activities.

Sequential relationships which are characteristic of families with pre-school children, (particularly dwelling types A and B1, see figure 1A) are:

food prep	infant care (A)
housework (clean)	infant care (A,B1)
child play	hygiene (A,C)
child play	sleep (B1)
sleep	dress (B1)
child play	meals (B1)

Sequential relationships characteristic of families with older children are those involving television:

child play -- television (B1, B2)

television -- child play (B1, B2, C)

The activity most often following meals is child play, somewhat surprisingly television is not significant, B2 dwellings with ten sequences is the highest.

Cleaning (housework) is only important for two dwelling types B1 and C, but for these families cleaning after meals must be a regular routine as it occurs almost thirty times (in households numbering 25 - total for one day).

The sequence of sleep --- hygiene --- dress --- meal, is constant for all types excepting the B1 townhouses, in which the dress category occurs after sleep.

In the 'Design Approach' it was proposed that sequential relationships can be used for allocating spaces to the most functional positions, and that in some instances the locations of activities happening sequentially should be proximally

related. The results of the study confirm some beliefs of this nature, for example: food preparation preceding meals, and sleep preceding personal hygiene. However, as important numerically as these relationships, are those involving large numbers of children, for example: child play -- meals, and meals -- child play. This suggests that the locations for child play should be related to those for meals and food preparation, especially as child play for the youngest children usually takes place under the influence of the mother.

d) Information relating to the value of activities

1. Essential/Discretionary activities:

For the purposes of the housing study essential activities are seen as those which occur in every household each day; discretionary activities are those which do not occur daily. This concept is elaborated upon in the section on the 'Value of activities.' Briefly it is proposed as a method for determining those activities of highest priority, indicating an order in which the physical requirements for activities should be met.

To obtain the information a simple graphic technique was used. Matrices of activities for each dwelling type were marked on transparent plastic so that they could be overlaid. Activities of each type for every household and those were recorded. In this way essential activities, common to all households, could be identified and those appearing in over 50% of

households (discretionary/frequent), these are shown in figure 1D(1) below.

Figure 1D(1)

Essential activities:	Discretionary activities:	
	Frequent	Infrequent
family meal	quiet hobby	active hobby
light meal	child play	social activity
sleep	relaxation	study
personal hygiene	television	telephone
dress		snacks
child care		laundry
food preparation		ironing
housework (clean)		

2. Frequency of occurrence and duration of activities

Frequency of occurrence:

Figure 1D(2) gives the number of times per day that each kind of activity occurs in the average household, it does not refer to the frequency of performance of activities by individuals. For example the category 'meals' has a frequency of 23 - this does not mean that 23 mealtimes occurred, but that the average family of 4 individuals ate or drank 23/4 times or 5¼ meals per person.

All activities of a recurring nature were counted as a new activity in each instance that a recorded activity was of a

different kind to that which preceded it.

For example:

time budget.	9.45	laundry
	10.00	laundry
	10.15	telephone
	10.30	laundry

Laundry would be counted twice only and telephone once.

The most frequently occurring activities were - meals of all types, child play, housework and television.

Magnitude of activities:- frequency x duration scale

The magnitude of activities describes the total of the units of use for any activity.

Figure 1D(3) gives the magnitude for the activity of an average family in all house types.

Meals and child play are seen to be significantly greater in magnitude than any other activities. The relative distribution of them as compared to television and housework indicates that they must be of slightly longer duration than the latter (i.e. comparison between magnitude and frequency). The order of magnitude of activities, with the greatest at the top, is as follows:

10 child play

9 meals

8 television

7 housework

6 quiet hobbies

5 relaxation

4 infant care

3 study

2 active hobbies

1 social activity

In the 'Design Approach' it was explained that a frequency/duration scale (magnitude) could be employed as a criterion for the determination of the 'value' of activities.

The other criteria contributing are:

1. the importance of the activity for the functioning of the whole, determined in the present context by the classification of activities into essential and discretionary categories. In future methods could be resolved by which individuals with particular ways of life (as manifest in activity patterns), could determine an importance scale for the activities in which they participate, Whilst such a method could be utilized on an individual basis, it could also be developed to meet the requirements of particular groups within the population - families with pre-school children, families with school-age children, families in which musical instruments are played, and so on. An 'importance' scale could provide

increasingly valid and objective estimates of the spatial needs of families, or any other social group.

2. the number of persons performing an activity is indicative of the importance of that activity, and like the other variables constituting 'value,' can be estimated from general data such as that presented here, or from specific cases.

A basic method for synthesizing the value of each variable is to use a matrix, an example is shown in which the values for each variable are derived from the data of an average family for all the dwelling types surveyed.

Figure 1D(4)

The Value of Activities: for a household representative of the total sample.

activity	importance		magnitude		nos. people	total value
meals	10	+	10	+	4	(24)
housework	10		8		1	(19)
infant care	10		4		1	15
child play	8		11		2	(21)
television	8		9		3	(20)
active hobbies	5		2		2	9
quiet hobbies	8		7		2	16
relaxation	8		6		2	16
social activity	5		1		3	9
study	5		3		1	9
sleep	10		12		4	(26)
personal hygiene	10		5		4	(19)

Note: the importance scale incorporates only three categories; essential - value 10, discretionary/frequent-value 8, and discretionary/infrequent - value 5.

It must be emphasized that the total value is not to be interpreted as being absolute: it is significant only in relationship to other values, for dissimilar population groups. Further refinement of the method, and data considering a wider range of variables, such as season, social class etc. is needed for a full utilization of the method.

FIGURE 1A

CHARACTERISTICS OF SAMPLE POPULATION

DWELLING TYPE	TOTAL POPULATION	AVERAGE FAMILY SIZE	FAMILY COMPOSITION NUMBER OF PERSONS (0 4 8 12 16 20 24 28 32)
A Apartment	33	3	Husband Wife Pre-School child Schoolage child
B1 Townhouse	53	4	
B2 Townhouse	55	5	
C. Detached house	45	4	

FIGURE 1C (1)

SEQUENTIAL RELATIONSHIPS BETWEEN ACTIVITIES IN DWELLING TYPES: A B1 B2 C

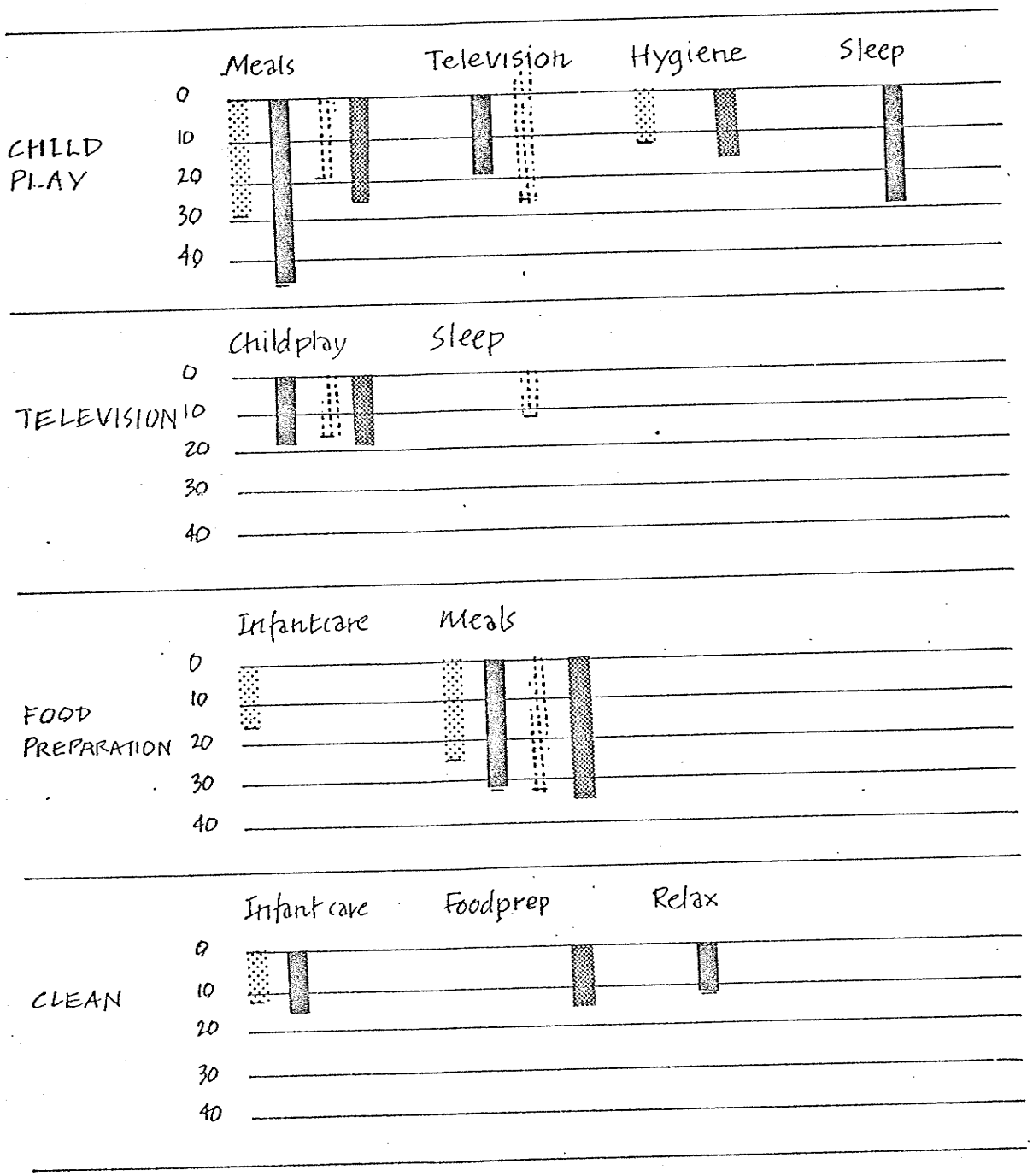


FIGURE 1C (1)

SEQUENTIAL RELATIONSHIPS BETWEEN ACTIVITIES IN DWELLING TYPES: A B1 B2 C

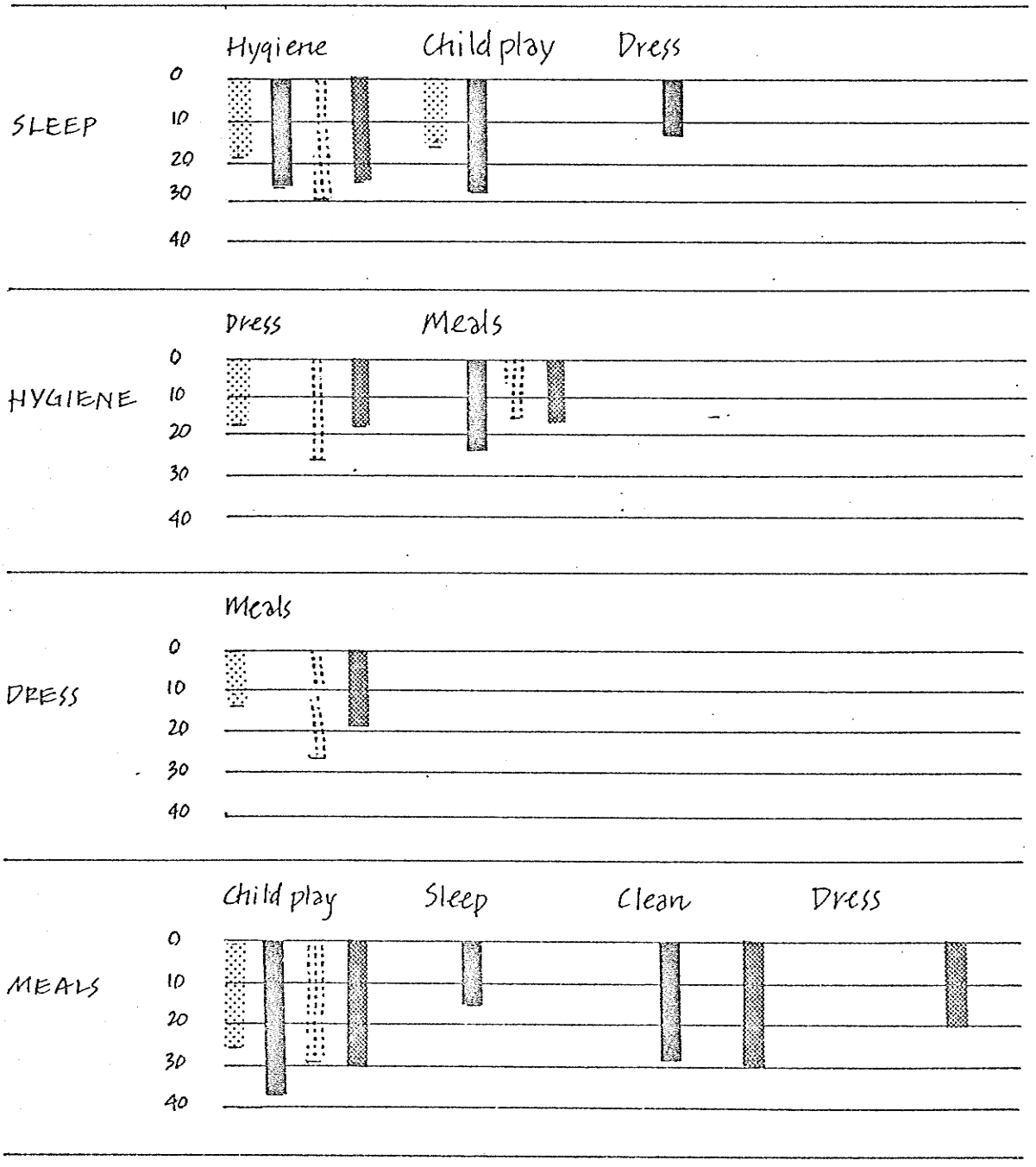


FIGURE 1D (2)
FREQUENCY OF OCCURENCE OF ACTIVITIES:
FOR AVERAGE FAMILY IN ALL HOUSE TYPES PER DAY

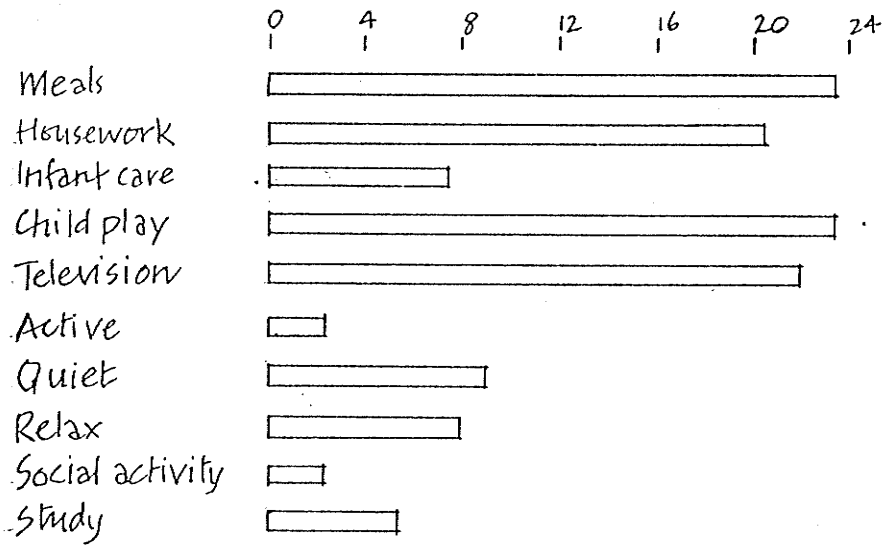
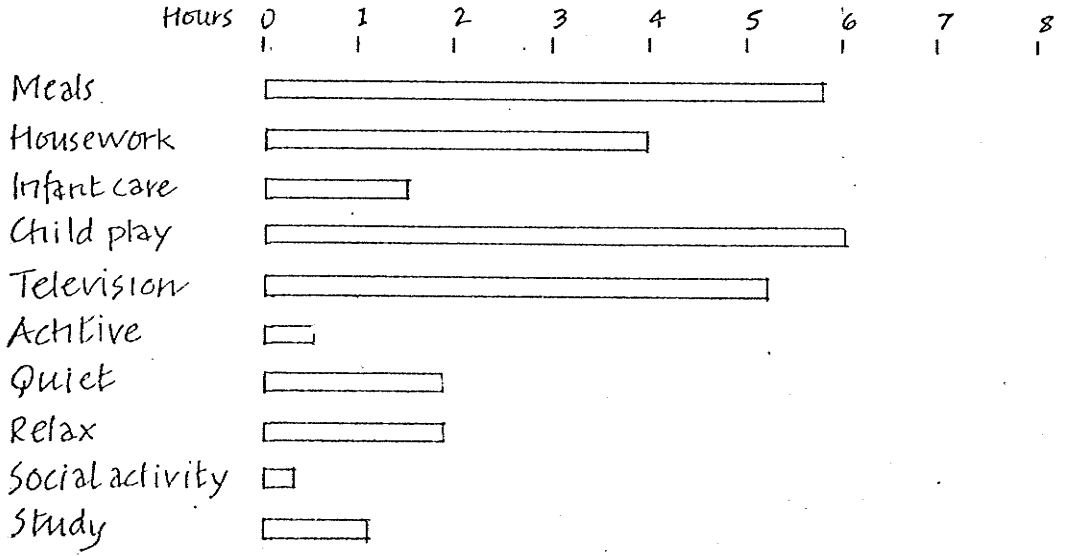


FIGURE 1D (3)
MAGNITUDE OF ACTIVITIES: FREQUENCY X DURATION:
FOR AVERAGE FAMILY IN ALL HOUSE TYPES PER DAY



2. INFORMATION RELATING TO THE DETERMINISTIC EFFECTS OF SPATIAL ORGANIZATION

The following postulate has been stated:

> "that particular elements of the physical form of dwellings; specifically the shape and area of rooms, the degree of openness/closure of the internal boundaries of the dwelling, and the spatial proximity of room/locations, will effect the nature of the use made of such rooms."

In an attempt to prove or disprove such a postulate, data was collected pertaining to the activities of families in four dwelling types during a 24 hour period.

It was proposed that comparisons between the activity patterns of residents of each type might illustrate differences in:

A. magnitude of each type of activity
B. use of room locations
C. location of different types of eating activity
D. use of locations by each person category
E. spatial organization related to amount of use.

If <u>differences do exist</u> it may be inferred that to some extent the 'physical form' of the dwelling has been the causal agent in determining residents behaviour. Particular combinations of variables, for example, activity Z occurring more frequently in location K than D when certain conditions

are met, e.g. when D is smaller in size than K or when the boundary between D and another location is 'open,' can be identified. Such combinations can then be tested in other situations, and if found to be consistent, will be of practical significance for determining the relative floor areas, proximity and boundary conditions of various rooms, to ensure maximum use.

If differences do not exist, or are insignificant relative to the differences between households from one dwelling type, the data is still of value. Firstly for providing evidence of 'general patterns of use,' which are necessary in simulation techniques and for model building. And secondly for the examination and testing of the methods used for collecting data, and for the analysis of activity patterns.

a) Magnitude of activities

In figure 3A(1) is given the amount of time that the average household - sum for total of persons in family, spends per day on each activity in each dwelling type.

These statistics must be compared with those in figure 3A(2) - which shows all activities as a percentage of the total activity time for the average family in each dwelling type.

These latter figures take into account the discrepancy in family size between types and allow valid comparisons to be made.

Meals - the amount of time spent on eating of all kinds can be expected to be directly proportional to the number of individuals participating. If reference is made to the population characteristics (figure 1A) it can be seen that there does not seem to be a direct relationship, for the C type has a higher total than the B1 type although the family size is the same. This pattern is confirmed by the percentage scores for each activity. Figure 3A(2) shows the 'meals' category slightly higher for house type C than for B1, the small difference could be explained by the younger population in the B1 type having fewer 'formal' meals.

Housework - it is interesting to compare figures 3A(1) and (2) for this activity, (1) shows far less housework performed in type A than in the three other dwelling types. This could possibly be attributed to two factors - the size of dwelling and size of family. Because type A1 have a smaller floor area than the other types they should take a shorter time to clean, and because A1 also, has the smallest family size less time should be spent on dishwashing and general cleaning up. Such a hypothesis is borne out by the totals for the other house types, B2 with four bedrooms and largest family size has the highest total. However, when seen as a percentage of the total of activities, housework is almost identical for the four dwelling types! This difference is a consequence of the activity totals being different in each type, (as a peripheral issue, it could be interesting to determine if a housework is generally proportional to the total of all

activities in a dwelling).

Child play - reflects the pattern of family composition, with the highest time for B1 and A types which have the greatest numbers of children.

Television - the highest score is in the B2 category which has the highest total population and the greatest proportion of school age children.

Active hobbies - the least amount of noisy or messy activities occur in the apartments and could reflect the lack of suitable spaces, and also a fear of disturbing the rest of the dwelling and neighbours.

Social activity - is minimal in all dwelling types - it does not necessarily reflect an accurate picture however, as people might not record the activities for a day on which they were busy entertaining. The maximum activity is for type C, and might reflect a more affluent or socially oriented way of life.

As was expected, routine or 'essential' activities such as personal hygiene, dressing, are generally of similar magnitude, exceptions such as housework have been noted. The greatest divergence existed between discretionary activities such as child play, television, social activity and 'snackin,' a contributor to the meals category.

The value of this data relating to magnitude of activity is:

1. to indicate the differences in the kinds of activities pursued (can be applied to the value of activities - see figure 1) by various families - which lead to differences in spatial requirements.

2. to provide a valid basis for comparison of the use made of locations in each dwelling type. It is unlikely that in most instances the physical form of a dwelling will prevent the pursuance of particular activities entirely, (with exceptions i.e. active hobbies as noted). It is more likely that the location of an activity will be effected. When making comparisons between the use made of locations in each dwelling type it is imperative to have knowledge of the total of each kind of activity, for if, for example, more eating occurs in house type C - then more use will be made of locations appropriate for that activity i.e., dining space, kitchen.

b) Use of locations

In figure 3B the use made of each location in all dwelling types has been given for an average family per day. Quantity has been expressed in hours - this does not mean, however, that a living room is in use for ten hours a day, but that the sum of the use of all members of a family equals ten hours. Quantity equals "units of use" (15 minute activity periods) divided by four to become hours.

In both type A apartments, and B1 townhouses, the most used

room is the living room, whereas in type C greatest use is made of the kitchen. In B2 townhouses slightly more use is made of the living room than the kitchen. Aspects of the relationship between the living room, dining space and kitchen are subsequently examined with respect to eating activity (Figure 3C).

Both figures 3B and 3C illustrate that in dwelling types A and B1, where the kitchen is small, increased use is made of the living room.

The master bedroom in each dwelling type is of similar size, each is used for uniform amounts of time except in the B1 type, in which the slightly increased use is accounted for by young babies sleeping in the parents bedroom. Bedroom two is smaller in types A, B1 and B2, all are of almost identical size and receive a uniform amount of use. However, bedroom two in type C is used to a lesser degree although it is bigger! The reason for this is the availability of alternative bedrooms, b3 and b4, which in spite of smaller size appear to be used more extensively than B2.

In type B2 the fourth bedroom is on the main level and is identified as a 'family room.' It could have been expected that activities other than sleeping would take place, however, it seems that in spite of its proximity to the most highly used parts of the house, and a larger floor area, it was used no more than bedroom two.

Evidence such as this indicates that the amount of use made of any location is determined not only by elements of physical form, size, shape, proximity, etc., of that location - but by the total organization of all the spaces (formal elements) of a dwelling.

Predictions cannot therefore be made that rooms of similar physical form will be used to the extent described in the present study - unless all other elements of the physical form of a dwelling are also equal.

c) Comparison of the location of eating activity:

Eating activity was classified as being of three kinds:
Family meals - the main meal of the day at which the whole family eats together
Light meals - breakfast, lunch etc.
Snacks - all drinks etc.

In figure 3C the location and magnitude of each kind of meal is compared for dwelling types A, B1, B2 and C.

The only variable uniform for each dwelling type is the location and magnitude of snacks. Living rooms appear to be used for this purpose to a very similar extent, they are however, in only one case - apartments, used for any other kind of meal, (T.V. dinners cannot in many instances be eaten in front of the television!)

Dining rooms appear to illicit contrasting responses, in

types A and B1 they are used extensively. In type A 73% of all meals, and in B1 64% of meals are eaten in the dining space. Whereas in types B2 and C respectively 23% and 12% of eating activity is located in the dining space and 71% and 87% in the kitchen. Comparison of the physical form of the kitchen in all dwelling types, makes it apparent that in this instance size and shape are not the most critical factors. Because whilst the lack of separation between dining room and living area in B2 makes the small degree of use of the former understandable, there seems to be no such reason why the dining room in C should not be used. It appears to adequately fulfill the criteria for physical form previously set out. Firstly it has sufficient area, although the shape is relatively poor, having least width where it is needed by the entry to the kitchen. Secondly, the boundaries and location (the entrance hall separating it from the living room) are such that activities performed within the space do not impinge on any other. The answer therefore, seems not to lie in the adequacy of the dining room itself but in two possible factors. Firstly, the kitchen provides a sufficient alternative with the extra advantages of a closer relationship with the food preparation and servery areas. Secondly, the kitchen has a different 'meaning' to that of the dining room, it is less formal and has more privacy facing onto the back garden rather than the street as does the dining room.

In conclusion, the evidence indicated that only when a kitchen is of insufficient size is a dining space used as the

location for eating. The presence of visitors is a factor which would be of influence, however, in only one instance were any recorded. When a kitchen is of adequate size as in types B2 and C, it is likely to be highly used in spite of the availability of adequate dining space as in dwelling type C.

3D Use of locations by categories of people:

Information relating to use by categories of people becomes more meaningful when read in conjunction with details of family composition. The percentages of people in each category in each house type are given in table 3D(1) below.

	husband	wife	pre-school child	school age child
A	33%	33%	27%	7%
B1	28	28	38	6
B2	18	20	8	54
C	25	25	20	30

The major difference in family composition is in the number of children. 54% of the population of the B2 housetype are school age children but only 8% are under school age, whereas in the B2 townhouses only 6% of the children are of school age but 38% are pre-school.

Figure 3D(2) shows the use of locations by categories of people, the locations most used by school age children are:

living room	(in particular B2)
kitchen	(B2 and C)
bedroom 2	(B2)
bedroom 3	(B1, B2, C)
bed 4/family	(B2, C)

The locations most used by pre-school children are:

dining space	(type B1)
living room	(A, B1)
bedroom 2	(A, B1)
bedroom 3	(B1)
bedroom 4/family	(C)

Basements are not much used by children in either category although pre-school children use them to an identical degree to that of the mother. Perhaps not surprisingly the pattern of use of young children closely follows that of the mother in most locations, the exception being for bedrooms 1 and 2, parents sleeping in b1 and children in b2.

The only deviation from this pattern appears for type A1 in which the dining space is not used by pre-school children. The very young age, mostly under one year, of the children in the sample apartments must account for this. The dining space furnished with table and chairs does not provide suitable crawling or sleeping accommodation.

Interesting contrasts appear between the locations most used by adults. Firstly the total amount of use, for all locations

in all dwelling types, is much higher for wives (see table Total units of use). This is most marked in the kitchen where housewives in the C type spent 24 out of a total of 58 units of use, and in the B2 type - 23 out of a total of 63, 40% and 36% respectively.

There appears to be an inverse relationship between the use made of the kitchen and the living room (shown in figure 3D(2)). Women in dwelling types A and B1, with the smallest kitchens, spend least time in them and correspondingly greater time in living rooms, whereas women in types B2 and C spent longer in the kitchens and less time in the living rooms.

The use made of bedrooms is as might be expected, bedroom 1 the master bedroom, being used in almost all instances by the husband and wife, the only divergence from this pattern is for dwelling type B2 which has a large family room or fourth bedroom on the main floor, and in some cases this is used by the parents for sleeping.

Note: during the counting of data all units of sleep were divided by a factor of four, this results in a distorted picture of the use of locations over a 24 hour period, but in this study of physical determinism it is comparisons between locations and dwelling types that is significant.

In conclusion it might be repeated that the family composition, age and numbers of children, ~~that~~ greatly affects the use of locations. Families with school-age children

make greater use of bedrooms than do families with younger children who sleep in the same room and stay close to the parents, particularly mother. From a sample as small as that in the present study it is probably dangerous to come to definite conclusions, however, it appears that greater use is made of the living room by families with young children than by families with older children who require more separate independent spaces.

If reference is made to Figures 3B(1) it will be seen that the greatest use is made of the living room and kitchen. Figure 3B(2) illustrates the location of activities, it can be seen that the activities of longest duration, television, meals and child play take place in three rooms - living room, dining space and kitchen. This cluster of rooms therefore constitutes the most intensely used part of all dwellings in the survey, and for this reason it was decided to focus on comparisons of the use made of these rooms only.

It must be noted that whilst in dwelling types B1 and C these rooms constituted the total of the main floor, in type B2 there is an additional space, a family room or fourth bedroom, and the apartment, A1, is of course all on one level.

e) Comparison of the spatial organization of four dwelling types with the amount of use made of three locations in each type.

The stated intention was to determine if particular elements of the physical form of dwellings, specifically floor area, boundary conditions and proximal relationships between spaces, will effect the patterns of use of them. By visually describing the physical elements constituting the form of spaces within dwellings, in juxtaposition with a visual description of the quantity of use made of the spaces, correlations can be made of the spatial characteristics of rooms with the degree to which they are used.

Any comparative study of the built environment needs a system of spatial classification. The only work of this type known to the author, is that done by John Musgrove and Charles Doidge of the Unit for Architectural Studies, at the Bartlett School of Architecture in London, published in 'Architectural research and Teaching May 1970.'

In this study the authors classify space by 1) 'effective area' - floor area x a shape factor, 2) facilities - environmental and mechanical services, and 3) zone - location within a complex (relationship of activities).

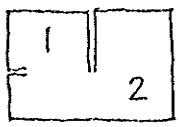
Their work is concerned specifically with university campuses and is consequently of only minor relevance to the present study, however two of the categories they use are similar to

those outlined, namely - area to topographic space, and zone to proxemic relationship.

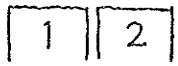
For the purpose of the present study the physical space defining elements already outlined will be used, for although such a categorization is not totally comprehensive, it considers many of the major elements relevant to a residential context. These elements of physical form have been fully described in the 'Design Approach,' briefly they are as follows:

1 Topographic space: floor area (x shape)
2 Sensory space: perimeter boundaries of locations
3 Relationships: the physical proximity of locations

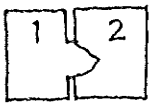
For diagramming purposes, see figure 3E,
<u>area</u> is denoted by a scaled two dimensional grid on which shape is also described,
<u>sensory space</u> is denoted by the percentage of the space which is enclosed by a solid boundary, 50% of any area of the boundary which is glass is deducted: Note in future studies sound transmission factors would be included,
<u>relationships</u> - spatial proximity only is considered, the following are the classifications used:

1 

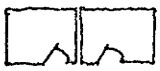
100% proximity - when spaces 1 and 2 have more than one adjacent boundary, which is 'open'

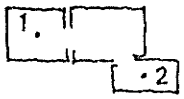
2 

90% - one edge adjacent with no boundary on one face

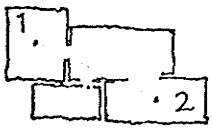
3 

85% - one boundary edge with doorway

4 
75% - one adjacent solid boundary and doors leading into common space

5 

75% x 1/10 distance between mid-points of locations 1 and 2

6 

100% x 1/20 distance between mid-points x number of intervening boundaries

The table below gives the percentage values for the proxemic relationship between: 1 dining space, 2 living room, 3 kitchen, in the four dwelling types.

Apartments

	1	2	3
1 dining	100%	40	85
2 living	90	100	60
3 kitchen	90	60	100

B1 townhouses

	1	2	3
1 dining	100	40	85
2 living	40	100	82
3 kitchen	85	82	100

B2 townhouses

	1	2	3
1 dining	100	90	80
2 living	90	100	45
3 kitchen	80	45	100

C detached houses

	1	2	3
1 dining	100	60	80
2 living	60	100	60
3 kitchen	80	60	100

The following table gives the percentage of the total use of each location in each dwelling type.

dwelling type	Location	total units	percentage of total use
Apartment	dining	104	14%
	living		38
	kitchen		10
B1 townhouse	dining	178	17%
	living		33
	kitchen		12
B2 townhouse	dining	201	5%
	living		26
	kitchen		22
C detached house	dining	160	5%
	living		25
	kitchen		27

To make comparisons truly valid, the units of use for each location were taken as a percentage of the total 'units of use' for the whole dwelling (average dwelling for each house type).

When analysing the diagram, figure 3E, it is easier to first compare the amount of use for each space. It can be observed that the greater the use made of the dining room, the less made of the kitchen - the reasons for this have previously been explained (see discussion of location of eating activity). It appears that the same is also true for the living room, as in dwelling types B2 and C, where least use is made of the dining space, the amount of time spent in the living room also decreases.

The relative floor area of the three spaces, 1 dining, 2 living, and 3 kitchen, appears very significant for it can

be observed that in each instance in which the dining space is larger than the kitchen, it is used to a much greater extent (types A and B1), as is the living room also. But when the kitchen (types B2 and C) is of comparatively large floor area, over 100 square feet, it is used to a greater extent, decreasing the amount of use made of both the living and dining areas. It is obviously being used for activities other than food preparation and eating, (see figure 3B(2)).

Other formal elements appear to have much less effect, than size, although proximity is a factor of significance. The spatial proximity of location 1 - dining space, to location 2 - living space, can be contrasted for dwelling types A, B1 and B2. In both A and B2 the proximity is over 80%, whereas in B1 the two locations are relatively separate, with a proximity figure of only 40%. The much greater use made of the dining room in B1 could be partly attributed to this factor, which is closely related to the boundary condition. In B1 over 85% of the perimeter boundary is closed, in A and B2 only slightly over 40% is closed. The relative openness of the dining and living areas in the latter, results in a general lack of differentiation, with the activities in the two areas influencing each other. Whereas in B1 the dining space is well differentiated boundary wise, and by proximity.

In conclusion itmust be emphasized that all space defining elements considered play a part in determining the extent to which

spaces are used, but it appears that topographic space (area)is in most situations, the major influence.

Of fundamental importance is the confirmation that no single factor can individually guarantee a room being used, it is the relationship among the factors, and the relationship of the rooms to each other that is significant.

Further work must have as its objectives the clarification of these relationships.

FIGURE 3A(1)
MAGNITUDE OF ACTIVITES: COMPARISON BETWEEN DWELLING TYPES: A. ▒ B1. ▓ B2. ⁙ C. ▓
UNITS OF USE FOR AVERAGE FAMILY

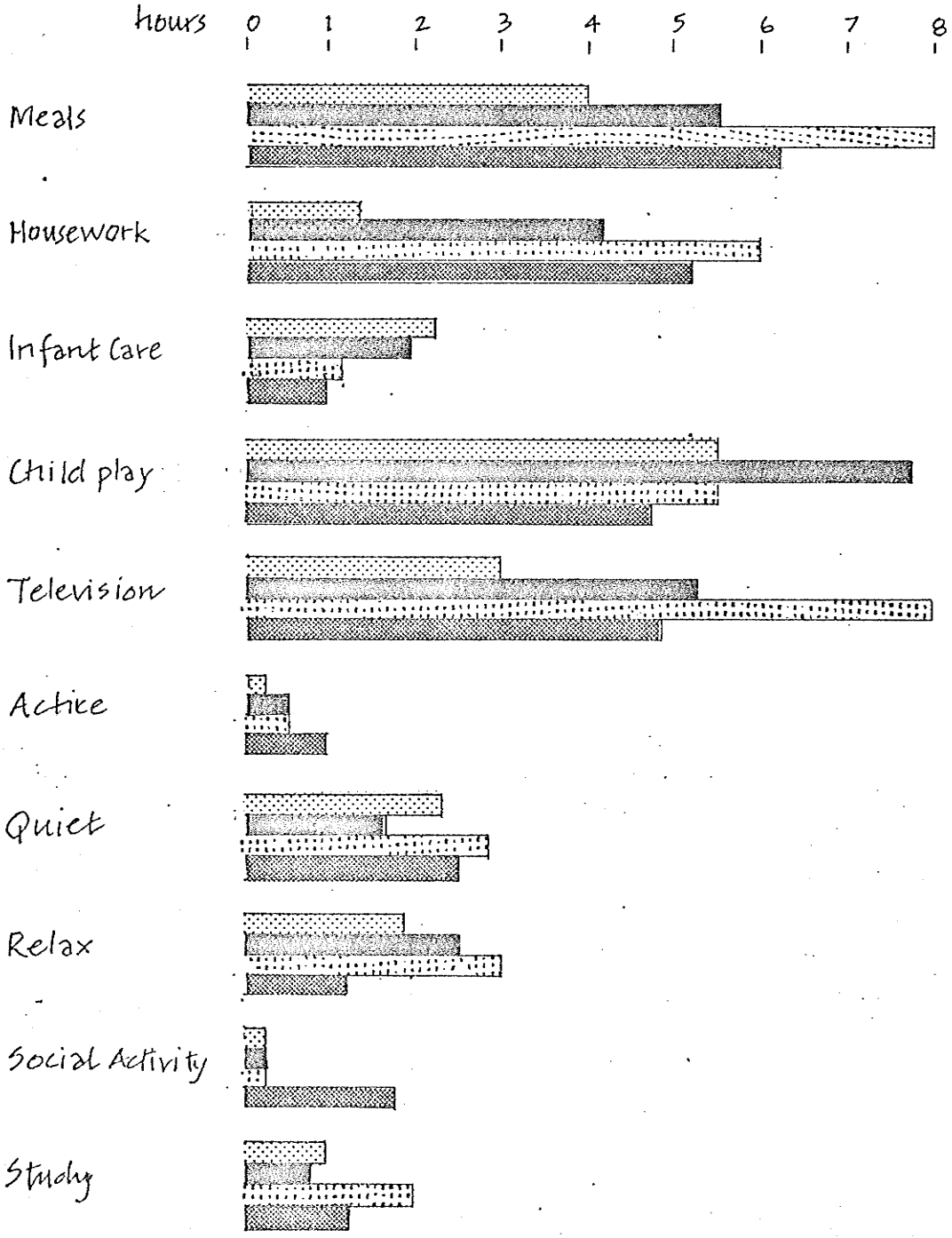


FIGURE 3A(2)
MAGNITUDE OF ACTIVITIES: PERCENTAGE OF TIME (UNITS OF USE) SPENT ON EACH ACTIVITY, EXCLUDING SLEEP, IN AN AVERAGE FAMILY IN EACH HOUSE TYPE

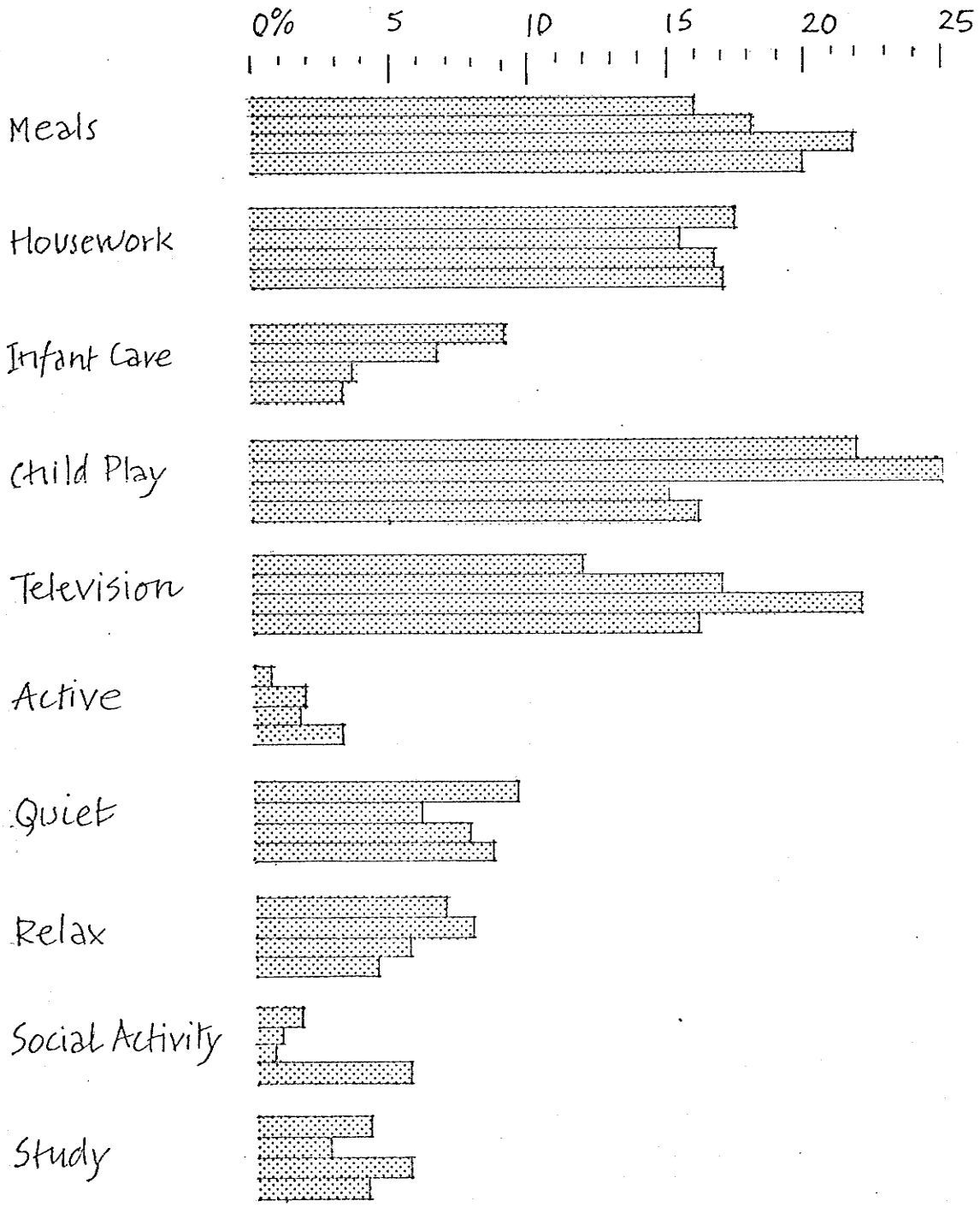


FIGURE 3B (1)

USE OF LOCATIONS - COMPARISON BETWEEN DWELLING TYPES : A. B1 B2 C

ACTIVITY FOR AVERAGE FAMILY IN UNITS OF USE

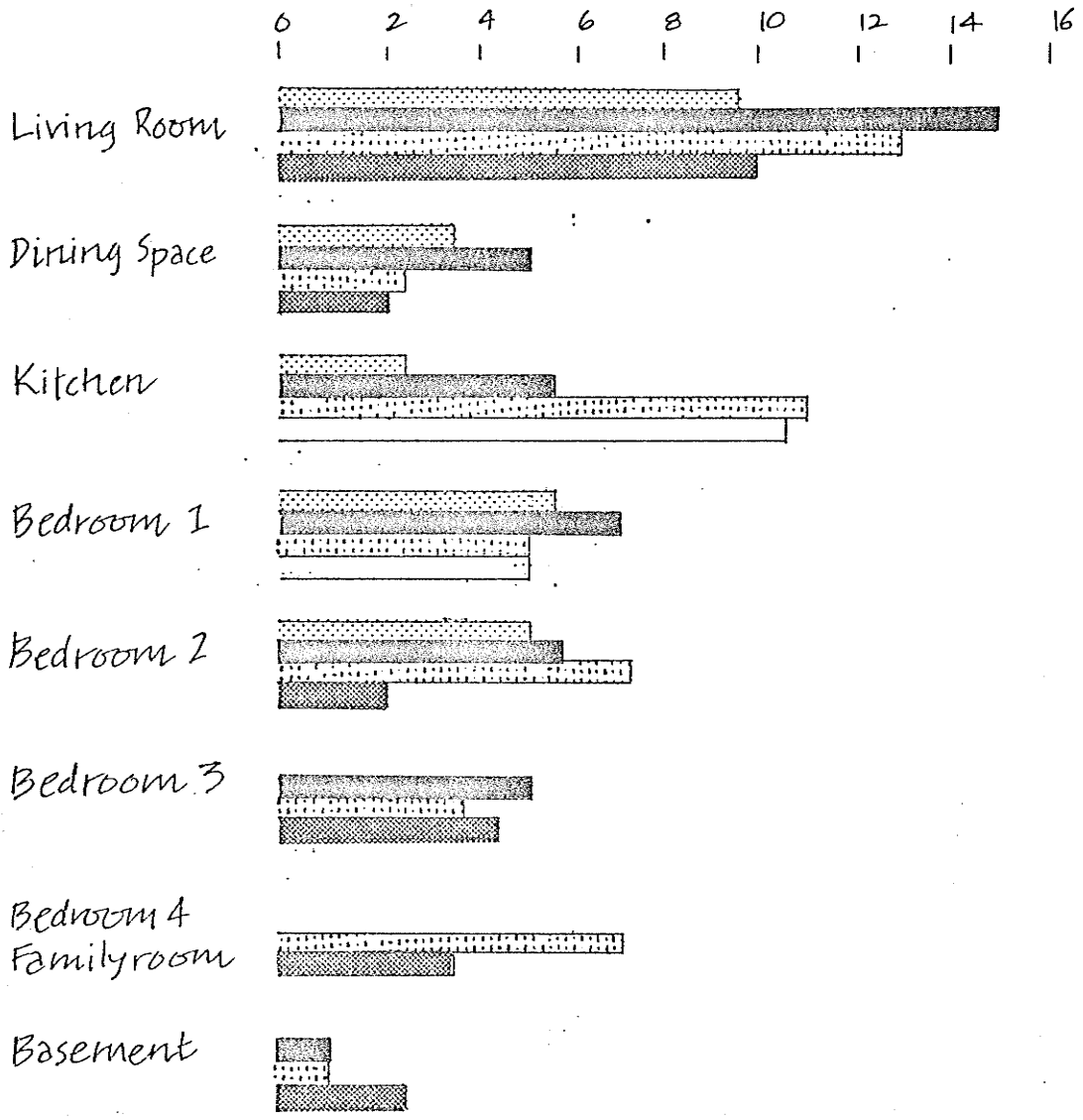


FIGURE 3B(2)

THE LOCATION OF ACTIVITIES

Units of use for each dwelling type: A B1
C B2

	living		dining		kitchen		bed 1		bed 2		bed 3		bed 4/FR		bsmt	
Television	130	285	0	0	0	0	0	0	0	0	0	0	0	0	0	00
	157	311	12	0	0	1	1	0	3	0	0	0	0	44	37	0
Meals	40	22	128	188	13	90	7	3	1	2	0	2	0	0	0	0
	16	11	29	86	213	249	0	2	0	0	7	0	0	2	0	0
Housework	31	20	13	17	125	175	10	12	5	9	0	11	0	0	0	11
	5	14	4	7	239	192	9	12	3	9	2	5	5	11	27	25
Child play	176	298	22	21	2	13	8	1	31	46	0	30	0	0	0	36
	89	98	2	11	44	17	9	13	19	21	16	21	16	39	16	16
Infant care	21	11	19	17	2	16	15	10	49	18	0	0	0	0	0	0
	4	1	0	4	4	11	0	3	17	5	4	11	4	6	0	0
Active	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	4	0	0	0	0	3	0	0	0	0	0	0	0	22	2
Quiet	58	71	17	14	0	0	24	0	1	3	0	8	0	0	0	0
	59	53	10	10	15	9	3	4	3	18	2	11	6	19	7	4
Relax	51	131	2	7	0	0	2	0	1	0	0	0	0	0	0	0
	47	57	0	4	10	7	1	0	2	3	0	0	0	7	0	0
Social activity	7	11	0	0	0	0	0	0	6	0	0	0	0	0	0	0
	43	4	8	0	0	0	0	0	0	0	0	0	0	0	0	6
Study	16	0	4	8	0	0	21	21	7	13	0	30	0	0	0	0
	2	5	5	0	0	12	0	9	5	31	24	16	7	25	0	0

FIGURE 3C
LOCATION OF VARIOUS KINDS OF EATING ACTIVITY:
COMPARISON BETWEEN DWELLING TYPES

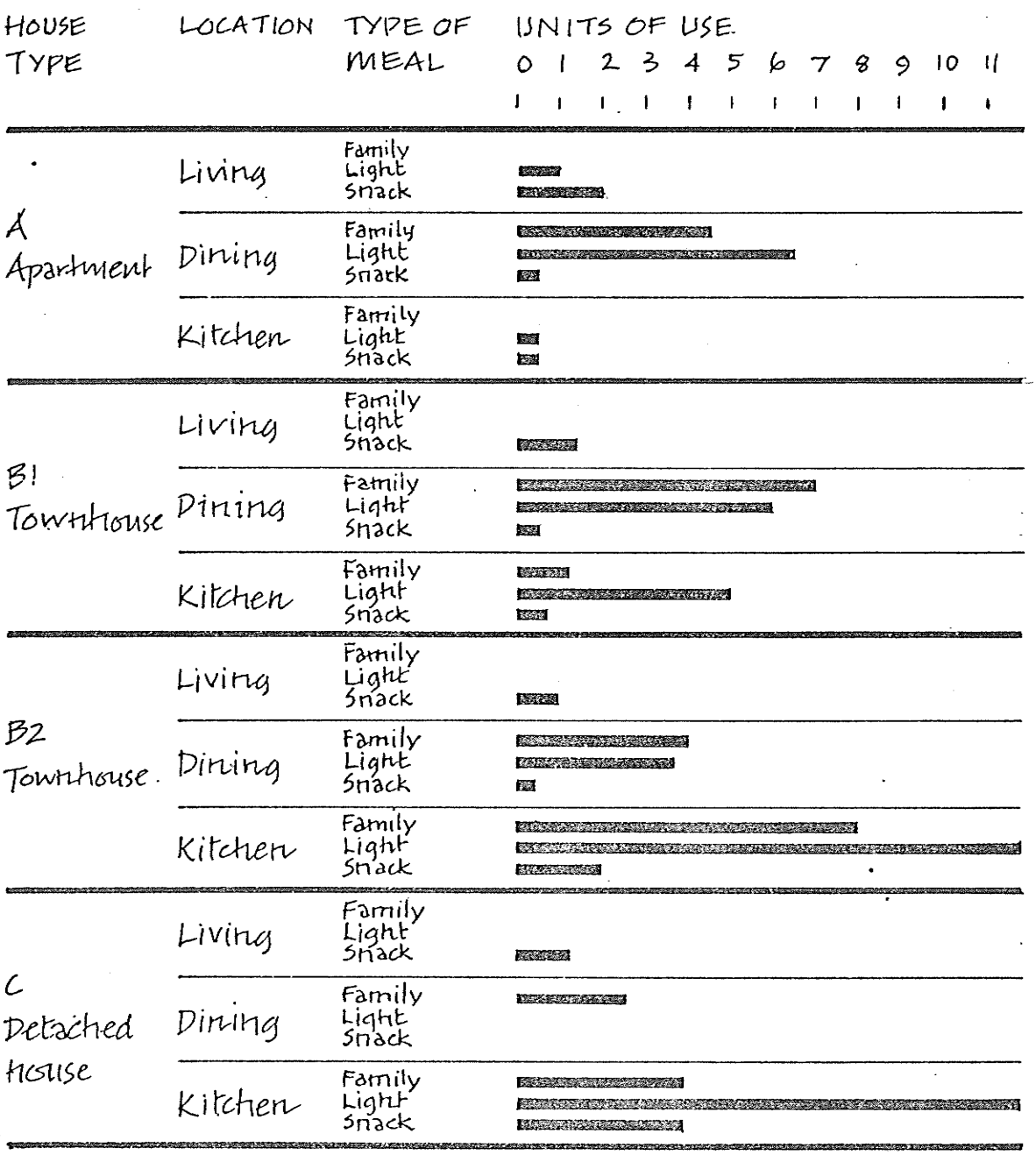


FIGURE 3D (2)
USE OF LOCATIONS BY CATEGORIES OF PEOPLE:
COMPARISON BETWEEN HOUSE TYPES:
A B1 B2 C
UNITS OF USE FOR AVERAGE FAMILY

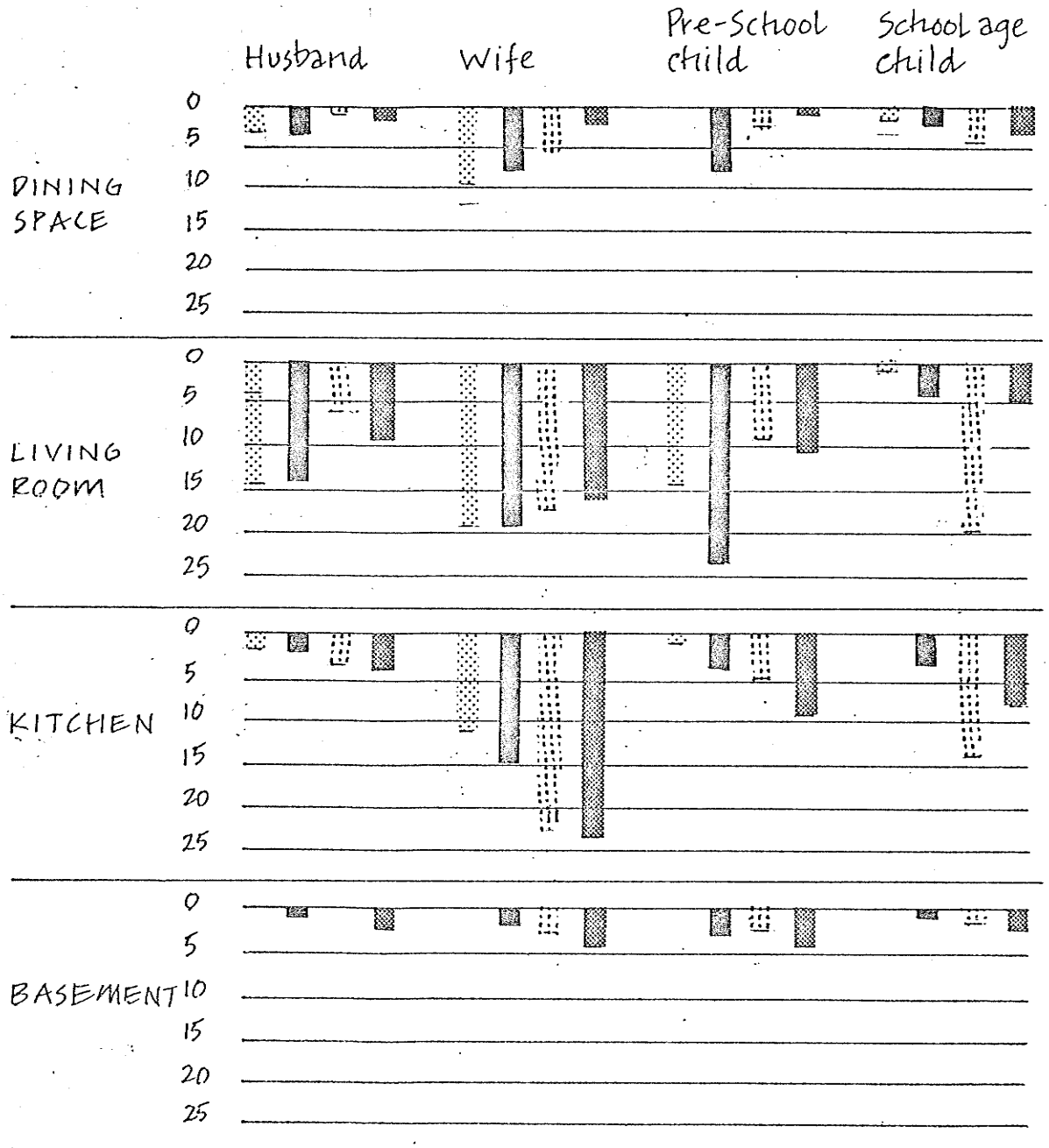
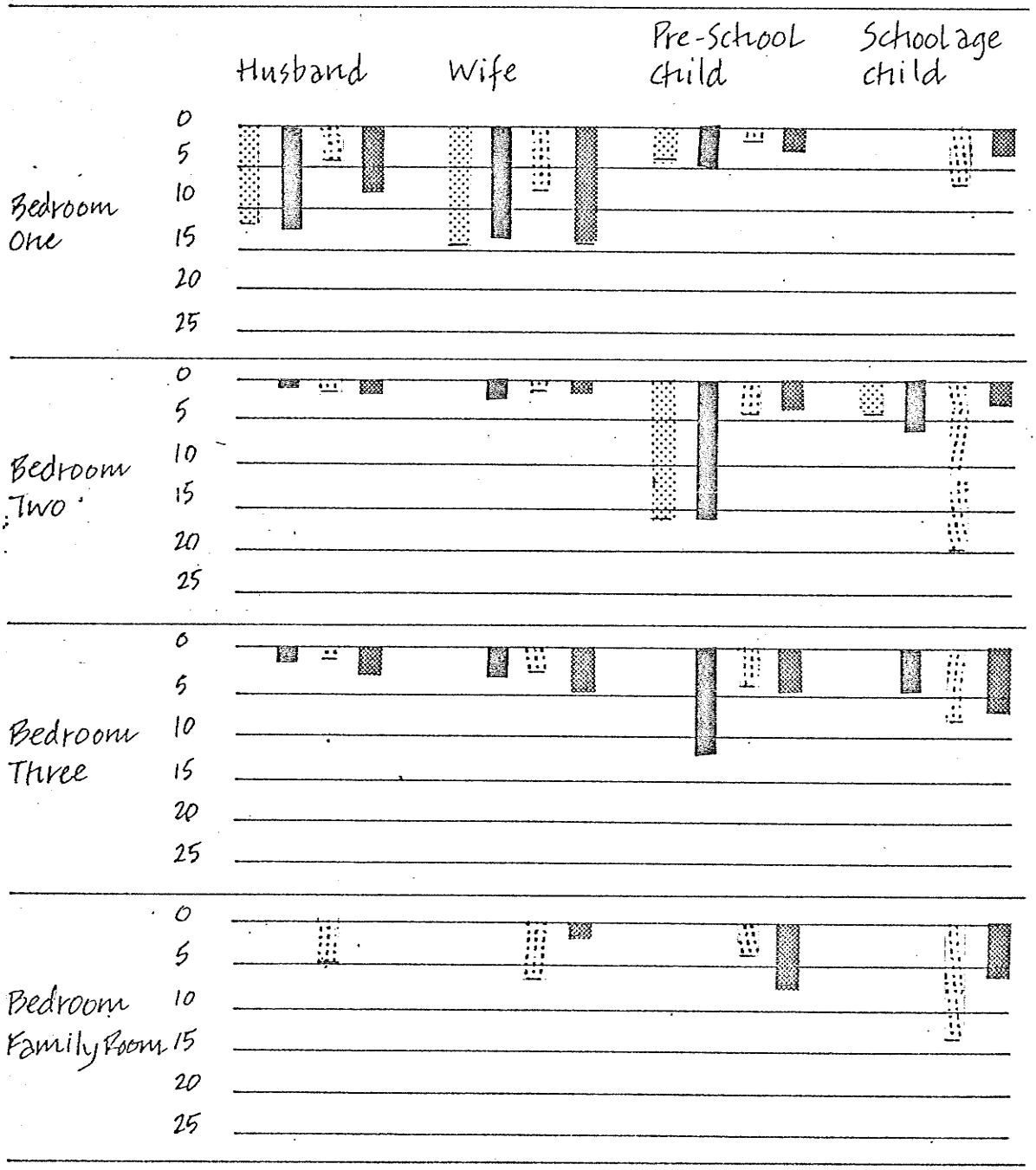
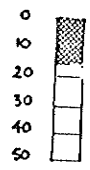
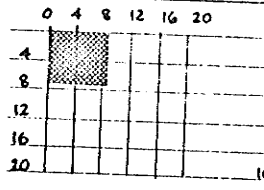
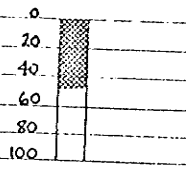
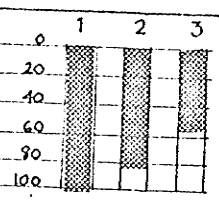
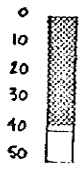
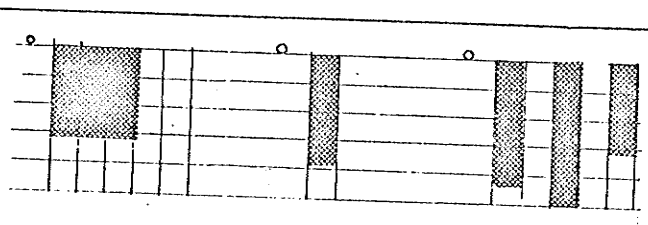
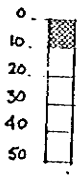
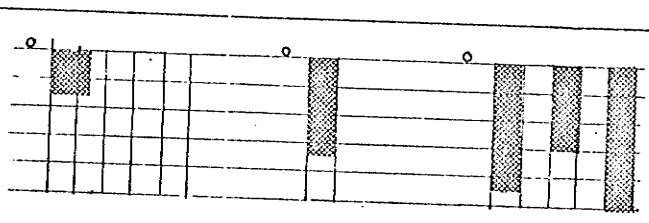


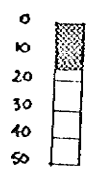
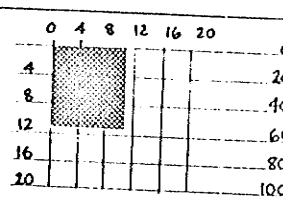
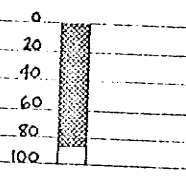
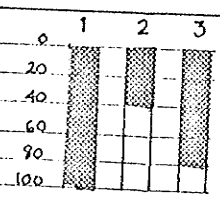
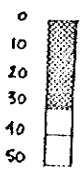
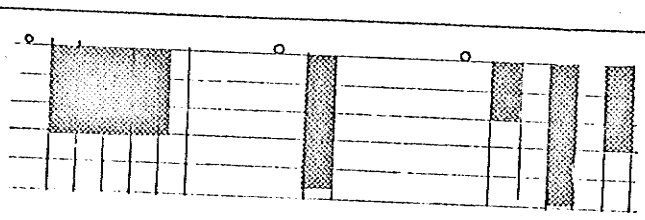
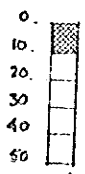
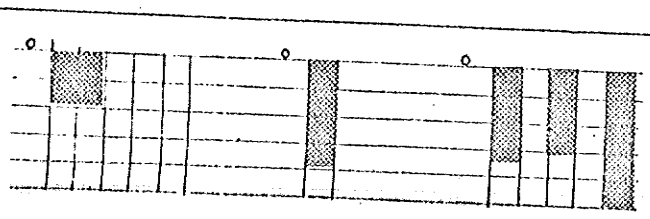
FIGURE 3D (2)
USE OF LOCATIONS BY CATEGORIES OF PEOPLE:
COMPARISON BETWEEN HOUSE TYPES:
A ▒ B1 ▬ B2 ⁞⁞⁞ C ▓
UNITS OF USE FOR AVERAGE FAMILY



MADE OF THREE LOCATIONS IN EACH TYPE

LOCATION TYPE A	AMOUNT OF USE % TOTAL UNITS	TOPOGRAPHIC SPACE AREA IN SQUARE FEET	SENSORY SPACE % BOUNDRY CLOSED	RELATIONSHIPS SPATIAL PROXIMITY TO: LOCATION
1 Dining				
2. Living				
3. Kitchen				

TYPE B1

1 Dinning				
2. Living				
3. Kitchen				

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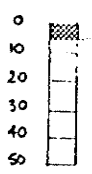
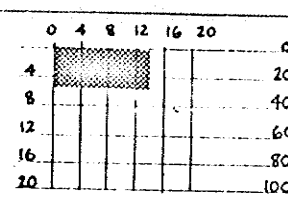
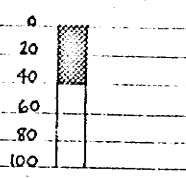
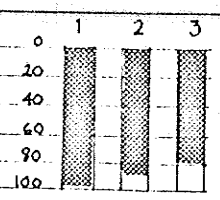
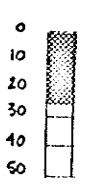
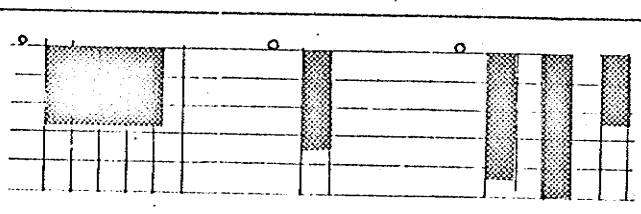
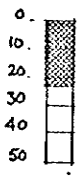
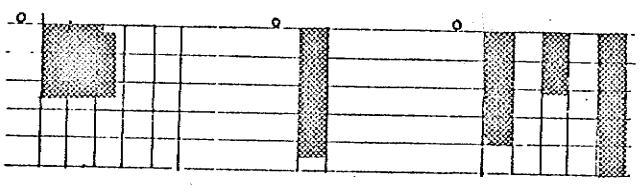
1 Dining				
2. Living				
3, Kitchen				

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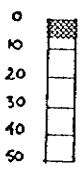
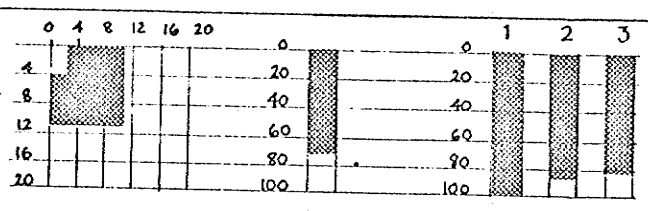
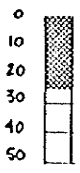
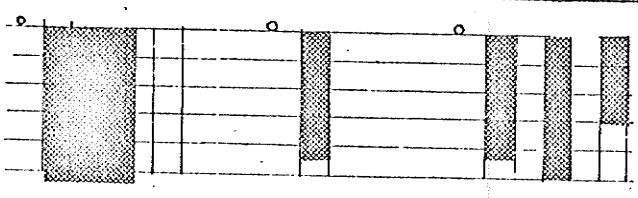
I Dining				
2. Living				
3. Kitchen				

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER WORK

6(1) The Shaping Of The Environment

population characteristics

sequences of activities

6(2) The Environment Shapes Man

magnitude and activities

use of locations

spatial organization related to degree of use

6(3) Activities as Units

1. for analysis of space requirements
2. for investigating the effects of physical determinism

The significance of data relating to the activities of people in specific environments will be discussed with respect to two types of application, for:

1 programming, estimating spatial requirements

2 activity modelling, determining how people use space

The two applications, it must be noted, are inter-related; for although the data pertaining to space use is interesting in itself, its value lies in contributing to more accurate estimations of spatial requirements.

6(1) THE SHAPING OF THE ENVIRONMENT

Information relating to the estimation of spatial needs and to the design approach outlined, will be of direct significance to:

1 architects (and building programmers)

2 developers, housing agencies etc.

3 users, particularly residents

Population characteristics:

The ratio between family size and dwelling size was not as simple as could have been expected. Householders in the largest houses did not have the most children, indicating a desire for more rooms than the minimum usually specified by housing agencies.

The next act would be to categorize families, not by dwelling type, as in the present study, but by family characteristics such as age and number of children.

Sequence of activities

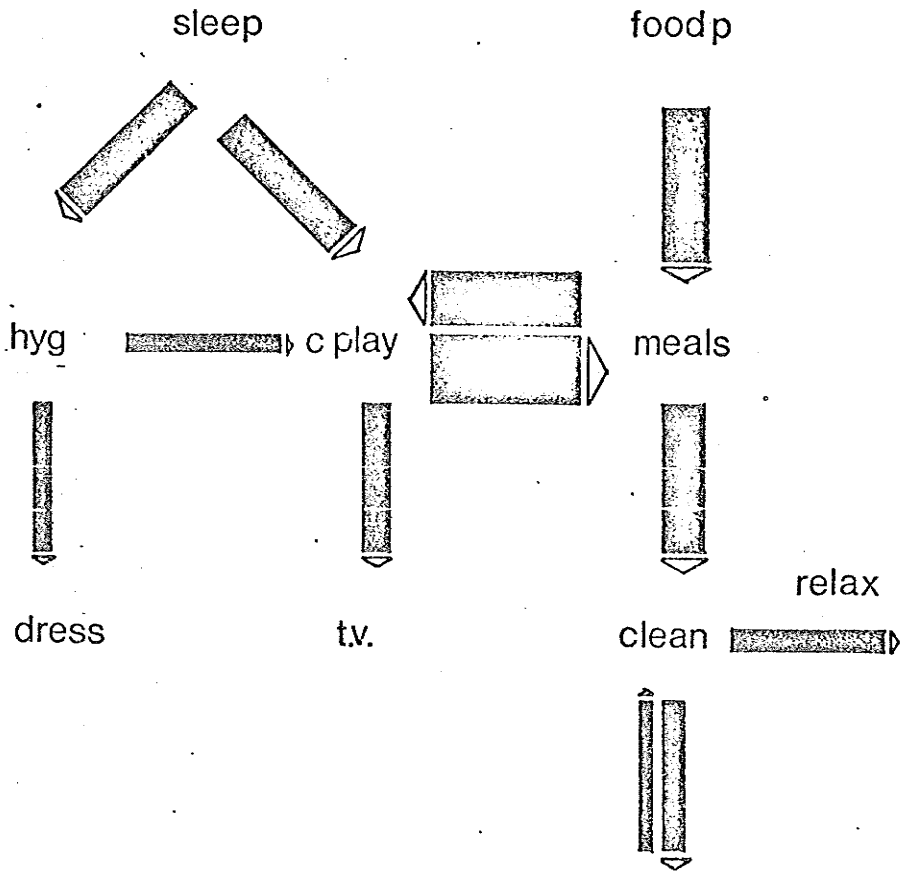
Information of the sequential order in which activities are performed are of particular interest to architects, as from data pertaining to sequential relationships 'flow diagrams' can be constructed which are directly transferable into spatial organization of rooms.

Information of sequential relationships between activities is, however, likely to be of most use for building types of far greater size than housing. For industrial and institutional complexes a method such as that outlined could be applied to determine the sequential relationships of the activities of individuals or groups of employees - these would lead to flow diagrams as in figure 1C(2). When data is unobtainable activity patterns would have to be simulated. Techniques of this kind are at present being developed, (see Working paper 21, Land Use and Built Form Studies, University of Cambridge).

FIGURE 1C(2)

FLOW DIAGRAM

SEQUENTIAL ACTIVITIES House type B1 Townhouses



20 60 width shows magnitude of relationship between activities – the number of times an activity precedes or follows another activity

VALUE OF ACTIVITIES

Although also of interest to architects, data relating to the 'value of activities' is particularly significant to housing agencies, developers and to prospective residents. It is foreseen that the concept of value, which gives rise to an hierarchy of activities, with a broader data base, can lead to a method for differentiation of families and their housing needs (for space). Such criteria would be valuable as various activity values will lead to differing spatial requirements and relationships between spaces. The number of such differences would help determine the variety of floor plans needed in each situation.

The concept of 'value' would also be of general significance, being appropriate for determining the structure of a wide variety of design problems. Knowing which of the immense number of requirements are most critical for a satisfactory solution is but the beginning of the design task, but it is nevertheless a major element.

Whilst the data obtained in the present study is inadequate for predicting the spatial requirements of population groups dissimilar to those comprising the sample group, it could still be of general significance. The sample was typical of much recent Canadian housing and it is expected that some of the findings will be of import for predicting spatial requirements in real situations.

A limitation of data pertaining to the sample is that information relates to an aggregate of many families, and as such could be misleading and unrepresentative of the 'activity value' of any particular family. More detailed analysis of the data, which would overcome this problem, would be worthwhile only with a larger sample. Further analysis could determine which variables, - characteristics of family size, age of children, income and education levels, personal values etc., lead to particular activity values. Such knowledge would be of use to all agencies that build dwellings.

Prospective residents (homeowners or renters) could also benefit from similar information pertinent to their own family. By completing a time chart of several days activities, families could ascertain the activities of highest value to them. This information could then be matched with dwellings (or plans) particularly suitable for their particular activity requirements.

Such a system would not be totally satisfactory, but as a custom built solution for all families is impossible, and even unnecessary, it could provide a greater degree of 'fit' between family and dwelling than is at present obtainable.

6(2) THE ENVIRONMENT SHAPES MAN

The intent was to determine the manner, and the degree to which, a particular built environment influenced the activities of the users of that environment.

A postulate stated that the physical form of spaces within a dwelling would determine the amount of use made of the said spaces, 'use' to be measured by the magnitude of activity. It was realized that variables other than those outlined contributed indirectly to the spatial character of rooms, influences such as lighting, colour, window shape and view. However, because of the preliminary nature of the study it was necessary to limit the variables to those which could be easily measured.

a. Magnitude of activities

It was supposed that the magnitude of each type of activity, seen as a percentage of the total activity, would indicate characteristics of the activity patterns of families. This seemed to be the case, as data illustrated that activities which could be expected to be of similar magnitude, such as personal hygiene, housework, etc. were in fact very similar. The major differences were in social activity, child play, infant care etc., activities which could be directly related to family composition and age of children.

Use of locations:

The contention that the degree of use made of a room, indicates to some extent, the suitability of that room for the activities performed in it, as use, or magnitude of activity, will increase with room suitability, is shown to be only partially true. In the case of kitchens such a relationship seems to apply, a point that will be discussed further with reference to particular formal aspects of space. However, in bedrooms room size does not appear to be a critical factor because in some instances smaller rooms were used as much, or more than, larger ones. It must be noted however that the smallest bedrooms were used least.

The effect of kitchen size significantly effected the location of most types of eating activity, where the kitchen was large it was used to a greater extent, for both light meals and family meals. Where the kitchen is relatively small it was used only for snacks and a few light meals.

Use of locations by categories of people:

The purpose of a comparison between housetypes was to determine if differences in the use of locations by categories of people were greater than the differences within types. Such information would indicate that particular rooms were more attractive to, for example, pre-school children. Such was found to be the case in some instances, for example in one house type where the dining room was separated from the

living room by boundary walls, the room was used to a greater extent than dining spaces which were not separated, inferring that older children will use such space for homework etc. if it is private.

Spatial organization related to degree of use:

Of the three aspects of physical form identified, size, in terms of topographic area, is the most significant. This, however, does not ensure that an appropriate sized space for activities to be performed, will guarantee that the space is in fact used.

Such a conclusion was illustrated by the comparison between the use made of living and dining rooms, and kitchens, (figure 3E). In the case of dwelling type C1, where both kitchen and dining rooms were larger than average - the dining room was used to a lesser degree than in some other house types. The critical factor seems to be the size of the kitchen, the larger the kitchen, the more use made of it and the less made of other related spaces.

Differences in use of space within housetypes.

The study has shown that size of spaces will determine to some extent the amount of use made of rooms: small size will prohibit use, large size will in the case of a kitchen encourage use. In rooms with less fixed functions the degree of use will be determined by the sizes, and relationships between, other alternative spaces. Both the proximal

relationships and degree of boundary enclosure appeared to have some influence. Further studies would be required to establish the extent to which these, or other variables are responsible. The present study has shown that there are significant differences in the location of activities within the various dwelling types, and that such differences can be attributed to the variations in the physical form of the dwellings.

It can therefore be concluded that both the spatial arrangement of boundaries (usually walls) within dwellings, and the degree of openness/closure of them, has a significant effect upon the motor behaviour of residents.

The concern of architects for the spatial planning of dwellings appears to be fully justified, especially in a context in which the boundaries of space are fixed, allowing for little flexibility or change. Because dwellings, and presumably other building types also, do effect human behaviour it is imperative that more is known of this process.

6(3) ACTIVITIES AS UNITS FOR ANALYSIS OF SPACE REQUIREMENTS

The study has shown that as a unit for analysis 'activities' have certain advantages:

1 with the time-budget technique data is readily obtainable
2 the relative value of each activity can be estimated
3 activity relationships, particularly sequences, indicate requirements which become design criteria.

The disadvantages or 'activities' are the limitations in the type of data obtainable with present techniques. Motor action can define quantity of space, and to some extent sensing stimulation levels and spatial relationships (proximal), but spatial quality is a product of many other, often intangible, variables. The term 'symbolic meaning' encompasses such variables, it remains to establish the types of symbolic meaning (including atmosphere) that are required for particular activities.

Detailed work in the area could not begin until a measuring technique was established. The preliminary study conducted of meaning, does indicate dimensions (of meaning) for dwellings, which differ from those of other building types. The technique investigated therefore appears appropriate for further investigation into symbolic criteria of environmental settings for particular types of activities.

The technique will have to be adapted to correlate data of motor activity with that of a psychological nature, for a fuller understanding of the effects of the built environment upon human beings to be achieved.

Activities as Units for Investigating the Effects of Physical Determinism

Activity modelling, using the time budget technique appears to be a promising method for the investigation of the deterministic effects of the built environment. Although the present study was of a very general nature it has indicated

that the location of activities is directly affected by the physical surroundings.

Using the methods described, careful experiments could establish the extent of changes in behaviour brought about by the physical environment.

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APPENDIX

1 Floor plans of each dwelling type

2 Semantic scale

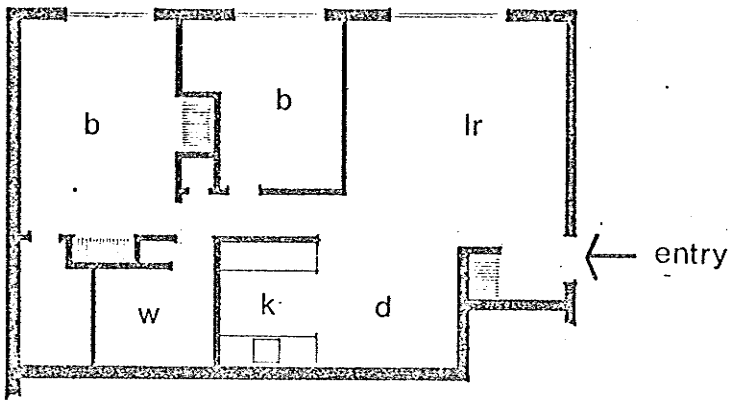
a) 18 item scale

b) 31 item scale - actual questionnaire

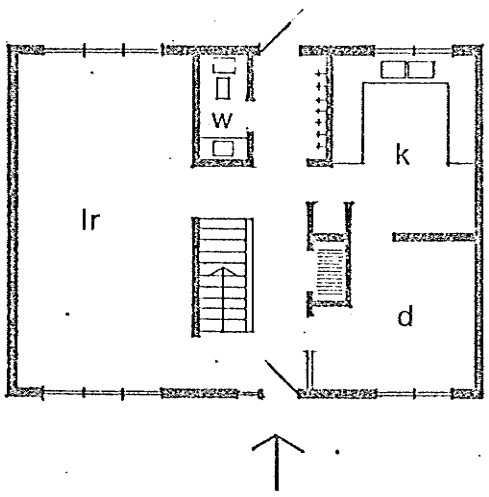
3 Sample time budget

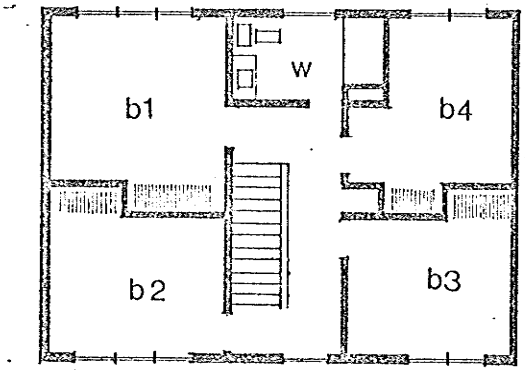
4 Computer matrix, sequence of activities

Floor plans of dwellings in survey



apartment A



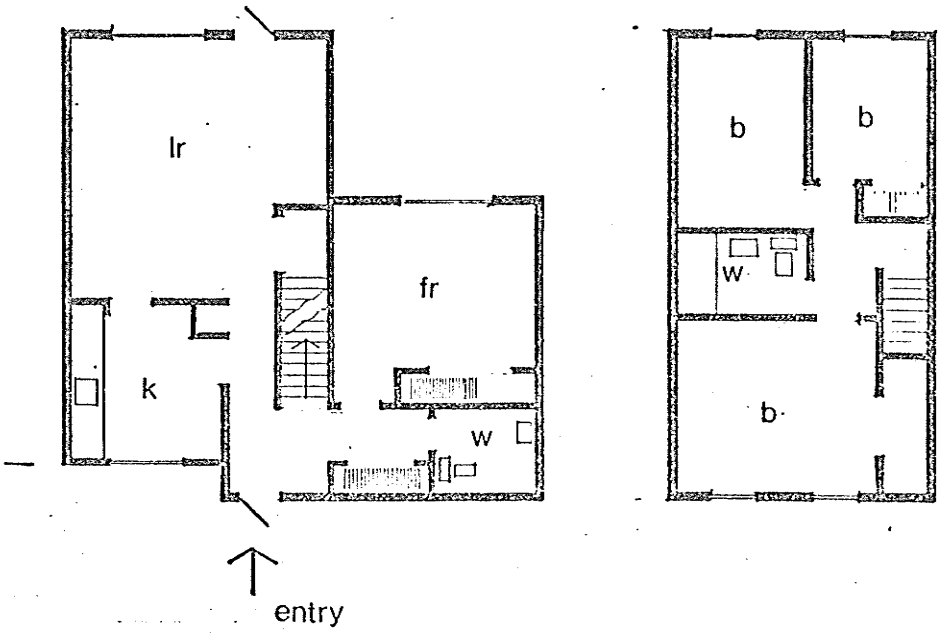


upper floor

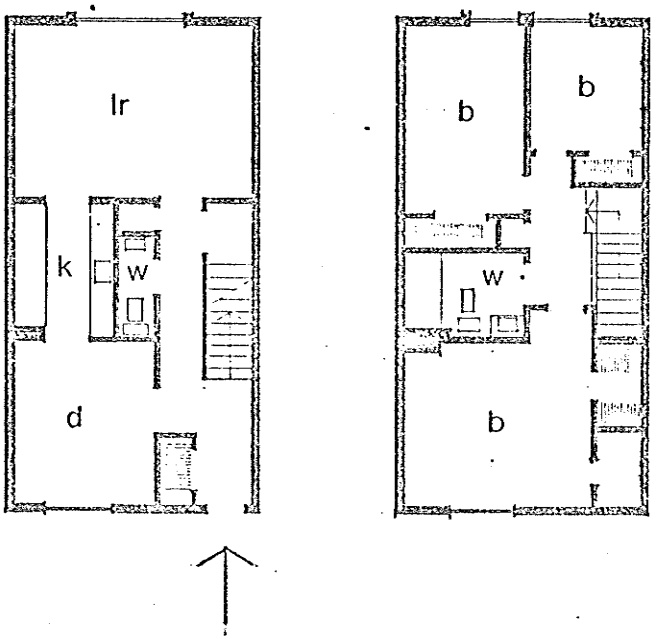
scale

0' 5' 10'

house type C



house type B 2B



house type B1

Variable list 001 to 018

1	dull	smart
2	unimpressive	impressive
3	painful	pleasing
4	forbidding	welcoming
5	depressing	elating
6	boring	stimulating
7	lifeless	lively
8	unattractive	attractive
9	unfriendly	friendly
10	insecure	secure
11	sad	happy
12	unstable	stable
13	inhospitable	hospitable
14	turbulent	peaceful
15	cheerless	cheerful
16	fussy	unfussy
17	unsociable	sociable
18	impersonal	personal

Questionnaire - with 31 item semantic scale

3 Investigation into symbolic meaning of physical forms in residential building.

There are thirty-two (32) statements in this questionnaire, please indicate your own personal opinion of each as it refers to your own home, by putting a zero mark '0' in the appropriate space, for example:

	1	2	3	4	5	6	7	
bad	—	—	—	—	—	—	0	good

If you strongly agree with a statement, in this example you think very good, put a zero in the space marked seven.

If you strongly disagree, put a zero in the space marked with a one. If you don't care either way, put a zero in the space marked with a four. If you agree or disagree less strongly, put a zero in the spaces marked 2, 3, 5 or 6. Work fast - write your first impulse.

The statements consists of pairs of adjectives which refer to your dwelling - particularly to its physical form, excluding furniture and personal decorations.

		1	2	3	4	5	6	7	
1.	Ugly	—	—	—	—	0	—	—	beautiful
2.	dull	—	—	—	—	0	—	—	smart
3.	unimpressive	—	—	—	—	0	—	—	impressive
4.	inflexible	—	—	—	—	0	—	—	flexible
5.	weak	—	—	—	0	—	—	—	strong
6.	unexciting	—	—	—	0	—	—	—	exciting
7.	painful	—	—	—	—	—	0	—	pleasing
8.	poor	—	—	—	—	0	—	—	luxurious
9.	forbidding	—	—	—	—	0	—	—	welcoming
10.	depressing	—	—	—	—	—	0	—	elating
11.	boring	—	—	—	—	0	—	—	stimulating
12.	lifeless	—	—	—	0	—	—	—	lively
13.	repulsive	—	—	—	—	0	—	—	attractive
14.	unfriendly	—	—	—	0	—	—	—	friendly
15.	insecure	—	—	—	—	—	0	—	secure
16.	sad	—	—	—	—	—	0	—	happy
17.	unstable	—	—	—	—	—	—	0	stable
18.	unimposing	—	—	—	—	—	0	—	imposing
19.	delicate	—	—	—	—	—	0	—	rugged
20.	tame	—	—	0	—	—	—	—	provocative
21.	restless	—	—	—	—	—	—	0	restful
22.	confined	—	—	—	—	—	—	0	spacious
23.	arbitrary	—	—	—	—	—	—	0	considered
24.	uncomfortable	—	—	—	—	—	0	—	comfortable
25.	unpleasant	—	—	—	—	—	—	0	pleasant
26.	inhospitable	—	—	—	—	—	—	0	hospitable
27.	turbulant	—	—	—	—	—	—	0	peaceful
28.	unspiritual	—	—	—	0	—	—	—	spiritual
29.	cheerless	—	—	—	—	—	—	0	cheerful
30.	fussy	—	—	—	0	—	—	—	unfussy
31.	unsociable	—	—	—	—	0	—	—	sociable
32.	impersonal	—	—	—	0	—	—	—	personal

This questionaire is to gather information for a Master of Architecture thesis at the University of Manitoba, all information will be solely for this purpose.

My intention is to compare activities within different housing types, to see what effects if any, that differences in the plan of the dwelling have upon the activities pursued.

Your help in completing the questionaire will be greatly appreciated, please don't feel that your private life is being intruded upon as no names are known.
If you have any questions about the questionaire, please phone Marian Doré at 269-1522.

The questionaire consists of:

1 A time chart with time throughout the day marked with 15 minute time intervals - you are asked to fill in what you were doing at different times.

Fill in the activities that you and your family pursued in a day in the appropriate time slot, also put the location letter (which are shown on the plans) that corresponds to the place of the activity, for example - if at 6.30am your husband had a shower, you cooked breakfast and your two children aged 2 and 4, slept, you would fill inthe time chart in the following manner.

Time	Wife	Husband	Child$_1$ Child$_4$
6.30am	Cooking K	Shower W	sleep I sleep H
6.45			

Do not attempt to record something in each time slot, just use the sheet as a method for calendering the days activities. Calendar an actual weekday and say at the bottom if not typical.

2 On the plan you are asked to quickly sketch in where your furniture is positioned.

3 The last sheet of the questionaire refers to your personal opinions of the meaning of the physical form of your dwelling.

Time	Wife	Husband	Child 2
6.30 am			Dress H.
6.45			
7.0 am			
7.15			
7.30			Dress I
7.45			
8.0 am	[illegible] K.	[illegible] G	[illegible] C [illegible] C
8.15	Breakfast K		Breakfast K Breakfast K
8.30			
8.45			
9.0 am			
9.15			
9.30		Breakfast K	
9.45			
10.0 am	Back [illegible] Kids W		Dress W
10.15			Dress W
10.30	Drive Train to Child's G	Shower - W	Drive kids G
10.45	Wash		
11.0 am	Make Bed - G.H.I	To University	Play [illegible]
11.15	Vacuum - Upstairs		Independently Watch TV
11.30	Clean - bathroom - W		Watch TV
11.45			
12 pm	Shower - W		
12.15			
12.30	Cook - K. Lunch		
12.45			
1 pm	Chauffeur for Nursery Sch		To babysitter — To N. School
1.15			
1.30			
1.45			
2 pm			
2.15			

This is a typical Wednesday. Since D. drives the kids (can feel) on Wednesday.

B2 B

Computer matrices showing the number of times that one activity follows each other activity.

Activities

Activities

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	206	16	1	6	5	0	1	18	2	5	0	1	0	0	0	0	3	3	2	2	6
0	1	494	27	3	1	0	12	28	0	0	0	5	0	0	0	0	0	4	2	13	0
0	2	12	31	2	0	0	11	8	1	0	0	0	0	0	0	0	0	2	1	19	0
0	5	1	3	62	0	0	0	12	15	0	0	0	0	0	0	0	0	2	10	0	1
0	4	0	1	0	7	0	0	5	3	3	0	2	0	0	0	0	0	0	6	1	2
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	3	3	1	0	0	1	10	1	0	0	7	0	0	0	0	0	2	2	7	0
0	19	29	12	12	7	0	1	314	1	3	0	4	0	0	0	0	0	7	2	26	0
0	5	2	1	1	4	0	1	2	78	7	0	6	0	0	7	0	0	14	12	1	0
0	5	3	2	0	4	0	0	2	2	69	0	4	0	0	1	0	0	4	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	2	0	12	2	0	0	1	7	1	0	44	0	0	0	0	1	7	4	18	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	2	0	9	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	6	1	0	2	0	0	1	0	0	2	0	0	0
0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	8	0	0	0	0	0
0	1	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	17	0	1	0	0
0	9	2	0	1	0	0	3	8	11	4	0	10	0	1	2	1	0	54	5	1	0
0	4	11	3	11	0	0	2	4	2	4	0	8	0	1	0	1	0	4	78	1	4
0	7	14	4	0	1	0	7	25	11	0	0	2	0	0	2	0	0	7	11	58	1
0	7	1	0	0	2	0	0	0	0	0	0	2	0	0	0	0	1	0	0	1	54

house type B1

17	1	0	1	0	0	0	1	1	0	2	0	0	0	0	1	0	0	1	0	0	2
2	128	8	5	7	7	0	1	19	3	1	4	4	0	0	0	0	1	0	3	3	6
1	1	326	24	1	0	0	8	7	0	0	1	3	0	0	0	0	1	1	1	9	0
0	0	8	20	1	2	0	19	8	2	3	0	4	0	0	0	0	0	0	3	13	0
0	4	1	0	41	1	0	0	3	15	0	0	0	0	0	0	0	0	1	3	0	2
1	7	4	6	0	13	1	1	6	2	2	0	1	0	0	0	0	0	2	5	0	2
0	1	0	0	0	0	14	0	0	0	0	1	2	0	0	0	0	0	1	1	0	0
0	2	7	0	2	1	0	5	10	4	1	1	6	1	0	0	0	1	0	5	16	0
1	23	8	14	4	6	0	5	116	2	4	0	2	0	0	0	0	2	2	1	14	1
1	4	0	4	0	2	0	2	2	42	6	5	14	0	0	4	1	2	5	1	0	2
1	6	6	3	1	0	3	1	0	1	54	0	4	0	0	0	0	1	2	3	1	3
0	1	0	1	0	0	1	0	2	3	0	7	4	0	0	0	0	0	0	1	0	1
0	1	0	1	7	6	0	1	4	3	4	1	42	1	0	0	1	0	0	2	20	0
0	0	2	0	0	0	0	0	0	0	0	0	0	47	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	1	0	0	1	0	0	2	0	0	10	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	17	0	0	0	0	0
0	0	1	1	0	2	0	0	1	1	2	0	0	0	0	0	0	5	0	0	0	0
1	1	2	1	0	1	0	1	2	4	2	0	1	1	0	0	1	0	26	0	1	0
0	9	5	1	4	3	0	0	2	2	5	0	2	0	0	1	0	0	0	24	0	0
1	4	3	1	2	4	0	17	21	12	3	0	2	0	0	0	0	0	2	4	58	0
1	9	1	1	1	3	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	37

house type C