

Ali Guney

Lecturer in precedent analysis and design

Delft University of Technology, Faculty of Architecture, Dept. of Urbanism, A.Guney@tudelft.nl

A Method for Precedent Analysis of Spatial Artifacts

Key words: knowledge, precedent analysis, creative design process, cognitive structure, analogy, source and target domain.

1 Abstract

This paper will treat two issues regarding innovative/ creative morphological analysis of spatial artifacts in relation to their Form, Operation and Performance. One will be about precedents and their usage in the design process, analogically; and second will be an example of a comparative (architectural) precedent analysis of two buildings of the same architect(office).

Learning by analogy is a powerful method, in general. Analogy has two domains basically; one is source and the other is target domain; thus, design domain will be target domain and that of analysis, source. I will try to show how we can use the structured- analogical source knowledge in spatial design process; target domain. This paper will go in depth with the creative analogy in terms of constraints of similarity, structure, and purpose as (Holyoak and Thagard, 1996) put it. There will also be presented a schematic paradigm about creativity through analogical and other creative mental behaviors like: defamiliarization, circumscribing, mental leaps, metaphor, simile, mimesis and aesthetical judgment, etc.

Each spatial artifact has a form, operation(working of the function; thus, not function alone) and a performance most of which is normative. Form will be analyzed and represented in terms of its spatial relationships, organizations, its physical properties(its structure, day- light quality, geometry, mass and abstraction of these properties as parti (dominant underlying characteristics of the artifact, in terms of form, at hand), and its topological(non-metric) properties; accessibility of its consisting building blocks and spaces. Operation will basically represent how spatial divisions and blocks possibly could be used best and see if their working of the function match with the actual ends of the artifact at hand. Performance will represent performative properties in relation to operation and form; how good/ bad it operates and also evaluating how the form is emerged in relation to its context, spatial quality and aesthetics. A schematic diagram of form, operation and performance can be shown like: $F(m) - O - P$. In the process of analysis we can observe whether the form will or will not afford operation, and operation performance; in design process, performance will ask for affordances from operation and operation from form(morph). This mutual working of design and analysis will be explained at some levels of design phases; concept, pre-parametric sketch, parti(pre-parametric design), parametric alternatives and; eventually the definitive design. Finally, the analysis of these two buildings will be compared with each other and a conclusion will be inferred, respectively.

2 Introduction

Explanation and description are sometimes more useful than definition; therefore I will treat some relevant issues concerning spatial design and analysis to describe the frame of its cognitive structure which is also relevant to teaching and learning perspectives regarding our design students.

Shortly, following relevant issues will be treated: learning/ teaching design, knowledge, empathy, intersubjectivity, creativity, education, precedent analysis and design.

3 Learning

Learning is a mental act as gaining knowledge by being told, taught, instructed, by discovery, analogy, etc. Learning and teaching are not only interactive but also participating educative activities as a whole;

this is the dialectic character of education which requires empathy for students or learners, in general; we all know what we teach is determined by what students understand from it. It is all about gaining knowledge; though even knowledge itself is one of the main matters within this issue. I should then present a summary of knowledge regarding its epistemological and cognitive aspects.

Epistemologically, I think, knowledge is "justified evidential true belief", concerning propositional knowledge; as it could be in Plato and Kant's understanding of it. We can take the component justification as evidence, truth as being the case or how reality is, how things really are, and belief as having psychological state related to that propositional knowledge. (Holyoak and Thagard, 1996)

Different sorts of knowledge can be summarized, in terms of some philosophical worldview and cognitive science, as following:

1- Propositional/Declarative knowledge, which can be either empirical (a posteriori), or non-empirical (a priori), meaning knowing what or something is so. Stillings et al. describe two kinds of declarative knowledge as language like representations and image like representations,

2-Procedural Knowledge (knowing how),

3-Tacit Knowledge, also called non-propositional knowledge (something like implicit knowledge, knowledge by acquaintance or by direct awareness), and

4-Linguistic Knowledge, which is also a kind of tacit knowledge, because even if we cannot explain all rules of our native language, we still can use it and can be understood by people who use the same language as his own native one. (Holyoak and Thagard, 1996 & Stillings, N. A. W et al.1995)

Even though there is no sharp distinguish between declarative and procedural knowledge, we can use this distinction as an instrument to operate further. To my own observation, I also believe, much of our knowledge is declarative as supported by Stillings et al.: "Traditional epistemology distinguishes between 'knowing how' and 'knowing that'. Though this distinction is not the same as the one psychologists draw between procedural and declarative knowledge, the two are closely related. Much of our knowledge- that is probably encoded declaratively, since much of it is mobilized in controlled processes." (Stillings, N. A. W et al.1995)

Tacit (or implicit) knowledge is a complex matter to explain what we know, explicitly in tacit knowledge. Any how, it is a very effective in thinking process, as Holyoak and Thagard explain: "Implicit knowledge often allows quicker reactions than does explicit knowledge and in some cases is actually more accurate. Moreover, even when explicit knowledge is being manipulated, the process that uses it may itself be implicit." (Holyoak and Thagard, 1996) Stillings et al. state Implicit (or tacit) knowledge further: "There is a classical intellectualist suggestion: if an agent regularly employs rules in the integration of behavior, then if the agent is unable to report these rules, then it is necessarily true that the agent has tacit knowledge of them." (Stillings, N. A. W et al.1995) By Fig. 1 we may schematize knowledge and its sorts.

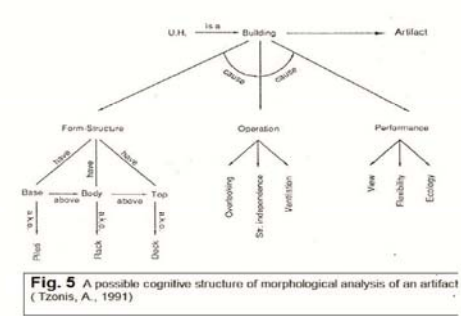
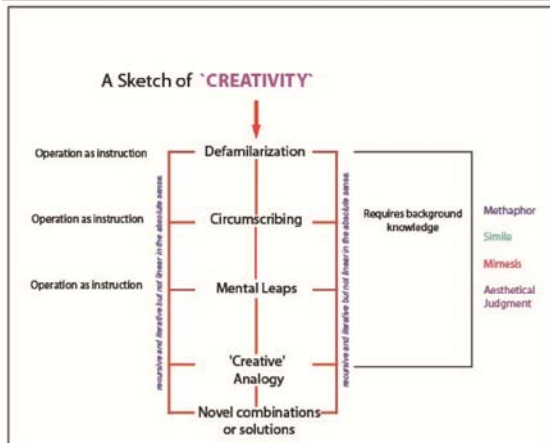
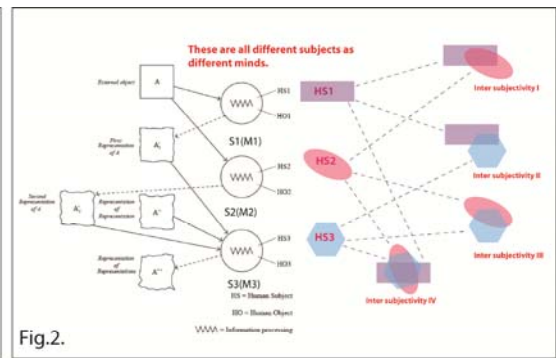
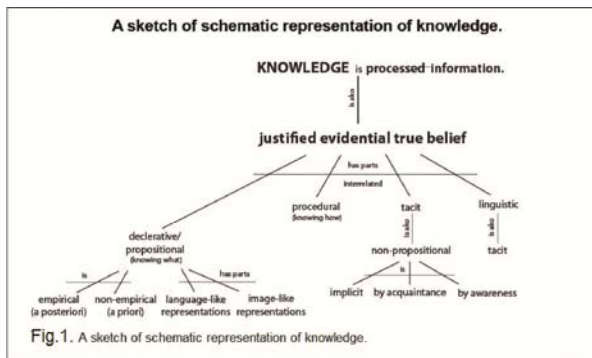


Fig. 1. A sketch of schematic representation of knowledge.

We should take all above mentioned knowledge sorts into account to develop entire mental abilities of students since there is a possibility that students can have different strong and weak points in their mental abilities. Diverse learners can be strong in language-like representations, the other ones in image-like representations and some those of tacit knowledge, etc. Educators should try to understand learners' minds with their weaknesses and strongnesses so that they can exploit all their diverse cognitive abilities. . Nevertheless, well developed abilities can compensate the less developed ones analog to the task of damaged part is taken over by the other ones. (Motloch, J. L., 2001)

While educating learners, we should take in to account not only the internal conditions but also the external ones as Gagne explains it: "Instruction means arranging the conditions of learning that are external to the learner". Continuing further: "In the most general sense, instruction is intended to promote learning. This means that the external situation needs to be arranged to activate, support, and maintain the internal processing that constitutes each learning event". (Gagne, R. M., 1985)

Nevertheless, educators should have suitable empathy for the students. Empathy is a complex matter which is related to intersubjectivity will be discussed below.

4 Empathy and intersubjectivity

Some philosophers took empathy and intersubjectivity as the relationship between subjects and the external world, in general; others between different subjects. The entire philosophical enterprise of empathy will not be treated entirely within this paper, but only its relevant parts:

"Einfühlung (German, 'feeling into'), empathy. In contrast to sympathy, where one's identity is preserved in feeling with or for the other, in empathy or Einfühlung one tends to lose oneself in the other." (Audi, R., 1996)

Husserl, discusses empathy, from phenomenological point of view, in relation to intersubjectivity. In his opinion, intersubjective experience forms the basis of our understanding of ourselves as objectively existing subjects, other experiencing subjects, and the objective spatio-temporal world.

According to him, the relation of empathy and intersubjectivity is as follows: "From a first-person point of view, intersubjectivity comes in when we undergo acts of empathy. Intersubjective experience is empathic experience; it occurs in the course of our conscious attribution of intentional acts to other subjects, in the course of which we put ourselves into the other one's shoes." (Stanford Encyclopedia of Philosophy, 28/09/2009)

Empathy is also helpful for intercultural understanding, which is to understand the other minds that are different from one's familiar world or culture. (Stanford Encyclopedia of Philosophy, 28/09/2009) Besides some ideas of Husserl, it might be useful to quote his student Edith Stein's idea of empathy which is: "a blind mode of knowledge that reaches the experience of the other without possessing it." (Audi, R., 1996)

Although the above mentioned powerful ideas are all reasonable statements, yet there should be a more sound explanation about the cognitive structure of empathy and intersubjectivity. I think, processed information becomes a kind of representation of the external world (either other minds or any kind of object) which is constructed in human minds as objective and subjective knowledge (after J.S. Doorman in his public debate lectures in the Faculty of Architecture at TUDelft). Cognitive properties of our minds' (which are also interwoven with emotions) have a lot in common with each other just because of being human which has also some different representations of the external world which is not common to all mankind, but to some of them. Subjects (minds) have, then, two kinds of representations of the external world; one might be called as human objects (common to all minds) and the other human subject (common to some subjects/minds) as shown in **Error! Reference source not found.** above.

5 Analogy and creativity

We all know analogy is one of the most powerful ideas in creative thought; it connects different but relevant domains to each other. Many different domains might have some significant similarities but as hidden suppositions which may not be seen immediately. Target domains stimulate humans to find some relevant source domains to make analogical couples to understand them better with their intensional and extensional meanings. Once you understand something, it is halfway solved as we all know. Analogy helps us to design with creative constraints as in the precedent analysis from which we learn a lot by finding out the hidden suppositions; analogical similarities, thus. Analogy employs all kinds of knowledge; propositional and non-propositional, etc., so that we use it in design process and design education. Although it is popular to support the non-propositionality of creativity, there is much power in propositional knowledge, too as stated by Holyoak and Thagard: "With propositional thought, one can still appreciate the richness and diversity of experience yet nonetheless be able to extract and make explicit similarities that connect distinct situations to one another". (Holyoak and Thagard, 1996)

As mentioned above, in creative learning, teaching and design process analogy is one of the prominent and creative mental acts, yet it is not enough by itself as Holyoak and Thagard explain it: "Although we do not believe that analogy is the only cognitive mechanism involved in creative thinking, it does play an important role. It has often been suggested that creativity is based on some mental mechanism for combining and recombining ideas in novel ways, where the recognition of viable new combinations depends in part on a kind of aesthetic judgment that the juxtaposed ideas fit well together". (Holyoak and Thagard, 1996)

Fig. 3 above is an abstract sketch of 'creativity' as combining and recombining in a novel way through aesthetical judgment and the other three creative mental acts; metaphor, simile and mimesis. Anyhow, learning is mostly combining new ones to old ones, and transforming them to novel combinations, etc. as Motloch puts it: "Since most learning is based on connecting the new to the familiar, education should develop the courage and skills necessary to connect new with familiar, extend existing patterns, and build new ones". (Motloch, J. L., 2001)

Analogy helps us to make our minds work efficiently; because otherwise we would be lost in trivial details instead of dealing with structural major similarities and abstractions. Abstractions help us to reason globally, otherwise we would have to operate on too much information. This is the reason why we abstract concepts to handle and prevent the combinatorial explosion.

Human cognitive device, inflates the information when there is too little of it, otherwise, compresses it; physically. There are also some more supporting ideas tell about the power of analogy: "Thus analogy helps to form new and more abstract concepts, which in turn help to see even more remote analogies, which in turn help to form yet more abstract concepts". (Holyoak and Thagard, 1996) And read further: "Although the individual concepts in a person's semantic network are important for thought, the full power of human thinking depends on its capacity to combine concepts to create more complex structures". (Holyoak and Thagard, 1996)

This is too complicated issue which exceeds the scope this paper concerning its entire enterprise; but, it is necessary to be aware of its instrumental help in terms of avoiding superficial global similarities, but focusing on selected attributes of an object like in design domain; as supported by Holyoak and Thagard: "The capacity to focus selectively on a particular attribute of an object, and hence on particular similarities between objects, is an important cognitive advance, because it breaks the dependence on global similarity". (Holyoak and Thagard, 1996)

Analogy is not a simple association; it requires mental initiative to propose one, at all. We need to force ourselves to use our mental leap capacity to find some relevant source domains as suggested by Holyoak and Thagard: "To propose an analogy, or simply to understand one, requires taking a kind of mental leap. Like a spark that jumps across a gap, an idea from the source analog is carried over to the target". (Holyoak and Thagard, 1996)

(Fig. 3 above is, of course, not an absolute formula or a receipt; it is rather a global cognitive structure of a possible 'creative' behaviour. This is not an rigid sequence, either; there may be some jumpings within this 'creative' process represented by this scheme. It is, also, like design phases(figure 9) recursive and iterative.)

6 Design education

Knowledge sorts are treated in former pages; propositional, non-propositional, tacit, etc. We make use of our logical operations together with our intuition on knowledge to reach intelligent and/or creative solutions. It is fruitful to support students to integrate their intuition and logical thinking through all knowledge kinds, which is in a way, creativity. Educators should train learners to get free from their prejudgments and, by using all their mental abilities freely, to become more creative; this can be thus by 'defamiliarization' which is also shown in Fig.3.

There are some schemes (concerning analysis and design of an artifact) which show some methods to analyze precedents (in the widest sense) and to design we apply in our Faculty of Architecture. 'Knowledge Representation' is one of the core issues in our teaching methods. 'Knowledge representation' being a kind of representation relates data structures to each other; as Winston puts it: "...a representation is a set of conventions about how to describe a class of things" and it has four parts: a lexical, a structural, a procedural and a semantic. (Winston, P. H., 1992) Students are asked to represent their analysis by a semantic net which is one of the techniques within which there are lexical, structural and semantic parts, also including other ones like: associational, structured object, formal logic based, procedural, common sense knowledge representations and other approaches. ((Brachman, R. J. & Levesque, H.J.(ed.) , 1985)

"Error! Reference source not found." represents a possible cognitive structure of design and analysis as an integrated mechanism. Students are asked to use a kind of 'Semantic Net' to represent what they analyze and design. This method of analysis and design has been very effective and efficient ever since 2004, which the 'Bridge Class' between bachelor and master programs would get ready for masters. These methods is explained above, schematically. (Fig.4 above.)

Figure 5 represents a possible cognitive structure of morphological analysis of an artifact.

Analysis: it is a kind of representation of breaking up a whole into its components on such a way that the elements do not have to be broken down into more ‘unnecessary’ (in accordance with some criteria) details; besides, the structural (syntactic) and semantic relations between components must be preserved and exposed. This “unnecessary details” will lead us to the term ‘morpheme (smallest meaningful unit of a domain)’ in morphological analysis of spatial design. (Guney, A., 2008)

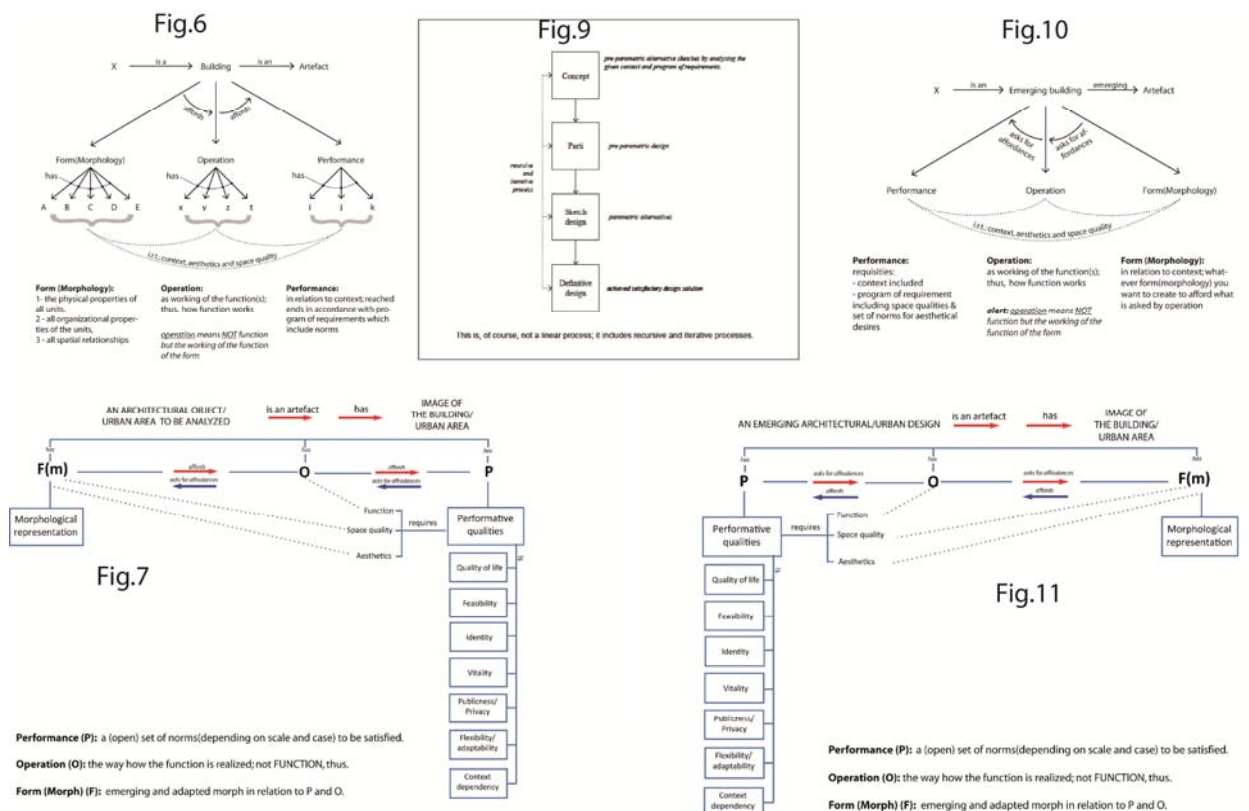


Fig. 6 above. delineates briefly, how 'Form-Operation-Performance' are inter-related to each other within a 'Semantic Net' which explains itself. (Guney, A., 2008) and Fig. 7. A schematic representation of spatial analysis; improvement of fig.6

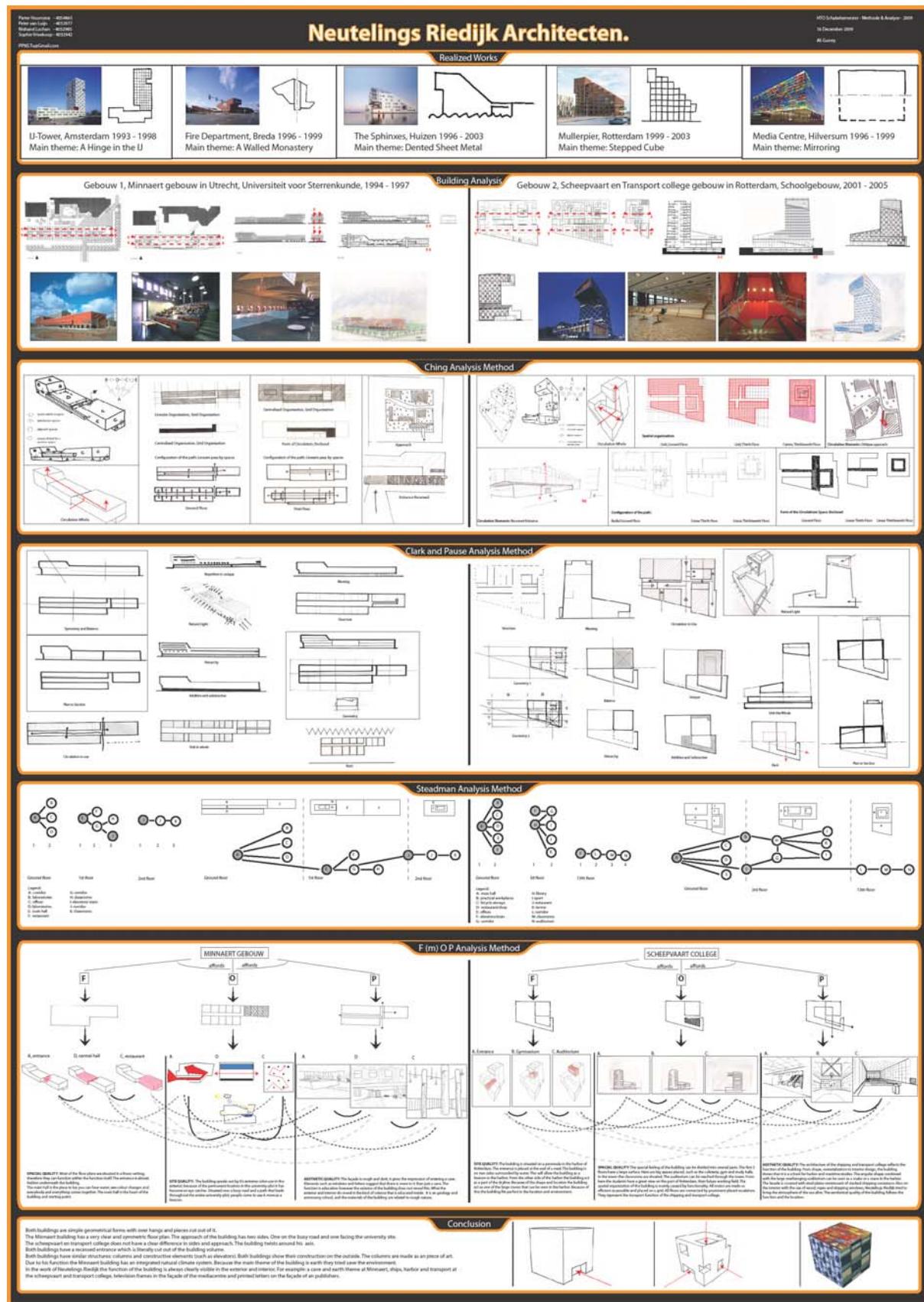


Fig. 8. An example of students' work for an architectural precedent analysis

This A0 poster, as it is seen, represents and oeuvre of an architect or an office above, and then the documents of two buildings of the architect. Then the buildings are represented according to

some three methods in accordance with their spatial relations(after Ching), some physical properties and parti(after Clark and Pause) and their topological non-metric representations. Then, the structured morphological data is analyzed and tested by FOP as explained above. Afterwards, these two buildings are compared and, finally, the conclusion.

Fig. 9 above, delineates briefly, how 'Design Phases' are inter-related to each other within a 'Semantic Net' which explains itself.

Explanation: All phases involve consideration: program of requirements, context, background knowledge(including precedential knowledge), design strategies(including design by study and study by desing).All the phases also include POF(M) and creativity.

Parti: dominant underlying characteristic idea

Recursive: 2: of, relating to, or being a procedure that can repeat itself indefinitely or until a specified condition is met.(M.W.)

Iterative: 1: marked by or involving repetition or reiteration or repetitiousness or recurrence.(M.W.)

Figure 10 above shows a possible cognitive structure of morphological design of an artifact and Fig. 11 above is the improvement of fig.10.

Synthesis/design: bringing the 'undividable' (in accordance with some criteria of a domain-morpheme) components into a possible whole(s) within their mutual structural (syntactic) and semantic relationships. This is, of course, a very short explanation of synthesis/design in general. Later on it will, further, be explained what possible combinable mutual structure and semantic are in (architectural or any kind of) compositions through their components or morphemes /and or: combination of morphemes (objects). (Guney, A., 2008)

References

- AUDI, R. 1996. *The Cambridge Dictionary of Philosophy*. Cambridge, Cambridge University Press.
- BRACHMAN, R. J. & LEVESQUE, H.J.(ed.) 1985. *Readings in Knowledge Representation*. San Mateo, Morgan Kaufmann Publishers.
- GAGNE, R. M. 1985. *The Conditions of Learning and Theory of Instruction*. New York, Holt, Rinehart and Winston.
- GOLDIE, P. 2000. *The Emotions: A Philosophical Exploration*. Oxford, Clarendon Press.
- GUNEY, A., "Architectural Precedent Analysis" in: Zarzar, K. M. & Guney, A.(Eds.) 2008. *Understanding Meaningful Environment*. Amsterdam, The Netherlands , IOS PressBV.
- HOLYOAK, K. J. & THAGART, P. 1996. *Mental Leaps; analogy in creative thought*. Cambridge, The MIT Press.
- MOTLOCH, J. L. 2001. *Introduction to Landscape Design*. New York et al., John Willey & Sons, Inc.
- ORTONY, E. et al. 1988. *The Cognitive Structure of Emotions*. Cambridge, NY & Melbourne, Cambridge University Press.
- Stanford Encyclopedia of Philosophy. 28/09/2009. <http://plato.stanford.edu/entries/husserl/>.
- STILLINGS, N. A. W et al.1995. *Cognitive science; An Introduction*. Cambridge et al., The MIT Press.
- VOSNIADOU, S. et al. 2003. *Similarity and Analogical Reasoning*. Cambridge, Cambridge University Press.

WINSTON, P. H. 1992. *Artificial Intelligence*. Reading, Massachusetts et al., Addison-Wesley Publishing Company.

HONDERICH, T. 2005. *The Oxford Companion to Philosophy*. Oxford, Oxford University Press.

TZONIS, A. 1991. *Huts, ships and bottleracks; Design by analogy for architects and / or machines* in CRANG, NIGEL et al.(ed.) *Proceedings of a workshop meeting*. Delft, Delft University of Technology,.