

SOME OBSERVATIONS ON DESIGNER
BEHAVIOR IN THE PARTI

by

Adel Tewfik-Khalil Foz

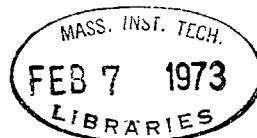
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Abstract

This study is divided into three major sections:

The first part traces the origin and development of my interest in designer behavior as a problem solving activity. It also describes how I hoped to study the subject experimentally.

The second part begins with a description of what designers do in the parti stage of architectural design. Then it describes two typical architectural models of designer behavior. Their limitations as design aids are discussed and point to ignorance of thought mechanisms as a fundamental difficulty. Two psychological models of human problem solving are presented and lead to a set of hypotheses about what skilled designers do that less able or experienced ones do not.

The third part describes the experimental method used to test these hypotheses. Their results are related and discussed in terms of their impact on these propositions and models introduced in the second part of this study. I then suggest some consequences of this discussion for the teaching and practice of architectural design. The study concludes with a brief look at areas of designer behavior in which further research would be useful.

The basic conclusions of this study are that skilled designers not only have more resources at their command, but that they use them with greater adaptation to the limitations of the human mental apparatus than their less able/experienced colleagues. They also make much greater use of three dimensional representational media.

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Introduction

Students are taught to design or improve their skill in designing buildings by apprenticeship, theoretical learning, or hopefully a combination. To be sure, one does most things - for instance, design buildings or play tennis - without considering their details explicitly. Problems of movement, organization, or poetic invention can be solved quite successfully without recourse to formal precision. However, the moment one self-consciously attempts to improve performance or communicate understanding of a process, the classification of phenomena must be made unequivocal and the meaning of organizing concepts independent of any personal situation. I have not found these conditions to be as fully met in architecture as in chemistry. How can one reconcile the views of Michelangelo, Corbusier, Wright, Venturi?

I believe the intellectual disarray of architectural thought is neither necessary nor accidental. I believe it would be immensely helpful for both the student and practitioner to have access to a shared set of principles about how people use and experience buildings and how they are designed. The confusion of approaches I have observed reflects the state of a field which is, in Kuhn's terms¹, in a pre-paradigmatic stage: an area of knowledge without shared views of its concerns, common models of action and judgement, or a baseline from which explorations can be evaluated. There is no experimental way to distinguish between the views of, for example, Venturi and Corbusier. Each

presents a competing alternative about the fundamental nature of the field. Each architect can, and I suspect has to, view himself as being on the frontier of knowledge in order to make sense of his efforts; but in a collective sense, all architects are adrift in a sea of suppositions and unverifiable opinion. In my view, architects share so few assumptions, they can hardly be said to belong to the same universe of discourse, much less engage in rational debate.

The difficulty of having every architect's conception of his field be a metatheory, a basic paradigm which all later efforts should build on, is and has been endemic since Western architectural practice became, in Alexander's term², self-conscious. Without a common body of architectural theory, designers cannot benefit from the experience and insight of others except by direct personal apprenticeship. While self-conscious, explicit, and often admirably articulated, the architectural knowledge of individuals has little impact beyond their immediate sphere of acquaintance. I believe we could raise the level of architectural performance if our ways of thinking about it allowed designers to share a universe of discourse in which knowledge could be systematically verified and expanded. The difficulty, of course, is to find something all architects will perceive in the same way as to both content and significance. If Kuhn is as right about the origin and function of intellectual paradigms³ as I think he is, nothing less than experiments (about how people use the environment or go about designing it) verifiable in Tokyo,

Boston, or Nairobi can establish shared architectural theories.

While we cannot easily test the architectural product because it really has to be done full-scale, we can experiment with its producer and his working methods as an ensemble. If we can identify some invariant aspects of the building design process, we can begin to develop a paradigm all architects can use as a design aid. I believe a way to do this is to observe designers at work on an architectural problem. I will not attempt to justify this expectation on elaborate rational grounds; instead, I will relate how I came to this point of view and explore it in some detail in later chapters.

Origin of Interests

I learned to design buildings in architecture school. I then suspected, and am now convinced, I was not as well taught as I could have been. The pedagogic program concerned itself with a rationally graded series of design problems of increasing spatial and social complexity; it was a parallel to the way in which physics and mathematics were taught. These latter fields have shared paradigms about the definition, solution, and evaluation of problems which justify the teaching method. In architectural school, I found only the pretense of such theoretical underpinnings. Where I had been led to expect a shared body of architectural theory about the experience and design of the physical environment, I found a mishmash of opinion, sloppy logic, and indifference to verifiable hypotheses. Starting with "fundamentals"

students and professors alike felt impelled to supply and defend their own insights as the proper concern of architecture. The picture of architecture which emerged was not rich; I found it a demoralizing intellectual chaos. When I graduated and went to work, competing points of view shrank to one: the boss'. It was not in fact necessary to resolve theoretical issues in order to function. The urgency of making systematic sense of the field vanished and I let the matter drift from conscious attention.

Later , I was exposed to ideas which rekindled my interest in the possibility of shared architectural paradigms. But after initial excitement, none seemed worth serious pursuit. While examining these approaches. and formulating objections to them, I refined and expanded my own ideas of what an architectural paradigm ought to be. I came to feel that theory should help the working designer rather than the critic. The paradigm would have to state what design was about as an individual mental activity and what strategies were made possible by available tools. Until I stopped looking at these requirements from the perspective of architectural form - as I had been led to do in school -, I was stumped because the discussion of the properties of the architectural product consists mainly of unverifiable opinion. The concepts used in institutional change studies led me to examine the design process from the point of view of the activities of its chief actor: the designer. What internal and external constraints did he perceive as he worked? From asking how the physical environment/architectural product affects its users, I went to

asking myself what is the individual process of design like? Why not see, I wondered, what designers actually do while inventing the solution to a design problem? How do they come up with ideas, test them, resolve difficulties? By concentrating on problem solving procedures, I hoped to uncover generalizations about the design process that could be an aid to designers as they worked.

In the following section of this study, I trace the history of these questions in more elaborate detail.

History of Hunch

The origin of my ideas about the need for a body of theory regarding architectural experience and design process lies in my school experience. I realized early that it was relatively easy to agree if a design proposal was logically organized, but well nigh impossible to determine if it was an appropriate response to the problem. The latter debate was framed in rational sounding terms which on inspection proved to be only opinion if one did not share a proponent's theories. I did not lose interest in these dramatic discussions, but I no longer expected them to reveal much that would help me to design better buildings.

The only consistent aspect of design I observed during those school years was that difficulties in the organization of form were more often resolved by a change in the point of view about the range of permissible solutions than by continued exhaustive analysis along a given line. Insight seemed to consist

of restructuring solution constraints which made an answer to several simultaneous difficulties obvious. Some of the literature on creativity confirmed this observation; but as it went on interminably about the occasions of creativity rather than its practical exercise, I lost interest.

In Planning School , I was exposed to planning process models and the controversies surrounding them. It was clear that insofar as design was an act of forethought, I had expected designers to behave synoptically: to have precisely defined, stable goals and criteria, know all the facts, and generate and analyze all the alternatives for an optimum solution - events as improbable in architecture as in most other fields. No one I knew behaved in this way, but I considered it an ideal towards which one must strive; the more nearly one approximated this approach, the better one's designs. Instead, I began to think that a useful design theory should be stated in terms of working tools: drawings, models, insight modes, etc.. My interest in planning process models predictably waned because they provided no clues for proceeding further towards my goal.

When I came across design method studies, I was excited by the promise of systematic procedure. The rigor of these ideas was invigorating, but by now unconvincing because it seemed immaterial to these methods whether man or machine executed their solution algorithms. I agreed with the intent of making all procedure explicit, i.e. testable, but the focus was too far away from individual architectural invention to hold my attention.

Courses on institutional behavior excited me next because of the parallel I saw between a social organization facing change and a designer working out a design proposal. The dynamics of the social group dealing with a crisis seemed precisely those of the designer developing his proposals. Once again, there was little help in how to experiment with any of this in architectural terms. However, the concepts of learning systems and existential problem solving seemed much better frameworks for thinking about the contents of design process paradigms than what I had been using. By focusing attention on the here and now situation, habitual expectations, and the capacities of tools for molding behavior, these concepts suggested areas of the design process in which to concentrate.

The fields of Artificial Intelligence and Psychology fascinated me next because they studied learning and human problem solving experimentally. They theorized on the basis of experimental observation rather than unsupported opinion as in architecture school. I began to feel it was possible to generate an explanation of how designers go about designing buildings that could be verified in Tokyo or Nairobi.

The Experiment

The question of what to observe was relatively easy. With limited resources, I should be looking at typical units of the design process - as distinct from the whole or small elements. A building project proceeds from the sensing of unmet needs

through programming, parti design, design development, working drawings, bids, construction, to occupancy. Broadly speaking, each phase involves identification and understanding of needs and performance criteria, the invention or selection of means to satisfy them, and the communication of those decisions for execution by others. Of these categories of problem solving, the second through the fifth are the most clearly identified as the core of architectural practice. Focusing on those which were accessible both to my expertise and practitioners' introspection excluded programming and working drawings. Myer and Krauss⁴ have shown how central the parti stage is to the final architectural product; it is in fact the period during which the structure, organization, and character of a form proposal and ultimately the building is arrived at. If every architectural design process has a parti stage, the experiment which suggested itself to me was to observe as many designers as possible in its steps. Then, I would see if their behavior in parti design displayed any recognizable patterns that might be aspects of a theory of the design process.

Making the observations into an experiment rather than case histories is straightforward: give subjects the same design problem. Eastman did it with a bathroom redesign problem^{4a}. My own preference is to use a small, but complete, building sketch problem whose solution does not involve learning new space-use relations. By concentrating designers' attention on a general rather than detail plane, I expect to make specifically architectural problem solving considerations more salient.

The question of what to look for in these experiments, at least as a starting point, is more difficult. I believe that looking at the properties of the design process rather than its product can clarify many hitherto opaque architectural issues. My hunch is that observing what architects actually do in developing a building design will suggest more useful ways of thinking about this activity than built-form evaluations and may eventually lead to the formulation of a design process theory. The hunch is not itself a specific hypothesis of designer behavior or strategy; it is an idea of how to go about discovering them.

I propose to first provide a general description of the tools and behavior of the designer in the parti stage. Then I will discuss two typical architectural models of parti design in terms of their assumptions about designers' problem solving behavior. Next I will present De Bono's and Simon and Newell's models of the mental mechanisms of problem solving behavior in general in order to see what they suggest about designer behavior in the parti stage. Finally, I will compare both sets of models with the observed problem solving behavior of the subjects in my experiments.

Through this analysis of inspirational, rational, pragmatic, and experiential models of designers as problem solvers, I want to see what they assert about: 1) The origin of form ideas and solution path alternatives, 2) The mode of exploring data and proposals, 3) The origin and use of test criteria, 4) The cues which suggest pursuit of abandonment of a line of enquiry. The

experimental observations will attend to the same questions to make comparison possible.

In this research, I intend to concentrate on sketching a paradigm of designer behavior rather than developing built form use/design models. by observation of working designers' procedures. I expect this will lead me into four categories of ideas: 1) Descriptions of what designers did in arriving at a parti proposal together with some reflections on that process, 2) What skills and tools were used and how they may be thought about as procedural aids, 3) Suggestions for additional experiments which could test and refine the ideas above, 4) Suggestions on new teaching approaches based on these considerations. Present resources limit me to studying the first two categories in some detail and only recording those ideas which that pursuit suggests in the other areas.

The next chapter summarizes the tools and circumstances of parti design from the point of view of the actor in the design process: what conditions does the designer face? The representational media commonly available to designers are discussed in terms of their capacity to carry two kinds of useful information: simulation of three-dimensional relationships and tests of built/proposed form use. Then I provide a description of how parti design proceeds and present some speculations on how it might be explained as a model procedure other designers could follow in their own work.

What Designers Do

Briefly stated, the architect's task is to take a set of space use requirements, make them into a building proposal, and supervise its construction. The designer's role is to transform the program, whether its space use requirements are precise or not, into a design/form proposal commonly called the parti. Although neither easy nor mechanical, the remainder of the design process is straightforward and can be done piecemeal. The fascination and challenge of the parti is that the designer must in one stage arrive at an overall order for the project. It consists of descriptions of how the space uses and forms of the eventual building are proportioned, organized, and related; the parti is, in a word, the concept of the building.

The designer can use four resources in parti design: the program, consultations with clients and experts, his own abilities and knowledge, and representational media. A brief example will clarify how he uses these tools as he works:

Suppose program requirements include a suite of rooms. The designer has to decide what such spaces will be in terms of shape, size, volume, and use. He does this by simulating and evaluating possible realities with the support of various media: drawings, models, photographs or movies, his own memories, talking with others, or the results of presenting a previous proposal. The principal advantage of the graphic media is that manipulating them is like performing full-scale experiments with physical realities; complicated spatial relationships can be proposed and evaluated at a glance. The designer synthesizes all

these inputs to provide the physical form of the desired suite or make them the occasion for inventing a new spatial configuration. Seeing the designer's interpretation of his intentions, the client or his representative (often the designer himself) may change or replace his requirements; or the designer may point out opportunities or consequences neither he nor the programmer had foreseen. By repeating the sequence of requirement definition, proposal making, and reaction for progressively larger chunks of the project, participants in parti design gradually converge to in-context agreement of what they want done and how. The parti is considered complete when the people involved in its design are ready to start preparing for working drawings - whether the readiness arises from design completion or time/money pressures. At this end point, the parti consists not only of drawings and models, but also of the ideas held about it by participants in its development. If at first, form proposals are used as trial balloons to discover what is really wanted, they later become test beds of design completion. The decisions which the final parti proposal reflects are only fully justifiable within the context its designers gradually develop in the interaction of presuppositions, discussion, and reaction to intermediate proposals.

Given this general description of the parti design process, let me discuss it in greater detail.

What does the designer do once the client hands him the program? His intentions are not only to meet program require-

ments, but also to develop a form proposal he personally finds esthetically satisfying. A program used to be what the client told the architect he needed in the way of rooms, sizes, groupings, adjacencies, budget limits, etc. Today, where the complexity and expense of projects is great, programming has become a specialized form of planning. Requirements are researched by expert staffs and made specific by room type, furnishings, square foot costs, desired spatial character, functional grouping, and time use patterns. Before he can make a proposal or have any sort of reaction, the designer has to assimilate the material. Program content is meaningless to him until he orders it into some familiar configuration.

During the first pass at the new data, the designer cannot avoid placing program requirements into his own pre-existing categories. How else can he make it manageable? The information at this command consists of what he already knows about parti design as problem solving, his memories of previous projects and physical environments, and the program requirements he recognizes as meaningful (recognition implying resemblance to something in the previous two categories). By presupplying a model of order: what is significant, what isn't, and in what sequence to consider facts, the designer can make a first try at fitting a physical form to the needs expressed in the program. Unless he can find a pre-existing form to meet those requirements exactly, he is forced to adapt or invent forms to suit. Making an order that wasn't there before is the proto-

typical design activity whether at the detail, subproblem, or total project scale. From the first exploratory search to the final parti proposal, every different spatial organization the designer proposes involves an inventive leap.

Once a new form proposal has been made, however imperfectly, it can be tested for meeting the requirements of use, space accommodations, construction sequences, esthetic preferences and so on whether supplied by the programmer, designer, or special conditions. In The Function of Testing During Architectural Design⁵, Weinzapfel examines the nature of design tests. He defines a test as : "... a comparison between the actual values of some aspect of the design and some value which it is supposed to achieve. The results of the test are acceptable within certain limits and unacceptable beyond those limits."⁶ According to Weinzapfel, tests have two simultaneous aspects: A) measurement of the value of a given design parameter, B) how near this value comes to a pre-defined normative goal of performance. Testing, however, is only of value if it provides feedback about fit of conditions to expectations in ways for which the designer already has categories or the readiness to form new ones. The progress of the parti iterations is a direct consequence of the tests applied to information and to form proposals. In this respect, parti development depends heavily on how the designer values things, i.e. on his internal context.

To recapitulate this description of designer behavior in parti design: First, he assimilates program information to dis-

cover what the problem is; second, he responds to program requirements by finding, adapting, or inventing a form proposal; third, he tests how far the proposal meets his performance and normative expectations for the project- is it a good, bad, or to-be-explored further answer?; fourth, he re-adjusts his problem definition, proposals, or tests to account for the new information and, if necessary, begins another iteration. Parti design involves cycling through these steps under the guidance of a problem solving strategy which is, hopefully, responsive to information uncovered in previous steps.

During the first few steps in the process. the only possible source of useful content and decisions is the designer himself. As parti design proceeds, the inputs with which the designer operates become less and less a priori. They are no longer injections to the process , but responses to what has already been established. Both architectural design elements and the social and intellectual context in which they are embedded develop over time. Insofar as its participants and products are concerned, parti development is a self-sophisticating process.

If designers cannot recognize the new except by fitting it into the often Procrustean bed of the familiar, how can they possibly learn anything, much less invent new forms? This obvious question is not trivial because answering it is a direct consequence of the conceptual frameworks within which we think about designers' activities. If we believe intelligent behavior, including invention, is basically a logical manipulation of dis-

crete, timelessly fixed facts or if we believe people think by holistic image shifts or transformations, we shall have very different expectations, understandings, and teaching advice about the parti design process. It seems to me that any explanation of how designers solve their problems must, however implicitly, take some position on the issue of how people think.

Any theory of the design process which aspires to be a design aid must also adopt some position with respect to the level of explanation it considers sufficient. One could seek to explain one's procedure so exactly that other persons, given the same input information, would duplicate one's results. Or one could be satisfied if the explanation or procedure enabled others to produce something functionally equivalent or better. The level of explanation required ^{is different} and prepares one to look for different evidence in the design process.

In the first case, one would need an algorithm specifying one's grasp and reaction to uncertainty; it would be necessary to describe the internal context which interprets data, how categories, forms, etc., are invented. In short, an entire mind and personality would have to be modelled to guarantee results. In the second case, one needs only to specify the nature ~~of~~ of the subject matter, problem solving mechanisms/strategies, and leave problem solving to the individual problem solver's ingenuity. There is no longer a guarantee of equivalent output unless the properties of knowledge and design methods somehow display similar causal relationships to every designer.

It seems to me that any explanation of designer behavior in the parti rests, at least implicitly, on some variation of these two extreme descriptions of intelligent activity. I do not expect to resolve the puzzle, but believing with Daley and Struder^{6a} in the importance of exposing fundamental assumptions to discussion, I wish to examine some architectural models of the parti design process in these terms.

Parti Design Models

The description of parti events in the previous chapter, leads me to ask what problem solvers, rather than their solutions, have in common. This cannot be answered without experiment or without some explanation of how people solve difficulties by thinking: how they process and transform information. To this end, architectural models of the design process are related and examined for assumptions. In a following chapter, I summarize psychological studies of human problem solving and extrapolate them to designer behavior. Finally, in the second part of this study, I confront some of the ideas that arise in these discussions with direct observations of designers at work.

I believe designing is learned by apprenticeship and practiced as a craft; as a consequence, architects put little effort in establishing a common base of verifiable architectural theories. Conventional models of design procedure are difficult to state because they are not considered important enough to summarize; they consist of scattered remarks designers make

about themselves and their work. By and large these opinions fall to inspirational or rational extremes. They are descriptions of steps involved in the design process and of conditions which encourage creativity. I have chosen two examples to represent each of the extreme points of view about the nature of design activity.

Inspirational Model: this model of designer problem-solving behavior is typified in Corbusier's remark : " Creation is a patient search." This view evolved from the difficulties designers experienced in devising good form proposals. In this view, once the designer is given the program he works very hard to understand what the problem is; generates many alternative solutions by invention, imitation, or borrowing, and soon realizes none of them are satisfactory; a period, sometimes called incubation, sometimes frustration, follows in which no answer seems possible; the impasse is rather suddenly resolved by a flash of insight wherein the problem reveals its own elegant logic; after this step, design is still arduous work, but consists of straightforward filling-in of blanks within a coherent outline. This sequence is believed to hold for solving the whole problem or any of its parts.

The inspirational model is too direct a reflection of designers' experience not to recognize the central role played by individual ability in the generation of alternatives and the synthesis of information into poetic forms. Some people simply invent better things than others, be they recipes, mathematical

proofs, or buildings. In this model, the mind (both conscious and unconscious) transforms facts into architectural solutions by a mysterious personal alchemy; the only explanation of form proposals /creativity is as an in-dwelling attribute of personality: " When an artist spits, it's art."⁷. In the inspirational model, the difference in designers' abilities is seen as so overwhelming it becomes magical. No content related mechanism is suggested for problem solving; creativity cannot be taught, only encouraged. Nevertheless, because of its origin in the problem solving experience of working designers, this model makes an effort to refuel inspiration in seemingly hopeless situations: What does one do when the nth alternative proposal does not work? The design aids provided consist of rules-of-thumb about redefinition of the problem represented in such works as those of Straus and Glegg.

In Problem Solving Notebook⁸ , Straus reports a comprehensive study of ways in which designers can coax their imaginations to produce. Not knowing why an alternative doesn't work and having no idea where to turn to next is the typical designer's dilemma. The remedy Straus suggests is ^{to} structure the problem in different terms or from a new point of view. He sees the difficulty as arising from inability to get out of a fruitless line of inquiry; his study contains rough definitions and examples of 75 or so pairs of strategies to break out of this sort of impasse, e.g. compare-relate, search-select. His catalog goes so far as to specify that for trouble i one should try

strategies j,k,l,...,n to which the designer can presumably adapt his particular situation with small effort.

Like architects, engineers have accumulated lore for coaxing the intractable beast of creativity. Glegg's The Design of Design presents typical advice of this sort:

- " (1) Beware of intrinsic impossibilities
 (2) Beware of pseudo-technical words
 (3) Define problems in figures or configurations"⁹
- " These guides to inventiveness, which are signposts and not moving staircases, can be summarized as follows:
 (1) Concentration and relaxation
 (2) Do not be conditioned by tradition
 (3) Complicate to simplify
 (4) Make allies [with the natural forces involved]
 (5) Divide up and tidy up
 (6) Feedback from physical sciences
 (7) Don't despise the untutored inspiration"¹⁰

The advice is good but not operational in the way I believe is necessary for a design aid. How does one know one is facing an intrinsic impossibility and not simply a mistaken approach?

In summary, the inspirational model of designer behavior does not believe thought processes can be fathomed and so restricts itself to descriptions of steps and rules-of-thumb as design aids. Design method is not considered to have much to do with quality of product except insofar as it creates conditions favorable to creative insight.

Rational Model: In Notes on the Synthesis of Form¹¹, Alexander develops the basis for a rational parti design method that is typical of those that go beyond imitation of the procedure of eminent architects. An analysis, not detailed in this book, led

him to say : " I believe that the great architect has in the past always been aware of the patterned similarity of problem and process, and it is only the sense of this similarity of structure that ever led him to the design of great forms."¹² Alexander proposes a two part method to make this resource available to other designers: 1) a procedure for rational analysis of program requirements , 2) a separate synthetic, form-making phase. I will discuss this proposal under three headings which seem appropriate for examination of an attempt to encompass the design process as a logical mechanism.

First, the nature of the subject matter: Alexander believes the architect's role is the provision of form (for human use). His method rests on the existence of invariant, universally recognizable aspects of form use: human activities such as cooking, conversing, etc.. For him every element of form can be dissected into a logical hierarchic structure of components via an analysis of its impact on use. Each component is regarded as a unit of a larger component as well as a pattern for its own sub-units. In other words, he believes architectural form and its uses follow laws we can discover and justifiably use.

Second, the nature of the information processing systems: Alexander believes people perceive form in two simultaneous ways: as what it is and as what it does. He also feels that " The incongruities in the ensemble are the primary data of experience"¹³ He explicitly assumes that these conflicts between form and expected uses will be essentially the same for all observers. He does

not think the mind automatically organizes experience, but that some effort must be made to structure information^{into} logical hierarchies if we are to manipulate it deliberately. He considers designing form to be an act of invention, not selection; yet he does not seem to care how it happens. I am left to speculate that Alexander believes the quality of invention is more conditioned by the logical coherence and structure of the data presented to imagination than by individual designers' ability.

Third, the contents of the design method: In Alexander's proposal, the function of the programming phase is to define activity requirements unequivocally enough to direct the designer in devising a form whose use will occasion no conflicts. The self-conscious method proposed requires that such misfits: " Any state of affairs in the ensemble which derives from the interaction between form and context, and causes stress in the ensemble, is a misfit."¹⁴, be identified and organized into a logical problem definition before the designer invents any building form. The judgements made in this procedure can only have their basis in the designer's previous knowledge of form and its use. Programming by this method means transforming activity requirements into what Alexander calls misfit variables.

A misfit can only be made into a variable if there is a scale along which to measure performance, not necessarily in a quantitative manner. If all variables are 1) of equal importance, 2) independent of each other, 3) as specific and, hence, numerous as possible, a finite number of spaces uses can be identified

for each design problem. They are then grouped into functional units of non-conflicting uses. Given these conditions, i.e. a finite set of variables consisting of uniquely defined, logically independent groups joined by single links, it is possible

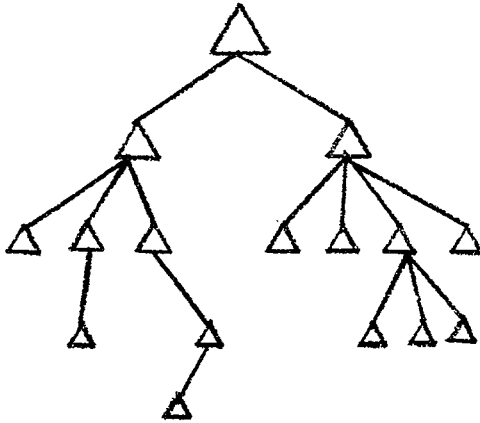


fig. 1

to create a graph known as a program decomposition tree (fig. 1). In practice, the synoptic requirement of exhaustive completeness of variables is amended to the best one can do. But since each designer defines the nodes of the graph uniquely, he can only construct one such tree. The programming procedure

yields: 1) a series of independently soluble subproblems, 2) an order of solution, i.e. up the tree from its bottom, and 3) ensures that the solution order of horizontal subunits does not matter because they are hierarchically equivalent. The procedure is only valid if the program decomposition tree is an abstract summary of the desired characteristics of all forms that would satisfy the program. Alexander's method for constructing the tree is intended to guarantee those results by its logical origin and structure.

The second step in Alexander's parti design method is program realization, i.e. synthesis of organized information into a form proposal. Since misfit identification occurred by reference to form, the program can be expressed as a constructive

diagram representing both facts and physical relationships without distorting either, i.e. no information is lost in making it. The production of this diagram is an act of invention by the designer based on the logical structure of the problem revealed by the program decomposition tree. Whatever form the designer creates necessarily matches the pattern of the problem.

In Alexander's method, design consists of successive accretions or combinations of ever more inclusive constructive diagrams- as subproblems are solved, the designer moves up the decomposition tree. What Broadbent calls analogue take-over: turning analytic diagrams into final form proposals¹⁵ is more than an accident in this proposed method; it is the heart of the approach.

For Alexander, the meaning of architectural form lies in the use people make of it - a humanistic bias departing from most esthetic canons. Recognizing that designers are caught in a self-conscious rather than experiential situation, he provides a logical mechanism to organize and display space-use information for the invention of form. He does not seem to care what particular form the designer proposes because it will satisfy use criteria and have no misfits, or at least as few as feasible. The difficult and important thing for him is that each designer produce his own unique logical definition of the problem.

Summary of conventional parti models: Most architectural models of parti design fall between the two extremes of unfathomable inspiration and rational analysis. They usually present

some strategy such as: design from the inside out, express the structure, form follows function, make your building anonymous, coupled to some method such as: select a site, draw bubble diagrams, develop floor plans and sections, draw elevations, make a model, etc.. With these models design can only be taught by apprenticeship because direct personal experience supplies the links between strategy, content, method, and technique which the explanation does not provide. To my mind, the peculiar drawback of these inspirational approaches is that they are not explicit. There is no built-in way of distinguishing which aspects of the procedure work and which are merely ritual automatisms; their logical structure and relevance cannot be easily debated by a community of practitioners.

By contrast, rational approaches such as Alexander's model provide a logical mechanism which can be debated and, as a result, improved. By describing invariant elements (activities) with which to interpret form, an operational criterion for decisions (misfits), and a systematic design procedure, it also gives the designer aid of a sort he can use himself. He is supplied with criteria for associating aspects of the subject matter with design method. The designer still has to invent form, but is not at a loss in determining which data are significant. The explicitness of his approach allows him to manipulate both content and method when he is stuck.

Along with its virtues, Alexander's model has some difficulties. The most interesting one in terms of this study is

that designers do not seem able to construct a unique program decomposition tree prior to completion of a final form proposal. Is this a failure of designer training or of the method? The pragmatic test suggests that the method is somehow at fault in expecting designers to behave in a way they cannot. I believe the problem is endemic to rational design methods and originates in their understanding of how designers solve problems.

Rational approaches emphasize the logical relations and structure of knowledge; they reflect the belief that the only real knowledge is that which is logically structured. Whatever the mind does which is not directly involved in developing such knowledge structures is not considered relevant to an explanation of problem solving. Consequently, the thrust of these methods is to help designers uncover logical structure in their problems . . . Since that structure is, by definition, the same for all designers because it consists of formally defined categories, rational design methods make no great effort to account for the differences in individual abilities.

It seems to me that ,as Dreyfus observes," ...although science requires that the skilled performance be described according to rules, these rules need in no way be involved in producing the performance."¹⁶. I believe rational design methods such as Alexander's confuse the requirements of communicating ideas with those of developing them. In so doing they assume the meaning of program requirements to be the same for all problem solvers, i.e. that meaning consists only of the logical defini-

tions and relationships which can assigned to facts. But if the definition of "two bedroom house" does not mean exactly the same thing to designers in Tokyo and Boston, it cannot be the basis for unequivocal discourse between them. In all likelihood, the two architects will still manage a meaningful conversation, but only because they internally compensate for the deficiencies of the logical definition.

If a designer cannot a priori tell what a requirement really "means" independently of his personal experience, a rational design method cannot be guaranteed to work. In other words, a designer ~~cannot~~ cannot be told that a design method works on logical grounds because its success is a property of the problem solver and not of the subject matter or the solution method.

The inspirational models of parti design reflect the assumption that mental operations cannot be fully understood or described as situation-free elements; as a result, they do not attempt to link internal mental operations with problem content or design method. They are recitals of devices which designers have found to be helpful in problem solving but without any attempt at examining why. Inspirational models are conceived and presented as catechisms to be believed rather than understood.

I believe it is impossible to devise a design method without some notion, however implicit, of how the mind of the problem solver works- how it perceives facts, how it compares them with memories, how it develops new solutions. To reduce effort wasted meeting impossible demands, it seems useful to match

the operations of a design method to the characteristics of human information processing mechanisms. In my estimation, the architectural models of parti design fail as design aids precisely because they do not reflect an accurate understanding of how designers go about problem solving. On the one hand, we have a mysterious alchemy; on the other, a denial of the impact of individual differences. I find it silly to strive after ideal design methods which deny my experience of both intuitive and logical episodes in parti design. Prior to proposing any parti design method, I believe it is necessary to state a verifiable mental mechanism. In particular, I want to know the occasions and conditions of analytic and intuitive thought and whether information must be organized/accessed differently in each of these modes. Discussing research in this field leads to a long excursion outside the immediate concerns of architectural thought.

Problem Solving Models

Devising an explanation of how designers solve problems requires assumption/ identification of invariant features of that process. In general, the observed reactions of designers to a design problem is to ^{seen as dwelling} dwell mostly in one of two modes: A) Analytic: breaking down the problem into diagrams, matrices, feature surveys, etc., or B) Holistic/Poetic: structuring the problem by one or more encompassing images, metaphors, analogies, or evocations of earlier experience. The former attempts to build up understanding piecemeal while the latter imposes a pre-con-

ceived order to be tested with local evidence. A fundamental question is whether these two modes reflect different approaches to problem solving or are manifestations of a single underlying process.

The analytic strategy for problem solving is to learn the meaning of the unknown material by testing its aspects one at a time according to categories whose properties are already known. The effect of this procedure is to hold off solution (invention of form in the designer's case) until facts have acquired explicit meaning in a newly formed context. If this model of designer behavior is accurate, it means he builds up stable knowledge structures incrementally. Pask's observations¹⁷ are ^{that} problem solvers operate in this mode with as few variables as possible using a minimum of analogies to guide themselves.

In the analytic procedure, the designer behaves so that his solution process appears to consist of counting out among alternative form proposals generated by logical analysis of the program requirements, e.g. Alexander's method. A rule-like model of intelligence describes this behavior and the progress of the parti design satisfactorily, although it leaves the origin of criteria, fit, and form invention ambiguous. It makes sense of what happens ,but not of how it appears in a person's mind.

By contrast, the holistic strategy for problem solving applies an already-meaningful structure to the unknown material and then goes about testing it for fit to requirements. This approach emphasizes the field-and-ground / image-like character

of the internal experience of knowledge. Pask's observations¹⁰ are that, in this mode, designers tolerate and, indeed, welcome ambiguity; they proceed by juggling four or five ill-defined variables and models simultaneously until something fits both program requirements and their normative expectations.

In the poetic procedure, the designer progresses by disjointed steps seemingly based on personal associations rather than strictly functional aspects of the problem. The typical holistic judgement is "I like" rather than "A therefore B". How he generates these alternatives or evaluates feedback is baffling because it does not seem to be logically predictable. We have no rules for explaining mental associations and no means of determining what the contents of a designer's mind are. It is of course possible that the designer is unconsciously following some set of procedural rules acquired over time. But these are so inaccessible to verification as to be useless in building the kind of mechanism being sought to explain parti design.

The first mode of problem solving discussed above proceeds by incremental variation and adaptation of a growing body of facts; the second progresses by discrete jumps of complex mental representations. Are they both instances of a single mental mechanism or different processes? Lurking behind answers to this question is the issue of whether some design methods are inherently better than others because they are more in tune with how people really think in problem solving. I have found two models of problem solving behavior which are architecturally

interesting: De Bono's and Simon and Newell's. In their very different ways they both suggest that problem solving procedures are not determined solely by the categories with which facts are unequivocally communicated. They suggest that observable regularities of problem solving behavior may be properties of how people think rather than of what they think about.

In Lateral Thinking,¹⁹ de Bono suggests that the mind functions as ~~an~~ a mechanism which does not actively determine the meaning of facts. He believes the mind is not a machine, but an(unexplained)environment which lets information organize itself into patterns - themselves undefined, presumably a common meaning of the word is intended. Once formed, patterns can be manipulated; the more they are used, the more firmly established they become as means of experiencing information and knowledge. Accepted patterns encode themselves and a person need only collect enough information to identify a pattern to evoke it into consciousness. Memory is like a landscape which is not only a record of the forces that have acted on it, but also a determinant of how new forces impinging on it affect it; in this sense, it is a passive self-organizing surface. Which part of this surface is activated by new information depends on what is being perceived, what was just perceived, and the state of the surface (i.e. the history of the landscape in the metaphor). The limited attention span of human beings means that only a single, coherent area of memory is activated at any one time- namely the most recent

and related pattern. Memory is not only self-organizing, but also self-maximizing- that is tends to stay on given tracks. In short , the mind is a device which inherently and automatically creates coded patterns of its surroundings stored in an associative, time-dependent memory.

The advantages of an information processing system organized on the basis of preset patterns are those of quick recognition and reaction. De Bono lists twelve specific disadvantages of such a system^{19a}, the most interesting of which are: resistance to the introduction of new patterns, centering: perceptual resemblance leading to the assimilation of new information into existing patterns, the sequence of arrival of information dominates the recall of patterns, snap changes from one pattern to another rather than continuity, and the tendency of patterns to get larger without limit. In short, the mind is biased in favor of establishing conceptual patterns, but ^{not} for ~~at~~ restructuring or updating them.

According to de Bono people can think in two ways within this environment: vertically or laterally. Vertical thinking is synonymous with logical thinking, i.e. by a sequence of steps each of which must be right before proceeding to the next. It is a selective mechanism which, by using information for its own sake, allows problem solvers to develop, refine, and prove the validity of conceptual patterns. However, this process can only operate once a perceptual choice has been produced for examination. The generation of alternatives is not itself a rational

procedure, but the domain of what he terms lateral thinking. It involves escape from old patterns, restructuring them (insight as reformulation of available information), and the provoking of new patterns (creativity). Lateral thinking uses information for its effect and associations; it does not judge data for consistency, workability or practical consequences. Since, along with humor, insight and creativity can only be prayed for rather than willed, de Bono proposes symbolic exercises and a verbal device to develop skill in lateral thinking which education has ignored in favor of logic.

De Bono defines a problem as the perceived difference between what one has and what one wants. To solve a problem by logical thinking requires that one be right at every step; therefore, the stability, invulnerability, and situation-independence of classification, labels, and rules of procedure is vital. This process stops at the first set of adequate answers. By contrast, lateral thinking does not problem solve as such; it generates approaches to solutions; it seeks varieties of answers rather than stopping at the first one. Because of its generative qualities, it necessarily precedes the exercise of critical thought.

De Bono's proposal unites the two extremes of the conventional model of parti design by giving inspirational and rational thought different, but complementary roles. It has the distinct advantage of fitting with the introspection of inventive behavior: some problems are logical, some are inventive, and some involve both ways of working. The mechanism proposed in

this theory allows for individuality of human actors, sophistication of knowledge, and opens the possibility of directing invention deliberately rather than scatter-shot fashion. The latter can be done by preloading memory with information about a topic of interest. Yet, in a sense, it is a frustrating scheme because it implies we cannot manipulate thought contents directly and can only provide conditions for flowering.

Does de Bono's method of separating the inventive and analytic aspects of parti design work? Broadbent²⁰ reports that it is popular in England, but isn't enthusiastic enough about the results to go into detail. Like Synectics²¹, the success of the practice is not universal.

In Lateral Thinking de Bono provides little evidence for his model of mental functioning. What is consciousness? Intentionality? How do facts organize themselves; indeed why is ^{KNOWLEDGE} not an act of volition? What are patterns? How do they link? He does not say and while his explanation appears to fit the introspected facts of problem solving, I am reluctant to accept it because he presents so little supporting evidence. Simon and Newell, long in the forefront of Artificial Intelligence efforts, have attempted to discover mental mechanisms by experiment in order to develop algorithms by which digital computers could simulate human problem solving behavior. Their results, rather surprisingly, buttress most of de Bono's assertions.

In Human Problem Solving²² ^{Simon and Newell} summarize their conclusions about human problem solving behavior in five observations: 1)

People can be treated as information processing systems (.IPs), 2) Any individual IPS can be simulated in any given task, 3) Different people solve the same problem using substantially different programs, 4) The structure of these problems differs a great deal, and 5) The task environment and the nature of the problem solver determine problem solver strategy and behavior far more than his information processing structure.²³, In terms of this study of designer behavior, their conclusions are that design methods cannot be specified across individual cases and further that human ips structure is so neutral as to not determine behavior. Knowing how the mind works is not enough information for understanding problem solving. The meaning of ideas and experiences to the individual problem solver must be accounted for to explain his behavior.

In Simon and Newell's models people's goals clearly affect the course of their problem solving behavior. Each goal structure appears to carry tests of its completion. Goals evoke programs, correlate and direct problem solving strategy over long periods of time. Goals must be described in accounting for problem solving behavior.

In this view, all problem solving is seen as taking place in a closed problem space - closed because it occurs in a limiting context partly determined by problem statement, goals, and by externalities such as available external memory devices. Problem spaces can be modified, restructured (is this insight?), or replaced in the course of solution. As far as Simon and Newell

can tell there is no rigid boundary between individuals following a predetermined plan (e.g. an analytic algorithm) and one searching through a problem space in an unprogrammed fashion (e.g. a holistic approach). In terms of this study the fact that the organization of search has no predictable impact on its successful outcome suggests no design methods can guarantee results.

Simon and Newell characterize the invariant, i.e. constant across individuals, characteristics of problem spaces as follows:

- " 1. The set of knowledge states is generated from a finite set of objects, relations, properties, and so on, and can be represented as a closed space of knowledge.
2. The set of operators is small and finite (or at least finitely generated).
3. The available set of alternative nodes in the space to which the problem solver might return is very small; in fact, it usually contains only one or two nodes.
4. The residence time in each particular knowledge state before generation of the next state is of the order of seconds.
5. The problem solver remains within a given problem space for times of the order of at least tens of minutes.
6. Problem solving takes place by search in the problem space -i.e. by considering one knowledge state after another until (if the search is successful) a desired knowledge state is reached. The moves from one state to the next are mostly incremental.
7. The search involves backup- that is, return from time to time to old knowledge states and hence the abandonment of knowledge-state information (although not necessarily of path information).
8. The knowledge is typically only moderate in size- containing at most a few hundred symbols, more typically a few dozen. " 24

In terms of this study, their description implies that a designer can be expected to problem solve in a series of small steps, each of which is contextually determined by its antecedents. It is more of an ad-hoc than plan-determined exploration .

Perceived task environment is seen as delimiting the possible problem spaces the problem solver explores. Simon and Newell have found it impossible to describe it independently of observer/actor characteristics- that is to say the designer's perceived context/situation defines his problem solving possibilities. The structure of the task environment is inherently redundant; it relates kinds of operators with kinds of nodes in knowledge states and also information across nodes; this duplication allows the human ips to map/predict from one problem space into another or, similarly, from one knowledge state to another. There is no neutral way of describing this world because the initial posing of the problem and solution programs define ^{it} in a uniquely personal way for the problem solver.

The observed preference of the human ips is to solve problems by search within a problem space. Search methods are surprisingly few: 1) Working forward, ie. selecting operators to be used in the next step or 2) means-end analysis, i.e. selecting new goals. In other words, there are only two main decision points in guiding a search: evaluating knowledge states and selecting operators. In Simon and Newell's view intelligence is unpredictably exercised in the variations and mixes, order, etc., of these two basic methods. Once a solution program is chosen its sequential order means that the behavior which follows is determinate, barring errors.

Simon and Newell feel there are four conditions which any theory of problem solving must account for: 1) Only a few gross

characteristics of human IPSs are constant over task and actor variations, 2) The regularities are enough to say problem solving exists in a particular mental space, 3) The structure of the task environment and the posing of the problem determines the structure of problem spaces, 4) The structure of the problem space determines the possible programs²⁴. In terms of this study of parti design, these conditions mean that it is nearly impossible to generate design methods applicable to all design problems or, given a single problem, a design method for all designers; it must be remembered that the design method Simon and Newell's conclusions apply to are those which associate method of solution with problem content.

The area of human commonality in problem solving which could support a theory linking content and solution method is very small. Human IPSs share 1) The same organizational and structural features, mostly identical memory structures and parameters, 2) Some similarity because they make rational responses to problems, 3) Some similarity because they learn and develop, i.e. become sophisticated, over time. These are the only constant features of human IPSs Simon and Newell have found in many years of extraordinarily detailed research; they are all structural characteristics implying nothing about the nature or experience of knowledge and meaning.

The internal mental context of the problem solver determines how and in what way the individual proceeds in a way that cannot be pre-specified by rules for distinguishing dependent

from independent variables. Simon and Newell's conclusions imply that rational design methods have no greater claim to validity than other approaches; in fact, no prescription of designer problem solving approach associating content and method is experimentally defensible because that conjunction misrepresents human IPS problem solving behavior.

The nature of the mental mechanisms uncovered in their studies is such that there is no guarantee that the features of a problem first selected as building blocks will continue to be part of the edifice. Designers, like other problem solvers, adapt their methods to both situation and problem content according to ad-hoc perceptions of meaning. "Meaning" itself seems to be a shifting amalgam of the individual's memories and perceptions- something we cannot specify a priori for all individuals. This conclusion supports de Bono's assertion of the primacy of the designer's inner mental environment in generating solution approaches in a way which is not logically predictable, i.e. is based on idiosyncratic associations.

And yet , the proposed mental mechanism has some characteristics which - if true- seem to me to have an important bearing on how designers should use the tools at their disposal. In this respect, it seems possible to me to provide practical design aids describing how to adapt one's favored working methods to the properties and limitations of our mental apparatus. It is worth examining Simon and Newell's model in some detail because it suggests testable hypotheses about designer behavior.

Simon and Newell's Problem Solving Model

The evidence gathered by Simon and Newell in long and careful observations of human problem solving behavior with cryptarithmic puzzles, symbolic logic problems, and chess playing has led them to a model in which IPS performance depends chiefly on the properties of memory in terms of capacity, accessing modes, and read, write, and decay times. They believe it consists of four parts: 1) Elementary processes, 2) Short term memory: STM, 3) External memory: EM, 4) Long term memory: LTM. They summarize these human IPS characteristics as follows:

- " 1. It is a serial system consisting of an active processor, input (sensory) and output (motor) systems, an internal LTM and STM and an EM.
2. Its LTM has unlimited capacity and is organized associatively, its contents being symbols and structures of symbols. Any stimulus configuration that becomes a recognizable configuration (chunk) is designated in LTM by a symbol. Writing a new symbol structure that contains K familiar symbols takes about 5K to 10K seconds of processing time. Accessing and reading a symbol out of LTM takes a few hundred milliseconds.
3. Its STM holds about five to seven symbols, but only about two can be retained for one task while another unrelated task is performed. All the symbols in STM are available to the processes (i.e. there is no accessing or search of STM).
4. Its STM and LTM are homogeneous, in that sensory patterns in all sensory modalities, processes, and motor patterns are symbolized and handled identically in STM and LTM.
5. Its elementary processes take times of the order of fifty milliseconds, but the overall rate of processing is fundamentally limited by read rates from LTM and EM.
6. EM (the immediately available visual field) has access times of the order of a hundred milliseconds (the saccade) and read times to STM of the order of fifty milliseconds. Write times are of the order of a second per symbol for overlearned

- external symbols.
7. Its program is structured as a production system; the conditions for evocation of a production being the presence of appropriate symbols in STM augmented by the foveal EM.
 8. It possesses a class of symbol structures, the goal structures, that are used to organize problem solving."²⁵

Simon and Newell hypothesize that the operations of STM are the irreducible elements of thought; they call them elementary processes. These are simple compare and replace operations which involve one or two symbols at the most. Their belief that the human IPS performs these operations serially does not mean he cannot be aware of several things at once in STM.

The contents of STM are " .. a small set of symbols, each of which can designate an entire structure of arbitrary size and complexity in LTM"²⁶. Any activity requiring attention subtracts from effective STM capacity. Simon and Newell remark that STM information decays over time, i.e. people have to rehearse data in order to keep it up to date. They don't believe this matters much since problem solving is a self-paced activity. STM errors are few, but obviously have major impacts that cannot be helped. Whether the human IPS accesses STM serially, address-wise, by meaning, or some other mode is not known and probably does not matter since STM_{contents} are essentially totally available at any given time.

In this analysis STM capacity directly affects what the human IPS can do at any given time. Functionally, it consists of its contents plus the visual display in the foveal field. The latter form of external memory increases STM capacity and

stability (i.e. less need for rehearsal of information).

External memory access time is comparable with LTM access time; consequently the human IPS can obtain information with equal ease from either of them. Given that EM capacity is essentially infinite, Simon and Newell feel that it is so important no problem solving program be completely specified without a description of available EM devices. The difference between LTM and EM read-write times affects the human IPS's problem solving strategies; it is more efficient for him to use programs already stored in LTM by previous experience or in EM displays than to constantly build up such structures for ad-hoc use. A designer, for example, will rely on routines he already knows and use drawings he has already made instead of redrawing them for every test of a sequence. (de Bono's pattern use)

Human information processing capacity appears to be roughly the same for all individuals - only so many steps can be performed within a given time period. These operations are executed by a mechanism comprised of STM, LTM, and EM devices which can only attend to a few symbols at once. It does not seem to matter how much information these symbols condense and encode. The content and sequence of these chunks of knowledge are the key to problem solving performance, but they vary with the individual.

De Groot's studies of chess players²⁷ support Simon and Newell's proposals. Grandmasters do not have better memories or larger processing capacities than other players. Their behavior is structured by the already meaningful patterns/chunks by which

they perceive the disposition of chessmen. They employ their IPS capacities in exploring the salient features of those patterns rather than in testing the possible moves and interactions of every piece on the board. As problem solvers, they do not handle more symbols than lesser players; but their symbols are more powerful. Their perceptions, memories, and solution moves are conditioned by the chunked patterns of significance they know. It is not method that determines their problem solving behavior, but the meaning and organization of their mental contents.

In terms of this study of parti design methods, Simon and Newell's and de Groot's work suggest that the thrust of any efficient design method should be to: A) keep internal short term memory as uncluttered as possible, B) increase the load on external memory as much as possible, C) increase the repertory and facilitate chunking of long term memories. In practical terms, these characteristics suggest a basic hypothesis that a good designer's problem solving approach implicitly, if not consciously, recognizes these IPS limitations, and that he does it in at least the following ways:

First, he deliberately strives to delay choice of problem space. This is accomplished by discussing and comparing the implications of parti proposals and programs.

Second, a corollary is that, when stuck, he preferentially examines his goal structures before trying new proposals or techniques. If Simon and Newell are right, goal structures carry techniques and methods in their wake.

Third, he continually strives to externalize his ideas and form proposals into external memory devices thereby keeping STM clear. By not requiring STM to hold both an object and tests of its significance simultaneously, its capacity is freed for invention and testing activities.

Fourth, he uses EM devices to display and correlate information automatically, again freeing STM from having to perform a task and retain its results. He uses representational media as analogous as possible to the final physical product, i.e. perspective drawings and models.

Fifth, he strives to know as much as he can about designing and using buildings in as many ways as possible. Yet sheer quantity of facts is not enough; chunking of LTM contents is what is really desired. No method is proposed for this heuristic aspect of thought which markedly increases the designer's effectiveness. (Perhaps de Bono is right; nothing can be done to ensure or accelerate that process).

If Simon and Newell's model is accurate and my suggestions follow from it, a better designer necessarily behaves more along these lines than a less able colleague. The basic hypothesis is an educated guess. Of the other five, only the last: LTM chunking, is a necessary and sufficient correlate of designer skill much as it is with chess players in de Groot's studies.

In the first part of this study, I gradually progressed to seeking a basis for designer behavior in the part in the mental mechanisms involved in problem solving. This explora-

tion led me to the conclusion that neither logical descriptions of facts nor mental mechanisms alone determine problem solving behavior because they do not, and cannot, specify the meaning of ideas for the designer. That is to say, design methods which rely on the properties of ideas are not too likely to be powerful unless those ideas refer to verifiably invariant aspects of people's use and experience of the physical environment. Instead, I am led to the view that the mental apparatus has verifiable limitations which any useful design method must respect. I have expressed a first understanding of these in the six hypotheses stated above. The first asserts that good designers respond quite directly to human IPS characteristics and the last five details specific guesses as to how they do it. In the next part of this study, I propose to perform some experimental observations of designers at work to test these propositions; discuss the results, and compare them with previously described models of designer behavior in the parti design process.

Experimental Method

The experiment consists of giving designers of different levels of skill an architectural sketch problem, recording their products and process, and making comparative analyses of their protocols. It will be interesting to discover if such a simple procedure yields any reliable information about A) what a skilled designer does more or better than a less skilled one, and B) regularities of designers' problem solving. Practical design aids can be based on both kinds of observations.

In the analysis of my observations, I expect to compare designer protocols along the five dimensions suggested at the end of the previous chapter, such other categories as suggest themselves, and also to consider which, if any, aspects of the models discussed in the first part of this study fit the experimental evidence. If there are consistent differences of procedure correlated with designer skill, some compensatory techniques can presumably be developed to speed the progress of student designers. Regularities of procedure could be the basis for a description of the design process giving designers an awareness of how to adapt their own procedures to the characteristics of the human mental apparatus.

Recreating the process of parti design for later analysis requires obtaining protocols by recording what designers do and what goes through their mind as they work. Resource limitations means neither the problem nor the analysis can take a long

time, i.e. no phrase-by-phrase analysis or models. After a test run, the following experimental design was arrived at:

First, subject selection. To perform this experiment requires distinguishing between good, bad, indifferent parti proposals and/or designers in order to assign designer skill. I do not propose to develop such scales; it probably is not possible to make them widely acceptable in any case. I must rely on external standards of performance to make the selection. Since the test run indicates that its length is not great enough to produce a finished parti for judgement, designer reputation and experience are my criteria for choice of subjects.

Selection of subjects was informal. I used friends although still meeting the criteria of different levels of skill. A brief description of each subject's background precedes the summary of his protocol.

Second, at the beginning of the experimental session, the subject is assured of anonymity and encouraged to make himself comfortable with familiar tools and implements.

Third, the subject is told:

" I'm asking you to do an architectural sketch problem as you normally would. I'll give you a program, site plan, tracing paper, and a two hour time limit. I'm not interested in the finish of your proposal or even whether you complete it. What I care about is getting a record of how people go about designing. To this end, I'll keep the drawings and record your words. I ask that you think out loud: doubts, side issues, speculations, in fact whatever goes through your mind as you work."

Fourth, the tape recorder is turned on and the program is

handed out. The program is as follows:

Sketch Problem

Over time it has become clear that the MIT School of Architecture and Planning needs two additional kinds of space: 1) Space for large classes (40-80) which are seminars in the sense that lecturing is occasional; class is usually participatory, and 2) Space for such visitors as I. Ilich, who first lectures for an hour or less and then engages the audience of about 200 people in give-and-take discussion for another hour or two. Easy access to a lobby for refreshment and informal discussion groups during breaks is necessary. Physical comfort, acoustic and emotional intimacy, and audio-visual facilities for sound recording, movie and slide projection, etc., are required.

The School has scraped together about \$ 250,000 for the facility. Discussion with the MIT administration resulted in a site to the East of the Student Center and between Kresge Auditorium, the MIT Chapel, and Amherst Street (see the accompanying map). The rerouting of utilities and connections for same will be handled and paid for by MIT itself. For these concessions, MIT asked that other departments be allowed to use the facility. Mr. Foz will represent the School in these circumstances.

Space requirements are as follows:

1 place for 200 people, 1 place for 80 people	3000 s.f.
Lobby with access to kitchen: 100 s.f., toilets	
: 200 s.f., and coat storage: 300 s.f.	1600 s.f.
Projection, recording, and storage facility	600 s.f.
Janitor's office: 100 s.f. and storage: 60 s.f.	160 s.f.
Mechanical space	<u>500 s.f.</u>
	Total ca. 6000 s.f.

Fifth, when a second parti proposal has been arrived at or two hours have elapsed, the subject is asked to stop. The observer then asks questions about problem solving approach suggested by watching; in particular, he asks what the subject would have done next had he more time.

Sixth, analysis begins after the verbatim protocol is transcribed and the drawings are keyed to it.

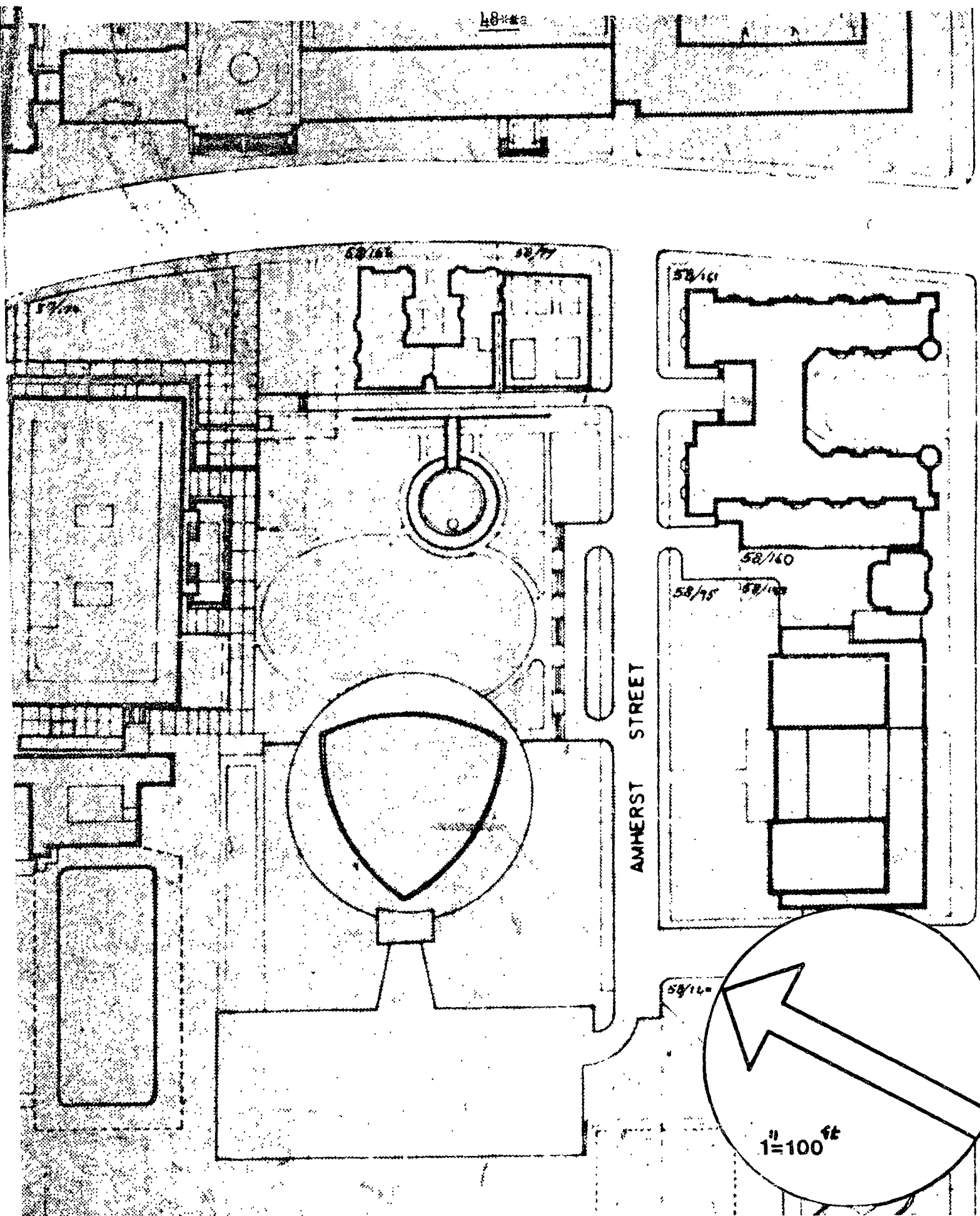


FIG. 2. SKETCH PROBLEM SITE PLAN

Protocol Summaries

Before summarizing the experimental observations, I want to set a zero mark by reporting how two naive designers, i.e. without architectural training, reacted to building design problems which they encountered.

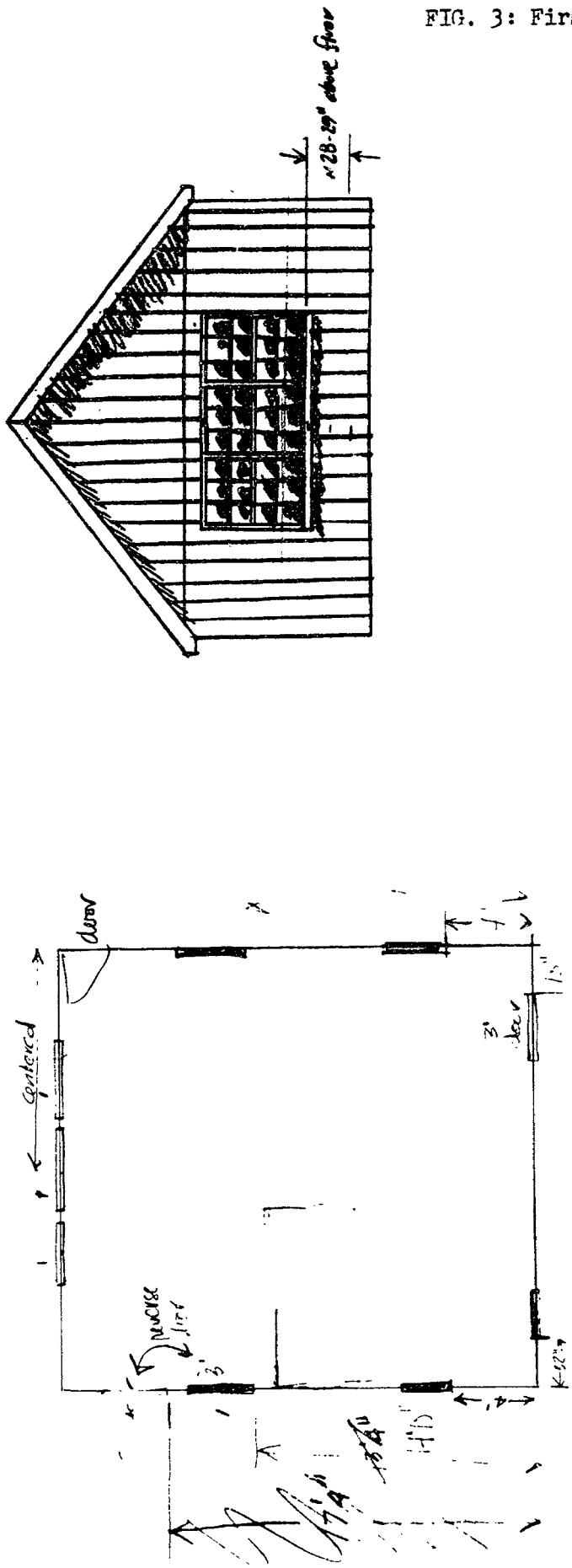
First, a Harvard assistant professor who designed and built a one room house on his property in Vermont. His original intention was to build a two bedroom, two family house; economics forced the abandonment of this scheme after he designed it. Instead he built a two car garage adapted as a one-room house with eventual reconversion in mind.

In the first instance, his procedure was to draw floor plans on grid paper, treating the various spaces as labelled boxes, and making organizational decisions on the basis of how people could come and go without trespassing on each other's privacy. He also drew some outside elevations and perspectives inspired by pictures of shed-roof houses in architectural magazines. The plans were labelled outline drawings without representation of furnishings or consideration of materials. He did not use any section drawings.

In the second instance, he interspersed construction with drawings. All the decisions about location of doors, bathroom, and kitchen were made prior to design and construction by virtue of site considerations: road access, view, slope. He used drawings when he felt he had to: elevations were drawn after

49a

FIG. 3: First naive subject drawings



the building frame was put up; they were necessary to visualize the final appearance and to order materials. In the same way, the kitchen and bathroom layouts (the latter copied from Graphic Standards²⁸) were considered in terms of use preference, then dimensioned for comparison to available space. Windows were located in plan (fig 2) but sized on the spot. Rafter size led to a very steep 8:1 roof pitch ; the resulting volume of enclosed space, when observed, suggested a loft. In short ,this design process comes close to being what Alexander calls unselfconscious²⁹, i.e. without mediation between sensing of need and response.

His reasons for not using drawings to design the house/ garage prior to construction were that drawings took him a long time to make (he did not use scales, triangles, parallel rules and other architectural drafting tools), his sketches were not intelligible, and that since the expenditure of resources on the building was small in comparison to his original estimates, he was not concerned to work things out in advance. It took less effort to make decisions on the spot than to use a simulation mode which did not help him visualize the dimensions or relations of objects. His drawings (fig. 2, ■) are interesting in that they contain only the information he was concerned with: for the plan, item type and location (notice the reverse coding of walls and windows) and for the elevation: appearance and size of materials (the shadows were added by an architect friend of his)

Second, an IBM systems analyst describing a house she and her husband were about to purchase. with renovation in mind (see fig. 3.4). Even though untrained in drawing she used floor plans, elevations, and perspective views of the site, the building exterior, a window frame, and a very interesting transparent view. No sections were used. Compared to architectural drawings, some of the striking features of these records are: 1) outline drawings with no line weight distinction between walls, windows, and screens; 2) spaces are grossly out of proportion: relative dimensions do not approach her reported dimensions; 3) walls and stairs do not line ^{up} on the two floor plans; 4) the mode of representation is not very graphic: rooms and appliances are shown by labelled boxes without furnishings or doors.

Third, are four experimental subjects:

S1, the first subject, ex-wife of an architect, is a media-specialist by profession and very concerned with the physical facilities which modern libraries require. She is familiar with the considerations involved in designing and evaluating buildings, but has no training in drawing.

In reading the program, she was surprised at the participatory nature of the classes in the small lecture space: " wow, laugh" (S1:1) and confused by the last parts of the program detailed MIT's role in the venture. She began designing by considering the site : " sigh, What a horrible place!... augh" (S1:1) and then began to analyze it in terms of available ground space equal to the building's programmed total requirements and of the

FIG. 4

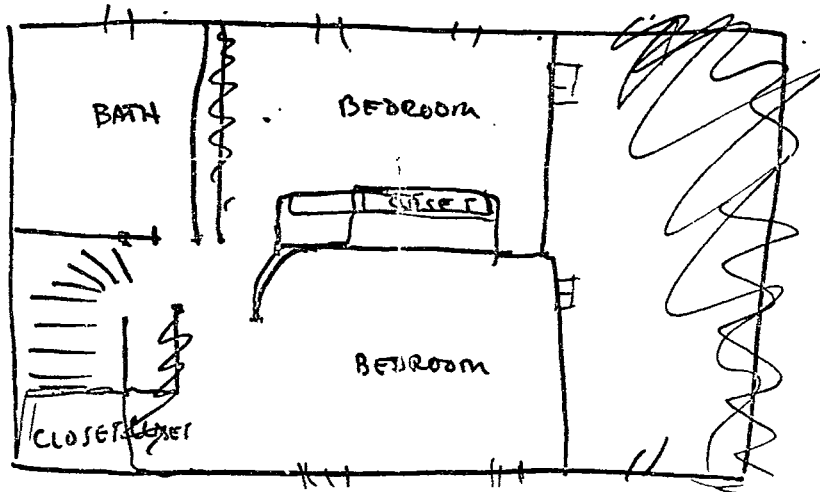
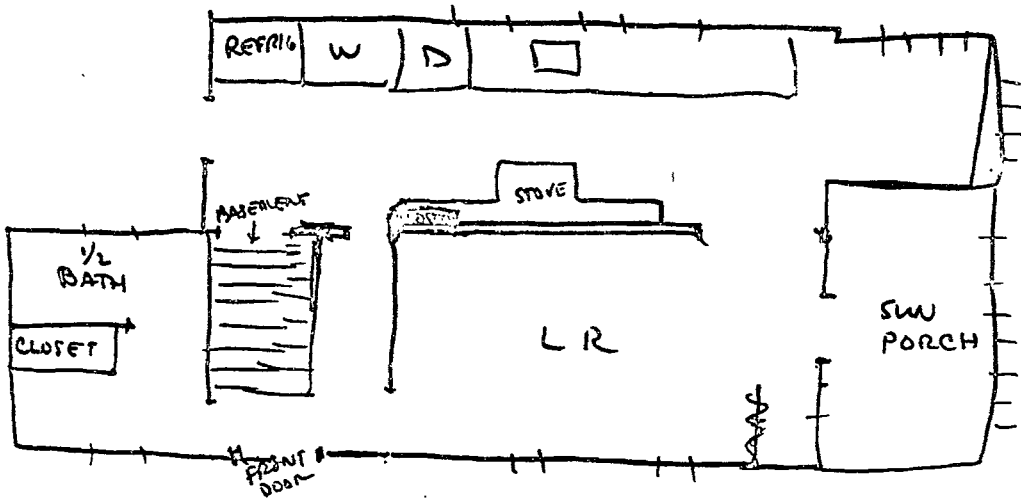
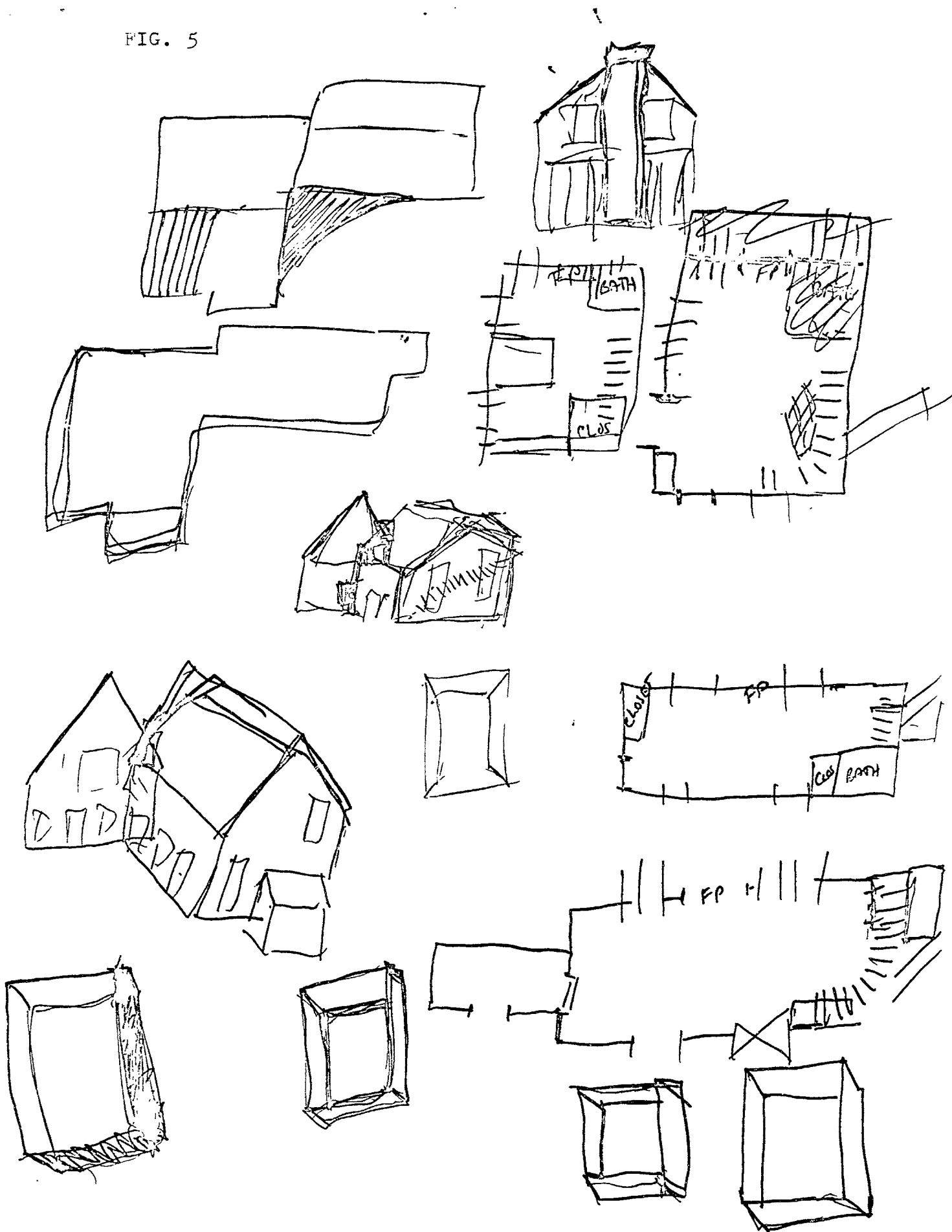


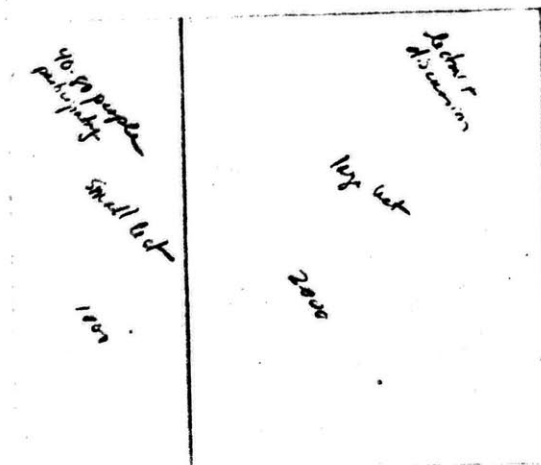
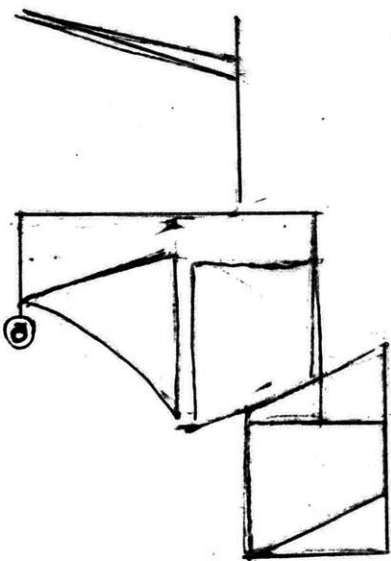
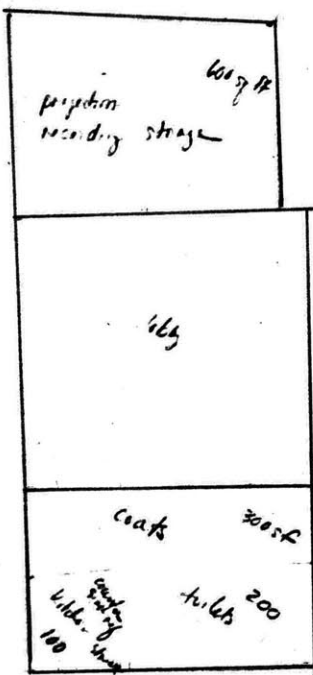
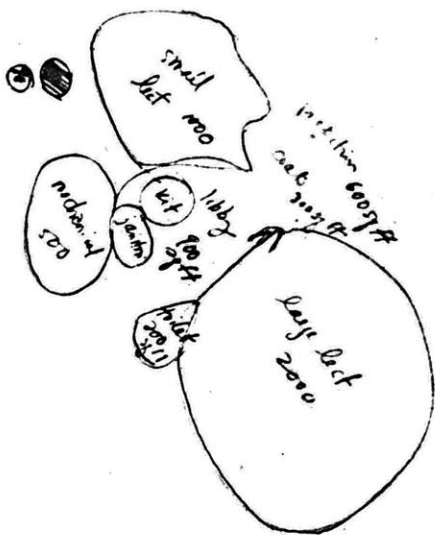
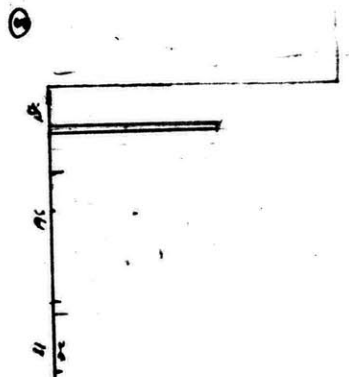
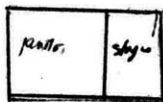
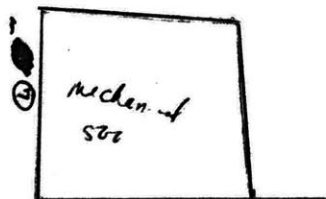
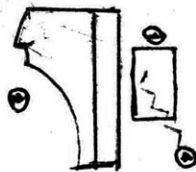
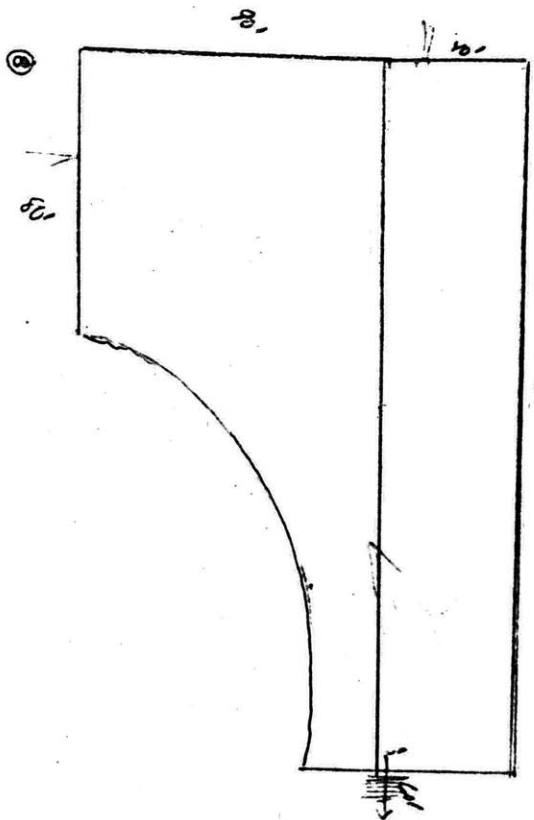
FIG. 5



visual character of the plaza; she soon settled on a site spanning Amherst Street, and with a sectional drawing considered how a building there would function. This was rejected because it adversely affected the dormitory rooms in Ashdown. She began to re-explore building location and finally settled on a spot southwest of Kresge Auditorium after saying the best one was between Massachusetts Avenue and the Student Center; the decision was made on the basis of available ground space to fit the proposed building on one story and to avoid visual intrusion into the plaza. Having discovered a sawtooth floor plan in the course of her site search, she used this analogy to lay out a lobby and relate the main functional spaces to it. This was not satisfactory to her and she decided to make a graphic comparison of program and site areas; unfamiliarity with drawing tools, especially the scale, slowed her down considerably. After a longer, but equally fruitless attempt at organizing a floor plan she remembered bubble diagrams and proceeded to make one. In the process, she introduced many considerations of use. This led to a more detailed floor plan also tested in terms of how people might use it; some tests also concerned functional adjacencies of space uses. A keystone analogy struck her and she was beginning to re-organize the plan geometry (while keeping track of required room dimensions) with a certain dash, when the time limit expired.

Her strategy was to site the building reasonably, develop workable-not- perfect floor plans, and later worry about three dimensional consequences, plan, massing, and elevation refinements.

FIG. 6: S1 Drawings



Unfamiliarity with tools hampered translation of her ideas into drawings; her verbal protocol is much richer than her drawings. Personally, she felt bothered not so much by lack of drafting skill as by inability to visualize in her mind the parts of the problem she knew were important. She spent most of her time trying to show things that crossed her mind rather than drawing or evaluating her form proposals. (See Appendix S1)

S2, the second experimental subject, had just completed the MIT M.Arch program. She worked in ^{an} architectural office the summer of her first year in school and has worked in rehabilitation, demolition, and construction other summers. Equipment troubles garbled her verbal protocol (which is not included in the appendix). The following reconstruction of her procedure is based on the notes I took as she worked plus some clear passages from the recording.

In reading the program she was struck by the requirement of "two different spaces..uhm,not necessarily". She began by making a small scale drawing of the building's ground coverage and after pushing it around the site plan almost immediately located the building with its main entrance off Amherst Street. She then laid out a dimensioned grid, as per her usual working method, and scaled off the required spaces to " see what they look like ". She then sketched a floor plan using the grid, tracing paper overlays, and a scale, making judgements mostly on the basis of functional adjacency requirements. She noticed a different entrance was possible than the one she had begun with and, in the process,

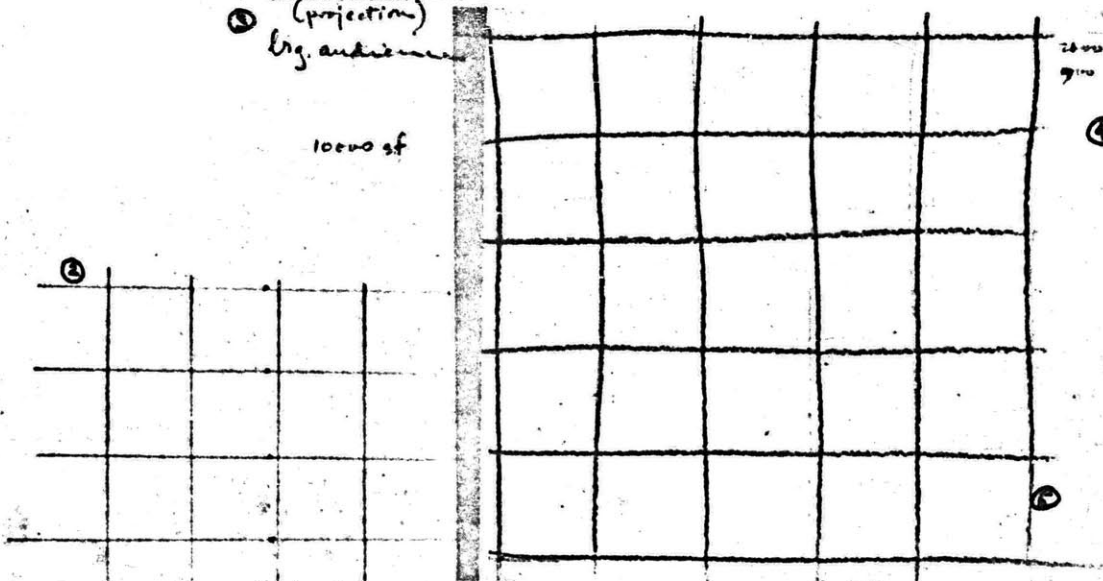
shifted the main rooms' axes, considered the location of the janitor's room, and decided the building needed two stories. With more tracing paper overlays, she adjusted the floor plans of the stairwell area until walls lined up on both floors and left circulation clear. This done, she transferred her ideas to 1/8 th inch scale and then returned to 1/16 th scale to continue rearranging the stairwell area to clarify the entrance and balcony- apparently guiding herself from the mental image of a building she had previously designed. A question about the disappearance of the projection booth prompted quick revision of floor plans with the first story undergoing the most changes; basically she arranged labelled areas within a rectangular envelope she was striving to maintain. Fire escapes were a brief and simple concern. The plan of the first story was firmed up with coat storage going in quite literally " the only place left" in the plan. She drew a section mostly for completeness of presentation and was beginning an oblique exterior perspective/elevation at the end of the two hours.

Her strategy was to quickly site the building " as a way of starting", then to sketch on graph paper to maintain space proportions and work out floor plans in detail by geometric rearrangements of dimensioned areas. Most of her effort was directed at achieving satisfactory adjacency relationships within an assumed envelope. Her next moves would have been to study structure and the possibilities it offered people in making use of the outside wall articulation. She quite clearly had a basic

FIG. 7 : S2 Drawings, a

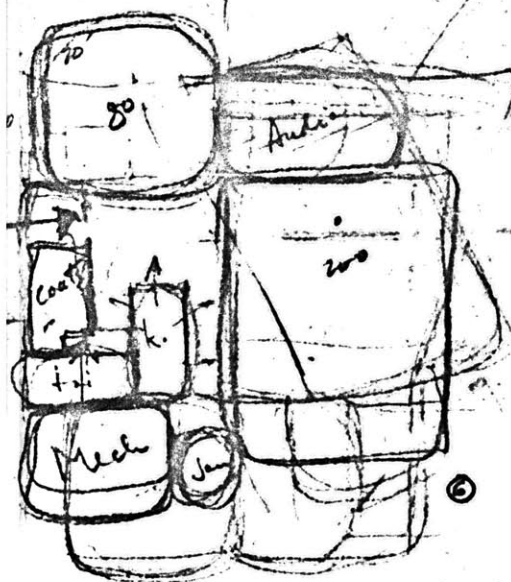
General
Lobby
aud. visual m.
(projection)
big audience

10000 sf

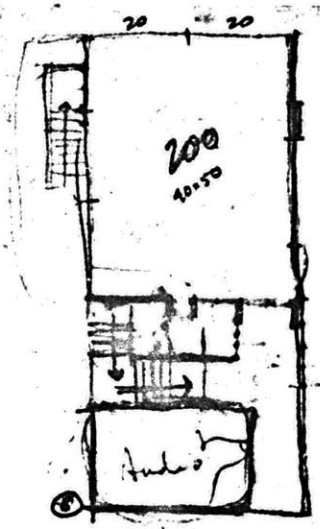
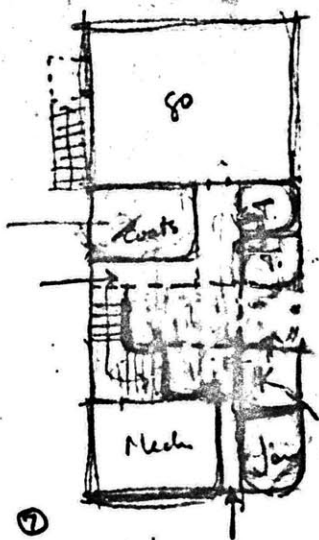


2000	200 people	50 x 60
900	90 people	
④	lobby	16 x 10
	tr.	10 x 20
	coat	15 x 20
	+	30 x 30
	aud. vis.	20 x 30
	janitor	10 x 10
	stor.	8 x 8
	mech.	25 x 20

TH SCALE

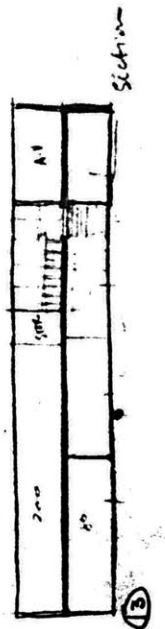
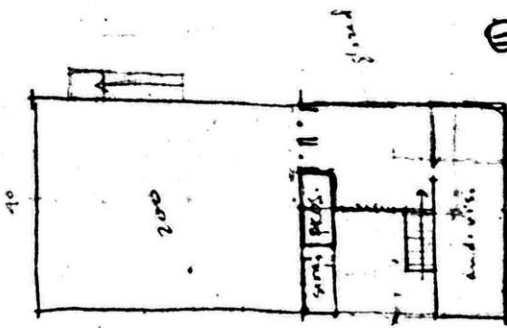
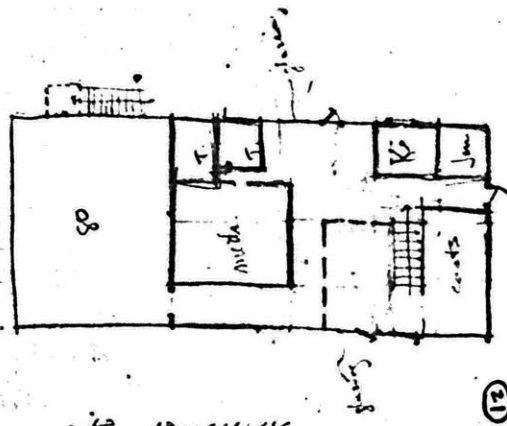
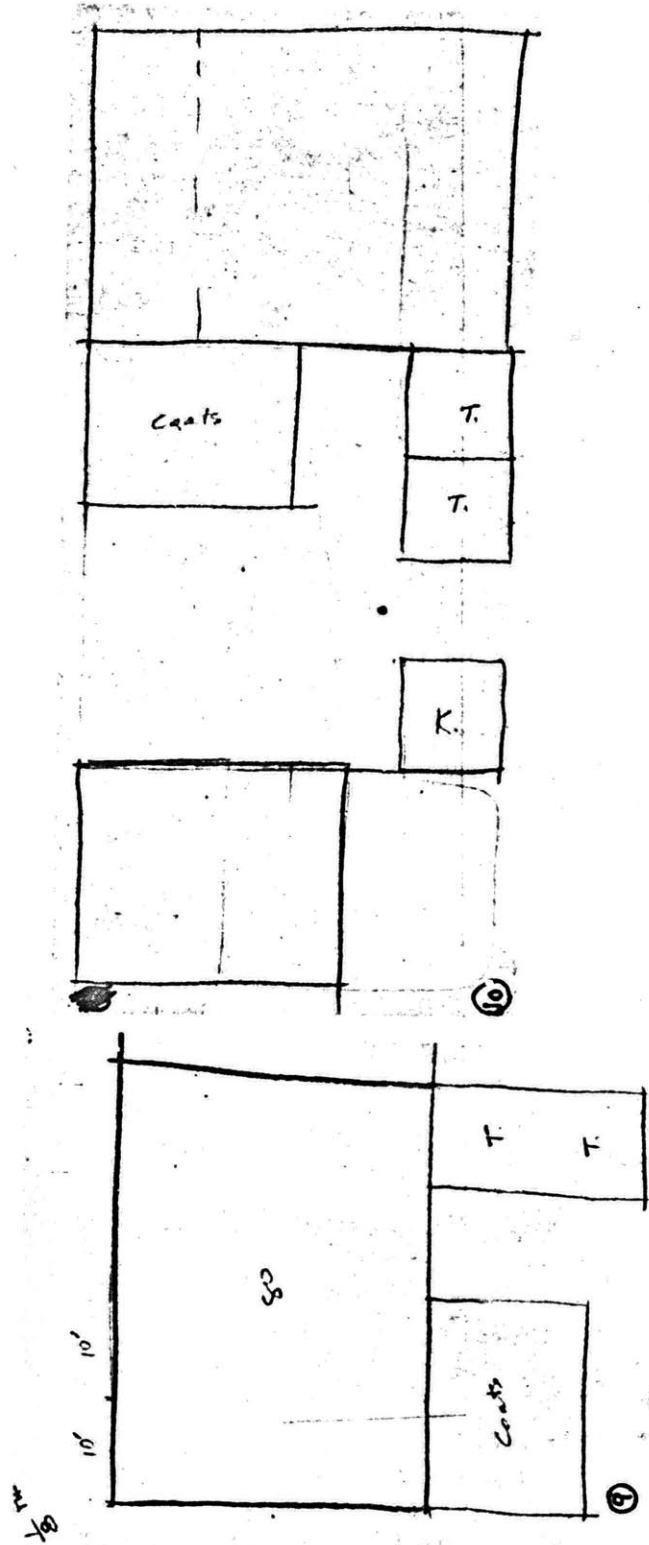


40 x 50
30 x 70
30 x 30



5/4 b.

FIG. 7 : S2 Drawings ,b



idea of the building's volume as a smooth parallelepiped and reported it. She used drawings primarily as a means of figuring out how pieces fit in plan and how such adjacencies affected space use and ease of construction.

S3 is a practicing architect about 30 years old with an M.Arch from Harvard. He has worked with several Boston and New York firms and is now designing private houses on an increasingly successful basis. He has also been involved in the design of posters and theater scenery.

He began by examining the program for site implications and the apparent complexity of uses of the proposed building. He also went through his known precedents for this kind of space use (mostly theaters and large academic halls). After this he made some diagrammatic floor plan sketches and soon found a basic feature to concentrate on: flexibly linked assembly spaces joined by a projection booth. He made a short excursion to study the site by replaying the experience of being there and stopped doing that once he had located the building. He then proceeded on a series of sketched variations of the basic feature of his proposal (leaving aside spaces he considered ancillary) until he reached a level of considerable frustration; insight resolving the floor plan impasse followed a few moments of busywork. After some more sketches following up the implications of the insight, a geometric analogy (L-shaped chevron) seemed to simplify form variations and made shape adjustments freer when the experiment ended.

FIG. 9 : S3 Drawings, b

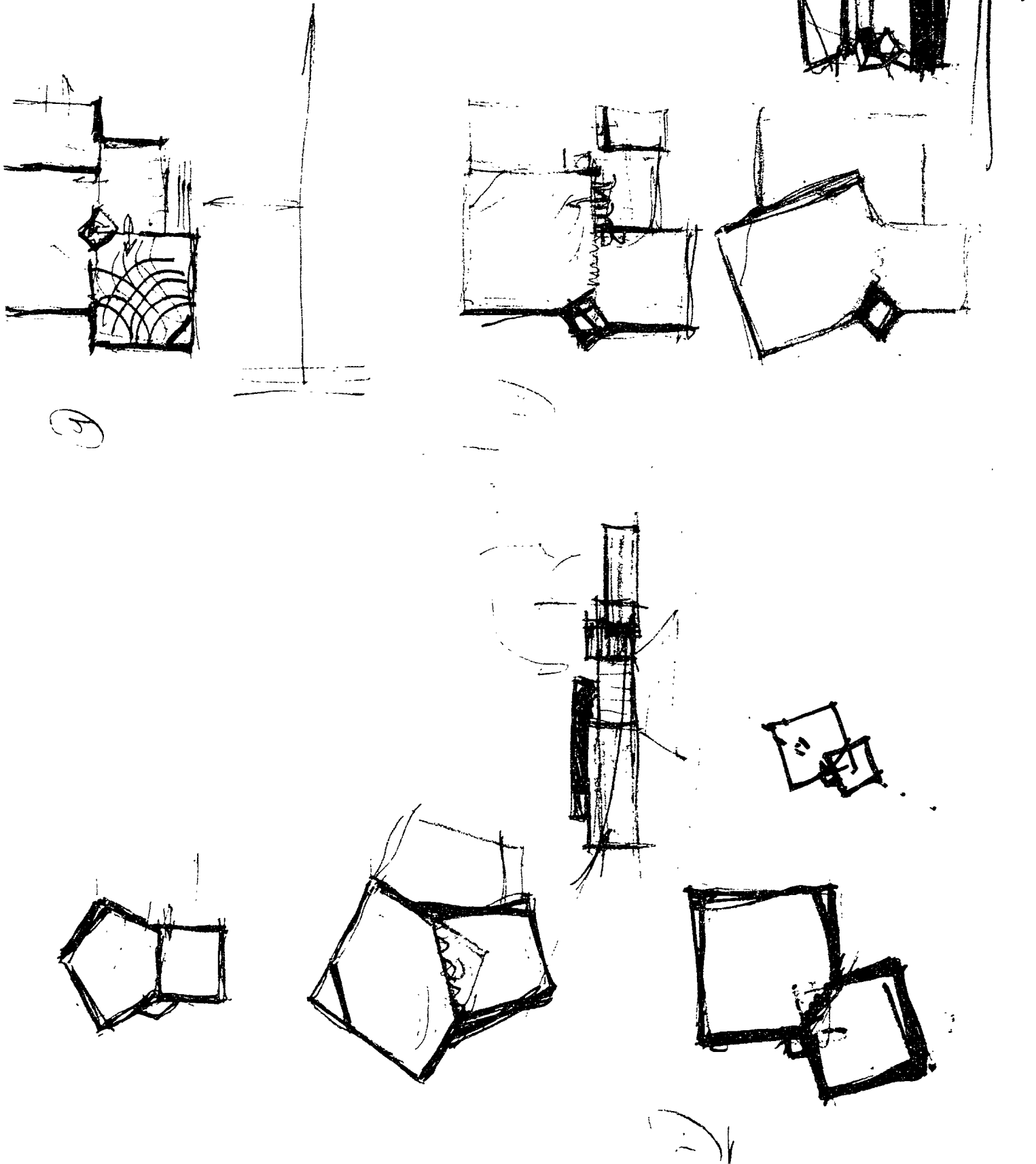
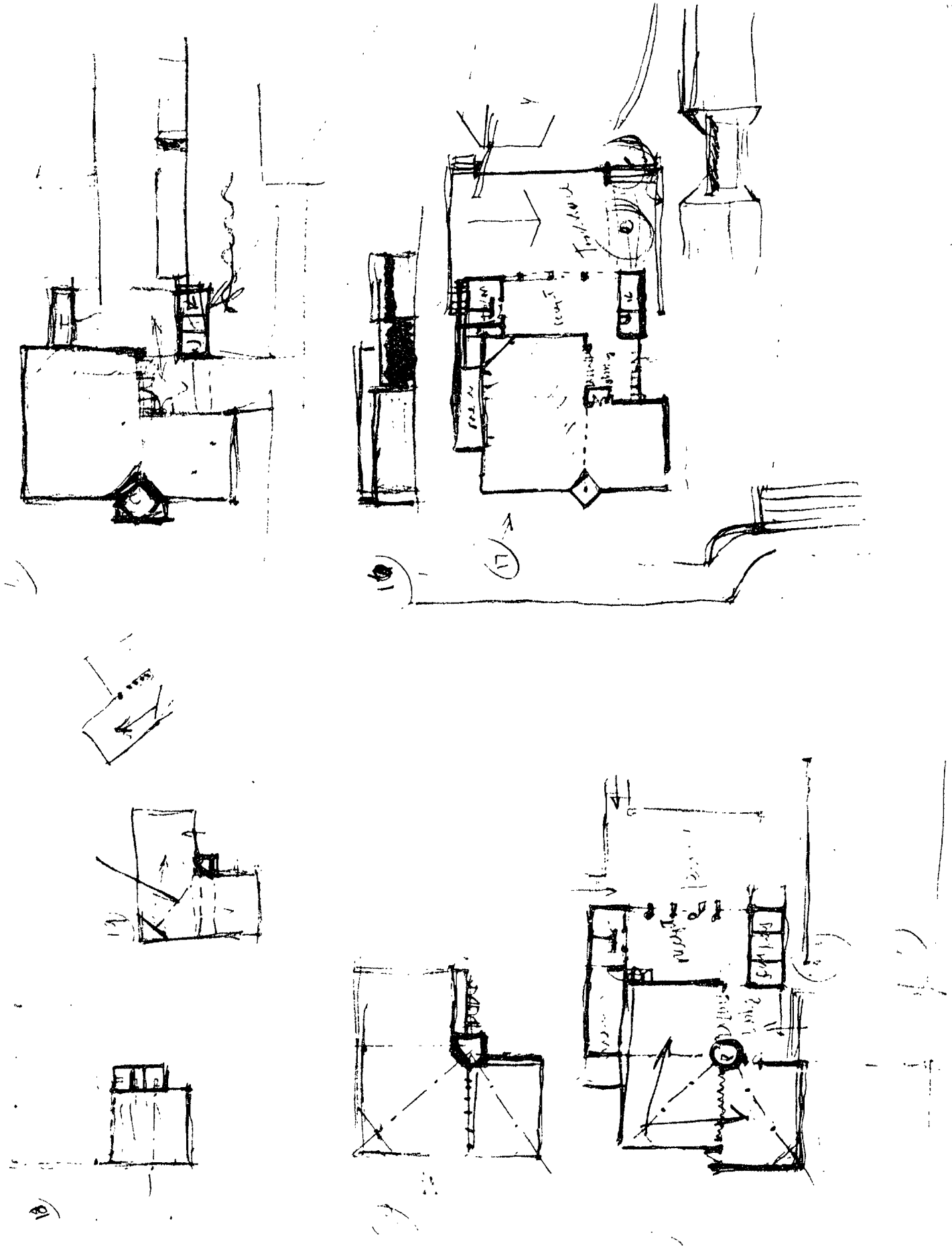


FIG. 10 : S3 Drawings, c



S3's procedure was to sketch floor plans, test them by a recreation of use incorporating both verbal and graphic techniques (e.g. seating and sight lines drawn out); occasionally he made perspective sketches to keep track of the impact of his plans on massing. Details of auxiliary space layouts and material specifications were produced when needed; he felt he could produce them on demand and so did not carry them into every explorative sketch.

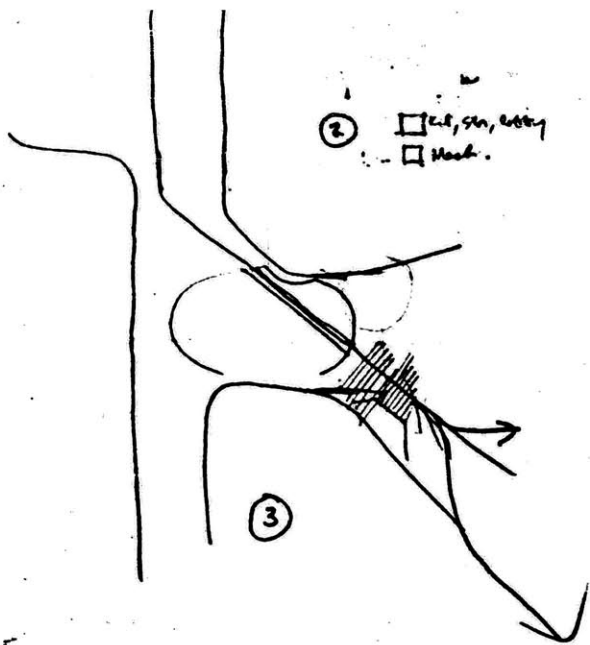
S3 deliberately begins working in plan because ^{he} feels that is how people use buildings; "it must work that way first". As reported, he used perspectives mostly as a check on the consequences of these primary efforts. He indicated that in later stages other considerations such as elevations, construction requirements, commercial availability of materials, etc., affected the proposed form in small ways. His main concern in the two hours was to develop a clear form ^{accommodating} circulation and photographic projection ^{and} which provided a pleasant, restful environment (e.g. the garden). (See Appendix 2)

S4 is a practicing architect and professor of architecture at MIT. He has been a partner in several firms and is the winner of several professional prizes for excellence of work.

He ^{egan} began by an extraordinarily prolonged examination and discussion of site considerations and uses. After a brief diagrammatic excursion into relative dimensions of building spaces and ground coverage versus available site area, he returned to extended exploration of the site, but more in terms of visual

considerations than before. This led to locating the building off Amherst Street and the development of form requirements for fitting into and improving the Student Center- Kresge Plaza area. He once again briefly concerned himself with program details and returned to site considerations in the guise of roof shape. By using analogies: bleachers, grassy slopes, pyramids, he sought to find an organizing form image for the building which also satisfied his own criteria of site use, appearance, and esthetic preferences. A digression on the impact of roof shapes on the building's interior was followed by a return to more exterior considerations which he always tested by means of perspective sketches overlaid on a view of the Plaza. Satisfied with his analysis of the situation, he would have preferred to stop work for the day. But, feeling time pressures, he went into a detailed interior study with plans and sections until near the two hour limit, further efforts seemed forced and he stopped working.

S4 made extensive use of perspective drawings and somewhat less of plans and sections. He called on a large number of varied precedents he already knew in evaluating possible solutions. He made many more form proposals, performed more tests, used more analogies more deliberately, and was much more explicitly aware of his creative process than the other subjects. He chose to work on the site in great detail because he felt the organization of the building was a trivial problem and also because he considered the plaza and not the facilities the real challenge. (Appendix 3)



57a

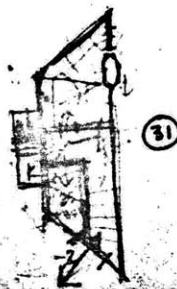
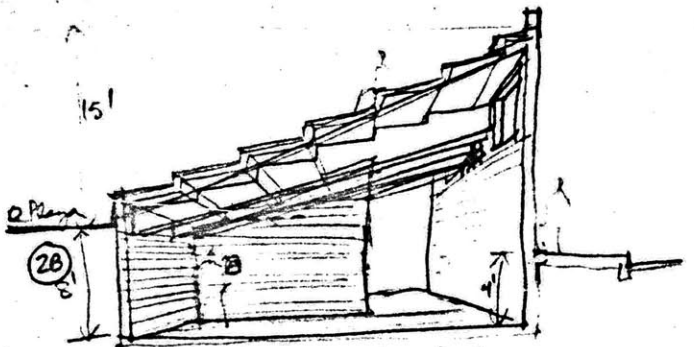
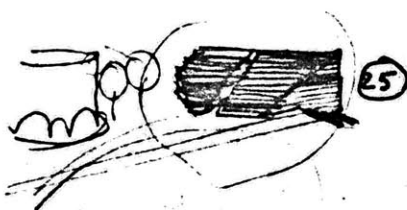
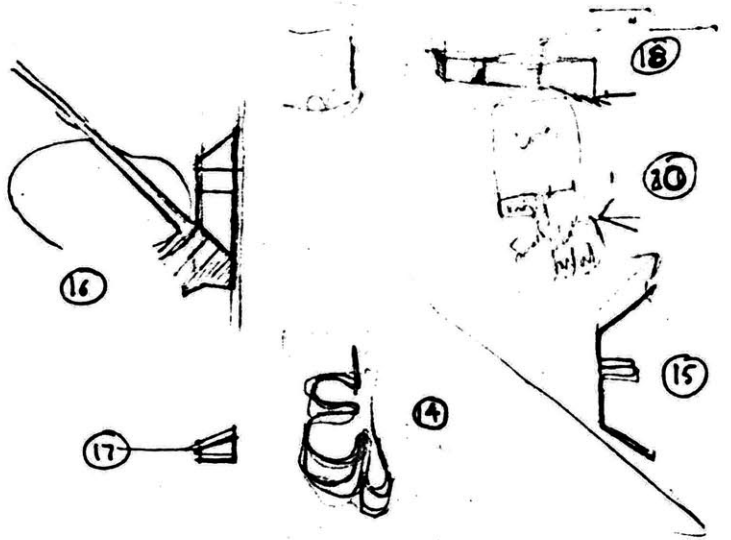
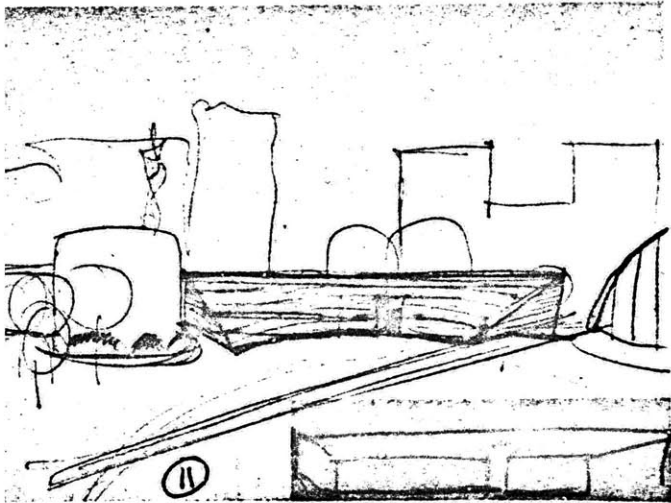
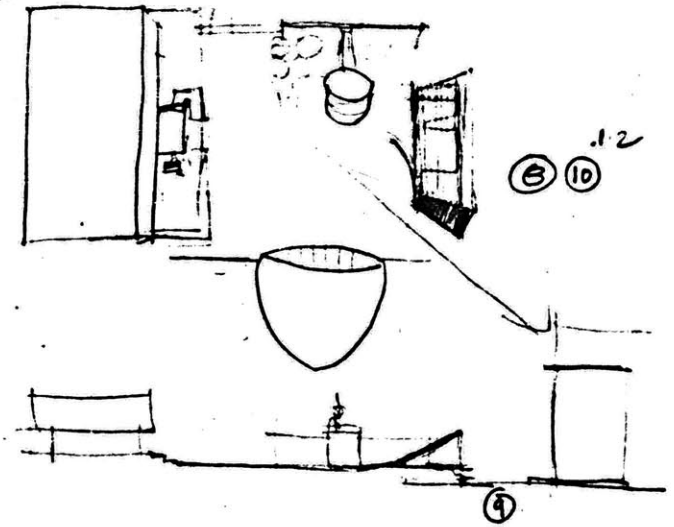


FIG. 11 : S4 Drawings

From the evidence of these subjects, parti design appears to be a way of making decisions about what to do in reality by simulating it. Designers strive to visualize what something would be like in order to be able to manipulate it. The more definite the object of their concern, either in the mind's eye or preferably in some external representation, the more design progresses. Designers are only able (?), willing (?), or comfortable (?) in testing an identifiable item. The more accurate and vivid that simulation of reality, the more varied and apt alternative solutions generated are and the easier decision making seems to be. From this evidence, visual representations are vastly more effective in supporting that activity than verbal recreations (compare S1 with S2,S3,S4). There is a distinct progression in vividness of graphic simulation with designer experience.

The increased use of drawings involves not only their increasing richness of information, but also an increase in their number and variety ~~of drawings~~. The first naive subject used drawings only to size and locate doors, windows, rooms, as items. The second subject did the same but also used drawings to record adjacency relationships of a list of items and places. The least experience designers S1,S2 used drawings to work out size and adjacency relationships of ideas they already had in mind; the more practiced S2 was more successful at this task. In addition to working out geometric plan relationships, the even more experienced S3 used drawings as a means of simulating potential

room uses more vividly; they originated in and were the occasion of internal discussions about how people behaved and wanted to feel in that kind of space. The most experienced designer, S4, did all of the above things, but in greater quantities. More than the others, he manipulated three dimensional graphic representations as if they were reality and saw more possibilities and suggestions in them than did the others. In short, there is an observable progression in internal and external three dimensional thought; it becomes more complete with greater experience.

The information load of the drawings included in the protocol summaries reflects the change from translation of abstract mental categories to working tool to quasi-reality. As a general rule, these designers only seem to include information they use in thinking on their working sketches. In other words, the purpose of drawings (and presumably models) differs with level of skill. The efforts of the naive subjects are directed at displaying a record of abstractions such as dimension or size or listing items; the distinction of functions is accomplished by verbal labels. With increasing designer skill/experience, drawings become ever more working tools and images of the objects they simulate. Differentiation of spaces, by means of graphic coding, furnishings, rendered materials and shadows appear as presentation devices and gradually become units of design thought. Simultaneously ~~with~~ with the increasing realism of the drawings, designers begin to treat these visual images more as single symbols rather than laboriously summing their parts into a single

label at each processing step. Representational media gradually become the reality with which designers deal; in a sense, they regain the unselfconscious design procedure of our ancestors.

A second general impression derived from these observations of designers at work is that design is better characterized as a learning activity than as an analytic dissection of a formal problem. It is primarily an effort of invention and simulation rather than selection between a finite set of alternatives. Part of design is an exploration through designer-chosen and interpreted context, using only that individual's mental resources and such external means of representation as he can muster. The insistence on individual subjective resources rather than logical ones may seem trivial until it is remembered that most rational design methods and architectural paradigms ignore it.

Designers do follow and develop rules, as locating buildings before designing their interiors, but the impact of those rules is not solely, or primarily, a function of their logical content. The designer's personal abilities and goals determine the product. The latter seem to vary with level of skill. Inexperienced designers are concerned with mastery of the architectural content: walls, volumes, shapes, structure, etc. Experienced designers, confident in their ability to deal with those mechanical aspects, are freer in manipulating them to achieve an effect whether in visual, spatial, or use terms. The designer's own confidence in his own skill seems to be a prerequisite for his creative exercise of it.

Discussion of Results

The ideas which suggested themselves in the course of protocol analysis are more varied than I had anticipated when I advanced some hypotheses in an earlier chapter. In reporting the former, I will go into details that clarify the evaluation of the latter. For this reason, I will discuss observed designer similarities and differences first. Because of the structure of the experiment, I have more confidence in reporting similarities of procedure displayed by designers than associating their differences with level of skill (see later discussion of experimental method for the reasons.). Consequently, I will discuss these two categories of observations separately.

Similarities: The aspects of designer behavior in part design that I observed to be common to all three levels of skill can be classed into four categories: 1) Basic approach, 2) Choice of problem space, 3) Design episode structure, and 4) Information processing characteristics.

1) As already mentioned, design is performed as a simulation process. All of the observed designers shared the strategy of first locating a building site, then defining the functional relationships of the building, and lastly of transforming these ideas first into floorplans, then into three-dimensional form descriptions. The guiding idea is literally: from the ground up . They evaluated the merits of possible solution paths and form proposals by 1) verbal recall of instances they knew of

similar space uses and comparing them, 2) testing geometric congruence and numerical measurements, 3) emotional appeal to the designer, and 4) comparison of proposal to the designer's perceived peer group standards/ideals. Another way to put it is to say that designers perform two basic kinds of tests on their proposals: those concerned with architectural consistency, e.g. structural integrity, exit requirements, seating dimensions, etc., and those concerned with the consistency of the proposal to various contexts the designer shares with other people. These remarks should not be taken to mean that the content of these events is the same for all designers, only that these are categories of thought which they all use.

In this experiment subjects were restricted to using drawings, their hands, and their mind's eye in simulating three dimensions. All first developed spatial concepts/images in their minds and then used drawings to represent that idea. They also used drawings as evidence to display the form proposals while they judged their merits on several dimensions and, occasionally, as springboards suggesting new form arrangements. Again, this is not to say that all levels of skill put equal emphasis or content into each category.

2) Problem spaces were quickly^k chosen in each of two strategic categories: site and building character. For the former S1 wanted something visually unintrusive; S2 stuck to a literal interpretation of the givens of the problem; so did S3 and S4, but their consideration of consequences for the public space

were much more elaborate. For the latter, S1 never really chose and never really made a form proposal; S2 wanted a smooth exterior volume and worked within it; S3 sought flexible, theater-like assembly spaces throughout; and S4 worked consistently from roof shape considerations. Two hours is apparently not enough time to explore many alternative form proposals, although the more skilled designers generated and tested many more possibilities.

Choice of problem space appears to have two aspects: A) comparison of apparent problem complexity to a personal estimate of skill, and B) some program requirement suggests a pre-solution model. Whatever the designer is entirely confident of being able to produce is put aside until needed (S3 seemed to pull ancillary spaces out of the air when needed to fill out drawings; S4 left the building interior alone for a long time because he did not consider it complicated). The designer then concentrates his efforts on something recognizably unfamiliar (the lobby and small lecture room for S1; the stairwell area for S2; the flexible spaces for S3; the site conditions for S4).

Demonstrating reliance on a pre-solution model to guide problem solving is straightforward. S1 , a media specialist, concentrated on the lobby, joint projection facilities, and flexible use of the smaller classroom; S2, an architectural student, recalled a previous building design; S3 , experienced in theater productions sought theater-like spaces; S4, experienced in harmonizing houses into landscapes, looked to the site for form guidance. Designers clearly interpret the new in terms of exp-

riences already stored in memory, somewhat as de Bono suggests. Explaining the function of these mysteriously activated LTM precedents is a speculative exercise.

It seems to me that exploring the program and site recalls some previous solutions or solution programs to the designer's attention. It is not quite an instantaneous choice, but compared to other decisions in the design process it is quick indeed. I suspect that structural features of these precedents are used as guides or templates for analyzing or developing form proposals in terms of program requirements; a similar procedure seems to hold for subproblems. A designer chooses^o problem space on the basis of his known precedents and then explores the problem in terms of the features of that pre-existing pattern. At some undefined point, the new idea develops its own identity; I suspect this is reflected by a sense of greater freedom in exploring variations. The only evidence I can advance for this interpretation of the use of previous knowledge is introspection. I am nevertheless quite sure the designer does not simply invent the first few proposals with which he explores the problem.

3) A design episode or sentence akin to Simon and Newell's knowledge state can be postulated as the basic unit of partial design activity. The designers in this study consistently proceeded by finding an aspect to work on via an LTM-supplied solution model. The recall of precedent is not logical in the sense of functional requirements, but based on some personal associations

of the designer's memory (which makes them unpredictable in a **formal** sense). Verbal protocols consistently display exploration of these precedents, but the drawings do not reflect that search; they start with a proposed form or plan. I suspect some procedure such as that described at the end of the previous section is responsible. Given this pre-solution model, designers proceed to explore the problem requirements.

Jigsaw puzzle solving is a good analogy for the basic episode of parti design except that the end product is not predetermined. For reasons which need further research, designers use some personal interpretation of the problem as a piece to which they attempt to fit/match other requirements. Abandoning this guide takes some major negative feedback implicitly expressed in such summary judgements as " It doesn't work" (S3 replying to the question of why he gave up an alternative) or " Sigh, doesn't do things I'd like it to." (S1;12). The protocols and introspection indicate that these evaluations are not exclusively verbal and so somewhat inaccessible.

The jigsaw procedure takes place on two fronts: inner speech and drawings. Although the designer seems to be verbally aware of a long list of aspects to check out (for example S4's consideration of the layout requirements of the big lecture room; pp. S4: 18-19), testing of graphic representations seems to proceed one aspect at a time. (S1 systematically examined every part of the site to locate her building; S2 worked through every possible geometric arrangement of functions within her lobby

envelope; S3 varied room shapes around a fixed projection booth location; S4 varied roof shapes and the layout of the large lecture hall aspect by aspect until he was satisfied). Essentially, what happens is that precedents culled from LTM are ~~not~~ processed one at a time rather than listed and tested in sequence. It does not seem to matter whether the focus of attention is a small aspect of the ensemble or the entire building as a unit; one symbol is dealt with at a time just as Simon and Newell report in their studies, and de Bono implies in his model.

The incremental functioning of the jigsaw procedure appears to hold for both analytic and poetic modes of working with drawings. In going from one sketch to the other, designers change only one aspect at a time (e.g. the succession of S3's first sketches). In the examples cited above, the designers varied these features systematically in order to select one of the possible outcomes- clearly an analytic, logical procedure applied to questions of architectural congruence. Where evaluation of use or context are concerned the subjects behaved otherwise.

The only convincing test of the effectiveness of a form proposal is to build and use it full scale. This is precisely what self-conscious design processes attempt to avoid. Nevertheless, both skilled and unskilled designers have to evaluate their parti proposals. While the former has a more informed judgement, he is not -logically speaking- more certain of its accuracy than his less experienced colleague. I suspect the reason S4 made many more decisions than S1 is that he applied

many more tests to each question. If the value of any given test is uncertain, people rely on the direction indicated by a preponderance of reasonable test outcomes. The greater the repertory of tests (within some undefined overload limits), the easier it is to make decisions. Evaluation of contextual appropriateness are, I believe, performed as summations of tests applied.

To recapitulate, the consistent basic unit of parti design is jigsaw exploration and adaptation of the structural features of an LTM-supplied model to the given problem conditions. Form proposals are borrowed/invented, tested, varied, and built-up on an incremental change basis. Architectural congruence tests are analytic and contextual congruence decisions are made on the basis of the sum of favorable or unfavorable outcomes of LTM-supplied tests.

4) Information Processing Characteristics: As expected, designers displayed similar information processing traits. Already discussed are the uses of LTM contents in guiding search and testing proposals. There are also LTM programs for proceeding from one step to another; designers share concerns about circulation, structure, visual coherence, etc.. When stymied, they direct themselves by reference to already stored precedents for dealing with that kind of situation : S1 turned to bubble diagrams, S2 to the stairwell/balcony area of a previous design, S3 to the strategy of breaking the square, S4 to inserting the projection booth into the wall like L.Kahn, or

to their own growing set of private rules of procedure: where to begin, what to emphasize, etc.. In short, all of the designers' guides seem to come from LTM rather than being developed ad-hoc; this confirms Simon and Newell's observation that this technique is more economical of effort for human problem solvers.

What Simon and Newell call a rehearsal process: the repetition of thought elements, phrases, and connective words within a single train of thought is very common:

S1:6 " Ahn, I was thinking that, that if you have a kind of sawtooth arrangement here, ah, one way the, the teeth might be used for is, is for discussion areas, ahm.. just kind of informal discussion areas."

S3:8 " it's not a..it's and it's, this maybe works a little bit; it's, it's not, it doesn't lead to handsome relationships those other spaces so...uh ...let us start from the other end and see, and see how, start from the other end; it doesn't work. Make it work and see if I can adjust the other things."

S4:1 " What might be useful over there? What I have in mind particular would, ah, would this, since it is in a , in a rather public area; would this for example be placed to..."

This two steps-forward, one-step backward looping pattern occurs most consistently with attempts to direct a train of thought; it seems to be the mind's way of keeping attention focused on a single aspect of the problem.

To exit from one jigsaw procedure and enter another, i.e. change knowledge states in Simon and Newell's terms, designers seem to require some bleeding-off of tension by emotional, muscular, or mental release, .e.g. a sigh , a yawn or stretch, a diversion or joke. This observation fits in with Abercrombie's

remarks that learning and thinking are whole-body activities²⁹. It is tempting to speculate about mind/body interactions, but it would be a digression in this context.

Major shifts of attention from one concern to another are marked by a tension release of the type mentioned above (e.g., sigh), a pause (....), and then a new focus for solution efforts:

S1:9 " Yea, I don't think it would be such a good idea to put a two story, even a two story building there... sigh. Just thinking that I hadn't done that little planning diagram sigh ... This was all 3000 wasn't it?"

S3:4 " Well, this is no good, because the natural projection spot if, if these things went like that and then his, at the perm, at the common wall sigh So this, ah, let's try it again XXXX thinking of XXX a big, big." (XXXX denotes drawing activity)

S4:3 " And I really hate to cut into that...because that thing seems to work as a general recreational field...uhm... there seems to be a major circulation path that comes...up from 77 Mass.Ave, goes.."

During the pause no inner speech is evident from protocols or introspection. I suspect a sorting procedure is going on whose result is a new test, some new way to seek a solution (not the form of the solution itself), or a new area of concern. It seems as if there are thought kernels which require time for reaching consciousness and verbal translation. These remarks are not intended to imply that every pause or tension release reflects a shift of concern, only that such demonstrations seem to accompany them in a consistent fashion.

In general, a designer who notices an oversight in his procedure, e.g. S3 forgetting mechanical spaces, only reacts

after performing some well-known intermediate task, e.g. S3 dotting grass on that same occasion. Again, I suspect this has to do with clearing consciousness for appeal to some LTM program. It is as if the mind had a pointer mechanism which required intermediary events between shifts of attention.

Insight seems to occur shortly, but not always immediately, after some period of frustration which seems a larger scale, more intense version of the tension built-up in subproblem searches and released by sighs, yawns, and the like. Insight occurs in a moment of inattention defined as a pause from directed thought by either silence, diversion, or automatic motor activity such as dotting grass, rendering shadows, etc.. I suspect this allows clearing of consciousness of its previous contents for the introduction of novelty - which seems to be an incremental synthesis of one or two aspects of the problem. If the symbols in question are very condensed representations of the problem, insight will have a more dramatic impact than if the symbols refer to the entrance detail of a room. It seems to me ^{the} process is the same: incremental restructuring of one or two features of whatever symbol is being paid attention to. This explanation does not account for extended periods of incubation and flashes of insight in subjects unrelated to what one is doing; but the subjects did not display any such behavior. In these experiments, insight seemed to be about how to go about getting a solution : " I know what I'm going to do next" is the typical expression. In this respect,

the evidence of these protocols is similar to that of de Groot's chess player studies who saw ways to figure out moves rather than the moves themselves.³⁰

Finally, it seems necessary for designers to feel some kind of completion pressure to mobilize their imagination. In this situation, time pressure was the driving force; subjects looked at watches, wondered how much time they had left, asked if it was late, and so on. A sense of urgency is necessary for problem solving. I suspect this has some relation to the mind/body connection mentioned earlier.

Differences: The evidence gathered in these observations of designer behavior does not, strictly speaking, warrant asserting that observed differences of designer procedure correlate with differences in skill/experience. My own experience in design and discussions with other architects lead me to make educated guesses that some of these differences are significant; a more complex series of experiments - discussed in a later chapter - are needed ~~needed~~ to confirm or deny these hunches. The differences which I believe are due to designer skill can be classed into two broad categories: 1) Procedure in the use of representational media, and 2) The actual contents of the design process steps.

1) I observed three main kinds of procedural differences among designers of different levels of skill/experience: A) By comparison to the less experienced, the skilled designer delays arrival at a building form proposal. Is this because his greater

confidence in his skill enables him to be freer in considering options? Or is it that exterior conditions were the most significant aspect of this sketch problem? B) He makes more tests of the ideas that occur to him; he calls upon a greater and more varied repertory of LPM precedents than his less experienced colleague. C) He uses three dimensional representation modes more often, more quickly, more realistically; the drawings themselves become an active part of information processing rather than displays of completed steps; they become more one of the phrases in the basic episode/sentence of design activity described earlier.

The totally naive designer uses outline drawings and relies on verbal labels for information rather than image similarity to the object in question. Most, if not all, of his working information is held and tested simultaneously in consciousness. Three dimensional coordination of plans, elevations, sections, etc., is likewise performed entirely internally. The STM overload is evident and has several unfortunate consequences. First, the naive designer is confused between goals, problem requirements, and possible solutions. Second, whenever his attention shifts, he loses track of what he had in mind before and must return again and again to recreate it. Third, he cannot evaluate or improve his form proposals in an orderly manner because he cannot see them as wholes; the repercussions of changes or occasions for them cannot be determined economically; he misses *(i.e. visually)* all the simulation benefits of external memory representations.

Fourth, he restricts himself to verbal and unconscious manipulations of data which are, I suspect, more difficult to condense, architecturally speaking, into single symbols/chunks than visual images. The basic difficulty of the unskilled designer is that he tries to do too many things simultaneously inside his head, possibly because he feels he cannot draw well.

The moderately experienced designer seems to use drawings to work out the physical relationships he is considering. In order of preference, this is achieved by using: floor plans, elevations, perspectives, sections. Most of the effort of coordinating three dimensions is still carried on internally. The rendering of drawings, furnishings, and materials is more a decorative afterthought than a way of labelling images.

The more experienced designer (or the less experienced dealing with an area of expertise) attempts rather more deliberately to externalize as many of his form proposals as he can ; he tends to put as many of them as possible into three dimensional rendered drawings. Thus the more constant use of furnished floor plans and perspectives and sections (S3,S4). These representations are used much more as cases for judgement than for display. Working out physical relationships in plan becomes a routine ability leaving attention free to test the proposal on other grounds than matching a mental image or architectural consistency.

The most skilled designers seem to structure both perception and imagination directly into the coding symbols used

in their sketches. They perform the same activities as other designers, but they do it in what appears to be larger chunks. The poor are poor, but the rich get richer.

2) If I may suggest a trend, it is that with greater experience/skill designers develop a larger repertory of techniques and approaches to use in problem solving. The benefits of this of this state of affairs are not merely those of a dictionary, i.e. a larger number of precedents to call upon; rather it is that structural features of these vocabularies, particularly those of three dimensional representation, begin to structure both perception and imagination. The coordination of plan, section, elevation, etc., becomes more and more automatic. Certain aspects of buildings or ways of thinking about them become chunked; they are grasped as units instead of being accretions of separate parts.

The greater use of drawings directly analogous to the physical reality being simulated by skilled designers suggests that these drawings carry information more efficiently than other media. As previously mentioned, I believe that this reflects the greater efficiency of images in correlating many different kinds of information.

Directly correlated with experience is greater knowledge of one's own efficient design procedure. The less experienced subjects kept working without pause; S3 by contrast would often pause for a few puffs on his cigar and S4 directly expressed a preference for stopping until the next day. Consciously and/or un-

consciously, the abler designer picks good moments to keep pushing a line of enquiry, to test, to shift attention, or to leave things alone. His use of his larger repertory allows him to separate functions which the less experienced person carries on simultaneously. He externalizes architectural ideas into external memory devices and uses his internal resources to think about thing at a time.

The approach of the more experienced designer to problem solving is distinctly more relaxed, detailed, and vivid in simulating how people would use a proposed form. I am tempted to say that with experience the goals of the designer shift from those of solving physical organization problems to those of providing appropriate responses to user needs and esthetic preferences. The difference of emphasis seems to free designers for more flexible consideration of possible form organizations. I suspect much of the this freedom comes from the confidence in one's ability to organize architectural form.

I have refrained from discussing differences in designer ability for two reasons. This particular experiment provides no finished product whose quality can be assigned by a jury of architects or potential users. It also only gives a single instance of a designer's performance in a somewhat artificial situation. My guess is that talent consists of innate mental powers for chunking and coordinating three dimensional information. In other words, some designers think more naturally in three dimensions. I hesitate to go futher on the basis of such small samples .

Hypotheses: The similarities and differences detailed in the previous sections provide a basis for evaluating the hypotheses about skilled designer behavior advanced at the end of the first part of this study. While the protocols confirm that in general greater skill is accompanied by greater adaptation to human IPS limitations, the five specific hypotheses are somewhat modified as follows:

First, selection of problem space is not delayed in proportion to designer skill; commitment to a particular approach is delayed whether this concerns site selection or form proposal. The delay of the decision is due to the larger number of tests applied in evaluation and to a more relaxed attitude towards the generation of alternatives: the first straw need not be clutched .

Second, in an impasse none of the designers considered or evaluated their goals explicitly. Instead they compared potential space uses or form with precedents known to them. Goal review is implicit by comparison to the LTM model; yet it performs the same go-no-go function as an analysis which dissects phenomena into logical mechanisms.

Third, the more experienced designer not only externalizes his thoughts more, but ,as already reported, does so in greater detail.

Fourth, the more experienced/skilled designer consistently proceeds by examining form or functional relationships by means of drawings; then , in a separate mental act, he tests it. The

kind of drawing used is a more direct representation of reality; it is both more three-dimensional and more image-like. The evidence is only circumstantial, but the effect of these operations is to keep STM free of bookkeeping tasks and of simultaneous operations. Full STM capacity is available for incremental acts of invention, variation, or testing.

Fifth, although the evidence is once again circumstantial, it is clear that more skilled designers have a larger and better structured repertory of facts at their command. This is evident not only in the way they test proposals, but also in their evaluation of site conditions, and in the higher level of organization shown by their first tries at a floor plan (compare the first efforts of S1, S2, S3, S4). The richness of their simulations argues for a different level of perception.

Architectural and Problem Solving Models: Finally, I should like to make some brief remarks about the models of designer behavior discussed in the first part of this study. By speaking only of designers in general, the inspirational model gives no clue as to what a good designer does that a less able one does not. Alexander recognizes differences and proposes to overcome them by rational procedure; the problem solving behavior of the designers observed in this experiment does not support his expectations. The analytic/poetic distinction was likewise unsupported as identifying major parti design problem solving modes. Designers behaved much more as de Bono's model suggests: memory associations picked areas for systematic rational analysis. Neither

this model nor Simon and Newell's suggested how differences of designer skill might be accounted for. However, the latter provides powerful tools for understanding designer behavior in the parti stage; the assignment of mental processing to three different functions: STM, LTM, and EM is particularly useful. My observations have confirmed Simon and Newell's conclusions. These experiments also suggest extensions of their findings to include the necessity of tension release to clear STM and the impact of the problem solver's confidence in his ability and resources in freeing him to consider a variety of possible approaches.

Consequences for Teaching and Practice

In this section, I want to summarize some theoretical issues I have pursued in this study and consider their practical consequences for teaching and practice. The former concerns itself with the characteristics of explanations of designer behavior which can function as practical design aids. The latter consists of advice which I believe to meet those requirements. Then I present some speculations awakened by these efforts.

I believe that explanation of an activity is most effective when stated in terms of its actor's internal experienceⁱⁿ manipulating the categories of knowledge and techniques associated with it. It seems to me^{that} this places a fundamental requirement on design methods that^{they} be stated in terms of and reflect how designers think about architectural issues. A second requirement

is that the explanation provide the designer not only with a description of the steps he is to through, but also with the mechanisms which underlie that choice. This is intended to free him from slavish adherence to methods by giving him the resources to adapt his procedure to unexpected circumstances. A student needs to know why perspectives are drawn if he is not to consider them mere presentation devices.

In the first part of this study, I sought to discover reasons for which conventional architectural models of parti design fail to satisfy these requirements. Briefly stated, the reasons are a traditional concern with practically unverifiable properties of the architectural product and a willful disregard or misconstruction of the mental mechanisms involved in problem solving behavior. An unfortunate result of these attitudes is the lack of shareable architectural paradigms which a community of practitioners can debate rationally and on which more reasonable teaching methods than those I experienced could be based.

It seemed to me that the area of architecture most accessible to this kind of study was in studying how designers worked in the parti stage. Investigating this activity led me to psychological problem solving models and finally to a brief experiment. The discussion of the results of these observations suggests a description of designer behavior which can, I believe, act as a practical design aid for the student and, possibly, the practitioner.

Perhaps the simplest way to put the suggestions I have

for improving the effectiveness of architectural education into perspective is to first present my understanding of how a skilled designer operates in parti design.

It seems to me that the designer is asked to define a problem and develop an answer by a simulation procedure. The better that representation of reality, the more vividly (yet with some detachment) he can experience it, the easier his problems of invention and decision-making will be. His resources are his memories, repertory of techniques, and representational media imbedded in a mental apparatus with specific limitations.

In solving a design problem or subproblem, he guides himself by some pre-learned strategy he believes appropriate to his task and goals. Studying the material triggers some LTM association in that area which, coupled to his estimate of skill vs. problem complexity, results in a (choice of) problem space. He then proceeds by using LTM-supplied models as templates for whose features he finds counterparts in the problem givens. This process takes place one feature at a time like the solving of jigsaw puzzles. New features are tested one at a time on as many dimensions of architectural and contextual congruence as the designer can summon without confusing himself. Eventually, the problem develops features and patterns of its own which free him to respond more imaginatively to its requirements.

All of these operations are simplified insofar as he can

separate the occurrence of strategic ideas, architectural inventions, and test performance in STM. The less it is occupied with bookkeeping chores, the more it is available for evaluation; his fundamental strategy is to occupy consciousness with as few different things as possible at any one time and to perform different operations sequentially. To this end, the skilled designer externalizes architectural ideas into representational media as directly analogous to the three-dimensional aspects of physical reality as possible; he also makes these representations as vivid and image-like as is consistent with speed. Besides freeing STM of another chore, this method means spatial information is automatically coordinated and can be grasped in STM as a single chunk.

Finally, the skilled designer tends to have some regard for his creative process. He encourages it by striving for vividness of simulation, use of structural analogies, and managing his exploration of the problem rather than compulsively attending to it. He provides himself with opportunities to release some of the tension built up in problem solving and allows for incubation time in his working schedule.

One of the first questions that comes to mind is whether the gaps between skilled and unskilled designer behavior can be quickly bridged? Can one, as it were, cram a repertory of techniques, precedents, and representational media practice into a student and expect, mirabile dictu, better performance after a short period of confusion? It seems to me that what we describe

as designer skill is an overlay of experience and practice on some still mysterious innate abilities. The effect of greater experience is not merely quantitative; it seems to condense knowledge into stimuli chunks which are not only accessed into consciousness as single units but also structure memory, perception, and imagination. Quantity of knowledge, is an asset, especially if it is structured information; but it is not by itself sufficient to improve performance. A designer has to assimilate a repertory before he can use it flexibly; it takes time and practice to obtain this confidence. What, in these circumstances, can the student designer be told?

I would begin by presenting him with some explanation of skilled designer behavior such as the above, if only to give him a clear ideal. Then I would tell him that designers have two distinct sorts of media at their command: those which abstract the physical properties of reality and those by which we make value judgements about parti proposals. In the first case, graphic media and models are analogous to the properties they represent and manipulating them is an economical method of performing experiments. In the second case, there is no intermediary symbolic language between the event and the reaction; it is much harder to distinguish the typical from the immediately experienced. Drawings and models are used to perform tests of architectural congruence, but the evaluation of proposals is based on subjective perceptions rather than logical relations.

Then, I would introduce the student to the limitations of the human information processing mechanism. My emphasis would be on ways to keep STM free of bookkeeping tasks and of ways to encourage stimuli chunking. The basic device would be the insistence on use of three dimensional drawings and models as working tools. I would hope that the explanation of the operation of choice of problem space and LTM recall would make them feel freer in calling upon their own life experiences.

The question here is whether exposure to the wider range of a skilled designer's resources and the information processing rationale behind them can speed up the learning process? Architectural students are being taught (or, more precisely, helped to develop) a skill rather than performance in designing certain building types. From my experience in learning to ski and in helping to teach a class in site planning, I believe this approach would -after some initial confusion- be more effective than a graded step-by-step introduction to problems of increasing levels of complexity. The stakes are high enough to try this teaching method with a group of students and, a year or so later, compare their performance to that of students taught in the conventional way.

Another sort of suggestion comes from acting as the observer in the experiments. The institution of a parti-counselor role might overcome some of the limitations inherent in design by individuals without getting involved in design team politics. The counselor's ^{functions} would have to be tightly circumscribed to that of fa-

cilitating the designer's problem solving procedure by making sure he did not overlook his resources. The counselor could remind the designer to externalize his form ideas, to test them in several ways, including potential uses, encourage him to use analogies, explore choice of problem space and goals, insist on three dimensional drawings, etc.. Not being as intensely involved in designing the project, the counsellor is in a better position to judge when to stop, rest, push on, etc.. Finally, although this becomes more observer participation than counselling, there is a high probability that the counsellor will notice possibilities the designer overlooks for some reason. My hunch is that playing counsellor would demythify the process of design for students.

The analysis of the protocols also raises some strictly architectural issues. Are some areas of search inherently more fertile in inspiring elegant architectural solutions? For instance is the greater concern of more experienced designers with site conditions in this experiment accidental or significant? It could be that site conditions inherently determine building form; it could simply be that salient problem characteristics are those which inspire elegant solutions; or, it could be an idiosyncrasy of the experimental subjects' styles. Running a large number of subjects (over 50) through this kind of experiment for given kinds of problems might begin to separate these effects.

If designers could be supplied with some mechanisms or

symbolic languages describing how people use spaces and the physical environment, their task would be much simplified. Simulation would be more thorough, vivid, and quicker. But is it possible to devise a formal symbolic language that keeps track of context? Its operators and elements would have to represent change over time and still be clear. Thiel³¹, Halprin³² and others have attempted to develop such modes of representation. There is a subtle snag to this effort; even an accurate symbolic language is an insufficient description of reality. Laban ballet notation accurately encodes dance movements in space and time. A trained person can "read" it, reproduce those movements, and even consider new movements in terms of its symbols. This notation is analogous in its operation to those aspects of reality it models. And yet, it is insufficient to reproduce dances even for the trained reader. Dancing is more than the sum of a sequence of movements and gestures set to music. Recreation of the original dance requires interpretation of the coded symbols by someone who experienced the original. This suggests there are aspects of experience it may not be possible to encode.

Any quicker way of making three dimensional representations whether by greater practice in drawing, the use of assistants, computer graphics or computer generated models, will multiply the designer's effectiveness - whatever the level of his experience or ability. If Schon³³ is right, the capabilities of tools have more to do with changes in behavior, output, and ideals, than any number of ideologies.

Discussion of Method

At this stage in the knowledge of designer behavior in parti design, the kind of observational experiment I performed seems adequate. It supplies more data than I have concepts and resources for analyzing. Two hours seems a long enough period for designers to choose a problem space, explore it, develop a proposal, and do some restructuring of it; but it is not long enough for parti completion. The other basic difficulty with a two hour observation/recording period is that it distorts some designers' working methods and constricts their creative rhythms. For these reasons, I suggest a slightly longer experiment running perhaps three to four hours.

The question is **how** long one can profitably record a designer's thoughts and activities? There is some point at which an enormous volume of unrelated observations will be produced. The limitation in the other direction depends on how far one is willing to forego recording information manipulations that go on between recording sessions. The trade-offs in longer experiments are the need for greater stamina and resources on the part of both the observer and subject versus willingness to ignore intermediary events, e.g. what goes on during incubation. Many session experiments running, say, 3 hours every day for several days will probably indicate just how long an experiment of this sort should extend.

The basic technical problem in recreating a design session for analysis is the synchronization of words, drawings, and gest-

ures. The tape recording and drawing protocol method I employed does not indicate what a designer did when he said " this" and proceeded to draw. The analyst is at a loss to recreate the event ~~what~~ and is limited in discovering links to other clues. Without some recording medium such as videotape or movies, the environment of tracing paper overlays, eye movements, body motion, order of drawing production, rise and fall of emotional tension, etc., is lost. These media also allow recreation of the event at some later time for analysis by more sophisticated concepts. I am convinced there are clues to designer behavior which are lost by media which cannot reproduce the event as an ensemble.

With a small number of subjects working on a single, small architectural problem, I am, as already indicated, more confident about their similarities of procedure than differences in behavior due to level of skill/experience. This particular experiment does not dissociate effects due to personality, skill level, or problem quirks from each other. To surmount these difficulties, I suggest performing a more elaborate set of experiments in which spatial complexity and site character are systematically varied. If a delicate site condition is a1, an indifferent site a2, an architecturally simple program b1, and a complicated one b2, then experiments combining a1b1, a1b2, a2b1, a2b2 should be done. The number and kind of subjects should also be varied for each run. There should be at least 3 designers at each level of skill; 5 to 10 would be even better. The experiment should be performed in two ways: with the same subjects throughout and with different

subjects for each design problem. After completing such a series of cross-checking experiments, I would feel some confidence that conclusions about differences between skilled and unskilled designer problem solving behavior ~~were~~ accurate.

The fundamental problems with observational experiments of this sort are the reliability and relevance of information obtained. The basic intention is to record what and how people think about architectural design. Drawings alone are not enough to explain the problem solving process because they do not display the context in which they were conceived. Words are a better clue to the designer's procedure. While thinking out loud is a very helpful key to the designer's internal information processing, it gives no clue to the content of pauses or mental images which introspection reveals. There is also the perhaps insurmountable difficulty that words are translations of what can be termed "kernel" thoughts, i.e. verbal records are not the ^{only} _^real contents of thinking. But until we can read brain waves as we do words, the synchronization of words and drawings is ~~the~~ only direct clue at our disposal for understanding designer's problem solving behavior.

In these experiments, the subjects found it hard to keep thinking out loud. Their stream of consciousness recitals varied from addressing the observer as participant, audience for explanations of what had just been done, or when interest and concern were intense to ~~what was~~ actually going through their minds. This last occurrence can only be demonstrated to other

analysts subjectively via presence at the experiment or its recreation by videotape or movies. Whether the analyst relies only on those moments of authentic inner speech or is willing to use everything the subject externalizes depends on his analytic purposes. It seems to me that so long as the analyst is not attempting to uncover the rules of association by which new ideas come to mind, he only needs to know the results rather than the contents of mental manipulations. Descriptions of the design process can be made without reference to brain functions. However, devising design aids of the sort I have advanced requires knowledge of the mental mechanisms of problem solving; but these need not be developed on the spot by the analyst.

Finally, I would like to suggest some areas in which further research would be helpful in establishing what designers do during parti design.

First, comes confirmation or refutation of my assertions about differences of procedure correlated with level of skill. The basic questions here concern the use of precedents, three dimensional representations, the conditions of insight and stimuli chunking. It would be revealing to perform the experiments with very good draughtsmen who are architecturally naive: Does their facility aid them?

Second, it seems important to determine whether a basic design episode/sentence really exists and is as universal as my analysis implies. If this is the only type of problem solving method or there are only a few others, we can justify pres-

cribing design methods predicated on this mode of information processing. A more systematic inquiry should be made about the release of tension I associated with shift of STM content; if it is an invariant feature, its intensity or rhythm may be used as a reliable clue of when to keep working and when to relax.

Finally, there are some questions of architectural content. Can the choice of problem space and pre-solution model be related to problem type, or quality of product?

Over time it has become clear that the MIT School of Architecture and Planning needs 2 additional kinds of space. The first is for large classes from 40 to 80 which are seminars in the sense that lecturing is occasional; the usual class is participatory--WOW! laugh and two for such...visitors as Ivan Ilich who,...who first lecture for an hour or less and then engage the audience of about 200 people in give and take discussion for another hour or two. Easy access to a lobby for refreshments and informal discussion groups during breaks is necessary. Physical comfort, and acoustic and emotional intimacy, and audiovisual facilities for sound recording, movie and slide projection, etc are required...the school has scraped together about \$250,000 for a facility, for the facility. Discussion with the MIT Administration resulted in a site to the East of the Student Center and between Kresge Auditorium, the MIT Chapel, and Amherst Street...the rerouting of utilities and connections for same will be handled and paid for by MIT itself. For these concessions, MIT asks that other departments be allowed to use the facilities. Mr. Foz will represent the School in these circumstances. Ahh, hum wait a minute now. For these concessions to be allowed...I, I don't understand () Right, but why is it important? () Right () Right() It's important that you represent the school so that..() OK () What--define concessions () OK () OK () Ahm...the space requirements are as follows: 1 place for 200 people; 1 place for 80 people..totalling 3000 sq ft at best...lobby with access to kitchen hundred sq ft, toilets 200 sq ft, coat storage 300 sq ft--totalling 1600 sq ft.. Projection, recording and storage facilities 600 sq ft; Janitor's office 100...sq ft and storage six, 60 sq ft Mechanical space 500 sq ft hum and the total is 6000 sq ft.... thousand sq ft, OK... May, can I look at this? Wow,...all right now, this () Is, Is this the chapel here? () Right OK and () OK so it's going to be here MIT? () allright...() sigh What a horrible place!... ugh. It has to be 6000 sq ft...() hum... XXX Ap, that like's a little outhouse... thing...Ahm, can you, can you give me some sense of the scale of this? () OK, Ahn hum () OK, Ahm, right () Oh OK, so you () Each of these is 10,..OK () So, so this is a 100 here () So if this would be 100 x 60 if it were a one, one

story kind of thing...uh...Can't remember what happens out here..., ahm, ah I'll try to think more out loud...ahm...It seems to me that, that t, this, sigh, this space here ah, isis a, is like a plain for, ah, for monuments..to be on it..laugh...ah this building that that that that really egoistic monument and..uh..I, I guess...it seems to me that, eh, putting anything in here would really be intrusive so I would tend to react one of two ways. OK, first possibility is that you build another monument to compete with them and if so, if you were to do that where would you cram another monument and, secondly, that you would try put something as, un, unobtrusive as possible to stay away from the monument and that, that is my immediate reaction..You know just intuitive thing..ah..it..maybe it's partly the uh... the na; the nature of what this space would be used for, uhm an auditorium, a student center, ah, a chapel, ah, a lecture space is, is kind of a different kind of feeling so, but also it's just that there are too many monuments there already. I, I'm, I'd be inclined not to put one some. What is this, is this a parking lot here () OK, soo you have to have parking, right? () didn't you say that was required? () Easy access OK easy access to a lobby for refreshments and informal discussion, OK...Uhm () So () So you could build over the street too, couldn't you? () Hm...hm. What's this? () What's the building here? () and who this? () Ah and this is playing fields here or? () Hockey rink, and this () Oh...and this, I don't remember it () and tennis courts in front? () Oh, OK () Aha, yea, yea, yea Ok, alright go you, hum.....XXXXX...And this has, has..great big steps going up like that; isn't it..., the Catalano Building? () really monumental (O What happens here? this big walk way here, going in like that () No, this is the walkway though, this the official, this is the the () so this is just open space isn't it () But, now how does this () Right...and this is the main entrance () So in space do I seem to recall that , that this appears to jut out even though it doesn't and uh you just have a feeling of mass here and there's, there's kind of an indentation here so that if you put something in here it would really change the character of that, that feeling? () Is that? () Right..() Yea, yea, yep...Well, the uhm.....What I'm thinking about is somehow using possibly this space, but that really bothers me because it seems that...that it really feels as though the entrance to this is this whole courtyard is

through here and that's really important space to have...ah, I, I don't want to use this space because...just...I just don't know kind of ah ah repels me Laugh around it. So, these spaces come to it and of course you could take this parking lot too () Yea () OK, () OK, but what interests me is the possibility of doing something here right across the road, starting in here and coming across because it seems () this is the seven story building here OK it's and brick () it's brick, it's uhm typical dormitory style () castle () Yea, but a, but, but that,...that wouldn't be bad just in terms of, of where it's located; it's really handy to this axis coming in here; I like, I like the way.....uh kind of encloses the space more.. without messing up the space. it almost makes it more...who knows, it seems if it were done right it might make it even more powerful... that the effect, the effect () Right, alright no, I'm not asking you to jump in just thinking out loud..ah that the effect would be almost to more to well...stop, say th an Italian piazza where where if you, if you close off ahn this, this space it, it tends to, to bleed out less and that would make the entrance here more strong and here more strong which is more closed off: and I, it's inter..it seems to me that, that this side of the chapel ah uhn isn't, isn't really that crucial, you wouldn't really be hurting it. The chapel is, is really seen from here and from here and here and it wouldn't, it wouldn't interfere with it. It seems to me that that this building comes is going to sawtooth form like that...wouldn't mind having laugh something behind it..uh right in here. But.. sigh OK () I can't justify hooking it into the dormitory laugh () 14 feet () OK...OK...p...XXXX I don't know how even to have try this sketch OK building by, building and a, building here and it's 7 stories high () how high is a story? () Let's use the scale of () OK I'm gonna start using a different, the same scale as this just to, to () thank you, uhm...How many stories high is it? () and how many feet did you say, you said eleven? Eleven feet is to () Seven times twelve is how many () thank you! It's really too small. a 100, scale 100 scale () yea so this is, OK so it's 84 feet high right so ah, double it. () Thank you XXXXX Nope, so that would be...one of these is twenty () Every, every one of these is 10 feet, no () every () OK, () OK, OK...Now this has, this thing, how wide is this? This is---() come again() 35 right. OK, Now we have 1,2,3,4,5,6. Now wait each one

of these is 10 () 0, 10, 20, 30, 40, 50, 60...1, 2.3;3,30 to the road, 30 ft to the road! is that really that wide? Wow! 1,2,3, 30 ft in the road...and then this setback is 20 ft...Now, 1 to 20. This 30 () This is 30, this is 30, and this is 20 to here right () 20? () Ah () 1 to 20...XX, allright 35 ft for that here, OK () it's thank you, 30 () 25 ft OK, there. Then 36 ft, 30, six and 20 ft there..and now that's, I have I don't think I want to, I want to go that far if I wanted () Thank you, OK This is to the walkway so 1,2,3,35 XX. 35 to the walkway..and maybe you could go..you're not going to do it any farther than that so sigh, is there is there a rule about how close you can go to the road? () Oh OK () So that means I have, uhm some of this XX. 20, 25 so that I have maybe 50 ft on level....so maybe XX--so forth, well let's mm say 15 ft anyway 20, 20 ft up in the air so it would have to go, this would be the minimum () eh? () Oh, thank you. It'd have to go this high and you'd probably want to be a good deal higher just to that many people see XX...These are bay windows here, aren't they? () This is stupid! it'd be really stupid thing to do....() Because to build it out that far, you'd have to, you'd have to take these bay windows here which would mean you'd take away all these rooms and that...that, that just seems uhm really unnecessary...And..if this were lecture hall or something you maybe could justify doing that but, but I don't it would mkae any sense..Now, of course the question is could you no if you destroy the windows in there you destroy these rooms....suppose ...if that XX..Yea XX () Excuse me, I don't think this site is such a good idea...tsk...sigh, now don't think it is.....Ah, I suppose I should say that that ah that I've been thinking of, of how things might fit in suppose you wanted to do this uhm does this make any sense laugh at all in terms of, of what the needs of the building are. I was thinking how you could have the samll lecture room down here and the large one here and ah the projection facilities would be in uh, in well probably the projection facilites here so that they would overlap this one and uhm and a pass through to the dormitory () section()...sigh XX.....this space, it, just itself and nothing else is XX this is right, no? Ah, why didn't I think of this before (Uses overlay) a 100 by 60, so it's...20,30 XX... Laughs..hm..XX well....(.) hum?(<)words, words, Uhm I was thinking that this, this site wasn't

so bad as I'd originally thought, that () No, no, the specific site, that whole site still sucks! Laugh...sigh I'm thinking that maybe I'm spending too much time worrying about where to site the thing and that I should be thinking about...uh what the actual needs are; part of I don't know, it just seems that's the first thing that has to be solved..uhm..sigh. I, it would really be helpful for me if you had pictures () Uh, uh, no it's isn't anything () It's not a thing for you to reply you're sorry: just so you'll know how I'm thinking () uh.. but, ...my, my immediate reaction is putting a building here, that would fix Catalano--this just has to be the most hateful building in the whole world just put it over right in front of it... Well, the thing would sit there and, and I don't think it would really interfere too much because I don't, I don't know, I ...if there was something that came right up like that it'd be, it might be just fine. It could go straight, is that right now. I'll try it...that's about I'll put it there..Now uh. Do you want me to say why I rejected these areas? () Uh, OK, () XX I, it really disturbs me; it's like putting a building in the middle of a football field somehow I can't get any feeling for, for...how that would be...it just that really bothers me. .Except thinking about it now, if you did something...it just, it XX I really, I really felt intruding ah putting a building here..It's like building a building in the middle of Stone henge, that's the way it would feel, to me... you know, I really, really feel tampering with the gods or something but on the other hand you might be able to do something that would--whistles.....XX whistles--let's think..it's back there one way or the other...XXX..()... XX..Ah...I guess, I guess which would be disrupt less disruptive. It seems to me that as far as lecture hall it really doesn't make much difference whether here or here, ah or here really ahm there's a lecture hall here people who go to it regularly, people like Ivan Ilich speak there now; it would be very handy to have it right next to the student center and it just, it you know, it just doesn't make me feel as though there's there's any difference in terms of the, the actual convenience to people of this thing now the parking lot closer to here, but my God it's no walk; it's closer to the MTA there ot it's really six of one, half dozen of another....So I guess it's just which, which is really a, a less disruptive site...and () Where, where you could place uh hm interesting hm where you could place a building that

wouldn't interfere with ah...with visual, with the visual feeling. Cause I, I really don't, I really don't see that...OK, so...And I was thinking that,...that that both of these... buildings behind are really designed to have space around them and ah this building could take something in front of it really quite easily even though it would hm tsk, hm... and then another thing I was thinking is that this kind of space, it seems to me, that this this space in which to put a building automatically suggested uhn this kind of uhm arrangement of buildings and whether there would be any usefulness in that kind of arrangement in a building to, to any...And I'm wondering about ..how a building here...ah, how this building is seen, trying to recall how I've seen it, it's really hard for me to remember, what, what's here Adel? This is, this is the river here? Oh no () This is the river out here () and I don't () right () yea (), it seems to me that you don't, that this isn't a major view of this building () So that something could there without and for this obviously you couldn't, it's just playing fields down here, nobody is ever down here what's out here Adel? () Yea () So there could be something in there very easily without any sweat at all, really. () Yea, at least there's a view. Uh there is the building is viewed from this side, but from this side there's no nothing. What's this? This has there's a change in level () Wait a minute, OK what's this again there's () Uh () This is a walkway (). This is a walkway, this is a walkway and this is landscaped? () OK () OK well then it's all...sigh then the building can go there sigh...I feel better..Right Now to see how big the building has to be and that won't be any difficulty achieving Hm really go over part part of the walkway, should put the walkway through.XX..maybe, make the walkway part of the building....Ahn, I was thinking that, that if you have a kind of sawtooth arrangement here, ah, one way the, the teeth might be used is for is for discussion areas, ahm... just kind of informal discussion areas,...if you if you had them off the lecture room--tsk.. .XX...Sigh..XX...Let me one place for 200 people one place for 80 people---3000sq ft....I'm going to have to scale these off; because I can't I can't visualize them; so if I use th, the 20 scale let me show () OK, ah () XX 52 ft, 4 ft () Nope Can I keep it up () You can mark it later Would you like me to mark it one () all-

right OK, ah...Now if..uhm,..in terms of slightly 100 wow! whistle () OK XX 3000 sq ft is..50 by 50 XX in sq ft 27 XX....2000 by 2000, 10 XX 35 ft by 50 XX about 2/3 of that XXXuhm then...XX that scaling is really difficult for me to do, I just don't think intuitively how much, how much space 3000 sq ft is as opposed to 1500 sq ft () It's really hard for me..eh..I've got lobby, the toilets, OK how many square feet for the lobby? See that's just the kitchen ah wait a minute : toilet, coat storage...Adel, I, uhm I don't understand () OK, but what about the kitchen? You've got () You mean you've got the kitchen () OK, but you () Well what have have got 100 sq ft here? a 100 sq ft toilet? () Oh all-right then () OK, 1500 is lobby: 50 x 32? Right? Have to be that much () XX times 32. I don't know how to do it make this easier Laugh () There often, there ah it annoys me to have, to go through this to visualize how big the spaces are going to be Ah, OK, 100 sq ft of that, 10 XX by 10 that's the kitchen, and toilets are 200 sq ft, so that's like that XX toilets XX then does that add up directly, Adel () so you haven't got, you haven't, you expect lobby to take, to have the the place where the people to meet and talk in small groups if you want that tha's to be happening it's happen in the lobby or anywhere () or anywhere, OK, I, it's meaningless to me () so () OK so I just uh all right Umah toilets, coat storage, back here 35 and 10 phew, Amazing! What kind of what kind of kitchen did you have mind? () OK, do ;you expect to to just buy sandwiches here or do you expect? () OK, allright () allright, OK.., OK () allright, OK----so now we have projection, recording, storage 600 so that's I guess 30 feet by 22; oops, this is..hm 30 feet by 22 is 600? I haven't done this Oh 32 by 20 () Right it's just, not for this anyway, 30 by 20 XX projection () Recording, XX storage XX in this XX right () OK lobby; this is 300 XX this is 200 XX this 100 XX how much did I figure that lecture space 2000 and the other 1000 roughly and...XX I don't know anything about mechanical space, and where, where it goes what it is, hell with it, 100 sq ft XX janitor and street) () Hard () that's what you mean near the kitchen..storage mechanical space is a lot () OK () Ah, sigh, 250 uh that's 25 times 20....huhm, OK, now XXX..the lecture room is, the big space is...the small the small space is from 40 to 80 people ah, I'll 40 make

it a lot smaller 30 people and it's participatory allright...XX this is lecture special XX..
 . So, hugh....it seems to me that the most...
 that this is really the challenging problem:
 the small lecture room--to make, to make up
 room that, that really encourages participation
 that holds as many as 80 people; it's really
 kind of mindboggling to me...and the way
 that ..could be...be done, I suppose to be arranged
 so that...that it would cause ah, somehow see
 this..OK, so the site..sigh..la right
 () OK OK, the site is say roughly 200, uhm
 () just want to rip this off, keep it quite
 handy, trying to quite...XX 200 by..what? that's
 1 times 60, wow what am I doing? Not familiar
 30 not XX () Uhm () I was just trying to get a
 feeling () Yea () right, yea, uhun, what I want
 ed to do is have these things and the site
 work there so I could look back and forth to
 get a feeling, but I can't do it...I should, I
 should of, of realized the 1/8th was too, too
 big to, to let me switch back and forth ()
 Well that's right..Being boggled by the scale..
 ...XX.....() I'm, I'm just Laugh ah I'm thinking
 just OK, so cutting everything in half...
 that would be that size, that would be about
 this..Oh XX....OK, ahm, how to, to get a feel
 for pot, what size going to be. Can I do it?
 Can I want it? No, XX anytime if I put down 1
 to 2 () so 1:20 is probably the best. All-
 righty, sigh XX So this 200 ft..., which is
 20 XX uhuh by...Thank you ; I'm glad I didn't
 really notice XX oops XX hum I don't understand...
 what...1,2,3? XX ..I don't understand what I've
 done here () Ah, this whole distance is 10, 12,
 right () This is 120 () Right there () but the
 space is 1,2,3,40, and this space is 40 like that
 right () no wait () scale () so it's set like
 this. Doesn't look right! () OK, ah...XX..15;
 1,2,3, a 100, no 7,8 XX... right XX so far the
 shortest XX that's 20 XX 20 5 and 20, carry 5,
 ten to throw away, like that sigh XX...Oh Now
 XX sigh, time to ponderpeople want to
 walk through, look out, people...do..OK here...
 and here and here XX can go here XX...XX..Did,
 did you say Adel there was a raise level here on
 this walkway () Goes down like that? () But goes
 down ts ts like that or here () I don't understand
 the purpose () Come up? () Down () OK, but
 that's, then this is level () OK Is there a
 change in level this way () Allright () Ok...
 XX walkway now...this is all the courtyard...
 Ahm, I was interested, I was thinking what

would happen if you built a building with the, the edge of the building coming right along this, this courtyard here...because, I was just curious, because this is such a strong circle and that rather than having ah, it seems to me there's just a nice feeling existing on the walk from one building to the next and it is't you put a built, set a building into the space like that then you've got you've got to, to put assuredly grass in it and have walks to it and that really disturbs the feeling and since, so what, if you built whistle, part of the building right like that? ...uh....uh for some reason I'm thinking in terms of a 2 story building and I don't really know why... either the small lecture or in one ahm and the small lecture on the top level and the large lecture on the bottom level simply because it's easier sending people in and out of... Sigh uhm...I really have no picture to do that because this thing's really low isn't? () Yea, I don't think it would be such a good idea to put a 2 story, even a 2 story building there... sigh. Just thinking that I hadn't done that little planning diagram sigh. This was all 3000 wasn't it? () Oh you All 6000? It wasn't was it? That means there was no problem fitting all that in one story. So, then, what have I done sigh....Well I suppose you have to...plan XX....Ah, it's difficult to think out loud, Ah. I guess I was thinking of ~~what~~, what has to go with what..Ah, do you want the the large lecture and the small lecture to open up to the same lobby?...Two things that uhm I should uhm be torn between making bubble diagrams and just how the spaces, the spaces should go--what should connect with what and just thinking of how it would actually, how it would actually fit together in terms of a building.....what now, uhm, large lecture and the lobby, that extra time, and the lobby..and the, the small lecture XX, kitchen, the kitchen sure runs to, meet the kitchen, ah what's, what have I got left coats and the hat checking, kitchen XX put it in the center for all I care, anything up that room for the janitor and that room would have to be...janitorXX...ah, that's a big problem XX lobby and ah, mechanical, mechanical have a problem XXX...Did I figure this in, I figured it, good grief XX 50 by 43, dimensions ...kitchen, 100 coats 300...Toilets...Ah I've got it, Now I see..when do people like to go to the toilets; they want to go when they come

in, they like to be able to leave the lecture room quickly...so they need to be in here somewhere..that can't phooey! Let me put them in XX....() Ah, what really needs to be near what () Ah,...ah () OK, ahm the large lecture has to open off the lobby, the ~~small~~ lecture has to open off the lobby, the uh projection area has to be connected to the small lecture and the large lecture, it's reasonable to have the same projection area for two that's why it's that way, the coats have to open off the lobby and should open and should be..ah easily accessible ah to the large lecture room and the small lecture, be people could be divided they certainly could be two separate coat rooms, but have to serve for both, ah, the kitchen it seems to me really doesn't have to be attached to anything but the lobby and could be right in the center of the lobby and I kind of wondered about that, putting a great big round thing in the middle of it but it's and it probably reasonable to have the janitor's quarters near that for some reason it seems to me an advantage to have that near the mechanical area but not, well I don't the mechanical area I just don't really know about that and I forgot the storage. And I reasoned then, the toilet ah need to be, or toilets need to be ah near or on, right off the large lecture room, the small lecture room, the lobby, and people as soon as they come in like to be able to go to the bathroom very often and I put them up in in here and ah that's as far as my thinking went about it. ...And I still don't have any damn feeling of how this thing fits in. Phooey! ..Awful! () This this how these spaces fit in on this. I still don't have any concept of that yet really that way, ah I read 130 ft there and 2000 sq ft there and neither of them. What was this 150 sq ft I think do you remember Adel? () Aah () Hum XX Stupid measure this; 200, yep XX... OK, let me think about it. Ahm This feels like the hardest part...ahm....what are some ideas? Entering this thing from here, here, and here that abuts the house huh that's huh that was what I intended...I really, I really the idea of having, of having this underpass, of having this walkway go underneath and until it came out, ah,..but I, I discarded that because of the, the problem of....just suppose that..if you took just a part of this....you have then XX the large lecture hall XX...like that Is that Bonnie? Is it that late? () Oh, Dear!

() Uhm....() I'm trying to figure out, Now I'm just sigh trying to get a, a basic feeling for the, a way the building might actually look on this thing, uhn so I'm guess I'm drawing in plan on the bottom level and I'm wondering whether it's just possible to fit a large lecture hall in kind of a new space with the small lecture hall on top with the lobby in here.....then the projectionXX...people enter from here... XX.....I'm really struggling to think in uhm in more than three dimensionally; it's really difficult....what's happened to the large lecture here; no, large lecture see be there and this little lecture....XX..20 times approximately 30, 600 feet ah 600 ft, this then will be 200 sq ft that large lecture room () OK () Yea () uhm () right, right I know, I got.....Ah, 40 by 50 feet OK and we've got that XX sigh this right, Adel, back face on this front is 2000 sq ft is 50 times 40 () So that, so I wasn't too far off. Interruption

Ah.....hum, you seem to have big area here; l area in here...l big box here XX an odd shape not sure...like that for a small area XX then you give, put them together..by a lobby X.. XX..in the back..putting something together () Yep...uhm..then, alright now...sigh projection there, projection doesn't have any of that uhuh take up in here, it may come all the way to here, right? What's this, Adel? () Not for people? () Oh, Ch () I'm shocked. good for for a kitchen, laugh () OK, the garbage truck comes this way. Ah, uhm, alrightee so Projection can be...can be back there, Now...projection... put this here...a good place for to try that alright, I'm gonna push this out to here into the projection area XX then you have, mechanical..it just has to go somewhere, I don't understand about mechanical laugh mechanical is a crown prince laughs () I would hope so laughs alright laugh we'll have a 500 foot basement laughs OK, I'll call it laughs () Right, good () OK, I hereby reject mechanical..Ah...I would really much rather have l projection room for both..tsk... XX.....OK, what I'm thinking about is, uhm, a small lecture room here, a large lecture room here with a lobby sigh that uh..is, issome kind of irregular shape along it to provide uh little spaces where can people can kind of congregate ahm it's, imp it's very important to me that this be somehow...not, I don't know even how to do this but I don't want

the smaller lecture room to be just a big
 box ahm, it's, it's got to have some kind of
 provision in it for, for making it feel like
 a smaller space.. and the large lecture room,
 I just don't really have much feeling for at
 all except for, for the way it, you know the
 way, you've got to make detail arrangement,
 something has to be figured out bu, uhm.. to
 do that you have to ... coats, hm ... mutter,
 toilets, coats XX well, just for fun let's
 see how big this lobby space is.. it's hard
 to measure, guess I'll do it across like
 this: 30, 30, and 20, 50.. that's 1500, 1500? Oh
 yea, that'll be something... XX.. uhm... Sigh
 Doesn't do things I'd like it to do () Uhm,
 doesn't.. ah... It doesn't interact at all with
 the sidewalks () Well, there's, I have no feel-
 ing for.. for.. uhm.. you know what would
 prevent it from just being a wall laugh.....
 this.... XX.. () Huhm?... ah, about why I was
 doing this? I was wondering about what was
 if someone were to ask footbridge to have,
 to have this be a really, the noisy edge be
 along here uff and the quiet edge uff to be
 on this way.... ()... sigh.... OK, I was haumh
 how come this is here?..... I suppose
 one thing like this: XX, one thing thing like
 this: XX.... XX... XX () uh, I haven't really done
 much, I've been thinking about uh how to make
 this more interesting here. () And () uhm, I
 still have the same essential scheme really..
 with, with.. one area here and one area here
 ... XXX.. hm.. hm.. Too big box.. XXX.. Heuch I
 suppose... Kind of like the idea of the building
 going right up to the, the edge of the thing
 and touching.. points... XXXXXX () What's hap-
 pening is uhm.. is; I was just wondering if
 you the idea of having the building going
 right up to the points with this, of the walk.
 Then, it bothers me this doesn't go up to this
 point psium, psium like that so then I begin
 to, messing.. well if this point goes there and
 if you have some kind of arrangement, some three
 blocks like that that go into each other, well
 .. then that, maybe you'd want to do it that way
 so that this, this edge go into and ah, for some
 reason, this ah lecture rooms make me think
 of big keystone shapes.. So I began to decide
 to do that, to make it equilateral.. XX.. it
 doesn't have to be very much of a, of just
 tiny little thing, tiny space.. and then what
 happens here? XX does it?.. Doesn't seem to
 do it... because.. XX really a bit much.. try
 it like that out.. and why? XX NO, how the
 building like this really operates. Go back to
 ... XX where's that other sketch I have ()

The one that I want to flip; this is it, Oh, I've let it sit right here OK, GEE, it wasn't really as far along as I thought it was, how disappointing. OK, so now we have ...XX So a large lecture area, this isn't really doing a small lecture area justice; no way I can fit that...XX alright, now the smallish area is approximately a thousand feet..() thank you () OK..30 () alright, try 35 is () over....XX hmm I refuse to have this... the small lecture area just ne tsk ah...The problem is something like this: do I have any XX uhm, any value... no,no...uhm, that's not the tiny thing-uh ,I'm wondering ... how messy it would be to angle, in order to make the size of the space more, I mean th, the shape of the space more conducive to kind of uh,uh something that would invite participation somewhere between..40 people and expanding to as large as 80 because that really seems to be a difficult problem.. and if there's some way you can projection areas into a space like this to uh, to.. that would both work in and, and at the same time help break that space so that the thing to do is just to figure out... how that space might be used.. suppose you have.. these are going to be used for lecture, right Adel? () OK, so what happens if you put people all around the center?..or what happens if you have..uhm,uhm XX something that feels more uh, like a that you have the projection; the people, people sitting around and yet not completely around; well, I'm sure is (Stop)

Awkward..big glass wall...hard place to build anything. Tsk... () no real blind side, secluded..traffic directions, origins, strength..() Building not very large..really..3 spaces maybe...two, to wit two..interior...special spaces for sitting...viewing and ...talking ...and some kind of release space to escape concentration of the..of the lecture or argument..some place open maybe, outward looking— that's why asking about blind side, a place to lie in little garden, relief know...thinking of precedent—take time if we talk about each thing that strikes me...thinking of Loeb experience, theater experience which in a sense same sort of thing as a lecture hall...sometimes, mostly it's a theater sometimes it's a lecture hall, spend an hour, or two acts, concentrating, the lights are lower— you know you're viewing and then you been sitting for a long time and you want to walk, you want to..uh, eh,, want more distant horizons to rest your eyes, which would mean more distant horizons like glass walls, walls, eh..some sort of view and into maybe even a possibility in good weather of sitting outdoors, sitting around in a kind of garden,... that, that contrasting, that experience, that little spaces don't, don't amount to hill of beans. ...hum, and so especially the character seems to be the relationship of the two large, ehm, in, ahm, volumes and...the lobby and..the uh. I don't know -sigh- whether the ...these spaces need to be necessarily darkened. Was first, first thought was theater like space. You talk about all your facilities, slides, and things like that which would necessitate darkening the room..uhm. There's kind of an expensive wogue,, closing off automatically ah, ah, large expense of glass, well no reason why lecture hall can't have lot of windows. ()...Yeah, yeah, yeah, uh, that's a restriction in a sense on kind of uh, on seating arrangements in a sense, in other words if you have a daylight screen but that in turn requires that uh, seat in kind of narrow angle in back of pre-, but then you want thing to turn around and be an easy, seminar sort of a thing which hm would, would indicate more of a square room or some kind of uh minimum distance ah situation where you have good eye contact and...small uhm..well, certainly not regimentation and the the long, deep solution that that a narrow screen angle would imply, but it doesn't seem to me that, that allows the uh the...whole point of this thing

to occur which apparently is uh the reason these are rather unusual in that one's going to remain after... and engage in discussion which I assume should not be homed.

I'm uh... what I'm doing—imagine me of it —.. small space and then some kind of flexible wall and,uh, a large space that's probably out of scale and each of these has some kind of contact with,with ah, a lobby space which in turn XXXXX has some relationship t to the.... outside,and... psh,psh pshiu...I assume the flow would be from the outside to the coats...and the coats into the ...spaces themselves,the,the kind of lecture spaces... and then from there on out..uhm...what if they put the coats in the lecture spaces themselves you know sort of...as a part of...or something... -sigh...ah..see,say you came here,if you entered and then...uhm..entered in either one of...these spaces- this was just,this was just that kind of warm air space you know—from for mud,somethng and uh then you could approach in a couple of ways and then you went into either one and then if this were...some sort of...huhm well little space has to look,little space has to be joined to big space,it has to... huh—that's where's the problem the ..uhm,, question of how to relate these spaces so that permanent projection facilities work for each yet don'tget in the way when you won't...() Oh yearh? () Yeah,it could be the same room.I mean it could work both ways uh () so that you could have movies at the same time although they,it, you,they don't want them in each other's room, but let's imagine,no, no I wouldn't make two projection rooms ~~Because~~ that's,they are expensive;they have to be fire-proofed.... let's imagine we had a, had some sort of a ..XXXXX let's see- what--XXX...some kind.ofXXXof...more like..XXXXX,that so you put a projection table here... a projection table here XXXXX..() They're all different ways uh, if this were... this has to be ~~XXXXXXXXXXXXXXXXXXXX~~ ~~XXXX~~ pretty reasonably centered in room,hum... XXXXXX so what hapens,..XXXXXwhat if you do this? WXXXX...put in a flexible wall ,up and down XXXXX with some kind of... some kind of projection space like that: XXXXXXXX... and then a flexible wall XXXXX and then this:XXXXXXX,hmm, this same thing....XXXXX..yeah....XXXXX.,starts to overlap, XXXXXX that's the thing and....that's that kind of relationship XXXXXX rhomboidal thing this is a square thing and eh,...uhm, I don't

know, uhm, this possible if we assume to ~~EEEE~~
 hold that a bit further and that and have an
 entrance there.....XXXX... and an entrance there,
 and then where, if this were to be useful for
 both.....you'd have a sightline problem; you'd
 probably...some kind of relationship like that...
 however screwy that looks.....would work both
 ways using this central position...now...let's
 get back to site plan: XXXXXXuhmXXXXXX this is
 further over XXXXXX this is over here XXXXXX
 I think that, that in a better world you'd have
 a xeroxed site plan — laughs— Foz. XXXX Oh,
 shit this thing's way down here because there's
 the advanced studies thing XXXXXX in the corner
 isn't there?— yeah. So this is, I don't know
 tight up against this or not? I notice you walk
 up these steps without, uh, bumping into that; it's
 something more like that..XXX..the student union
 is pretty close this, hum.. this isn't XXXXX, isn't
 trafficked to here XX, there's traffic like that:
 XXXXX there's traffic like that: XXXXX. You
 wouldn't see putting this thing thing over here
 would you? () Down here all over parking lot ()
 This is, this is at least 200 feet () Sure it is
laughs. AT any rate () it's really awkward not
 knowing where these buildings are because uh ()
 Well, ~~my~~ uh,....I don't think that would make, I
 don't think that would make-laughs- that much
 difference so far as walking goes and uh, -sigh-
 it would in a sense preserve this rectangle which
 ..Tehh has not been wise in creating in the first
 place. In other words, I ~~EEEE~~ don't think Cata-
 lano ever expected there would be anything ~~EEEEEE~~
 between him....XXXXX... and the chapel XXXXX, uh,
 not unless you wanted, you wanted to uhm, ah, no,
 there's just no, that building is meant to be seen
 dead on.... it's meant to be a big one of the few
 outdoor major.....visible campus elements in....
 at Tech outside say of the thing in front of the
 uhm, uh Ida Green building. I mean that seems to be
 so far ~~removed~~ removed from anything this really
 has a certain personality and of course the uh,
 this thing is very elegant seen from the ground
 so it seems like....some kind of perspec-
 tive through to.. it would, seems a shame to throw
 a building in front of that because this is a
 major traffic (). Well also I mean if we have
 these grand stairs to a tiny little building, it
 does a little awkward and overwhelming. So, ~~E~~ I
 would say let's.... imagine that we have, then we
 a building here that has, hugh, we could develop,
 this a courtyard XXXXX a maybe courtyard between

XXXXX Kresge and that nice glass wall. I don't know I live with something () Yeah, yeah, but we don't need much, any more than 15,20 feet and there's some sort of exterior thing, but it wouldn't be ~~a~~ on street side, it wouldn't be on natural entrance, you could spike it into this, into this kind of XXXX access XXXX I guess that there's some kind of triangular XXXX couple of triangles for traffic like that I don't know which way back here, athletics back here () Something like that () Ah, then there's this then too, hum.... well, it seems to put it, it seems to put, to put a minor building there, wrong (). Well now, now let me get a possibility of developing next to this nice glass surface, uh, and XXXXX with the building sort of presenting maybe even a black wall or some sort of ribbon under wall... or some kind of thing to the street and then you'd have perhaps this entrance lock here XXXX might begin to develop some kind of uh, uh geometry to the problem XXXXX which uh is more uh traffic entry XXXXX and then XXXXX, uh some kind of uh, uh meeting space, both the rooms XXXXX that is maybe we could, maybe could we die..down it like entry and then hmm both, the little room, the little room has to touch there XXXXX and, oops, the uh that has to be permeable... and but since we want.... say terrace XXXXX there.... that's ~~not~~ not good, that can't happen, this would probably allright XXXXXX yeah, there's a wall here, you know for privacy or something and then the..... the big part XXXXX of XXXXXuhm Kresge, ~~How~~ How do you spell that? () Allright.. sigh.. Then your, your lobby would in a sense want to be XXXXX there, uh, because if it were one, a bad lobby, don't want to have space, you want a kind of visual connection there.....allright...then the.. uh....uh.... XXXXX..uh..sigh ... that's no good.. XXXXXX, can't really fold one into the other,.. what'd we do here.....sigh.....put them, that there and then had this big space here XXXXX Allright put the little one here and then so that we could enter both of them like that XXXXX and both had this access out..... ~~Let's~~ Let's, ah enlarge that. XXXXXX, uhm XXXXXX. Still hung on these scales of this, this sort of figuring

Well this is no good, because the natural projection spot if, if these things went like that and then his, at the perm, at the common wall - sigh- So this ah, let's try it again XXXXX thinking of XXX a big, big. I draw this square because it seems

to me that the, this casual thing has more chance in a square, or round or a rhomboidal shape than it does in a long narrow rectangle....and there's, there's still some kind of interest problem....well let's see....let's imagine that XXXXXX we've got XXXXX a small room in there XXXX I can put a projection XXXXX booth something like that and you could have a screen kind of that way or that way....same screen....screen,,, and then this could be flexible, so that could be over there, uhm, XXXXXX and you have an entrance... that's not the best place to.... anyway suppose, but XXXX uhm and then.... maybe the terrace is out here.... maybe there's some lock or something. Lobby, lobby rather XXXXXX if enter, space flows into that XXXXXXXX with, with terrace beyond XXXXXX and outdoors XXXXX, yeah.

() if you go over 'em too many times, can't pick out first stage. I don't normally, always work as literally, but work reasonably consecutively. Well, this is all out of proportion and I suppose we should talk about, uhm put some actual scale to the.... to the uhm rooms and you space for 200 people and a space for 80 people, total of about 3000 square feet so I don't really know () I'm glad you're allowing 15 in tiny little school rooms where people are packed in () but isn't an ~~ARM~~ auditorium, this is really something to, well, I mean, you see it as an auditorium type space rather than as a... like with fixed seating. ..I mean is if somebody going to bother to set up thing () is it like Boylston Hall () Well, right () yeah, you () No, there are folding chairs that have arms, uhm. Well it could be fixed if it were semicircular with a, the slop has to be small if any at all. I think that the Mallinckrodt lecture rooms are reasonably intimate. They're uh, they're uh, square practically () I don't know quite what they are or maybe it's two Divinity () Two Divinity, there's a very low sort of wide thing with a lot of aisles up and down, what it has a central lecture point uhm -sigh- uh well -clears throat- hunch. Well I don't know, I'm a little f - slaps thigh in evident frustration, I think it should be figured a little more especially if you know there's, want a lot of slop. from you know if you want a little slop so there's a lot of circulation space that can be turned in fact into illegal sitting and space, hum. A certain amount of freedom it seems to me is imperative if the thing is going to be relaxed. In other words if you can't, if you've got to, got, if you've

got to go down the aisles to get to the bathroom in the middle of a two hour bull-session, uh, especially where you know, uh, you don't want to stumble over... let's imagine; I think that they should up that figure to at least, to say at least 12 to 15 per person....in other words to give Continental seating of hm, forty inches between aisles. It seems to me that's a minimum condition if you have fixed seating, at least it should be Continental seating so that you're , so there's almost an aisle in front of each row that, that's quite sloppy from pure space utilization, but but it's, uhm....well....well....I think it's a basic decision on character that uhm one should make right at the start, isn't it? whether it's going to be a situation like Hunt Hall where for lectures the seats are set up and then as the thing breaks up, they are progressively destroyed, the space can be cleared, the speaker can walk into the center, and, other people move their chairs around; in fact, they may even uh uh surplus of uh uh chairs which could be added from a supply and, another, uhm, it seems to me one fact that I know about meetings in general is that people are psychologically depressed by meetings in a room that is too large for the group. There was this conventional in, in business motivation books to, to discuss the uh, uhm when uhm utility of providing fewer seats than you expect people so that there's either some crowding or people have to get, get seats out so that uh possibly, uhm, it would make some sense to have a room where the seating, the number of actual seats out could be started, slightly under what you expected and increase them or have a, a sort of storehouse of seats. Things could be set up neatly and if the uh anticipated crowd didn't turn out, it wouldn't like meetings in Lowell Lecture Hall, you know small meetings out there are terribly depressing, always look like such a tiny minority whereas if they have in a small room, even you know the choice of a volume is important just for. I think giving people the initial idea something important is going to happen here; it's not the rump session. So okay, I'll make ~~MMMMM~~ that decision now as correct, could be reversed but I think that we, extra we use uhm some sort of flexible seating like like gangable, gangable folding chairs that that can be ~~stacked~~ stocked and then can be set maybe at 175, half of most of the time and then if you expect more can move out

into and have and can stick with me the, the uh figure of uhm XXXXX say 10 XXXXX which would give us 2000 feet plus uhm some kind of slop, say another 500 feet XXXXX now this adds and and they need some kind of storage space for these extra chairs but OK let's imagine that we start out like Kahn says disproving the square which is now approximately uh...well, it's about psy, psh, pushhumm, 50 by 50, right; 0,0,25 using scale- 50 by 50 and for the large XXXXX and the uh, this hum large XXXXXX, the small would be something; we said 80 people at 10 which will be 800+....ah, say it's a 1000, uhm....XXXXXX or that's about say 30 feet on a side. humn, curious seems too large XXXXXX, no it doesn't seem too large, well you can fiddle with those for approximate, approximate sizes, hum. Now you say toilets, kitchen,....uh, coat storage 1600 feet ~~XXX~~ well () that's, well. It may be more may be less. OK, I'll go back to that. I'll try to put some, this is obviously too small, it's a little tiny seminar room with a lecture room. These things are really, more really more comparable scale, um, so revise that preliminary parti... and pretend that that 50 foot and uhm then 30 foot would be something, yea something in there, something like that leaves 20 feet here, 30 foot ~~XXXXXXXXXX~~ psss, messed flexible wallup; we're talking about uh XXXXXX some kind of projection space although that projection is at the moment, is on the accessible XXXXX....well that's not too bad...maybe should,....maybe should be cocked a little XXXXthat's a better relationship, huh XXX with ah... entrance...entrance XXXX, let's imagine.. that this begins flexible wall, how this outlines, gets somewhat better ~~XX~~ huh? if you want to view it..... where's that red Pentel? How do you like that? XXXXX uhm, if we do this XXXX now does this have to be this shape? XXXX yea, well, fiddle... ah, let's see, we have XXXXX....overcoming here.

....XXXXXX that could be smaller....XXXXX, it's not the sort of thing that, no....this has to be a permeable wall, uhm, I've got to ...XXXX wider room rear which would shine into that....more... like that XXXXXX and a window here seems so that light comes back. In other words, you dim lighting maybe, but then this becomes, remains in darkness.. XXXXX projection without reaching, nearing complete darkness....hmm....XXXXXX now the...~~XXX~~ Jesus, what a weird building! We want, uhm, some sort of control and, uh,....XXXX....and kitchen

facilities, janitor spaces () janitor's office
 and uh some cleaning storage, cleaning materials,
 uhm, floor wax and things like that () right,
 right () uh...it's really, could be anywhere
 XXXXXXXX.....should probably give 'em the lobby
Does it necessarily have to have, uh,it's
 a long trap and if you were, if you were to have
 refreshments set up,would someone bring them
 into room or people go out? () yea () uhuhuh....
 humh,I don't know, uhm what we are doing here
 XXXXXXXXXXXX there's some tiny little office there
 XXXXXXXXtoiletsXXXX well this ,this lobby -clears
 throat- uh.....mmm..... XXXXXXXX Well, let me see
 I am going to work on this part for a little bit
 and see whether it gets anywhere () Na, well, uhm
 () it's mainly frustration ab being unable to
 uhm realize uhm the-sigh-; it's not handsome ()
 huh-laugh- ~~W~~ it's not a.... it's and it's this
 maybe works a little bit, it's ,it's not, it doesn't
 lead to handsome relationships those other spaces
 so.....uh.... let us start from the other end
 and see, and and see how start from the end, it
 doesn't work, make it work and see if I can ad-
 just the other things () Yes, I did, will, would ...
 these steps down here... which were to the
 street....and....uh and we would have uhs.. the
 building's gonna enter in some fashion from here
 we're going to have ~~xxx~~ , maybe some kind
 of XXXXX. I don't know, lift it a little bit and
ah.... this be ...blank and ,the thing could
 have this kind of corner opening.... and that
 gives the....let's call this the foyer and we
 have some doors....to get in XXXXX and....yes
 some sort of,space uhm XXXXX and ther's....
 access to the first....lecture room.... XXXX,
 uhuh maybe there's.... maybe the projection booth
 goes at the opposite, maybe it goes in here and
 we access to the second.... and perhaps that...
 XXXXXXXX....uhm.... and this lobby's is like this
in other words we have XXXXXXXXXXXXXXXX so one
 could proceed like that or like that and this
 some sort ofmilling space....maybe this is
 a solid wall XXXXXXXXXXXX and this has.... some
 space.... and then what have we got ~~■~~..... sort
 of running out of.....XXXXXXXX...XXXXXXXX...tsh,
 hum....Well, that's no good...it'd have to be the
 other way around XXXXXXXX....if that projection
 were to work out it'd have to be like this -laugh
wouldn't it? no, that's alright XXXXXXXX.Let's
 imagine that, uh,XXXXXXXX....now since if

these, ~~XXXXXXXX~~ if these are....XXXXX...flexi-
 vle seats, one assumes, one assumes that they
 could be turned around to ~~in~~ face that way...
 OK.. hum...XXXX...Ugh...Well...hush...Frus-
 tration!- slaps thigh- XXXXX It's hard to
 break out of these rectilinear- clears throat-
 uhm XXXXXXXXXX, ouch XXXXXXXX.....XXXXX yea XXXXXXXX
 Huunh, back to the same uh - laugh- same situa-
 tion, hum.... () Just the time limit laugh- ()
Ah....OK, well.....I suppose that...uh...
 XXXXXXXX... to this XXXXXX-sigh- XXXXX tjtat's
 over here XXXXX it's a weird geometru XXXX this
 isn't too bad, just not.....XXXXXXXXXXXXXXXXX...
 XXXXX and the others, so that it hasmuh, a cert-
 ain appeal to it: number 10, uhm there's, uh,
 just because it's rectilinear I guess,....but
 qw know that there's... I know that there's
 this problem with it for sight lines and the
 con....contact is not good,....so....maybe if
 one draws the square differently XXXXXXX...and
 try to make those relationships..XXXX... in a
 different fashion, maybe it that's.... XXXXX....
 maybe if they fit together XXXXXXX in a XXXXXXX,
 you know if this was larger and they're this, at
 this kind of angles , we try....huh...and with
 XXXXXXXX that being square, maybe that semi-per-
 meable so that...., the big rooms becomes much
 flatter () Well, it's not so square, it's more,
 it's like hexagonal XXXXX And then this becomes,
 then you have....uh....you always wind up with
 this problem, I guess, shit, well screw it. Maybe
 there's..... maybe it's not essential that this
maybe this....XXX,...conjoinability....it's
 more important than the ..than the uh...that
 good joinability is more important than uh...
 maximum utilization of the - sigh- ... project-
 ionists space XXXXX... in other words, this XXXXX
 if you get hat something, hah! it's really and
 it dovetails like that where there's XXXXX then,
 then you can join them to it, to a big space.
 XXXXXXXX, it doesn't lend itself to a lobby XXXX
 trying to get a space, it's an interesting little
 problem ~~HERE~~ we're trying to get a space that,
 that uh... this has a certain sense to it, this
 number 10, in which the lobby is accessible, this
 is acessible, that's accessible and that and that
 works and this doesn't work too badly... in other
 words, it seems to me then you can, you could put
 the kitchen over here uh..... with the janitor..
 and you'd get a volume. What would you get? You'd
 get a....XXXXXXX a ~~XXXXXXXXXX~~ lowest volume XXXX
 and it , frankly, probably make that higher if I
 were joining them.

Let's say between the auditorium and the chapel... like there would be overlay () Taking some of the parking area? () Oh...you mean a 90x90 square over on that side?() Can I mark on this?() Just gotta get an idea of, of...this...well...and this d take it can slide() that's not a good site, you know() OK, now this program doesn't really make itself clear immediately. It needs two additional kinds of space, 1 for large classes which are seminars...and 20for such visitors as Illich...Oh, I see...OK, so you need space for 200 people can give and a take with somebody...and you need a space where 80 people can do it() ...And we're going to overlook the fact that this a totally silly thing to do() it's really against the school() ... so basically we need two assembly spaces...1 for 200, 1 for 80, and then we have the lobby, the kitchen, toilets, coats storage, projection space,... so it's basically just...two...large spaces and service spaces for those() throat ehem...and that comes up roughly 6000 sq ft as opposed 810000 sq ft piece of ground it could go on...Do really want to represent the school on a program like this?()... Well the site seems like a tough one because,... it's a rather formal area that's set up like primarily by three other buildings, see: the auditorium, the chapel, and student center but it also ahm seems to be right on main path of circulation that goes over to McCormick Hall...which is, eh another building that got really tagged on, outside of this grand complex of three buildings... and Ash, the corner of Ashdown comes in there too ...so,...there's also a rather weird site, in that it's, eh...off in the midst of a bunch of rather public buildings and this one seems to be a, slightly more private although it is for, for public gatherings of the...School of Architecture and Planning() ... Yea, I suppose it could be...One of the interesting things about the program as it's set up is that a facility like this probably would be standing empty some of the time...and the way this one's set up it really would be empty because there's no provision here for a receptionist or secretary or...or anyone who would manage the facility and...() be there all the time...so it's curious kind of a thing...Now, to what extent would the school be willing to consider adding other fundations into this?() What might useful over there? What I have in mind particular would be, ah would this, since it is in a, in a rather public area, would this for example be placed to,...eh have any

exhibition from the school, would it be a good place to set up a coffeehouse or something like that...
 () Let me ask you a technical question() What's going to happen to my sketches and stuff? () I think I would be somewhat hung up if I felt that... my design were going to be() on any kind of public display anyplace() or even prominent in your thesis
 () So probably I'll create those drawings as a result of that() OUGH OK, well, this is a tough problem because you, you give a nasty site for it... psss...Well what I am going to do first is to try to get a handle on the problem at all..., is...to ah...make at the scale of the site plan...just some little rectangles which will represent the various sizes of various things and that'll give me an idea of the scale I'm working with...it's an awfully small scale to work at--for this purpose I think I'll be alright...uh...Now for...200 people and 80 people we've got a grand total of 3000 sq. fr., that comes to a little better than 10 sq ft per person let's add a 2000 sq ft space which is, uh, let's let's say for the sake of argument 40x50... XXX...This space for 80 people, let's say that's 1000 sq ft...roughly, so that's --uhm---let's see 40x25...Were you trained as an architect?()...OK, lobby, with access to kitchen 100 sq ft, toilets and coats storage and 600 sq ft for all the,... no 750...plus mechanical...So these just ah,... that's another little square about that size XXXXX plus kitchen and storage, lobby...and...the one about that size for mechanical equipment..., OK I didn't put those in any particular order, I just put down 6 squares and start those around on the site plan..to get some sense of uhm how big a mass we're talking about...in this building...they say we can't wipe out that parking area, huh() except during special events().....OK Somehow...my spaces don't as big on the site as they ought to, cause I only cover 6000 out of 8000, have to cover 3/4s ---uhm...I guess it almost does that...sigh... Well, the big thing that's bothering me about this, is the site...It's obvious we can fit the building in there...ah...it also bothers me the program's kind of unrealistic but I'm think I going to keep trying to disregard that(). Let's assume, ah I would feel a little better in fact if I were to assume that these were for general institute use, that they were smaller kinds of gatherings that could occur in the Kresge Small Theater or in some of the student center rooms so that they might happen in here too () The main thing's that's troublesome about the site is that...somehow it seems like the site was set up for other purposes and now we're going to cram a new building in there...the...

I'm just gonna make a sketch here. () of the...how the space seems to work...in this place XXXXX the, the open public space XXXXX.....there's a weird thing about them. I expect with respect to that which is today all the space builds up towards the river and stopped only by McCormick and... XXXXX It does it does get to be a little, strange over there...toward McCormick Hall. One of the things that seems to be nice is that great ellipse in front of the..., uh auditorium which is used for frisbee games and folk dancing and stuff... picnics also for crowds to sit and watch whatever may be going on up on the podium in front of the student center uh...and I really hate to cut into that..because that thing seems to work as a general recreational field...uhm... there seems to be a major circulation path that comes.. up from 77 Mass Ave, goes diagonally along the sidewalk, through the grove of trees by the chapel and then it,...seems to cut across the oval which has a bare spot of dirt and ends up servicing McCormick here and Baker House and other houses down there....that seems to be such a major thing that it ought to be taken into account somehow in whatever's designed here .. either to...put the building in such a way that, that, uh it becomes a feature of that circulation path... or is put in such a way that it's pushed to one side of circulation path...doesn't mess it up too much.....Now what I want to do what I'm doing now, not what I want to do--is uhm I'm looking again at the sizes of the spaces on top of this new diagram that I've made....pretty typical the diagrams I make when I'm designing something that I don't, mess around using any time to make making them understandable to anybody besides myself...XXXXX... It's rather hard to describe what I'm doing now... I'm just laying little squares on these little squares that are approximately to scale of the different spaces, trying to see how big they are in relation to my diagram and how they might fit in different ways. Do you have a pair of scissors? () That's OK () Yea, I'll take that() that's hard, that's hard.....Do I have all these? that's a very dull razor blade () that's OK I think it'll probably do the job then again it may not, uh that's OK...When I have these squares laid out on on a single sheet of paper the, the arrangement on a sheet of paper tends to get in the way so I'm going to I cut these out...Guess I don't worry about...the...kitchen storage, lobby mechanical so much...my immediate concern first of all not to...larger spaces..... uhm...Now something else is going through my mind

right now, I'm ..already beginning to think about the shape of things...and...it's thought because there's some rather different kinds of shapes all strange around where this buildings gotta to go...the chapel of course is a drum... and flat wall and the auditorium is an eighth of a sphere, I guess...a there's a directory shape and the Student Center is a big ominous hunk of concrete leaning up in the air overhanging on all sides McCormick Hall...is ah, one of those buildings that looks like it started sprouting out of the ground and could have stopped at any height, it's just a pair of straight shafts.. uh Ashdown seems to have a very funny relationship to these other buildings because because it's it's off in a corner...as far as the space between Kresge and the chapel, it doesn't seem to have an awful lot to do with it...XXXXX...I suppose that leaves me carte blanche to make almost any shapes I want out of these....Actually with all the buildings around there, the one that interests me the most is the chapel because... it's he's done a lot..... with the materials that he had in the chapel...the uh strongest, one of the stronger things about the space I guess is the fact that it's all raised, that it's flat, and it's got retaining walls all the way around it and....that it has walls on 3 of the 4 sides one of those walls being the front wall of the student center, another one being that funny curved wall of the auditorium. But then the chapel itself has a big brick wall. One of things I guess that I'd be tempted to try is to put another fragment of wall on the fourth side and to make that fragment of wall somehow work both to help define that space in the middle and to do something like that space in the middle or equip them in some way and also to uhm define these two assembly spaces....One really...jarring thing about that space now I guess is the fact that there's clear circulation route across that isn't accommodated by the present arrangement of sidewalks that's the one that cuts across one side of the oval; maybe there ought to be some way of handling that...My temptation at the moment would be to try and do something with that circulation path, like just live with it put a strip of paving across and develop the route down to the dormitories better. To leave, ah, to, to not obstruct McCormick Hall, ugly though it is... from that space..and perhaps to try to push my building up more toward the chapel along the

street to uh...to deal with the rather funny corner of it..that goes off toward Ashdown House...uh I'm still having problems, it's a little like sliding down a razor blade, eh...you...uh put me astride that place where birds can coop; that triangle in level there...() Do you know what the triangle in level is there? My guess is it's about 4 feet. () uhum...Now I'm trying to decide what to, if I were to put up a structure in that knoll what it would do to things...regarding the general character of the space...in front of Kresge Auditorium...XXXXX...To the best of my knowledge there's almost no circulation either diagonally or in the opposite direction across there, scarcely anybody coming from the uh, the zone over by the rink or over from the Student Center and going to Ashdown House around the, what is it? the S. side of the Chapel...so I wouldn't want to squeeze the Chapel by putting the building too close, and yet I feel I could push one down in between it and Ashdown...without hurting things too much...an alternative strategy would be to put, to put some building just astride that diagonal circulation that exists...but that puts it awfully close to Kresge...and...I don't think it's going to do much for people to have to walk through some... opening in the building to walk to get to McCormick...I think if one were to do that it would almost dignify McCormick with more of a visual impact than it would have than if you simply came to the building and saw McCormick looming up behind. I'd almost rather leave McCormick naked there... uhm...One could, it's much easier to design silently ()...XXXXX...Well let's see now uh I'm going to go with the decision to work up in this zone near the chapel---and to one side of the diagonal path that I've marked...Now I'm worried about a couple of things I guess. One of them is how to relate my building to the diagonal path which seems to be a lot more important than the designer of the plaza..uh..gave it credit for and the other is...how to deal with the site there which has the four foot change in level...I'm going to postpone coming to a decision on that for a moment by working over it along the path itself it would seem like if we're going to wipe out this driveway that comes in...that just as well in the process of doing that uh make the diagonal path a little better, where it comes off the oval and has to go down to Amherst StIt's interesting I didn't realize Amherst is one of those split streets that gets interrupted by the institute and takes up on the other side () So...I'm gonna assume that I can do almost anything there. I was contemplating for a little

while maybe putting up a building on legs or letting the driveway come in under but it doesn't seem like a terribly good thing to do...uhm We could get the same amount of parking and pull off space by just pulling off the sidewalk in from the street by one lane if, if that proves to be desirable..uh and... what has always seemed to me to be awkward are all those sets of steps that go down from the plaza to the parking area so maybe we could do something a little nicer...I would be tempted then down by the corner of Kresge in what seems a rather awkward corner to try to bring in some kind of steps uh would cater to the dormitory crowd and maybe put them at some angle XXXXXthat wouldXXXXX...be at right angles to the circulation path so it would be convenient for those people and maybe to make them relatively grand because there's an awful lot of circulation across there. It's also a South facing area, uh, we noticed on nice days that a lot of things seem to be going and that along to the North of uh McCormick Hall and that might furnish them with a a..place across the street where people might talk and it and sun and so forth..A little bit of a puzzle how to how to deal with that round platform that the auditorium sits on XXXXX so maybe the stairs should be moved back a bit, so it comes more perpendicular to the curb..uhm... so what I'm trying to do now is work out a little larger site solution that'll help me determine what the form of the building ought to be because I'm at a little bit of a loss as what, how that building ought to be shaped. Now the other idea that I had was to was to try and do a little more with the edge of, of, this platform that runs around as Saari-men did with the long flat brick wall along on side; maybe this would be a good place to pick up with another piece of...brick wall that uh could...perhaps merge with the set of steps I'm working on down here for the dormitory people...but also somehow scoop around XXXXX and enclose the XXXXX kinds of spaces that I'm wanting to..to enclose for these gathering places....One thing...that's bothering me a little I guess is that...these spaces are ones which are pretty private or should be fairly private once people are inside them; they need acoustic privacy from the outdoors, they need uh enough visual privacy so that the proceedings inside won't be distracted by...the goings on outside.... So in that sense they're...Yawn...they're closed like the chapel.....Well I give up, what's the answer? () Keep track of time here (watch put out) ()....XXXXX...trying to visualize this space in three dimensions by making a little straight over here aerial perspective out of the plan..now...XXXXX ...and there's that terrible set of steps in front

of the student centerXXXXX One thing I'd do if I had a chance to remodel that plaza would be to re-make those steps in front of the student center so that they no longer symmetrical but uh picked up the people coming across from 77 Mass Ave and the pattern of traffic through the Student Center. I can't even remember how the student steps go--XXXXX there they are..however they are they're ~~wddng~~...uhm...then there's uh a break in the level there...XX XXX...break in the level thereXXXXX...and the student center, that's I guess more steps uh....uhmm...then there's that nice bosque of trees around the chapel...XXXXX.....uhm...am I constrained to a 90x90 site or could it take my 8100 in some other shape? () Yea, well I got a mildly outrageous idea ()...And that idea is to begin to develop that diagonal circulation path very strongly...uhm...and to build on a segment of one of the schemes site over here XXXXX starting from the diagonal path and moving up between the auditorium and Ashdown House..to build..XXXXX..I guess that's a little bigger than the building would have to beto uh, uh ...Let me show it to you in section...Over here you've got student center looming up, XXXXX...and that's a little bit above the clouds and then there's the plaza...and there's the chapel sitting over here, that sculpture on top along wall and then the plaza just dribbles off on the back side becomes a part of Amherst St and the dormitories beyond...XXXXX...I guess they're not quite that tall XXXXX...uhm what I'm considering doing ~~doing~~ is not putting another mass of brick-walk or concrete or steel and glass on that site rather trying to take, well I'm trying to force a certain advantage of the level change on that site, try to reinforce the usefulness of its old; it must be one the nicer gathering places on campus by building a perhaps setting a low retaining wall to help out with the change in level and then to build some kind of a grassy slope which would be over the roof and to dig the, this building into the ground along Amherst Street and to provide in other words some kind of a, a grassy slope opposite the student center which would be useful for people to sit on.. unfortunately it faces Northwest...so that uh, well in any good weather the sun is gonna get in over it OK ah....I can try to let that grassy flat area in front of the Student Center become a, a sort of grassy bowl that sweeps up on one side instead of drooping off into the street...that would mean ah, and then, they we'd have to, we'd have to that whole emplaced by some various retaining walls

and have to be cut into in a couple of places to get people in and out it would also dig us fairly deeply into the ground probably below Amherst Street---uhum....cause of the lower level of the street not under it....space for 200 people what do you figure: 2000 sq ft or a little more... that probably ought to be something of the order of 15 ft high anyway. we've only got a 4 ft let's assume you've got a 4 ft change in level from the grade above to the curb below and that we could build that floor at curbside and at curb level below that give us already 4 ft out of 15 we'll need another 11 ft....uhum that seems like that's going to be difficult to get an 11 ft rise---well the 11 ft rise isn't so hard to get uh if it's going to be sloped it's going to have to go higher than that at the outside end...and a grassy slope at the maximum can be probably be a, a 1 in 2 slope but we're 40 ft,,,ah...well I guess you could rise 20 and 30 that's perfectly adequate, and a 1 in 4 slope would rise 10 in 40, a 1 in 3 would rise 15 13 and 40...OK so that's an idea that might work. Another possibility with that would be not to put in the long building like it's shown here but to let that, no that'd be hard uhm, you're going to keep me honest () you're going to keep me honest.....uhum, cough, uhum.... Another possibility instead of spreading grass on the roof would be to build a set of bleachers on the roof,...not quite in the sense of a set of baseball bleachers but pretty close to that; people would sit up on the roof..uhm....I'm gonna ...do something,try... a bleacher type structure on a...XXX draw..draw an aerial perspective to see what it does..XXXX..uhm ...I suddenly realize it looks more like Gund Hall at Harvard than ... I care to admit which means I probably won't do that...XXXXX..sigh . I don't think the shape of it looks so bad, In fact I think it'd look fairly well with uhm with the space....think it'd work pretty well with the circulation paths..uhm, cough, uhm - still haven't looked at the inside of it of course. I don't know yet how it's going on the inside....I'm trying to verbalize what I'm thinking; I'm,I'm worried about the materials ought to be and how the thing ought to look.... XXXXX....Now I'm trying to draw a little perspective which has not been very successful so far uh ...in looking from the student center over towards the chapel...XXXX...XXXX. Now the street down

there with a lot of shrubbery behind it and there's trees down there too, by golly, uhm, XXXX and there's more cover involved setting of this elms across the street....XXX then there's my new diagonal path across the oval..Now...XXX.. if I were to put in...something over there... uhm XX, just as a block of stuff..XXX they'd look like that and then the steps would drop off here ...XXXX... and the trees'd be gone..XXX... you'd see more trees looming up across the street, you'd see.. the corner of Ashdown over here..uhm...XX need some roof with a lot of character because the roof is all you're going to see over thereI'm just exploring what would happen if that roof were made out of grass and if it did come down and fit the oval a little more closely..uhm ..and then just for fun well not quite in the middle but someplace near the middle of this thing, we cut in an entryway of some kind..XXX.. no, not that way..it'd be a curious roof shape because it would be curved at the low edge and stragith at the front edge and I guess a lot of that would just be fill and not part of the drawing at all....XXXX..uh, I suppose I'd be tempted to make any retaining parts of it out of brick uhm...XX nice of brick.....uhm...Going to try something else.I'm going to try the idea of letting one of these walls meander around over there and uh...XX, enclose things as they will...I'm going to assume for a moment a flat roof on it XXXXX That's pretty terrible XXXXX that's what it's being now, just a building...not a meandering brick wall....uhm that's a hard problem...I'm going to back off for a minute, work at it from another angle....So far I've been thinking of this building as being rather a close thing uhm either covered with grass or bleachers or, or as a brick wall. The brick wall idea I think is really not too bad....the building's gotta open a little bit more somehow....to make it a little less geometric, you make it more inviting...Can I give up? ().....let me just get this out of the way, it's pretty bad .. uhm try another ideaXX well the aerial perspective seems to be fairly useful, I can somehow project into that pretty well...another idea would be...to really use a meandering brick wall...which could..begin as a part of the retaining wall down between the Chapel and Ashdown; could then uh build up and start to enclose some structure.....uhm XXXX

I'm wondering whether really weighing me on this uh enclose this, these two little assembly space plus the smaller one, trouble is it looks so much like the chapel I feel that it wouldn't you know do justice either to itself or the chapel and maybe you got be a little more angular than that so that...it doesn't...try to compete with the chapel....uhm....one other thing...it could be in the back of my, is the idea that maybe the thing would go two stories high....that makes an awfully small thing in terms of its ground coverage...unless other measures were taken...to make it look bigger on the ground...that's uh...thatbothers me a little because that means it would increase the clutter over in that side of the..oval....X....uhm...XXXX...trying out another brick wall stunt...which is....coming off at an angle to try to accommodate that diagonal path that I like so much and also to...leave...some kind of a ,a circulation path and a view through to Ashdown house....well, that hand blew it but Ashdown's garbage cans which would be blocked off by this building..What this building would do in visual terms- I've gotten sight of the hope is to plug up that service area, plug up the view of the service area..between Ashdown and McCormick ... from the plaza...uhum... XX I'm making a teeny little sketch now to try to help myself visualize there

what I've wrought here...XXX... n for the moment, let's just do go with a flat roof and fo gor... XX.. I'm thinking brick right now...XX..OK flat roof. I don't think it's much good at all.. It's actually not a bad site for a building now that I stop and think about it...XX.. Have you taken a state board exam in design?() It's a, an entertaining thing to do; you've got twelve hours and reuired a set of drawings; you really start to sweat about along toward the end of the morning and you realize your desigr. isn't tied down and you need a lot of drawing done...hum... I was just noticing that I've used up better part of an hour and I,I'm still not inside the building... that bothers me because the roof doesn't do anything; I kind of like the plan shape of it... this is ah very clearly a,uhm, a matter in this case of designing a building from the outside in -which is just the opposite of what I preach,uh.. Doesn't bother me toomuch because I think it's for a good cause here..it'd serve the School of Architecture and Planning right if they got crammed into an architect designed building...XX... Now,sigh... gotta go back and figure it out in section. I think there's a four difference in elevation between the plaza level and the curb level.have to get a building insomehow I don't like the idea of a tall building in that site? that's hanging me up a bit....What I'm pondering right now is just how...how high the building uh should be,or how it should be handled,what one would want to see looking across there.. or one would be happy to see... one could look across and some grass sloping up there but, the more I'm thinking about it the more that's really anomalous because you know perfectly well the grass' gotta drop off sheer to meet,to the street. That doesn't make any sense...obviously what's needed there is a retaining wall.I'm trying to make a building that's that's part of the retaining wall...ah.. one would look across there and see a glass roof and that might be intriguing; but it doesn't much sense with regards to the types of spaces inside...one would look across and ah...XXXX...hum...one possibility is hust to poke up an entrance on that side...and then to bury the building completely under the plaza....huh, that's an intriguing idea because what it would do is put any old,just to put in a rataining wall and some graceful means

for getting people down to the Amherst street level and then to get them back in under the plaza in an excavated space that would hold the actual rooms- I guess the budget can handle it, about \$ 40 a square foot, isn't it? ()...But what that does, that I don't like is that it removes any, a good reason for putting up some kind of... visual thing at the opposite side of the plaza from the Student Center.....XXX.... Another idea I'm toying with there is the that of putting in a retaining wall and keeping the building at... the Vassar Street curb level... Amherst Street is the name of it; Amherst street curb level...but have basically just the wall itself visible to the plaza above...and... and build the building in the space hollowed out by that retaining wall out of some material other than the retaining wall material...XXXX....but that doesn't make much sense either because that would imply the building could be rather open towards Amherst street and and I still don't believe it can be and serve the assembly functions in the way it should...uhm.... Well, I'm gonna abandon that for the moment and think about what it would like inside a little bit..Space for 200 people and you talk about somebody like Ivan Illich....and... from what I've seen...XXXX.. from what I've seen of the kinds of things that go on around the school it seems like these spaces ought to be flat floored, both of them because they would be used in a lot of different ways... in particular a lot of these things seem to happen in an easy, free circulating way... people walking around with wine in their hands () uhm..also I think some of these would just as soon speak from the center of the group and others would just as soon speak from the end of the group and...therefore I would tend to make a ,a space which was rather on the golden rectangle proportions whether it was a rectangle or not which could be, which could be, which would allow it to be as a person in the center, persons on the long side of it, the short end... with regard to the... participatory seminars, classes of 40 or 80 -that's pretty high- something the size of two classrooms I guess...uhm... thing that'd be freaky is the use of these for audio-visual stuff...the usual internal arrangement in such a building is... one where you've got a central zone that includes the projection booth...XX.. a larger space to one side..projection booth got to be a little more central I think...

smaller space to the other....XX and some kind of a lobby XX with the associated toilets and stuff..that comes in the middle...XXXX... one entering in a location such as that...uhm mechanical space can go wherever it has to Strange-ly enough I bet that in size and everything else this is quite similar to the, well it would be pretty similar to the facilities in E21 for the film program (). You've got a large uh viewing room which would I think hold about 200 and a smaller one which would hold about I think 48-80 and a projection booth between.. on a rather different axis because the physical set-up is quite a bit different... Well, the character of those places if they were completely underground or enclosed..might be a little depressing. I think people would like the opportunity to open them up to something nice...er, in order to open them to anything up one would almost rather have to have them closed- a garden of some sort to open them to, because on one side you've got ehm Amherst street which is not particularly attractive, which has much too much pedestrian and auto traffic to ...going on outside without distracting things; on the other side, you've got the plaza which I suppose is interesting enough but then again it's so full of life that...that in good weather at least that, it would be very distracting ...uhum perhaps it would be better to just have some skylights which can be closed off but which at least pull in sunshine... can have only be a relatively open .. won't know to be open to a public space. Would there very often be admission events here? () yea() it would make a little difference in the way you'd have to set up control of access to the two rooms. If they, they didn't pay admission they just can pretty much have doors that open into the lobby, pretty indiscriminate fashion; if it would be paid admissions then it would have to be some slightly more tightly... constricted and controlled access to them so that that ticket takers could have a little better control of people going in and out... in the diagram that I've sketched here one would just have a set of doors which would be rather hard to control... uhum...X... () Right.... Ordinarily, at this point in the process I'd leave it and come back tomorrow laugh because I've got the thing pretty well Yawn dissected Yawn in my own mind; I haven't started to put it back together yet; but just for you I'll keep going uhum... Actually I probably wouldn't be

able to put it off until tomorrow because I've got a couple more things to do and do some other things in between... OK, the big thing that's bothering me right now is not thinking about the internal arrangements: what ought to show its face to Kresge plaza, what's going to improve the plaza....XXXXX... I really like the image of this retaining wall thing, just can't figure out how much wall should, ought to stick up against the plaza and whether the roof ought to hang above it...uhum, hm... hang on; try an idea here, the idea is to keep this basic trapezoidal shape that I've set up...ahm, I think it might fit in there a little bit more comfortably if the two outside corners were rounded... but that the entrance could be also in the center that would be sharp cornered... that uh... it might work a little better with the plaza...XXXX if there were some some kind of broad steps coming up to it...XXX... that people could XXX could use, could sit on to enjoy whatever's happening in the plaza XX and so far it's not working very well, it's not worrying me right at the moment... let's see what will happen if that roof got steps on it: XXXX Do you know who Hack Roark is, by the way? () He's, he's a Graham Fellow of Nick Negrofonte this year XX he's been leaving this week but he let me read his paper this week, but he is, he has written a computer program that can design like Frank Lloyd Wright () he concluded that...what people see as being a style whether you hypothesize in the beginning that a style is probably not so much the superficial trappings that somebody hangs on a building, but rather it's the result of the working method that the architect uses and some rules that he sets up for himself. So he tried to deduce the rules Wright had set up for himself in designing his, his Usonian houses back in the late 30's and early forties, and..uh programmed about a third of the rules that he actually developed.. in, in a program and because of time he didn't put in the other two thirds and he then took an actual program for one of these houses () and ran it through and uh had it do the plans and perspectives on the plotter and then compared it with the actual house that Wright had designed and one of the, uh plotter diagrams; it needs only to be flipflopped to make it the exact same house () almost no differences whatsoever in fact even the, the computer perspective which is actually of the roof planes superimposed in space over them,

over the perspective plan; even that looks an awful lot like the house () but I think he, to me it was interesting because I've always found I and, and architects I worked for tend to set up rules for themselves and design according to rules- whatever comes out at the end is a form that's satisfactory () with uh only minor changes ah..XX OK, I was experimenting there with some steps on the roof and also down in front of the thing, uh XX I'm going to do a little sketch now that's just XXX make me feel what would happen if steps went all the way up somehow. I think I'll put a little, a step pyramid monument for ourselves over to one side... that would have this interest effect; also that some of these steps could peel off and go around the podium Kresge sits on...XXX.. be a terrible building to build ...uhum... OK, I'm gonna try one more bit of gadgetry here which is to just mound up the dirt in front of it ...XXX that doesn't do a thing for me ...I guess one thing that I'm self-consciously doing here is trying to make ah building that doesn't compete in terms of a lot of detail; trying to make a very, very simple exterior... again I'm letting the interior pretty much take care of itself. after I get the exterior designed....XXXXX...Well, that's much too fashionable; that'll never do it.. just trying here... well, part of it was, was some steps people could go up and use ah and another was be more unobstrusive.... this thing here flattererXXXXX.... I guess th, if one puts on a simple pitch roof like that, it gets to be awfully hard to justify the height at the high end.. or does it? maybe not.... I don't think I'm going to like this and what I'd rather do ...ah, XXX drawing a little of the detail around that XXX I'm going to see if I can go someplace with that... uhum..XX....XXX. Actually, I don't think so many steps... I think what I'd be tempted to do rather than put in steps there is put in a long, a long stepped ramp or maybe just a ramp. It's a four foot difference. We have about 80' to do it in-that would be 1 in 20, let's just put in a , a long brick ramp there... in fact, wrap it a bit..yes...XXX let it come down to street level, ah we got the problem we should need a sidewalk downstairs I suppose... OK to try and squeeze in a 40 foot wide building...XXX.. now that's 40 feet wide and at a, at about a 1 in 2 rise, it would rise 20 feet from one side to the other-which is more than I could handle.... XXX uhum...XXX this,

that famous diagonal wall coming sliding along the building there and this is just a big warped plane actually that's curving down at the stoop;ahm, ah we could right up to the sidewalk line, some kind of hard edge along the sidewalk XXX uhum haven't rally got room to do what I wanted to do in this perspective sketch because I'm already tight up against the sidewalk at the end of the oval and you have to change the shape of the oval a bit which uh looks like somebody's done that already: squotched off the end of it a little bit; I'm going to back off a bit on the idea of the building...XXX... or I might sink the building going down into ground— which is another possibility; have to go down another four or five feet under the ground XX...XX uh, I think I'm beginning for the first time to think of this as a whole building () as a whole building ... beginning now to think about a structural system, a little about the internal character as well as... what it does for Kresge Plaza... one of the structural problems is I, I'm thinking of trying to hang a brick roof in the air there with steps for people to get up on.. ah, that gets to be a very heavy structure...XXXX...XXX uhuh, about a 1 in 3 pitch XXXX.. it's uh XXX going to present just blank brick face to Amherst street, going to start almost,almost from ground level..it's going to..have... a XX sloping, spectorine and I,I guess it would have to terminate at the back in some kind of a.. parapet so things couldn't run up and fall off the top. Now, that's going to be a terribly heavy structure, I guess that's going to be bricks laid flat just like they have at Kresge... ah,those could be laid actually over a concrete slab that stepped up like this;so it wouldn't be such a terrible thing...however... XXXX in order to support that we'd have to probably put in some big concrete beams... pour the thing in place and I suppose just have this staggered poured of roof exposed on the inside and then that would have to be held up on. on what?...now, this way would be just putting a concrete beam that had a stepped topside XXX and a smooth bottom side;that works that much; that's entrance XXX have to go between the, between the brick walls on either side which would be bearing walls.. uh XX when you go straight a brickly, it becomes sort of a feature of the interior space XXX Then I would envision that along the Amherst street side it becomes sort of a feature of

interior space XX then I would envision that along the Amherst street side we wouldn't present exactly a blank wall either but take advantage of some of that southern sunshine XXXX probably put in some kind of clerestory windows with some kind of ah... shade control element .. and that's below street level... this drawings not to scale () understand? I don't think that's... something close to scale at all.. and sigh maybe people could use this space up here which would be rather broad and flat and a 1 in 3 slope and they catch sunlight through most of the day, ...ah, the outside would look pretty much like this sketch here with these broad brick steps going up and a parapet wall at the back XXX. It sure looks like a set of bleachers. Now, one of the big problems is we're 4 feet below ground level; we need ,ah, 3 exits out of the building and we need a, a decent entrance in; in this case, I'm I'm saying it should be in from Kresge plaza, ehmuhum....XX so this building has a floor eight feet below the plaza and 4 feet below the sidewalk on Amherst street XXX now, what I'm gonna do down here is to just pretty much, to make a barn, just plain space except for that concrete roof going on over head and clerestory windows...ah... I'm going to put in a brick floor also; make the whole thing brick except for that concrete roof ... Now the main problem about, about that one becomes putting the entrance in the thing. () putting the entrance in the thing gets to be difficult because we've got to come down 8 feet... I suppose... if we're really clever with that 8 foot differential in elevation... we can bring in the entrance behind that wall, have a projection booth below the entrance...uh, let's see that building's though 20 feet wide; we've got to get down eight; that's going take about 16 feet of run ah..tsk, it's ought to be indoors or it's going to trap leaves and ice and snow and things....uhum...you don't particularly care about having finished, definitive drawings do you? () if that rises 1 in 3 it goes up about uh 13 feet; I'm saying that means 15 feet above plaza level at that side XXX just wondering what happens if I put a coup, a pair of 15 foot walls there... put an entrance right between them XXXX..X. Is the design comprehensible to you at this point? Do you understand what I'm () What I'm doing () laugh I imagine...you'd better not either or I'll slug you...XXX that's poor..Must be doing something wrong because it seems to me my

building all out size. It seems to me it should be 40 by 50, about 150; nah, it's approaching that ...OK.... I know what I'm going to do; I'm not going to have an, ano, another entrance... I'm going to have an entrance in the end down by Kresge, off that brick slope... I'm going to have the uh.. smaller room alongside that somehow; I'm, I'm not going all the proportions things worked out I'm sure; there's the smaller room! then you have a larger room.. down at the other end.. got a screwy shape that's not going to help us much... especially because I didn't know we were going to have projection in the middle- that doesn't work at all... Yea, actually that works kind of nicely because...uhm, this building is getting to be a big piece of sculpture or not, not a piece of architecture; but what it'll enable us to do is to come in here at some level like uh if you take plaza level at 0 this enables us to come in at -2; we've got get down to -8, that gives us a great long distance to do it in, a place to hang stuff and so forth; one really arrives in the middle of the place... and is uh... Aha, OK, let's do this: XX one can enter either way, we will put... that's going to be about 25 uh 30, five something so... and we'll see people come in around... like this. We'll put some kind of protection facility across the back where they can enter the plaza, people brought in that; it'll be able to project onto this side here.. and on to this side here... I guess what we actually end up is 2 separate projection booths..toilets and coats ah...don't fit.. nor the kitchen... I suppose what we, what I would do... can't drag you in on this- is to uh..XX hmm at this point in the remaining time to compromise and instead of a couple of small projection booths which are entered off of the spaces that they serve- which are now entered separately is to just strip table like and to develop an area back in here which would include a kitchen ... in the center XX and then a couple of toilets that would entered by sliding past the two sides of the kitchen.. So, for the first time it's all on paper... have to think about yawn that drag?..... I sort of like what I did outside, not much care for some features of the inside... Another thing I haven't worked out yet are, I, the additional exits that are required... cause those just don't work at all... Don't know the code all that well for assembly spaces; got one here obviously and probably one in the middle and one on the other side... I think it's, is that your about what would be re-

quired? () I'm getting we probably can't get by
without the middle one () Yea, yea got to, we
get those people up four feet somehow () that's
the hangup uhum ... that's another little problem
in this room that I've been putting the speaker
alongside a row of windows; it bothers me. It's a
little hard on the audience to try to see him if
there's much light coming up there...XX... I think
it would be more ideal in a room like this if the
speaker were over here... OK, I'm gonna try some-
thing a little different: I want this diagram
here.. let me put the speaker down here.. I'm gon-
na carve up this room a little bit..X laugh to
make my building work. I'm gonna give up on the
flat floor thing for that room. I'm gonna start
by uh putting in some... levels in this room,
some change now which would get back up to the
4 foot level at the rear and simply discharge to
the street through a pair of double doors would
ordinarily be closed. I'm going to simply uh and
then, then... put in a major entrance down here
and possibly if this ramp worked out properly could
possibly sliding. Well, a little subsidiary ramp
could come up, connects with this up here. Now the
place begins to work much better as place where a
man could stand and see, be seen ah; but that
puts the windows in here illuminated in and opened
letting in sunlight and fresh air it uh..doesn't
leave us a place for a projection booth..so... I
would be tempted either to encroach on the sidewalk
with some kind of a uh small recess that uh is,
would be about 4 feet minimum for that, which is
going to wipe out the sidewalk.. but maybe, I know
what I would do there- pull an old Lou Kahn trick:
let the wall spread in two directions working the
projection booth up at the back there.. ah, it
would have to come this way a little bit and pro-
ject out in the street up here... Now, I don't mind
that room so much aby... Ah, sigh. I think I'll
revise my arrangement here in the kitchen, bathrooms
...ah... maybe have a kitchen XX that can serve
either into the lobby or into the smaller room
here which could be used as a reception room after
a big lecture () and then we have a, a little ah,
hallway here XXX 10 feet which feed entrances to
the men's and women's room like that sideways so no
one can see the doors from directly into the lobby
and.. I guess I'd have to push that passage point
against there... OK, now uh, that leaves us still
this room that has... that, I really do think ought
to have a platform; am I trapping myself? cause I

don't know how I'm going to get people out of there...this room has now got exits; it's got two very clear and sperate ways out, this one's ... ah, still got, only got one clear way out; it really needs a way out back here someplace... tsk... Oh, we, you're also talking about that center.. center doorway.. well, the exits are all fouled up.. sigh..tsk... Actually this whole thing still quite unworked out; could come just about sidewalk level here, but then it's gonna have to go down another four feet in about...15- which is too steep... break into the stairway there... At this point obviously, I'm forcing the thing...

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