THE PROPOSED LIST

*** -------- Major: design methods and design thinking -------- ***

DESIGN METHODS

-- hierarchical graph decomposition of problems and use of patterns --


In the Synthesis of Form, Alexander argues that a design is inventing form in response to function and its context. A form, therefore, should be described not just as "what it is" but also "what it does." He defines diagram as a representation of both form and functional requirements. He suggests breaking down design problems into components by using graph and tree diagrams and working with simple mathematics operation. A program is considered to be decomposed as subsets that are easier to analyze. In the other hand, a program realization is a synthesis, a fusing composition of diagrams. The later book, Pattern Language views design process as the use of "pattern language." A pattern is an operator that transforms occurring problems and the reasoning into solutions. The book argues that all design, architectural and urban alike, good and bad alike are done using pattern language; and each design has its individual pattern language. Therefore, collecting and providing good design patterns can stimulate good design solutions.

-- generalization of design process and design method cross domain --


Archer attempts to lay down a foundation for a science of design based on structure of a design process. He adopts abstract mathematical notation and terminology from
operational research and management. He also draws from statistics and psychological measurements. He aims to provide a framework that design of any filed may be perceived, and so the "logic" of designing would be independent of the thing being designed; and so design of different field can be compared if they use same notation and terminology.

-- one author view on design methods --

All these books represent individual author's views on design method. Broadbent proposes a design process model as an interaction -- human, environment and building. He suggests four types of design development - pragmatic, iconic, analogical & canonic. He also discusses the use of references as visual analogs and metaphors. Sanoff suggests using visual notation techniques to record interaction between human behavior and the environment. He suggests the research and planning methods should stress the visual features of the environment to aid traditional verbal descriptions. Jones' book is about methods for exploring design situations, searching ideas, exploring problem structure and evaluation. It is a instructional, how-to book, with lots of strategy suggestions. The book does not provide solutions or check lists for solving design problems, it proposes that design goals can be achieved by following certain techniques suggested in the book. Zeisel's book attempts to make better design by using environment behavior research. He describes the similarities between research and design, and then suggests research methods such as observation on physical objects and environmental behavior, interviews and questionnaires. He stresses the importance of fulfilling goals of different aspects by applying social-science and program evaluation strategies with qualitative and
quantitative analysis. Heath's book suggests that there are three types of building--commodity buildings, symbolic, and system buildings. He argues that though the design process for these three types of building are different, but the methods used are similar -- they all use "identify" "generate" and "test" in the process.

* edited book with collections of design method articles --


Moore's edited book is a collection of articles presented at the Design Methods Group First International Conference, 1968. It includes thoughts on designs, computer-aided design proposals, problem identifications and evaluations, reflections and approaches to design and planning. The book provides models of design process, and suggests tools for design. Cross's edited book collects articles about design methods employed from various domain includes mechanical engineering and industrial designs. The interests of paper ranged from management of design process, structure of design problems, nature of design activities, to design method philosophy and history.

DESIGN THINKING & COGNITIVE PROCESS

* Simon, Herbert A. The Sciences of the Artificial. Cambridge: MIT Press, 1980. in particular the chapter on "the Science of Design


All these books discuss about design thinking involved during design process. Simon in the Science of Artificial views all human mental processes, including design, can be described as information processing. Design is a process that acts to change an existing situation to a preferred one. He argues that all professions do design: science deals with natural things and design deals with artificial artifacts. Lawson's view on design process is that design problem solving is done by using small set with targeted goals at hand. He set up some experiments to test on how people solve simple design problems. He concludes that designers' methodology on approaching synthesis does not need to be based on the completion of problem analysis. Schon's Design Studio talks about the intuitive processes of design, Knowing-in-action, and Reflection-in-action. He describes design problems are "messes" that have conflicts, uncertainty, unstability and can be unique. Unlike other books, he stresses the importance not only on reasoning but also intuition. Akin uses protocol analysis (based on Newell & Simon's problem solving arguments) to infer the information processing mechanisms that underlying human problem behavior. He focus on "intuitive-design" instead of rational design tools. He suggests that design problem solving are processed through state space search and the unique aspects of design behavior is the "constant generation of new task goals and redefinition of task constraints." Rittel and Noble's articles describes design as issue based argumentation. An issue is a design question or any question. The Issue-based information system reveals design rational through the design process. It has no definite formulation or stopping rule, solutions can be good or bad but not correct or wrong. Rittel differentiates the design problems to those solved by scientists or mathematicians. He argues that there is no right or wrong solutions but good or bad ones with lots of alternative explanations. Rowe's Design Thinking examines how architects and planners practice design. He describes different techniques used by those designers in action. He observed several designers in their design process and collected their design documents and his interviews with them. He classifies design aspects as two major kinds, procedural and normative. He argues that a design inquiry has two major interacting components, 1). man and his world 2). building & its components.


*** --- Minor: knowledge representation, drawing & computation --- ***

**DRAWING**


All the above stress the importance role of drawing plays in design thinking. For example, Michael Graves in "The Necessity for Drawing" argues that drawing is central in architectural design and he identifies various functions that drawing fulfills. Graves explains that a "referential sketch...is a shorthand reference ... which has the power to develop into a more fully elaborated composition when remembered and combined with other themes...." Goldschmidt has looked closely at the logic that connects sequences of architectural sketches. She argues that sketching is a "problem-solving heuristic procedure" that is employed to enhance visual feedback. When designers "read" information from the displayed sketch image, the reason embedded in the sketch or the sketcher can be extracted.  Herbert in his Architectural Study Drawings examines the graphical media and design processes of six practicing architects. He argues that drawings are more than just a convenient strategy for solving design problems and that they are “the designer’s principal means of thinking.” He argues that study drawings play an important role in the exploration and development in the early stages of design that
serves as principal graphic thinking tool. Herbert also explains applications of drawings for design practice, research and teaching and indication for future computing tools. Fraser and Henmi’s Envisioning Architecture looks at how techniques used to make different drawing types influence the making of architecture. The book starts with an example on Le Corbusier’s design development of Carpenter Center with drawing. It then describes different drawing types with history backgrounds and applications of different drawings in use of design process. It draws various design examples to illustrate the use of different drawing such as diagrams, referential and visionary drawing, design and presentation drawings. Robbin’s Why Architects Draw, like Herbert’s book, examines the work of well-known professional architects. However, Robbins’ book focuses on the social role of drawings in architectural practice. The book includes various design drawing examples and architects’ own descriptions of their personal design processes. Oxman points out that the designer sketching is to explore an analogy, thereby restating the design problem before returning to develop the design.

DESIGN KNOWLEDGE REPRESENTATION

-- media representation


The above books and article express the role of media representation in design. Representation and Architecture is a collection of articles concerning design representation. The range of contributors includes practicing architects, environmental
behavior researchers, design methodologists, cognitive psychologist and computer aided design researchers. The book presents various representations of architectural design, such as design drawing, the use of visual metaphor in design and computer aided design approaches. Eastman in The Computer as a Design Medium argues that "representations consist both of a data organization and operators suited to that organization." Design development is an exploration process through different kinds of representation such as spatial modeling, performance and functional relation representation, database management and logical relations, and coordination between all these representations. Crowe and Laseau's Visual Notes assembles examples that demonstrate how to record visual information to facilitate communication of visual information. They argue that visual note taking is as important and useful as verbal notes in that it complements our abilities from other areas and expand our knowledge for recording information, solving problems and facilitating understand. Lawson's Design in Mind contains interviews with ten famous architects, he emphasize the design process instead of end products. He argues that the most magical and precious of all human activity is the creation of something new and original, so he focus on how designer might be thinking while designing. Each chapter includes architect's biography and discussion between the author and the architects, and what they have written about their works and ended with suggested reading list.

-- shape grammar for form generation

Stiny's article introduced the definition and formalism of shape grammar and the algorithmic definition of "languages" for spatial design. Flemming presents shape grammar as a tool for design feature description and generation and testing of rules. Mitchell's book attempts to lay logical foundation of design thinking by describing language of architectural form, "their specification as form grammars and the role in structuring design thinking." These books propose the use of shape grammar for architectural design. They suggests that design language can be defined as shape grammar. The grammar is computable rules for generating form. Shape grammar is to
treat shape making as a transformation processing -- it has a start symbol, rule of replacement (rewrite rules) and then a stopping rule. The power of shape grammars is that they have abilities to generate a mass of different designs by using the same grammar, with only a few rules. Shape grammar are proposed to represent an architect's style.

-- games to explore design problems

Sanoff proposes that gaming is an approach for problem solving, and learning occurs best when theory and experience are connected activities. He argues that real life design situation can be compressed as gaming so that "the essential characteristics of the problem are open to examination." In Design Games, each game contain rules of the game, concepts depicted by pictures and recording methods. The theoretical concepts of gaming is provided for participants to involve in an exploratory and discovery process to provide experience. Likewise, Concept, Design Games describes using games as a tool for research in design theory and methods. Each game is designed toward a particular design or planning problem though not explicated stated in the program. Some games involves communication of design moves, and some involves conflicting intentions and goals of different players. Researchers gain understanding of game task and goals by following up those playing rules in the game or developing new games.

-- computer aided design
Negroponte in Architecture Machine describes a computer aided design system URBAN5 and its implications for future developments. He argues that by using automation would reduce costs and design methods and design process would evolved and re-considered.

Eastman's edited book Spatial Synthesis includes The Electronic Design Studio is a collection of various ideas about CAD that includes articles of different concerns such as theoretical foundations, knowledge-based design tools, design information delivery systems and case studies of electronic media in the design studios. The paper came from experiences of universities from international researchers and teachers and were presented at the CAAD Futures 89 conference.

-- knowledge based systems


* Gross, Mark D. “Design as Exploring Constraints.” PhD, M.I.T., 1986. Gross proposes design process as solving problems with the exploration of design constraints. A constraint can be a rule for a functional requirement or shape adjacency.
By assigning and applying different constraints to the initial design problem, designer discovers design moves shape her design to fulfill her own proposed constraints.


Eastman proposes a "central database" for computer aided design system in which a building in all its aspects can be represented. The database serves as a core for design in which all the various useful and multiple views can be taken. He believes design is a process that involves many different kinds of information processing such as collecting
and analysing ideas, drawing and representation, decision making and impact evaluations which should all be organized and stored in one place that can be drawn with different representations for different use.


-- discussion on computational knowledge representation

* Purcell, P. “The role of media technology in the design studio.” 1987.

All the above discuss views of how knowledge can or can not be represented by computers.