A “Language Game”
Approach to Architectural Typology

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Abstract

This paper examines the role of natural language in architectural design methods. It first investigates the role of language in decomposition and synthesis of architectural design problems giving special attention to Christopher Alexander's theories. Then the notion of ideal types in architectural design is compared with empirical typologies that regard types as groupings of objects which have certain attributes in common. It is shown that Ludwig Wittgenstein's game theory of language may serve as a method to cope with an underlying paradoxon of this empirical approach. Finally, we present an attempt to use the "language-game" approach to describe and analyze architectural types.

Introduction

Architecture is often regarded as a language with its own vocabulary, syntax, pragmatics (context and style) and semantics [Gero 1987, Mitchell 1990]. Shape grammars allow to build up structures from a given vocabulary by applying transformation rules [Stiny 1978]. Looking at a plan generated by the Palladian Grammar of Stiny and Mitchell, an architect can identify and name it by saying: "This is the plan of a Palladian villa." Although this might seem most natural, we have to distinguish carefully between the notion of architecture as a language and the language we use to communicate about architecture. By calling the output of a shape grammar "Palladian Villa" we do not establish the semantics of an architectural language, but we try to map the syntax of one language into the semantics of the other. An architectural language has its own Semantics beyond verbalization: Stonehenge and the Cathedral of Chartres are both meaningful because of the impression they make on us and not because of a convention to call a set of elements arranged after a specific syntax in a certain context "holy places". [1]

The relation between these two languages is a crucial problem in design theory in general [Alexander 19641 and in the development of knowledge based architectural design systems in particular [Gero 1987]. The first part of this paper investigates possible approaches to this problem in respect to Ludwig Wittgensteins theories of language: One approach is to avoid verbal representations as far as possible; another approach is to introduce a hierarchy of definitions to standardize the elements of a language; a third approach is to investigate the usage of the vocabulary of a critical language [2], thus making the meaning of a sentence reveal itself in the context of a language-game- ("Sprachspiel"), a term coined by Ludwig Wittgenstein in his Philosophical Investigations [Wittgenstein 1952]. The second part of this paper presents an attempt to use the latter approach to describe and analyze critical vocabularies for architectural typology.

Architecture and its verbal representation

Although the necessity to communicate about architecture in natural language seems to be obvious at first glance, we can certainly imagine buildings being designed and erected without verbal representation. Instead of saying "This is the plan of a Palladian villa" the architect in the example given above could simply start to follow the specifications of the plan and actually build. Simple procedural phrases like "Put this part on top of that would be sufficient for an elementary building process. For many practical reasons, however, architectural knowledge is usually represented as a combination of graphics, natural language and numerical specifications. In this case the meaning of the words used has to be described. For the late Wittgenstein, following a nominalist philosophic tradition, words are names. He compares naming with a process of labeling: "To name something is similar to attaching a label to an object" [3][Wittgenstein 1952. #15]. As long
as language is used as a passive tool to describe factual knowledge about e.g. physical objects and their relation to each other, the problems arising in this process have little practical consequences. On the other hand, language is an indispensable active force in the definition of architectural design problems, especially if we consider architecture as a “social art” that responds to a variety of social and cultural needs. The discussion and propagation of social and cultural issues is to a large extent carried out in natural language. [4]

**The role of language in decomposition and synthesis**

Considering the idea that architectural design problems are the result of social and cultural needs, one can distinguish between the role of language in the analysis and in the synthesis of a design problem: decomposition usually proceeds from a concept described in natural language; in the further process of decomposition natural language is an active and guiding force besides emerging graphic representations. In the synthesis of form the language of architecture and its graphic or three-dimensional representation are the active forces; in this part of the design process, natural language is rather used to justify a design and to communicate about it.

In his Notes on the Synthesis of Form Christopher Alexander deals extensively with the consequences of these assertions [Alexander 1964]. He claims that the concepts of designers about a problem rarely correspond to the actual structure of the problem. The process of decomposition necessary to deal with complex problems may result in a variety of constraints - referred to as "misfit-variables" by Alexander- but the actual relations between these constraints are not described by the hierarchy of verbal concepts used to decompose the problem. "Since the concepts are on the whole the result of arbitrary historical accidents, there is no reason to expect that they will in fact correspond to the subsystems". [Alexander 1964] Figure 1 shows Alexander's graphic representation of the problem: 1a represents the actual relations between the constraints of a design problem, 1b shows an inadequate concept of a design problem, 1c shows a reasonable decomposition.
As an example Alexander presents the problem of designing an Indian village: A designer usually would begin to analyze and decompose issues like Traffic, Religion and Caste, Social Forces etc. and treat them as comparatively independent problems. A closer look reveals that the actual relations do not correspond with these issues at all: the constraint "provision for animal traffic" (issue: traffic) conflicts with "cattle is treated as sacred"(issue: religion and caste); on the other hand it connects positively with "need for family solidarity" (issue: social forces), because this latter requirement tends to group the houses of family members in compounds, and so reduces the number of access points required by cattle.

Alexander claims that designers try to fit new concepts into the pattern of everyday language by relating their meanings to those words at present available. "Unfortunately, although every problem has its own structure, and there are many different problems, the words we have available to describe these problems are generated by forces in the language, not by the problems. and are therefore rather limited in number and cannot describe more than a few cases correctly." [Alexander 1964][5]. In the Notes on the Synthesis of Form Alexander indicates that a reasonable decomposition of an architectural problem is computable, although he does not give an example.'

A correct decomposition is no solution by itself but just a more promising starting-point for the synthesis of form. To avoid the fallacies of natural language in the further process of design Alexander introduces the idea of "constructive diagrams" as a means of representation. On the one hand these diagrams "summarize aspects of a physical structure by presenting one of the constituent patterns of its organization" (form diagram), on the other hand the diagram "summarizes a set of functional properties or constraints" (requirement diagram). A constructive diagram has to contain both aspects. Each diagram describes the interacting and conflicting forces of an independent subproblem. Figure 2 shows how a set of twelve elementary constructive diagrams can be hierarchically combined to form a solution for Alexanders Indian village problem. Most obviously, to understand the diagrams a detailed description is necessary. This may look like a contradiction, but as the language used is entirely descriptive it only makes the essence of the diagram "show itself" without playing an active role.
The Pattern Language Concept

In his later work Alexander calls the diagrams "patterns" and publishes a collection of 251 patterns covering the issues urbanism, building design and construction under the title A Pattern Language [7][Alexander 1977] Each pattern "describes a problem which occurs over and over in our environment, and then describes the core of the solution to that problem." Each pattern has the same structure: First there is a picture, which shows an archetypical example for the pattern. Then the context of the pattern is shown, by explaining how it helps to complete certain larger patterns. Then a headline gives the essence of the problem. After the headline comes the body: it describes the empirical background of the pattern, the evidence for its validity, the range of different ways it can be manifested in the building. Then a solution is given in the form of an instruction, starting with "Therefore: .......Finally there is a paragraph which ties the pattern to all those smaller patterns in the language, which are needed to embellish it. The order of the patterns from large (city) to small (detail) is just one possible sequence. Due to the links the patterns form a network of independent subsystems.

The active role of language is reduced as far as possible: for any given problem, the designer has to find a starting pattern. This involves the matching of two names: for designing a "hospital", pattern Nr. 47 ("Health Center") is most promising. After that, the process of decomposition is automated by the links to smaller and again smaller patterns, thus creating a structure similar to the Indian village example in figure 2. Including links connected to "larger" patterns which seem especially interesting creates a network instead of a tree structure. The text of each pattern is not intended to explain the meaning of its name, but how it works.

Alexander claims that the pattern language is a comprehensive and sufficient design-method: its results are seen as part of a timeless, pre-stabilized harmony. [8] Thus the pattern language is closely related to the philosophic concept of ideal types. This concept claims that we are able to perceive the objects of our world because they are just instances of, in the words of Plato, "shadows" of a transcendent, ideal reality. Thus we can distinguish between essential and accidental properties of objects, the latter varying from instance to instance within a type. Historicism gives up the idea of types being timeless and unchanging: in aesthetic theories of the 19th century types are regarded as mediating between "the singularity of form and its historic development" [Dal Co 1990]. Even if types are no absolute essences any longer in this concept, they still are regarded as outstanding products of an experimental tradition providing well organized operational information [Malfroy 1986].

The Role of Language in Architectural Typology

Much in contrast to the idealistic approach described above typology is often regarded as a system of groupings of objects which have some attributes in common. In this definition types are used to describe resemblances between objects. This method of grouping has formed the starting point for sciences like chemistry or biology. The distinction between taxonomy and typology is not really precise if the assumption of ideal types is abandoned; it seems reasonable to speak of taxonomy as a method to represent the coincidence of phenomena, and about typology as a first approach to explain their occurrence: In a typology those groupings are selected in which the occurrence of phenomena is likely to have the same reason and thus provides a promising starting point for further research.

In architectural typology this empirical method has been widely used to investigate the relation between the form (in a general sense) and the function of buildings. In, for example, his History of Building Types [Pevsner 1976] Nikolaus Pevsner groups buildings by their function. This sort of typology helps the designer
to find design solutions related to the current design problem. Using existing solutions related to the current task has always played an important role in architectural design. Recent theories in design methods and cognitive science [Schank 1982] question the predominant role of analysis and synthesis in the design process and point out the importance of finding and adapting existing design solutions which either directly or analogically match the current-design problem.

Architectural typologies provide a wide range of possible groupings, for example by structural system, function, material, urbanistic situation, style, etc. To be precise, the groupings are made by the name of the style or function: Pevsner discusses "hospitals", "prisons", "town-halls" etc. In an empirical typology these names cannot be regarded as absolute essences, which would again introduce ideal Platonic types, but as conventions: if there is no absolute idea of what a hospital is we may try a definition by asserting that hospitals are places for the medical treatment of sick people. But is a sanatorium a hospital? Are pregnant women actually sick? If a church is converted into a hospital, is it rather a church or a hospital? Is a Kneipp cure a medical treatment? We could try to overcome the problems related with these questions by providing additional information, but we will finally have to face the paradoxon that we use attributes to describe objects and at the same time use the objects to describe the meaning of an attribute.

In his Philosophical Investigations Ludwig Wittgenstein deals with this very paradoxon. His solution is no new approach to overcome the paradoxon but to accept it: Instead of seeking the true meaning of words we should rather be interested in how they are used and thus in their different functions: “Think of the tools in a toolbox: there is a hammer, a pair of tongs, a saw, a screwdriver, a ruler, a glue-pot, glue, nails and screws.” As different as the functions of these objects are the functions of words (although there are some similarities in both cases).” [Wittgenstein 1952,#11] In contrast to the picture theory of his early philosophy Wittgenstein claims that we can approach the function of a word by studying the “language-games” it is used in.

This language-game approach can be used to assist architectural typology by providing a tool to describe critical vocabularies. In the following we want to show how this can be realized by extending a hypertext system that integrates a large set of detailed descriptions of buildings: in addition to the usual explicit links the system provides for implicit links that are generated by matching the buildings' attributes. As a consequence of the paradoxon described above the system has a double function: it provides a tool to describe sets of attributes by relating them to sets of buildings; at the same time the tool can be used to describe the buildings by relating them to the attributes. In the context of a "language-game" it makes no sense to worry about this paradoxon - one rather should make good use of the tool.

A Hypertext System for Architectural Typology

Figure 3 shows the general layout of a hypertext system for architectural typology (HySAT). The core of the system is formed by a collection of detailed building descriptions that try to give an impression of the building as close to reality as possible. In the following we will call these descriptions "building files". [9] As shown in figure 4, each building file is distributed into three stacks: one stack for text, one stack for plans and one stack for pictures. The decomposition into three stacks allows the comparative study of text, pictures and plans of a building file.
The textstack is divided into main topics which are directly accessible via buttons. These main sub-nodes are the starting card, the bibliography, attributes, an overview diagram and the textual description. The latter is subdivided into several topics, some of which are common to all building files (history, function, site, etc...), while others may be individually added. Indexes and keywords support cross-references.

Picture and plan stacks contain graphical information. Both are explorable in a sequential manner via arrowkeys or through a stackmap. The system provides for hypermedia additions like high resolution color images, video-sequences on laser-disc (showing for example the movement through a building) and 3D models of the building to carry out simulations (e.g. lighting studies).

Navigation between these three stacks is provided on three levels. The user may switch between the stacks by clicking into the window of the target stack; he may use buttons that activate context-sensitive node-node links (e.g. taking him from a cross section of a building to the topic "construction" in the text-stack); or he may use point-point or point-node links that take him from a keyword or a "hot-spot" within a picture to other points or nodes. All links are set explicitly and are ½ hardcoded ½ as hyperTalk statements.

The anchoring of links within text is made prominent through use of special typographical cues. The type (i.e. picture, plan, text) of their destination is indicated for better forecasting. Thus several destinations for a single anchor are possible. Anchoring of links within graphics is supported through icons, which can be turned off and on by the user to avoid 'graphical distress'. Point to point links are usually bidirectional. Links arrive at clearly indicated points within nodes of one of the three stacks of a building file. Targets are highlighted either by inversion (in text stacks) or by blinking icons (in graphic stacks). The general strategy is to achieve full predictability of what will happen when activating a link is activated.
Figure 4a Screenshot showing the textstack of HySAT

Figure 4b Screenshot showing the planstack of HySAT
Connecting distributed information

In a collection of the previously described hypertext building files each building file becomes a single node in a much larger information space. As shown in figure 3 no direct links between these nodes are defined, instead, the system offers two possibilities to investigate relations between the nodes: explicit links via guides and implicit links via attributes.

'Guides' are views of the information space that represent an expert's concept about a certain topic (e.g. A Guide to Building Types, A Guide to Kindergarten Design, etc.). They may provide much additional information and just use the building files as examples for their arguments, as they may access single points in the files. The advantage of the system is that the user always has the possibility to explore the entire building and not only the part the expert focuses on. If the user is "inside" a single building file he cannot access the guides directly, but has to pass through a sort of gate: a reference stack informs him about the guides that apply to his current node or to the entire building file.

Nevertheless this approach lacks the kind of analytical freedom an advanced user will be interested in. This user will expect the system to reduce the extent of the information space by preselecting a set of nodes according to some given constraints. Therefore links may be computed when requested through a more or less sophisticated matching algorithm (reaching from direct match via relaxed match to fuzzy match) on the attributes of a building file. The words that describe the attributes of each building are taken from a critical vocabulary and stored in a single attribute stack for all building files. This makes it possible to investigate different vocabularies and to analyze their validity.

Figure 5. Graphic representation of matching
Figure 5 shows how the degree of overlap between the topic of interest and the nodes of the system will be presented to the user in graphical form. The radial distance of a node to the center of a polar co-ordinate system indicates the degree of overlap, the circular position corresponds to the membership to a certain primary group.

**Implementation**

In the current prototype version the system is implemented in HyperCard 11 as far as representation and explicit links are concerned. For performance reasons query and mapping features and their graphic representation will have to be realized as 'external routines'.

A first approach to implement the overlap function is by matching the set of attributes which define the search with the attributes of each node. Counting the hits (equal attributes) results in a hit-ratio for each node which provides a simple rating of the nodes.

Although this strategy is permissible for a first attempt it lacks a lot of the general flexibility we are looking for. Major disadvantages are the restriction of attributes to a predefined vocabulary (otherwise no matches would be achieved at all) and the reduction to direct hits (nodes with a lot of 'very close' attributes cannot be detected).

More sophisticated matching functions have to meet a number of objectives: they have to allow some combinations of attributes to be regarded as more important than others., they have to consider relationships between issues established not only directly through attributes, but also through abstract concepts; and they have to provide the user with information about the type and degree of mapping.

A first improvement to the search algorithm can be achieved by rating the attributes' values (e.g. the sentence 'This building is a hospital' is rated 80 % "true"). This would allow the attributes values to vary in a predefined range. Nevertheless, the definition of absolute thresholds for the validity of an attribute (the attribute is or is not set) is not suited to qualify objects in a human manner. Allowing the attribute "attractive" to have more than one value (like low, medium, high) does not solve the general problem of the threshold but moves it to a higher level of granularity. (Why is a house not attractive at the level of 0.29 and medium attractive at the level of 0.3 ?) A system with this kind of matching algorithm using predefined thresholds for determining the validity of an attribute (i.e. attribute attractive is low, medium or high) will not consider the implication of the relationship between attributes on the validity of these attributes.

Fuzzy sets theory is a possible method to cope with this problem [Zadeh, 1973]. It allows to extend the range of valid values of an attribute beyond predefined thresholds. In fuzzy logic, the probability of a nodes relationship to a topic is affected by its relation to other attributes. Attributes could he realized as so called linguistic variables in order to meet human decision-making strategies. As fuzzy inferences [Zadeh, 1985] include the notion of hierarchically structured sets of linguistic variables matching by abstraction and analogy is also supported.
Conclusion

We have shown that the idea of describing architectural objects empirically by their attributes leads to the paradox that the meaning of the attributes themselves has to be explained through the very objects they apply to. According to Ludwig Wittgenstein's game theory of language this paradox cannot be solved but may be eluded by a shift in our interests: instead of looking for the "real" meaning of a word we should be interested in the way it works.

A Hypertext System for Architectural Typology with additional matching functions that provide and evaluate implicit links between its nodes has been proposed to explore architectural language games. Future research will investigate the possibility of creating information spaces in which an organisation as shown in figure 3 would be just one of many possible materialisations provided by a variety of overlapping and interacting data-structures.
Notes

1 Compare with Adolf Loos, Architektur [Loos 1909]: "If we find a mound of earth piled up in the forest, 6 feet long and 2 feet broad, ( ... ), we grow silent and something in us says: somebody is buried here. This is architecture". To understand the difference one can think of the following sentence: "If we see a mound of earth piled up 5 feet long and 2 feet broad, we may call it a grave".

2 Mitchell defines the term critical language as a method to make assertions about a design or construction world. Using first-order logic as a notation for such a language he assumes that "the symbols of the sentences refer in some consistent way to the shapes, functions and relations of the design world" [Mitchell 1990]. This is similar to the early Wittgenstein’s attempt in the Tractatus [Wittgenstein 1918] to trace reasonable sentences back to -elementary sentences” which are evidently true or false (Mitchell refers to Tarski and Carnap in this context).

3 In Wittgenstein’s theory the labels we attach to objects do not indicate any essence or Platonic type. Classification of words is "dependent on the purpose of the classification and on our preferences." [Wittgenstein 1952, #17] Natural language, numerical and logical notations are part of Wittgensteins general idea of language: “We may compare our language with an old city: there are crooked streets and places in the center, old and new houses. houses with additions from several centuries; surrounded by many new suburbs with rectangular streets and uniform houses.” [Wittgenstein 1952, #18]

4 Louis Sullivan for example describes architecture as "interpretation and initiation" of social forces, that can be transformed into architecture by the architect-artist through a mystical unity [Sullivan 1956]. More recent examples of creative use of poetic language in architecture can be found in the work of e.g. Louis Kahn and John Hejduk [Hejduk 1985]. Even in so called primitive cultures as for example the Dogon in Mali there exists a complex mythology related to the built environment [Vogt 1980].

5 The great number of words that would be needed to define different design problems unambiguously makes the idea of precise definitions for each word unfeasible. Even if this was possible to a certain extent, every definition reduces the ability of modification, thus usually causing serious problems. English orthography may serve as an example: its early definition hindered its adaptation to the changes in pronunciation. Today spelling and speaking hardly represent each other (think for example of the words rough, dough and blow).

6 The decomposition of the Indian village problem is obviously done "by hand". The mathematical treatment of decomposition given in appendix 2 of the Notes on the Synthesis of Form cannot handle complex real-world problems.

7 Although closely related to some of the techniques of computer aided design methods (e.g. rulebased systems, object-oriented systems and hypertext systems) Alexanders work is quoted comparatively rarely in the literature on the subject. Maybe this is due to Alexander's attitude towards the protagonists of the field: In fact, people who study design methods without actually practicing design are almost always frustrated designers who have no sap in them, who have lost, or never had, the urge to shape things. Such a person will never be able to say anything sensible about 'how to shape things either." [Preface from 1971 in Alexander 1964].
8 In its printed form a A Pattern Language presents itself as a "total" solution - a bible rather than a manual – and not as an open system that can easily be combined with other approaches to design. The small influence of A Pattern Language on current architectural practice in contrast to its high aspirations may be due to this fact. The pattern language concept provides, nevertheless, for considerable flexibility inside the system, as the user is invited to modify patterns, add new patterns or even delete a pattern he does not agree with.

9 In the past 10 years about 500 of such descriptions have been conducted by students at the Institut for Building Design at Vienna University of Technology. They deal with - mostly Austrian - public buildings from the 20th century, and contain a photographic documentation, plans, the analysis of site conditions, function, circulation system etc. A subjective critical description of the object is also provided.
References


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