REPRESENTATION OF ARCHITECTURE
(SYSTEMATIC AND EMPIRICAL ANALYSIS)

by

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Abstract

Representation can be defined as a replication or reconstruction of a system which exists, has existed or is expected to exist. Furthermore, replication consists of a concept-expression derived by the selection by the observer(s) of system certain characteristics and has some stated and unstated rules about concept-expression. Concept-expression is accomplished via a medium by the observer(s) using suitable instruments.

Given this definition of representation, it becomes possible to explore verbal notions about architectural system. Based on phenomenological and empirical work in "meaning in architecture", this study attempts to establish 24 notions such as form, scale and proportion, texture, spaciousness, organisation, complexity, modernity, pleasure.

78 empirical studies reported in English and conducted in the last decade gave insights into following four areas of the study.

1. To establish the information gap between the actual building and each of its representation on various architecture related notions.

2. To explicate the relationship between money and time required for representation and the information gap between environment and its representation.

3. To determine the extent to which observers can comprehend the representations in terms of the architectural notions.

4. To derive a classification of representation using notions related to architecture.

This study used a space relation diagram, verbal description, plan and section, sketch drawing, isometric drawing, perspective drawing, black and white photograph, colour slide, architectural model and the actual building to represent the study building, Gaslight Square. The survey questionnaire, rating techniques, study field station and representational

techniques were carefully constructed to fulfil the above purposes.

Results based on 1400 sets of observations made by 185 respondents suggest that there can be an information gap between the actual building and its representation. Generally, the less abstract and more detailed the representation, the better are architectural notions conveyed. The value for the relationship (measured by Kendall's Tau) between the general impression conveyed by representation of the actual building and the cost of the representations was 0.78 and for the time required to prepare for representations was 0.5683. Analysis of variance suggested that observers were able to distinguish between the amount of information conveyed by various representations and and between architectural notions. Furthermore, the difference between architects and non-architects were statistically significant and there were recognizable differences between their reactions to representations. Overall similarity between all the representations, as indicated by cluster analysis was 40.6 Percent. Eye-level, overview and abstract were the three major categories derived from the 10 representations used in this study.

Dr. R. W. Seaton,
Faculty supervisor.

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CHAPTER 1

BACKGROUND UNDERSTANDING OF REPRESENTATION.

> Science and God have many aspects in common. They both are mythical, invisible and invented by human beings. Unfortunately their comprehension depends largely on patience, hard work and desire. Maybe they are one and represented by different names.

1.1. Architectural representation.

How does one "represent architecture?" This is a fundamental question, but science has yet to produce any definitive answer. This question is not unique to professional architects or environmental researchers; and it has been asked by laymen. This chapter elaborates some essential concepts bearing on the question of representing architecture.

Plans, pictorial drawings, photographs, three-dimensional replicas or even architecture itself are some of the common techniques used by architects to represent architecture. Such techniques place major emphasis on the visual character of the building. However, physical laws or theories can also be used

to understand and explain a building's character, particularly its non-visual aspects. For example, through simulation or simulation modelling one can explain such abstract characteristics of the building as its structure, acoustics or illumination. From the literature, it appears that techniques of representation of buildings may be far more diverse than commonly understood. Thus representation can be broadly defined so as to accommodate these wider and more diverse meanings as related to architecture while at the same time incorporating the existing conceptual understanding.

1.2. From idea towards theory.

How one represents architecture depends upon the ideas underlying the architecture. For complex phenomena, there must be an equally complex set of ideas and explaining those ideas forms a necessary task of the representation.

Suppose one wanted to represent a simple idea such as Pythagoras' theorem. One may use words such as "in a coplanar right-angled triangle, the area of the square constructed on the hypotenuse will be equal in area to the sum of the squares constructed on the other two sides". It is also possible to use

a mathematical form such as $c^2 = a^2 + b^2$. Alternatively one might prefer a graphical display such as is shown in Figure 1.1.

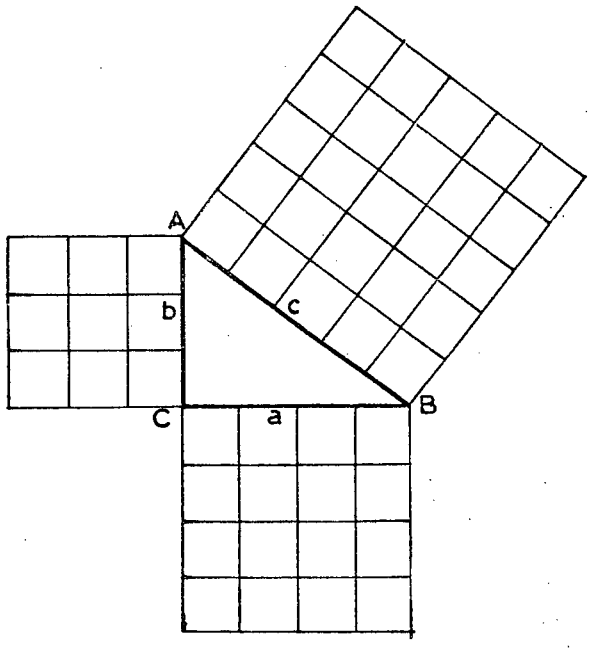
Even with this simple idea, one would nctice that the degree of comprehension and explicitness of the underlying concept would differ as one changed the technique for explaining it. Obviously, it is the representation that exhibits the idea and therefore in order to understand about representation, one must first understand about ideas.

There are informal and formal ideas. Informal ideas are used for day-to-day interactional purposes, whereas formal ideas relate to the future theory or law. Although both types of ideas can be used to explain architecture, the major emphasis here is given on formal ideas: theories or laws. Even though theory is a general term, it has very specific meanings attached to it. As Raser(1969) points out:

> [theory is] a set of statements about reality, such as a past reality, present reality, or a predicted reality. A theory attempts to describe the components of that reality and to specify the nature of the relationship among those components. (p. 6)

Deutsch(1966) further elaborates the content and language of theory.

> Theories are not only a set of propositions about reality but they are also at the same time a special



GRAPHICAL REPRESENTATION

$$c^2 = a^2 + b^2$$

MATHEMATICAL REPRESENTATION

In a coplaner right-angled triangle, the area of the square constructed on the hypotenuse will be equal in area to the sum of the squares constructed on the other two sides.

VERBAL REPRESENTATION

FIG. 1.1. Representation of Theory.

> class of languages about reality, with very limited vocabulary and relatively stringent criteria for relevance and verifiability. (P. 3)

Theory, theorems or laws deal with relationships within conceptual realities and with concepts that are not immediately tangible to the senses. Moreover, theory demands that basic underlying assumptions be explained and limitations for proof for it must be given.

Of course, one may not always be dealing with a simple theorem, but with a more abstract idea such as one from economics. For example,

> If a greater quantity of a good is thrown in on the market, then - other things being equal - it can only be sold at a lower price.
> (Samuelson and Scott, 1975, p. 65)

Ideas which can be proven and which possess defined limitations are called laws. Examples presented so far are relatively simple as compared to ideas in architecture. However, in architecture, thinkers have put forward sets of ideas, hoping that these ideas will be made into theories. For example,

> People need green open places to go to; when they are close they use them. But if the grass greens are more than three minutes away, the distance overwhelms the need. (Alexander _et al._, 1976, p. 305)

Ideas like this one seem valid before they are verified. To verify such an idea requires that concepts involved - "green space" - be clearly explained, so that they are correctly interpreted by everyone. This means that in order explain an idea one must understand the concepts that compose the idea.

The purpose of any theory, according to Raser, is to explain certain intangible ideas about reality. Since reality is virtually always complex and almost impossible to comprehend and explain to any person completely, one may choose to abstract one portion of a system from complete reality. This portion of the system thus becomes one's understanding about "truth"; its purpose is to explain the underlying idea. Ackoff (1971) explains a system as

> a set of interrelated elements. It is an entity which is composed of at least two elements and a relation that holds between each of its elements and at least one other element in the set. Each of a systems's elements is connected to convey other elements, directly or indirectly. Further more, no subset of elements is unrelated to any other subset.
> (p. 662)

With this definition of a system, Ackoff further elaborates and defines various terms like abstract system (social or psychological aspects of a building), concrete system (building materials, structural details), environment of a system (site location, political and social environment). This implies that by abstracting the system from the reality, one is able to grasp

even complex phenomena such as a building in an understandable whole. Moreover a system thus abstracted can be used for many purposes. Many times it is not possible to use a whole system for manipulation, so it may be desirable to recreate only a part of the complete system. This process of abstraction is called simulation, modelling, representation or gaming.

The conceptual distinction between the idea and system could be a matter of philosophical concern. One may note that both require abstraction and both can be recreated through representation. While elements and relationships for the system may be defined, it may not be possible to define ideas. If one thinks of architecture as assembly of building elements and their relationship, one may consider architecture as a system. However architecture can be considered as idea since perceptual impacts generated are not defined. For subsequent discussion words the 'system' and architecture are used with both of these meanings.

Just as "theory" means something very specific "simulation" also has a specific meaning. For example Raser(1969) makes an interesting comment about simulation.

> In popular usage simulation is often a fancy term for an imitation, for something that is false or phony, a copy of something. However simulation may mean much like another in that it reproduces the characteristics of something else in certain important respects, but is otherwise different. But when social scientists

> speak of simulation. ... they are restricting the term to a much narrower sense than used above. ... [simulation is] an operating model that displays processes over time and that thus may develop dynamically. (p. 6)

Raser's comment about simulation reaffirms Verba's (1964) explanation about models and simulation.

> A simulation is a model of a system. Other models. ... may attempt to represent a system through verbal means, mathematical means or pictorial means. Like simulations, they involve the abstraction of certain aspects of the system one is studying and an attempt to replicate these aspects by other means such as words or mathematical symbols. But a simulation model differs in that it is an operating model. ... There are many forms of simulation, and where simulatin shades off into other forms of study or model-building is hard to specify and probably not important. (p. 491)

Shannon (1975) gives a similar explanation of an operating model. He states,

> Model building is a process of designing a model of a real system and conducting experiments with this model for the purpose either of understanding the behavior of the system or of evaluating various strategies (within the limits imposed by the criteria) for the operation of the system. Further, a model of a system is a representation of a group of objects or ideas in some form other than the entity itself, and the term "real" is used in the sense of existence or capable of being brought into existence. (p. 2)

Hence a simulation, according to these authors, expresses the dynamic nature of the system and a model is the static

identity of the system.

Shirts(1975) argues that there must be some rules governing gaming simulation.

> A simulation is anything which simulates or models reality, [and according to Suite's concept] "a game is an activity in which people agree to abide by a set of conditions (not necessarily rules) in order to create a desired state or end". (pp. 76-77)

Of course, such a precise distinction is seldom found in the literature and the reader is often left in confusion. For example, Echniques(1970) defines a model as a

> representation of certain characteristics of the observed reality... where reality consists of the objects or systems that exist, have existed or may exist (p. 25).

On the other hand Steadman (1973) defines a model as,

> Any kind of representation, image or simulacrum or some object or phenomenon. (p. 29)

Hawks(1973) has conveyed a similar notion while trying to define an environmental model. He suggests that an

> environmental model is some formal process structure which relates to the property of a built form to some physical quantity of heat, light or sound and some other external stimulus. (p. 35)

Thiel(1976) defines representation as,

> special human activity of mentally abstracting certain presumed structual and functional attributes of the situation.

All these definitions and illustrations suggest that simulation, models and gaming may loosely be used interchangeably. A model clearly carries a static notion, and simulation conveys a dynamic notion about the system. Gaming implies a acceptance of posited assumptions about the system. But one must remember that a building as a system, consists of both static elements (doors, windows, walls) and of dynamic elements (uses over time, social purposes, meanings attached by users). When choosing a term to convey an attempt to portray the building as a system, the only common term is 'representation'.

1.3. "Representation" defined.

Representation is a replication or reconstruction of a system which exists, has existed or is expected to exist.

In order to explain the underlying idea about a coplanar right-angled triangle, verbal, mathematical and graphical

techniques were used. Paper was selected as the medium on which these techniques were transcribed. Finally, it was the action of instruments (typewriter, pen and pencil) which completed the reconstruction of Pythagoras' theorem. Words, equations and graphics are examples of some of the common means of representation. These are some of the concept-expressions or languages used in conveying ideas. Similarly, instead og paper one may choose some medium such as glass or illustration board; and the typewriter may be replaced by drafting equipment.

A similar choices exists while representing architecture. There may be some additional constraints for completing the representation. First, there may be some rules governing representation. These rules may be due to the type of concept-expression or medium used. It is obvious that even with a simple concept-expression such as verbal language there are definite linguistic requirements which must be fulfilled. This suggest that each concept-expression may have its own grammatical rules and conventions. Next, there is the additional requirement that the system represented has existed, exists or may exist.

In summary, replication consists of a concept-expression derived by selection of certain characteristic about the system by the observer(s) and has some stated and unstated rules about the concept-expression. Concept-expression is accomplished via

a medium by the observer(s) using suitable instruments.

Architecture systems deal with buildings, which generally have various qualities and aspects including form, spaciousness, and volume; these concepts are further elaborated in Chapter 2. Since the sysstem is an abstraction, no system can be equal to the total reality. Suppose that I_t represents the total information about the reality and I_s for the total information derived in the system, then I_g is the total information gap between the reality and the system.

$$I_t > I_s$$

and $$I_t = I_s + I_g \quad \ldots (1)$$

However loss of information from reality occurs when the system thus abstracted is further simplified for the purpose of representation by a suitable concept-expression, medium and instrument. This means that if the observer of the system and the mediator (representer) of the observed system are one person, then the represented information, I_r, must be less than or in a few instances equal to I_s. However good the observer and representer may be it seems likely that one would not explain all about the system in the representation. But if the same representation is seen by another person who may or may not have seen the system, there is a possibility that the information conveyed by the representation may have increased or

decreased with respect to information contained by the system because of the second observer's experience. Little or nothing is known about the exact magnitude and direction of the observer reaction under such circumstances nor about the type of representation involved.

$$I_s = I_r \pm I_d \quad \ldots \quad (2)$$

where $\underline{I}$ is the difference between the abstracted system information($\underline{I}$) and the represented information($\underline{I}$). Equations (1) and (2) are the basic assumptions under which this study was formulated. The same equations will be used in later chapters to elaborate additional concepts.

1.4. Components of representation.

Words, equations and graphics are examples of some of the common means that are used for representations. It is possible that there may be more than three categories of concept-expression. Similarly there are many different categories of medium as well as of instrument. The overall complexity of representation cannot be appreciated until the possible variety of all three components is illustrated.

Concept-expression is well illustrated by Thiel(1976), Duke(1975), Echenique(1970), and Winkel and Sasanoff(1969), who

have interesting ideas on classifying representational techniques. Duke(1975) suggests three major categories on what he calls the communication continuum: primitive, advanced and integrated. Figure 1.2 shows the communication categories and subcategories that he used. Even though he considers his review to be less than exhaustive, the continuum appears to have a good variety of concept-expressions that are in use. He points out that primitive communication techniques require the least learning and can be learnt only in generic order. For example, techniques such as hand signals do not require much learning effort and can be called primitive. On the other hand, advanced communication techniques require special skills and have standard, highly structured codes and carry sophisticated messages. Highly advanced communication techniques are integrated, use extremely complex conventions for learning and closely approximate the system. They can produce special desired effects in communication; he cites job-training as an appropriate example of this category.

In his "simulation matrix" (see Fig. 1.3) Thiel also has three basic categories into which he classifies various representations. Thiel's analytic-presentational category probably coincides with Duke's primitive category, his homomorphic with Duke's advanced category, and his identity category with Duke's integrated. Thiel further groups all simulations according to form: presentational (information is

THE COMMUNICATIONS CONTINUUM*

(Examples of Each Communication Form) / Characteristics	PRIMITIVE		ADVANCED				INTEGRATED			
	INFORMAL	FORMAL	SPOKEN	WRITTEN	EMOTIONAL	TECHNICAL	SIMULATED		REAL	
							MULTI-MEDIA	HYBRID	EXPERIENCE	REALITY
	Grunts Hand-Signals	Semiphore Lights Flags	Conversation Lecture Seminar Radio	Telegraph Manuscript Books Text	Acting Art Role-Playing	Math-Notation Musical-Notation Schematics Diagrams	Film Television	Gaming/Simulation	Apprentice Job Training	(Any Shared Real Time Perception)
SEQUENTIAL-GESTALT (Degree to which the form is constrained)	Most Constrained Because of Sequential Nature		Basic Character is Sequential but Various Devices Employed to Ease Constraint				Highest Gestalt Ability Short of Reality		Fully Gestalt Because Actual Reality	
SPECIFICITY-UNIVERSALITY (Degree of Flexibility of Use)	Employed for All Situations but Limited in Material Conveyed		Standard (universal) Modes Selectively Employed to Meet Specific Communication Need				Mode Specifically Tailored to Communication need		Specific (It is the Reality Encountered)	
SPONTANEITY OF USE (User Resistance, Skill Required, "Dryness" of Form)	Natural, Easy, Convenient		Special Skills Required. Sophistication Often Accompanied by Dryness, Artificiality of Use Inherent				Very Special Effort to Initiate; Then Spontaneous in Use		Natural "Life" Form, Skill Limits Involvement	
CHARACTER OF CONVENTIONS EMPLOYED (Formality, Complexity)	Relatively few Simple, Simple, Informal		Formal and Informal, Simple and Complex, Highly Structured, Many				Many, *Unique to Each Situation*, Fairly Complex		Many Informal Complex	
CHARACTER OF CODING AND DECODING (Inherent)	None Required or Simple Effort		Essential; May be Elaborate and Highly Specialized				Elaborate Coding to Initiate Simple Effort by User		None Required	
CHARACTER OF THE MESSAGE THAT CAN BE CONVEYED (Complexity, Analogy, Qualitative or Quantative thought, Subtility, Permanance, Precision, Intangibles, Time Constrained, Systems Characteristics)	Only Rudimentary Message		Sophisticated Messages				Gestalt Substitute for Reality		Reality	

* This diagram is only meant to suggest major relationships among the various media to illustrate the character of gaming/simulation there is no suggestion of the comprehensive review of communication forms or their character.

From: "Gaming Simulation—A New Communication Form", by Richard D. Duke, presented at the Third International Conference on Gaming/Simulation, Birmingham, England, July 1972.

Fig. 1.2. Duke's communication continuum

Actual user-participant					
Environ mental operator managers					
Construction contractors					
Public regulating agencies					
Financing clients, public and/or private					
User-participant analogues or surrogates					
Individual or group innovators					
Degree of abstraction	increasing ..... decreasing →				
Simulation type and mode	Analytic (symbolic)	Laboratory/Studio (homomorphic)		Identity (isomorphic)	
		Analogic	Iconic		
Presentational		topo maps, plans.	sketch perspective, isometric, photo slides.		
Discursive	logic systems, mathematics, verbal, languages, notation system.	flow charts, structural maps, system simulation	model films and t.v. computer films and CRT.	full size mock-ups, studio sets.	the real world or actual system itself.

Fig. 1.3. Thiel's simulation matrix

simultaneously and usefully perceived in any order) or discursive (achieves its signification chiefly through specific order and rate of perception). Thiel also includes users' categories as part of his simulation matrix. It is unclear from his discussion, whether analytic and identity presentation techniques are non-existent or were simply omitted from the matrix.

Echenique(1969) gives additional insights for categorising various representations by using a three-dimensional classification (see Fig. 1.4). The purpose of the representation constitutes a first dimension (description, prediction, exploration and planning), the time factor (dynamic, static) represented in the technique constitutes a second dimension, whereas materials (icons or analogues) and concepts (verbal or mathematical) constitute a third dimension in his classification. This classification seems complex but it includes comprehensive information about activities that go into representation. Broadbent(1973) uses an identical framework and expanded to eight purposes, four dimensions (three Euclidian dimensions as well as time), two types of materials and two types of concepts. With all possible combinations (using a cross-classification) there would be at least 128 different types of models. The idea of categorizing models by three factors is innovative but it says nothing about which representation best approximates the system that is represented.

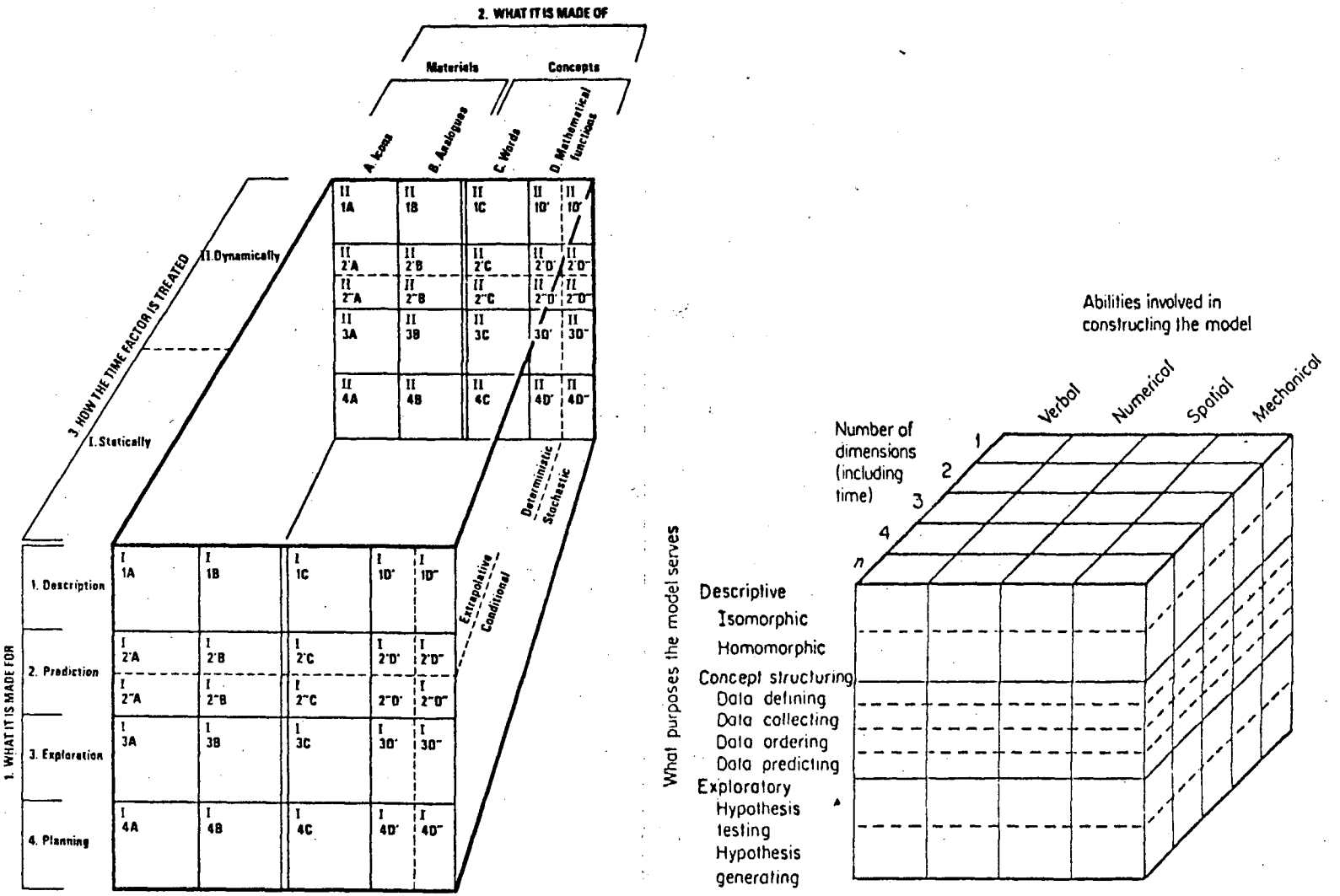


Fig. 1.4. Echenique's and Broadbent's model classification

It is also unknown whether all 128 different types of models are actually used by designers, or whether there are even more 128 type, not yet indicated by anyone.

Three approaches, though not exhaustive, seem to include a variety of ideas that are presented by other authors. Some, like Wood(1972) and Craik(1969) have cited examples of representations whereas McKechnie(1977) has identified static-dynamic and abstract-concrete categories. Cowen et al.(1968, pp. 133-141) presented the purposes of representation as augmented by Echenique and Broadbent. Rowe(1964) has also used the analogic to real continuum explained by Duke and Thiel. Similarly Chorley and Haggett(1967) identified the descriptive and normative, static and dynamic categories discussed by Echenique.

The classification attempts are not restricted to architecture, planning, geography and management science are neighbouring fields of enquiry which also rely heavily on understanding through some type of representation.

Given these several attempts to categorize various representations used in practice in various disciplines, the following discussion adds further insights by looking at the question holistically. Since the representation is composed of three features - concept-expressions, media and instrument - it

may be possible to expand on them. There is some loss of meaning in using labels such as "concept-expression", "medium" and "instrument" but no better descriptors were found.

Three major intentions guide the proposed classification scheme: (1) to include any type of representation however insignificant, (2) to allow an understanding about the relationship between the system and its representation at all levels of abstraction, and (3) to incorporate in the categories for classification some value of predictive effectiveness for future research as well as for architectural practice. To achieve these ends, a universe of representations were listed; members were then classed according to the languages that are commonly used for them; and languages were categorised according to their degree of abstraction. These sequence of operation was iterated for media and tools or instruments.

Any representation can be produced using one item from each of these three independent dimensions. To achieve a representation, one may use almost any one or more categories from each of the three dimensions. Even though it may appear that there are numerous combinations available for representation, the final choice of a combination depends largely on the size of the building, that is, the complexity of the idea or system. The final classification appears to be inclusive of large number of categories and presents holistic

idea underlying representation.

1.5. Concept-expressions.

Concept-expressions that are commonly used can be put into three major categories: identity-isomorphic, laboratory-homomorphic and analytic-symbolic. In the isomorphic category, a representation must have a one-to-one relationship with the system represented; the homomorphic type of representation must have a many-to-one reduction (Broadbent, 1973); and the symbolic type of representation must have symbolic and analogic transformations from the concept, using some specified rules. Figure 1.5 presents overall categories for concept-expression.

The isomorphic category can be further divided into two subcategories analogic, use of a convenient transformation from one set of properties to another set of properties in accordance with some rules, and iconic, the use of a "something-that-looks-like" transformation. Each of the

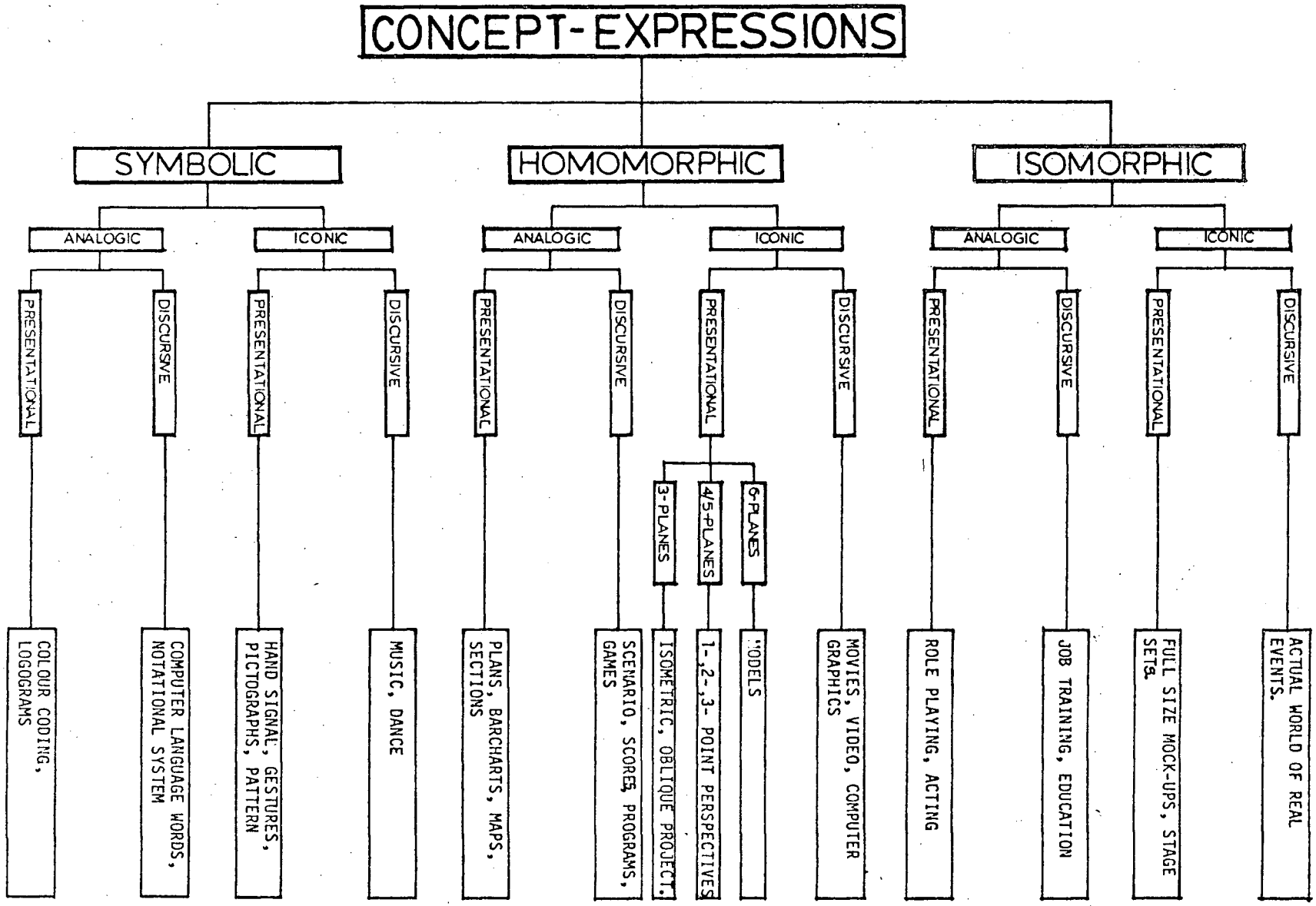


Fig. 1.5. Concept-expressions

categories, analogic and iconic, can be further subdivided according to how they are observed: presentational, where the whole is perceivable simultaneously and discursive, with sequential ordering of perception.

Figure 1.5 illustrates the conceptual categories explained above with appropriate examples of each subcategory. Each of the above categories can be further subcategorised but for the sake of simplicity further categories are not given.

Similarly, homomorphic concept-expressions can be categorised as anlogic and iconic and, in turn, as presentational and discursive. The iconic-presentational category can be subdivided depending upon the number of planes expressed. Six-planes are illustrated in the case of models, while four- or five-planes are displayed in perspective drawings. Isometric and oblique projections display three of the possible six planes present in architecture. The entire homomorphic range of concept-expressions is shown in mid-section of Figure 1.5. There could further categories such as sectional or planometric view for each of above categories since it is possible to make sectional or planometric perspective and isometric drawings.the Symbolic category is subdivided first into two categories, analogic and iconic, which in turn can be divided into presentational or discursive concept-expressions. Figure 1.5 shows these four subcategories and apropriate

examples. Figure 1.5 shows the entire range of concept-expression represented on a continuous scale from abstract to real. Furthermore each of the above categories may have varied degrees of formality, which might provide another dimension on which to classify concept-expressions.

1.6. Representational media.

The medium is the message. (McLuhan, 1967)

Wood(1972) lists all media commonly used in practice as well as in reseach. He acknowledges that testing of media for relative effectiveness is necessary and that some theorectical understanding would be beneficial in determining further applications of media in architecture. This attempt to classify various media proceeded in a similar manner to that of the classsification of concept-expressions.

There seem to be two major approaches by which most media images are projected: objective image and projective image, (see Fig. 1.6) Each objective and projective image category can be further subdivided into discrete-presentational and discrete-discursive media. While sketches and photographs are viewed in objective-discrete-presentational; and music sheet and

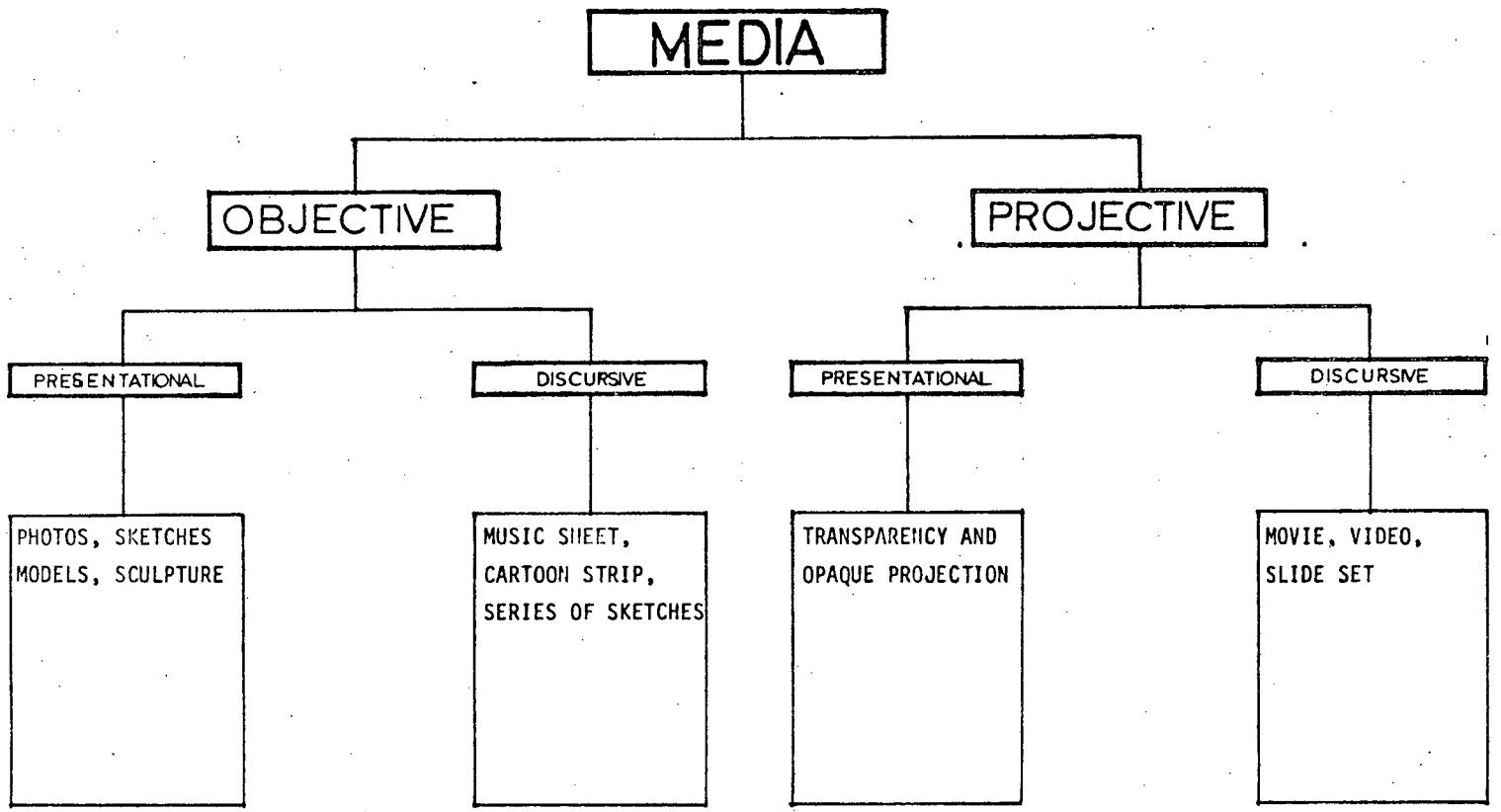


Fig. 1.6. Media for concept-expression

sketch sequences are viewed in objective-discrete-discursive. Transparencies and opaque projections are discrete-presentational while movie, video and slide set presentations are discrete-discursive.

Colour of the medium, an important categorizing factor, is not illustrated in the above classification. It must be noted that although there are numerous categories of concept-expressions, the choice of medium for representation purpose is extremely limited.

1.7. Instruments and intentions.

Instruments by themselves are neutral things and are used in transcribing expressions on media. But it seems that the instrument chosen might be directly related to efficiency (cost and time) of accomplishing the representation. Even though modern intruments such as the cal-comp plotter and the video cameras have emerged, their capital cost has prevented wide spread usage.

There are three major purposes to which instruments can be

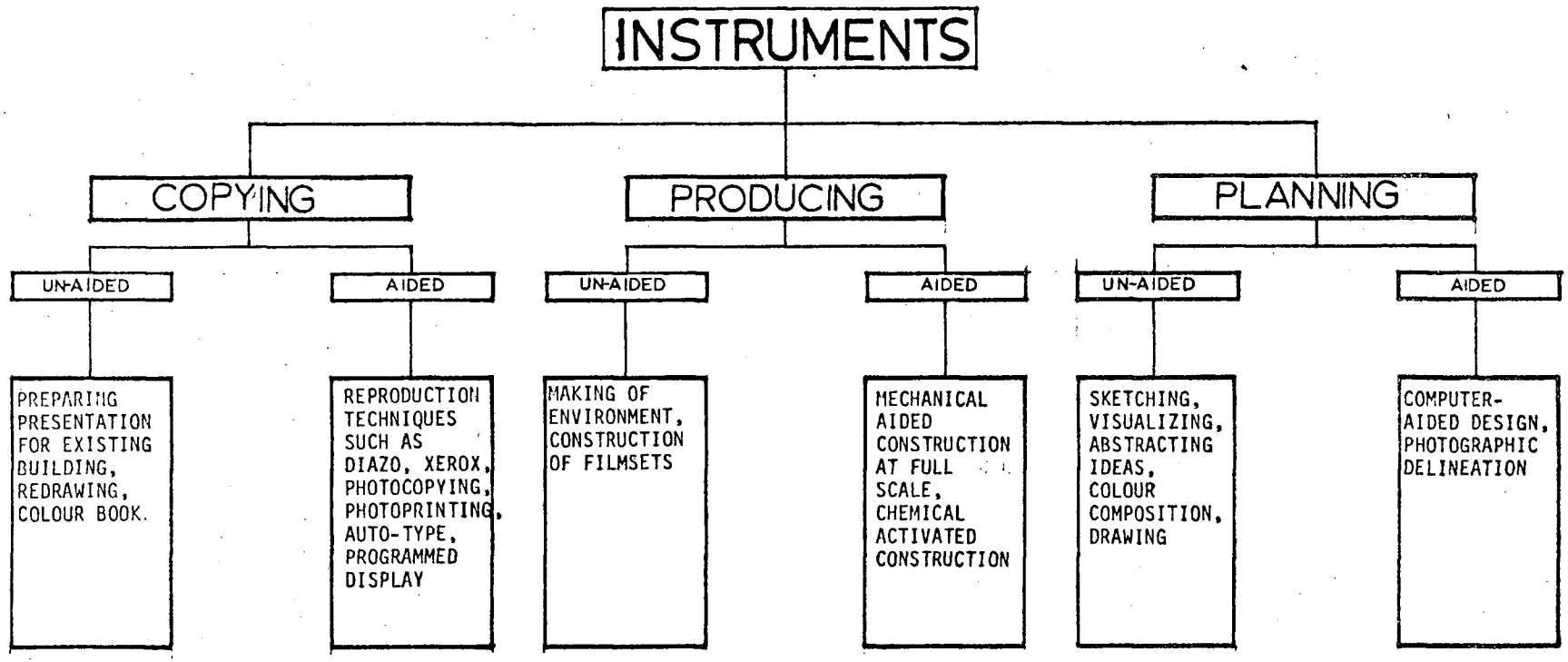


Fig. 1.7. Instruments and intentions

put: copying, production and planning. In copying, the instrument is used for duplication while for planning purposes instruments are required for generating the original source material on which subsequent operations can be done. In production, on the other hand, instruments are used to produce a concept-expression using pre-programmed instruction.

Each of these intentions can be fulfilled with or without human aid. Thus, three intentions and aided or un-aided categories would imply that there are six categories in which to group different instruments.

Figure 1.7. Illustrates conceptual categories discussed above with relevant examples of each category. It would be obvious that human skill is an important dimension in the use of various instruments including drafting materials.

1.8. Summary of the representation process.

In this chapter, the conceptual basis for representation has been developed. Representation is defined as a replication or reconstruction of a system which exists, has existed or is

expected to exist. Replication consists of a concept-expression derived by selection of certain characteristics about the system by the observer(s) and has some stated or unstated rules. Concept-expression is accomplished via a medium by the observer(s) using an instrument suitable for particular intentions.

This chapter also examines various alternatives for concept-expression, medium and instrument and outlines conceptual categories for each dimension. Conceptual discussion is an important step in understanding the overall structure of representation in architecture, and it is on this basis representations for the study were selected.

CHAPTER 2

DETERMINANTS OF ARCHITECTURAL REPRESENTATION.

> Man [or woman] need not bend to linguistic circumstance but may easily bend language to his [or her] needs. Joshua Whatmough.

Architectural representations must convey those particular notions relevant to a particular built environment. Since architecture can be considered as a system of objects and relationships, there must exist a minimum of ideas or notions about the architecture. This chapter will give the essential background of and meaning attached to architecture.

Simplistically, architectural qualities are derived from elements like doors, windows, walls and floors, and these elements are resolved along three Euclidian planes. Interrelationships and combinational arrangements of these elements give a unique character to any architecture. For example, a 7'X3' vertically placed wooden piece can be called a door, can function as an opening and can be interpreted as more friendly if it is open and less friendly if it is closed. Similarly every such element has diverse meanings and functions

associated with it. Even though architectural elements are visually observable, finite in number and common to most buildings, their characters, their meanings and their functions depend upon the context and combinations under which they exist. This implies that architectural qualities must be derived from the context or situation in which architectural elements exist in combination.

Attributes such as form, texture, and scale are also derived from the manner in which building elements are arranged. In psychological terms, such attributes are "information" about the object or stimulus. Cultural pre-conditioning, social training or self-development may help the observers to derive different sets of meanings from the same characteristics of a building. Qualities such as spaciousness, pleasantness, or rigidity are examples of observer-derived notions. Even though some authors argue that there is a philosophical difficulty in separating these two sets of attributes, - disposition of elements and qualities they convey -, practical reasons dictate that they be considered as a single part of the general phenomenon of architecture.

2.1. Interpretations of architecture.

Architecture as an assembly of elements can be interpreted in a wide variety of ways. It is true of any art that it can be interpreted not only on aesthetic grounds but also on political, philosophical, religious, scientific, economic, social, and technical grounds(Zevi, 1974, pp. 163-192). Zevi also acknowledges the importance of formal interpretation of architecture and he elaborates on qualities such as unity, contrast, symmetry, balance, and proportion according to which such criticism can be structured. Phenomenological attempts such as Zevi's are rare in the literature but Kahn, Corbusier, Wright, and others have tried to explain similar qualities in relation to their own work. Even though the qualities discussed below may not be exhaustive, they seem to present the state-of-the-art of formal analysis of architecture.

Qualities explained by architects and architectural critics are specific, with a contextual meaning. By contrast environmental researchers have attempted to explain the observer's point of view with almost no conceptual reasoning about the environment. Hershberger(1972), Seaton and Collins(1972), and Bechtel(1975) are some of the researchers who seem to be interested in developing a theoretical rationale for

such qualities by choosing systematically environments as well as observers for their work. This strategy may lead to general statements about architectural interpretation.

The literature about "meaning in architecture" has followed two parallel approaches: the first is phenomenological, abstract, individualistic and is written in contextual architectural language; the second approach is empirical, based upon "the average person's" perception, with concrete numerical results but vague notions of applicability. Both approaches are essential to an understanding of the subject and each has its place in scientific research.

2.2. The search for architectural qualities.

The ground-breaking search for basic qualities in architecture has been completed by Vielhauer(1965, 1970), Craik(1969, 1972), Collins(1969), Canter(1969), Küller(1972), and Hershberger(1970). None of these researchers was looking notions related to architecture, but for uni-polar or bi-polar descriptors by which observers could conceptualise and describe architecture. This approach had some implicit advantages such

as lack of bias about notions and abundance of notions but it rejected those notions which could not be described in uni-polar or bi-polar words. For example, to measure form of architecture in bi-polar terms one could use descriptors such as "form-formless," "cylindrical form-square form", "good form-bad form" but it might not be meaningful to use such words like this unless one first defined the attributes of form.

Secondly, the architectural setting studied could not include all qualities. Similarly a particular observer group might not comprehend all the architectural notions. These types of problems can be partly resolved if studies are conducted using different buildings and and different observer groups. A number of such attempts are summarized in Chapter 3.

Third, each observer probably uses each set of words with a somewhat different interpretation. In such instances the researcher gains no clear understanding of general architectural notions. For example, if the "form-formless" pair is used to measure form, the observer might interpret it as the quality of form or the appropriateness of the form or maybe as something else. This issue of inter-observer variations in interpretation of words is further detailed by Bechtel(1975), Dawes(1975), Heise(1969) and Mirron(1972). This does not mean that words cannot be used to measure notions but it alerts one to possible problems that one may encounter.

Hence the first task is to enumerate all the notions related to architecture and to explain the intricate meanings that are attached to them. Although the researcher's bias may surface in assembling a set of notions, every attempt is made to express the original author's opinions as explicitly as possible. Furthermore, certain verbal quotations or verbal descriptors might appear under an incorrect heading, but the main intent of the chapter is to establish common notions about a quality.

The second issue, then, is to define all notions with clarity for operational purposes, while at the same time giving clear indications of possible differences of opinion about notions. In the following pages, the attempt is made to grasp simple notions about a complex phenomenon, architecture.

2.3. Notions about architecture.

Zevi (1974) argues that formal notions of architecture are unity, symmetry, balance, accentuation, contrast, proportion, scale, expression, truth, propriety, urbanity, style, variety and sincerity. Appleyard (1975) describes buildings by their form and imageability. He further suggests that form consists of movement, contour, size, shape, surface and quality, and

imageability consists of viewpoint intensity, viewpoint significance and viewpoint immediacy.

Laurie(1975) argues that inherent qualities and characteristic components of landscapes are proportion, scale, outline in plan, profile in elevation, shape or form, colour and texture or pattern. Litton(1972) considered landscape in terms of primary recognition factors: form, space and time variability; and secondary recognition factors: observer position, distance and sequence. He further argues that form and space are composed of lines and surfaces and surfaces are composed of colour and texture.

While phenomenological research has focused on above notions, the summary of empirical research documented by Seaton and Collins(1972) suggests, that architecture may consist of aesthetic evaluation (dynamic, exciting), activity (revolutionary, lively, active), organisation (tidy, neat), simplicity (rational, straightforward), spaciousness and strength-boldness. Hershberger(1972) attempted a similar summary and suggested meaning in architecture consists of aesthetic evaluation, friendliness, organisation, potency (rugged, massive) spaciousness, ornateness (bright, complex), colour (lavish, gay, rich), neatness (clean, tidy), size, temperature (comfort, heated), light (airy, light), privacy (protected, secluded, private), shape, ventilation, noise,

rigidity, formality, texture, time and utility.

Through extensive efforts Mehrabian and Russell (1974) proposed that affective components of environment can be conceptualised in terms of pleasure, arousal and dominance while appropriateness of form, surprisingness, scale-size, continuity and outdoor-natural could be "information" about the environment.

Although various notions are presented for "meaning of architecture", the following appeared more frequently: form, figure, physical-colour, texture, light, shade and shadow, scale and proportion, volume and length, spatial excitement, friendliness, solidity, organisation, size, spaciousness, colourfulness, complexity, modernity, balance, cleanliness, ventilation, rigidity, pleasure, arousal and dominance appeared more frequently. Hence, this discussion will focus on these notions.

2.4. Notions of form.

It is not surprising that a notion such as form has received a great deal of attention from architects. Since "the final aim of the design is form" (Alexander, 1964, p. 1) the notion of form is intrinsic to architecture.

Rioux de Maillou(1895) associates form with harmony, proportion and colour

> Measurement, as far as form is concerned, means harmonically expressive proportions and harmonic proportions in colour as well.
> (in Benton et al. 1975, p. 4)

Adolf Loos(1908) considers form as style,

> A bad form - I mean, any form which does not confcrm to the style of our time.
> (in Benton et al. 1975, pp. 40-41)

Kahn(1961) claims form has no shape while Johnson considers that form nothing to do with function.

> Form encompasses a harmony of systems, a sense of order and that which characterizes one existence from another. Form has no shape or dimension... Form is impersonal. (Kahn, 1961, p. 146)

> Comfort is not a function of beauty... Purpose is not necessary to make a building beautiful. ... Sooner or later we will fit our building so that they can be used... Where form comes from, I don't know, but it has nothing at all to do with the functional or sociological aspects of architecture.
> (Johnson, in Heyer, 1966, p. 278)

Wright considers "form as function", while Esherick considers form as a purposive thing, only meaningful within the context of the purpose for which it exists. He argues,

> Form is a composition of satisfying structure, with the 'wants-to-be-ideas' suggestive of some kind of purpose; what you have to do is find it out and then design very specifically for it. Form should not be judged by some arbitrary standard, but only as good or bad in relation to a specific purpose.
> (in Heyer, 1966, p. 112)

Craig Ellwood gives a similar notion with additional ideas regarding qualities associated with form such as rhythm, style, and harmony.

> Form is valid only when it is shaped by structure and possibly characterized by function, region, culture and climate. ... Form is decoration - the rhythmic interplay of mass, volume and line. Material is decoration - the rhythmic emphasis of texture and colour. Depth is decoration - the rhythmic movement of light and shadow.
> (in Heyer, 1966, p. 150, 151)

Grillo(1960) explains form as a combination of surfaces and volumes with the additional quality of time.

> Architectural forms may be lines, surfaces or volumes, but they must always posses the dimension of time, which signifies movement - and life. p. 34

Norberg-Schulz(1966) considers the analysis of the form is based upon the description of elements and relations.

> The word 'element' denotes a characteristic unit which is a part of an architectural form. [element] denotes both an independent whole (gestalt) and a part belonging to a more extensive context. ... The term 'relation' denotes a lawful way of distributing

elements. (pp. 133-144)

Hugo Haring(1925) distinguishes between man made forms and natural forms.

> Forms which result from functional criteria are created by life, and are therefore of an elementary and natural kind, not originated by men [human beings]; while forms chosen for the sake of expression derive from laws formed by human intellect. Thus functionally-based forms, though they are continuously modified by external circumstance, are fundamentally eternal and universal because they are constantly regenerated by life; while forms created for the sake of expression are ephemeral and exposed to changes in human cognition.
> (in Benton et al. 1975, pp. 103-105)

Caudill et al.(1978) give examples of forms,

> There are only three basic forms, plastic, skeletal and planar... each of the three basic forms might be rectilinear or curvilinear... plastic forms look sculptural... Skeletal form shows its bones... planar form consists of overlapping, sometimes interlocking planes - vertical as well as horizontal. (pp. 21-29)

Hesselgren(1975, p. 34) and Prak(1977, p. 18) argue that since laws of form perception are lawful, good forms are based upon Gestalt laws. They further argue that organised (regular, symmetrical, simple, coherent, similar) forms are good. They list Gestalt laws as follows:

> The law of prägnanz: [It] indicates that, as far as possible, the visual system integrates the separate

> visual stimuli in a (meaningful) whole. Psychological organisation of visual stimuli will always be as 'good' as the prevailing conditions in the outside (something wrong) world allow... good embraces such qualities as regular, symmetrical and simple.
> The law of proximity: Forms which are close to one another tend to be perceived as a coherent group.
> The law of equality: Equal or similar elements are immediately recognised as such.
> The law of continuity: There is a tendency for perceptual organisation to continue a figure as it started. (Prak, 1977, p. 18)

Appleyard(1969, 1976) argues that form is distinctiveness and imageability and he addes the notion of visibility as developed by Lynch(1961). He further argues that instead of measuring form, one could measure distinctiveness by notions such as movement, contour, size, shape, surface and quality(!) while Lynch suggests that imageability can be measured by viewpoint intensity, viewpoint significance and immediacy. Even though their definition for each of the terms seems to form a separate notion, each building was rated on the above attributes and the ratings summed for all terms, to achieve a measure of form.

> Movement: Most of the movement associated with building has to do with people. Intensity of movement and estimated building users are two basic determinants. External and internal level of movements in public space are attributed to low or high intensity.
> Contour: Sharpness of boundary defines a building from its ground making it stand out, even if it is small building.
> Size: Building size is measured by the apparent height and bulk of a building as seen from its approach view. Perception of size frequently depends upon singularity.

> Shape: Simplicity or complexity associates character of imageability.
> Surface: Brightness, coarseness and complexity of surface can be salient characteristics of a building.
> Quality: Categories under this heading are; expensive material, careful landscaping, cleanliness and good condition.
> Viewpoint intensity: The number of people (both auto and pedestrian travelers) likely to pass the most prominent viewpoint of the building during a typical day is an approximate measure.
> Viewpoint significance: The readiness of travelers to see buildings at decision points in the city, whether at intersections, bus stops, bends or ferry crossings.
> Immediacy: The immediacy of a building to the viewing or circulation system, defined by its closeness and centrality in the case of vision.
> (Appleyard, 1976, pp. 74-76)

To measure "form" Craik suggested using descriptors related to geometric shapes such as cylindrical, diagonal, and globular. Vielhauer used descriptors related to presence of form and Mehrabian and Russell(1974) considered "goodness" of form in the bipolar terms "good form-bad form".

Webster's dictionary gives about 25 sets of meanings for the notion of form, of which two appeared to be related to architecture.

> Form may suggest an appearance in which both clear outline and also structure and orderly dispositions of details are presented or suggested.
>
> The shape and structure of something as distinguished from the material of which it is composed.

It appears that notions of form bear several meanings. It

may mean suitability of building (Loos, Kahn), and purposes of the building (Wright, Esherick). Grillo, and Norberg-Schulz argue that form characteristics are derived from surfaces and lines and hence are plastic. Planar and skeletal forms can be seen in architecture. Hesselgren and Prak argue the dichotomy of good and bad form.

Since the suitability of a building is generated by the disposition of building elements (walls, floors, windows) and building elements give surface quality, one can deduce that form means the specific arrangement of features like walls, railings, skylights, windows, doors etc. which give the building its unique appearance.

2.5. Notions of scale and proportion.

Like 'form', 'scale' has received wide attention from architects and equally confusing notions exist in explanations of the quality. For example, Caudill et al. (1978, p. 79) have already noted some uses of the word scale such as: human scale, inhuman scale, intimate scale, aesthetic scale, small scale, large scale, grand scale, super scale, structural scale, pedestrian scale, automobile scale, residential scale, urban scale, elegant scale and finally out-of-scale.

Zevi argues that scale is the proportional relation between man and building and their combined effect on the observer.

> If man is the measure of all things, if it is an error to establish proportion without establishing scale, it is also a mistake to establish scale without proportion.... Scale means dimension with respect to man's visual apprehension, dimension with respect to man's physical size. (pp. 196-197)

Allen and Moore (1976) break scale into four parts.

> Scale is not the same thing as size; scale is <u>relative</u> size, the size of something relative to something else. [relative sizes have four common directions] - relative to whole, ...relative to other parts, ...relative To usual size, ...relative to human size. (pp. 18-19)

Caudill <u>et al</u>. (1978, pp. 79-83) present a scheme for three types of scale: physical measurable scale, associated (past experiential) and effectual (contextual) scale.

Proportion seems to be a similar notion which Zevi and Caudill <u>et al</u>. consider to be the relationship between different elements of architecture. Zevi argues that proportion is,

> the relation of the parts to each other and to the whole of the building.... proportion is the means by which a building is divided to achieve the qualities of unity, balance, emphasis, contrast as well as harmony and rhythm.... proportion is closely tied to the scale of a building. (p. 196)

Grillo has combined presented scale and absolute size into one notion as proportion.

> Human scale [is] ... the notion of relative proportion, and all ratios considered will be expressed in relation to the human size and action.... absolute proportion, which is absolutely independent from [human] size and action. (p. 124)

Corbusier (1957) proposed the modular measure for proportionality.

> A harmonious measure, both human and mathematical (the modular), ensures certainty in proportioning by methods similar to those which, in even by the greatest epochs, have guaranteed a wealth of combinations - variables, constrasting, capable of infinite graduation - through craft secrets and traditions of builders. (pp. 160-161)

To measure the notion of scale Mehrabian and Russell suggest considering size-scale. Wedin et al. (1973) considered scale in terms of its appropriateness and Veilhauer considered correctness of proportion and suitability in terms of human scale.

To conclude, scale and proportion have similar meanings; 'scale' tends to mean both relative size characteristics and the observer's notion of relative size of the architecture whereas 'proportion' means size-fit or misfit. Hence scale and proportion together would mean relative sizes of building

elements within the whole building as perceived by the observer.

2.6. Notions of colour (physical).

Colour is associated with the character of the building elements and colour also generates emotional feelings.

Hesselgren (1975, pp. 39-51) makes a distinction between colour attribute (red, yellow) and colour value. He further argues that the colour attribute is due to three primary surface qualities: surface colour (colour attached to the surface material), volume colour (colour of the material imposed inside another object) and film colour (e. g., sky colour). Colour values comprise such phenomena as hue (ratio of chromatic primary colour), colour value (lightness and darkness) and cclour intensity (chroma). Mark (1974, ch. 3) and Stevens (1975) have given thorough overviews of psychophysical dimensions related to colour, including hedonic aspects of cclour. Caudill et al. (1978, pp. 117-118) agree that colour is an attribute of all building elements and different colours (red, yellow, blue) bear different meaning within the context of their use.

Gabo and Pevsner (1923) argue that colour is a superficial

attribute of the surface material.

> In painting, we renounce colour as a pictorial element, colour is the idealised optical surface of objects; an exterior and superficial impression of them; colour is accidental and it has nothing in common with the innermost essence of a thing.
> (in Benton et al. 1975, pp. 87-88))

Furthermore Corbusier and Amadée Ozenfant (in Benton, et al. 1975, p. 90) conceives some colours to be brutal and others to be sauve. Szczuk and Zarrower (1924) argue that colour is an attribute that can be used for optical balance and harmony.

> New architecture uses colour (not painting), throws it into light, displays with it the changes of shapes and space. Without colour, we would have no play of shapes. It is only by means of colour that we can attain a clean optical balance and equilibrated integration of the particular parts in the new architectural style.... Colour (it must be made clear to architects - enemies of colour) is not an ornament or embellishment - it is an essential element, organically belonging to architecture like glass and iron. (in Benton et al. 1975, pp. 102-103))

In measuring pure attributes (hue, value, chroma) related to colour, physicists and psychophysicists have made substantial advances but a such notions of colour appear to have little direct application in architecture. In architecture colour attributes, including mixtures of colours are present together; to add further complexity, the phenomenon of light is also present.

To measure colour in relation to buildings Collins(1969) suggested using continua of colours such as brown - white, and blue - yellow. Craik(1969) used a checklist of various colours and Veilhauer(1965) attempted to measure characteristics of colour such as flashy, ascending, and bright. Küller(1972) has included a checklist of colours and suggests that appropriateness of colour should be considered.

The literature suggests that building elements - walls, floors, doors - possess numerous colours. These colours are either natural or artificial. Pure colour attributes are hue, chroma and value. Colour is an attribute of building elements and one can summarize the notion of colour; however, the qualitative impact of colours in terms of their flashy, rich, bright character is considered under notions of colourfulness.

2.7. Notion of texture.

Texture is an attribute of building elements and one of the key words in the architectural vocabulary. Just as colour, texture refers to a natural quality of the material as well as to an artificial quality imposed on external surfaces.

Hesselgren(1975, p. 58) presents texture as a surface

quality. He breaks down texture into three continua: regular-irregular, small-large, rough-smooth. He further argues that it is a visual attribute if perceived by the visual senses, and tactile when it is experienced by means of touch. He prefers to call the latter "grain".

Maaløe (1976) and Hesselgren (1975) both agree that texture helps in depth perception and suggest a distinction between pattern (surface character imposed) and texture. Maaløe (1976) says,

> texture is neither the quivering of a single line, nor the way all lines quiver individually. It is the way they all quiver, which fascinates.... the rational change and texture facilitates perception of depth and nurtures our feelings for liveliness while unity [within textural qualities] facilitates understanding and peaceful enjoyment. (p. 23)

Wright feels that texture enhances the quality of the form.

> In architecture, expressive changes of surface, emphasis of line and especially texture of material, may go to make facts eloquent, forms more significant. (in Heyer, 1966, p. 64)

Ashihara (1970) argues that the texture of material should be appreciated from some optimum distance.

> In the design of exterior space the relationship between distance and texture is an important design element. Knowledge of how building materials appear

> at certain distances helps the architect to choose materials best suited to be seen from certain distances and goes a way toward improving quality of exterior space. (p. 50)

Grillo (1960) argues,

> Texture, which directs the choice of tools to use, that is in accord with its internal function.... be rough or smooth, polished, glazed or grained. It can be left natural... [or] crafted. The effect of texture is to bring out a dramatic expression of material itself and not cover it with pretentious doodlings. (p. 73)

To measure the quality of texture, Shafer and Richards(1974) considered softness and Danford and Willems(1975) considered roughness. Mehrabian and Russell(1974) emphasised patterning character. Vielhauer considered this quality in terms of coarse, soft, smooth and polished character. Canter(1969) and Janiskee(1970) empirically indicated the verbally expressed quality of smooth and coarse as present in buildings.

Thus the literature indicates two notions related to texture: the attributes of texture and the perceptual effect generated by such attributes. It seems that the perceptual effect - dramatic character - of textural qualities must be kept separate from the attributes themselves. Textural attributes are roughness or smoothness and graininess of the material. Similarly regular-irregular is another notion behind texture.

2.8. Notions of light, shade and shadow.

Light energy is the basic requirement for visual perception and hence it is not surprising to find substantial efforts by psychophysicists devoted to studying qualities of 'white' light such as intensity and brightness. The impact of light on building surfaces has long been exploited by architects for visual delights. Such visual delights are generated by varying colour and patterning of light sources and the sharpness of shadows. Caudill et al. (1978, p. 96) describe light as "a catalyst between space and form". Brewer (1962) also considers light to be an important ingredient in visualising the environment. Hesselgren (1975, p. 52) considers light in terms of brightness, warmth and monotony. Erickson (1975, p. 33) notes that "light can be hard and glaring, ineffably soft and luminously subtle."

Enhancement of surface quality partially depends upon the light source and its arrangements to generate shade and shadow. Just as texture improves depth perception, shade and shadows reinforce texture. Hesselgren (1975, p. 53) identifies four types of shadows: large shadows due to large objects, half shadow, hard shadow and small shadow. He further argues that architects and illumination engineers use these shadows to

generate desired states or qualities on surfaces.

Danford and Willems(1975), and Lowenthal and Riel(1972) attempted to measure the light-dark attribute. Hendrick *et al.*(1977) attempted to measure clarity, brightness, radiance and dullness of light. Veilhauer(1965) and Collins(1969) considered bright, diffused, soft attributes of light and indicated that such attributes are present in interiors of built environments.

To summarize, building elements - doors, windows, walls - are used to generate varying dispositions of surfaces and light sources which also vary in colour. Patterning displays lightness and darkness on building surfaces. By generating ordered and or balanced effects in terms of lightness or darkness, one may generate visual delights such as softness, subtleness, clarity and brightness. Since visual delight is a spatial experience, it is explained along with spatial excitement.

2.9. Notions of figure, profile, contour.

> A visual form is (almost) always perceived as a figure against a background and our eyes are much more sensitive to the figure than background.
>
> (Hesselgren, 1975, p. 10)

Such a Gestalt notion of figure invites interesting philosophical arguments, since both figure and background are interchangeable. There seems to be little argument against the presence of the notion in architecture.

Appleyard (1975, p. 74) considers contour as a part of form distinctiveness, where he defined contour as "sharpness of boundary lines". Hesselgren (1975, p. 13) considers figures to have either sharp or blurred contours. Prak (1977) draws an intricate distinction between "figure" and "ground". He considers

> the figure is harder, more material and more a 'thing' than the ground; the ground is conversely weaker, more diffuse, indeterminate.... If one form is entirely enclosed by another, the larger is perceived as 'ground' and smaller as 'figure'.... Without enclosure, the smaller form is still perceived as 'figure' and the larger as 'ground'. 'ground' continues behind the 'figure'; the 'figure' seems therefore to lie before or on the 'ground'; consequently the 'ground' has no contour at the edge of 'figure'. (pp. 13-14)

Notions like shape and configuration probably overlap with form, figure and clarity and distinction of meaning is difficult to express verbally. Webster's dictionary explains these notions as follows:

> <u>Figure</u> is likened to attention to outlines, to boundary enclosing circumference or outer lines.
>
> <u>Shape</u> may sometimes suggest both outline and also

content, mass, body, bulk or detail.

Configuration is applicable to a detailed outline or statement of the nature and disposition or arrangement of various parts.

Profile is representation of something in outline.

The preceding discussion suggests that the notion of figure entails boundary lines (outline and profile) and surfaces of the building (geometrical shapes). Figure can be defined as the impact of boundary lines, vertical, horizontal and sloping surfaces of walls floors and windows and so on.

2.10. Notions of volume, area and length.

Volume is the product of three quantities: length, breadth and height. Apart from objective Euclidian volume there are other subjective phenomena related to it, such as size(largeness, bigness) and spaciousness (size adequacy, roominess). These will be discussed in the following pages. The volume that is inconcluded here is Euclidian.

Just as volume might be associated with size and spaciousness, area (the product of length and breadth) might be interrelated with objective proportion, shape, profile. Similarly Euclidian distance between two given points is length

and probably might be related with perceptual distance and perceptual direction.

Of course, these three notions are so physicalistic it seems unlikely anybody would argue against their presence in a building.

2.11. Notions of spatial excitement, spatial delight.

Spatial excitement or aesthetic excitement is commonly conceived of as a human reaction towards the built form. Even though the exact underlying principles and physiological changes within an individual are not known, there seems to be enough empirical evidence for one to believe that there is such a notion (Berlyne, 1960; Mehrabian and Russell, 1974).

An interesting overlap exists between phenomenological and empirical work in explaining the domain of aesthetic excitement. Phenomenologists have tried to present examples as to how excitement can be achieved and suggested descriptors such as serene, graceful, and eloquent; whereas empiricists have demonstrated that there are similar descriptors in the lay vocabulary.

Erickson considers,

> cadence, the rhythm of a building, can be monotonous or exciting, stately or graceful, heavy or light. Rhythm can be in size of spaces and in patterns and textures of the surface material. (p. 14)

Yamasaki and Stubbins advance much the same notion regarding spatial excitement and serenity.

> Spatial excitement derives from the contrast of small and large, enclosed to open, light to dark - a drama extending even to a lively silhouette. With serenity, we must have delight - the light of the interesting silhouettes, of waterplay of variety in outdoor and indoor spatial experience. But serenity, the physical manifestation of the belief that man can live in quiet dignity, must unify the whole.
> (Yamasaki, in Heyer, 1966, pp. 187-189)

> We have failed to provide the kind of surroundings that create a feeling of delight, that banish drabness, light the voice of the spirit, and make interplay of light and shadow a daily enjoyment.
> (Stubbins, in Heyer, 1966, pp. 220)

Hershberger (1972), while summarizing research efforts, says that almost every empirical study has indicated spatial excitement to be a general notion; descriptors for such notions can be: impressive, interesting, unique, dynamic, expressive. Seaton and Collins (1972) find that spatial excitement is intermixed with a pleasing character. This intermix is particularly evident in Vielhauer's and Küller's results.

Vielhauer attempted to measure excitement of the built environment as graceful, rhythmic, impressive, interesting, serene, scenic qualities. Craik, Küller, and Collins add dramatic, glamorous, delightful notions to this quality. Garling(1976) considers this quality in terms of high and low aesthetics.

The general underlying notions suggest that the quality of spatial excitement can be described by words such as unique, interesting, and expressive. There also seems to be a dramatic and dynamic notion with another overlapping quality to excitement which would be better captured by descriptors such as graceful, serene, glamorous.

2.12. Notions of friendliness.

Alexander(1966) argues,

> If the city is to be a mechanism for sustaining intimate human contact, ... We shall ... create new kinds of primary groups which might work in our society.... [or] Create a social mechanism which is able to sustain informal, daily contact between people. (p. 33)

If one considers buildings to be smaller elements of a city, then one must interpret notions of friendliness.

Canter(1969) and Canter and Wools(1970) conducted a series of studies related to built environment friendliness. They conceptualized this quality with the descriptors welcoming, kind and sympathetic character. Veilhauer(1965), Collins(1969), Craik(1972), and Küller(1972) seem to consider this quality with words such as appealing, attractive, familiar, gentle, personal, inviting. Other researchers such as Winkel et al.(1969), Pyron(1971, 1972), Hendrick et al.(1977), and Wedin et al.(1973) suggest measuring this quality in terms of inviting, appealing, and helpful character of the building.

Qualities associated with a friend are kind, sympathetic or even helpful, but this does not mean that one should associate similar qualities with the building. The quality that seems to be applicable to buildings, can be best described by words such as welcoming, inviting, attractive, appealing and beautiful. Even though "friendly" is a general term, it covers the inviting-attractive-welcoming quality of the building. Hence for operational purposes one should include a dimension called "friendliness".

2.13. Notions of solidity.

Weese argues that,

> Buildings are masculine and aggressive.... a building should be handsome, elegant, strong.
> (*in* Heyer, 1966, (p. 44))

Moreover Osgood *et al.* (1957) have discussed the notion of potency in *The measurement of meaning* and they indicate that strength, power, and masculinity underlie most notions in a basic notion vocabulary. In architecture, the strength, massiveness, and powerful character of pyramids, castles, prisons and ziggurats is always interpreted as an indicator of political power or strength.

Weese considers that,

> Buildings are masculine and aggressive. You have to take the long view and assume they will last; therefore they cannot be pretty - the adjective, I least like applied to architecture. I am embarrassed when architects talk about beauty; like happiness, it is only a by-product. A building should be handsome, elegant, strong, lean - beauty is too vague an attribute. (*in* Heyer, 1966, (pp. 42-45))

Yamasaki also presents much the same notion.

> There are a few very influential architects who sincerely believe that all buildings must be 'strong'. The word 'strong' in this context seems to connote 'powerful' - that is, each building should be a monument to the virility of our society. These architects look with derision upon attempts to build a friendly, more gentle kind of building.... there is another, much less desirable aspect of this effort toward monumentality. There are examples of architectural 'muscle-flexing' that evince a desire to be stronger, more powerful, more exciting than the building of competitors. The result of this thinking inevitably end in crudity, to the point of brutality.
> (in Heyer, 1966, (p. 186))

While summarizing empirical work in "meaning of architecture", prior to 1971, Hershberger(1972), and Seaton and Collins(1972) found notions related to strength, boldness, ruggedness and massiveness to be present in architecture. Küller also derived a composite measure: masculine-feminine, fragile-powerful. Hershberger suggests using rugged-delicate to describe this notion.

The definite agreement that seems to be appearing in the previous discussion is that the notion of solidity can be best enunciated by descriptors such as strong, powerful, massive. Some researchers (Canter, Hershberger) seem to relate coarseness and roughness with solidity but such attributes are already discussed under texture. Hence it seems solidity should be limited to massiveness, heaviness and strength.

2.14. Notions of organisation.

Previously scale and proportion were shown to be intermixed with both size and volume. Similarly organisation is related to balance, harmony, and composition. It is unclear whether spatial organisation is achieved through rhythm, composition and so on, but it does seems that the notion of organisation must exist in architecture.

Zevi (1974) argues,

> If unity means that quality which makes every element of a work of art necessary and to which nothing can be added and subtracted.... every composition, both in plan and elevation, must be characterized by a connection between all its components. (p. 194)

Goldberg (in Heyer, 1966, p. 50) considers that "the inner order and the integrity lead to unity". Corbusier's (1957) work on modular coordination suggests that unity is the coordination of modules.

> I mean that geometry denotes order and mankind expresses itself through order.... the first thing a man does is to square up, to arrange, put in order, look plainly at what is before him, he has discovered the way to measure space by using co-ordinates of three perpendicular axes.... the standard elements will provide unity of detail, and unity of detail is an indispensable requirement of architectural beauty.

Le Corbusier, in Benton et al. 1975, pp. 132-135)

Rapson, Mies, Tange, and Venturi all seem to focus on the common notion that order means composition, coherence or total organisation despite circumstantial confusion.

> There is a need for contrast; our environments cannot be played in a single key - richness, variety and complexity - it should be woven into an orderly composition. (Rapson, in Heyer, 1966, p. 58)

> A valid order accommodates the circumstantial contradiction of a complex reality. It accomodates as well as imposes. It thereby admits 'control and spontaneity', 'correctness and ease' improvision within the whole. (Venturi, 1966, p. 41)

> We must create order out of the desperate confusion of our time.
> (Mies Van der Rohe, in Venturi, 1966, p. 41)

> Order is to evolve spatial harmony and order within diversity".
> (Tange, in Kultermann, 1970, p. 286)

And finally, Wright(1953) considers "continuity as a part of spatial rhythm." Ashhara(1970), Litton(1972) and Arnheim(1977) present notions of organisation to mean unity of the whole building.

> A cluster of architecture is not merely the sum total of individual buildings; it can - and should - be an efficiently coordinated and internalized group of buildings. (Ashihara, 1970, p. 130)

> Unity is that quality of wholeness in which all parts cohere, not merely as an assembly but as a single harmonious unit.... It is organisation providing harmony (unity) among shapes, edges, lines, colors and

textures. (Litton, 1972, p. 284)

> Order has come to mean a reduction to simple geometrical shape and standardization of everything for everybody, the favouring of basic physical function over expression and of rationality at the expense of spontaneous invention.
> (Arnheim, 1977, p. 162)

Prak (1977) and Mehrabian and Russell (1974) have taken the notions of composition to mean similar, coherent, continuous. Vielhauer, Canter, Collins, Brittell, Küller, and Hershberger using factor analysis indicated notions such as orderly, organised, efficient, equipped, coherent, coordinated, clear.

It is obvious that organisation in a building can be order, coordination, coherence, efficiency, equippedness and so on. Composition and organisation seem to have similar underlying notions.

2.15. Notions of size.

Notions such as form, volume, and scale indirectly mediate the notion of relative size. Moreover the notion of size is based upon the observer's preconceived and experienced notion about the "appropriate" size. If volume is an objective measure, then the notion of size defines a perceived measure.

Caudill *et al.* (1978) have distinguished between actual Euclidian measure of size, visually perceived size and size of objects in relation to other objects and illustrate distinctions between the latter two types of sizes. A similar distinction is proposed by Scott (1925).

> In building three[sizes] may be distinguished: the bigness which it actually has [mechanical measurement], the bigness which it appears to have [visual measurement], and the feeling of bigness which it gives [bodily measurement]. The last two have often been confused, but it is the feeling of bigness which alone has aesthetic value. (p. 173)

Appleyard (1976, p. 74) considered size to be "visible height bulk as seen from the approach to a building", - a notion which should be related to Caudill's visually perceived size. Zevi's and other authors' notions related to scale and size were presented earlier. One would have difficulty separating size and scale as Heath (1965) noted,

> A simple description of the idea of human scale [is] ... The spectator's impression of the size of a building, relative to his own size and position, and relative to these shapes with customary recognizable sizes. (p. 70)

Vielhauer (1965), Craik (1966), Collins (1969) and Hershberger (1969) have analytically shown that notions captured by descriptors such as large, huge, big, and broad can be associated with buildings. Hershberger on the basis of previous

research suggests that large-small would be an appropriate descriptor for this notion.

To summarize, the notion of size is related to qualities of largeness, bigness and broadness of the object.

2.16. Notions of spaciousness.

The idea that size is related to perceived size and to the observer's preconceived notion about size has been discussed; in contrast spaciousness deals with the spatial adequacy of volume for a given built environment and function. This means that notions such spatial adequacy, functional efficiency, comfort, and spatial organisation are interrelated and poses an interesting operational problem in separating each quality under different notions.

Vielhauer using factor analysis, indicated spaciousness with descriptors such as roomy, adequate size, free space and noted that size adequacy was intermixed with size (largeness, bigness). Canter discusses the notion in relaticn to the words flexible and spacious. Hershberger suggest the noticn be described by words such as loose, and spacious.

Empirical evidence discussed above suggests that spaciousness might deal with openness and freeness. If this suggestion is true Mies' "open plan", Johnson's "comfortable form", Kahn's "free order" and Corbusier's "openness" and "freedom" for living would endorse the legitimacy of an architectural concern with a notion such as spaciousness.

2.17. Notions of colourfulness.

Physical colour is an attribute of environmental elements; exotic character of these colours can be termed colourfulness. The notion of colourfulness can be thought of as a parallel notion to spatial excitement where the latter notion deals more with volumetric interplay and surface contrast.

Vielhauer was able to indicate a colour notion that can be expressed verbally as colourful, gay, flashy colours; and Collins indicated the notion by "textured", and "bright colours". Craik indicated the notion with words such as conservative, colourful, and bizzare, while Hershberger showed a lavish, rich, and generous quality to relate to the built environment.

For operational purposes Hershberger suggests using

colourful-subdued as descriptors and Küller suggests lavish-expressive as appropriate descriptors for this notion. Garling (1976) and Culvin et al. (1972) suggest colourful-drab as appropriate pairs of descriptors. Danford and Willems consider vivid or drab as correct descriptors for this notion. Thus, the literature indicates that this "colourful" notion might well be described by words such as vivid, rich, bright, flashy, and lavish.

2.18. Notions of complexity.

Under the general heading of complexity there are at least two phenomena that can be traced from the existing literature. It seems unlikely that the two concepts would be independent of each other.

First, there is numerical complexity such as the one measured in terms of "information rate" and discussed by Atteneve (1956), Shannon (1949), Garner (1960) and proponents of "information theory" in Psychology. A similar notion is presented by Vitz (1966) where he demonstrated that preference for various shapes increases steadily up to a certain limit and then again preference drops subsequently as the number of sides of polygons increases. The general conclusion from all such

works has been that "the preference for moderately complex stimuli is high and preference for high or low complex stimuli is low" (Mehrabian and Russell, p. 106). This notion of complexity is one that has some direct numerical measure in physical units; objects studied are often simple.

Secondly, there is the phenomenon of complexity in terms of collative properties of an object (simple-complex, patterned-random, harmonious-jarring, homogeneous-heterogeneous, redundant-varied, similar-contrasting, consonant-dissonant and continuous-intermittent) as proposed by Berlyne(1960) and Wohlwill's(1976) aesthetic notion in terms of certainty-uncertainty, usual-unusual, familar-unfamiliar, congruent-incongruent. A similar notion is presented by Rapaport and Kantor(1968), Lozani(1975), and Rapaport and Hawkes(1973) in their architecture-related works. The general notion is suggested by Mehrabian and Russell(p. 77-95) that random, heterogeneous, varied, contrasting, dissonant, uncertain, incongruent objects may have higher "information", than simple, patterned, harmonious objects and hence this category of complexity yields the subjective measure of the numerical complexity discussed in the preceding paragraph. Litton(1972, p. 286) proposed subjective measure of variety by defining, "an index to how many different objects and relationship are found present." It seems that these collative properties or aesthetic notions should be called

comprehensibility or understandability; and misfit-fit of the environment and numerical complexity might be related to this notion.

There is a third vague notion about complexity which could be called paradoxicality; and Venturi(1966) seems to have taken this argument to impressive length. He argues,

> I like complexity and contradiction in architecture. I do not like the incoherence or arbitrariness of incompetent architecture nor the precious intricacies or picturesqueness of expressionism. Indeed, I speak of a complex and contradictory architecture based on the richness and ambiguity of modern experience, including that experience which is inherent in art.... Calculated ambiguity of expression is based on confusion of experience as reflected in architecture and program. (1966

Arnheim(1977) further elaborates the same notion by indicating two types of ambiguity.

> Orderly ambiguity can make one and the same building look tall when it is perceived in one context and small when perceived in another. There is no contradiction here, only enriching complexity. However, ambiguity becomes disturbing when the same thing under the same condition vacillates when, for example, it looks curved one moment and straight another, thereby upsetting its particular visual function in the design as a whole. (p. 179)

The preceding discussion suggests that ccmplexity can be described by the words comprehension, intricate, varied, diversified; whereas correctness of fit would be considered

under balance. Patterning is considered in organisation and the surprising or originality notion is considered under modernity.

2.19. Notions of modernity.

Styles in buildings and clothing are repeated over historical time with the difference that clothing styles change more rapidly than do architectural styles. Hence style in architecture means the particular style-period while newness refers to the time when the building was built.

Building modernity has three basic facets: style of the building (Gothic, International, Japanese style), age of the building, and building use over time. "Style decays over the age of the building" (Caudill *et al.*, p. 72) and is "culturally shared" (Moore and Allen, p. 12). Building use over time is an experiential notion. Caudill *et al.* (1978) suggest modernity to be,

> The spirit and expression of the times in the use of materials and technology available at the time [of construction]. (p. 166)

Similar notions are indicated by Emile Gallé (1900).

> Modern that is invented by the living generation, made to be used and decorated to please. Conceived by our contemporaries and not by men from other ages with other customs, it must be made according to our ideas, for our pleasure, to our size, and to fit in with present day life.
>
> (in Benton et al. 1975, (p. 29))

Hershberger suggests the descriptors old-new to be appropriate to the notion of modernity. Collins considered this quality in terms of new, modern, and civilised whereas Vielhauer used contemporary, dated, modern, new, stylish, and fashionable as descriptors. This notion is identified by Küller by using descriptors such as timeless, aged, modern, and new.

Appropriate descriptors for the notion are up-to-date, contemporary, fashionable, new, and novel.

2.20. Notions of balance.

Because a building contains many so elements, there must be some attempt toward equilibrium of various components present in the building. This intricate notion has its origins in the discipline of aesthetics and in general relates to architectural composition. One may think that the notion of balance might have an underlying philosophy similar to that of the principles of optimization.

Zevi(1974) considered symmetry, contrast and balance as three distinct categories. He explains,

> Symmetry is the balance of formal, axial buildings.... Balance is the symmetry of informal, non-axial architecture. For a building to be alive, it must show contrast between vertical and horizontal lines, between solids and voids, between defined and intangible forms, between volumes and between masses.
> (p. 194-195)

A similar notion is put forward by Alberti.

> I shall define beauty to be a harmony of all the parts in whatsoever subject appears, filled together with such proportion and connection that nothing could be added, diminished or altered but for the worse.
> (quoted by Rapson <u>in</u> Heyer, 1966, p. 58)

Unity and composition were discussed earlier under the notion of organisation. Berlyne's, and others' arguement in terms of a harmonious, symmetrical, and consonant quality was considered under complexity. Sanoff(1974) and Shafer and Richards(1974) considered the notion of harmony and symmetry.

In general, it can be seen that balance is not only a difficult quality to describe verbally but also difficult to comprehend. But in general, one can assume that balance refers to harmonious character, equality and proportionality in contrast and symmetry.

2.21. Notions of cleanliness.

Earlier it was suggested that modernity is building relevance over time (present, past, and future). In this context maintenance and up-keep become critical issues. Apart from this utilitarian notion of cleanliness, a building through its faulty design often becomes defaced, vandalized and consequently difficult to maintain.

This is a common notion but surrounding such a notion there is little phenomenological discussion. Empirical work of Vielhauer(1965), and Collins(1969) indicated a notion described by words such as clean, uncluttered, neat, well kept. On the other hand Craik showed the opposite of cleanliness, on the verbal dimension with words such as dirty and filthy. Clean-dirty has also been considered by Garling(1976), Pyron(1971, 1972), Lowenthal and Riel(1972), and Brodin(1973) in their work related to architecture. Even though Küller presents an exhaustive list of words (dusty, faded, decayed, sallow, neglected, filthy, healthy, dirtied, shabby, worn out, tidy, neat, trim, littered, slovenly, dirty, smutty, sober, littered, discoloured, mismanaged, not properly kept, well groomed, well looked after, well polished, well kept, rotten, messy) for this notion, he and his colleagues were unable to demonstrate the

empirical importance of such a notion.

All this discussion indicates that the notion of cleanliness probably can be well described by words such as well kept, well maintained and neat.

2.22. Notions of ventilation and rigidity.

Buildings may have one quality that decreases the total utility of the building for other functions than those it was supposed to support. Rigidness of building design is an effect of the designer's style.

Neither phenomenological nor empirical results exhibit the presence of this notion in buildings. However, both Vielhauer(1965) and Hershberger(1970) present the notion of rigidity by descriptors such as rigid-flexible. Küller offers fixed, immovable, immobile, and static as descriptors for this notion.

Ventilation seems to be another seldom explored notion. Of course, air movement inside and outside of the building, solar radiation and sun movement (Olgay and Olgay, 1957) as climatic determinants of building design (Fry and Drew, 1964) are well

illustrated.

Ventilation also has different meanings. Hershberger labelled it the drafty-stuffy character of the building and a similar notion seems to have been empirically demonstrated by Vielhauer. In fact, she was able to demonstrate the notion for all the buildings that she studied, with descriptors such as good temperature, comfortable temperature, drafty, warm, good ventilation, fresh odour. Collins also reported a similar notion with words such as heated, breezy, drafty, and heat. Shafer and Richards(1974) and Brodin(1973) considered stale-fresh and Lowenthal and Riel, smelly-fresh as appropriate descriptors. Küller gives descriptors such as cold, chilly, cool, scented, windy, and stormy to describe this concept. Hence ventilation seem to indicate a fresh, airy and open character of the building.

2.23. Pleasure-arousal-dominance notions.

Osgood et al. presented a general case for The measurement of meaning and their work suggests that evaluation, potency and activity are major determinants of any verbal meaning. Almost the same notion is given by Mehrabian and Russell who argue that the notions of pleasure, arousal and dominance are major

environmental notions. It would be convenient, at least in operational terms, if it could be demonstrated that these three determinants can encapsulate the major subjective notions about the built environment.

Mehrabian and Russell measured pleasure by the descriptors happy, pleased, satisfied, contented, hopeful, relaxed; arousal by stimulating, excited, frenzied, jittery, wide-awake, aroused; and dominance by controlling, influential, in control, important, dominant, autonomous. After repeated studies using verbal descriptions and hundreds of colour slides of the environments, they demonstrated that these appeared to be major determinants of the perceived environment.

The clarity and definitiveness of Mehrabian's and Russell's work seems to contradict earlier pioneering work of Vielhauer, Collins, Hershberger, Canter, Küller and Craik. Most of the latter indicated that there are more than five or six determinants by which experience of architecture can be verbalised. Hershberger suggests that there are about 20, and most of them have already been discussed. Moreover closer examination of Mehrabian's and Russell's descriptors reveals that the arousal notion is closely related to the notion of spatial excitement and balance; dominance seems to be a conglomeration of notions such as size, rigidity, social status, spaciousness, organisation and privacy and, lastly, their

pleasure notion seem to be expressed as "happiness".

Mehrabian and Russell have raised some interesting questions. They argue,

> One drawback of sampling from the lexicon [vocabulary] of a professional group outside psychology is that descriptors that are suited to the problem of that group may not be representative of the concerns of environmental psychologists. ... we present the results of the factor analyses of a set of environmental descriptors proposed by Kasmer (1970) taken from architectural and design journals. The descriptors were highly redundant, and most of them measured evaluative attitudes. In addition, they referred mainly to visual sources of stimulation and thus did not include adequate representation of stimulation in other modalities. (p. 7)

Even though the review presented here seems to be about the environment and provided the concern is about the same environment, one wonders whether either set of research has captured the essence of the problem. Maybe it is neither a psychological nor architectural problem, but simply a 'semantic game'.

CHAPTER 3

LITERATURE REVIEW AND STUDY PURPOSES.

> What meaning, if any, can be assigned to the probability of a hypothesis, law, theory that is itself a probability distribution so that its falsity or truth is not, in general, an observable event on which bets can be made and paid off? (Marschak, 1975)

3.1. Representation and concepts.

The analysis presented in Chapter 1 implied that the process of representation is one of the fundamental steps for deriving most architectural ideas. A process is achieved by selection of suitable concept-expressions, media and instruments. The selection of proper combinations along these dimensions defines the uniqueness of the representations. Given the open-ended nature of the representation and its usage in architectural practice, is it possible to establish some empirical framework for a representation? How does one seek

such an empirical basis?

Thus far, representation has been discussed only on an analytic basis, but it is also a practical activity that a professional architect must perform to sell his or her ideas. What practice-related questions should one examine such that the study would be helpful to an architect? For a professional person, time is the most valuable commodity and it costs money. The relationship between time spent in preparing a representation and the impacts of each possible representation would be one such question.

As indicated in Chapter 2, architecture consists of at least 24 different qualities. Some of the qualities were identified through theoretical discussion and some of them evolved through empirical justification. Can one generate some general understanding of these notions so they are less difficult for lay observers to comprehend? Indeed, which (if any) of these notions do lay obeservers use in making these judgements? Does that pattern of judgements differs from judgements of trained architectural professionals?

3.2. The literature review.

In Chapter 1, while presenting conceptual issues about representation, the relevant literature was reviewed. Similarly in Chapter 2, some phenomenological and empirical findings were examined. To arrive at the purposes of the study, it may be helpful to examine some empirical studies conducted in the area of architectural representation and environmental meaning in the past 15 years. Whether one prefers to call the domain of knowledge Environmental Psychology, Architectural Psychology, Environmental Assessment or Architectural Evaluation, there seems to be overall agreement among the researchers about the questions one must ask before beginning any study.

> [<u>which</u>] building, urban scenes, forest [should I study?] <u>Whose</u> comprehension am I to study (observer)? <u>By what</u> means am I to present the environmental display[building] to the observer (presentation of environmental display)? <u>What</u> behavioural reactions of the observer am I to elicit and record (nature and format of judgement)? <u>By what</u> standard might I evaluate the observer's comprehension (validational criteria)? (Craik, 1968, p. 30)

By answering these five questions, one can summarize an empirical study in this area of research. For convenience, which building and means to display can be labelled "enviromental condition". The nature and format of judgment are

two conceptually different areas. Given verbal questioning as the most common approach, one may classify it in terms of "number of measures" and "rating methods". Usually it is on the basis of statistical criteria that results are validated and hence "statistical results" are needed to complete the summary.

An informal bibliographic search produced 78 empirical studies written in English after 1965 in the United States, Canada, Sweden, England, Australia and New Zealand.

The 78 studies do not include any aimed primarily towards understanding environmental cognition, such as those of Harrison and Sarre(1971), Harrison(1975), Downs and Stea(1973), Moore and Golledge(1976) and Honikman(1972, 1973). Also excluded were studies conducted for determining attitudes towards environment, such as those reported by McKechnie(1970, 1977) and Kaplan(1977), and studies exploring socio-demographic relationships with environment such as those reported by Sewell and Little(1973), Sewell(1971) and Groves and Kahalas(1975). Furthermore, studies reported by Garling(1969, 1970), Franklin and Heyward(1975), Miski _et al_.(1975) and Dainoff _et al_.(1975), are related to this domain of research but these studies only examined openness or enclosure perception, and were not included here. Another 5 to 10 studies, reported in Dissertation Abstracts International, were excluded since details for such studies were not available.

Using Craik's modified criteria, each study is condensed in Table 3.1 by chronological, then alphabetical order.

In general the bulk of the studies, 42, were reported between 1972 and 1974. 15 of the 78 studies focused at the scale of a room, nine focused on interior aspects of the building, seven studied the inside of the building, 23 considered facades, 14 gave attention to landscaping and scenic qualities and three studies each approached qualities of the environment at street and city scales. Another 13 studies attempted to sample from a large set of environments.

The 78 studies included 122 attempts to display an environment. Almost one-quarter of the displays entailed the actual environment; about two out of five used photographic techniques and about one in eight included conventional graphic or model techniques to display environments. The remaining twenty percent of representations included techniques such as topographical maps, verbal descriptions, imagining the environments or holography. Küller(1972) and Wood(1972) were the only two researchers who attempted to study more than five representation simultaneously.

The median number of verbal descriptors (verbal response measure) used in these studies was 21.

Table 3.1 summary of studies

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Veilhauer, Unpublished doctoral dissertation, 1965	Interior of 4 buildings in use	66 bipolar descriptors selected from 198 (source: interior design journals)	Students, non-students, test-retest for some students: 250 males, and 250 females	7-point semantic differential scale	Separate factor analysis for each building indicated 5-7 factors accounting for 72-80% of total variance
Peterson, Journal of Regional Science, 1967	23 colour slides of facades and landscaped scences	10 verbal measures	140 observers	5-point scale	Multiple regression and factor analysis revealed preference related to proximity to nature and age with R^2=.79
Acking and Sorte, 1969 (in Kuller, 1972)	15 photographs describing landscaped environment	11 verbal descriptors for composite complexity, primordial-natural and unity aspects	43 high school pupils	7-point verbal scales	3 factors accounted for 80% of the variance within the means for 15 photographs'
Canter, Environment and Behavior, 1969	2 BW slides for each of 20 students' projects	45 bipolar descriptors	30 architecture students	7-point semantic differential scales	7 factors accounted for 62% of total variance
Canter, Environment and Behavior, 1969	Monochromatic line drawings of 24 interiors	50 bipolar descriptors	67 students	7-point semantic differential scale	8 factors accounted for 60% of total variance
Collins, Unpublished doctoral dissertation, 1970	Interiors of 3 library buildings during use	198 bipolar descriptors (source: students of architecture and psychology, and architects)	228 students	9-point discrimination scale	10 factors accounted for 44% of total variance and predictor-criterion interaction yielded validities in .80's and cross validities in the lower .20's
Hershberger, Proceedings of EDRA I Conference, 1970	Exteriors of 25 buildings viewed through colour slides	30 bipolar descriptors	26 each of the final year architecture, pre-architecture and non-architecture students	7-point semantic differential scale	Separate factor analysis for each group indicated 3 factors for each group with architects differing on pleasure factor
Sonnenfeld, Environment and Behavior, 1969	55 slides depicting seasons and weather conditions	25 physical concepts	High school students from Barrow(92), Wainwright(14), and Anaktuvuk pass, Alaska(19) and Newark, N.J.(86)	5-point semantic differential scale	Analysis of variance suggests that personality variables may be an important source of within group differences, and a source of behavioural variation in environment

Table 1.1 (continued)

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Winkel, Malek and Thiel, Proceedings of EDRA I Conference, 1970	10 street routes; slides retouched to show 4 alternate conditions of roadside signing	65 bipolar descriptors	4 groups formed by male and female, students and non-students	7-point semantic differential scale	Factor analysis for each experimental condition gave similar factor structure
Canter and Wools, Building Science, 1970	Actual interiors of 6 music practice rooms, 3 house types, 31 residence bedrooms and 2 secretarial offices	10 bipolar descriptors measuring friendliness	75 housewives, 64 music students and 31 architecture students	7-point semantic differential scale	Analysis of variance indicated that scale distinguished between different environments
Canter and Wools, Building Science, 1970	Exp. design with 2 types of ceilings, 2 seating conditions and 2 types of windows for interior of the room shown through sketch drawings	10 bipolar descriptors measuring friendliness	Architecture and Psychology students, and architects	7-point semantic differential scale	Analysis of variance illustrated that the two student groups gave similar responses while architects responses were more influenced by windows
Garling, 1970 (in Kuller, 1972)	Factory shop, 100mx20m and 15m high	27 bipolar descriptors	40 architecture students and 30 factory workers	7-point semantic differential scale	Separate factor analysis for each group indicated students' major concern with unity-function and workers' concern about pleasantness; explained variance=64%
Laumann and House, Sociology and social research, 1970	Interior of 897 actual living rooms	53 item checklist	Not reported	Binary responses	Guttman-Lingoes SSA analysis indicated modern and social status dimensions with coefficient of alienation=.464
Lau, Proceedings of EDRA II Conference, 1971	Interior of the study bedroom shown through different lighting conditions through model	Measure of pleasantness and gloominess	64 architecture students	4-point Likert type scale	Analysis of variance and rank order correlation indicated that the two modes of representation were assessed in a similar manner
Pyron, Environment and Behavior, 1971 and 1972	4 house form and 4 spacing conditions shown through BW film	20 bipolar descriptors and information content of experimental condition	120 residents	7-point semantic differential scale	Analysis of variance showed that visual search behaviour was function of environmental uncertainty
Calvin, Dearinger, and Curtin, Environment and Behavior, 1972	15 landscape views shown through slides	21 bipolar descriptors	139 students	7-point semantic differential scale	Factor analysis indicated 3 factors derived from means of the responses to landscape views accounted for 90% of total variance

Table 1-1 (continued)

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Canter and Thorne, Environment and Behavior, 1972	16 slides of facades of Scottish and Australian houses	10 friendliness-related descriptors	34 Glasgow and 58 Sydney students	7-point semantic differential scale	The differences in response to each slide was found to be closely related to the differences in recent trends in house design in the two countries
Craik, in Krutilla, Natural environments, 1972	50 landscape scences	Landscape rating scale, graphic sorting and aesthetic scale	286 observers with varying professional background	7-point scale	Analysis indicated panoramic, focal and colourful views generated aesthetic appeal with correlation coefficient of .36 and .34
Howard, Milynarski and Sauer Proceedings of EDRA III Conference, 1972	4 buildings (with 6 interior spaces in each) with actual spaces, colour slides and BW slides	28 of Osgood's semantic descriptors	59 students for real, and 16 students for colour and BW slides	7-point semantic differential scale	Factor analysis for each building and each exp. condition indicated slides induced affective responses otherwise general agreement between exp. Conditions
Jackson and Johnston, Environment and planning, 1972	Home town (Christchurch) and 2 each of desirable and undesirable locations	38 verbal measures	High school and university students	7-point scale	14 factor analytic components accounted for 67% of total variance for Christchurch but factors for other places were unstable
Kaplan, Kaplan and Wendt, Perception and Psychophysics, 1972	56 environments: 28 man-made and 28 natural categories	Preference, complexity and excitement-intrigue measures	68 students	5-point rating scale	Smallest space analysis indicated natural scenes preferred; complex natural scenes preferred over other natural scenes
Kuller, National Swedish Building Research D12: 1972	15 photographed living rooms	78 unipolar descriptors (selected from 1058)	43 high school pupils	7-point Likert type scale	8 factors explained 95% of total variance within the means of interiors
Kuller, National Swedish Building Research D12: 1972	One actual drawing room in sixties' style, observed when not in use	78 unipolar descriptors	63 architecture students	7-point Likert type scale	Factor analysis explained 28% of total variance through 3 factors
Kuller, National Swedish Building Research D12: 1972	Residential development built in 1958, exterior of the buildings	78 unipolar descriptors	50 high school pupils	7-point Likert type scale	4 factors accounted for 48% of total variance

Table 3-1 (continued)

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Brodin, Proceedings of Architectural Psychology III CONFERENCE, 1973	Exterior of 25 suburban houses, flats and town center environments	29 verbal measures	242 residents of the three types of environment	7-point scale	Correlation between enclosure and evaluation and within flats was .79; within suburban houses was .29 and within town center was -.43
Canter, Penyan and West, Perceptual and motor skills, 1973	Model of room interior shown through slides and holograph	10 bipolars for friendliness and room depth judgement	25 architecture students	7-point semantic differential scale	Analysis of variance indicated the effect of mode of presentation related to the sequence in which judgements were made
Canter, Proceedings of Architectural Psychology III CONFERENCE, 1973	28 school buildings with interior and exterior conditions	5 physical elements using several constructs about the school buildings	510 school teachers from all levels	7-point scale	Factor analysis for each construct separately indicated differentiation of the elements was more more dominant than diffentiation of the constructs
Cunningham, Carter, Reese and Webb, Proceedings of EDRA IV Conference, 1973	BW video of photomontage scale model, and super 8mm colour and BW video of streetscape	Mechanical recorder for visual excitement and 12 bipolar descriptors	Design students, faculty and non-designers	7-point semantic differential scale	Comparisons between means indicate similar responses to various representations; designers and non-designers have different "interest peaks"
Kaplan, Proceedings of EDRA IV Conference, 1973	60 slides of outdoors, half of which were drawing and remainder photographic	Mystery, preference and coherence measures	38 architecture, 30 landscape and 39 psychology students	5-point rating scale	Coherence and mystery were found to be relatively independent of each other and each was strong predictor (r^2 greater than .65) of preference
Sanoff, Proceedings of EDRA IV Conference, 1973	12 houses shown through photographs	Sorting for similarity, ranking and other attitudinal measures	153 high school students	Rank-ordering method	Content analysis of the sorting technique revealed descriptive and affective categories as well as hierarchical preference patterns
Toqnoli, Environment and Behavior, 1973	Experimental design with 2 chair, 2 window and 2 floor conditions	Interestingness, comfortableness, distractingness and pleasantness	56 students with equal male and female	7-point rating scale	2x2x2 analysis of variance indicated comfort, interestingness varies simultaneously with complex environmental variables
Wedin, Avant and Wolins, Proceedings of Architectural Psychology III CONFERENCE, 1973	3 living rooms each shown through floor plan, isometric and photograph	4 sets, each of 4 bipolar descriptors	105 housing students	99-point verbal scale	Analysis of variance with aggregate data indicated responses to size were least consistent across graphic forms

Table 3.1 (continued)

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Kuller, National Swedish Building Research D12:1972	8 exteriors and 7 interiors of buildings	66 unipolar descriptors	56 selected by advertising in newspaper	7-point Likert type scale	8 factors explained 97% of variance within the means for 15 building conditions
Kuller, National Swedish Building Research D12:1972	9 landscape slides	4 unipolar descriptors	Students from arch. related disciplines from different Scandinavian cities (N=18 to 43) and 15 housewives	7-point Likert type scale	One-way analysis of variance and intergroup correlation indicated that there was considerable similarity between the different groups
Kuller, National Swedish Building Research D12:1972	15 slides of landscaped environment	8 unipolar descriptors	41 high school students and 27 architects	7-point Likert type scale	Analysis of variance and intergroup comparisons indicated similar results between groups with correlation between groups greater than .6 except for pleasantness (r=.34)
Kuller, National Swedish Building Research D12:1972	9 underground sub-way stations	5 unipolar descriptors	17 arts and crafts students and 30 station users per station	7-point Likert type scale	One-way analysis of variance and intergroup correlation indicated the design group agree well with the judgements of the general group
Kuller, National Swedish Building Research D12:1972	Two actual rooms with differing complexity and pleasantness	Two unipolar descriptors	50 visitors, students and teachers visiting rooms in different order	7-point Likert type scale	2-way analysis of variance showed reliable and significantly different group averages on complexity and pleasantness
Lowenthal and Biel, Environment and Behavior, 1972	Perceived and imagined city	25 bipolar descriptors	300 observers from Boston, Cambridge, New York and Columbus (Ohio) areas; different social backgrounds	5-point semantic differential scale	Both environmental experience and verbal responses reveal mental structure involving clusters of attributes that seem to shape our view of the world
Seaton and Collins, Proceedings of EDRA III Conference, 1972	4 building facades represented in 4 ways from each of 2 positions	5 verbal measures	600 visitors or 38 observers for each experimental condition	7-point scale	Analysis of variance indicated the representations significantly affect the relative mean values between different buildings
Wood, Unpublished B. Architecture thesis, 1972	Experimental design with 5 buildings, 6 media conditions	7 verbal descriptive measures and mapping	207 students	100-point anchored scale	Analysis of variance indicated the best representation of an existing building is a sequence of colour slides

Table 3.1 (continued)

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Zube, Landscape architecture, 1973	18 slides of real landscape and 9 slides of drawings of landscape	14 bipolar descriptors	Designers, managers, design students, management students and others with total of 185	7-point semantic differential scale	Analysis indicated responses to drawings differed but good agreement between groups with correlation coefficiets greater than .49
Acking, National Swedish Building Research, D7:1974	2 housings projects in plans, slides, perspective drawings and models	8 unipolar descriptors	Groups of 20 users, each group viewed different experimental conditions	7-point Likert type scale	Analysis indicated plan, perspective and white model differed; while colour film and colour model gave similar responses to actual environment
Betak, Brummell and Swingle, Proceedings of EDRA V Conference, 1974	Outside and inside walking tour of the building	Free recall over plan drawings and 34 bipolar descriptors	67 students	7-point rating scale	Factor analysis gave 9 factors accounting for 68% of total variance and MDS analysis gave 2 dimensional solution
Canter, Cecilio, Bohles and Watts, in Canter, Psychology and built environment, 1974	19 colour slides describing urban exteriors	10 bipolar descriptors phrased in different languages	Architecture and non-architecture students from Germany(44, 33), England(29, 20) and Spain(23, 20)	7-point semantic differential scale	Intergroup comparison indicated agreement between groups with correlation coefficients greater than .34 but some words translation may not be acceptable
Canter, Gilchrist, Miller and Roberts, in Canter, Psychology and built environment , 1974	A living room shown with 2 presentations, 4 focus elements, 3 seating direction and 2 seating spacing conditions	4 activity suitability measures	???	10-point Likert type scale	MANOVA analysis indicated furniture arrangement and presentation technique affects satisfaction with the living room
Hershberger and Cass, Proceedings of EDRA V Conference, 1974	BW film, colour film and video for 12 proto-typical housing units	30 bipolar descriptors	120 students	7-point semantic differential scale	Separate analysis of variance for each scale and environment indicated good agreement between media and building with correlation coefficient greater than .72
Hershberger and Cass, Proceedings of EDRA V Conference, 1974	12 exteriors of commercial and institutional buildings	30 bipolar descriptors	27 pre-architecture students	7-point semantic differential scale	8 major factors emerged with similar factor structures for all buildings
Leff, Gordon and Ferguson, Environment and Behavior, 1974	Colour slides of exterior environments and room interiors viewing from various approaches	Pleasantness, complexity, concentration, interest and 23 other bipolar descriptors	Total of 650 subjects for all experiments with range of 13 to 241 observers	7-point rating scale	The set to view a scene as an abstract collection of shapes, lines and textures increased judged complexity

Table 3-1 (continued)

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Zube, Environment and Behavior, 1974	4 landscape sections shown through aerial photographs and topo. maps	25 bipolar descriptors	30 designers, 30 resource managers and 30 secretarial workers	7-point semantic differential scale	Factor analysis and intergroup comparison indicated that the agreement between environmental designers and and managers was high
Craik, in Zube(eds), Landscape assessments, 1975	Marin site (large landscaped area)	104 adjectives	Sample of 187 drivers	Adjective checklist (binary responses)	Cluster analysis demonstrated 4 word clusters accounted for 62% of total variance
Danford and Willems, Environment and Behavior, 1975	Guided walk, informed with visual, informed and naive simulation for one environment	16 affective and 16 descriptive adjectives	160 students for each experimental condition	5-point rating scale	Comparison between experimental groups indicted an unprecedented degree of agreement for both descriptive and affective responses
Zube, Pitt and Anderson, in Zube, Landscape assessments , 1975	56 views, actual sites and photographs	18 bipolar descriptors	123 field and 184 non field study samples with different social backgrounds	5-point semantic differential, landscape checklist, rank order and Q-sort	Inter group and inter measure correlational analysis indicated general agreement between groups and measures
Berlyne, Proceedings of EDRA VII Conference, 1976	20 slides of exteriors of buildings from variety of cultures	13 bipolar, paired similarity and preference measures	16 architecture students and 30 non-architecture students	7-point scale for all ratings	INDSCAL analysis resulted in 3 to 8 dimensions and explained about 85% of total variance
Friedberg and Whiddon, Proceedings of EDRA VII Conference, 1976	10 abstract sculptures selected from pool of 30	20 bipolar descriptors from Hershberger(1972)	29 mathematics, 22 pre-design and 18 design students	7-point semantic differential scale	Analysis of variance for group and sculpture indicated a high degree of agreement between groups when evaluating sculptures
Garling, Environment and Behavior, 1976	24 slides showing detached houses, flats and city center areas	9 bipolar descriptors	20 for semantic differential, 12 for similarity and 8 for sorting study	7-point semantic differential, 10-point for similarity and ranking for sorting	Factor, multidimensional and cluster analysis revealed similar evaluation of environment by differing measuring techniques
Garling, Scandinavian Journal of Psychology, 1976	24 slides showing detached houses, flats and city center areas	24 bipolar descriptors	12 semantic differential and 10 similarity study	7-point verbal scale and 10-point similarity measure	8 verbal factors accounted for 94% and 2 dimensions in similarity rating explained 88% of total variance

Table 3.1 (continued)

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Mehrabian and Russell, in An approach to Environmental Psychology, 1974	40 verbally described situations	28 bipolar descriptors relating to pleasure, arousal and dominance	134 students	9-point semantic differential scale	3 factors accounted for 60% of total variance
Mehrabian and Russell, op. cit., 1974	40 verbally described situations	23 bipolar descriptors	163 students	9-point semantic differential scale	3 factors accounted for 61% of total variance
Mehrabian and Russell, op. cit., 1974	40 verbally described situations	18 bipolar descriptors	214 students	9-point semantic differential scale	3 factors (pleasure, arousal and dominance) accounted for 64% of total variance
Mehrabian and Russell, op. cit., 1974	40 verbally described situations	66 bipolar descriptor from Vielhauer's (1965) study	216 students	9-point semantic scale	Factor anlysis indicated 9 first order factors accounted for 45% and 2 second order factors for 61% of total variance
Mehrabian and Russell, Environment and Behavior 1974	40 verbally described situations	21 bipolar descriptors referring to information content of situation	214 students	9-point semantic scale	5 factors accounted for 60% of total variance. the information rate from a environment was correlated to arousal elicited by it
Mehrabian and Russell, Environment and Behavior, 1974	24 settings shown through colour slides	21 bipolar descriptors referring to information content of situation	56 students	9-point semantic differential scale	Factor and regression analysis indicated "information rate" accounted for pleasure and arousal eliciting qualities of environment
Sanoff, in Lang (eds), Designing for human behaviour, 1974	Exteriors of 4 housing projects displayed through photographic means	26 bipolar descriptors	30 architecture and 30 planning students	7-point semantic differential scale	Factor analysis indicated 4 factors and explained 64% of total variance with considerable agreement between groups
Shafer and Richards, in Canter (eds), Psychology and built environment, 1974	8 scenes viewed as real and through colour photographs and slides	27 bipolar adjective descriptors	Total of 100 students of whom 29 viewed actual scence, 41 viewed colour slide and 30 viewed colour photos	7-point semantic differential scale	Factor analysis indicated 3-8 factors for each scene explained average of 75% of total variance

Table 3-1 (continued)

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Hall, Purcell, Thorne and Metcalfe, Environment and Behavior, 1976	11 building foyers	6 descriptors	35 students	10-point similarity scale	MDSCAL analysis resulted in 3-dimensional solution accounting for 85% of total variance
Herzog, Kaplan and Kaplan, Environment and Behavior, 1976	86 environments shown through slides(74), labels(22) and verbal description(25)	Familarity, preference and complexity descriptions	121 students	5-point rating scale	Smallest space analysis indicated 5 dimensional solution but representational condition did not change preference pattern
May and Basalla, Proceedings of EDRA VII Conference, 1976	Exterior of 14 public environments	22 bipolar descriptors and similarity measure	65 residents for similarity and 20 for semantic differential technique	3-point for similarity and 4-point for semantic differential	MDSCAL and factor analysis gave 4 factors and accounted 85% of total varience
Hendrick, Spencer, Flynn and Martyniuk, Environment and Behavior, 1977	Interior of one room with 6 different lighting conditions viewed through slides and real	34 semantic differential scales and one overall similarity rating	185 students for semantic differential and 45 for similarity	7-point semantic differential and 11-point similarity	Factor analysis indicated 5 congruent factors but MDSCAL and INDSCAL did not replicate the real room results
Palmer, Robinson and Thomas, Environment and planning, 1977	34 countryside locations	35 verbal measures	60 street observers interviewed	7-point semantic differential scale	Factor analysis in first order explained 75% of total variance and 60% of second order
Ward, Journal of Multivariate Behavioural Research, 1977	20 colour photographs of different exterior environments	Sorting three components and similarity measures	56 students	Q-sort and 10-point similarity measure	INDSCAL and MDSCAL analysis resulted in 5-dimensional solution accounting for 78% of total variance
Penker, Proceedings of EDRA IX Conference, 1978	40 spaces during use	24 bipolar descriptors	34 students	7-point semantic differential scale	Regression (R^2=.54 and .75), factor(4 accounted for 56% of variance), canonical and discriminant analysis gave accessible and public dimensions
Hansvik, Proceedings of EDRA IX Conference, 1978	5 Canadian cities as perceived by observers living in one of the five cities	25 bipolar descriptors	503 regular and extension students	6-point verbal scale	Cluster, factor and discriminant analysis indicated images of cities differed and environmental indicators did not correspond directly to urban images

Table 3-1 (continued)

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Horayangkura, Environment and Behavior, 1978	35 exteriors of residential environment shown through BW photograph	21 verbal and sorting approach	25 respondents for each of verbal and sorting tasks	11-point semantic differential ratings	MDSCAL and factor analysis revealed similar dimensions and explained about 60% of total variance
Oostendorp, McMaster, Rosen and Waind, Int. review of applied psychology, 1978	12 entrances to buildings	1 similarity, 5 descriptive, 13 technical and 28 bipolar measures	40 students total for 4 separate studies	7-point scale	INDSCAL and factor analysis indicated 3 similar dimensions accounting for 90% of total variance
Russell and Mehrabian, Environment and Behavior, 1978	90 colour slides selected from set of 320 with 3x3x2 levels of pleasure, arousal and dominance	5 approach-avoidance and 2 affiliate measuring items	200 students	8-point Likert type scale	Analysis of variance indicated approach toward the setting was determined by pleasure and interaction effect of pleasure and arousal qualities of the setting
Russell and Mehrabian, Environment and Behavior, 1978	90 colour slides selected from set of 320 with balanced levels of pleasure, arousal and dominance	5 approach-avoidance and 2 affiliate measuring items	310 students	8-point Likert type scale	Multiple regression analysis with R^2=.55 for approach and R^2=.23 on affiliation measure
Sims, Koebel, Cohen and Siegall, Proceedings of EDRA IX Conference, 1978	4 streets with 2 conditions of signs shown through line drawing slides	21 descriptive scales, 35 activity checklist and 6 beh. Preferences	260 students	7-point scales	Analysis of variance indicated that 2 conditions of signs did not improve appearence
Starr and Danford, Proceedings of EDRA IX Conference, 1978	One perceived and imagined environment	8 descriptive and 6 affective descriptors	20 students for each exp. Condition	5-point unipolar and 5-point forced choice types of scale	One-way analysis of variance and comparison of means indicated one pattern of affective responses and suggested possible verbal biases

The number of observers in the 78 studies ranged between 21 and 510 with a median sample size of 91. More than three quarters of the studies have used a large sample strategy; three out of four used student populations as observer. There were 19 studies whose major observer group was identified a laypersons and four studies did not identify the observer group. Only five studies used professional designers as the observer group.

Five-, seven- or nine-point rating scales appear to be most popular. Similarly most studies(78%) have used either the semantic differential technique or a simple modification of it. There were very few attempts at using other psychometric techniques such as similarity rating, magnitude estimation and ranking.

Of the 15 studies (see Table 3.2) reported at the room scale, two were devoted to finding differences between lighting conditions and both concluded that differences between the actual room and its representation were statistically small. Among the 13 remaining studies, only one used more than two representations; it found no statistical differences between different representational techniques such as plans, isometric and black and white photographs. In general, the remaining 12 studies indicated that observers differentiate between physically dissimilar rooms but often fail to notice the difference between physically similar rooms.

Table 3.2 Studies conducted for perceptual aspects at the room scale

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Canter, Environment and Behavior, 1969	Monochromatic line drawings of 24 interiors	50 bipolar descriptors	67 students	7-point semantic differential scale	8 factors accounted for 60% of total variance
Canter and Wools, Building Science, 1970	Actual interiors of 6 music practice rooms, 3 house types, 31 residence bedrooms and 2 secretarial offices	10 bipolar descriptors measuring friendliness	75 housewives, 64 music students and 31 architecture students	7-point semantic differential scale	Analysis of variance indicated that scale distinguished between different environments
Canter and Wools, Building Science, 1970	Exp. design with 2 types of ceilings, 2 seating conditions and 2 types of windows for interior of the room shown through sketch drawings	10 bipolar descriptors measuring friendliness	Architecture and Psychology students, and architects	7-point semantic differential scale	Analysis of variance illustrated that the two student groups gave similar responses while architects responses were more influenced by windows
Laumann and House, Sociology and social research, 1970	Interior of 897 actual living rooms	53 item checklist	Not reported	Binary responses	Guttman-Lingoes SSA analysis indicated modern and social status dimensions with coefficient of alienation=.464
Lau, Proceedings of EDRA II Conference, 1971	Interior of the study bedroom shown through different lighting conditions through model	Measure of pleasantness and gloominess	64 architecture students	4-point Likert type scale	Analysis of variance and rank order correlation indicated that the two modes of representation were assessed in a similar manner
Kuller, National Swedish Building Research D12: 1972	15 photographed living rooms	78 unipolar descriptors (selected from 1058)	43 high school pupils	7-point Likert type scale	8 factors explained 95% of total variance within the means of interiors
Kuller, National Swedish Building Research D12: 1972	One actual drawing room in sixties' style, observed when not in use	78 unipolar descriptors	63 architecture students	7-point Likert type scale	Factor analysis explained 28% of total variance through 3 factors
Kuller, National Swedish Building Research D12: 1972	Two actual rooms with differing complexity and pleasantness	Two unipolar descriptors	50 visitors, students and teachers visiting rooms in different order	7-point Likert type scale	2-way analysis of variance showed reliable and significantly different group averages on complexity and pleasantness

Table 3.2 Studies conducted for perceptual aspects at the room scale (continued)

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Canter, Benyan and West, Perceptual and motor skills, 1973	Model of room interior shown through slides and holograph	10 bipolars for friendliness and room depth judgement	25 architecture students	7-point semantic differential scale	Analysis of variance indicated the effect of mode of presentation related to the sequence in which judgements were made
Tognoli, Environment and Behavior, 1973	Experimental design with 2 chair, 2 window and 2 floor conditions	Interestingness, comfortableness, distractingness and pleasantness	56 students with equal male and female	7-point rating scale	2x2x2 analysis of variance indicated comfort, interestingness varies simultaneously with complex environmental variables
Wedin, Avant and Wolins, Proceedings of Architectural Psychology III CONFERENCE, 1973	3 living rooms each shown through floor plan, isometric and photograph	4 sets, each of 4 bipolar descriptors	105 housing students	99-point verbal scale	Analysis of variance with aggregate data indicated responses to size were least consistent across graphic forms
Canter, Gilchrist, Miller and Roberts, in Canter, Psychology and built environment , 1974	A living room shown with 2 presentations, 4 focus elements, 3 seating direction and 2 seating spacing conditions	4 activity suitability measures	???	10-point Likert type scale	MANOVA analysis indicated furniture arrangement and presentation technique affects satisfaction with the living room
Hall, Purcell, Thorne and Metcalfe, Environment and Behavior, 1976	11 building foyers	6 descriptors	35 students	10-point similarity scale	MDSCAL analysis resulted in 3-dimensional solution accounting for 85% of total variance
Hendrick, Spencer, Flynn and Martyniuk, Environment and Behavior, 1977	Interior of one room with 6 different lighting conditions viewed through slides and real	34 semantic differential scales and one overall similarity rating	185 students for semantic differential and 45 for similarity	7-point semantic differential and 11-point similarity	Factor analysis indicated 5 congruent factors but MDSCAL and INDSCAL did not replicate the real room results
Penker, Proceedings of EDRA IX Conference, 1978	40 spaces during use	24 bipolar descriptors	34 students	7-point semantic differential scale	Regression (R^2=.54 and .75), factor(4 accounted for 56% of variance), canonical and discriminant analysis gave accessible and public dimensions

It is perhaps surprising to find that only seven studies (see Table 3.3) considered the inside of the building; most of these were intended toward different methodological implications, rather than adequacy of representation. Three studies reported that their major concern was the reliability and validity of verbal judgements about a building. The findings of these studies suggest that verbal judgements can predict behavioural phenomena such as the amount of time spent inside the building and the usability of the building but the findings also indicate that verbal judgements might introduce linguistic biases. Two studies explored differences between visitors' (architecture and art students) and users' (factory workers and sub-way riders) responses to verbally described building qualities. They found that the important quality to the visitors was the unity-function aspect and for the users, pleasantness. Howard et al. (1972) indicated that responses to the actual environment and to colour slides of the environment were consistent but affective responses to slides (but not to actual places) depended upon familiarity with the building.

Of 23 studies (see Table 3.4) which considered the facades of architecture, six were primarily devoted towards determining differences between various representational techniques. The findings of all six studies indicate that the colour slides and colour photographs generally give the responses most similar to the actual building. A multiple set of colcur slides of the

Table 3.3 Studies conducted for peceptual aspects of interiors at the building scale

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Veilhauer, Unpublished doctoral dissertation, 1965	Interior of 4 buildings in use	66 bipolar descriptors selected from 198 (source: interior design journals)	Students, non-students, test-retest for some students: 250 males, and 250 females	7-point semantic differential scale	Separate factor analysis for each building indicated 5-7 factors accounting for 72-80% of total variance
Collins, Unpublished doctoral dissertation, 1970	Interiors of 3 library buildings during use	198 bipolar descriptors (source: students of architecture and psychology, and architects)	228 students	9-point discrimination scale	10 factors accounted for 44% of total variance and predictor-criterion interaction yielded validities in .80's and cross validities in the lower .20's
Garling, 1970 (in Kuller, 1972)	Factory shop, 100mx20m and 15m high	27 bipolar descriptors	40 architecture students and 30 factory workers	7-point semantic differential scale	Separate factor analysis for each group indicated students' major concern with unity-function and workers' concern about pleasantness; explained variance=64%
Howard, Milynarski and Sauer Proceedings of EDRA III Conference, 1972	4 buildings (with 6 interior spaces in each) with actual spaces, colour slides and BW slides	28 of Osgood's semantic descriptors	59 students for real, and 16 students for colour and BW slides	7-point semantic differential scale	Factor analysis for each building and each exp. condition indicated slides induced affective responses otherwise general agreement between exp. Conditions
Kuller, National Swedish Building Research D12:1972	9 underground sub-way stations	5 unipolar descriptors	17 arts and crafts students and 30 station users per station	7-point Likert type scale	One-way analysis of variance and intergroup correlation indicated the design group agree well with the judgements of the general group
Canter, Proceedings of Architectural Psychology III CONFERENCE, 1973	28 school buildings with interior and exterior conditions	5 physical elements using several constructs about the school buildings	510 school teachers from all levels	7-point scale	Factor analysis for each construct separately indicated differentiation of the elements was more more dominant than diffentiation of the constructs
Starr and Danford, Proceedings of EDRA IX Conference, 1978	One perceived and imagined environment	8 descriptive and 6 affective descriptors	20 students for each exp. Condition	5-point unipolar and 5-point forced choice types of scale	One-way analysis of variance and comparison of means indicated one pattern of affective responses and suggested possible verbal biases

Table 3-4 Studies conducted for perceptual aspects of building facades

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Peterson, Journal of Regional Science, 1967	23 colour slides of facades and landscaped scences	10 verbal measures	140 observers	5-point scale	Multiple regression and factor analysis revealed preference related to proximity to nature and age with R^2=.79
Canter, Environment and Behavior, 1969	2 BW slides for each of 20 students' projects	45 bipolar descriptors	30 architecture students	7-point semantic differential scales	7 factors accounted for 62% of total variance
Hershberger, Proceedings of EDRA I Conference, 1970	Exteriors of 25 buildings viewed through colour slides	30 bipolar descriptors	26 each of the final year architecture, pre-architecture and non-architecture students	7-point semantic differential scale	Separate factor analysis for each group indicated 3 factors for each group with architects differing on pleasure factor
Pyron, Environment and Behavior, 1971 and 1972	4 house form and 4 spacing conditions shown through BW film	20 bipolar descriptors and information content of experimental condition	120 residents	7-point semantic differential scale	Analysis of variance showed that visual search behaviour was function of environmental uncertainty
Canter and Thorne, Environment and Behavior, 1972	16 slides of facades of Scottish and Australian houses	10 friendliness-related descriptors	34 Glasgow and 58 Sydney students	7-point semantic differential scale	The differences in response to each slide was found to be closely related to the differences in recent trends in house design in the two countries
Kuller, National Swedish Building Research D12:1972	Residential development built in 1958, exterior of the buildings	78 unipolar descriptors	50 high school pupils	7-point Likert type scale	4 factors accounted for 48% of total variance
Seaton and Collins, Proceedings of EDRA III Conference, 1972	4 building facades represented in 4 ways from each of 2 positions	5 verbal measures	600 visitors or 38 observers for each experimental condition	7-point scale	Analysis of variance indicated the representations significantly affect the relative mean values between different buildings
Wood, Unpublished B. Architecture thesis, 1972	Experimental design with 5 buildings, 6 media conditions	7 verbal descriptive measures and mapping	207 students	100-point anchored scale	Analysis of variance indicated the best representation of an existing building is a sequence of colour slides

Table 3-4 Studies conducted for perceptual aspects of building facades (continued)

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Brodin, Proceedings of Architectural Psychology III CONFERENCE, 1973	Exterior of 25 suburban houses, flats and town center environments	29 verbal measures	242 residents of the three types of environment	7-point scale	Correlation between enclosure and evaluation and within flats was .79; within suburban houses was .29 and within town center was -.43
Sanoff, Proceedings of EDRA IV Conference, 1973	12 houses shown through photographs	Sorting for similarity, ranking and other attitudinal measures	153 high school students	Rank-ordering method	Content analysis of the sorting technique revealed descriptive and affective categories as well as hierarchical preference patterns
Acking, National Swedish Building Research, D7:1974	2 housings projects in plans, slides, perspective drawings and models	8 unipolar descriptors	Groups of 20 users, each group viewed different experimental conditions	7-point Likert type scale	Analysis indicated plan, perspective and white model differed; while colour film and colour model gave similar responses to actual environment
Canter, Cecilio, Rohles and Watts, in Canter, Psychology and built environment, 1974	19 colour slides describing urban exteriors	10 bipolar descriptors phrased in different languages	Architecture and non-architecture students from Germany (44, 33), England (29, 20) and Spain (23, 20)	7-point semantic differential scale	Intergroup comparison indicated agreement between groups with correlation coefficients greater than .34 but some words translation may not be acceptable
Hershberger and Cass, Proceedings of EDRA V Conference, 1974	BW film, colour film and video for 12 proto-typical housing units	30 bipolar descriptors	120 students	7-point semantic differential scale	Separate analysis of variance for each scale and environment indicated good agreement between media and building with correlation coefficient greater than .72
Hershberger and Cass, Proceedings of EDRA V Conference, 1974	12 exteriors of commercial and institutional buildings	30 bipolar descriptors	27 pre-architecture students	7-point semantic differential scale	8 major factors emerged with similar factor structures for all buildings
Sanoff, in Lang (eds), Designing for human behaviour, 1974	Exteriors of 4 housing projects displayed through photographic means	26 bipolar descriptors	30 architecture and 30 planning students	7-point semantic differential scale	Factor analysis indicated 4 factors and explained 64% of total variance with considerable agreement between groups
Shafer and Richards, in Canter (eds), Psychology and built environment, 1974	8 scenes viewed as real and through colour photographs and slides	27 bipolar adjective descriptors	Total of 100 students of whom 29 viewed actual scence, 41 viewed colour slide and 30 viewed colour photos	7-point semantic differential scale	Factor analysis indicated 3-8 factors for each scene explained average of 75% of total variance

Table 3-4 Studies conducted for perceptual aspects of building facades (continued)

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Berlyne, Proceedings of EDRA VII Conference, 1976	20 slides of exteriors of buildings from variety of cultures	13 bipolar, paired similarity and preference measures	16 architecture students and 30 non-architecture students	7-point scale for all ratings	INDSCAL analysis resulted in 3 to 8 dimensions and explained about 85% of total variance
Friedberg and Whiddon, Proceedings of EDRA VII Conference, 1976	10 abstract sculptures selected from pool of 30	20 bipolar descriptors from Hershberger (1972)	29 mathematics, 22 pre-design and 18 design students	7-point semantic differential scale	Analysis of variance for group and sculpture indicated a high degree of agreement between groups when evaluating sculptures
Garling, Environment and Behavior, 1976	24 slides showing detached houses, flats and city center areas	9 bipolar descriptors	20 for semantic differential, 12 for similarity and 8 for sorting study	7-point semantic differential, 10-point for similarity and ranking for sorting	Factor, multidimensional and cluster analysis revealed similar evaluation of environment by differing measuring techniques
Garling, Scandinavian Journal of Psychology, 1976	24 slides showing detached houses, flats and city center areas	24 bipolar descriptors	12 semantic differential and 10 similarity study	7-point verbal scale and 10-point similarity measure	8 verbal factors accounted for 94% and 2 dimensions in similarity rating explained 88% of total variance
Herzog, Kaplan and Kaplan, Environment and Behavior, 1976	86 environments shown through slides(74), labels(22) and verbal description(25)	Familarity, preference and complexity descriptions	121 students	5-point rating scale	Smallest space analysis indicated 5 dimensional solution but representational condition did not change preference pattern
Horayangkura, Environment and Behavior, 1978	35 exteriors of residential environment shown through BW photograph	21 verbal and sorting approach	25 respondents for each of verbal and sorting tasks	11-point semantic differential ratings	MDSCAL and factor analysis revealed similar dimensions and explained about 60% of total variance
Oostendorp, McMaster, Rosen and Waind, Int. review of applied psychology, 1978	12 entrances to buildings	1 similarity, 5 descriptive, 13 technical and 28 bipolar measures	40 students total for 4 separate studies	7-point scale	INDSCAL and factor analysis indicated 3 similar dimensions accounting for 90% of total variance

building has been recommended as one of the useful technique for representation of the building facades (Wood, 1972 and Hershberger and Cass, 1974).

Although differences between graphic techniques such as perspective drawings, plans and the actual building exist, the exact magnitude and direction of the differences is unclear. The findings of these studies indicated that observers can differentiate between the various buildings; if differing representational techniques are used, observers often fail to discriminate between techniques. Studies reported by Wood(1972) and Seaton and Collins(1972) that there might be a possibility of a joint impact of representation and building facades. Other studies did not report such an impact but their results suggest certain representations might be useful for certain types of environments.

The remainder of the 23 studies focused mainly on differences between building facades, observer differences in terms of education or socio-demographics, and differences between rating and ranking techniques. The findings of the majority which focused on differences between building facades indicate that most oberver groups can differentiate between exteriors of the buildings. If this is true, one should be able to classify various facades but such attempts have not been rigourous enough to give unified categories. Building purposes

such as cultural, commercial and educational, appear to be one prominent notion. One might expect the existence of some relationship between these purposive aspects of the buildings and the qualities discussed in the previous chapter. Berlyne and Oostendorp *et al.* are the only researchers who have exploited the idea of formulating relationships between facade qualities and physical attributes of the building.

The studies comparing the differences between architects and non-architects in visualizing building facades give contradictory results. Hershberger indicated that ratings of architects and non-architects differ only in terms of their general evaluative nature and Kaplan suggested that architects observe buildings in more detail. Friedberg and Whiddon suggest that there might not be any differences between architects and non-architects.

The cross-cultural preferential differences for building exteriors is another promising area of study but Canter and Thorne, Brodin, Sanoff, Horayankura and Canter *et al.* have not made any definitve statements about such differences. The findings suggest two ideas: observers prefer the environments with which they are familiar, or they prefer the environment to which a particular culture attributes higher status value.

The studies which employed measuring techniques such as

ranking, rating and sorting, applied to the set of building facades, have given congruent results with each other. The verbal as well as graphic rating approaches also have given similar results.

There were 10 studies (see Table 3.5) which particularly focused on landscape and scenic qualities of the environment. Even though most studies tested 15 or more environments, methodological advances in this area are relatively smaller than those discussed for the facades of architecture. Scenic quality studies have used either photography or the actual environment or both. Comparisons indicate about 80% agreement between actual environments and their representations. There were five studies which attempted to establish inter-professional group agreements; most studies have concluded that there is about 60% or better agreement between different professional groups. Zube et al. also attempted to establish inter-measure (ranking, rating, sorting) agreement and found 85% or better agreement between semantic differential rating, rank ordering and Q-sorting.

There were three studies which focused on qualities of streets (see Table 3.6) and three studies which focused at the scale of whole city (see Table 3.7). Despite the change of scale, their findings seems to be congruent with the rest of the studies.

Table 3-5 Studies conducted for perceptual aspects of landscaping

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Acking and Sorte, 1969 (in Kuller, 1972)	15 photographs describing landscaped environment	11 verbal descriptors for composite complexity, primordial-natural and unity aspects	43 high school pupils	7-point verbal scales	3 factors accounted for 80% of the variance within the means for 15 photographs'
Sonnenfeld, Environment and Behavior, 1969	55 slides depicting seasons and weather conditions	25 physical concepts	High school students from Barrow(92), Wainwright(14), and Anaktuvuk pass, Alaska(19) and Newark, N.J. (86)	5-point semantic differential scale	Analysis of variance suggests that personality variables may be an important source of within group differences, and a source of behavioural variation in environment
Calvin, Dearinger, and Curtin, Environment and Behavior, 1972	15 landscape views shown through slides	21 bipolar descriptors	139 students	7-point semantic differential scale	Factor analysis indicated 3 factors derived from means of the responses to landscape views accounted for 90% of total variance
Craik, in Krutilla, Natural environments, 1972	50 landscape scences	Landscape rating scale, graphic sorting and aesthetic scale	286 observers with varying professional background	7-point scale	Analysis indicated panoramic, focal and colourful views generated aesthetic appeal with correlation coefficient of .36 and .34
Kuller, National Swedish Building Research D12:1972	9 landscape slides	4 unipolar descriptors	Students from arch. related disciplines from different Scandinavian cities (N=18 to 43) and 15 housewives	7-point Likert type scale	One-way analysis of variance and intergroup correlation indicated that there was considerable similarity between the different groups
Kuller, National Swedish Building Research D12:1972	15 slides of landscaped environment	8 unipolar descriptors	41 high school students and 27 architects	7-point Likert type scale	Analysis of variance and intergroup comparisons indicated similar results between groups with correlation between groups greater than .6 except for pleasantness (r=.34)
Zube, Landscape architecture, 1973	18 slides of real landscape and 9 slides of drawings of landscape	14 bipolar descriptors	Designers, managers, design students, management students and others with total of 185	7-point semantic differential scale	Analysis indicated responses to drawings differed but good agreement between groups with correlation coefficiets greater than .49
Zube, Environment and Behavior, 1974	4 landscape sections shown through aerial photographs and topo. maps	25 bipolar descriptors	30 designers, 30 resource managers and 30 secretarial workers	7-point semantic differential scale	Factor analysis and intergroup comparison indicated that the agreement between environmental designers and and managers was high

Table 3-5 Studies conducted for perceptual aspects of landscaping (continued)

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Zube, Pitt and Anderson, in Zube, Landscape assessments, 1975	56 views, actual sites and photographs	18 bipolar descriptors	123 field and 184 non field study samples with different social backgrounds	5-point semantic differential, landscape checklist, rank order and Q-sort	Inter group and inter measure correlational analysis indicated general agreement between groups and measures
Palmer, Robinson and Thomas, Environment and planning, 1977	34 countryside locations	35 verbal measures	60 street observers interviewed	7-point semantic differential scale	Factor analysis in first order explained 75% of total variance and 60% of second order

Table 3-6 Studies conducted for perceptual aspects of streets

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Winkel, Malek and Thiel, Proceedings of EDRA I Conference, 1970	10 street routes; slides retouched to show 4 alternate conditions of roadside signing	65 bipolar descriptors	4 groups formed by male and female, students and non-students	7-point semantic differential scale	Factor analysis for each experimental condition gave similar factor structure
Cunningham, Carter, Beese and Webb, Proceedings of EDRA IV Conference, 1973	BW video of photomontage scale model, and super 8mm colour and BW video of streetscape	Mechanical recorder for visual excitement and 12 bipolar descriptors	Design students, faculty and non-designers	7-point semantic differential scale	Comparisons between means indicate similar responses to various representations; designers and non-designers have different "interest peaks"
Sims, Koebel, Cohen and Siegall, Proceedings of EDRA IX Conference, 1978	4 streets with 2 conditions of signs shown through line drawing slides	21 descriptive scales, 35 activity checklist and 6 beh. Preferences	260 students	7-point scales	Analysis of variance indicated that 2 conditions of signs did not improve appearence

Table 3-7 Studies conducted for perceptual aspects of urban areas

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Jackson and Johnston, Environment and planning, 1972	Home town (Christchurch) and 2 each of desirable and undesirable locations	38 verbal measures	High school and university students	7-point scale	14 factor analytic components accounted for 67% of total variance for Christchurch but factors for other places were unstable
Lowenthal and Riel, Environment and Behavior, 1972	Perceived and imagined city	25 bipolar descriptors	300 observers from Boston, Cambridge, New York and Columbus (Ohio) areas; different social backgrounds	5-point semantic differential scale	Both environmental experience and verbal responses reveal mental structure involving clusters of attributes that seem to shape our view of the world
Hansvik, Proceedings of EDRA IX Conference, 1978	5 Canadian cities as perceived by observers living in one of the five cities	25 bipolar descriptors	503 regular and extension students	6-point verbal scale	Cluster, factor and discriminant analysis indicated images of cities differed and environmental indicators did not correspond directly to urban images

Table 3-8 Studies conducted with combined levels of environment

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Craik, in Zube (ed.), Landscape assessments, 1975	Marin site (large landscaped area)	104 adjectives	Sample of 187 drivers	Adjective checklist (binary responses)	Cluster analysis demonstrated 4 word clusters accounted for 62% of total variance
Betak, Brummell and Swingle, Proceedings of EDRA V Conference, 1974	Outside and inside walking tour of the building	Free recall over plan drawings and 34 bipolar descriptors	67 students	7-point rating scale	Factor analysis gave 9 factors accounting for 68% of total variance and MDS analysis gave 2 dimensional solution
Danford and Willems, Environment and Behavior, 1975	Guided walk, informed with visual, informed and naive simulation for one environment	16 affective and 16 descriptive adjectives	160 students for each experimental condition	5-point rating scale	Comparison between experimental groups indicted an unprecedented degree of agreement for both descriptive and affective responses

There were another three studies (see Table 3.8), which seem to overlap between the categories that were discussed above and must be mentioned separately. Craik studied a large urban area, Betak et al. and Danford and Willems used one building and asked observers to walk inside and outside the same building. Danford and Willems have raised doubts about subjective responses, since they found that the responses to the actual environment, colour slides with verbal description, colour slides and verbal description were similar. This suggests that representations of the enviroment might in themselves be powerful enough to generate a complete image of the environment or that such methods convey on particular environments, but do not discriminate among data collection methods. If these findings are true, one must use a very carefully designed instrument, to detect differences between the representations.

Lastly, there were another 13 studies (see Table 3.9) which attempted to sample environments for their studies. Kaplan and co-workers used man-made and natural categories tc classify various environments for sampling purposes whereas Russell and Mehrabian have used pleasure-arousal-dominance dimensions. The remaining authors seem to have selected environments without much theoretical reasoning. The findings frcm these 13 studies also appear congruent with the other studies discussed.

From this overview, it is clear that there have been many

Table 3-9 Studies conducted by sampling from a pool of environments

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Kaplan, Kaplan and Wendt, Perception and Psychophysics, 1972	56 environments: 28 man-made and 28 natural categories	Preference, complexity and excitement-intrigue measures	88 students	5-point rating scale	Smallest space analysis indicated natural scenes preferred; complex natural scenes preferred over other natural scenes
Kuller, National Swedish Building Research D12: 1972	8 exteriors and 7 interiors of buildings	66 unipolar descriptors	56 selected by advertising in newspaper	7-point Likert type scale	8 factors explained 97% of variance within the means for 15 building conditions
Kaplan, Proceedings of EDRA IV Conference, 1973	60 slides of outdoors, half of which were drawing and remainder photographic	Mystery, preference and coherence measures	38 architecture, 30 landscape and 39 psychology students	5-point rating scale	Coherence and mystery were found to be relatively independent of each other and each was strong predictor (r^2 greater than .65) of preference
Leff, Gordon and Ferguson, Environment and Behavior, 1974	Colour slides of exterior environments and room interiors viewing from various approaches	Pleasantness, complexity, concentration, interest and 23 other bipolar descriptors	Total of 650 subjects for all experiments with range of 13 to 241 observers	7-point rating scale	The set to view a scene as an abstract collection of shapes, lines and textures increased judged complexity
Mehrabian and Russell, in An approach to Environmental Psychology, 1974	40 verbally described situations	28 bipolar descriptors relating to pleasure, arousal and dominance	134 students	9-point semantic differential scale	3 factors accounted for 60% of total variance
Mehrabian and Russell, op. cit., 1974	40 verbally described situations	23 bipolar descriptors	163 students	9-point semantic differential scale	3 factors accounted for 61% of total variance
Mehrabian and Russell, op. cit., 1974	40 verbally described situations	18 bipolar descriptors	214 students	9-point semantic differential scale	3 factors (pleasure, arousal and dominance) accounted for 64% of total variance
Mehrabian and Russell, op. cit., 1974	40 verbally described situations	66 bipolar descriptor from Vielhauer's (1965) study	216 students	9-point semantic scale	Factor anlysis indicated 9 first order factors accounted for 45% and 2 second order factors for 61% of total variance

Table 3-9 Studies conducted by sampling from a pool of environments

Reference	Environmental condition	Number of measures	Observer types	Rating methods	Statistical results
Mehrabian and Russell, Environment and Behavior 1974	40 verbally described situations	21 bipolar descriptors referring to information content of situation	214 students	9-point semantic scale	5 factors accounted for 60% of total variance. the information rate from a environment was correlated to arousal elicited by it
Mehrabian and Russell, Environment and Behavior, 1974	24 settings shown through colour slides	21 bipolar descriptors referring to informaticn content of situation	56 students	9-point semantic differential scale	Factor and regression analysis indicated "information rate" accounted for pleasure and arousal eliciting qualities of environment
May and Basalla, Proceedings of EDRA VII Conference, 1976	Exterior of 14 public environments	22 bipolar descriptors and similarity measure	65 residents for similarity and 20 for semantic differential technique	3-point for similarity and 4-point for semantic differential	MDSCAL and factor analysis gave 4 factors and accounted 85% of total varience
Ward, Journal of Multivariate Behavioural Research, 1977	20 colour photographs of different exterior environments	Sorting three components and similarity measures	56 students	Q-sort and 10-point similarity measure	INDSCAL and MDSCAL analysis resulted in 5-dimensional solution accounting for 78% cf total variance
Russell and Mehrabian, Environment and Behavior, 1978	90 colour slides selected from set of 320 with 3x3x2 levels of pleasure, arousal and dominance	5 approach-avoidance and 2 affiliate measuring items	200 students	8-point Likert type scale	Analysis of variance indicated approach toward the setting was determined by pleasure and interaction effect of pleasure and arousal qualities of the setting
Russell and Mehrabian, Environment and Behavior, 1978	90 colour slides selected from set of 320 with balanced levels of pleasure, arousal and dominance	5 approach-avoidance and 2 affiliate measuring items	310 students	8-point Likert type scale	Multiple regression analysis with R^2=.55 for approach and R^2=.23 on affiliation measure

attempts to understand representation of environments and qualities related to environment. The essence is made that although the general methodological approaches in all 78 studies are dissimilar but findings bear interesting methodological implications.

3.3. Purposes of the study.

The overriding question that this study must answer is how well each of the representations convey each of the several architectural notions. In other words, <u>one must establish the information gap between the actual building and each of its representations</u>. Since the ultimate aim of the representation is to describe the environment, one must know the adequacies as well as inadequacies of each of the various types of representation.

In Chapter I, the notion of the information gap between the architectural phenomenon and its representation was outlined; philosophical and practical arguments were presented. Some empirical evidence suggests that such a gap may not exist. In particular, Lowenthal and Riel, and Danford and Willems present

strong evidence to suggest this. It is difficult to explain this finding in light of the previous discussion. However, noting that individual observers differ in their perceptions of the buildings and that a variety of verbal rating techniques were used in the reported studies, it is possible that building and observer differences might conceal, compensate or be insensitive to the "true" differences between various representational techniques.

If the information gap between a building and its representation in conveying different qualities of the environment can be established, then such an information gap can either be reduced by spending more time or money or both simultaneously in preparing representations. The assigned purpose of this study is to explicate the relationship between money and time and the information gap between environment and its representation in order to provide some objective basis for selecting any particular representation.

Of course, one can discuss the information gap of an architectural representation if, and only if, qualities such as spaciousness and pleasantness of a building can be understood by obervers and they are able to differentiate among different qualities. Hence, it might be useful to determine the extent to which obervers can comprehend the representations in terms of the qualitative aspects. Furthermore, if environmental

designers have a better comprehension of these concepts, they should be able to make finer distinctions about the concepts than the layperson.

The taxonomy in Chapter 1, established a theoretical basis for representations. If categories such as iconic, analogic and photographic can be shown useful, then this research is substantiated by providing further insights in the classifications of representation.

This study has a holistic approach to study representations in terms of defined subjective verbal criteria. To summarize, four purposes of the study are:

1. To establish the information gap between the actual building and each of its representations on various architecture-related notions.
2. To explicate the relationship between money and time required for representations and the information gap between environment and its representation.
3. To determine the extent to which observers can comprehend the representations in terms of the architectural notions.
4. To derive a classification of representation using notions related to architecture.

CHAPTER 4

THE EXPERIMENT.

> It is said that a science will dehumanise people and turn them into numbers. That is false....
> A science is a very human form of knowledge. We are always at the brink of the known, we always feel forward for what is to be hoped. Every judgement in a science stands on the edge of errors, and is personal. A science is a tribute to what we know although we are fallible. (Jacob Bronowski, 1973)

To fulfill the purposes of the study, an experiment with both laboratory and field phases was conducted. The laboratory phase consisted of preparing several architectural representations and pre-testing a questionnaire. The field experimental phase involved evaluation of representations by both users of the building and architects. This chapter outlines theoretical and practical considerations of the experimental setting that generated the final form of the study's methodology.

4.1. Selecting an appropriate architectural setting.

Every architectural setting is unique by its character, ownership and use. How then to choose an architectural setting appropriate to the study? Three simple criteria aided the elimination of architectural settings unsuitable to experimental purposes.

If a building is constructed only for economic consideration, then the setting may substantially lack architectural qualities; hence such architectural settings as utility sheds, warehouses, bridges were considered unsuitable. Further, even if some houses are architect-designed, it was assumed that it would be difficult to gather a variety of experimental observers at such a location. Hence houses were excluded.

If a building is 10 or more years old, users and viewers of such a building may develop imagery and ideas about a building; such ideas would then perhaps dominate the impact on the observers of representations of such a building. Moreover, as a practical matter, architectural drawings for older projects are difficult to obtain. Hence, buildings older than 10 years were not considered.

Practical considerations demanded that the study site be either in Vancouver or a maximum of 15 to 20 miles away from the city with easy and reasonably priced public transportation to the building.

Twenty architectural settings in Vancouver were chosen which satisfied the above three criteria. They were then visited and rated by the researcher on a zero-to-ten scale as on the criteria recorded in Table 4.1.

Size optimality: Since too large or too small an architectural setting places constraints on the choice of representation, large and small settings were rated low.

Number of repetitive elements: High numbers of repetitive element, result in representations which are more time-consuming and boring to prepare. Hence, settings with many repetitive elements were rated low.

Accessibility: The buildings around downtown can be easily reached by various user groups. Hence buildings located around downtown areas were rated high and buildings in outlying areas were rated low.

Building constancy: Since one of the purposes of the study was to test for the hypothesized information gap between the actual building and its various representations, ideally both should remain unchanged throughout the study. Movable furniture and heavily landscaped grounds would reduce building constancy and

Table 4.1. Ratings for sample environments

Building name and location	SIZE OPTIMALITY	REPETITIVE ELEMENTS	ACCESSIBILITY	BUILDING CONSTANCY	BOUNDARY DEFINITION	TOTAL
Angus Building, third floor, study area, U.B.C. Campus	1	8	1	3	8	21
Biological Sciences Building, courtyard, U.B.C. Campus	6	1	1	3	5	16
Buchanan Building, courtyard, U.B.C. Campus	2	0	1	0	2	5
Burrard Medical Centre, lobby, Burrard Street	2	4	7	2	3	18
Canadian Broadcasting Corp. Building, plaza	1	3	7	5	2	18
Canadian National railway station, lobby area	4	3	6	8	2	23
Arthur Erickson's office, Broadway Avenue	8	6	6	2	4	26
Fishery, Capilano Canyon	0	6	5	2	2	15
Forestry Building, courtyard, U.B.C. Campus	6	4	3	8	7	28
Four Seasons Hotel, lobby	4	3	2	3	3	15
Gaslight Square, Gastown	7	7	8	5	7	37
Harbour Centre, ground floor lobby	7	2	8	7	8	32
Instructional Resources Centre, lobby area, U.B.C. Campus	7	2	3	7	8	27
Law Building extension, foyer, U.B.C. Campus	8	2	3	4	3	20
Marine Building, lobby, Downtown	2	4	6	6	2	20
Centre for Mentally Retarded, courtyard, U.B.C. Campus	6	2	4	1	6	17
Museum of Man, entrance area, U.B.C. Campus	2	6	4	3	3	18
Office building, Hornby and Davie Streets, Downtown	2	7	5	2	3	19
Queen Elizabeth Park	0	8	5	0	0	13
Students' Union Building, conversation pit, U.B.C. Campus	6	4	4	4	7	25

hence, buildings with heavily landscaped grounds and moveable furniture were rated low.

Boundary definition: If the physical boundaries of the buildings are well defined, then observers can easily identify a portion of the architecture, thus facilitating comparisons between the architecture and its several representations. Hence, physically well-defined architecture was rated high.

It can be seen from the column of totals (Table 4.1) that there is no building which served perfectly on all five criteria. Hence, the first four most desirable buildings (buildings with high ratings) were ranked independently for overall acceptibility by three other judges who had extensive knowledge of the study. Gaslight Square, 131 Water street, emerged unequivocally as the most desirable site for the study.

4.2. Selection of representations.

The financial constraints on the study made selection of the representations relatively easy. Although computer graphics appears to be a promising technique, in its present form it suffers from high initial cost. Furthermore, to represent

simultaneously both interior and exterior surfaces of the building, hidden-line removal algorithms become complex and existing solutions for the algorithm are far from satisfactory. Finally, the type of plotter available at the University of B. C. is relatively inferior and angular lines are often drawn jagged.

Display techniques such as video and movies also have potential but initial cost for equipment made their use impossible. Holography is another technique by which to display architecture but the technique is still in its infancy.

By eliminating the mechanical and some of the chemical categories of instruments, the choice of medium was also reduced to only the discontinuous category (see fig. 4.1.). This means that the study had a wide choice cnly in terms of concept-expression.

According to heuristic ideas presented, differences in meaning between a one-point perspective and a two-point perspective would be substantially less than the differences between a sequence of perspective sketches and a plan drawing. This implies that the farther the two categories are from each other, the larger this potential difference in meaning would appear. Accordingly, representations were chosen from broader categories.

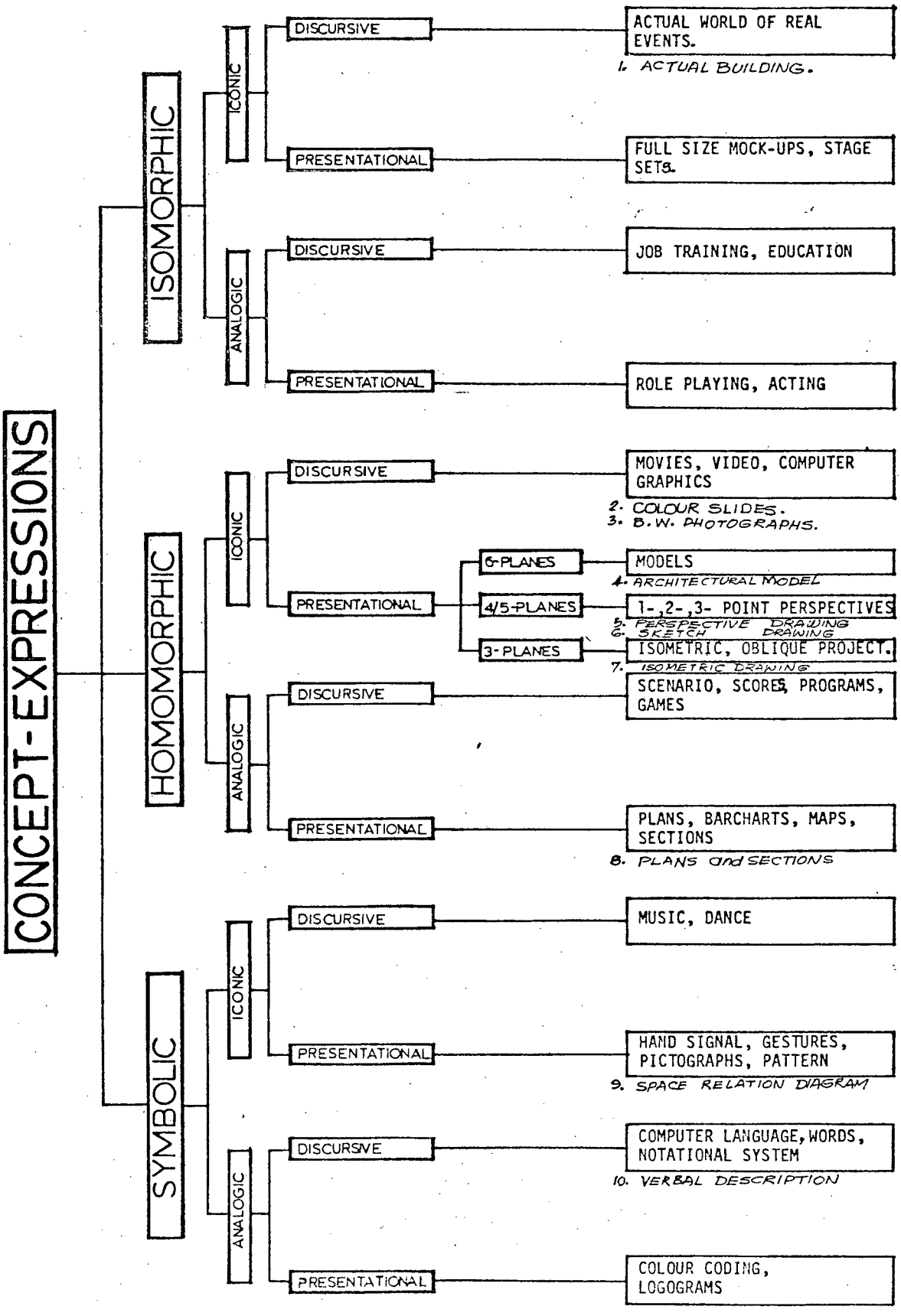


Fig. 4.1. Selected representations

4.3. Representations and their costs.

There was only one representation from the isomorphic category, informal-iconic subcategory. "The actual building" from here onwards refers to the built structure at the time an observer viewed other representations. Initially it was hoped that the actual building would be viewed from four different positions but principally due to lack of observers and other operational problems, all obervers were asked to view the building from a single point.

With respect to cost of the actual building as a representation, it is hard to put an exact price tag on the building, since it was four years old at the time of the study. According to its project engineer, construction cost of the building was about $1.80 million dollars in 1974-76 and construction time was about 14 months.

Seven representations were selected from the homomorphic expression category. Only the colour slides belonged to the iconic-discursive subcategory. 18 slides were selected for non-redundancy from a set of 30 slides of the building, taken over a three month period. Some 10 hours of working time (about two and half hours per visit) were needed to take the

photographs. Approximate dark-room working time was about five hours. Transportation cost was $3 and camera rental charges were about $40. Material cost for the colour slides came to about $43. To prepare these slides ASA 64 Ektachrome and Agfachrome films and a Cannon AEI camera were used; the films were processed by the respective photographic dealers.

Five iconic-presentational type concept-expressions were selected and four were formal. Black and white photograph representations consisted of five photographs, selected for non-redundancy from a set of 20 photographs taken at one time. These photographs were taken by a Konica fixed-lense camera using Kodak Plus-X-Pan film. The processed film was then exposed on Ilfobrom IB4.1P glossy, single weight photographic paper. The size of each photograph was approximately 8"X10" and all five photographs were mounted together on 20"X30" grey illustration board.

Four hours were required for photographing and 3 hours for processing and printing the photographs. The camera rental charges were be $5, rental charges for the darkroom were $8, and the photographic paper cost $2 for total of about $15 were needed.

The architectural model belongs to the six-plane-planometric category. This represpentation was

prepared from illustration board, paper, plexiglass, and balsawood at the scale of a quarter inch to a foot. The total cost of material required for the model was about $45; construction time was logged at about 250 man-hours.

The isometric drawing also belongs to the planometric category but exhibits only three-planes. This representation was prepared on textured paper, drawn in black-drawing ink and shaded with 2B pencil for contrast. The total material cost was be $3 and working time was about 22 hours.

The perspective drawing exhibiting four planes, belongs to the sectional category. The two-point perspective was prepared on tracing paper, using perspective charts. The resulting drawing was blue printed on blue-line white background paper and then coloured using chalks. The cost of paper, chalk and other materials totalled of about $4 and took about 15 hours of working. Due to time constraints, the inital outline for the perspective was prepared by the researcher and it was then modified and coloured by another graduate student in architecture.

The sketch drawing was informal and was drawn on tracing paper, using a sketch pen. Although the sketch appeared similar to the perspective drawing, the major difference was that the former was drawn without instruments. Two dollars were spent

for materials and it took about 3 hours to produce the sketch drawing.

The plan and section belong to the analogic-presentational category and were drawn with pencil on tracing paper using drafting equipment. The plan and section consisted of three drawings showing the ground floor plan and four major sections at a scale of an eighth of an inch to a foot. Neither dimensions nor material specifications were included on the drawings. It a took total of about 30 hours to redraw from the architect's original plan and section, at a total cost of about $5 for materials used.

Two of the representations were selected from the symbclic category. The content for a verbal description was decided by the researcher and was formalized by another graduate student in the School of Community Planning at the University of B.c. it consisted of a two page description of the building which was type-written in double columns on 11"X15" paper. Typing costs totalled about $2; and compositionc required total of 4 hours of work.

The symbolic-iconic-discursive category created problems, since representations from this category have primarily research value. Sound simulations or pedestrain movement simulations can be modelled by using general purpose computer simulation

languages but the size of the building would have made such representation meaningless. However, a space relation diagram possessed suitable symbolic character; it belongs to the modern formal category. The space relation diagram consisted of a typical "pattern" description with a vague notion about building design. It took three hours of work and about $2 for the materials used.

To summarize, most representations belonged to the homomorphic category and iconic subcategory. Although the representations were prepared principally by the researcher, some additional help came from other students. Generally, instruments and media for representation were chosen for convenience, while the concept-expressions were varied systematically. The costs figures quoted were based on actual money spent for materials used and do not include such costs as office maintenance, organisation and overhead. Similarly, figures for preparation time time do not includ time for such activities as coffee breaks, talking with friends, thinking and conceptualising, but includes only actual production time.

Table 4.2, summarizes the costs and time spent in preparing representations. The additional column of remarks gives the overall time frame and fixed costs for each of the representation.

Table 4.2. Time and Cost for 10 representations

Representation	Time	Overall	Cost	Remarks about cost
Actual building	-	14 months	$1800000	Cost includes labour cost.
Architectural model	250 hrs	2 months	$45	Model base, work table.
Colour slide	15 hrs	3 days	$40	Camera, tele-photo and wide-angle lens, commercial processing.
Black and white photograph	4 hrs	1 day	$15	Camera, darkroom facility.
Perspective drawing	15 hrs	3 days	$4	Perspective charts, blue print machine, drafting equipment.
Isometric drawing	22 hrs	4 days	$5	Drafting equipment.
Plan and section	30 hrs	7 days	$5	Drafting equipment.
Sketch drawing	3 hrs	1 day	$2	-- --
Verbal description	4 hrs	1 day	$2	Typewriter
Space relation diagram	3 hrs	1 day	$2	-- --

4.4. Rating technique.

Stevens (1974, p. 374) has presented empirical evidence to suggest that the choice of rating methods must be an important consideration in psychological measurement. He argues,

> "It makes rather little difference whether the subjects use numbers [1, 2, 3,...] or adjectives [extremely, very, somewhat,..]. The forms of the two category scales are similar, because, whenever the subject is asked to categorize, he is forced to divide the continuum into parts or segments in order to make it conform to the limited, finite set of numbers or adjectives that he is required to use. In other words, he is obliged to attend to differences or distances".

Within the same context, Anderson (1974, p. 284) has put forward five practical criteria for psychological measurement and he emphasizes that any measurement technique must satisfy these criteria. His criteria are,

1. It [measurement technique] should be testable.
2. It should have been tested with some measure of success.
3. It should apply to psychophysical stimuli[representation] with a physical metric.

[OR] 4. It should apply to verbal and symbolic stimuli without a physical metric.

5. It should apply to the single subject[observer].

Given the fact that representations are ultimately

evaluated by an observer, all five criteria are simple and self-explanatory. Discussions about 'testability' (reliability, accuracy and validity) and other rating methods are discussed by Anderson(1974) and Stevens(1975). If one follows Stevens' admonition "[not to limit] the subject to a finite set of numbers", one might satisy all five criteria.

Using Stevens' strategy to test for an "information gap", one must allow every observer to construct his or her own individualized continuum for each quality by giving a starting point. In other words, the question might be phrased, "If a perspective drawing conveys 100 units of spaciousness, then how much more or less is spaciousness conveyed by the other techniques?" An appropriate approach might introduce higher inter-individual differences but such person specific differences can be adjusted for by the mathematical techniques commonly used and suggested by Jones(1974), Stevens(1966, 1971) and Anderson(1974).

4.5. Experimental design.

In Chapter 2, architecture was related to 24 notions of form, figure, texture, colour, scale and proportion, volume, length, shade and shadow, spatial excitement, friendliness,

solidity, organisation, complexity, modernity, ventilation, rigidity, spaciousness, pleasure, arousal, dominance, colourfulness, size, balance, and cleanliness. Furthermore, for experimental purposes, the actual building, colour slide, black and white photograph, architectural model, perspective drawing, isometric drawing, sketch drawing, plan and section, verbal description and space relation diagram were representation of Gaslight Square.

There are 10 representations that need to be evaluated on 24 qualities related to architecture. To ask every observer 24 questions about each of 10 representation would result in 240 questions. Preliminary trials suggested that, on average, to answer one question using a free numerical response procedure requires about 25 seconds. Replying to 240 questions would require at least one and a half hour.

Since the study intended asking these questions building users and they probably would not spend much more than 30 minutes, some experimental strategy to reduce response time had to be developed.

One approach could have been to ask every observer to view all 10 representations but in terms of only one out of the 24 qualities. Such an experimental design would yield the information gap across representations but would require

relatively large observer groups to test all 24 qualities and would also give only weak indication about inter-quality differences.

A second approach would have been to ask every observer questions pertaining to all 24 qualities but only one representation. Such an approach would generate relationships between qualities and a statistical basis for deriving an information gap between the environment and its representation.

But any attempt to combine these two approaches would reduce the value of results. Since the major emphasis of the study is on representation of the building, hence the relationship between qualities is secondary. Accordingly, the experimental design included every observer's responses to all representations, but sampled among the 24 qualities. To sample six of the 24 qualities required an effective completing time of about 20 to 30 minutes, which seemed reasonable of request to building users and other observer groups.

To help decide which six qualities an observer should respond to, pseudo-random numbers (one to 24) were generated such that for a given sequence of 24 no number was repeated. Since each integer number identified one quality, the first six numbers assigned randomly selected qualities to the first observer, the next six random qualities were assigned to the

second observer and so on. This process was repeated after four observers. In the terminalogy of experimental design, this procedure resembles, "partially balanced (qualities) incomplete blocks (obervers) with representation appearing in a split-plot type arrangement".

4.6. Questionnaire design.

The questionnaire used in the study was specifically designed to accommodate the experimental design in the field setting. Its format grew over a period of four months and was finalised after two pilot studies. The questionnaire was divided into three parts: (1) general instructions about the study, (2) the specific questions regarding architectural qualities of the 10 representations and (3) biographical information about the observer.

The general instructions were further divided into three parts: (1) the overall purpose and the specifics of the study, (2) a trial session explainnation about the scoring technique and (3) an actual "warm-up" trial using five lines of varying length to explain the kind of assessment that the observer was expected

to produce. All these instructions were reinforced in a 2.75 minute tape recording, played while the observers read through the general instructions. These tape recorded instructions appear as Appendix I.

The first pilot study indicated that even though the "length of lines" question was appropriate for practice, it did not encourage observers to think about typical architectural concepts. For this purpose, an opening question was devised to allow the observer to think about architecture in terms of the representations. There were two considerations: the question must be related to the representations actual 10 and it should invite immediate mumerical judgement. The question could have related to cost of displays or to time taken to complete the displays. It appeared that "time" units for displays elicit sensible responses, so a further pre-trial question about time taken for production of the representation was introduced.

Furthermore the descriptors referring to physical dispositions such as colour, texture, shade and shadow, scale and proportion, volume, length, form and figure might be more easily understood than the remaining affective descriptors; hence two of the physical qualities, chosen randomly, were used as a transition between the question of preparation time and the affective questions. The experimental design was modified such that pseudo-random numbers were generated, first eight for

physical descriptors and then 16 for affective descriptors. Thus, two physical descriptors followed by four affective descriptors were grouped for each observer. The same random selection procedure ensured that eight physical descriptors and 16 affective descriptors were randomly distributed among all observers. A final question asked every oberver to assess the "general impression" as conveyed by each of the 10 representations.

Each question consisted of a description of a quality, the subjective meaning of the assignment of a numerical value(100) to the first display, the task that the observer was expected to complete and a list of the displays. Only for the question of time did all observers use a fixed order to view the representations; on all other occasions the questions first displayed and the order of displays within each question were varied using pseudo-random numbers from one to 10. Although each questionnaire appeared structurally similar, the internal question content and order of displays were unique.

To generate the unique questionnaires, FORTRAN and the text-processing (TEXTURE) computer programs were used. The purpose of the FORTRAN program was to generate random integers within the specified limits defined above and, corresponding to each numerical value, to assign an appropriate key such that the key would call forth a question through the text-processing

program. This program assisted in maintaining the dictionary for complete descriptions of each question and display. It also helped to set the format of the questionnaire and to generate a printed copy of the complete questionnaire. For convenience, the complete description of each question had to be divided into two parts and these two parts were linked by the identity of the first display. For example, the first part (key <P1>) was "Consider the impression of Form: the form of a building is the specific arrangment of features like walls, railings, skylights, columns, doors etc. which gives Gaslight Square its unique appearance. If the" - the latter part (key <H1>) continued with the description - "is given 100 points for conveying effectively this impression of form of the Square, then HOW MUCH more or less effectively is the form of the Square conveyed by the remaining items? Give the right numbers of points to each one compared to the" Similarly, key <S8> was associated with colour slides. When

<P1>+<S8>+<H1>+<S8>

are added together, the verbal format of the question can be accomplished. The details of the dictionary and computer program are given in Appendices II and IV.

The last part of the questionnaire consisted of questions about biographical details and the observer's experience of the building. The purposes and details of the questions are given in section 4.8. Each questionnaire consisted of 6 pages, 7½"

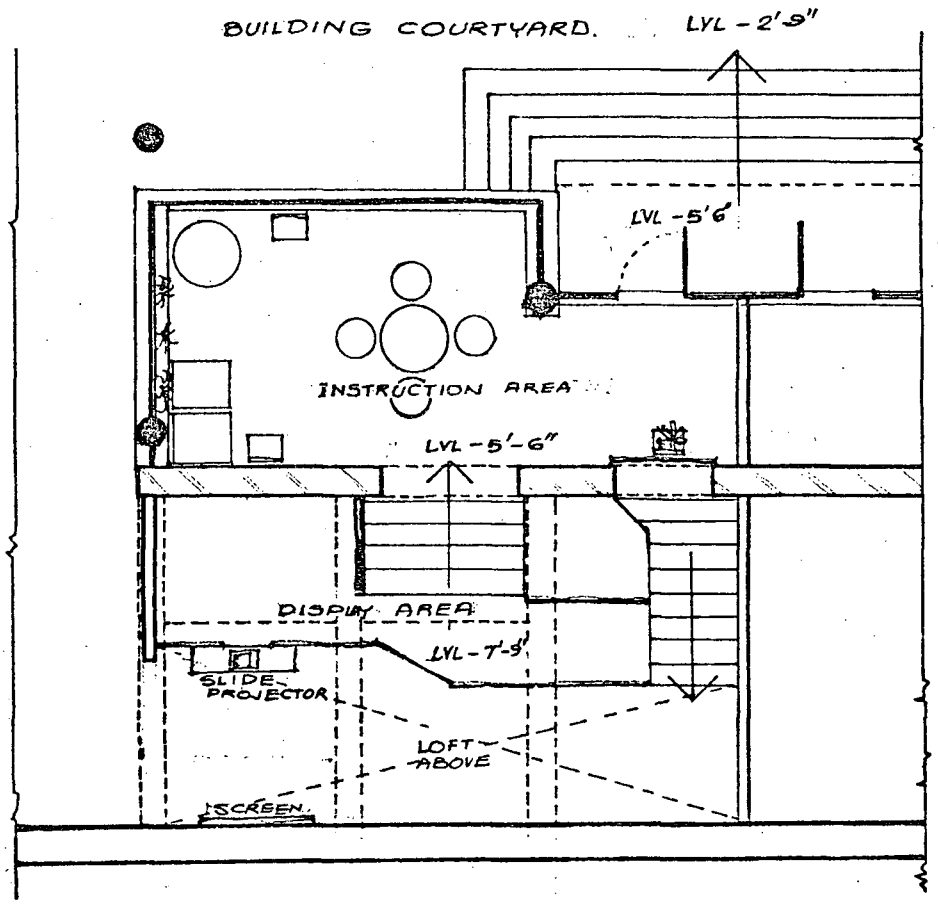
by 11" inches. This odd format was necessary because the computer paper available was 15"X11".

4.7. The experimental station.

The experimental station was located inside Gaslight Square in one of the street level shops. Figure 4.2 shows details of the arrangement that was put together for purposes of the experiment. The station was open almost every day between 11 am and 5 pm from 10 February to 1 April, 1978. The initial intent of the study was to get about 200 obervers for each viewing position but it appeared difficult enough tc get obervers for one viewing position. Hence with 205 observers, the experiment was terminated.

The experimental station consisted of an instruction and a display area. The instruction area was equipped with a tape recorder with loop-type cassette tape, speaker, tables, chairs and a refreshment facility. In the display area, representations were arranged in the order shown in Figure 4.2. Details of each display area are illustrated in Figures 4.2 to 4.12.

The operator for the study was someone whose first language



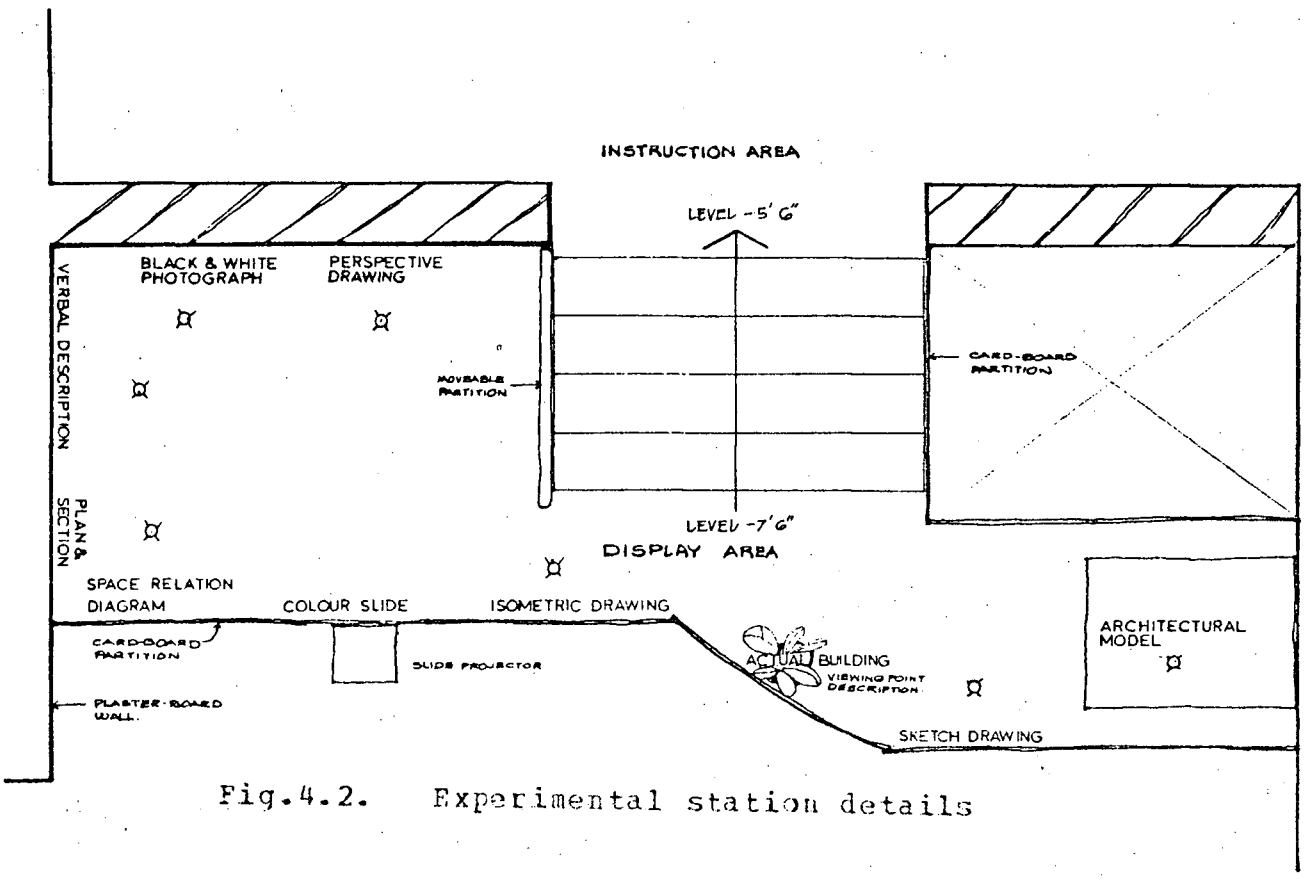
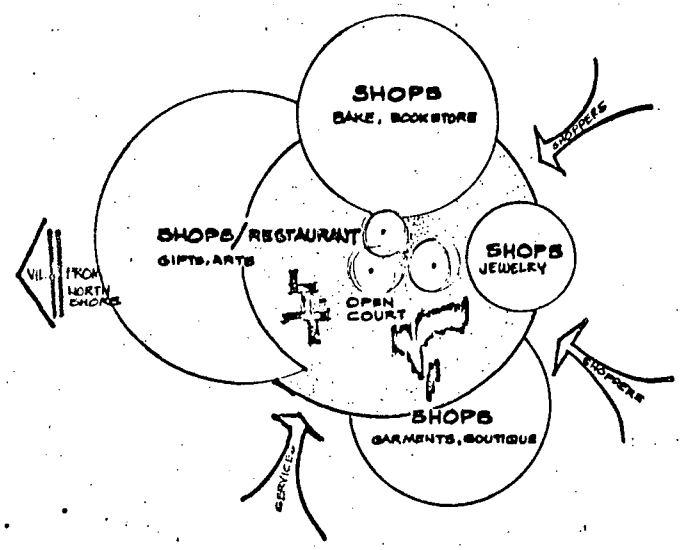


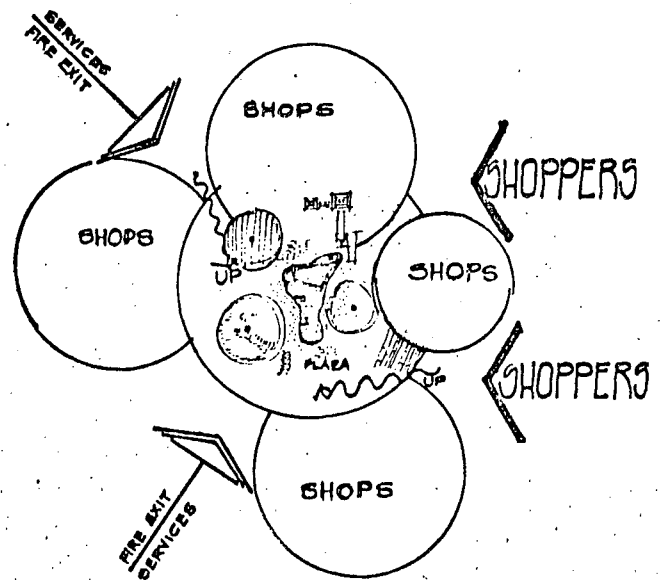
Fig.4.2. Experimental station details

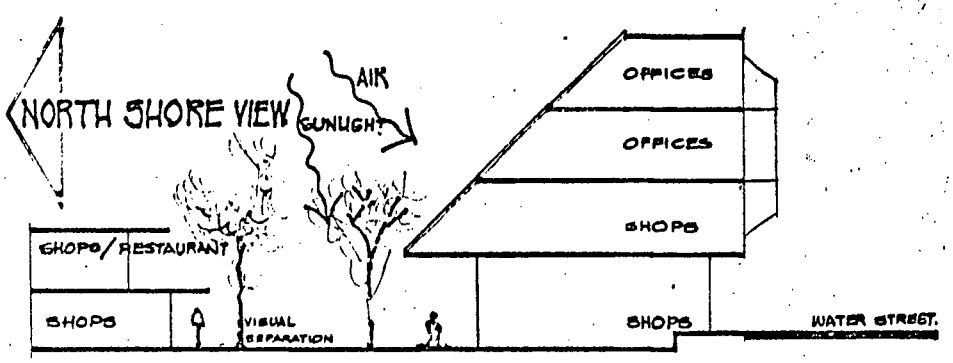
CONCEPTUAL SPACE RELATION

GUIDING FACTORS: GROUND FLOOR

- DEVELOP PEOPLE ORIENTED INTIMATE SPACES.
- SEPARATE SHOPPER AND NON-SHOPPER BY ARCADE AND PLAZA
- ALL USERS VISUALLY PART OF SHOPPING PLAZA.
- BREAK UNIFORMITY OF SHOPS AND FORMS.
- MAXIMIZE DIRECT SHOP FRONT EXPOSURE TO USER & SHOPPER MOVEMENT.







CONCEPTUAL CROSS-SECTION

Fig. 4.3. Space relation diagram

GASLIGHT SQUARE

Gaslight Square, located on the north side of Water street in Gastown, is the first part of a three stage block-long infill and redevelopment plan. The U-shaped building houses 23 shops, 2 restaurant and offices, incorporates two existing buildings at its base and top into a three level stepped system of arcades, spiralling about an open court. The second and third phases proposed restoration of block facades and cornices and conversion of existing upper level warehouse space into residential and office uses. The Square will be the focal point and largest of a series of open spaces behind the buildings in Gastown.

The rhythm and scale of adjoining facades are reflected by concrete columns at ground level and narrow glazed bays rising three storeys. Within the square, glass bays over front shops facing north and south, echo the street-side windows. The principal entrance to the court descends beneath a glazed wedge cantilevered from the western end of the facade, then continues under a second-level bridge. The theme of diagonals presented by the wedge is picked up by the smaller entrance at the east end of the facade, which snakes on a diagonal into the main court.

Construction materials have been carefully chosen to reflect the warmth and charm of surrounding buildings. Lighting and tinted glass cast an amber glow over the court on overcast days. The tawny brick of the walls also paves the court.

An existing stucco wall was washed to tone with the brick and hung with striped awnings, which mark the gradual descent from second to ground level of a walkway that has been attached to the existing building on the west.

Diagonally across the main court from the principal entrance, an intimate court enclosed by shops opens from the corner. From the circular patterned floor, a free standing stircase spirals to the second level.

From the top of the stairs, a walkway rises gradually, past several shops, toward the south. The second and third floors of the building along Water street step back at an angle of 45 degrees from the courtyard, behind a skylight that extends past a full three floors and allows penetration of sunlight into the Square. The path continues westward beneath the skylight, emerging at the bridge which spans the principal entrance. From the bridge one looks north across the court to a restaurant and small second-level plaza tying an existing building on the west to the shops which line the north face of the Square. Here a panorama of mountains, sea and sky unfold before the viewer. From the end of the bridge, a small stair descends, to regain the entrance.

Fig.4.4. Verbal description

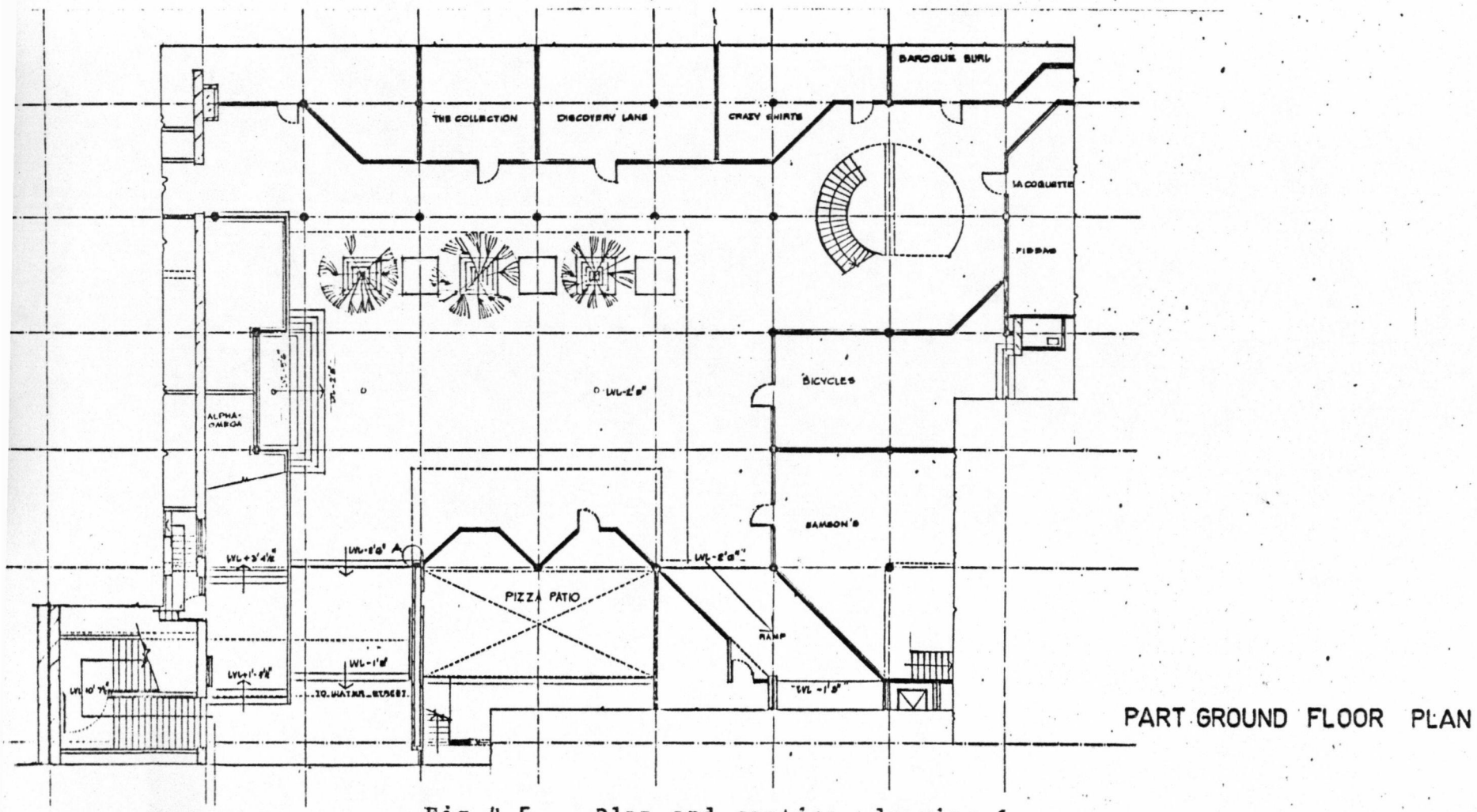


Fig.4.5. Plan and section, drawing 1

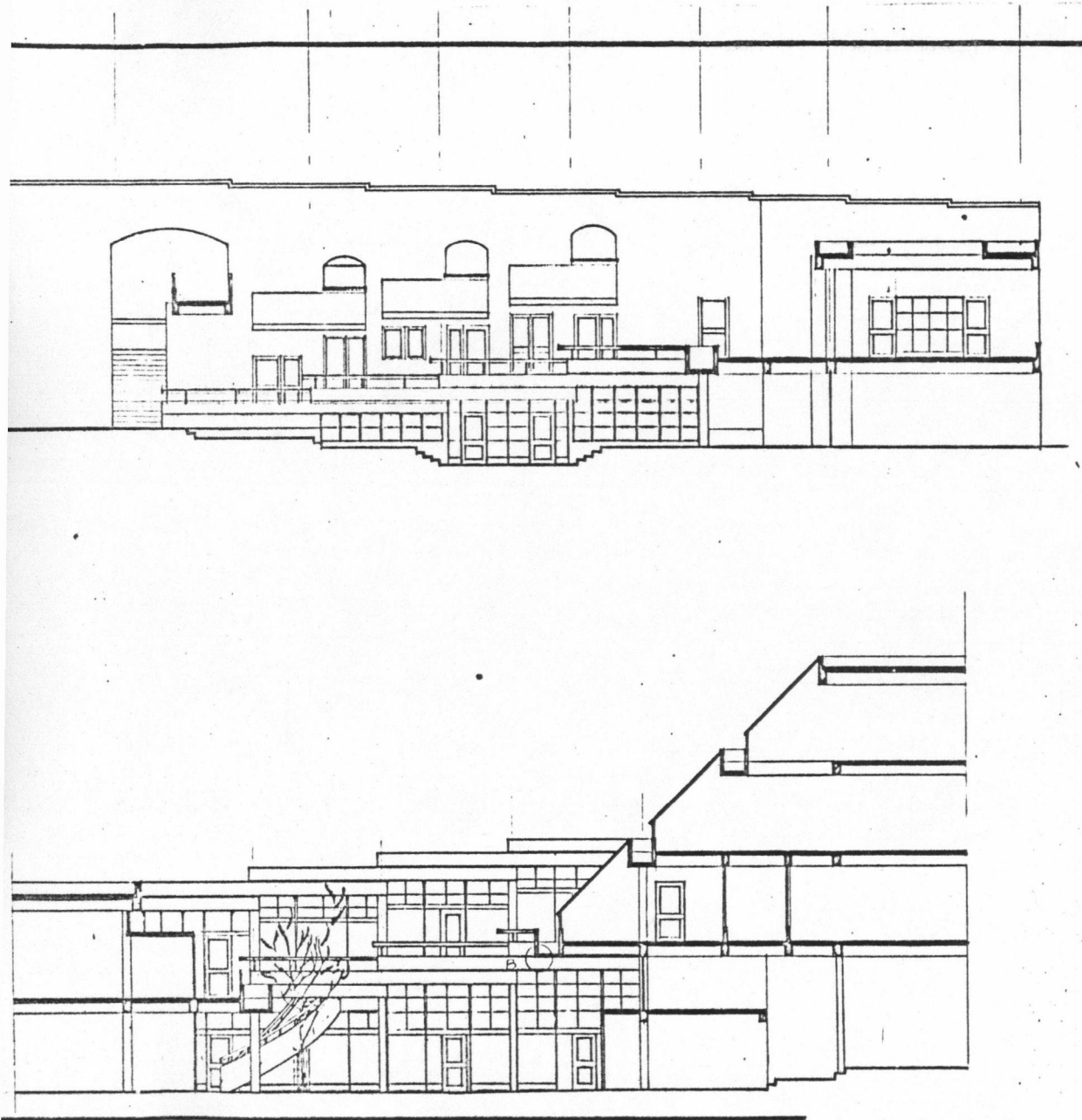


Fig.4.6. Plan and section, drawing 2

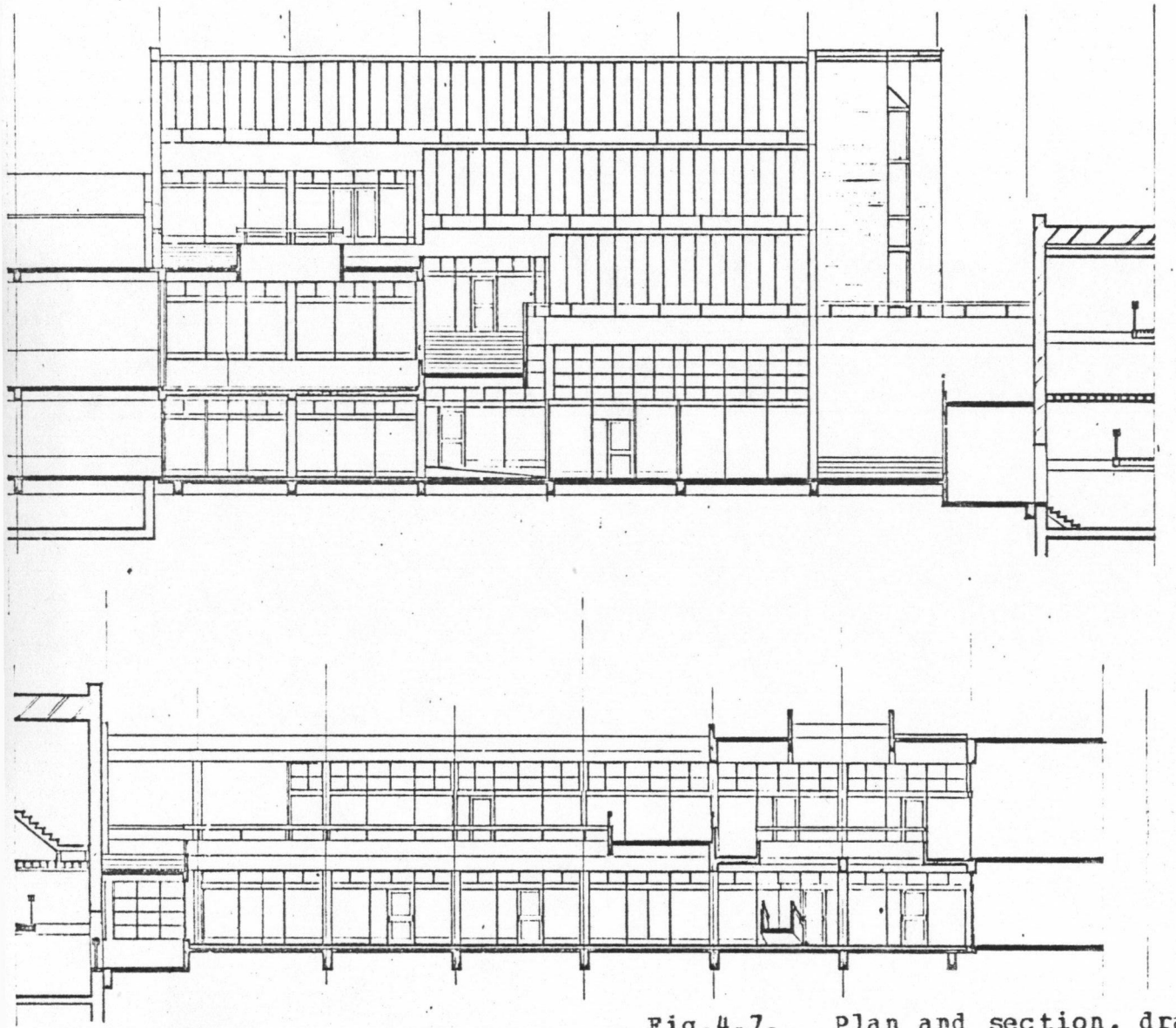


Fig.4.7. Plan and section, drawing 3

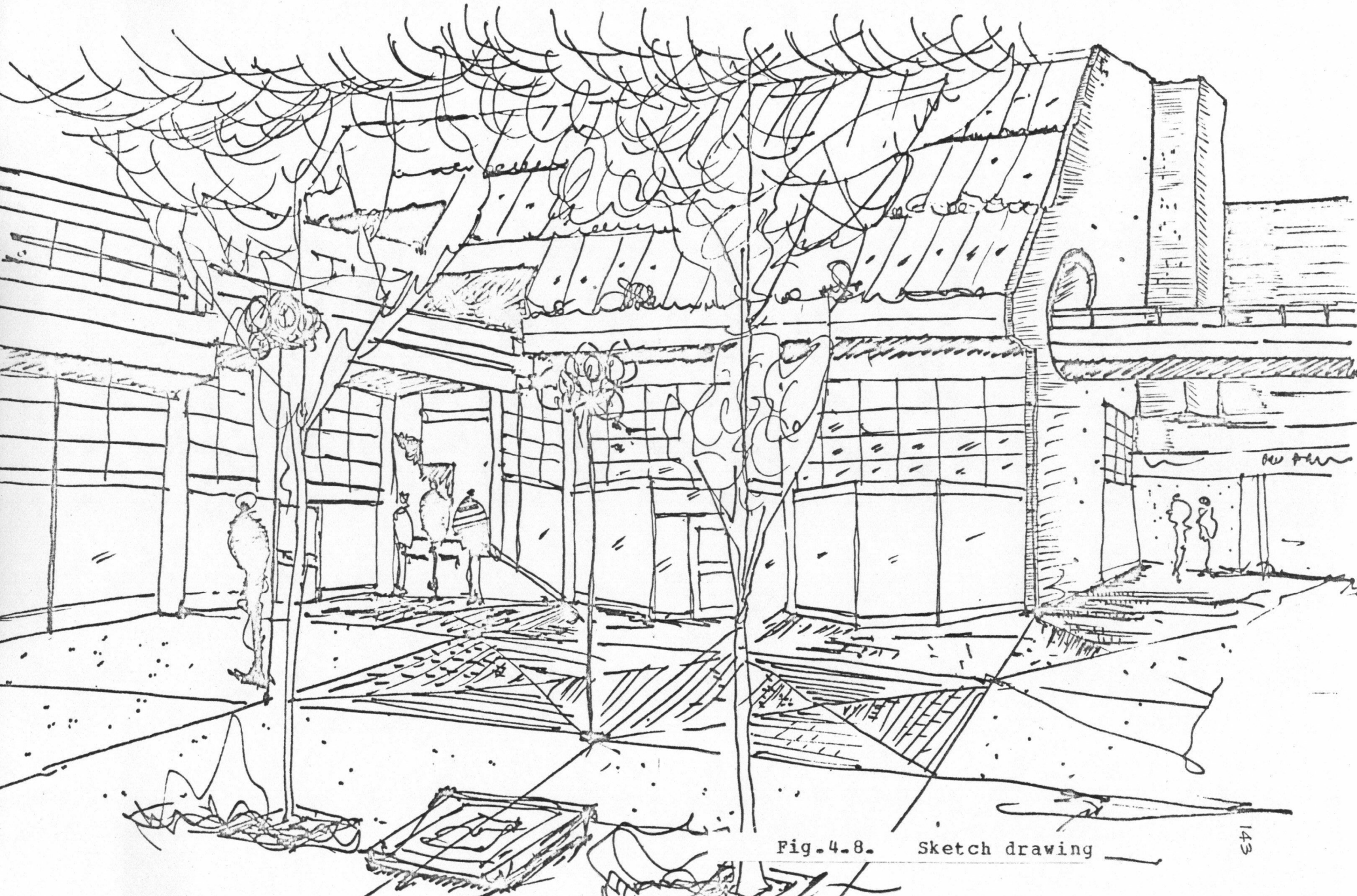


Fig.4.8. Sketch drawing

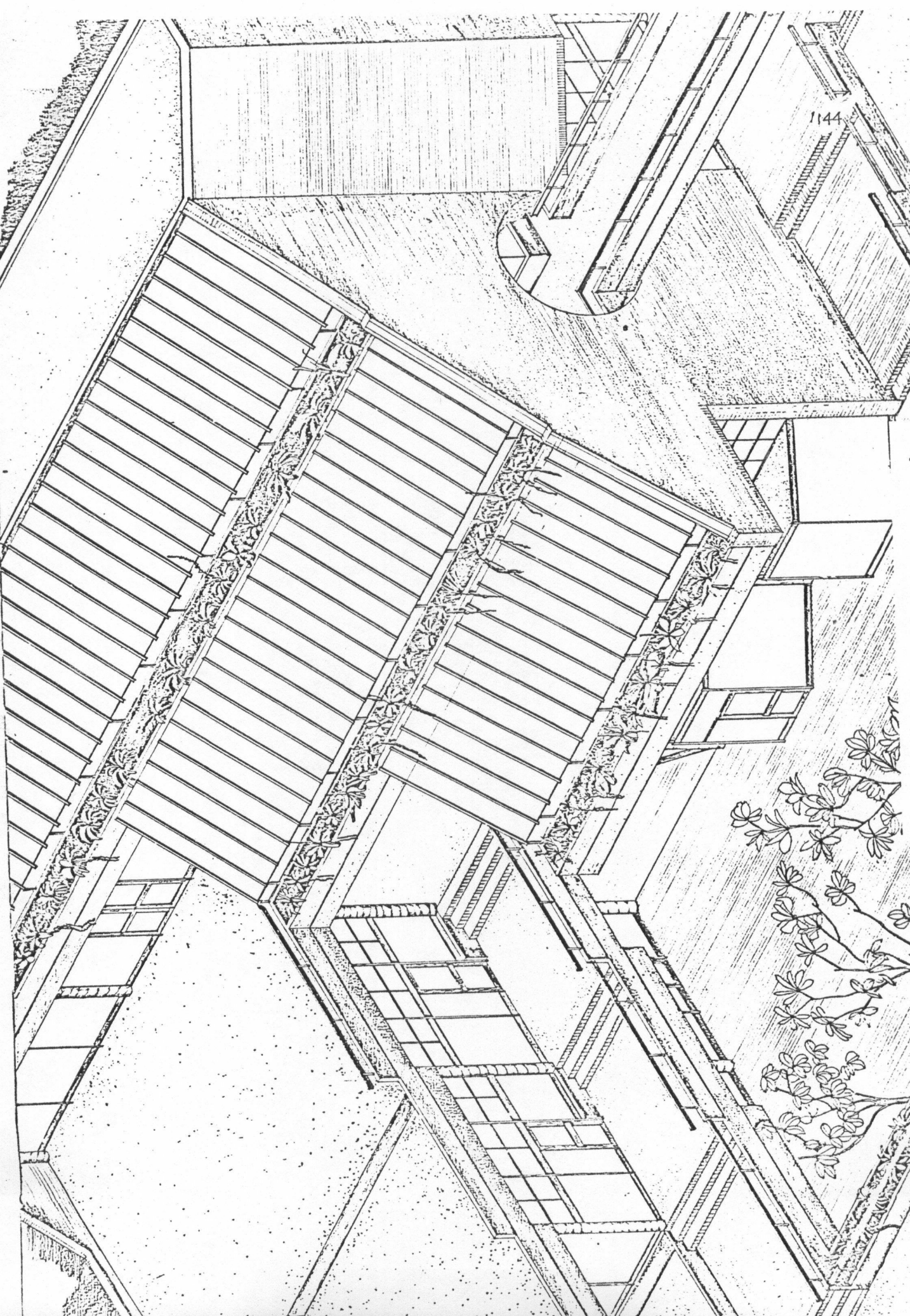

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Fig.4.10. Perspective drawing

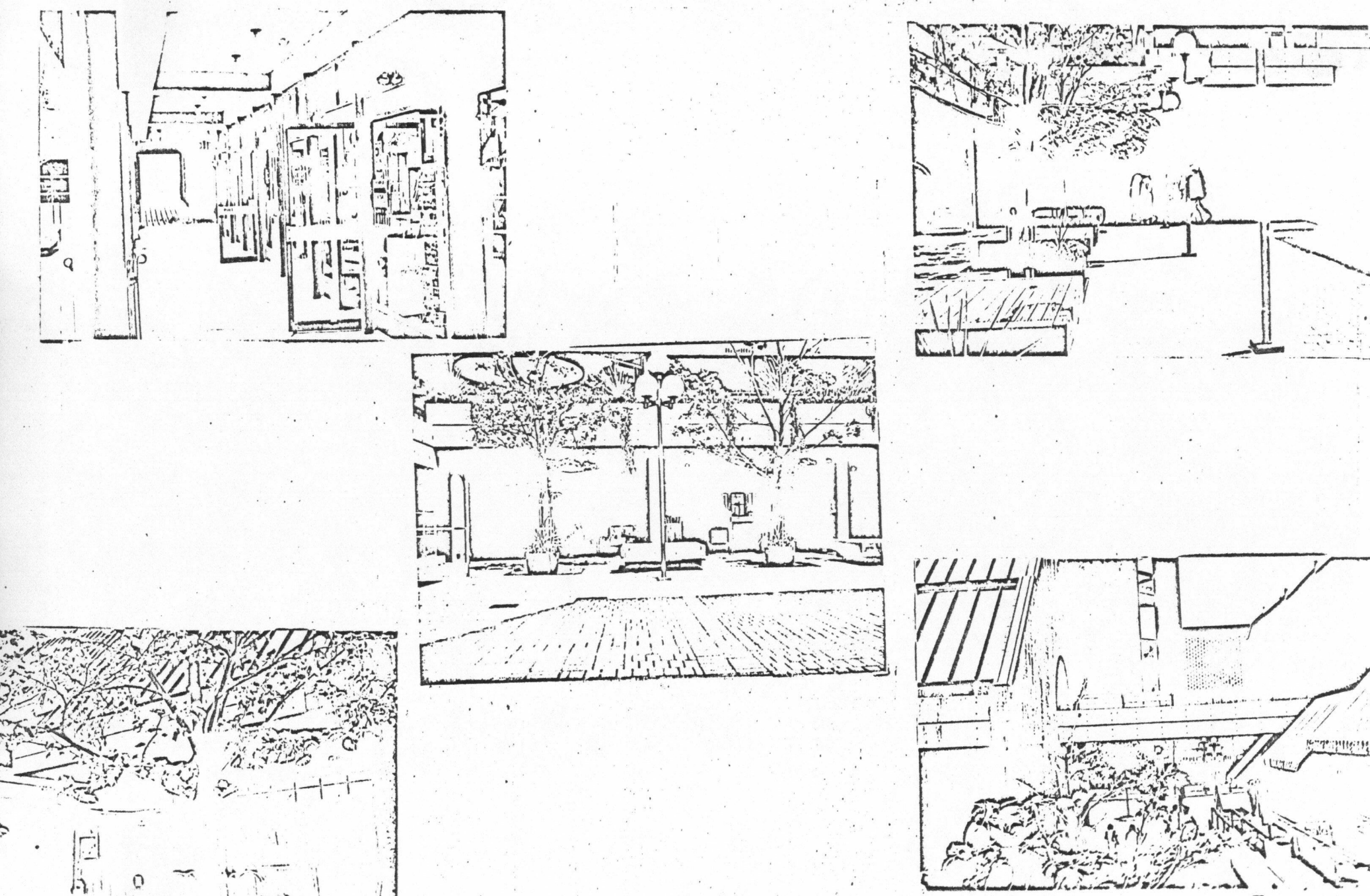

Fig.4.11. Black and white photograph

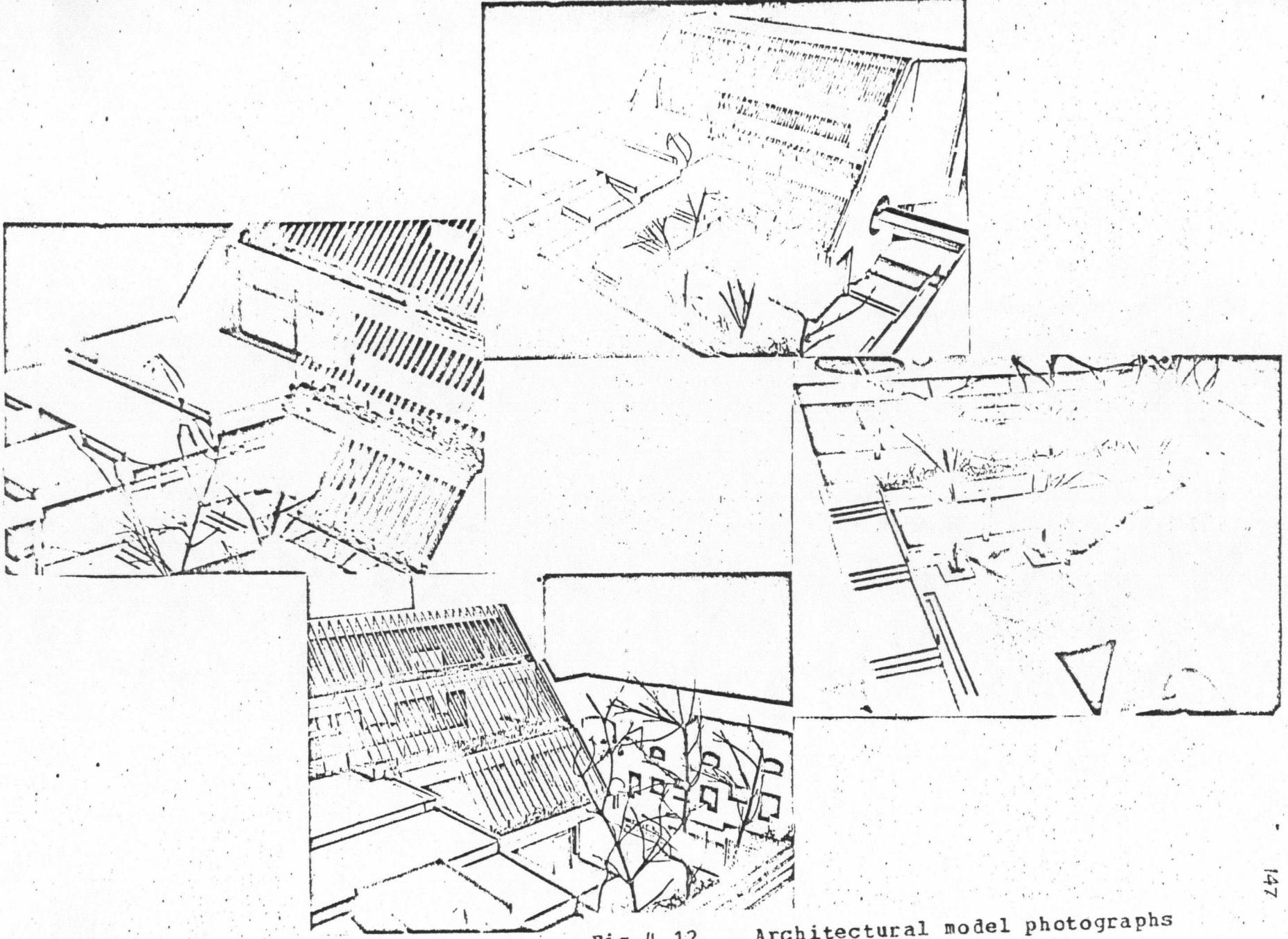

Fig.4.12. Architectural model photographs

was English and who was given a token salary. The operator's tasks were to invite participants, to operate the tape recorder, to show the display area and to offer coffee or tea to each participant. Due to the long duration of the study, it was not possible to have the same operator throughout the study. Most of the trials, however, were operated by one woman.

To attract more participants, a poster measuring 4'X9' was placed in the instruction area which was visible from most parts of the building. Another weatherproof sign 3'X4' was hung outside the shop and it was visible from the main access road to the building. The poster said "Join opinion survey about Gaslight Square" and the sign announced, "Free coffee for your opinion about Gaslight Square".

4.8. Demographic and experiential correlates.

Even though the specific intent of the research was evaluation of representations in terms of qualities conveyed, it was also considered appropriate to seek standard demographic information about the observers. Questions about education, employment, and association with architecture and fine arts were asked and are included in the sample questionnaires given in Appendix IV. There was also a set of questions which related to

the observer's familiarity with the building. Additional questions should have been included, dealing with the observer's familiarity with the building, such as total time spent by the observer over all visits and the number of times shops were visited, as well as background information such as the observer's residential environment. However, more question would have meant longer response time, hence questions had to be kept to a bare minimum.

Other measures unnoticed by the participant were made by the operator. These consisted of the time required to complete the questionnaire, the date and time when the subject observed the building. Rain, wind, cloud and sun conditions during the observer's participation were also recorded. Observer's sex, apparent age group, and number of companions with observer were recorded. The oberver's uncertainty was recorded by an unobtrusive means: the number of times observer erased responses.

4.9. Data coding.

Information from and about each observeration was coded on 10 80-column data cards. For ease of keypunching observers' scores had to be transferred to coding sheets. The first eight cards recorded the participant's responses for the eight qualities and 10 representations. Card number nine contained responses to the length of line while the last card contained all background information and all other observational measures described above.

Although the median number of digits used by the observers for each rating was three, there were instances where eight and nine digits were used. To maintain complete accuracy and to save data storage space, responses with more than five digits were coded in FORTRAN E-type format. To code one complete questionnaire took on average 20 minutes. This unusually high coding time had to be attributed to the questionnaire design.

CHAPTER 5

RESULTS AND DISCUSSION.

> Perform all thy actions with mind concentrated on the Divine, renouncing attachment and looking upon success and failure with an equal eye.
> (translated from Bhagvadgita, Chapter 2.47)

The results described below treat the four major purposes: indicators for information gap, the relationship between costs of representation and information gap, relative discrimination between architectural notions and categories of representation. Since the analytical methodology used in these sections is elaborate, the results for each purpose are preceded by a discussion of the statistics used. Furthermore, the intention of the following sections is principally descriptive; hence the more robust statistical techniques were used.

5.1. The information gap indicators.

Each observer indicated the relative position of a representation according his or her own reference representation; the first representation, varying randomly, was assigned a score of 100, with respect to any one of the notions understanding. This score served as a point of reference for the scores, on that quality, assigned by the observer to the other representation.

In analysis, one must first make adjustments for an observer's numerical behaviour pattern. The empirical evidence documented by Jones (1974, p.356) suggests that the observer tends to use a preferred range of numbers. Stevens (1966, p. 530) has argued that perceptual information is a power function of the physical magnitude of stimulus information. Hence, every observer's scores were transformed to natural logarithms, such that the mean score for a given quality was set to 100. Arguments in favour of similar types of transformation have been made by statisticians working in the areas of biometrics (Snedecor and Cochran, 1957; Bartlett, 1940) and psychometric research (Bock, 1975). Using the resultant scores, the sample means and other relevant statistics were computed for each representation and for each of the 24 qualities.

```
========================================  Actual building (100%)
                  ================        Colour slide (42%)
                         =========        Black and white photograph (24%)
                            =======       Perspective drawing (19%)
                               =====      Isometric drawing (14%)
                                ====      Sketch drawing (10%)
                                  ===     Architectural model (9%)
                                    ==    Verbal description (7%)
                                    ==    Plan and Section (5%)
                                     =    Space relation diagram (3%)
```

Fig.5.1. Information gaps for texture

```
========================================  Actual building (100%)
                 ========================  Colour slide (63%)
                           ============    Black and white photqgraph (31%)
                              =======      Perspective drawing (19%)
                              =======      Architectural model (18%)
                               =====       Isometric drawing (14%)
                                ====       Sketch drawing (10%)
                                  ==       Verbal description (6%)
                                  ==       Plan and Section (6%)
                                   =       Space relation diagram (4%)
```

Fig.5.2. Information gaps shade and shadow

The means of such transformed scores, when converted to natural numerical form, yield geometric means. It is well known that a geometric mean is invariant, given the possibility of extreme responses. Using the representation having the highest geometric mean for a given quality, ratios were computed between the mean of that high representation - in all cases, the actual building - and every other mean. Those ratios can be interpreted to be the percentages of information conveyed by each representation relative to that conveyed by the most effective representation.

It seems that over all aspects, the actual building best conveys itself; none of the representations gives a stronger impression of a quality than the actual building. In the following discussion the actual building is always rated highest and hence conveys 100% of information over all aspects. This implies that the remaining representations will be always be referred to in relation to the actual building.

The same procedure was repeated for all qualities and for the general impression question, using all non-zero responses. The useful number of responses for each quality varied between 45 and 50 and for the general impression question was 185. The resulting percent information gap is indicated in Figures 5.1 to 5.26. All these figures are arranged in successive order such that the quality with highest discrimination (the highest

difference between the first and the last representations) appears first and quality with least discrimination appears last.

The aspect of texture (Figure 5.1) seems to be best approximated by the colour slide, which conveys about 42% of what the building does. This is not a noteworthy performance. The black and white photograph conveys about 25% and the perspective drawing about 19%. The remaining six representations convey between 14% and three percent. The data indicate that the aspect of texture was very poorly conveyed by representations that the building is uniquely powerful with respect to this aspect.

The aspect of shade and shadow (see Figure 5.2) seems to be similar to texture in terms of information gaps, with the colour slide performing at about 63% of possible effectiveness and the black and white photograph about 31%. The architectural model seems to have a better capacity to convey this aspect than texture, but generally percentages for other representations on shade and shadow and texture appear uniformly low.

The architectural model apparently conveys 57% of the aspect of length (see Figure, 5.3); the plan and section follow the model with 44%. The colour slide was slightly inferior for this aspect whereas the perspective and isometric drawings have about equal potency in displaying length. While the black and white photograph is weaker than the sketch drawing, the latter

```
========================================  Actual building (100%)
                   =====================  Architectural model (57%)
                        ================  Plan and Section (44%)
                          ===============  Colour slide (41%)
                            =============  Perspective drawing (35%)
                             ============  Isometric drawing (33%)
                                ==========  Black and white photograph (29%)
                                   =======  Sketch drawing (20%)
                                       ===  Space relation diagram (8%)
                                       ===  Verbal description (8%)
```

Fig.5.3. Information gaps for length

```
========================================  Actual building (100%)
                   =====================  Architectural model (57%)
                      ==================  Colour slide (49%)
                          ===============  Plan and Section (43%)
                             =============  Black and white photograph (39%)
                             =============  Perspective drawing (39%)
                              ============  Isometric drawing (33%)
                                   =======  Sketch drawing (22%)
                                       ===  Space relation diagram (9%)
                                       ===  Verbal description (8%)
```

Fig.5.4. Information gaps for proportion and scale

has about 29% of the potency of the actual building. Generally the verbal description and space relation diagram were very poor in conveying this aspect; both were rated at about eight percent of effectiveness.

The aspect of scale and proportion has a similar pattern of responses to that of length; i.e. the architectural model, plan and section, isometric drawing, verbal description and space relation diagram have almost identical percentages. The colour slide has about 50% effectiveness in describing proportion and scale while the black and white photograph and the perspective drawing show about 40% effectiveness. Even though the sketch drawing has improved its percentage, it still achieves only a fifth of the potency of the building.

The configuration for the aspect of form (see Figure 5.5) seems to be different from that of the previous aspects. The architectural model and colour slide share 50% effectiveness while differences between the isometric drawing and the perspective drawing, the perspective drawing and the black and white photograph and the black and white photograph and the plan and section appear to be eight percent each. The isometric drawing conveys about one third as much as the actual building. The sketch drawing, verbal description and space relation diagram all convey less than 20% of the aspect of form.

```
========================================  Actual building (100%)
                    ====================  Architectural model (50%)
                     ===================  Colour slide (48%)
                           =============  Isometric drawing (34%)
                            ============  Perspective drawing (32%)
                            ============  Black and white photograph (30%)
                             ===========  Plan and Section (28%)
                                 =======  Sketch drawing (18%)
                                   =====  Verbal description (14%)
                                     ===  Space relation diagram (9%)
```

Fig.5.5. Information gaps for form

```
========================================  Actual building (100%)
                         ==============  Colour slide (73%)
                    ====================  Perspective drawing (49%)
                              ==========  Architectural model (26%)
                              ==========  Black and white photograph (26%)
                                  ======  Verbal description (17%)
                                  ======  Isometric drawing (15%)
                                   =====  Space relation diagram (14%)
                                   =====  Sketch drawing (14%)
                                    ====  Plan and Section (10%)
```

Fig.5.6. Information gaps for colourfulness

For colourfulness, the colour slide communicated about 73% of the actual environment, and about half of the building's colourfulness was conveyed by the perspective drawing. The architectural model and black and white photograph both conveyed about 26%. The differences between the verbal description, isometric drawing, space relation diagram and sketch drawing seem to be very small with the verbal description on the top of the list. The plan and section convey this aspect least well with about 10% of the potency of the actual building.

The architectural model seems to convey the aspect of figure remarkably well, about 88% as well as the actual building (see Figure 5.4). The colour slide conveys 56% while the isometric drawing and perspective drawing conveyed 46% and 43% respectively. The black and white photcgraph and plan and section approximate about 40% effectiveness in conveying this aspect of the figure.

The sense of rigidity can be illustrated by the architectural model with an information gap of 28%. The isometric drawing, plan and section and colour slide lose about half of the information; the black and white photograph and the perspective drawing leave out about 56% and 64% respectively; while the relative positions of the sketch drawing, verbal description and space relation diagram appear to be similar for rigidity and figure.

```
========================================  Actual building (100%)
=====================================     Architectural model (88%)
======================                    Colour slide (56%)
==================                        Isometric drawing (46%)
=================                         Perspective drawing (43%)
===============                           Black and white photograph (39%)
===============                           Plan and Section (38%)
=========                                 Sketch drawing (23%)
=====                                     Verbal description (14%)
====                                      Space relation diagram (11%)
```

Fig.5.7. Information gaps for figure

```
========================================  Actual building (100%)
============================              Architectural model (72%)
====================                      Isometric drawing (54%)
====================                      Plan and Section (53%)
===================                       Colour slide (52%)
================                          Black and white photograph (44%)
==============                            Perspective drawing (36%)
=======                                   Sketch drawing (19%)
=======                                   Verbal description (18%)
====                                      Space relation diagram (11%)
```

Fig.5.8. Information gaps for rigidity

```
========================================  Actual building (100%)
                    ====================  Colour slide (54%)
                    ====================  Architectural model (53%)
                  ===================  Isometric drawing (48%)
                  ==================  Black and white photograph (46%)
                ==============  Perspective drawing (36%)
                =============  Plan and Section (34%)
                =========  Sketch drawing (23%)
                ======  Verbal description (17%)
                ====  Space relation diagram (11%)
```

Fig.5.9. Information gaps for solidity

```
========================================  Actual building (100%)
                          ============  Colour slide (74%)
                    =================  Architectural model (43%)
                  ===============  Perspective drawing (38%)
                  ==============  Black and white photograph (35%)
                     ===========  Isometric drawing (28%)
                     =========  Sketch drawing (23%)
                       ======  Verbal description (15%)
                       =====  Plan and Section (13%)
                       ====  Space relation diagram (12%)
```

Fig.5.10. Information gaps for arousal

Again, for conveying the aspect of solidity (see Figure 5.10) the sketch drawing, verbal description and space relation diagram have maintained their inferior positions while that of the plan and section has deteriorated. Even though the colour slide and architectural model convey more than half of the building's solidity, the isometric drawing and black and white photograph do almost as well.

The colour slide apparently conveys three fourths of the arousing aspect of the environment but the architectural model does not even reach the half-way mark. The perspective drawing and black and white photograph assume an intermediate position, while the isometric drawing has a slightly weaker ability to convey this aspect. The plan and section, with the sketch drawing, verbal description and space relation diagram, fall in last place; all of them have a potency in the 10 to 20 percent range.

About 60% of the harmonious character, equality and proportionality in contrast and symmetry ("balance") of the building can be captured by using the architectural model or the colour slide (see Figure 5.11). However, the perspective drawing, plan and section and black and white photograph seem to capture only about 40% and the isometric and sketch drawings can only reach 32% and 25% respectively. The space relation diagram and verbal description share the bottom position on this

```
========================================  Actual building (100%)
                  =========================  Architectural model (62%)
                   ========================  Colour slide (58%)
                          ================  Perspective drawing (41%)
                            ==============  Plan and Section (37%)
                            ==============  Black and white photograph (37%)
                              ============  Isometric drawing (32%)
                                ==========  Sketch drawing (25%)
                                   =======  Space relation diagram (19%)
                                       ====  Verbal description (12%)
```

Fig.5.11. Information gaps for balance

```
========================================  Actual building (100%)
        ================================  Colour slide (83%)
                        =================  Perspective drawing (44%)
                                ==========  Architectural model (27%)
                                  ========  Black and white photograph (21%)
                                  ========  Isometric drawing (20%)
                                    ======  Space relation diagram (16%)
                                    ======  Plan and Section (15%)
                                    ======  Sketch drawing (15%)
                                      ====  Verbal description (12%)
```

Fig.5.12. Information gaps for colour

continuum.

One would expect the colour slide to portray colour characteristics of the building elements almost as well as the actual building but there seems to be a gap of about 17%. Scant use of colour on the perspective drawing has made that gap 56%. It is not surprising to find that the remaining seven representations are clustered and all of them have a potency between one-fourth and one-eighth of that of the actual building.

It appears that the colour slide conveys almost 90% of the feeling of pleasantness of the actual building while the perspective drawing conveys about half. The black and white photograph outweighs the architectural model by about two percent but both have a potency of about 40% of the actual building. The sketch and isometric drawings convey about one-fourth and the verbal description, one-fifth, of the pleasantness aspect. The plan and section and space relation diagram appear to communicate least of this aspect.

About three-fourths of the building's volume (a combination of length, breadth and height) is captured by the architectural model and colour slide, while the isometric drawing and plan and section convey about 45% (see Figure 5.14). The perspective drawing conveys about 37% and the black and white photograph

```
========================================  Actual building (100%)
=================================         Colour slide (89%)
===================                       Perspective drawing (48%)
================                          Black and white photograph (42%)
================                          Architectural model (40%)
=========                                 Sketch drawing (24%)
=========                                 Isometric drawing (23%)
========                                  Verbal description (21%)
=====                                     Plan and Section (14%)
====                                      Space relation diagram (12%)
```

Fig.5.13. Information gaps for pleasure

```
========================================  Actual building (100%)
============================              Architectural model (74%)
==================                        Colour slide (46%)
================                          Isometric drawing (42%)
================                          Plan and Section (41%)
==============                            Perspective drawing (37%)
=============                             Black and white photograph (33%)
========                                  Sketch drawing (22%)
======                                    Verbal description (16%)
====                                      Space relation diagram (12%)
```

Fig.5.14. Information gaps for volume

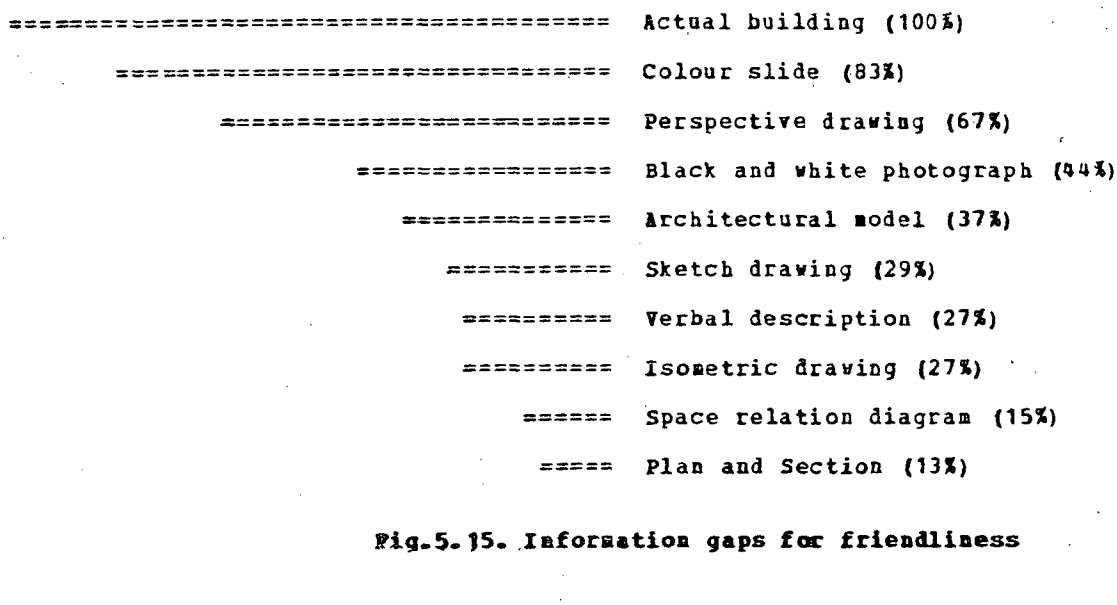

Fig.5.15. Information gaps for friendliness

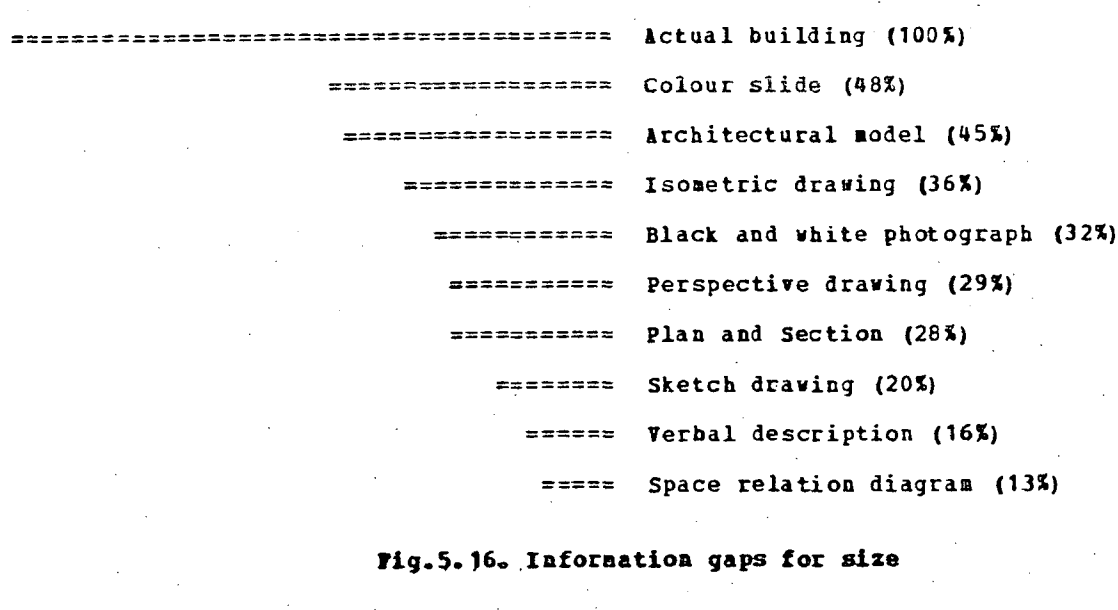

Fig.5.16. Information gaps for size

describe about 33% as well the volume of the building. The sketch drawing, verbal description and space relation diagram appear to be very weak techniques for conveying this aspect.

There appears to be a remarkable similarity between the relative abilities of different representations to portray the aspect of friendliness and the feeling of pleasantness even though the relative percentages differ for all the representations. The distribution for these two are somewhat paralleled by friendliness. There is one exception, however: the space relation diagram and plan and section have exchanged their positions (see Figure 5.15).

Results for the sense of size and the aspect of volume should show similar configurations but instead the colour slide and architectural model more effectively convey these qualities of the building while the isometric drawing, black and white photograph, perspective drawing and plan and section convey about one-third. The sketch drawing, verbal description and space relation diagram have about one-fifth to one-eighth the potency of the building to convey this aspect.

The question dealing with the overall impression of the Square is unique, since every observer in the study responded to it. The colour slide are was judged as 65% as powerful as the actual building in conveying overall environment and the model

```
========================================  Actual building (100%)
                  =========================  Colour slide (65%)
                      =======================  Architectural model (56%)
                          ==================  Perspective drawing (46%)
                              ==============  Black and white photograph (36%)
                                =============  Isometric drawing (34%)
                                 ============  Plan and Section (31%)
                                     =========  Sketch drawing (23%)
                                       =======  Verbal description (18%)
                                        ======  Space relation diagram (15%)
```

Fig.5.17. Information gaps for general impression

```
========================================  Actual building (100%)
                  =========================  Architectural model (65%)
                  =========================  Colour slide (65%)
                            ================  Black and white photograph (41%)
                            ================  Perspective drawing (41%)
                              ===============  Isometric drawing (38%)
                                  ==========  Plan and Section (27%)
                                     =========  Sketch drawing (23%)
                                       ========  Verbal description (20%)
                                        ======  Space relation diagram (16%)
```

Fig.5.18. Information gaps for dominance

was estimated to be 56% as strong (see Figure 5.17). The perspective drawing and black and white photograph lie 10% apart on the scale, from 46% to 36%. Both the iscmetric drawing and the plan and section convey about one-third of the impression of the building. The remaining three representations (sketch drawing, verbal description and space relation diagram) share their usual bottom position, demonstrating their very poor ability to convey an overall idea of the building.

Both the architectural model and colour slide convey about 65% of the building's dominance; the black and white photograph, the perspective and isometric drawings convey about 40% of the feeling of dominance (see Figure 5.9). The ordering of the remaining five displays is almost identical to that for the general impression with minor changes in the percentages.

The idea of complexity seems to be fairly well captured by the plan and section, the colour slide and the architectural model; the isometric drawing, perspective drawing and black and white photograph reach the half-way mark (see Figure 5.19). The remaining three representations (space relation diagram, verbal description and sketch drawing) have maintained their bottom-most position.

The aspect of excitement of the building can be very well portrayed by using the colour slide (see Figure 5.20). The

```
========================================  Actual building (100%)
                  =======================  Plan and Section (62%)
                  =======================  Colour slide (60%)
                   ======================  Architectural model (59%)
                      ====================  Isometric drawing (51%)
                        ==================  Perspective drawing (45%)
                        ==================  Black and white photograph (45%)
                              ============  Verbal description (30%)
                                  =========  Sketch drawing (27%)
                                      =======  Space relation diagram (18%)
```

Fig.5.19. Information gaps for complexity

```
========================================  Actual building (100%)
                 ================================  Colour slide (86%)
                     =====================  Perspective drawing (57%)
                       ====================  Architectural model (52%)
                            ===============  Black and white photograph (39%)
                            ===============  Isometric drawing (38%)
                              ============  Sketch drawing (31%)
                                  ========  Plan and Section (21%)
                                      =======  Space relation diagram (18%)
                                      =======  Verbal description (18%)
```

Fig.5.20. Information gaps for excitement

perspective drawing and architectural model convey only about half this aspect. The black and white photograph and the isometric drawing show similar potencies of about 38% while the sketch drawing conveys about 31% of the spatial excitement compared to the actual building. The remaining three techniques convey about one-fifth of this aspect, if ccmpared to the real environment.

About 60% of the spaciousness (see Figure 5.21) of the building can be conveyed by the architectural model or colour slide. The black and white photographs, isometric and perspective drawings convey about half of the same aspect in comparison with the actual environment. Among the remaining four representations, the sketch drawing and plan and section have about one-fourth of the potency of the actual building but the verbal description and space relation diagram do not show any potential for conveying this aspect.

Compared to the actual building the aspect of ventilation or airiness (see Figure, 5.22) is conveyed 75% as well by the colour slide. The architectural model, isometric drawing and black and white photograph range down to one-third of the actual building's effectiveness in expressing this quality. The remaining representations exhibit a low range cf performance.

The aspect of organisation can be conveyed by the

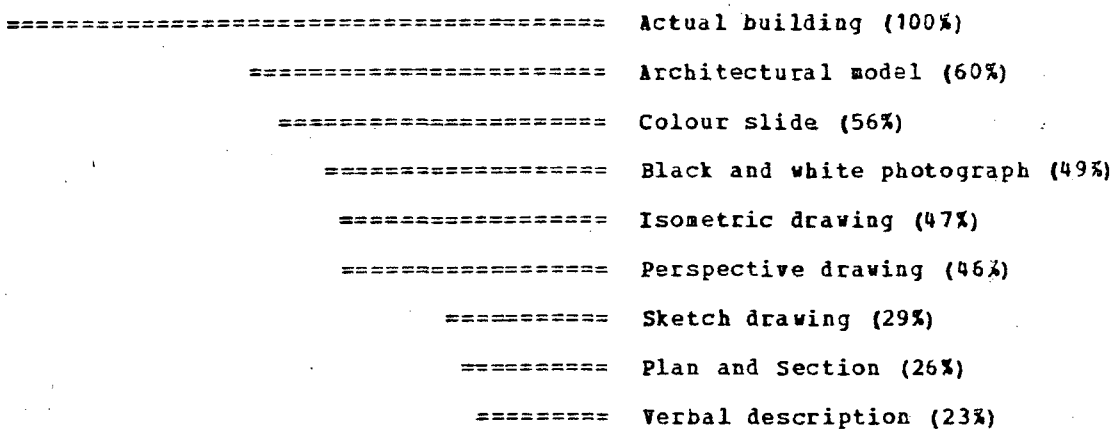

Fig.5.21. Information gaps for spaciousness

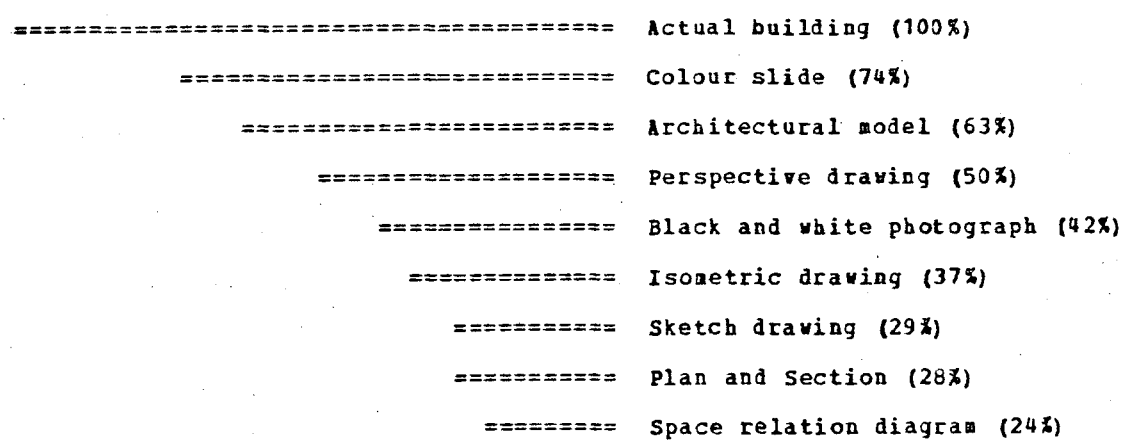

Fig.5.22. Information gaps for ventilation

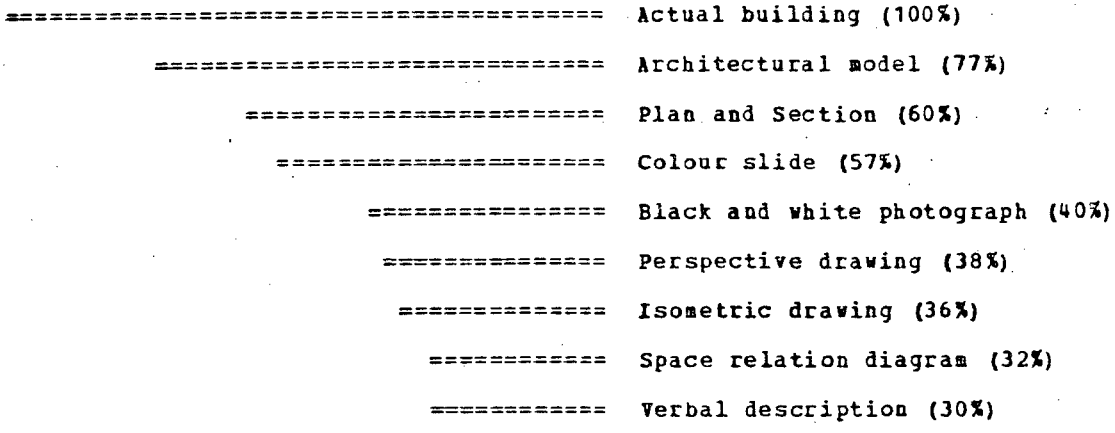

Fig.5.23. Information gaps for organisation

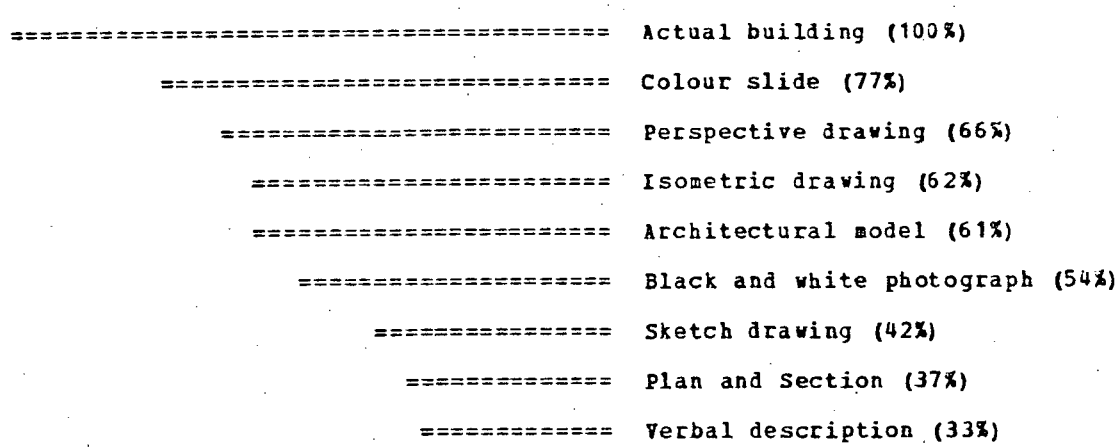

Fig.5.24. Information gaps for modernity

architectural model about 77% as well as by the actual building; the plan and section and colour slide, about 60% as effectively (see Figure 5.23). Of the remaining six representations five convey this aspect in the range of 40% to 30% while the sketch drawing conveys one-fifth of this aspect as compared to the actual environment.

The relative configuration for the quality of modernity shows that the colour slides convey about three-quarters as much as the actual environment; the perspective and isometric drawings and the architectural model can convey about two-thirds of this aspect. The black and white photographs convey slightly more than half while the remaining four techniques convey about two-fifths to one-quarter.

Finally, the aspect of cleanliness has four distinct groupings of representations. The space relation diagram, verbal description and sketch drawing convey about 30%; the plan and section, about 50% of the environment; the architectural model, black and white photographs, isometric and perspective drawings about 60 to 68%; and colour slide about 88%.

To summarize, no representation other than the actual building describes the building very well. If one sums the geometric means for all the aspects and each representation and computes the total information gap, then the architectural model

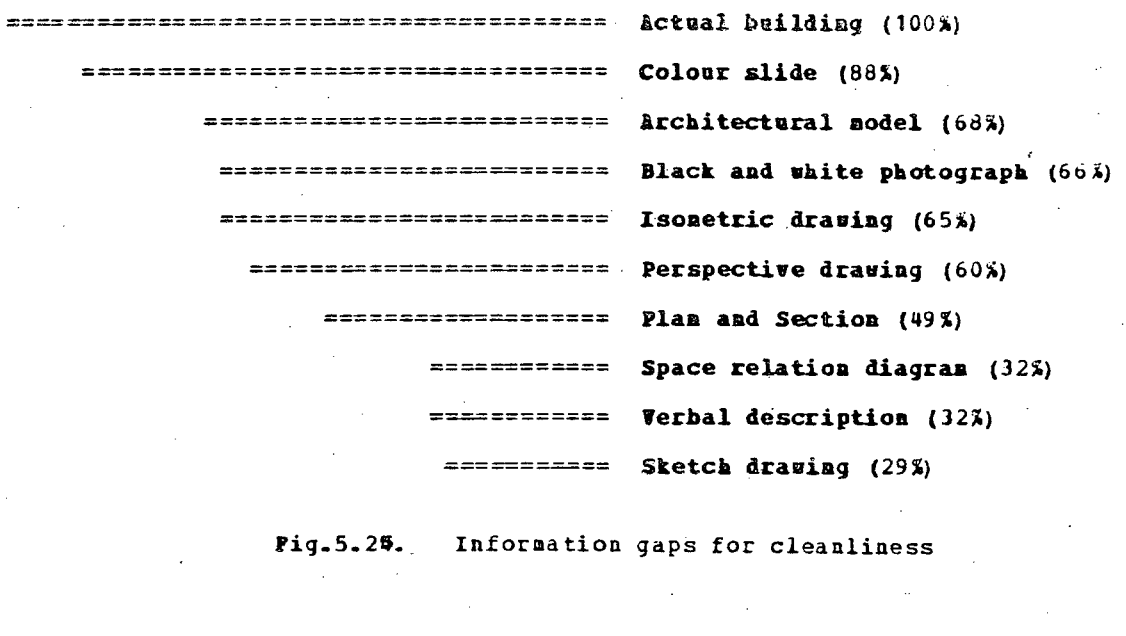

Fig.5.25. Information gaps for cleanliness

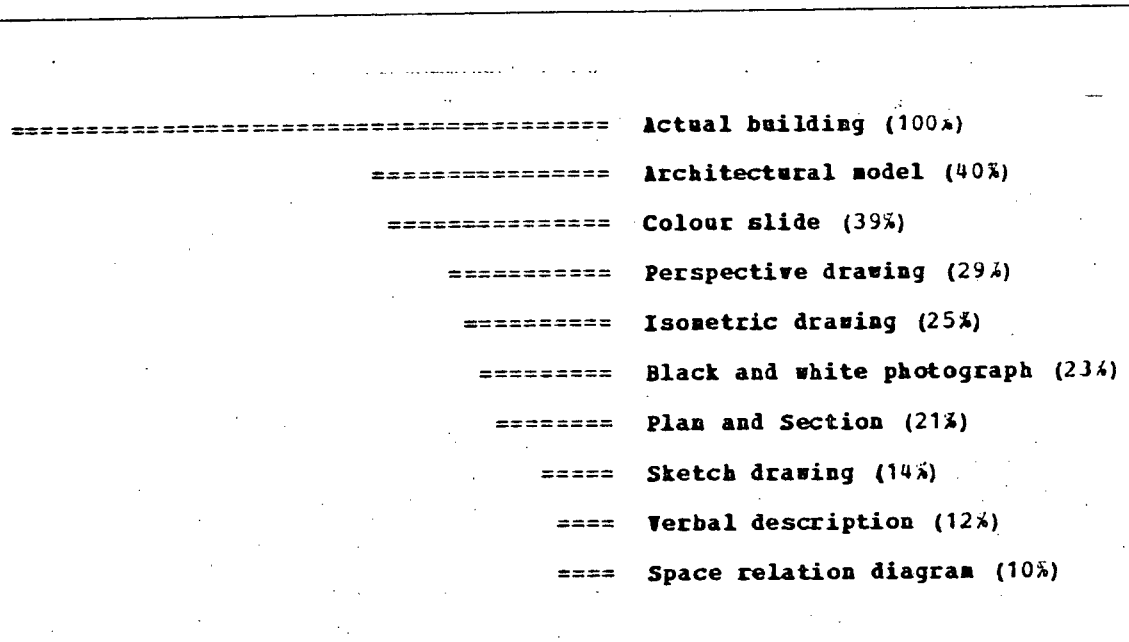

Fig.5.26. Information gaps for aggregate of all aspects

and colour slide share the top position; both convey about 40% of "the truth" (see Figure 5.26). Furthermore, the colour slides perform well for describing colourfulness, arousal, colour, pleasure, friendliness, excitement and cleanliness while the architectural model seems to occupy the same position in conveying figure, rigidity, volume and organisation. The aspects other than these described above demonstrate have larger gaps between the actual building and its closest representation. The space relation diagram, verbal description, plan and section and sketch drawing do not, it seems, have much potency to convey any of the aspects as compared to the other techniques. The remaining techniques, the isometric drawing, perspective drawing and black and white photograph maintain middle-rank positions for almost all aspects.

The results described above, based on 1400 sets of observations made by 185 observers, may not be a complete description. However, critical examination suggests that there can be an information gap between the actual building and its representation; apparently the actual building in full scale most strongly represents the 25 architectural notions examined here. Furthermore, most representations used in this study convey some aspects well but are not as useful in conveying other aspects. Generally, the less abstract the representation, and the more detailed, the more are architectural notions conveyed. Those representation which are most readily

generated, like a space relation diagram, a sketch drawing or the verbal description, conveyed least about architectural qualities. Those that require more intense effort, like a perspective drawing or an isometric drawing or plan and section were more effective. Most effective in conveying building qualities were a model and photographs of the actual building.

It is interesting to note that qualities such as ventilation, organisation and modernity produced relatively narrow ranges. This suggests that although observers were free to choose any range of numbers, they failed to show any discriminatory power for this and a few other architectural qualties. It also suggests that these qualities are poorly conveyed by representations.

5.2. The relationship between the time consumed and information potency of the representation.

The amount of information about qualities of an actual building which is conveyed a by representation is a partial function of the level of efforts committed to them. Efforts can be time, (T), in terms of measured hours, or by money spent for

materials, (C), measured in dollars. One can assume that information potency, (I), will be a function of these quantities. To evaluate such a functional relationship one must first assume an underlying mathematical mcdel and then use statistical techniques to judge the validity and appropriateness of the model used.

Stevens(1966,p. 530) presented a general case for the relationship between the physical magnitude of stimuli, measured in terms of basic physical units of length, mass and time, and the perceptual magnitude of such stimuli, measured in terms of subjective ratios. He and his followers have further argued that perceptual magnitude, (P), is a power function of a physical magnitude, (Q). In mathematical terms this would be

$$P=bQ^{a} \quad .....(1)$$

where a is an exponent of the power function and b is a proportional measurement constant.

One may consider perceptual magnitude of, for example, cleanliness as measured in terms of the amount of dirt present and subjective cleanliness to be comparable notions but the present study does not permit us to treat as equivalents physical and subjective magnitudes. Time is a physical quantity but exactly how to tranform money to time or time to money is also unknown. Hence, a simple strategy was followed to indicate such a relationship. The question of "general impression", to

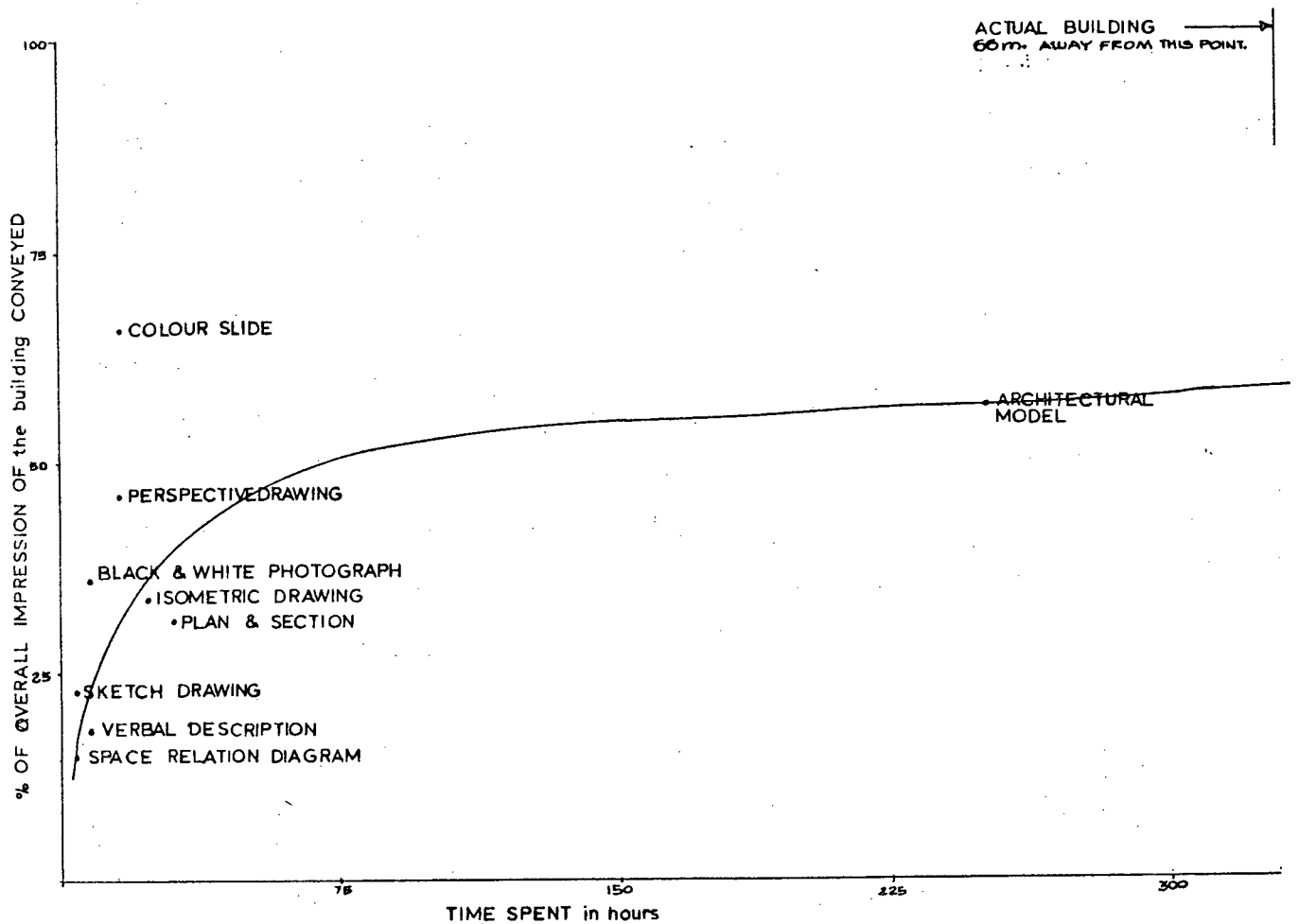

Fig.5.27. A relationship between time and information gap

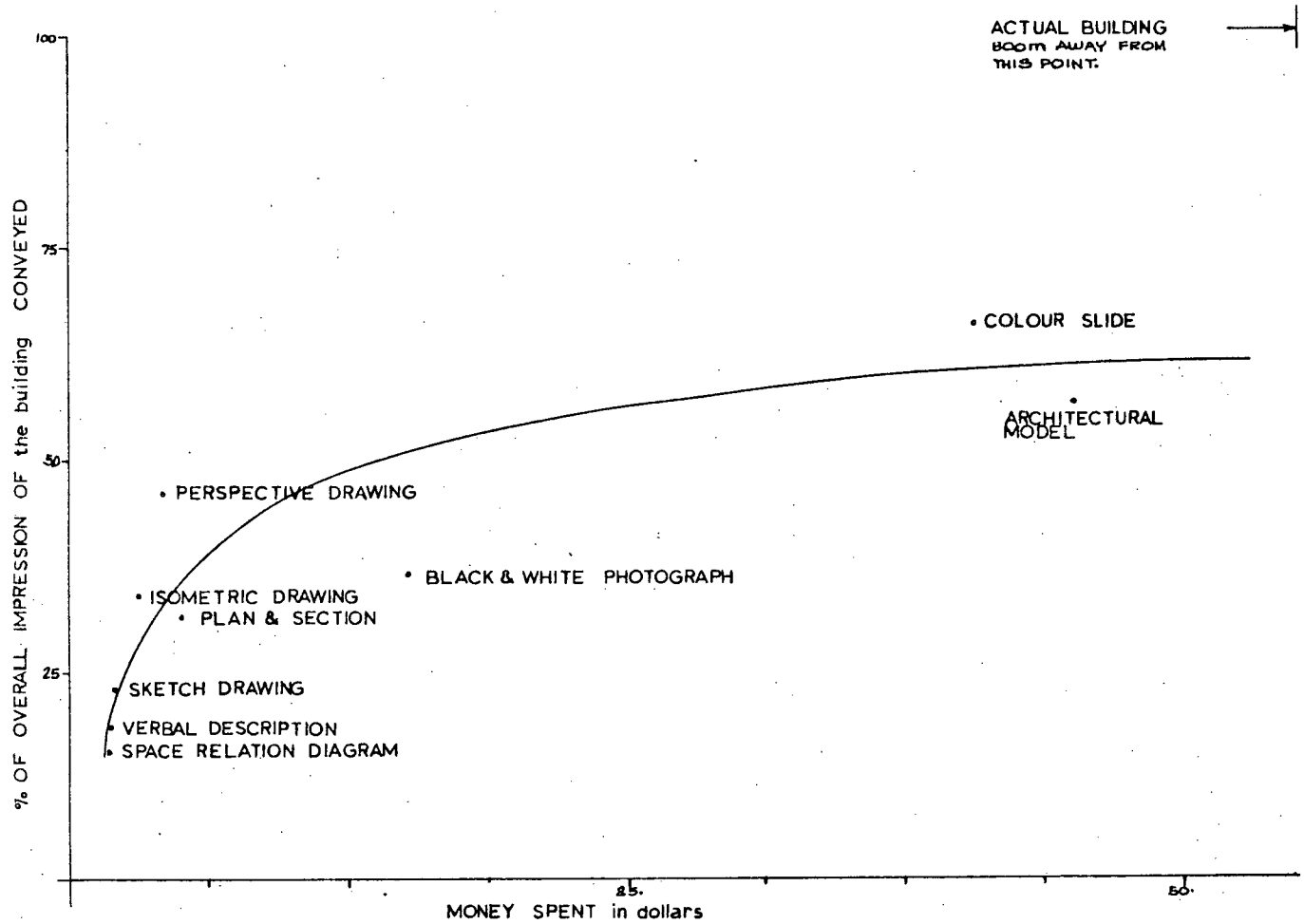

Fig. 5.28. A relationship between cost and information gap.

which every subject replied, is used to illustrate the strategy of relating costs to information effectiveness.

Figure 5.27 shows the relationship between time spent on each representation and the percent of the overall impression (conveyed by the actual building) conveyed by each representation. A similar relationship for cost is indicated in Figure 5.28. In neither figure is the actual building is shown on the given scale.

It is evident from both figures that there exists a relationship between time spent or cost and information potency and that this relationship is not a simple linear or log-linear one. Hence Kendall's Tau (a measure of overall agreement between two sets of ranked quantities) was computed for the 10 representations. The value for the relationship between general impression conveyed by representation of the actual building and cost of the representation was 0.7821 ($p<0.0001$) and time for the representation was 0.5683 ($p<0.012$). This suggests that there is a stronger relationship between dollars spent for materials and information potency than between time spent preparing the representation and information potency.

5.3. The relative discrimination between the aspects.

If there were discrimination across representations between various aspects of architecture, one would have found Figures 5.1 to 5.26 illustrating similar rankings of information gaps. The evidence, however, suggests that the information gap not only varies from representation to representation but depends on which quality of a building is being evaluated. To indicate the magnitude of such differences, an analysis of variance was computed using the information gap of 10 displays on 24 aspects.

Table 5.1. relative discrimination between aspects and representation.

Source	Sum of squares	Df	Mean squares	F-ratio	F-prob
Aspects*	1.4733	*24	0.06138	6.6875	<.00001
Displays	14.424	9	1.6027	174.59	<.00001
Error	1.9828	216	0.0092		
Total	17.880	249			

* Includes "general impression"

The summary shown in Table 5.1 suggests that observers were able to differentiate between the various architectural

qualities (Eta=0.287) and they also perceived each representation differentially (Eta=0.898). However, their distinctions between representations are about 20 times those of the differences between aspects.

Given that observers do discriminate between representations in terms of their information effectiveness, one would expect architects to make finer discriminations than non-architects with respect to the effectiveness of different representations. To determine whether such is the case, all the subjects were divided into three groups: architects (professionals, architecture teachers and students of architecture), architecture-conscious users (work in the building industry, manage some other building) and users. Using their responses to the overall impression question, the information gap for each representation was computed for each subject separately by dividing their responses to the actual building. Then using this information gap to indicate ability to discriminate between the overall effectiveness of the different representations, an analysis of variance was performed. Since the actual building was used with no information gap for all subjects, there are only nine representations for analysis.

Table 5.2. Architect and non-architect differences.

Source	Sum of squares	Df	Mean square	F-ratio	F-prob
Observers	4925.28	184	26.7678	38.7854	<.0001
Observer groups	137.53	2	68.7633	2.6139	0.076
Error	4787.75	182	26.3063		
Displays	357.54	8	44.6924	64.7573	<.0001
Displays X observer groups	20.34	16	1.2714	1.8422	0.0219
Error	1003.48	1454	0.6801	-	-
Total	6442.17	1664			

The above table shows a summary of the computation and indicates that although there are differences between architects and non-architects (reliable at the $p<0.076$), there are also differences between their reactions to representations (reliable at the $p<0.0105$).

To examine further these differences, profiles for group means for each representation are drawn in Figure 5.29. It indicates that although architects generally attributed more overall information value about architecture to all the representations, they seem to consider the verbal description and space relation diagram as relatively less useful than did the non-architects. The latter (architecture-conscious users and lay-users) gave similar but distinctly lower ratings to the representations.

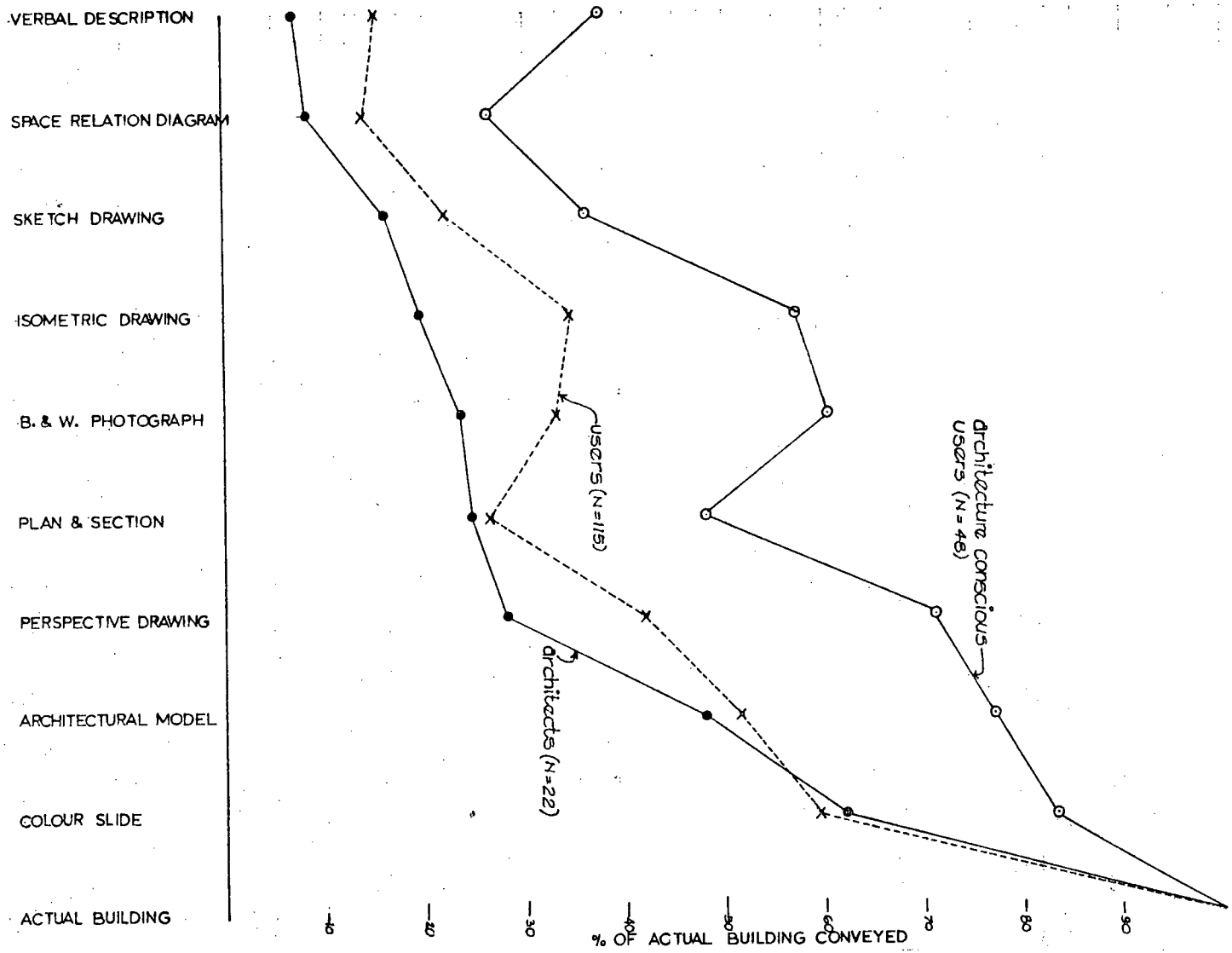

Fig.5.28. The mean profiles for user groups

5.4. The categories of representation.

To indicate the categories underlying the spectrum of representations, cluster analysis was used. The inverse of relative information scores of 10 representations on 25 qualities described in section 5.1 were used for data points. Product-moment correlations were computed between each pair of the representations across all 25 qualities. Then, absolute correlation being a measure of similarity between representations, clusters were constructed such that representations showing overall similarity in their qualitative information effectiveness were grouped into categories.

Figure 5.30 shows the observed cluster structure and indicates that there is about 40.6% overall similarity between all the representations. The strongest cluster consisted of the black and white photograph, actual building and colour slide; addition of the perspective drawing and the sketch drawing would change the similarity measure slightly. The second cluster consisted of the architectural model, the plan and section and the isometric drawing with similarity between these techniques ranging up to 67%. Finally, the verbal description and the

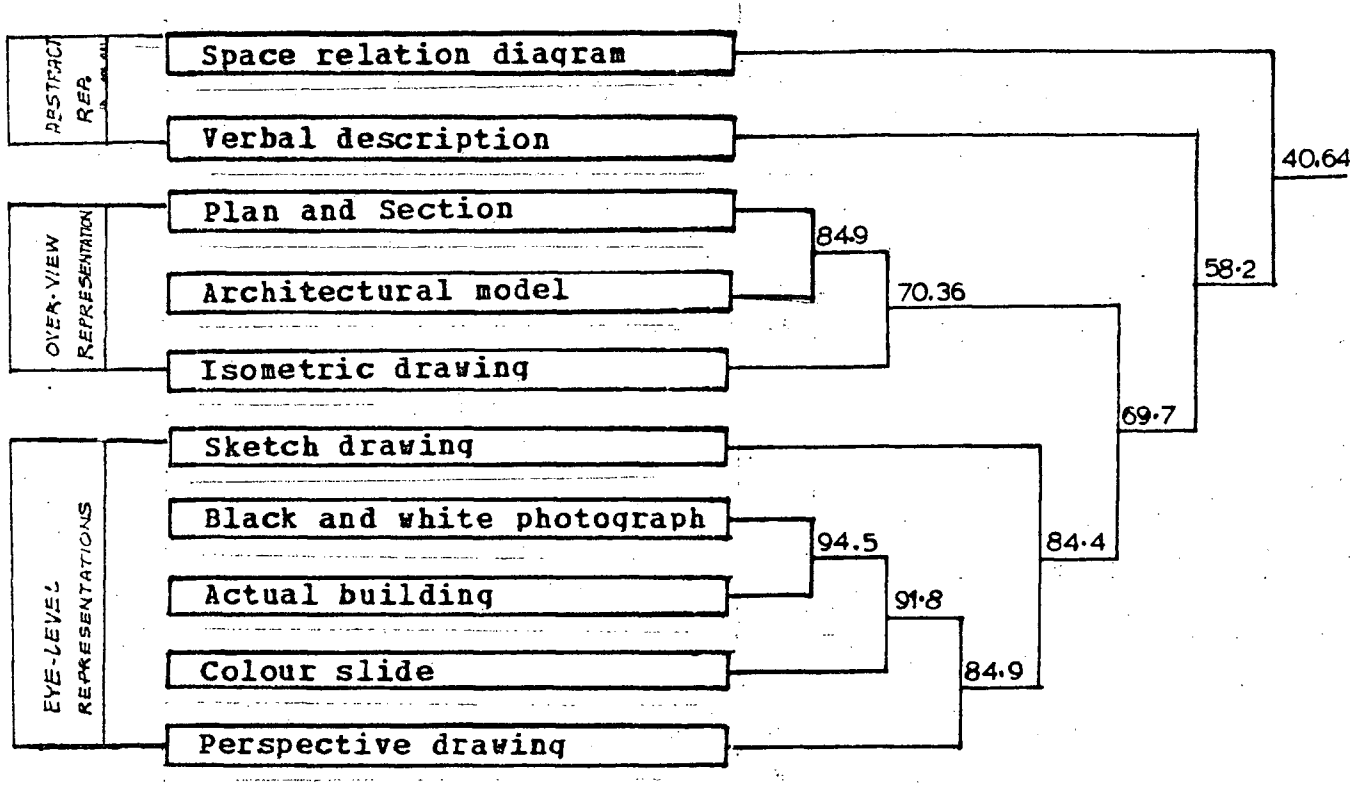

Fig.5.20. A perceived structure of representations

space relation diagram do not belong to any of the clusters; this would suggest that these representations form their own categories.

Representations for the study were selected on the basis of their forms of expression. It does not seem that the same categories could be completely validated on perceptual dimensions. Although the three-plane category, having as representations the isometric drawing, architectural model and plan and section may be recognized, a stronger cluster can be formed with eye-level and non eye-level techniques. There is a further possibility of differentiating pre- and post-construction techniques under separate categories. Symbolic categories, verbal and modern, can be discussed using theoretical as well as empirical rational.

CHAPTER 6

RECOMMENDATIONS.

> Knowledge, the object of knowledge and the knowing subject, are the threefold incitement to action: the instrument, the action and the agent are the threefold composite of action.
>
> (translated from Bhagavadgita, Chapter 18.18)

The literature about representation has been examined and some empirical findings have been added. With this background, one can make practical suggestions to designers as well as to environmental researchers. The emphasis in this chapter is primarily on what-should-be-done; furthermore these, recommendations are given with qualifying general principles. To help comprehend the substantive material, each recommendation is preceded by a question and discussion ensues either from past work or some intuitive understanding of the question. Clearly these are not final and definitive answers.

6.1. Recommendations for the designer.

A. To convey one's design ideas....

At the design stage, neither designer nor the client is 100% sure of their "environmental-ideas"; hence it is designer's task to determine the exact needs of the client. The location of various spaces within the building can be understood by architects if sketch plans or sketch sections are drawn but the client may fail to grasp the essence of notions from such techniques. Hence the designer should use simple three-plane projectional techniques such as isometric, axonometric or oblique representations. If time and money permit, block model photographs also help but the relative benefits of a block model at the early design stage are small unless the design project involves a large land area.

Aspects related to building imagery cannot be conveyed by projectional techniques. For such purposes, eye-level views are the best techniques. Quickly drawn perspectives with some colours are useful for communicating the general imagery of the building. If money permits, perspective drawings shown through colour or black and white slides would further improve the representation.

None of these efforts help to convey the spatial excitement and pleasantness-related qualities of the building; hence, multiple views of several features of the building, verbal commentary and a slide presentation need to be added. Even then the lay-client may not comprehend fully and the designer should be careful to elicit the client's opinion and ideas about these aspects.

B. To describe the completed project to fellow designers....

A designer's interest in the completed project often centres on the <u>process</u> of achieving a suitable solution; hence graphical illustratations of the design process and the final product are important. Sketch plans help which show important decisions and features that lead to a final solution. Accurately drawn plans and sectional perspectives lead toward the final solution. If time and money permit, cclour photographs of the model or the model itself might help to focus attention on the final solution.

If the building is already completed, present a sequence of colour slides or colour photographs with short verbal captions indicating the exact use of the building and communicating spatial excitement and pleasure-related qualities.

The building totality cannot be fully communicated by these

means. Major loss of ideas always occurs for aspects such as texture and light, shade and shadow. Ideas about the "fit" of the building within the total environmental context are poorly communicated by most techniques known at present.

C. To describe one's completed project to a lay-client....

Lay clients place major emphasis on imagery and details of the building and they are interested in finding out about appropriateness and workability of building solutions. This implies less emphasis on plans, sections, and elevations and more on pictorial techniques: colour slides, colour photographs, movie, video. Elaborate on all building aspects in prose.

If photographic means are not available or time constraints exist, good eye-level drawings with colour are the the best substitute. "Realistic" presentations such as those used by Jacoby(1971) and Kemper(1973) are perhaps equivalent in potency to those of other colour photographs. One problem, however, with such techniques is that they impart exaggerated amounts of excitement and pleasantness to the building. On the other hand, with bird's-eye-view techniques (Rudolph, 1971), one might over-emphasize the spatial relationship, spaciousness and such similar qualities which may escape the client.

Finally, although the fuller information of the actual

building can never be conveyed by any single representation, the designer must still attempt to explain to lay-clients those underlying building qualities such as spatial excitement, balance and form. This study has shown that untrained users were able to differentiate between various intricate architectural notions and in so doing, learned more about architecture. Such training of clients would have dual advantages to architecture: easy access to critics and a demand by users for creative designs to challenge designers' abilities.

D. To use only the designer's favourite techniques....

If the designer restricts use of multiple techniques, building characteristics come to depend upon the technique used. Evidence compiled by Lange(1976) suggests that Mies' buildings appear organised (influenced by plans and sections), Rudolph's buildings appear large, massive and big (isometric and bird's-eye-view commonly used), while Kahn's or Corbusier's architecture appears exciting (sketches commonly used). Lange's findings are corroborated by this study, although the causul links are not yet proven.

The history of environmental design provides further evidence that decisions about representational tools have influenced the quality of architecture. Prior to the invention of perspectives, buildings were designed with detail in texture

and with symmetry and balance as major design forces. The invention of perspectives lead to more eye-level excitement; models have introduced more brutal, solid, massive, expansive architecture; while photographic technology has already induced more exotic, arousing, pleasing types of architecture.

E. To use computer simulation or computer guided video system....

The computer graphic simulation techniques developed so far have the potential to display imagery very well. The advantage of computer graphics is to allow multiple frames to be viewed and to achieve accuracy in drawing the picture. The programming time to get good visual simulation techniques is often four or five times that required for simple sketch perspectives. Fortunately computational time for such simulation is minimal and by using rendering techniques on computer plotted drawings one might achive pleasing-exciting aspects and spatial locational aspects. On the whole, graphic simulation techniques best serve to reduce the information gap at the pre-construction stage.

The numerical computer simulations using discrete or continuous system models might prove useful once the parameters of behavioural as well as physical aspects of the building are known. These models may afford insights into the systematic

approach once their validities are better understood. With such simulation techniques, one can generate large numbers of feasible alternatives, for given constraint condition. Thus large amounts of time are needed to evalute the advantages of each of these alternatives(Bazjanac, 1975).

Computer-guided video systems presently operate at the University of California, Berkeley. Such systems are useful for large-scale projects (more than 100 acres) but some sort of model is needed to accomplish this. Although published reports (Appleyard and Craik, 1974; Appleyard, 1977; McKechnie, 1977) paint a glossy picture about the future of video systems, relative benefits of such a large investment must be weighed against the costs.

First, at the scale of 1" to 40', if a model of a large urban or rural area is made, detailing on the model is difficult and then imagery portrayed on the video will not be effective. On the other hand, should one worry about imagery at such a scale since economic, organisational, geologic and other factors might have larger roles to play in making policy decisions?

Second, even if one succeeds in convincing oneself that the imagery is an important factor, one might suspect that such a system will not do any better job than a sequence of colour slides with audio presentation. This means that such a

sophisticated system will only reduce the information gap another 10 to 15 percent above colour slides but it might over-emphasize excitement and pleasure, and under-emphasize spaciousness, size and volume.

6.2. Recommendations to the researcher.

A. To relate information gap with size of environment....

Although the overall information gap between the representation and the system will not vary with the size of the system, a particular environment may posses excessive amounts of one aspect and lack some other aspect and this variation may affect the configuration of information gaps. If one investigates 10 to 15 environments differing on aspects such as form, volume, pleasantness and complexity and displayed through 10 to 15 representations, only then can a definitive relationship can be established.

Another typical study might involve defining the environment such that the area or volume of it is changed and eight to 10 representations are used to display the system. Then each observer might respond to a quality. The results of the research would provide a relationship between physical area

or volume and information gap.

With respect to complexity, measured in terms of Berlyne's collative properties or Mehrabian's and Russell's "environmental information" and the information gap, subsequent research might exhibit some functional relationship between Mehrabian's and Russell's pleasure-arousal-dominance dimensions and information gap. The results might suggest that pleasing environments have smaller information gaps while familiar or complex environments would have larger information gaps.

B. To indicate a mbination of representations for designer for minimizing information gap....

The designer's main concern often is what techniques best communicate ideas. This can be established by first determining the appropriate time and cost required for various representations and finding the relative efficiency of each. Then by using either nonlinear- or linear-programming techniques to determine optimal solution based on various constraints. Although part of the question is given in this study, due to only 10 data points, it does not seem useful to apply programming techniques.

To accomplish such research one should use about 25 representations from each pre- and post-construction technique

and using some sort of incomplete block designs, evaluate representations. It would involve rather complex, non-traditional psychometric experimental research techniques but it might give intriguing insights into representations and cost or time constraints.

C. To indicate the relation between time or cost and environmental aspects....

If one spends more time conceiving the building one might expect the building to have greater spatial excitement, solidity or organisation; on the other hand if on spends more money and uses decorative and ornamental building materials one might gain on the pleasing, colourful aspects of the building. Furthermore, if such a relationship can be established, can optimum time or material costs be set, so as to maximize for given environmental (qualitative) criteria?

One might consider establishing a similar relaticnship between time or money spent on representation and the amount of an aspect conveyed by such techniques. It seems likely that aspects such as figure, volume, spaciousness and dominance might bear a stronger relationship with time than cost while the friendliness, colour, texture, light, shade and shadow aspects might bear a stronger relationship with cost. Finally, there might be some aspects such as balance, complexity, form and

spatial excitement which might demonstrate a balanced simultaneous relationship with cost and time.

D. To complete the list of architectural nations....

Given the 24 architectural qualities derived in this study, can these qualities be used to comprehend the "true meaning" of architecture? It seems simple to see the relevance of some of these aspects to different buildings and use these qualities to classify buildings. Although most reseachers do not as yet possess a clear conceptual understanding of each aspect, it does not seem useful to start each research project from scratch. It is evident from past research that architectural meaning if verbalised is a complex phenonomenon; hence the strategy in research design should be to build on past work on architectural aspects.

Furthermore, one must also explore missing qualities that were not included in this study. One might attempt to give some external factor validation; a possible relationship might indicate pleasure related to quality of imagery, or solidity related to ratio between positive and negative surface area. Furthermore, size might relate to bigness while spaciousness might relate to density of spatial elements. There might aspects such as safety, functional identity and efficiency not yet discussed by other researchers.

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Appendix I

How would you describe your experience of going through Gaslight Square to someone else? There are many ways but writing may be too much work, picture taking requires a camera and painting requires special artistic skills. Some displays convey certain aspects of Gaslight Square well and other displays are better for other aspects.

To find which ways of describing architecture works best for you, it will take 15 minutes to look at these 10 building displays and will give you chance to make some interesting comparisons among them. Of course, you are already aware of some aspects of buildings but there are cther aspects of buildings you may never have thought about before, like spaciousness, friendliness, excitement or even complexity. You don't have to know anything technical about architecture because you already know what colour means to you, or friendliness or excitement. "Before you begin". Now look at the box. There are five lines on each face. Since length is one aspect of a building, compare the lengths of lines A and B. If you arbitrarily say line A is 100 points long, how long is line B? Is it shorter or longer? --- longer --- How many times? --- about twice. Hence line B is about 200 points long. Write that

down in the proper space in the booklet. Now try line C. Is it shorter or longer? --- shorter --- How much shorter? About 5%. So line C is how long? Write the number in the proper space in your booklet. Now make the same comparison for line D with line A and line E with line A. Write their appropriate lengths in the proper spaces.

Sometimes the idea of an aspect comes through <u>more clearly</u> than in the first display, then you use a number more than 100 --- either little bit more or a lot more depending cn how you feel and when less of that particular aspect comes through, use a number less than 100. You may use any number except zero because each display has <u>some degree of each aspect</u>. And remember that to say 200 means that you really feel that something works twice as well as something else. To say 25 means that it works only one-quarter as well. If you feel it works better but just little better, then use a number just a little larger than 100 and so on.

Your booklet and signs will guide you through the next part of this experiment so refer back to the front page where it says "To begin "

APPENDIX II PROGRAM TO PRODUCE QUESTIONNAIRE.

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      FORTRAN IV LISTING  MAIN        02:49 P.M.  JULY 12, 1979     PAGE 1
                          (FILE=BASIM)
MTS     ISN
 1        1          INTEGER*4 NEMS/16/,NPHY/8/,NSC/10/
 2             C---
 3             C        DESCRIPTION OF KEYS
 4             C---
 5        2          REAL*4 SIMS(10)/'<C1>','<C2>','<C3>','<C4>','<C5>','<C6>','<C7>',
 6                  *'<C8>','<C9>','<C0>'/,PHYS(8)/'<P1>','<P2>','<P3>','<P4>','<P5>',
 7                  *'<P6>','<P7>','<P8>'/,CONC(16)/'<PB>','<EX>','<SO>','<OB>','<CO>',
 8                  *'<SP>','<NC>','<SI>','<CX>','<MD>','<BA>','<VE>','<TI>','<PL>',
 9                  *'<AB>','<DO>'/,PHYE(8)/'<H1>','<H2>','<H3>','<H4>','<H5>','<H6>',
10                  *'<H7>','<H8>'/,CONE(16)/'<IE>','<CI>','<DI>','<GA>','<PX>','<AC>',
11                  *'<AT>','<ZE>','<TY>','<ON>','<LA>','<NT>','<GI>','<EA>','<OU>',
12                  *'<MI>'/,ALPHA(10)/'@E','@C','@D','@I','@G','@A','@B','@F','@J','@H
13                  *'/
14        3          INTEGER*2 ISTO(99)/99*0/,ISIM(10)/10*0/,IPHY(8)/8*0/,IEMO(16)/16*0
15                  */,IPRE(1)/'*'/
16        4          CALL FTNCMD ('ASSIGN 6=-FILE',14)
17             C---
18             C        READ TOTAL SETS OF QUESTIONNAIRE REQD
19             C---
20        5          WRITE (6,4)
21        6          READ (5,IPRE) NQUES
22        7          DO 2000 IABCD=1,NQUES
23             C---
24             C        GENERATE 1-16 AND 1-8 RANDOM NUMBERS
25             C---
26        8          CALL RANUM (NEMS,ISTO,0)
27        9          DO 10 IJ=1,NEMS
28       10          IEMO(IJ)=ISTO(IJ)
29       11          ISTO(IJ)=0
30       12    10    CONTINUE
31       13          CALL RANUM (NPHY,ISTO,0)
32       14          DO 20 IJ=1,NPHY
33       15          IPHY(IJ)=ISTO(IJ)
34       16          ISTO(IJ)=0
35       17    20    CONTINUE
36             C---
37             C        INITIALIZE INPUT FILES
38             C        TEXT:BRAX AND TEXT:INCLUDE ARE LIBRARIES
39             C        TKAB:STRING   STORES DICTIONARY OF KEY WORD CODES
40             C        TKAB:FRONT    CONTAINS THE FRONT PAGE OF QUESTIONNAIRE
41             C        TKAB:BACK1    CONTAINS BACKGROUND INFO PAGE 1
42             C        TKAB:BACK2    CONTAINS BACKGROUND INFO PAGE 2
43             C---
44       18          ID=0
45       19          IM=0
46       20          ICO=0
47       21    4     FORMAT (' <INLIB,TEXT:BRAX> <INLIB,TEXT:INCLUDE> <INCLUDE,TKAB:STR
48                  *ING> ')
49       22    30    ICO=ICO+1
50       23          INVA=0
51       24          WRITE (6,5)
52       25    5     FORMAT (' ¬<NEXT> <INCLUDE,TKAB:FRONT> ')
53       26          IM=IM+1
54       27          IMX=IM+1
55       28          JP=1
56             C---
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ATS    ISN
57            C         WRITE CODES FOR TWO PHYSICAL SCALES
58            C---
59       29         DO 40 IN=IM,IMX
60       30         CALL BANUM (NSC,ISTO,INVA)
61       31         DO 35 IJ=1,NSC
62       32         ISIM(IJ)=ISTO(IJ)
63       33         ISTO(IJ)=0
64       34    35   CONTINUE
65       35         ISTO(1)=ISIM(1)
66       36         INVA=1
67       37         JP=JP+1
68       38         WRITE (6,8) PHYS(IPHY(IN)),SIMS(ISIM(1)),PHYE(IPHY(IN)),SIMS(ISIM(
69                 *1))
70       39    8    FORMAT (' <LI,0>',A4,'"<U>',A4,'<NOTU>"',A4,'"<U>',A4,'<NOTU>".')
71       40         IF (JP.EQ.2) WRITE (6,1000)
72       41    1000 FORMAT (' <PIM-TYPE>')
73       42         IF (JP.EQ.3) WRITE (6,1001)
74       43    1001 FORMAT (' <SEC-TYPE>')
75       44         WRITE (6,1003) (ALPHA(ISIM(IP)),SIMS(ISIM(IP)),IP=1,NSC)
76       45    1003 FORMAT (' <LI,10><L,2>',A2,'.¬',A4,' <HUN><L>',8(A2,'.¬',A4,' <DOT
77                 *S><L>'),A2,'.¬',A4,' <DOTS>')
78       46         IF (JP.EQ.3) WRITE (6,7)
79       47         IF (JP.NE.3) WRITE (6,6)
80       48    7    FORMAT (' <NEXT> ¬ <NEXT> <INCLUDE,TKAB:BACK2> ')
81       49    6    FORMAT (' <L,2>')
82       50    40   CONTINUE
83       51    1    FORMAT (' <LI,0> ',A4,' "<U>',A4,'<NOTU>" ',A4,' "<U>',A4,'<NOTU>"
84                 *. <LI,10> <L,2>',A2,'.¬',A4,' <HUN> <L>',/,8(A2,'.¬',A4,1X,
85                 *'<DOTS><L> '),A2,'.¬',A4,1X,'<DOTS>')
86       52         IM=IMX
87       53         ID=ID+1
88       54         IDX=ID+3
89            C---
90            C         WRITE CODES FOR FOUR AFFECTIVE SCALES
91            C---
92       55         DO 50 IN=ID,IDX
93       56         CALL BANUM (NSC,ISTO,INVA)
94       57         DO 51 IJ=1,NSC
95       58         ISIM(IJ)=ISTO(IJ)
96       59         ISTO(IJ)=0
97       60    51   CONTINUE
98       61         ISTO(1)=ISIM(1)
99       62         JP=JP+1
100      63         WRITE (6,1) CONC(IEMO(IN)),SIMS(ISIM(1)),CONE(IEMO(IN)),SIMS(ISIM(
101                 *1)),(ALPHA(ISIM(IP)),SIMS(ISIM(IP)),IP=1,NSC)
102      64         IF (JP.EQ.6) WRITE (6,3)
103      65         IF (JP.NE.6) WRITE (6,6)
104      66    3    FORMAT (' <NEXT>')
105      67    50   CONTINUE
106      68         ID=IDX
107      69         CALL BANUM (NSC,ISTO,INVA)
108      70         DO 61 IJ=1,NSC
109      71         ISIM(IJ)=ISTO(IJ)
110      72         ISTO(IJ)=0
111      73    61   CONTINUE
112           C---
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 NTS     ISN
113            C         WRITE GENERAL IMPRESSION SCALE
114            C---
115        74        WRITE(6,2) SIMS(ISIM(1)),(ALPHA(ISIM(IP)),SIMS(ISIM(IP)),IP=1,NSC)
116        75   2    FORMAT ('        <LI,0> <L,1> <GEN> "<U>',A4,'<NOTU>" <IMP> ',
117                 *<LI,10> <L,2>',A2,'.¬',A4,' <HUN><L> ',/,8(A2,'.¬',A4,1X,
118                 *'<DOTS><L>',/),A2,'.¬',A4,1X,'<DOTS><NEXT> <INCLUDE,TKAR:BACK1>')
119            C---
120            C       REPEAT QUESTIONNAIRE TILL SET IS COMPLETE
121            C---
122        76        IF (ICO.NE.4) GO TO 30
123        77   2000 CONTINUE
124            C---
125            C       WHEN ALL KEY CODES ARE FINISHED LINK IT TO TEXTURE PROG
126            C---
127        78        CALL LINKF ('OBJE ',0,0)
128        79        STOP
129        80        END
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FORTRAN IV LISTING  RANUM      02:49 P.M.  JULY 12, 1979      PAGE 4
                     (FILE=BASIM)
 ATS     ISN
 130       1        SUBROUTINE RANUM (NVA,ISTO,INVA)
 131       2        INTEGER*2 ISTO(99)
 132            C--
 133            C        INITIALIZE RANDOM NUMBER GENERATOR AND SET LIMITS
 134            C--
 135       3        IRAND(D) = FRAND(D)*NVA + 1.0
 136       4        S = SCLOCK(0.0)
 137       5        Z = RAND(S)
 138       6        IK = INVA
 139       7   6    I = IRAND(0.0)
 140       8             DO 20 IKP=1,IK
 141       9             IF (ISTO(IKP) .EQ. I) GO TO 6
 142      10   20        CONTINUE
 143      11        IK = IK + 1
 144      12        ISTO(IK) = I
 145      13        IF (IK .LT. NVA) GO TO 6
 146      14        RETURN
 147      15        END

END OF FILE:  147 LINES

 MAIN      1  RANUM     4
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APPENDIX III INPUT TO TEXT-PROCESSOR

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LISTING OF -FRONT                                                    AT 12:57:22 ON JUL 11, 1975 FOR CC(1) = TRAP   PAGE    1

 1    <MIN-WS,1><MAX-WS,2>
 2    <LI,0>¬<L,3><AUTOCAP><SET-SENTENCE,.? >
 3    <CENTERED><U><UP> THINKING ABOUT ARCHITECTURE*: <L>
 4     HOW DO YOU DESCRIBE WHAT YOU SEE, HEAR, FEEL?<L,2>
 5    <NOTU><DOWN>
 6    <JUSTIFIED><AUTOCAP>
 7    <SET-SENTENCE> @HOW WOULD YOU DESCRIBE YOUR EXPERIENCE OF VISITING
 8     @GASLIGHT @SQUARE <AUTOCAP><SET-SENTENCE> IN @GASTOWN TO SOMEONE
 9     ELSE? @OF COURSE, THERE ARE MANY WAYS*: SOME WAYS ARE SIMPLER, OTHER WAYS ARE
10    LESS TIME CONSUMING. @SOME ARE BETTER FOR SOME ASPECTS BUT NOT SO GOOD
11    FOR DESCRIBING OTHER ASPECTS OF ARCHITECTURE.
12    <L,4>@TO FIND OUT WHICH WAYS OF DESCRIBING ARCHITECTURE WORK BEST FOR YOU,
13    YOU WILL EXAMINE 10 DIFFERENT METHODS
14     THAT ARCHITECTS COMMONLY USE TO DESCRIBE WHAT @GASLIGHT
15     @SQUARE IS REALLY LIKE.<L,4><U>
16    @BEFORE YOU BEGIN*: <NOTU>@LOOK AT THE BOARD AT THE 5 LINES. @YOU
17     MIGHT WANT SOME COMPARISONS ABOUT HOW <U>LONG <NOTU> THESE LINES ARE (SINCE
18    LENGTH MIGHT BE ONE ASPECT OF A  BUILDING).
19     @COMPARE LINES @A AND @B  FIRST. @IF YOU ARBITRARILY SAY LINE @A IS 100 POINTS
20     LONG, THEN HOW LONG DOES LINE @B APPEAR? .¬.¬. @ABOUT TWICE AS LONG? .¬.¬@THEN
21    THAT WOULD BE ABOUT 200 POINTS  @WRITE THAT DOWN IN THE PROPER SPACE BELOW.
22     @NOW COMPARE LINE @C WITH LINE @A, LINE @D WITH LINE @A AND LINE @E WITH LINE
23    @A. @WRITE DOWN THE NUMBERS IN ITS PROPER SPACE. <L,4> <LI,10>
24    <STRING,LEN,@LENGTH OF LINE><STRING,DOTS,*_*_*_*_*_>
25    <LEN> @A <STRING,HUN,*_"<U>'100"*_<NOTU>' > <HUN> ¬¬POINTS.<L><LEN> @B <DOTS>
26    POINTS.<L>
27    <LEN> @C <DOTS> POINTS.<L><LEN> @D <DOTS> POINTS.<L><LEN> @E <DOTS>     POINTS.
28    <LI,0><L,4> <U>@TO BEGIN<NOTU>*: @INSTEAD OF LENGTH, YOU WILL GIVE POINTS TO
28.5   OTHER ASPECTS WHICH RELATE TO <GAS>.
29     @TURN OVER TO THE NEXT PAGE AND READ THE DESCRIPTION FOR EACH <U>ASPECT
30      <NOTU>CAREFULLY. @THEN STUDY EACH OF THE 10 ARCHITECTURAL DISPLAYS AND DECIDE
31    HOW WELL <U> THE FIRST ONE <NOTU>COMPARES WITH EACH OF THE OTHERS IN TERMS OF
32    THAT PARTICULAR ASPECT. @THE FIRST ONE IS GIVEN  100 POINTS AS A STARTING POINT:
33      DECIDE HOW MUCH BETTER OR WORSE EACH DISPLAY CONVEYS THAT PARTICULAR
34    ASPECT OF THE ARCHITECTURE OF @GASLIGHT @SQUARE. @COMPARE ALL 10
35     DISPLAYS AND RECORD HOW YOU PERSONALLY FEEL ABOUT EACH OF THEM.<L,4>
36     @ANY DISPLAY ITEM  THAT YOU WILL SEE CLEARLY HAS _S_O_M_E DEGREE OF EACH
37    ASPECT,
38     HOWEVER SMALL. @SO _N_O ITEM CAN BE GIVEN ZERO POINTS OR NEGATIVE POINTS.
39    <NEXT>
40    @CONSIDER THE QUESTION OF <U><UP> TIME*: <NOTU> TIME  <DOWN>FOR THESE
41    DISPLAYS REFERS TO THE NUMBER OF "UNITS" REQUIRED TO PREPARE THEM IN ORDER TO
42     SHOW DETAILS ABOUT <GAS>. @IF THE "<U><C6><NOTU>" TOOK 100 ARBITRARY MAN-"UNITS"
43     OF TIME TO COMPLETE, THEN <MUC> TIME WOULD EACH OTHER ITEM TAKE? @ESTIMATE THE
44     APPROPRIATE NUMBER
45    OF  TIME *"UNITS*" COMPARED TO THE "<U><C6><NOTU>".
46    <L><LI,5><L>@A.¬<C6> <HUN> <MHS> @B.¬<C7> <DOTS><MHS>
47    @C.¬<C2> <DOTS><MHS> @D.¬<C3> <DOTS><MHS> @E.¬<C1> <DOTS><MHS>
48    @F.¬<C8> <DOTS><MHS> @G.¬<C5> <DOTS><MHS>
49    @H.¬<C0> <DOTS><MHS>@I.¬<C4> <DOTS><MHS>@J.¬<C9> <DOTS><MHS><L>
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<MAX-WS,2><LI,0><L>@NOW HERE ARE SOME QUESTIONS REGARDING YOUR PERSONAL
BACKGROUND WHICH HELP EXPLAIN WHY PEOPLE HAVE DIFFERENT IDEAS ABOUT
 ARCHITECTURE.<L>
<CENTERED> <U><UP> BACKGROUND INFORMATION <DOWN><AUTOCAP><SET-SENTENCE> <L,2>
<NOTU> <JUSTIFIED>
1.¬¬@WHAT IS THE HIGHEST LEVEL OF FORMAL <LI,4>EDUCATION YOU HAVE COMPLETED?
(CHECK ONE) <L>
<DOTS>@ELEMENTARY SCHOOL.<L><DOTS>@SECONDARY SCHOOL.<L><DOTS>@HIGH SCHOOL.<L>
<DOTS>@SOME COLLEGE OR UNIVERSITY.<L><DOTS>@COLLEGE OR UNIVERSITY COMPLETED.
<L> <DOTS>@SOME GRADUATE LEVEL WORK.<L> <DOTS>@MASTERS DEGREE COMPLETED.<L>
<DOTS>@DOCTORAL LEVEL DEGREE COMPLETED.<LI,0><L,2>
2.¬¬@PLEASE WRITE <LI,4>HOW YOU ARE PRIMARILY EMPLOYED AT PRESENT.
(E.¬G.¬¬@HOMEMAKER, @STUDENT, @CLERK, @MANAGER, @DOCTOR ETC.)<L,2>
<STRING,COL-LEFT,"<SUM,<LEFT>,5>"> <STRING,COL-RIGHT,"<DIFF,<RIGHT>,5>">
<H-LINE,<LINE>,<COL-LEFT>,<COL-RIGHT>,_>
 <LI,0><L,3> 3.¬¬@FOR HOW MANY <LI,4>YEARS HAVE YOU BEEN EMPLOYED IN THE
WORKFORCE? (EXCLUDE
 THOSE YEARS DURING WHICH YOU WERE PRIMARILY A STUDENT)<DOTS>YEARS.<LI,0>
<L,2>
4.¬¬@WHAT IS THE LEVEL OF YOUR PERSONAL <LI,4>INVOLVEMENT WITH BUILDING
 INDUSTRY? (@CHECK ALL THAT APPLY) <L>
<DOTS>@EVERY DAY USER OF BUILDINGS.
<L><DOTS>@WORK HERE, USE THIS BUILDING FOR BUSINESS
 REASONS.<L><DOTS>@OWN A LARGE BUILDING OR MANAGE LARGE BUILDING.<L>¬¬¬¬¬¬@WORK
 WITH BUILDINGS*:  <LI,10> @DO YOU <L><DOTS>@CONSTRUCT OR WORK ON BUILDING
SITES?<L><DOTS>@STUDY ARCHITECTURE?<L><DOTS>@WORK AS AN ARCHITECT?
 <L><DOTS>@OWN AN ARCHITECTURAL PRACTICE OR EQUIVALENT?
      <DOTS>@OTHER (PLEASE SPECIFY <DOTS><DOTS><DOTS><DOTS>)
<LI,0><L,2>5.¬¬@WHAT
 INVOLVEMENT <LI,4>DO YOU HAVE IN ARTISTIC PURSUITS (@FINE @ARTS)
 PAINTING, SCULPTURE,  PHOTOGRAPHY ETC.? (CHECK ONE) <L>
<DOTS>@NOT REALLY <LI,9>INTERESTED, MAY TAKE OCCASIONAL SNAP SHOTS.
          <LI,4><L><DOTS>@OFTEN
<LI,9>PAINT OR TAKE PHOTOGRAPHS BUT NO IN-DEPTH TRAINING IN FINE ARTS.<LI,4>
<L><DOTS>@PAINT, TAKE PHOTOS ACCORDING TO  ART PRINCIPLES.<L><DOTS>@STUDY
THE PRINCIPLES
 OF FINE ARTS.<L><DOTS>@TEACH AND*/ OR PRACTICE @FINE
@ARTS.<L>
     <DOTS>@OTHER (PLEASE SPECIFY <DOTS><DOTS><DOTS><DOTS>)
<NEXT>
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 1   <LI,0>6.¬¬@HOW MANY TIMES HAVE YOU  <LI,4>VISITED THIS PLAZA BEFORE
 2   TODAY? <DOTS>@TIMES.
 3  <L><LI,0><L>7.¬¬@THE FOLLOWING IS A LIST <LI,4> OF SHOPS IN @GASLIGHT
 4  @SQUARE. (@CHECK ALL
 5  THOSE SHOPS WHICH YOU HAVE VISITED TODAY, OR WILL PROBABLY VISIT
 6    BEFORE YOU LEAVE THE @SQUARE).
 7  <L><DOTS>@ALPHAOMEGA (@METAL ENGRAVING)<L>
 8  <DOTS>@THE @COLLECTION (@PICTURES AND PRINTS)<L>
 9  <DOTS>@DISCOVERY @LANE (@GIFTS)<L>
10  <DOTS>@CRAZY @SHIRTS (@T-SHIRTS)<L>
11  <DOTS>@BAROQUE @BUBL (@HANDCRAFTED TABLES)<L>
12  <DOTS>@LA @COQUETTE (@CLOTHING)<L>
13  <DOTS>@FIBBAS (@GIFTS, HANDBAGS)<L>
14  <DOTS>@PIZZA   @PATIO (@RESTAURANT)<L>
15  <DOTS>@SAMSON'S (@CUSTOM MADE CLOTHES)<L>
16  <DOTS>@SILVER @SANDS (@JEWELRY)<L>
17  <DOTS>@THRIFTY*'S (@JEANS, SHIRTS)<L>
18  <DOTS>@CLASSICAL @GLASS (@GLASS ORNAMENTS)<L>
19  <DOTS>@BEAU @JANGLES (@JEWELRY)<L>
20  <DOTS>@HIGH AS A @KITE (@KITES)<L>
21  <DOTS>@TWEED AND @THINGS (@WOVEN GARMENTS)<L>
22  <DOTS>@SHALE (@JEWELRY)<L>
23  <DOTS>@COTTAGE @DELI (@RESTAURANT)<L>
24  <DOTS>@TANGS @ART @GALLERY (@OIL PAINTINGS)<L>
25  <DOTS>@SHAMASH @CREATIONS (@LADIES GARMENTS)<L>
26  <DOTS>@LE @FLIRT (@HAIR DRESSERS)<L>
27  <DOTS>@TROPICANA (@PHILIPPINO GIFTS)<L>
28  <DOTS>@CLOGS BY @INGRID (@CLOGS, SHOES)<L>
29  <DOTS>@MAYART @IMPORTS (@SOUTH @AMERICAN IMPORTS)
30  <LI,0><L,4> @THANK YOU FOR YOUR TIME, YOUR EFFORT AND FOR SHARING YOUR OPINIONS.
31    @IN THE SPACE REMAINING YOU MAY WANT TO SUGGEST WORDS OR IDEAS
32  THAT YOU THINK ARE GOOD DESCRIPTIONS OF THE BUILDINGS OR OF THE
33  VARIOUS ARCHITECTURAL DISPLAYS.
34  <NEXT>
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<MIN-WS,1><MAX-WS,2>
<DEFINITION-SPACE-SIZE,60>
<STRING,DOTS,*_*_*_*_*_>
<STRING,HUN,*_"<U>'100"<NOTU>'*_ >
<SET-LIT,*>
<NOTUND,"1 ,:;?.'>
<STRING,HOW,"<UP>'HOW WELL "<DOWN>' >
<STRING,MUC,"<UP>'HOW MUCH "<DOWN>' MORE OR LESS >
<STRING,GAS,@GASLIGHT @SQUARE>
<STRING,C1,@SPACE RELATION DIAGRAM>
<STRING,C2,@VERBAL DESCRIPTION>
<STRING,C3,@PLAN ¢A¢N¢D @SECTION>
<STRING,C4,@SKETCH DRAWING>
<STRING,C6,@PERSPECTIVE DRAWING>
<STRING,C5,@ISOMETRIC DRAWING>
<STRING,C7,@BLACK ¢A¢N¢D WHITE PHOTOGRAPH>
<STRING,C8,@COLOUR SLIDE>
<STRING,C9,@ARCHITECTURAL MODEL>
<STRING,C0,@ACTUAL BUILDING>
<STRING,SEC-TYPE,*(@AGAIN*, THE ORDER IS DIFFERENT*.*) >
<STRING,FIR-TYPE,*(@NOTE THAT THE ORDER IS DIFFERENT*.*) >
<STRING,HHS,MAN-*"UNITS*" OF TIME. "<L>'>
<SET-ARGSEP,=>
<STRING=P1=@CONSIDER THE IMPRESSION OF "<UP>'"<U>' FORM*: "<NOTU>'"<DOWN>'
@THE FORM OF A BUILDING IS THE SPECIFIC
 ARRANGEMENT OF FEATURES LIKE WALLS*, RAILINGS*, SKYLIGHTS*, COLUMNS*,
DOORS ETC*.  ¢WHICH  GIVES "<GAS>'  ITS UNIQUE APPEARANCE*. @IF THE >
<STRING=H1= IS GIVEN 100 POINTS FOR CONVEYING EFFECTIVELY THIS IMPRESSION OF
 FORM OF THE @SQUARE*, THEN "<MUC>' EFFECTIVELY  IS FORM OF THE SQUARE
 CONVEYED BY THE REMAINING ITEMS*?
  @GIVE THE RIGHT NUMBER OF POINTS TO EACH ONE COMPARED TO THE >
<STRING=P2=@CONSIDER THE IDEA OF "<U>'"<UP>' FIGURE*: "<DOWN>'"<NOTU>' @THE
  @F@I@G@U@R@E OF "<GAS>' IS IMPACT
 OF BOUNDARY LINES*, VERTICAL*, HORIZONTAL AND SLOPING SURFACES
 OF WALLS, FLOORS, WINDOWS ETC*. @IF THE >
<STRING=H2= IS GIVEN 100 POINTS FOR SHOWING CORRECTLY THE IDEA OF
 @F@I@G@U@R@E OF "<GAS>', THEN "<MUC>'
 CORRECTLY IS @F@I@G@U@R@E OF THE @SQUARE SHOWN BY THE REMAINING
 ITEMS?  @GIVE THE RIGHT NUMBER OF POINTS TO EACH ONE COMPARED TO THE >
<STRING=P3=@THINK ABOUT THE ASPECT OF "<U>'"<UP>' SHADE AND SHADOW*: "<DOWN>'
"<NOTU>' @SHADE AND SHADOW
REFER TO CONTRASTS OF DARK OR LIGHT ON THE SURFACES PRESENT*. @IF THE >
<STRING=H3= IS ALLOTTED 100 POINTS FOR DESCRIBING THE CONTRAST BETWEEN THE
BRIGHTEST LIGHT AND THE DARKEST DARK* OF "<GAS>', THEN "<MUC>' IS THE CONTRAST
BETWEEN THE BRIGHTEST LIGHT AND THE DARKEST DARK  OF THE @SQUARE DESCRIBED BY
 THE  REMAINING ITEMS*? @ALLOT THE  NUMBER OF POINTS TO EACH
     ONE COMPARED TO THE >
<STRING=P4=@CONSIDER THE IMPRESSION OF "<U>'"<UP>' TEXTURE*: "<DOWN>'"<NOTU>'
@TEXTURE IS COARSENESS OR GRAININESS
 OF SURFACES *(WALLS*, FLOORS*, CEILINGS*, ROOF*)*. @IF THE >
<STRING=H4= IS ASSIGNED 100 POINTS FOR CONVEYING A PRECISE @TEXTURAL IMPRESSION
 OF "<GAS>', THEN
 "<MUC>' EFFECTIVELY IS THE IMPRESSION OF TEXTURE OF THE @SQUARE CONVEYED BY THE
 OTHER ITEMS*? @GIVE THE RIGHT NUMBER OF POINTS TO EACH ONE COMPARED TO THE >
<STRING=P5=@CONSIDER THE IMPRESSION OF "<UP>'"<U>' COLOUR *(PHYSICAL*)*:"<NOTU>'
"<DOWN>' @COLOURS ARE FEATURES OF WALLS*,
 FLOORS*, AND OTHER PARTS OF BUILDINGS*. @IF THE >
<STRING=H5= IS GIVEN 100 POINTS FOR CONVEYING A DETAILED AND CORRECT IMPRESSION
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 59     OF THE COLOURS OF "<GAS>', THEN "<MUC>' DETAILED AND CORRECT AN IMPRESSION OF
 60     COLOUR OF THE @SQUARE IS CONVEYED BY THE REMAINING ITEMS*? @GIVE THE RIGHT
 61      NUMBERS OF POINTS TO EACH ONE COMPARED TO THE >
 62     <STRING=P6=@CONSIDER THE SENSE OF "<UP>'"<U>' SCALE AND PROPORTION*: "<DOWN>'
 63     "<NOTU>' @SCALE
 64     AND PROPORTION RELATE TO SIZES OF WALLS*, FLOORS*, CEILINGS ETC*. @IF THE >
 65     <STRING=M6= IS ALLOTTED 100 POINTS FOR SHOWING THE CORRECT  PROPORTIONALITY
 66     AMONG WALLS, FLOORS ETC*. IN "<GAS>', THEN "<MUC>' CORRECTLY AND IN SCALE ARE
 67     THESE THINGS SHOWN BY THE OTHER DISPLAYS*?
 68     @ALLOT THE PROPER NUMBER OF POINTS TO EACH ONE COMPARED TO THE >
 69     <STRING=P7=@CONSIDER THE ASPECT OF "<UP>'"<U>' VOLUME*: "<NOTU>'"<DOWN>' @VOLUME
 70     IS THE COMBINATION OF HEIGHT*, LENGTH AND WIDTH OF THE
 71     BUILDING*. @NOW, IF THE >
 72     <STRING=M7= IS GIVEN 100 POINTS FOR SHOWING CORRECTLY THE ASPECT OF  PHYSICAL
 73     VOLUME OF "<GAS>', THEN
 74      "<MUC>' CORRECTLY IS  PHYSICAL VOLUME OF THE @SQUARE SHOWN BY THE
 75      OTHER DISPLAYS*? @GIVE THE RIGHT NUMBER OF POINTS TO EACH ONE COMPARED TO THE >
 76     <STRING=P8=@CONSIDER THE ASPECT OF "<U>'"<UP>'LENGTH*: "<DOWN>'"<NOTU>' @LENGTH
 77     IS THE PHYSICAL DISTANCE BETWEEN TWO GIVEN POINTS*. @IF THE >
 78     <STRING=M8= IS ASSIGNED 100 POINTS FOR SHOWING CORRECTLY DISTANCE BETWEEN POINT
 79      @A AND @B, THEN "<MUC>' CORRECTLY IS THE SAME DISTANCE SHOWN BY THE OTHER
 80       ITEMS*? @ASSIGN RIGHT NUMERICAL SCORE TO EACH ONE COMPARED TO THE >
 81     <STRING=PR=@THINK ABOUT THE NOTION OF "<U>'"<UP>'FRIENDLINESS*: "<DOWN>'"<NOTU>'
 82      @OBJECTS THAT ARE
 83      BEAUTIFUL*, APPEALING*, ATTRACTIVE AND WELCOMING ARE FRIENDLY*. @NOW IF THE >
 84     <STRING=IE=IS GIVEN 100 POINTS FOR EFFECTIVELY INDICATING
 85      FRIENDLINESS OF  "<GAS>', THEN "<MUC>' EFFECTIVELY IS
 86       THE NOTION OF FRIENDLINESS OF THE @SQUARE INDICATED BY THE OTHER ITEMS*?
 87      @GIVE THE PROPER NUMBER OF POINTS TO EACH ONE COMPARED TO THE >
 88     <STRING=EX=@THINK ABOUT THE FEELING OF "<UP>'"<U>' EXCITEMENT*: "<DOWN>'
 89     "<NOTU>' @EXCITEMENT IS  THE UNIQUE*,
 90     INTERESTING*, EXPRESSIVE AND DYNAMIC CHARACTER OF A THING*. @SO IF THE >
 91     <STRING=CI=IS GIVEN 100 POINTS FOR CONVEYING EFFECTIVELY THE FEELING OF
 92     EXCITEMENT IN "<GAS>', THEN "<MUC>' EFFECTIVELY  IS
 93      EXCITEMENT OF THE @SQUARE CONVEYED TO YOU BY EACH OTHER DISPLAY*? @GIVE
 94      THE PROPER NUMBER OF POINTS TO EACH DISPLAY COMPARED TO THE >
 95     <STRING=SO=@CONSIDER THE IMPRESSION OF "<UP>'"<U>'SOLIDITY*: "<DOWN>'"<NOTU>'
 96     @SOLIDITY MEANS MASSIVENESS*, HEAVINESS AND STRENGTH OF FEATURES. @IF THE >
 97     <STRING=DI=IS ASSIGNED 100 POINTS FOR DISPLAYING THE AMOUNT OF SOLIDITY OF
 98      "<GAS>', THEN @W@H@A@T @A@M@O@U@N@T OF SOLIDITY OF THE @SQUARE IS
 99      DISPLAYED BY EACH ITEM*? @ASSIGN THE PROPER NUMBER
100     OF POINTS TO EACH DISPLAY COMPARED TO THE >
101     <STRING=OR=@CONSIDER THE ASPECT OF "<U>'"<UP>'ORGANISATION*: "<NOTU>'"<DOWN>'
102     @ORGANISATION IS THE ORDER*, CO-ORDINATION*, COHERENCE AND EFFICIENCY AMONG
103      THE PARTS OF "<GAS>'.  @NOW IF THE >
104     <STRING=GA= IS ALLOTTED 100 POINTS FOR SHOWING EFFECTIVELY THE ASPECT OF
105     ORGANISATION OF THE @SQUARE, THEN "<MUC>' EFFECTIVELY IS THIS ASPECT OF THE
106      SQUARE SHOWN BY OTHER ITEMS? @ALLOT THE PROPER NUMBER
107      OF POINTS TO EACH DISPLAY RELATIVE TO THE >
108     <STRING=CO=@CONSIDER THE IDEA OF "<UP>'"<U>'COMPLEXITY*: "<DOWN>'"<NOTU>'
109     @A COMPLEX OBJECT SEEMS COMPLICATED*, VARIED*, INTRICATE*, AND DIVERSIFIED
110     IN CHARACTER*.  @NOW, IF >
111     <STRING=PX=IS GIVEN 100 POINTS FOR DESCRIBING THE DEGREE OF COMPLEXITY IN
112     "<GAS>', THEN @W@H@A@T @D@E@G@R@E@E OF COMPLEXITY IN THE @SQUARE IS DESCRIBED
113     BY EACH OTHER DISPLAY*?
114      @GIVE THE  PROPER NUMBER OF POINTS TO EACH DISPLAY COMPARED TO THE >
115     <STRING=MD=@CONSIDER THE ASPECT OF "<U>'"<UP>'MODERNITY*: "<NOTU>'"<DOWN>'
116     @MODERN THINGS ARE
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 117      FASHIONABLE*, NOVEL*,  UP*-TO*-DATE AND CONTEMPORARY*. @IF THE >
 118     <STRING=ON=IS ASSIGNED 100 POINTS FOR EFFECTIVELY DISPLAYING MODERNITY OF
 119      "<GAS>', THEN "<MUC>' EFFECTIVELY IS MODERNITY OF THE SQUARE DISPLAYED BY
 120      EACH OTHER DISPLAY? @ASSIGN THE RIGHT
 121      NUMBER OF POINTS TO EACH DISPLAY COMPARED TO THE >
 122     <STRING=BA=@CONSIDER THE SENSE OF "<U>'"<UP>'BALANCE*: "<DOWN>'"<NOTU>'
 123     @FEATURES ARE IN BALANCE IF THEY ARE HARMONIOUS*, SHOW PROPORTIONALITY AND
 124      EQUALITY OF CONTRASTS AND SYMMETRY*. @SO IF THE >
 125     <STRING=LA= IS GIVEN 100 POINTS FOR CONVEYING EFFECTIVELY THE SENSE OF BALANCE
 126     IN "<GAS>', THEN "<MUC>' EFFECTIVELY IS THIS SENSE OF THE @SQUARE CONVEYED  BY
 127      OTHER DISPLAYS*? @GIVE THE PROPER NUMBER OF
 128     POINTS TO  EACH DISPLAY COMPARED TO THE >
 129     <STRING=VE=@THINK ABOUT THE ASPECT OF "<U>'"<UP>'VENTILATION*: "<DOWN>'"<NOTU>'
 130     @A THING THAT IS
 131     VENTILATED SEEMS TO BE  FRESH*, AIRY AND OPEN IN CHARACTER*. @SO IF THE >
 132     <STRING=NT=IS ASSIGNED 100 POINTS FOR DESCRIBING EFFECTIVELY THE ASPECT OF
 133      VENTILATION OF THE "<GAS>', THEN "<MUC>' EFFECTIVELY IS THIS
 134      ASPECT OF THE @SQUARE  DESCRIBED BY THE OTHER DISPLAYS*?
 135      @ASSIGN THE PROPER NUMBER OF POINTS TO EACH DISPLAY COMPARED TO THE >
 136     <STRING=CX=@THINK ABOUT THE FEELING OF "<UP>'"<U>' COLOURFULNESS*: "<NOTU>'
 137     "<DOWN>' @COLOURFUL THINGS ARE VIVID*, BRIGHT, LAVISH AND RICH IN OUTLOOK*.
 138     @IF THE >
 139     <STRING=TY=IS ALLOTTED 100 POINTS FOR EFFECTIVELY EXPRESSING COLOURFULNESS OF
 140      "<GAS>', THEN "<MUC>' EFFECTIVELY IS COLOURFULNESS OF THE @SQUARE  EXPRESSED BY
 141      EACH OF THE OTHERS? @ALLOT THE RIGHT
 142      NUMBER OF POINTS TO EACH ITEM RELATIVE TO THE >
 143     <STRING=SP=@CONSIDER THE ASPECT OF "<U>'"<UP>' SPACIOUSNESS*: "<NOTU>'"<DOWN>'
 144     @SPACIOUS OBJECTS SEEM TO BE ROOMY*, WIDE AND FREE IN CHARACTER*. @IF THE >
 145     <STRING=AC=IS ASSIGNED 100 UNITS FOR DESCRIBING EFFECTIVELY THE ASPECT OF
 146      SPACIOUSNESS IN "<GAS>', THEN "<MUC>' EFFECTIVELY IS SPACIOUSNESS OF THE
 147      @SQUARE DESCRIBED BY THE REMAINING DISPLAYS*? @ASSIGN
 148      THE PROPER NUMBER OF POINTS TO EACH DISPLAY RELATIVE TO THE >
 149     <STRING=NC=@CONSIDER THE ASPECT OF "<UP>'"<U>'CLEANLINESS*:"<NOTU>'"<DOWN>'
 150     @CLEAN THINGS ARE WELL KEPT*, WELL MAINTAINED AND NEAT IN CHARACTER*.  @SO IF
 151     THE >
 152     <STRING=AT=IS GIVEN 100 POINTS FOR SHOWING EFFECTIVELY THE ASPECT OF CLEANLINESS
 153      OF "<GAS>', THEN "<MUC>' EFFECTIVELY IS THIS ASPECT OF THE @SQUARE
 154      SHOWN BY OTHER DISPLAYS*. @GIVE THE
 155      PROPER NUMBER OF POINTS TO OTHER NINE COMPARED TO THE >
 156     <STRING=SI=@THINK ABOUT THE SENSE OF "<U>'"<UP>' SIZE*: "<DOWN>'"<NOTU>' @SIZE
 157      IS THE PHYSICAL LARGENESS, BROADNESS AND BIGNESS
 158     EXPRESSED BY THE OBJECT*. @SO IF THE >
 159     <STRING=ZE=IS GIVEN 100 POINTS FOR DESCRIBING CORRECTLY THE SENSE OF SIZE OF
 160      "<GAS>', THEN "<MUC>' CORRECTLY IS SIZE OF THE @SQUARE DESCRIBED
 161      IN OTHER NINE? @GIVE THE
 162      PROPER NUMBER OF POINTS TO EACH DISPLAY COMPARED TO THE >
 163     <STRING=YI=@CONSIDER THE SENSE OF "<U>'"<UP>'RIGIDITY*: "<DOWN>'"<NOTU>' @RIGID
 164     OBJECTS ARE FIXED*, STIFF AND IMMOBILE IN CHARACTER*. @IF THE >
 165     <STRING=GI=IS ALLOTTED 100 POINTS FOR DESCRIBING EFFECTIVELY THE SENSE OF
 166      RIGIDITY OF "<GAS>', THEN "<MUC>' EFFECTIVELY IS RIGIDITY OF THE
 167      @SQUARE  DESCRIBED BY EACH OF THE REMAINING DISPLAYS*?
 168      @ALLOT THE PROPER NUMBER OF  POINTS FOR EACH ITEM COMPARED TO THE >
 169     <STRING=PL=@CONSIDER THE FEELING OF "<U>'"<UP>' PLEASANTNESS*: "<DOWN>'"<NOTU>'
 170     @FEATURES WHICH
 171     APPEAR CHEERFUL*, HAPPY AND CONGENIAL ARE CALLED PLEASANT*. @NOW IF THE >
 172     <STRING=EA=IS GIVEN 100 POINTS FOR EFFECTIVELY CONVEYING PLEASANTNESS
 173      IN THE @SQUARE, THEN "<MUC>' EFFECTIVELY  IS THE
 174      FEELING OF PLEASANTNESS IN "<GAS>' CONVEYED BY THE OTHER DISPLAYS*?
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 175     @GIVE THE POINTS TO EACH DISPLAY RELATIVE TO THE >
 176    <STRING=AR=@THINK ABOUT THE "<U>'"<UP>'AROUSING "<DOWN>'"<NOTU>' ASPECT*:
 177    @AROUSING FEATURES ARE STIMULATING*, AGITATING AND ACTIVATING IN CHARACTER*.
 178    @IF THE >
 179    <STRING=OU=IS ASSIGNED 100 POINTS FOR CONVEYING THE DEGREE OF AROUSING ASPECTS
 180     OF "<GAS>',
 181     THEN @W@H@A@T @D@E@G@R@E@E OF AROUSING ASPECTS OF THE @SQUARE IS CONVEYED BY
 182     EACH OTHER DISPLAY*? @ASSIGN THE PROPER NUMBER OF POINTS TO EACH DISPLAY
 183     COMPARED TO THE >
 184    <STRING=DO=@THINK ABOUT THE SENSE OF "<UP>'"<U>' DOMINANCE*: "<DOWN>'"<NOTU>'
 185    @DOMINATING FEATURES SEEMS
 186     CONTROLLING*, IMPOSING, INFLUENTIAL AND IMPORTANT IN CHARACTER*. @IF THE >
 187    <STRING=MI=IS GIVEN 100 POINTS FOR DESCRIBING EFFECTIVELY THE SENSE DOMINANCE OF
 188     "<GAS>', THEN "<RUC>' EFFECTIVELY IS THIS SENSE OF THE @SQUARE  DESCRIBED BY
 189     THE  OTHER DISPLAYS*?
 190     @GIVE THE PROPER NUMBER OF POINTS TO EACH DISPLAY RELATIVE TO THE >
 191    <STRING=GEN="<UP>'"<U>'GENERAL IMPRESSION*: "<DOWN>'"<NOTU>' @ALL THINGS
 192    CONSIDERED *(AND
 193    INCLUDING THINGS THAT ARE IMPORTANT TO YOU PERSONALLY*), WHAT IS YOUR OVERALL
 194    ASSESSMENT OF EACH OF THESE DISPLAYS IF THE >
 195    <STRING=IMP= IS ASSIGNED 100 POINTS FOR DESCRIBING AN OVERALL IMPRESSION OF
 196    "<GAS>'*? >
 197    <SET-ARGSEP=,>
 198    <DELETE-LAYOUT,STANDARD-LAYOUT>
 199    <PAGE-DEPTH,61>
 200    <BLOCK,STANDARD-LEFT,1,60,1,61>
 201    <BLOCK,STANDARD-RIGHT,70,130,1,61>
 202    <LAYOUT,LEFT-RIGHT,STANDARD-LEFT,STANDARD-RIGHT>
 203    <INVOKE,LEFT-RIGHT>
 204    <NOSTATISTICS>
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APPENDIX IV COPY OF A SAMPLE QUESTIONNAIRE

THINKING ABOUT ARCHITECTURE: HOW DO YOU DESCRIBE WHAT YOU SEE, HEAR, FEEL?

How would you describe your experience of visiting Gaslight Square in Gastown to someone else? Of course, there are many ways: some ways are simpler, other ways are less time consuming. Some are better for some aspects but not so good for describing other aspects of architecture.

To find out which ways of describing architecture work best for you, you will examine 10 different methods that architects commonly use to describe what Gaslight Square is really like.

Before you begin: Look at the board at the 5 lines. You might want some comparisons about how long these lines are (since length might be one aspect of a building). Compare lines A and B first. If you arbitrarily say line A is 100 points long, then how long does line B appear? . . . About twice as long? . . Then that would be about 200 points! Write that down in the proper space below. Now compare line C with line A, line D with line A and line E with line A. Write down the numbers in its proper space.

Length of line A 100 points.
Length of line B _____ points.
Length of line C _____ points.
Length of line D _____ points.
Length of line E _____ points.

To begin: Instead of length, you will give points to other aspects which relate to Gaslight Square. Turn over to the next page and read the description for each aspect carefully. Then study each of the 10 architectural displays and decide how well the first one compares with each of the others in terms of that particular aspect. The first one is given 100 points as a starting point; decide how much better or worse each display conveys that particular aspect of the architecture of Gaslight Square. Compare all 10 displays and record how you personally feel about each of them.

Any display item that you will see clearly has some degree of each aspect, however small. So no item can be given zero points or negative points.

Consider the question of TIME: TIME for these displays refers to the number of "units" required to prepare them in order to show details about Gaslight Square. If the "Perspective drawing" took 100 arbitrary man-"units" of time to complete, then HOW MUCH more or less time would each other item take? Estimate the appropriate number of time "units" compared to the "Perspective drawing".

A. Perspective drawing 100 man-"units" of time.
B. Black and white photograph _____man-"units" of time.
C. Verbal description _____man-"units" of time.
D. Plan and Section _____man-"units" of time.
E. Space relation diagram _____man-"units" of time.
F. Cclour slide _____man-"units" of time.
G. Isometric drawing _____man-"units" of time.
H. Actual building _____man-"units" of time.
I. Sketch drawing _____man-"units" of time.
J. Architectural model _____man-"units" of time.

Consider the aspect of VOLUME: Volume is the combination of height, length and width of the building. Now, if the "Perspective drawing" is given 100 points for showing correctly the aspect of physical volume of Gaslight Square, then HOW MUCH more or less correctly is physical volume of the Square shown by the other displays? Give the right number of points to each one compared to the "Perspective drawing". (Note that the order is different.)

A. Perspective drawing 100
G. Isometric drawing _____
I. Sketch drawing _____
H. Actual building _____
C. Verbal description _____
D. Plan and Section _____
B. Black and white photograph _____
F. Colour slide _____
E. Space relation diagram _____
J. Architectural model _____

Consider the sense of SCALE AND PROPORTION: Scale and proportion relate to sizes of walls, floors, ceilings etc. If the "Perspective drawing" is allotted 100 points for showing the correct proportionality among walls, floors etc. in Gaslight Square, then HOW MUCH more or less correctly and in scale are these things shown by the other displays? Allot the proper number of points to each one compared to the "Perspective drawing". (Again, the order is different.)

A. Perspective drawing 100
C. Verbal description _____
F. Colour slide _____
D. Plan and Section _____
B. Black and white photograph _____
I. Sketch drawing _____
G. Isometric drawing _____
E. Space relation diagram _____
H. Actual building _____
J. Architectural model _____

Think about the notion of FRIENDLINESS: Objects that are beautiful, appealing, attractive and welcoming are friendly. Now if the "Perspective drawing" is given 100 points for effectively indicating friendliness of Gaslight Square, then HOW MUCH more or less effectively is the notion of friendliness of the Square indicated by the other items? Give the proper number of points to each one compared to the "Perspective drawing".

A. Perspective drawing 100
F. Colour slide _____
E. Space relation diagram _____
C. Verbal description _____
I. Sketch drawing _____
G. Isometric drawing _____
B. Black and white photograph _____
D. Plan and Section _____
H. Actual building _____
J. Architectural model _____

Think about the AROUSING aspect: Arousing features are stimulating, agitating and activating in character. If the "Perspective drawing" is assigned 100 points for conveying the degree of arousing aspects of Gaslight Square, then WHAT DEGREE of arousing aspects of the Square is conveyed by each other display? Assign the proper number of points to each display compared to the "Perspective drawing".

A. Perspective drawing 100
G. Isometric drawing _____
C. Verbal description _____
D. Plan and Section _____
E. Space relation diagram _____
B. Black and white photograph _____
I. Sketch drawing _____
F. Colour slide _____
H. Actual building _____
J. Architectural model _____

Consider the impression of SOLIDITY: Solidity means massiveness, heaviness and strength of features. If the "Perspective drawing" is assigned 100 points for displaying the amount of solidity of Gaslight Square, then WHAT AMOUNT of solidity of the Square is displayed by each item? Assign the proper number of points to each display compared to the "Perspective drawing".

A. Perspective drawing 100
C. Verbal description _____
B. Black and white photograph _____
I. Sketch drawing _____
J. Architectural model _____
H. Actual building _____
F. Colour slide _____
E. Space relation diagram _____
D. Plan and Section _____
G. Isometric drawing _____

Consider the aspect of SPACIOUSNESS: Spacious objects seem to be roomy, wide and free in character. If the "Perspective drawing" is assigned 100 units for describing effectively the aspect of spaciousness in Gaslight Square, then HOW MUCH more or less effectively is spaciousness of the Square described by the remaining displays? Assign the proper number of points to each display relative to the "Perspective drawing".

A. Perspective drawing 100
J. Architectural model _____
D. Plan and Section _____
F. Colour slide _____
H. Actual building _____
C. Verbal description _____
B. Black and white photograph _____
G. Isometric drawing _____
E. Space relation diagram _____
I. Sketch drawing _____

GENERAL IMPRESSION: All things considered (and including things that are important to you personally), what is your overall assessment of each of these displays if the "Perspective drawing" is assigned 100 points for describing an overall impression of Gaslight Square?

A. Perspective drawing 100
I. Sketch drawing _____
B. Black and white photograph _____
F. Colour slide _____
J. Architectural model _____
G. Isometric drawing _____
C. Verbal description _____
H. Actual building _____
D. Plan and Section _____
E. Space relation diagram _____

Now here are some questions regarding your personal background which help explain why people have different ideas about architecture.

BACKGROUND INFORMATION

1. What is the highest level of formal education you have completed? (check one)
_____Elementary school.
_____Secondary school.
_____High school.
_____Some college or university.
_____College or university completed.
_____Some graduate level work.
_____Masters degree completed.
_____Doctoral level degree completed.

2. Please write how you are primarily employed at present. (e. g. Homemaker, Student, Clerk, Manager, Doctor etc.)

_____

3. For how many years have you been employed in the workforce? (exclude those years during which you were primarily a student)_____years.

4. What is the level of your personal involvement with building industry? (Check all that apply)
_____Every day user of buildings.
_____Work here, use this building for business reasons.
_____Own a large building or manage large building.
Work with buildings: Do you
_____Construct or work on building sites?
_____Study architecture?
_____Work as an architect?
_____Own an architectural practice or equivalent?
_____Other (please specify _____)

5. What involvement do you have in artistic pursuits (Fine Arts) painting, sculpture, photography etc.? (check one)
_____Not really interested, may take occasional snap shots.
_____Often paint or take photographs but no in-depth training in fine arts.
_____Paint, take photos according to art principles.
_____Study the principles of fine arts.
_____Teach and/ or practice Fine Arts.
_____Other (please specify _____)

6. How many times have you visited this plaza before today?
_____Times.

7. The following is a list of shops in Gaslight Square. (Check all those shops which you have visited today, or will probably visit before you leave the Square).
_____Alphaomega (Metal engraving)
_____The Collection (Pictures and prints)
_____Discovery Lane (Gifts)
_____Crazy Shirts (T-shirts)
_____Baroque Burl (Handcrafted tables)
_____La Coquette (Clothing)
_____Fitlas (Gifts, handbags)
_____Pizza Patio (Restaurant)
_____Samson's (Custom made clothes)
_____Silver Sands (Jewelry)
_____Trifty's (Jeans, shirts)
_____Classical Glass (Glass ornaments)
_____Beau Jangles (Jewelry)
_____High as a Kite (Kites)
_____Tweed and Things (Woven garments)
_____Shale (Jewelry)
_____Cottage Deli (Restaurant)
_____Tangs Art Gallery (Oil paintings)
_____Shamash Creations (Ladies garments)
_____Le Flirt (Hair dressers)
_____Tropicana (Philippino gifts)
_____Clogs by Ingrid (Clogs, shoes)
_____Wayart Imports (South American imports)

Thank you for your time, your effort and for sharing your opinions. In the space remaining you may want to suggest words or ideas that you think are good descriptions of the buildings or of the various architectural displays.