SOLVING AN ARCHITECTURAL PROBLEM
FOR USE IN TEACHING

by

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B. S., Kansas State College
of Agriculture and Applied Science, 1949

A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Architecture

and Allied Arts

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1955

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INTRODUCTION

It has been envisaged that the ideas recorded here will be useful to the teacher in the field of architectural education. A new system of education has not been proposed but rather a method or approach that can be used within the existing academic system. This is primarily a philosophy for approaching and solving a problem and is not considered as the only approach. The material recorded here is offered in the hope that it may contribute to the teaching of architecture. The author has found many of the ideas useful in his teaching experience. Possibly some of the material will inspire other ideas and further thought by the reader.

This subject was approached with confidence that the following statement was true.

> It ill becomes a man who ventures into print to profess modesty. A heart of gun-metal and a brow of teak can alone sustain him in face of his critics, if art be the theme and English the language. (Nobbs, 17), p. 9.

It was realized that full agreement by any educator would be improbable. However, most of the persons seriously trying to improve education have recognized weaknesses in the existing methods. Little attempt is made here to give an analysis of what these weaknesses are. Rather it is hoped that by giving positive ideas the reader will be stimulated to evaluate and improve the procedure.

A major criticism leveled at the schools by the profession has been summed up in a statement by Mr. Frank Lloyd Wright:

> A creative art cannot be taught. It can only be learned by actually facing and solving the problem. School is a waste, you learn nothing of the nature of materials, or how to think like an architect. (Wright, 29).

Schools have tended to ignore the real problems of architecture at times and have advanced in the realm of "pink cloud" concepts. This has justified Mr. Wright's criticism in that the real roots of the problems of architecture have been ignored. Much has and is being done to correct this attitude in the schools. It was felt that the ideas given in the thesis might contribute something to this movement toward reality and better architectural training. The first part of Mr. Wright's statement has been agreed with, but no reason has been found which prevents learning by experience within the framework of the educational processes in solving an architectural problem. It was the intention to provide a sequence or framework of ideas and methods that would encourage this process of learning by experience.

The text of this thesis is dealing with a method or outline that may be used in teaching. It may be considered for use as:

1. A check list to help in setting up a problem and to insure thorough coverage.
2. A suggested method of solving an architectural problem from which the teacher may develop his own variations. The material is presented with the hope that it will suggest to the reader a way of application. An exact

means of application is not given in each part. The method can form an overall guiding program for a four- or five-year course. This can be effected by giving systematic emphasis to different parts until a total understanding is had by the student. Another way of using the method would be for an individual problem of any length.

3. A series of steps all of which will not be useful for every problem. The parts that are not applicable may be checked off in turn and ignored in the solution. Any parts that the student is not ready for or that do not contribute to his timely development should be subordinated or left out.

4. A method, not a formula, of organization. An architect is primarily a master organizer and the student should be taught to organize from the beginning in a logical way. Organization alone will not produce architecture but will form the solid foundation necessary to its creation.

> When we approach a problem, whether in design or in anything else concerning ourselves and other humans, let us look for relations, for order. Such an approach ought to help us, for it will enable us to see the problem more clearly. We would probably get much the same advice from others who are primarily concerned, as we designers are, with the empirical world--with the world of our experience and observation. . . (Newton, 16), p. 4.

5. An encouragement to assimilate a wide background knowledge by research into fields important to producing man's environment.

> Wright is right. . . .architects must need for their professional work some knowledge of sociology, sculpture, mechanical engineering, painting, woodwork, electrical engineering, public health, geography, plumbing, landscaping, civil engineering, city planning, office administration, law, design, physics, sanitation, accounting, and, besides many other items, climatology and microclimatology (Aronin, 1), p. 9.

It is paramount that a critical eye be developed toward nature, man, and man-made objects so as to give a constructive criticism, thus making the observation useful. The student needs to develop a sense of reality and understanding of man.

> An architect must know our civilization as he knows his home, by living in it, sharing it, believing in it, and his knowledge must be so intimate and so pervasive that he cannot lay stone upon stone without the silent channeling of the world around him. He will reestablish the unity of architecture as social utility and social expression, not through his learning or through his philosophy but through his way of working. (Hudnut, 12), p. 135.

The background for the writing of this thesis was the author's experience as a student, as a teacher of architecture, as a designer for an architectural firm, as a practicing architect, and as a graduate student doing research in the field of education.

BASES FOR SOLVING AN ARCHITECTURAL PROBLEM

Assumptions and Definitions

The following assumptions and definitions are given to form a basis of understanding between the author and the teacher. It is important that these assumptions and definitions given below be kept in mind while considering the proposals that are offered.

A Definition of Architecture. Architecture means the three-dimensional objects that form the living environment of man. This includes not only shelter but the far more complex organization of all the objects that satisfy man physically and psychologically. This is restricted to objects that form man's living environment and are usually classified under headings such as city planning, landscape and site planning, landscape planting, industrial design, interior design, furniture design, etc. Architecture in its broad meaning must include all of the fields of effort that form and control man's daily living environment.

> The effect of our environment on our mental and physical well-being cannot be exaggerated. We translate the world around us into our own physical sensations, and we can be made cruelly uncomfortable, physically and mentally, by the influences that play upon our nerves. We have no firm grasp on serenity and we lose our mental and physical equilibrium with fearsome ease. We need a world in which we can stand firmly and proudly, our mental balance unendangered. (Teague, 21), p. 190.

A clear definition is needed by a student of his ultimate goal and his future responsibility.

The Responsibility of the Architect Assumed. Geniuses will always be ahead of their time and set the pace; but a truly great national architecture will be produced only when the majority of "average" architects are able to produce good design. The effect of a few geniuses on the total environment is small. The living environment will be improved when the total problem is understood and dealt with by the majority of architects. Most architects start their career in some school. The initial responsibility for understanding the problems and needs of our civilization lies with the teachers.

The society of the United States and its government are peculiar in history. There are no precedents for designers to follow in understanding the problems. In addition to this new machines, tools, and equipment are at hand for use. New materials and methods flood the market. No designer can hope to be successful without an understanding of life as it is today with sympathy for its problems, both social and economic. Knowledge of machines and factories is useful to the designer. All of this can help the student to see how difficult the problem for which a solution is being sought.

The designer who is equipped with this knowledge is well prepared for creative work. Creative work may come about by that agency called imagination as a result of having all the background factors well in mind. In addition to this knowledge, a sympathetic and understanding attitude on the designer's part should prevail. Work produced without the love of sympathy is rarely creative art. Teague describes this creative activity thus:

> The flash of insight, the sudden illumination that may occur when he has all the factors in hand, revealing to him a solution that surprises him with its rightnesses, this creative intuition comes to him in the chromosomes transmitted to him by his ancestors. There is no school where he can acquire even a trace of talent, and certainly not any genius at all. But if he has a spark in him, the world today is full of many winds that will make it blaze. Surely there never was a more stimulating time than this, one that had more need of creative work or gave it more scope. It is a time of sweeping change, with gigantic forces loose in the world; evil and good, both are active on a vast scale. We walk between catastrophe and apotheosis. In spite of the mighty destructive powers that threaten us, our vision of a desirable life was never so clear and our means of realizing it

> never so ample. There is a world around us to be rebuilt and the man who does not take fire at the prospect of a share in the job had better realize at once that he has no creative gift and take employment under someone who has: then at least he will be in the fight and share its excitement. (Teague, 21), pp. 230-31.

What is an Architect? The following definition of an architect by Frank Lloyd Wright can serve to challenge the student and architect alike.

The Architect Who Is He and Why

> He is a relentless observer. He is always active and effective in the investigation of Nature.
>
> He sees that all forms of Nature are interdependent and arise out of each other, according to the laws of Creation.
>
> In his every design a bit of Nature enters into building.
>
> His perceptions (insight) science later verifies.
>
> Intimacy with Nature is the great friendship.
>
> He sees ideas as also manifest actions of Nature.
>
> It is the poet in him that is the great quality of him.
>
> The profound naturalness of his own being is the essential condition of a great architect and the condition of greatness in the man.
>
> Expect from him a system of philosophy and ethics which is a synthesis of society and civilization.
>
> Such an architect was he who invariably signed himself Louis H. Sullivan. (Wright, 25), p. 3.

The Use of Reason and Creation Assumed Necessary. To solve an architectural problem, both reason and creation need to be employed.

> An architect must be a practical dreamer. If he is only a practical man, it is not enough. If he is only a dreamer, it is not enough. (Lescaze, 14), p. 15.

A future architect can profit by early contact with the different methods of reasoning. Some understanding of the term creation is also desirable. Following are definitions of the two basic reasoning processes and how they can apply to architectural design processes. An explanation of creation and the evolution of design is included. These basic definitions can form a point of departure for the student.

The Inductive Process of Reasoning. The process of inductive reasoning is useful to an architect and follows these four steps:

Inductive Reasoning

1. Exact observation.

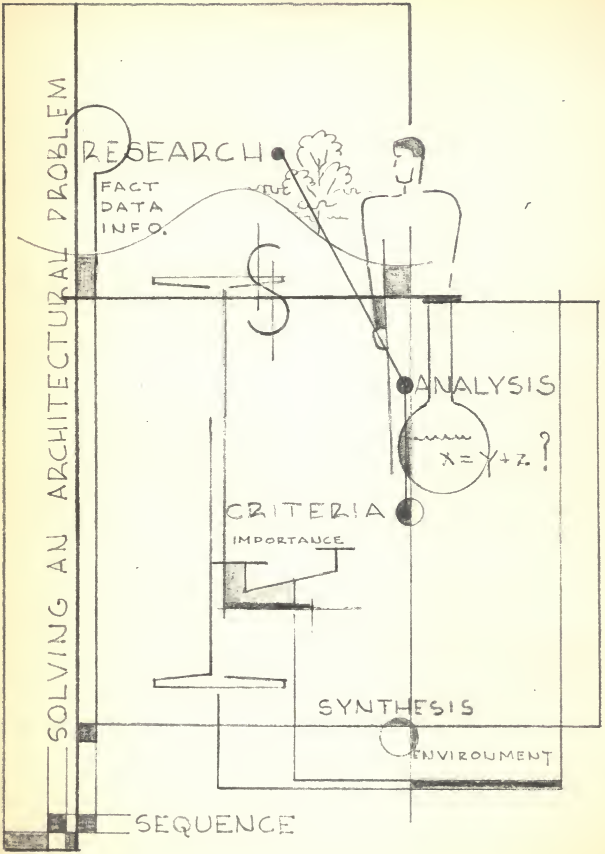
2. Correct interpretation of the observed facts with a view to understanding them in relation to each other and to their causes.

3. Rational explanation of the facts by referring them to their real cause or law.

4. Scientific construction, putting the facts in such coordination that the system reached shall agree with the reality (Funk, 7), p. 1254.

In design these steps may be classified as: 1. Research, 2. Analysis, 3. Criteria, 4. Synthesis.

The Deductive Process of Reasoning. Within the framework of the inductive reasoning process a deductive process can take place. By definition deductive thought is "that form of reasoning in which a fact or truth of a specific or individual statement, is inferred from a general fact, law or principle." (Funk, 7), p. 667. This is applicable to the design process in that it is usually necessary to accept the previous decisions as accurate. These established premises which are usually more general than the subsequent material serve as a basis for deducing or arriving at the solution. The previous decisions may be


SOLVING AN ARCHITECTURAL PROBLEM
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X = Y + Z ?
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IMPORTANCE
SYNTHESIS
ENVIRONMENT
SEQUENCE

brought about by reason or intuition. This whole process or architectural design is one of evolution or the process of development and growth.

The Act of Creation. Creation is defined "To cause to be or come into existence, to produce as a new construction out of existing materials." (Funk, 7), p. 609. The process of creating architecture results from reasoning and the intuitive powers of the designer. Imagination is that agency by which the creation takes place. It is regulated by thought and stimulated by intuition or perception of truths, facts, etc.

> Really, I consider it essential in all education--and emphatically in education toward creative art--that education should be so directed as to embue the student with the spirit of creation by means of his personal sensing, thinking, and experience. To that end I have been anxious to have the students understand that we all--instructors and students alike--are engaged in a creative search for forms to come, and that each one, individually, must--so to speak--digest his own food. (Saarinen, 18), p. 18.

The Evolutive Creation of the Design. It is assumed that the evolution of a design requires a series of creative decisions by the designer, the sum of which will be the solution.

> In short, the only factors in modern design that should always be assumed to be right, determined in advance of each problem and never varying in character, are the designer's intention and his approach to his problem. If these are not sound, nothing else can be right and no repertoire of tricks will save the work from futility. But even if they are right, the designer is still human and fallible: his work can fail merely from his lack of strength to realize his intention, however honest that may be. For success he must not only be sincere and do the expected, he must go further and surprise us with something more of interest and value than by all the rules we had any right to expect. And this illumination that by some curious success of vitality he is able to give his work at

> times will surprise himself as much as it surprises us. It is another factor in design that cannot be turned on at will. (Teague, 21), p. 218.

The creative decisions that are continuously made by the designer need to be taken in a logical order. By using a logical ordered direction, the designer arrives at a solution without the uncertainty of snap judgment about many facts at one time, being unable to separate them quickly. By taking each one in its order, the possible error is less. It is felt that one of the major purposes of instruction is to help the student develop a sound ordered approach to the problem.

> Design, of course, cannot be taught. All that an architect in charge of the design done in a school can do is to encourage an orderly mental process in the solution of problems, and when a student is found with something to say in the hypothetical building material or imaginary structure, to help him say it grammatically. (Nobbs, 17), p. 4.

Directing Limitations

<u>The Program</u>. A program of the problem is usually the first step in its solution.

> . . . .architecture cannot be created in a vacuum, you can't create real architecture until a clearcut program has been first established. (Lescaze, 14), p. 142.

The factors need to be assembled that would be present in actual practice if the problem is to have significance. In a school situation a certain amount of fiction replaces the facts of practice and some factors of practice must be left out altogether. One of the factors that usually does not become a part of the school program is the actual construction of the building, for example. It is not always possible to have a live client but a fictitious client serves very well for most problems. The source of finance can be assumed. These and other factors can be fictitious but should as nearly as possible resemble an actual situation. It is felt that whenever possible the program should contain a real situation, however. It is better to be able to see and walk on a site than to have only a map of it, or worse, not a site at all. Some of the basic facts that need to be included in the program are those without which a building cannot exist. Some of these are a site, a climate, a function, a client, economic values, and other limitations. These and other facts, either real or imaginary, needs be part of the problem if its purpose is altogether realistic.

Due to the limitations of the school situation, it is usually best for the teacher to assemble most of the program. If some of the data for the program can be gathered by the student, it is valuable experience. The student could be responsible for gathering the facts about the site to complete the program, as an example.

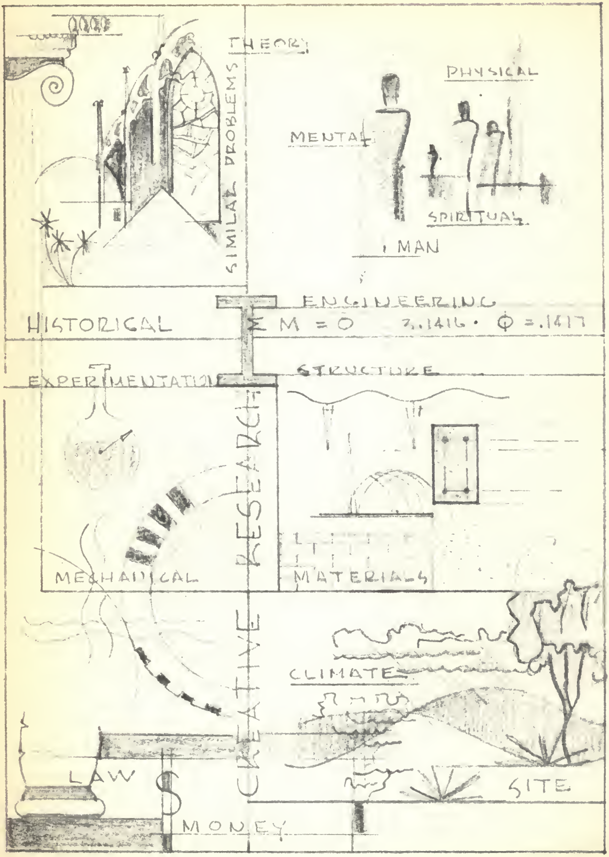
The Scheduling of Time. Time is a limitation in the solving of most problems. It is rare when a solution reaches a point that the author cannot improve some part of it by added work. Usually time limits the solution. The solution is then stated as the best attainable under the limitations. In the learning process a time schedule determined as part of the program will tend to give the problem a spirit of realism. This, in turn, may be a great help to the student when he faces actual problems.

Scheduling of time gives the teacher a method of placing emphasis on that part of the problem deemed most important to the development of the student. Another method of scheduling work is by a study method. At the problem's outset a predetermined number of studies can be required. An example of this would be to have each student develop, say, ten different basic solutions, all of which would have possibilities as a solution. Then make ten studies of each idea to see what would develop. From these, by a process of elimination, the best basic idea can be found and then developed. A hundred studies might be allowed for this development. This, then, would be the solution. In any event some realism is suggested concerning time when giving a problem. The student habit of inconsistent work habits and waiting for the last week to solve the problem does not seem to prepare him for the future. A good time schedule could go a long way toward helping the student develop good work habits and consideration for the element of time.

Research

Investigation and Research. Once the facts are known, the next step toward solving an architectural problem is that of investigation and research. This can be a rewarding part of the problem for a student. The first effort here is to uncover the essential elements necessary to solving the problem.

> The first step in every one of our design problems is the separation of the essential sheep from the superfluous goats, a process we all approve in logic but find exceedingly difficult to complete in practice. We admit the value and the necessity of direct advance, but we



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> find bypaths extremely alluring. It is difficult to adhere to a ruthless process of simplification which, discriminating between distracting and significant elements, eliminates the former and coordinates the latter into an essential unity. And yet there is no other method whereby the order we seek can be achieved. (Teague, 21), pp. 110-11.

Research need not be confined to the initial part of the problem but may play an important role in all the phases. The solution to each part lies in the problem itself. This idea is stated best by Louis H. Sullivan in the following quotation from The Autobiography of an Idea.

> Louis welcomed new problems as a challenge and a test. He had worked out a theory that every problem contains and suggests its own solution. That a postulate which does not contain and suggest its solution is not in any sense a problem, but a misstatement of fact or an incomplete one. He had reached a conviction that this formula is universal in its nature and in application. (Sullivan, 20), p. 299.

A Research Check List. The following research list is given as a check list. For complete research it may be necessary to consider each research topic. In many problems the teacher may select only the research topics that will be most beneficial to the student at that time. The research topics are: historical research, investigation of man, theoretical research, the study of similar problems, structural research, the use of materials, the site, legal and financial facts, the engineer's contribution to research, creative research, and research questions. Following is a brief explanation and suggested use of research.

Historical Research. The consideration of historical systems is helpful to the production or architecture.

> For planning of any sort our knowledge must be beyond the state of affairs that actually prevails. To plan we must know what has gone on in the past and feel what is coming in the future. This is not an invitation to prophecy but a demand for a universal outlook upon the world. (Giedion, 8), p. 7.

> A wider survey of the whole domain of human activity is the unmistakable need of the century. It is in this connection that history can play an important role. One of the functions of history is to help us to live in a larger sense, in a wider dimension. This does not mean that we should copy the forms and attitudes of bygone periods, as the nineteenth century did, but that we should conduct our lives against a much wider historical background. (Giedion, 8), p. 8.

Part of historical research is the study of existing systems and their background or origin. By considering each problem as a new system to be created to coexist with and within other preexisting systems. The historical framework takes on importance when viewed in this way. Some examples of systems are: social, political, economic, various physical and chemical, domestic, law, and religious systems.

The universe is made up of systems. Each design problem is a system which is in turn part of another system or systems. One consideration when viewing a new problem in architecture is to discover what kind of a system it is and to what system it belongs. By starting with the largest system of significance and working toward the individual system for which we are seeking a solution, a complete background can be had. In addition to discovering the historical aspects, many other problems bearing on the one being solved may be brought to light.

Some good questions for the student to answer are: What are the implications of the problem? Do they affect the world, the continent, the nation, state, town, or neighborhood? How does each system, starting with the largest, affect the solution of the problem? Each of the historical systems will give certain facts which help form the bases for the solution. The student can gain a general education from this type of research. The following quotation serves as an example of this type of thinking.

> . . .The foundation of a flourishing modern school of architecture depends on the successful solution of a series of closely connected problems--the major issues of national planning, such as the readjustment of the relations between industry and agriculture and the redistribution of population on rational economic and geopolitical principles; a re-orientation of town planning, based on a progressive loosening of the city's tightly-woven tissue of streets by the alternation of rural and urban zones and a more organic concentration of the residential and working districts with their educational and recreational centres; and, finally, the discovery of the ideal type of dwelling. (Gropius, 9), p. 79.

Investigation of Man. The most important single investigation is that of man. This is closely allied with historical research and will overlap it in places, perhaps. The nature of man, when understood, will help guide the solutions intended for man's use. This investigation should deal with the physical, psychological, mental, spiritual, and social aspects of man as related to the problem under consideration. This necessitates knowing about life and its problems.

> Architecture has ceased to be the concern of passive and businesslike specialists who build precisely what their clients bargain for. Architecture has cast off this passivity; it has gained the courage to deal actively with vital questions, inquiring into the needs of the child, the woman, and the man. It asks, "What kind of life are you leading? Are we responsible for the conditions you have to put up with? How must we plan--not just in the case of houses, but clear

> through to regional areas--so that you may have a life worthy of the name?"
>
> When we go to the bottom of questions like these, we see that contemporary architecture takes its start in a moral problem. (Giedion, 8), p. 494.

The architect then must be more than a building specialist or engineer. The architect must be in vital contact with the nature and problems of man whom he is serving.

> He is master of the elements: earth, air, fire, light, and water. Space, motion, and gravitation are his palette: the sun his brush. His concern is the heart of humanity. He, of all men, must see into the life of things; know their honor. (Wright, 25), p. 112.

Theoretical Research. There are usually parts of every problem that will require theoretical research by the student. This may be the investigation of a new idea, or a new application of an old principle.

The Study of Similar Problems. The student can sometimes come to a better understanding of a problem by the study of solutions to similar problems, both historical and contemporary. This study can be done in a critical way by asking the questions: what was the purpose of this?, why was this solution reached?, does it fulfill its purpose well?

> So let the student and the teacher observe as much as they can, analyze why the thing they see was done that way and figure out how it was done, both as to the technical means and as to the way the maker's mind worked. Then let them proceed on their own, on that basis. What they will do thereafter should be a genuine expression of themselves, conditioned by their individual endowments. When they are thus freed from the impulse to copy literally, yet can find suggestions from which to develop their own ideas, creativeness is not dulled but encouraged. The student's inventiveness can grow. Good teaching and good learning lead always in the direction of growth in self-reliance and creativeness. (Smith, 19), p. 15.

It will be necessary also to establish an understanding of the era in which the solution served in order to know if it fulfilled its purpose.

> . . . it becomes apparent that the building which can be called Architecture, the building which has provided the necessary environment for a particular activity in terms of psychological as well as physical needs will actually be a mirror of the culture within which it was built. In its structural systems and uses of materials will be recorded the stage of technological advancement of the era. It will indicate the social organization of the time--how people work and live together, what their activities and their attitudes are. Finally, it will show what elements in life they consider important and suggest the relationships existing between the family and its neighborhood, city, state, and nation. (Triffit and Carlson, 22), p. 114.

Structural Research. Structural research is usually developed after other aspects of the problem are complete. There are sometimes considerations to be made in the initial stages of the work, however. As a result of research, it may be found that structural considerations will form one of the major criteria. The factors uncovered in research concerning materials may give reason for structural research. The locality being dealt with may dictate both materials and structure, or the economic problem may well be the limiting factor.

The Use of Materials. The process of selecting materials is a complex affair that is involved in many parts of most problems. Research as to availability, economy, structure, or beauty is often necessary. The student should acquaint himself with the nature of the material to be used as fully as possible.

> The designer's work in materials has only begun when he has selected the material most suitable for a specific use. He has to extricate it from any masquerades in which it may come to him, and study to obtain the maximum effect from its individual qualities. Then

> he still must consider the forms in which he will shape it, with reference to the processes by which it will be fabricated. This is just as true of the materials which have been in use for countless centuries as of the latest invention, since our processes are either wholly new or have not yet been studied with sufficient thoroughness. The tool leaves its mark on whatever it touches, and this applies to our enormous complex tools of today as it did to the carver's chisel. The tool--any tool--can do certain things very well with certain materials, but to force it to do anything else is to produce a sorry result. We shall not be able to put our environment in order until we learn not only how to make the best possible use of our material resources, but also how to use our tools to fabricate these materials in the most useful and satisfying forms. (Teague, 21), pp. 82-83.

The use of material in the structure is better understood many times by application. When possible, the building of models of parts such as joints, corners, and connections will reveal much about the nature of the material being used. The major problems of construction become most critical at the point of joining with another material or the same material. After the details of the structure are developed sufficiently, research models of the joints and corners can be made. As an example, the design of a window opening and the fitting of the window into it can be studied by building a small part of the total, as one corner of the jamb. It is often valuable to build a typical section of a wall with the actual material to be used to acquaint the student with the material and the process of building with it. By building these models and full-size sections some insight of the problems facing a builder can be gained.

Experimental Research with Space Form. This type of research must need be done during the design stage for the most part. Experimentation with space can be done with models to determine the relationship of one space to another, the physical and psychological potentials of each space, and the interior exterior relationships. The spaces should be studied in simple form, making revision and experimentation possible. After the small model solves the problem as a whole, then a larger model will help in refining the solution. If a way can be devised for the study of space at full size by use of planes that can be controlled with pulleys and other supporting devices, it will allow the student to actually experience the space and form under consideration. Models, as good as they are, cannot reproduce exactly the same physical and psychological reactions in an individual as actually being in the space and walking through its parts.

> An object is always seen within a surrounding space, and usually in combination with other objects whose forms, as well as colors, change its appearance profoundly. Even though an object may be isolated, the color, the material, and the depth of the space around it affect its appearance. (Emerson, 6), p. 111.

When working with space the student should realize the importance of color, texture, and light study.

Mechanical Problems. The following problems will all require a certain amount of research if they enter into the design: plumbing, heating, cooling, acoustics, lighting, electrical, and other equipment.

The Site. Site research concerning its geographic and geological limitations, controlling laws, existing and future surroundings, etc., forms one of the major controlling factors in the design. Richard Neutra gives an admonition to persons who are considering a plot of ground for building.

Look where the sun rises and sets. We all depend on radiation penetration into the interiors of our cubby holes, but we also can get too much of it.

Watch from where the wind blows and ask long-resident neighbors about it. Flowing air is better than the biggest storage of it. We also must worry about weathering and tightening our shelter at will.

See what you can see from the place, and in what direction. Our eyes relax and rejoice in sweeping over distant vistas. Eyes may get used to a disordered vicinity, always close-up, but we keep on suffering just the same, subconsciously. Overhead supply wires, telephone poles, looming or unsightly neighboring structures are the greatest offenders. Think at once of screening your little visual empire. Calculate the possibility of "planting out of sight" what you do not want to see.

Trees are wonderful--even though they may drop leaves or seeds and give you the chore of tidying up the place. But who would want to forfeit his teeth, just to avoid brushing them? If there are trees granted you by fate, can you conceive a layout to conserve them? Never sacrifice a tree if you can help it.

How is the ground? Can it drain? Is it steep to plant? Can you construct with ease or connect indoors with some level spot outdoors?

How is the soil? Is it good enough to nourish and support roots? Will it be eroded by your building operations and grading?

Are there any existing neighbors? Or where most likely may they build in the future? Neighborliness will be best preserved if you can arrange your building to keep your privacy and let them keep theirs. Sometimes you may wish to be alone, undisturbed, with the spirits of your place.

Finally, try to understand the character and peculiarities of your site. Heighten and intensify what it may offer, never work against its inner grain and fiber. You will pay dearly for any such offense, though you may never clearly note what wasting leak your happiness has sprung. (Neutra, 15), p. 62.

Legal and Financial Facts. The projected client's financial resources and how they are to be distributed, use of loans, mortgages, etc., must be fully understood and will usually require research if this is part of the problem

The Engineer's Contribution to Research. The dependence of the designer on professional and related fields cannot be denied.

> Good design, like most products of this machine age, is the result of group activity. The engineer in this group is responsible for the performance and the manufacture of a product. The designer therefore must draw constantly on the engineer's technical knowledge, not only that functional requirements may be fully met, but that he may discover in all their details the factors which will determine and give significance to his form. The engineer is the designer's reservoir of knowledge, his guide and mentor. (Teague, 21), p. 39.

Not much can be done in school except to point out the necessity for cooperation with the allied professions when in practice.

Creative Research. Research can be the key to new adventures in architectural design and better environment if it is approached creatively. An example of the use of this principle is seen in the application of a principle of physics to the design of a space by Buckminster Fuller.

> The physical movement of heat radiating from a center is to roll in a do-nut shape up and out returning on itself forming a rolling do-nut. If this principle is applied to heating a space the ideal shape for efficiency and economy is a dome with the heat source in the center radiating upward and out. If the heat comes from a decentralized circular shape it forms a rolling do-nut moving in the opposite direction. This has its application in cooling a dome shape by the radiated heat forming a thermal column and returning through an opening in the top of the dome and out under its edges giving a continuous change of air in the space. (Fuller, 27)

This example serves well to illustrate the type of thinking most useful to design. It is in the understanding of nature's principles and the following of them that lies the solution to man's struggle. (Malin, 28).

> We are unique among animals--and this will bear repeating, although it has been said before--in that we have undertaken to adapt our environment to us instead of adapting ourselves to our environment. (Teague, 21), p. 232.

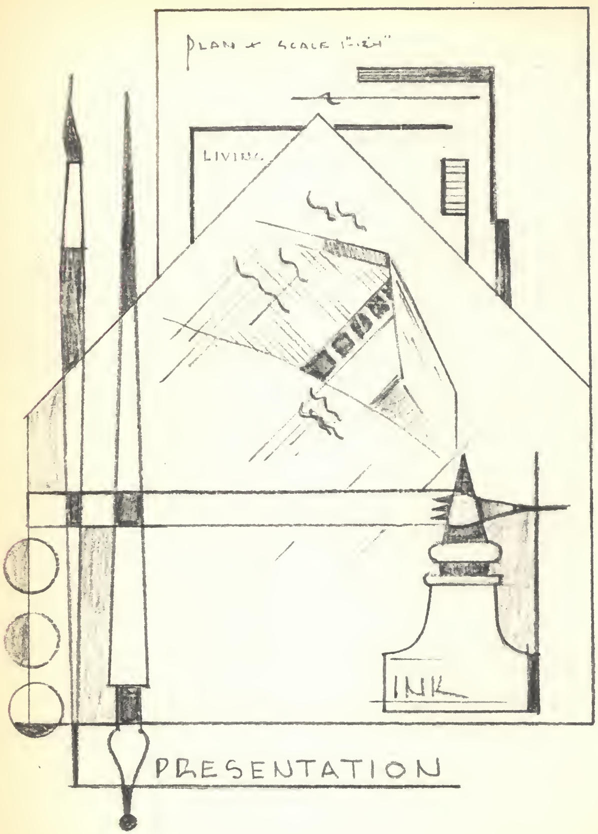
However, going against nature is not efficient and will be a poor solution or may fail altogether.

Research Questions. The following basic questions need to be answered in order to proceed with the design. What are the physical and psychological needs? What is the nature of the site? What are the problems of climate? What materials are available? How much money will be spent on the project? Is there a good labor source? What are the means of power that may be used? Depending on the problem, there may be additional research items to cover

PRESENTATION

Definition

Presentation is a "bringing forward" or "offering to be considered." (Barnhart, 2), p. 614. All presentation, written, drawn, or verbal must be easily understood and well organized. All of the student's design ideas are conveyed by the presentation. A designer who cannot put his ideas on paper is without a language of expression.


INK
PRESENTATION

Complete Presentation

When the problem is complete, the record of its development and the solution can also be complete. No final presentation should be necessary unless some special need requires it. The last or final studies should give an adequate picture of the solution. In some cases a summary of the problem may be desirable, in which case drawings from the various stages of the development can be arranged to form this type of final presentation. The presentation process suggested here takes the emphasis from the final "rendu" and places it on all the presentation. This overcomes the superficial final presentation.

Start of Presentation. During the early stages of the problem before the drawings are started, the presentation needs to be considered by the student. This consideration might well include the following.

1. What type of problem is being presented? The character of the problem can determine the character of the drawings.
2. Who will view the problem, at what stages, and for what purpose?
3. Where will the drawings be viewed? What is the color and lighting of the display space and how will it affect the presentation? If the space of presenting the final solution is not known, it would be good to have drawings that would do well in many situations.

4. The number of people that must view the problem and from what position will help determine the size of the important sheets or pictures. The distance of viewing figures prominently in the decisions.
5. Does the display space have the proper facilities for viewing the problem with ease or will it be necessary to provide a means for this? If so, the design of an easel or display device becomes an integral part of the problem. When considering the display it is also good to think of the storage and moving of the problem.
6. The medium and technique are important in all the phases of the presentation. By using unfamiliar media for various parts of the problem, the possibilities and limitations of all of them will soon be learned. Some parts of the problem can be devoted to the experimentation with new mediums, papers, and technique.

Design Studies. It is often good to keep the design studies at a small scale to avoid becoming involved in detail prematurely. The sheet size should be uniform, and all the studies should be to a given scale and retained for reference. As the work progresses and a larger scale is necessary to include more detail, the sheet size can increase. Each study sheet can of itself be a small presentation of the design to date as well as being the design of the sheet. This gives the teacher an opportunity to criticize sheet composition, appearance, sketching ability, perspective, and other factors important to presentation.

Records. Records of all aspects of the problem need to be kept by the student. When a study model is completed, a photographic record can be made of it before destroying it for the next study. Other studies, such as the site, construction details, written data, etc., may be included in this record. One of the most important results of a recorded step-by-step design development can come from the teacher's using it to understand the student's thinking process. By following the development, weak spots can be traced to their origin and corrected with understanding.

Drawing Types. As the problem progresses, the type, perspective, isometric, plan, section, elevation, etc., of the drawings should be selected to illustrate the ideato the best advantage.

Presentation is a language by which ideas are illustrated for perusal. The idea should be stated as clearly as possible and in a simple direct method.

SOLVING AN ARCHITECTURAL PROBLEM

Analysis

Analysis Defined. Analysis is "the act of ascertaining, separating, or unfolding in order the elements of a complex body, substance, or treatise." (Funk, 7), p. 101. In architecture the analysis usually must go beyond this scientific meaning and be creative. A student needs some understanding of the difference between the physical science research analysis and creative analysis. The basis for this analysis is the tabulated data of research from which the design will grow.

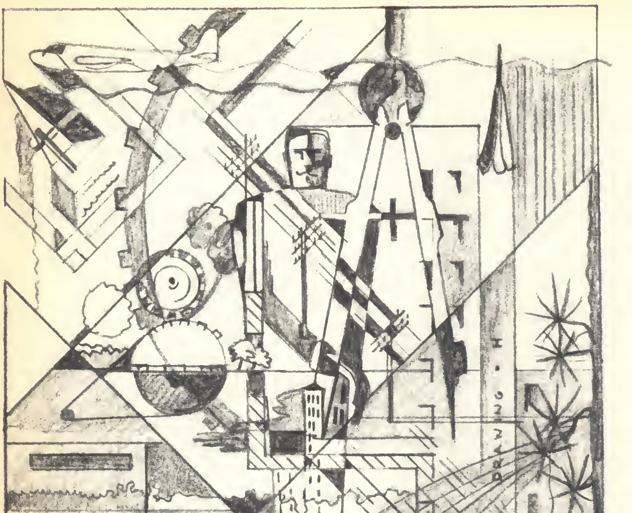
> When we have analyzed the function and materials of a product or a city, and the methods by which it must be built, and have let these factors determine the form we give it; when this form has been simplified and clarified, and knitted into an indestructible unity by creating rhythmic relations between its parts, lines and areas; when these rhythms have been subjected to a dominant theme within a consistent scale, and given order and continuity by means of graduated accents; when the whole structure has equilibrium and stability, and that balance of tensions which reflects itself in our own physical satisfaction as we contemplate it--when all these things are done, the designer has used the tools that may be mastered and handled with placid intent. What must still be done to lift the work out of a pedestrial mediocrity can be discussed and defined, but is not subject to the designer's will. The spirit of a time cannot be consciously evoked, and inspiration that goes beyond planning cannot be turned on and off like a water-tap. (Teague, 21), pp. 204-05.

This quotation outlines the place of scientific and creative analysis. The scientific is nearly always basic and necessary to the creative analysis and the two must complement and support each other.

The term analysis as used here may be defined as the act of separating the elements of a complex body and creating from them an organization useful to the design of architecture. It seems best to analyze each part of the problem separately.

> Functional design requires that all phases of the design problem be dealt with simultaneously, and the ultimate form must be a composite answer to many subsidiary problems. If we discuss and analyze these phases separately, it is only because our minds are not built to hold much more than one thing at a time and it is quite necessary that no aspect of a problem be overlooked. (Teague, 21), pp. 65-66.

The analysis should be kept ideal as far as possible. By starting with the ideal and making only necessary sacrifices the solution will more nearly approach the ultimate.


ENVIRONMENT

Where to Start the Analysis. Function is the beginning and the end in architecture. A reasonable place to start the analysis would be with function as it usually is the item of major importance. Function, as discussed here, is divided into two major parts, physical function and psychological function. This division is made as a result of and is based on the user, man, who is both physical and psychological in make-up. Man's environment affects him in both aspects of his make-up and either serves or hinders. This double aspect of function is defined by Newton as follows:

> Now, within the area of assigned functions--of conscious intent--we have two subdivisions of functionality that emerge as critically important to designers. Virtually everything we do in design can be described in terms of these two aspects of functionality. The first of these, for which I use the term mechanical function, is all too commonly and blindly regarded as the only aspect involved in functional design. The second. . . concerns the functional relationship referred to earlier as existing between the behavior of humans and the affective values in their environments. This affective functionality we seem almost to ignore in much of our talk about functional design, even though we are continually dealing with it in our work. (Newton, 16), p. 123.

It seems logical to attack the analysis of the physical or mechanical functions first and then the psychological.

Physical Function. Physical functions are as numerous as there are problems and few of them are exactly alike. Generally, however, they will classify themselves under the following headings: circulation, sound, sight, physical comfort, protection, size (area, shape, height, etc.), equipment, and service. Architecture directs the movements and actions of man for the most part from his birth to death. Some designers' decisions will influence the actions of the individual during most of every day. The far-reaching influence of physical environment is evident and is well summarized by Brownell and Wright.

> Architecture requires of those who live in buildings a muscular response. It directs action. It gives design to our comings and goings. Though other arts also are kinaesthetic or muscular to a degree not often recognized, architecture is directly involved in physical activity. As long as a man lives in a building, or works there, he will move about in a figure of action that is determined in great measure by the plan that the architect has wrought into the building. The number of his steps, his right turnings and his left turnings, his climbings and descendings, his repose and his exertions will be written into the building by the architect as a composer writes the orchestration of a theme into the musical score. The man will dance, indeed, the long dance of day-by-day life, to a tune that the architect has made in stone and wood, in rooms and passageways, in terraces, and in the light flooding a window.
>
> Architecture, for this reason, is a powerful influence in creating the future in the present. It may formulate the future in the present. It may formulate, create it indeed, and give the present new character and direction. And because architecture redesigns the activities of people who inhabit its works, it is able to carry these creative influences, these futures as it were, into the active life of man. It can bring families together or separate them. It can bring different groups and classes of people together in friendliness, or it can segregate them. It can weary people and make them irritable through constraints and obstructions and the continual frustration of normal rhythmic activity. It can debase their taste and their moral judgment with structural fakes and ostentatious decoration. It can seal them in dull monotonies of expressionless life through indifference to human welfare. Or it can give to life a gracious pattern of action. It can release powers and abilities for significant achievement that otherwise would be absorbed in frittering. It can provide a rhythmic pattern of activity that transforms the present, gives it new dimensions, depth, and significance.
>
> This indeed is the expressive function of all art. Not only does it reveal life; it creates life. In creating new forms and relationships, in making new significance or reviving old, it really is creating life over and beyond the life that nature gives. It

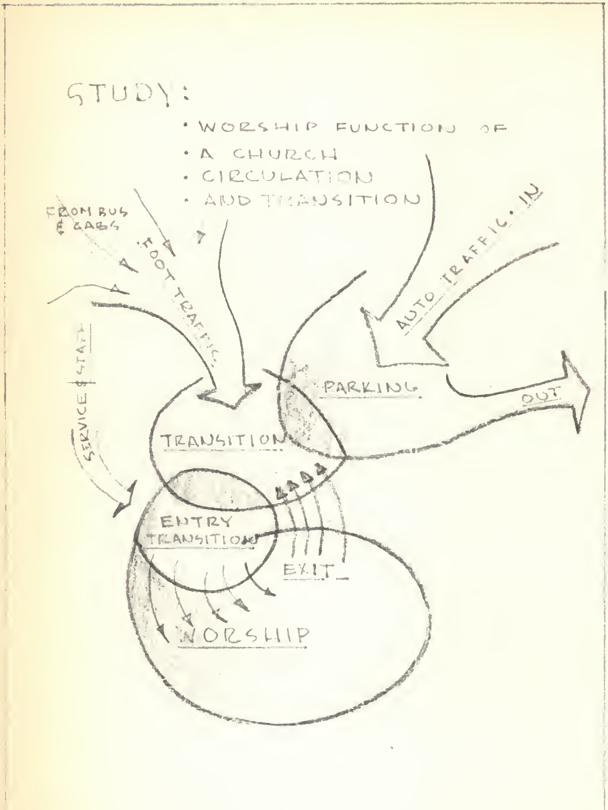
> gives to "natural" life additional dimensions and significance, forms and futures within the present, that nature without art never could provide. It is nature and more than nature, "super-nature" as it were, and the only supernatural influence that we need consider here. (Brownell and Wright, 4), pp. 212-14.

When considering physical functions it is difficult to keep the psychological entirely out of the picture. It is felt there is no need to avoid this but that is natural and preferable. This interdependent nature can lead the student into the psychological aspects of the problem with ease.

Analysis of Physical Functions. It is suggested that by classifying the function under the proper heading, the analysis can be made by the student using the following method.

Diagrammatic Analysis. Diagrammatic analysis is an abstract planning and design method. The following explanation by Newton gives a clear picture of this type of analysis.

> As a procedure, therefore, I suggest that you try, as the first step in the middle creative phase of your designing, to draw a structural diagram (some prefer to call it a relational diagram or a functional analysis) of the activities to be provided for in the solution of your problem. The aim of such a diagram is to enable you to visualize and to relate to each other the kinds or phases of activity, to come to a tentative conclusion as to which of these are in their nature closely connected (as, say, cooking and eating), which ones less closely (as, say, parking the car and sleeping), and so on toward the establishment of a workable structure--an optimal set of relations and order--of the varied activities concerned.
>
> In setting up this structural diagram of activities, if you are trying to follow the hints of biology, you will avoid as completely as possible any premature visualization of the specific spatial form or forms in which the activities are going on. Concentrate on visualizing solely the activities--on visualizing human participants, alive and active but in space that is "free" and yet unformed. Visualize their movements


STUDY:
• WORSHIP FUNCTION OF
• A CHURCH
• CIRCULATION
• AND TRANSITION
FROM BUS & CABS
FOOT TRAFFIC
AUTO TRAFFIC. IN
SERVICE & STAFF
PARKING
OUT
TRANSITION
ENTRY TRANSITION
EXIT
WORSHIP

> their moods, their actions, their total behavior in terms of full functionality. See them doing the things they need to do and you want them to do, not with mere mechanical efficiency as so many automatons but as living humans responding effectively, with expressions on their faces indicative of how they feel and of how you want them to feel. But avoid the early visualization of specific spatial form.
>
> To foster this freedom from preconception of form, I suggest that at first you use in your structural diagram no geometric shapes whatever, but merely visual symbols or words for the activities themselves. Or, if you find this too difficult, use shapes with relatively indeterminate outlines--such as those often called "amoebic," or at most quickly made circles--and within these the word or other symbols for the activity being visualized. (Newton, 16), pp. 138-39.

The major (most general) functions can be diagrammed first and each lesser system taken in turn until a complete picture of the general to the specific system is had. This language of diagramming makes prominent use of zoning. Zoning is the relating of functions with similar characteristics. An example is sound; various sound zones may be present in the problem such as quiet, semi-quiet, loud, and very loud. The same divisions can be made in relation to use, active or inactive functions, service and other functions.

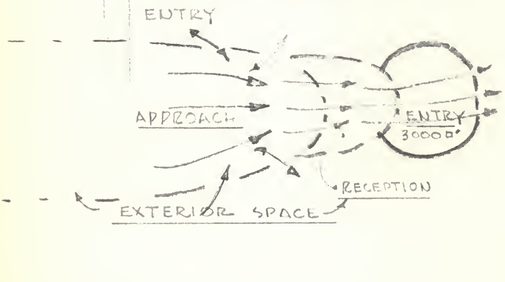
Analysis by Tabulation. The use of a chart showing many items serves as a quick reference during design and a fast system of organization during analysis. All of the data on sizes, orientation, light, sound, service, heating, cooling, views, privacy, etc., can be put in this chart. One method of doing this is outlined by Triffet and Carlson as follows:

> As a starting point for design it is suggested that upon completion of the necessary research into the nature of the activities to be carried on in the building a table be compiled containing the approximate

TABULATION OF ANALYSIS:

FUNCTION	SQ. FT. AREA	ORIENTATION	SOUND			VIEW	PUBLIC	PRIVATE	SERVICE
			LOUD	MED.	QUIET				
A ENTRY									
1 APPROACH		S	✓			✓	✓		
2 RECEPTION			✓			✓	✓		
3 VEST.	3000			✓		NO	✓		✓
4									
B									

SPACE DEFINITION & AREA



square-footage of floor area needed for each volume, and specifying the most desirable degree of definition for its boundaries. This information may be summarized, if so preferred, in the form of a series of small sketches. Each sketch should be a simple rectangle, roughly a third longer than it is wide, containing the approximate number of square feet required and a word or two indicating the use to which it is to be put. A conventional system of indicating different degrees of definition, such as a solid line for complete enclosure, dashed lines for a predominance of openness, and no lines for complete openness, should be adopted and used to indicate the desired character of each of the boundaries for the volumes. These sketches then provide the basis for further design.

Any impediment to the continuous flow of space tends to define a part of it--a tree, a fence, a roof overhang, even a few balsa wood sticks--each will alter universal space; once defined this space becomes tangible and useful, a volume which may be altered or combined unchanged with others to form a working whole.

Different human activities demand different degrees of definition; this is the fact which provides the starting point for architectural design.

The architect, then, must be able not only to analyze carefully and accurately the nature and needs of all human activities, but also to determine and achieve the degrees of definition these activities require. (Triffet and Carlson, 22), pp. 23, 24, 25.

As the student learns to use one given method of physical analysis it can suggest other methods. This should help the student to arrive at his own variation.

Psychological Function. Psychological functions are as complex as man and equally difficult to interpret, especially into three dimensions. Once the physical or mechanical functions are satisfied it is only the necessary that has been accomplished. Man must be satisfied psychologically.

. . . . of all the materials we use in design, the most important, by far, is a material upon which we work only indirectly. It is people. Not an over-generalized something called "Mankind" in a vague and

> lordly way. Real, living, human individuals, seen or imagined extensionally as peopling the plans we have drawn for them, moving about in the spaces we have contrived for them, reacting to all we have prepared for them by our design. We do not practice "art for art's sake." We do not design in a vacuum. The professions we practice are social arts in the fullest sense.
>
> Since we are seeking to serve the whole man in the fullness of his human potential, the psychological factor thus reveals itself as one of the most fundamental sustaining values with which we must be concerned. For, if our experience has proven anything at all about people, it has shown beyond a doubt that human needs--as against those of animals--are not physical and physiological alone, but that they are to a profound degree psychological as well. A man's well-being and happiness do not arise from the mere mechanical adequacy of his environment: he responds to, and can be greatly aided by, his perception of the sight, the sound, the smell, and the feel of what surrounds him. The need for considering this factor we designers recognize--not as an occasional matter of additive luxury, but as an ever-present one of completely integrated psychological necessity in all wholly human problems.
>
> With the full support of scientific evidence, then, we accept this factor as imposing a psychological requirement, which must be met as surely and soundly as the mechanical and physiological requirements if the men and women and children we serve are to enjoy the splendid richness of human living. (Newton, 16), pp. 93, 107-08.

It is necessary that the designer and even more so the student, make a conscious effort to interpret the psychological functions. Man is a psychological social, spiritual, thinking being and requires recognition of these qualities in his environment. This expression is often termed the aesthetic aspect of architecture.

> The term aesthetic is derived from a Greek word, meaning perception. Originally it described the act of perceiving "objects" by means of the senses. But the term aesthetic has come to have another meaning, especially in respect to sense-perceptions derived from seeing and hearing. It means that the perception

> gives us pleasure, because it stirs in us a sense of beauty. It may do so without any conscious activity on the part of the sensation; or it may appeal to our mind--to our memory or imagination--in such a way as to set us thinking and feeling not only about the immediate "object" but also about something which our mind associates with it. (Caffin, 5), p. 4.

The expression of abstract feeling in space, scale, character, material, color, texture, form, and movement is the problem confronting the designer. This aspect of design seems to be one of the most difficult for students. It is suggested that on some problems the major emphasis be on psychological functions.

Analysis of Psychological Function. There are three steps that can be used in going from the abstract feeling to the architectural expression of that feeling.

1. Reduction of major functions to fundamental feelings.
2. Development of fundamental feelings into the expression of that feeling that will in turn satisfy or cause the feeling.
3. The architectural elements that satisfy that feeling and will in turn produce it.

The following analysis was made by the author for the design of a church and illustrates these three steps of reasoning. It might be to the student's advantage to attempt such an analysis without a precedent. This should contribute to his insight of the problem.

This analysis is a demonstration of how a logical thought process can evolve abstract feeling and thought into an architectural expression. The case under consideration is a church for which the site and the creed have been chosen. These conditions influenced the breakdown of terms and ideas to the extent that another site or creed would give a different result.

Listed below is the first step of the analysis. The six major functions of the church are listed opposite words that represent the fundamental feeling or psychological response people should have.

1.	Introduction	Going to church to worship.
2.	Transition	Change in thinking from world to spiritual.
3.	Worship transition	Beginning of worship, humility, and reverence.
4.	Worship	Meditation, intercession, glorification, submission of will, humility, reverence, inspiration, and consecration.
5.	Instruction	Exaltation, introspection, inspiration, and information.
6.	Transition to world	The time for thinking on the service just completed.

The second step is to analyze the desired fundamental feeling a person should have for that function. This is done in outline form. A number of creative decisions are required at this stage. An example of this is: How shall the feeling be imparted to the person, by sight, touch, smell, or sound? Possibly a combination of the senses should be employed. Next: What will stimulate or effect the change? Will it be color, texture, light, scale, sudden change, view, speed, direction, restriction, or some other factor? By making these creative decisions with care the character of each function is established to serve in guiding the design. Following are the six major functions and the psychological analysis of each.

1. Introduction

Change of thought
Change of direction
Change of speed

Thought - - - directed to church (spiritual)
Direction - - toward the church
Speed - - - - slowed to give time for thoughts concerning church

Marker - - - tells where you are going
Symbol - - - tells why

Means of emphasis on <u>direction</u> toward marker
Means of emphasis on <u>change of character</u>

Change: Road and walk width, materials, color, texture, and scale. Nature giving emphasis to the marker--symbol or church.

Materials: Road and walks become narrow and very directional (the width will depend on site, conditions of approach, and parking). Use of gravel or close-set stones in the road to slow the traffic. Walks of a small material, as various colored flag stone set in a design, will slow movement and change the character.

"Natural scale" growth may be most noticeable at this point, becoming more "gardened" as the church is approached.

These changes in character are to give change in the above--thought--direction--and speed.

2. Transition (A complete thing in itself)

Nature--contact with God through nature
Association of nature and God and man as part of the whole

Slow
Suggesting worship
Relaxing

The change from introduction: More space, wider walks, roads and walks less directional.

Materials: Natural--generous. As natural as possible to serve direction and separation from world. More "gardened" than in the introduction. (Parking could take place here and its flow be completely divided and even be an interior transition for the car passengers.)

Interior transition gives the problem of building materials.
Color
Light
Viewing nature
Texture
Still giving a natural scale transition

3. Worship Transition

Beginning of worship
Directed thinking
Directed movement
Small, quiet, intimate, directional, slow, symbolical (focal point). In scale with man--restricted directional.
Acoustical treatment of noise
Quiet
Small materials
Low value color
View of symbol of worship or worship space itself

Walk up into worship space? At least do not go down to it as this usually gives a feeling of too much command over the situation. Too much walking up usually gives a feeling of being commanded over.

4. Worship

Meditation
Prayer

Thinking
Introspection
Decision

Pease of mind (relief)
Hope
Love
Faith

An individual action

Quiet
Modesty--humility
Wonder at man's place in the universe (awe)
Courage--strength--inspiration
Light
Love
Peace

Nature

Greatness of the universe
Greatness of God

Man's feeling of smallness in relation to the whole
Use nature in the scheme
Thinking directed to spiritual matters. Use of a symbol that shows the strength of faith--belief--love--light--etc.
Quiet--color, light, movement, no sudden change in space, regulated sound (music, speech, etc.)
Nature--man's smallness relative to the universe--destiny--God

Humility	Not--force, fear, luxury, comfort, or relaxation
Modesty	
Awe	Nature gives awe without fear (to the modern
Peace	man who understands natural phenomena)--it
Courage	also gives strength, courage and light--nature
Inspiration	combines modesty and courage with beauty

Directed thinking--dominant element or symbol to guide thinking

Contrast: Color, light, design, center of interest (see section 5)
Center of interest--a part that stands for the spiritual in life--the mystery of the universe--that which man cannot explain but feels and follows and uses to guide himself.

Quiet
Color: Balance of color--not exciting or depressing, not cold or hot. (Plastic color might not always be balanced if a special character change is needed.)
Light: A place of light and hope, not darkness
Use a balanced light with high enough intensity for reading.
Color and light: An actual architectural situation is needed to suit color and intensity of light to its needs. Hues are not as important as their value, intensity, and combination with other hues. Warm colors are exciting or depressing, depending on intensity. Cool colors are quieting or depressing, depending on intensity. Sharp contrast attracts attention and would not be wanted except for centers of interest.

Movement: Noise, floor--soft, sound-absorbing material of quiet ground or floor color. Simple in design and weaving. Directional floor covering. Acoustical treatment of noise areas--entries--outside noise. Walls and ceiling of worship space should be partly sound-absorbing but not enough to deaden the space. Room for moving with little disturbance of others.

Vision: All outside movement except nature should be cut off from the vision of worshipers.

Space: Nature--not a break but an integration of inside space with nature--no violent space change by color or light.

Sound: Regulated system

Scale: Nature seems to have three general scale groups relative to man

1. Intimate scale
2. Natural scale
3. Natural over-scale

In the intimate scale group falls the natural and man-made gardens which are in man's scale of comfortable adjustment.

The natural over-scale causes awe, sometimes fear, domination and command. (As man becomes acquainted with over-scale conditions, they lose the element of fear, but some awe remains with domination and command.) Examples of natural over-scale are the great plains, mountains, grand canyons, oceans, and giant trees.

Natural scale is a point between these two but not a direct combination of them. What makes the great plains or mountains overpowering? There are trees, grass, rocks, etc., present which are in scale with man yet they only add to the dominance of nature. Man cannot grasp the size of the plain or mountain and there is too much over-scale nature to be neutralized by the few objects in scale. Natural scale is the bigness of nature balanced by the intimate.

Look at a tree: It is tall but its size can be understood by man because of the bark (texture and color), leaves and branches (structure and texture), and surrounding grass and bushes (surrounding color, texture, and intimate nature). The vast unending sky is not disturbing on a sunny day but, when storm clouds roll, man likes an intimate place--nature has suddenly gone out of scale. The shores of an ocean and large river are similar but man cannot see the ocean's expanse and gets no hint of it from the shore or waves--it is too big for man.

The worship space must be in a natural scale

Natural scale includes:

1. Space that is out of scale with man
2. Structural elements that give hint of scale
3. Texture and color that give a hint of scale
4. Natural light
5. Surrounding objects that are in a scale familiar to man as nature, man, and furniture

This is the basis for scale, space, materials, color, texture, structure, etc., of the church.

5. Instruction

Exaltation
Inspection — Not commanding as slavery or fear
Inspiration
Information

Food for thought--help for life--to the end of love, hope, peace, faith, direction, and decision

During instruction
Dominant--not overpowering
Attention
Symbolic
Directive

The most important thing during this time is not the individual but his attention on the instruction. The space or the individual becomes unimportant and the center of interest is emphasized.

Scale
Color
Light

Sound
View
Quiet
Dominant element

A character change from worship. A scale change from worship.

Color and light: The actual color would depend on the service character. A contrast of color and light is used to give emphasis. The lighting should shift away from the individual to this center of interest. This center of interest is the dominant element of the space and can be contrasting in design and given added importance with light and color.

Symbolism and Dominant Element

A center of interest that represents the belief in love, faith, and hope--the instruction should come from this center or at least take advantage of its dominance.

Sound is regulated

View: The individual must be able to see the speaker.

6. Transition to world

Time
Reflection
Semi-quiet
Easy flow

A short time for thinking on the service and its meaning before entering a conversation zone.

The feeling of being still in a part of worship--the same character as worship.

Moving into nature, then into a conversational zone of more intimacy and close contact.
Much space
Worship character
Carry through of materials and color

The overall character analysis. The type of analysis given above can form the basis for the overall character. For some projects it is best to establish a general character before study of the parts. This is a decision that rests with the student or instructor.

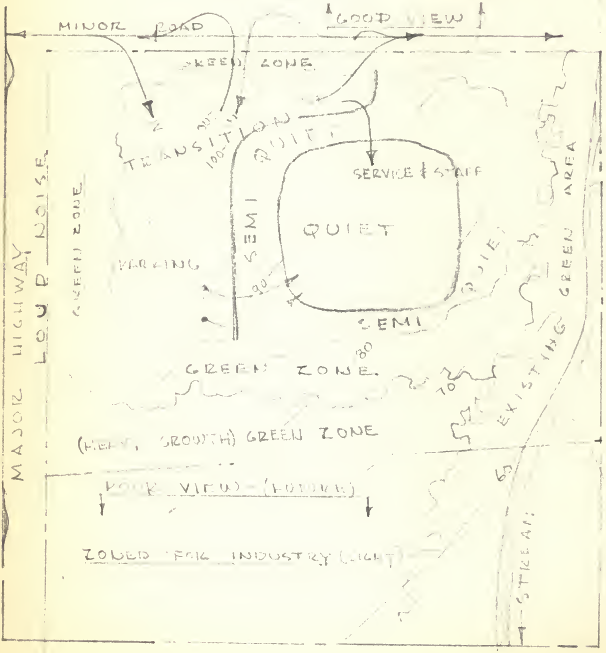
It seems good to encourage students to arrive at a good definition and understanding of the word character and its implications. The following quotation can serve as a good starting point.

> Character in general calls to mind the qualities which distinguish any person or class, qualities which make a person or a thing unique and capable of standing out among contemporaries. In architecture that building which by the quality of its design--its refinement of parts, its use of materials, the logic of its plan and volume relationships--stands out among others is said to have architectural character: and further, if a building tends to create within its tenant a mood which will contribute to its more complete and pleasant use, it is said to have character.
>
> Character frequently is defined as "moral force." Here, too, architectural application can be made: the designer as he develops a solution will, if his approach is sound, express in the design convictions and ideals held by both himself and his client. If, rather than imitating, he analyzes and creates directly from that analysis, he will impart to the building the honesty which characterizes his own personality.
>
> The design of a building should be such that a particular mental attitude is created in the individual as he approaches, enters, and uses it: it should produce within him reactions which will contribute to more pleasant and efficient living. There are certain general human emotions which must be catered to in design and it is the character of the building which provides the opportunity to satisfy them. (Triffet and Carlson, 22), pp. 109-10.

Plot Analysis. All buildings have a plot, and it is deemed advisable to always have a real plot if possible. If a real plot cannot be had, drawings of a plot can be substituted. The analysis of this plot and its surroundings may dictate many of the future design decisions. The plot analysis usually falls in one of the following divisions: regional and legal considerations, zoning, circulation, orientation, drainage, and general

STUDY:

- PLOT ZONING STUDY
- FOR A CHURCH
- CIRCULATION • VIEWS • SOUND



data related to the particular site. In order to carry out the analysis of the plot in a creative way, the help of other overlapping processes need be employed.

> What we need to see quite clearly, particularly with respect to the planning professions in design, is that between the human activity called "architecture" and that called "landscape architecture" or between either or both of these activities and that called "city or regional planning," there are no sharp lines of cleavage. They are overlapping processes. They are interdependent, not independent of each other. They fit into one over-all organic scheme of thought and creative action. (Newton, 16), p. 89.

Regional and Legal Considerations. The regional considerations are bound up to a great extent in the overlapping processes mentioned above. The data discovered in research can be considered to determine its effect on the particular plot. In addition to this, the laws, ordinances, deeds, and other legal data may be analyzed with reference to their influence on the design decisions, if this material is available.

Zoning. Before the zoning can start, a complete knowledge must be had of the plot and its surroundings in drawing and in writing. There needs to be a good survey of the ground that can be supplemented by pictures taken of the site and its surroundings. The existing and future surroundings must be considered here. All of this and other information should be collected in the research. The building of a small model of the site out of clay will help. After a study of all the data is accumulated to date, the plot can be zoned for use. This is done by dividing the plot into use areas. Some examples of use areas are: approach or transition, reception, service, major function, minor functions, natural or green area, parking, and any other major division in the problem.

Circulation. The above zoning is immediately concerned with the circulation as it exists. Now the problem is to make sure the new circulation pattern will work with that in existence or to discover if changes must be made in one or the other. This work is best done in a diagrammatic way and should be coordinated with the zoning. The diagrammatic circulation pattern can strongly suggest the design solution.

Orientation. The orientation is especially concerned with view, sound, sun, wind, weather (climate in general), topography, entourage, and the zoning and circulation diagrams. In addition to the above information as related to the site, a good diagrammatic solution to the functional problem with understanding of the psychological functions is needed. By diagrammatically arranging the functions on the plot drawing, giving primary consideration to climate, view, topography and entourage, keeping the whole as ideal as possible, the orientation can be nearly ideal in its beginning.

> Whatever the approach we may use, let us make the most of the climate; let us learn how to live with the climate, not in opposition to it. Let us realize that there are not only many different climates on this continent but also so many in every state and province, in every country and parish, in every city and town, in every village and hamlet, in every garden, and, indeed, right up to every front door. Let us make sure that the climate at our door knocks softly. (Aronin, 1), p. 281.

Drainage. The above solutions to orientation, zoning, and circulation may need some revision when drainage is considered. By analysis it should be determined if underground drainage can be had, if facilities are available for use as city storm sewers and drainage ditches. If the drainage problem is serious, it may affect the building type.

General Data. All information collected in research about the plot must be carefully considered to evaluate its importance to the design.

When a student works with this phase of the problem some of the data may not be available. When this is true it seems that discussion of all the facts would be important.

Cost Analysis. The use of money is rarely unimportant to design. The limiting factor of most importance is usually to get as much for that money as possible. The tabulation of where the money is to be spent and in what quantity will save time in the design. This tabulation will fall under the headings of fees, construction, landscape construction and planting, furnishing, insurance, reserve, and other items occurring in particular jobs. There are a number of items that fall under fees which are: the architect's fee, often the engineer's fee, landscape architect, surveyor, lawyer, abstractor, the permits for building, sewer, and utilities, et cetera. The distribution of the monies among the various functions with relation to their importance or cost may further dictate the design.

The source of finance will usually be assumed for the student, as well as the amount. This is a good time for students to learn about loans, mortgages, interest, and government regulations.

Client Analysis. Here, again, the usefulness of the analysis depends on the completeness of the research. The student needs to understand the importance of the client to the architect. If some person will act as a client for some problems, this phase can be most valuable. When a live client is not possible, the situation should be assumed and less emphasis placed on this phase of the problem.

> The architect, unlike other artists, is dependent upon patronage for the realization of his ideas. He can build nothing without a client, and his clients have been successively priests, nobles, and business men, under the influence of each of whom his art has developed. (Yorke, 26), p. 124.

Not only must the architect have a client, but the building will always be part a product of the client's ideas, personality, and understanding.

> . . . the architect's building is always the product of at least two personalities, that of the architect and that of the owner of the building, and oftentimes it is the product of a great many more, it may be the impression of a collective personality, of a guild, of a state, of a religion. (Hamlin, 11), p. 264.

The client's position should be analyzed to determine what parts are basic and valid and what parts are whim, habit, or prejudice. These basic facts will influence the design in a direct manner. It is sometimes necessary to perform an educational service to the client in explaining why some of his ideas are basic and why others might with study be done a better way. This part of client analysis that deals with education cannot be present in school problems as it will be in practice, but the idea can be dealt with in theory to prepare for the time of actual use. The element of education will usually be present in every meeting between the architect and the client. This exchange of information is not a one-way proposition as often the client will be able to give the theme or reason to the problem, and in turn this will help suggest the solution.

Structural Analysis. The research usually indicates how much can be done in the field of structure. The least that should be done at this stage by the student is to arrive at a structural idea. This idea may be derived from a number of factors, some of which are suggested. The locality may have native structural material or may produce materials useful to the project under consideration. The project may have special needs such as durability, ease of cleaning, or fast construction. The local labor supply may be the limiting factor in determining the materials to be used in structure. Cost analysis will set the limits of the structure and might well dictate the materials and system of use. Economic comparisons then become a criteria of design. Climatic conditions will often enter into the analysis. The psychological functions already analyzed should be considered in relation to color and texture or possible finishes for material being considered.

The Structural System. Some thought can be given to the structural system after the material analysis is complete. In cases where the structure is the controlling limitation, a very complete study of the possible solutions should be made. In such cases some of the preliminary engineering analysis may be helpful. There are some key items that will open the door to the general type of structure that should be used. First of all, the amount of space that must be free of obstruction. Then the space that can have supports but no major or large obstructions and the functions that can be enclosed by weight-bearing partitions.

Most of the engineering analysis will of necessity take place after the design is nearly complete.

Mechanical and Electrical Analysis. Some of the analysis as the type of heating, cooling, necessary plumbing, lighting, and other electrical needs can be tabulated at this time but the major portion of this analysis must accompany the design process.

Criteria

Basis for the Criteria. Criterion is "a rule for making a judgment," (Barnhart, 2), p. 206, which will guide the problem through the design sequence. The arriving at a criterion may be done by the third step under the inductive reasoning process (the rational explanation of the facts by referring them to their real cause of law). After the completion of the research and analysis, it should be easy to establish the criteria. By asking the questions suggested by Walter Dorwin Teague, the process will be simplified.

> We deliberately ask ourselves: "What is the purpose of this thing we are making? What shall it be made of? How shall it be made?" And we must be especially careful that our answers to these questions are correct, in these days when so many of the things we need to make are without history or precedent and our materials and tools are equally new. When we commit ourselves to a specific form it will be an answer to these questions, whether or not we intend it to be. It may be a wrong answer--like so many the Machine Age has produced in the past--but it will be an answer nevertheless; and if it is too far wrong, the result may be economically and socially calamitous. (Teague, 21), p. 41.

Method of Arriving at Criteria. A method of arriving at the controlling elements is to take them in the order of their importance, starting with the general and working to the specific. A good test or rule to decide the importance of different elements in relation to each other is necessary. A good test is, what element is it that without which the problem would not exist? An example of this is, in a church development the worship space is most important, for all aspects of the church are centered around and have their purpose in worship. What is most important to worship? The assembly of people, seeing and hearing are first and the protection next, with the surroundings and their psychological impact forming the remaining criteria. All the other elements should take their place within and as part of the above with the minimum of sacrifice to the ideal. By always knowing the importance of each part, the decisions during design are easier to make.

As the criteria are studied a major idea or theme will emerge. As suggested by Teague, this may not always be a result of the analysis but of perception.

> A competent designer instinctively chooses a theme, or leitmotif, for a given structure, and allows it to influence all his choice of form and line within that structure. His theme usually is suggested by the problem itself; he abstracts it from the object with which he must deal, from its most essential shapes, its structural necessities, or its functional purpose, and thus it has significance and authenticity. Often his selection is not made by a careful balancing of various possibilities, but by a quick instinctive perception of what is most vital, most characteristic among these possibilities. In many instances structural or functional necessity determines his choice of theme without his option, and his job is simply to refine and clarify the subject. (Teague, 21), pp. 177-78.

When the criteria have been established they should serve as a guide for the designer, keeping him on the right track and stopping the design when the criteria have been satisfied. "For a designer to steer straight toward his proper goal, without digressions, and stop his work when he has accomplished the essential, is a feat beyond most men's self-control." (Teague, 21), pp. 112-13.

Once the criteria have been established the active design stage can be entered as the abstract statement of the problem is complete.

Synthesis

Synthesis Defined. This is the active design stage or the "Combination of parts or elements into a whole." (Barnhart, 2), p. 784. This is the fourth step in the inductive process which is the scientific construction, putting the facts in such co-ordination that the system reached shall agree with the reality. The reality is taken to mean here, the meeting of the needs that are present--these needs having been discovered in research, analyzed, and criteria set forth.

Design Limitations. The age in which the design is produced forms a basic limitation. The joint design enterprises on which our society depends, demand recognition of our machine-age way of working. Good design must accept, "the characteristics of machine production not as limitations but as means for the creation of new types of rightness." (Teague, 21), p. 37. The machines are tools that enormously augment the possibility of humanizing our world.

The challenge of the machine-age way of working is an inspiring one but also a difficult one that has no precedent in history. Design for this age is a complex process as is well stated in the following quotation:

> This is no perfunctory task. Only patient effort directed by knowledge and skill, and illuminated by a kind of creative insight, will ever succeed in extricating right form from the envelopes in which it is hidden. In fact it may elude us, retreating before our advancing approximations. But under the conditions facing us and the exigencies of machine and mass production, our advance must be accelerated to the limit of our powers. So far as it is humanly possible, our conscious intelligent planning should eliminate trial and error, and experiment should be confined to the laboratory stages of our work. Our mistakes may be disastrously expensive. Our responsibility as designers of a new world to be built in new ways is heavier than designers ever have borne before, and its demands proportionately broader equipment. (Teague, 21), pp. 38.

Design Steps. Listed below are design steps, not to be thought of as a rigid system or procedure, but as a group of considerations which can be taken in varied order and degree of importance by the student. Some steps may be left out completely in some problems. The problem will usually suggest what steps to use and in which order. The steps follow.

Diagrammatic Development. The developing of the established diagrams into an arrangement that satisfies as many of the requirements as possible, always sacrificing the least important, when elimination is necessary, in accord with the established criteria. This development of the diagram into a diagrammatic solution can give consideration to all aspects of the problem in a systematic way. The diagramming includes site, circulation, function, views, topography, and all previous study of the problem becomes part of it.

Thinking in Three Dimensions. All the thinking from this point on needs to be in the three dimensions.

> All of our creations are destined for existence and use in three dimensions, and for this reason they must be designed as groups of volumes rather than arrangements of areas. (Triffet and Carlson, 22), p. 21.

Design Study. Plan development at small scale and as a direct development from the diagrammatic solution may be done in a general overall manner without detail, as the next step. Planning in this early stage of design should include the total problem and be in no way restricted to <u>interior</u> thinking.

> Every square inch of the outdoors, as well as the indoors, is subservient to a specific use, including decorative and fallow uses. Lawns, woodlots, back yards, contain essences of their own, and it is as important to the whole that these be expressed and furthered in planning, as it is that the essence "living room" be expressed. Trees, for example, contain messages of their own, which are nearly always available, but which are invisible most of the time. These essences are made visible, and incidentally lend added significance, when they are related to other elements in such a way that the total scene related to the total human being. Trees also exert important effects on noise levels and microclimate. The goal in siting is thus a balanced use of, for example, the evaporative effect of foliage, of sunlight, of solar radiation, of the acoustic shielding effect of banks, etc., while at the same time subordinating each such factor to the whole concept. (Kennedy, 13), pp. 479-80.

Not only must the plan development continually consider the total plot but the community and countryside must enter in the scheme. This is pointed out by Sigfried Giedion:

> Architects today are perfectly aware that the future of architecture is inseparably bound up with town planning. A single beautiful house or fine residential development accomplishes very little. Everything depends on the unified organization of life.

> The interrelations between house, town, and country, or residence, labor, and leisure, can no longer be left to chance. Conscious planning is demanded. (Giedion, 8), p. 25.

As the plan begins to take shape in drawing, other study tools will be needed. The design is a result of the planning being done on the inside at this stage.

> A sound job of exterior space composition will almost automatically result from a well composed interior while the reverse of this may certainly not hold true. It is more practical, therefore, to work from the inside to the outside rather than to design first an exterior, then attempt to fit activity volumes into it. (Triffet and Carlson, 22), p. 37.

As these studies progress the major interest should be in three-dimensional space and form. The mediums being used for this study need to portray space and form.

The demands made by a modern concept of space-form are outlined below. Three-dimensional space has the following characteristics:

1. 1. Space can be measured by three units of measure relative to a given point of view

    a. Up and down
    b. From side to side
    c. Forward and backward

    No complete description of space can be given without all three.

2. When man gives form to space, by dividing it, measuring it, enclosing parts of it with two-dimensional walls, he does not change its three-dimensional character, the two-dimensional objects simply define units of measure of three-dimensional space.

3. A space form when it is experienced cannot be grasped or adequately described by a single set of three-dimensional relationships. X-ray view, or birds-eye views, or plan views, while they can give some kind of knowledge of the experience

of living and moving around in space, they do not give all the data necessary to design properly for space living.

One author has referred to the "many sidedness of space" and the "interpenetration of space," and these are the true characteristics of space that we must take into account in our design thinking.

4. Man moves about in space, making design a dynamic problem; therefore, static symbols which take into account only one fixed position in space are inadequate for the task.

5. Consideration must be given to the following kinds of motion:

    A. motion toward a building which involves:

        a. near and far
        b. relation of topography and shrubbery forms to building forms
        c. outside to inside relations

    B. motion around the exterior of a building. This involves studies of:

        a. relations to major volume units of the building to each other, and the progressive change in the significance of these relationships as the point of view is changed around the building.
        b. relations of landscape elements to building elements

            (1) up and down views

    C. outside to inside movement

        a. effects of transition from outsideness to insideness

            (1) exposure
            (2) partial enclosure

        b. form relation of outside elements to inside elements

    D. movement around, in and through the building

        a. transition from major volume to major volume

b. view from front to back of a room and the relation of parts in it
c. view from the other end of the room back to front and the changed relationships of parts

E. up and down movements on stairs, etc., with changing lines of sight and visual effect

F. relation of inside to out. Degree of felt enclosure (23)

Ways are needed to study three-dimensional space ideas. It is very necessary to work with floor plans and elevations when designing. However, the student will want to recognize that these are essentially two-dimensional. These drawings do not illustrate the actual reality of the problem. As the student progresses in the planning stage a point is reached where a translation into three dimensions is necessary. This translation needs to come at the right time in the work and be done with the right tools.

The finest tool for three-dimensional translation is that of the mind. The student who can learn to visualize and think about three dimensions simultaneously while his design is in its formative developing stage has gained an essential attribute of the designer. Additional tools are still needed to test the thinking visually and to tell the instructor of the thoughts. It is necessary to tell others of design thinking in terms of drawings or models if criticism is to be given. A perspective drawing or a series of them can often present an adequate picture of the complete three dimensional form. During the formative stage it is not practical to laboriously construct a mechanical perspective. This type of perspective works well for the presenting of a design solution but another type of perspective is needed for study. It has been suggested that the thumb nail study is the most useful. (See presentation.) Section studies are a revealing tool for design and testing three-dimensional thoughts. There is not, it seems, any tool so good as a three-dimensional one to study three dimensions, however. Clay is one such tool that the student can profit from by learning to use in designing.

Clay offers a partial solution to the problem of manipulating space ideas. It has the following advantages:

1. Setting and building relationships can be easily established objectively, so that the

"total form" can be visualized as the organic relation of topography, shrubbery, and building exterior. By turning the model at eye level exterior movement around the sight, and around the exterior of the building can be simulated.

2. By means of the above, the first thinking is directed to the major three dimensional relationships. It is thus assumed that later analysis cannot be erroneously thought of out of its context to the three dimensional whole.

3. Clay is easily shaped so that it can keep up with the change in the thought processes. Adjustments of parts to the whole can be made quickly and often, until a satisfactory relationship of parts is attained, yet all the time the thought process is kept objectively in three dimensions.

4. It is important to note that the use of clay is a preliminary three dimensional thought process. If it is misused so that the clay is used only to put into the third dimension, thought processes that went on in two dimensions, its value is lost. It is not like final balsa model, a description in three dimensions of the solution. It is rather, one way by which the formative idea is manipulated three dimensionally. It implies that the clay, like the thought process, will be changed and adjusted. If the clay model is not changed and adjusted it has failed as a medium for the thought process.

5. Another misuse of clay models is that of studying the relationships from a birds-eye view. This is nearly as bad as floor plan thinking, because it gives a statement about formal relations that are normally experienced at a ground level. It does not, therefore, give a true picture of what is sometimes mistakenly called the 'total form'. While it gives a certain kind of knowledge about the relationships of parts which is helpful, the student must be made to realize the building is to be used and lived in by people whose knowledge and experience of the form will only be had at near ground level as he moves around and through the building.

6. While the clay model seems to be a helpful tool for three dimensional thinking, he must also recognize that it has some limitations:

A. While it works effectively for considerations of exterior relation of the space form, it is quite limited as an aid in visualization of:

a. outside inside relation
b. inside relations experienced at floor levels
c. transparencies (23)

Major Criteria. The major criteria, established earlier, need to be considered carefully before the planning goes further. It may be necessary to use both drawing and models to study these criteria.

Refinement of Design. As the plan studies are made at a larger scale including more detail and structural considerations, the use of a space-volume model can be employed. This model study should be a simple working model studied in relation to the site and should include all the major elements of the design such as trees, roads, building elements, and any other factors that influence the project. In complex designs the important parts may need to be enlarged, to more clearly understand the space-form relationships. During this phase of study, perspectives, sections and elevations are wonderful tools for making decisions before trying them in the model form. The thumb-nail scale study is fast and efficient when testing ideas on paper before enlarging them for more careful inspection.

> There will be many times when you do what you do for no apparent reason other than that to you "it feels better that way." But do, even so, be experimental about it to the extent of trying it and seeing; do realize that the test may be one of visual judgment--involving, of course, both "feeling" and "thinking"--rather than one of instrumental measurement or computation of verbal argument. (Newton, 16), p. 41.

The clay site model should be kept up to date at all times, never getting more detailed. This allows a check on the simplified building form which includes proportion, scale, mass relationships, exterior space-form, composition, movement of the eye, balance, and other over-all characteristics. The changes can be made quickly and accepted or rejected. The space-volume working model is a supplement to the clay studies. The limitations of the clay model can be overcome with the space-volume studies.

Detailed Design Study of Parts. As the all-over design proceeds, detail study of parts becomes necessary. Functions contained in an area that has been established in the overall plan must be developed in detail to meet their individual requirements and to fit into the scheme with as little change as possible. Usually this planning can be done by use of drawings.

> The study of a problem in design, especially during the middle or creative stage, consists normally of drawings to scale--in plan, elevation, section, perspective, or a combination of these--a tentative graphic statement of whatever is being studied, and then of redrawing it with increasing precision on successive layers of tracing paper fixed directly over the first sketch, modifying here and there as the designer's visual judgment suggests improvements of proportion and arrangement, until there emerges what the designer considers the best solution he can reach in the time available. (Newton, 16), p. 11.

Finally the conclusions reached by use of the drawings can be inspected by adjusting the space volume model. In some cases individual functions should be inspected in model form at large scale by themselves. This is especially true when the function is repeated several times in the design.

Final Design Statement. By combining the final statement of the parts with the whole scheme, a preliminary solution can be had. This combining of elements studied as individual problems within the total problem poses an unavoidable difficulty. This adjustment of all the parts into a harmonious whole might be termed a synthesis within the synthesis.

> It is clear that the architect cannot think of plan apart from elevation, and that he cannot think of either apart from the method of construction he will use. . . a process of synthesis takes place in which plans, elevations, and structural system are adjusted one to the other so that there is a perfect harmony. It is perhaps this complete elimination of dissonance that gives the architect most pleasure on the rare occasions he is able to achieve it. (Yorke, 26), p. 120.

Structural Considerations. The structural considerations of the problem should be refined and studied in detail. The final structural calculations need not be done now but a check should be made to assure no major errors are made.

The mechanical and electrical provisions should be checked to insure adequate facilities so that later revisions in the overall idea will not be necessary.

Design Check. A careful check should be made to insure the meeting of all criteria. The planning should be checked with the analysis to find any omissions. Most of all, the overall character needs to be considered as well as that of the parts.

Design Refinements. The final refinement of the design can be done in the drawings and in the models by bringing them up to date. The working model can be refined to show the final statement of the problem. The refinement of the solution will include the consideration of color, furnishings, painting, sculpture, landscape construction, planting, etc., in short all the things that have been thought of earlier, some of which may not have been recorded, plus the many items that cannot be decided until the solution is almost complete.

Preliminary Working Drawings. In some problems the student will gain much from facing the realities of working drawings. When there is not time for complete working drawings to be done, preliminaries may serve well.

Preliminary drawings may include the detailed study of important parts of the building, establishing of a typical wall section, and setting overall dimensions. Models may form an important part of the preliminary working drawing studies. This idea has been suggested in research.

Working Drawings. The producing of complete working drawings should be experienced by each student at least once while in school and more often if possible. A set of final working drawings can be evolved from the s tudies. The use of isometric and perspective drawing is encouraged in both the studies and final working drawings. The purpose of the working drawings must be kept strictly in mind by the student; it is to inform the builder how to construct what has been designed.

> Without builders there can be no architecture. Architects can design and engineers devise, but it is the builder who has in the end to carry out the work. (Braun, 3), p. 17.

Unless the builder understands the ideas shown in the drawings, all the work in design may be lost and the intentions of the designer destroyed.

Specifications. Specifications can be prepared concurrently with the working drawings. This can only be done when complete working drawings are prepared. The discussion of types and styles of specifications needs to precede this writing.

Documents. Documents of contract and bidding, as well as other papers, may be studied and included in the specifications.

The design process is not complete until every decision is made that will in any way influence the final product. It is often true that as a result of the way contracts are drawn, the building will be different. This is common when alternates are included for bidding. After the building is under construction many decisions are made that will change and alter the design. Although it is not possible to include this as part of the schooling experience, the student should know about it and realize that the design process continues until the building is completed.

CONCLUSION

It is envisaged that the solution a student reaches by the process given above will be organic in nature. It is felt that the statement made by Newton describes the attitude of the author.

> If you have followed with reasonable care and understanding the initial method outlined here, you will have arrived at a suggestion of forms organically, for you will have allowed them to evolve through the interplay of resilient forces in visualized action; they will have revealed themselves to you as expressions of dynamic equilibrium through a sequential process of growth. And yet they will be your own, for they will have been born from your power to visualize, from your insight and your experience and your personality, but from these applied to the problem in a natural order. (Newton, 16), p. 142.

As was written by Frank Lloyd Wright: "In a fine art sense these designs have grown as natural plants grow; the individuality of each is integral and as complete as skill, time, strength, and circumstances would permit." (Wright, 24), p. 40.

As the challenge of a changing world is realized and the opportunity it affords is made use of, the prospect of sharing in the solving of its problems is an exciting one.

> Before us stretches the gigantic task of rebuilding our whole environment to meet the complex new needs of men today, a fair and orderly environment in which life can be lived with dignity, serenity and ample scope for our human potentialities. (Teague, 21), P. 47.

The ability to cope with and conquer complex architectural problems must be as a result of education. This ability will be developed by first, starting right and then by always proceeding in the right direction. The start may be small but it must be right. The educational experience must be a logical one that will form a foundation for the future.

The best way to learn about the problems and their solution is to do so by experience. It was the intention of this thesis to provide a sequence or framework of ideas and methods that would encourage this process of learning by experience. By using the suggestions offered here, within the existing system of education, it may be possible to make the foundational experience of the architect stronger and thus improve the solutions to the environmental problems of the days to come.

ACKNOWLEDGMENT

The author wishes to acknowledge the assistance and able instruction given by his Major Professor, J. C. Heintzelman, during the writing of this thesis. Also, the author would like to thank Professor Ronald Whiteley for his encouragement and guidance during the early phases of writing.

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SOLVING AN ARCHITECTURAL PROBLEM
FOR USE IN TEACHING

by

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ABSTRACT OF A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Architecture
and Allied Arts

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1955

INTRODUCTION

The ideas recorded here will be useful in the field of architectural education. A new system of education has not been proposed but a method that can be used by both professor and student within the existing system as a check list to insure thorough work, a way of developing the student's own approach, a series of steps all of which will not be applicable in every problem, a method of organization, and an encouragement to assimilate wide background knowledge.

BASIS FOR SOLVING AN ARCHITECTURAL PROBLEM

Assumptions and Definitions

The following assumptions were made as a basis for the ideas presented. Assume architecture to mean the three-dimensional objects that form man's living environment. Environment will only be improved when the majority of architects are taught to understand the problem. Both reason and creation must be employed in solving an architectural problem by the following steps: research, analysis, criteria, and synthesis.

Directing Limitations

All of the factors must be assembled that would be present in actual practice to form a program. This program plus a time schedule will set the limitations.

Research

The first part of any architectural problem is research. However, research is not confined to the initial part of the problem. Research can be classified under the following headings: historical systems, investigation of man, theoretical research, study of similar problems both historical and contemporary, structural research, the use of materials, experimental research, mechanical problems, site research, legal and financial research, and engineering research. The whole process should be a creative one.

Presentation

The presentation conveys all the ideas of the designer. All phases of the problem should be carefully recorded and when the problem is complete the presentation will also be complete. Only drawings for some special purpose would have to be made after the design is complete.

SOLVING AN ARCHITECTURAL PROBLEM

Analysis

Analysis is the act of separating the elements of a complex body and creating from them an organization useful to design. The place to start the analysis is with function, physical and psychological. The functions must be classified and organized by use of charts, diagrams, and written material. The plot, climate, governing laws, surroundings, and other factors must be analyzed. The analysis of finances and the client will often give the key to solving a problem. Structural and material analysis must be started and carried on through most of the problem.

Criteria

After the completion of the research and analysis, it is easy to establish the criteria. The criteria or controlling elements of the design should be listed in order of their importance.

Synthesis

Synthesis is the active design stage. The design steps are listed below.

1. The development of the functional diagrams.
2. The diagrams are to be interpreted in clay at a small scale as the thinking from this point on must be in three dimensions.
3. Overall planning at small scale without detail and as a direct result of the diagrams should be done on paper and in clay model form.
4. All major criteria should be considered to insure their recognition in planning.
5. As the plan studies are made at a larger scale, including more detail and structural considerations, the use of a space volume model should be employed and the im-

portant parts enlarged, for careful study.

6. The detail study of individual functions already established in the overall scheme must be completed.
7. By combining the final statement of the parts with the whole scheme, a preliminary solution is had.
8. The structural considerations should be studied in detail and the mechanical and electrical aspects checked.
9. A careful check should be made to insure the meeting of all the requirements and criteria.
10. The final refinement of the design, including color, furnishings, paintings, sculpture, landscape construction, planting, and all other unfinished portions, should be done in drawing and by bringing the models up to date.
11. The preliminary working drawing studies will be done on paper and in model form.
12. A set of final working drawings are to be evolved from the studies.
13. Specifications will be prepared concurrently with the working drawings.
14. Documents of contract and bidding are to be prepared and included in the specifications.

CONCLUSION

It is envisaged that the solution reached by the process given above will be organic in nature, having grown naturally as a plant would, and be as complete as knowledge, time, and other circumstances will permit.