Abstract
This paper attempts to clarify a design process that is being used by Kazuyo Sejima and Sou Fujimoto based on the use of scale models. Two typical cases are studied and represented graphically in order to map the workflow. The results reveal that the mutual influence between team members, the continuous process of production and selection are closer to an “editing process” rather than the conventional linear design process. The architectural quality and character of the work produced by Sejima and Fujimoto can be seen as a consequence of the process itself. The process based on the use of scale models becomes an object of design, and its advantages and disadvantages are discussed in this article. This systematical study is expected to offer new ideas to practitioners on how to integrate scale models in the design process and how to enhance creativity and collaborative teamwork.

Introduction
This paper examines a particular process of architectural design based on scale models. The process will be documented through two recent projects by the offices of Kazuyo Sejima and Sou Fujimoto, but it can be found also in other Japanese offices. This article shows how the working process has been ‘designed’ in order to produce an architecture that, at least in the case of Sejima and Fujimoto, is broadly recognized by critics and the media. The aim here is to clarify their general way of working and how the scale model – an old and conventional technique of representation – is used in an innovative way, referred here to as editing process.

Scale models have been employed by architects and builders since antiquity. However, compared to the topic of architectural drawings, little specific research has been done about their meaning and relevance for design (Smith 2004). The reason might lay on the general understanding of the scale model as the most easily understood presentational technique (Hohauser, 1970, p. 06) and therefore they are
often seen as lacking the suggestive potential of drawings.

Contrary to that view, this study explains the relevance of models in the design process, beyond their use as a presentation technique of the finished design. Smith (2004) does research in the same direction, but taking a philosophical point of view. The focus here is on the specific representational and thinking tools for contemporary architectural design. This paper supports the idea of a theory of process design, i.e., the possibility of designing creative protocols embedded in the process itself that will result in a better architecture. It is expected also that this study will contribute to a better understanding of the Sejima’s and Fujimoto’s work by examining their design process, which, as it will be argued, is intimately related to the character of their built works.

Background

Design Process vs. Process Design

The protocols shown here have been addressed as process designs instead of design methods. The literature on design methods can be seen as charged with deterministic connotations that many architects tend to refuse. The body of research on design methods was initially triggered by John Chris Jones’s 1950s article “A Systematic Design Method” and 1962 “Conference on Systematic and Intuitive Methods in Engineering, Industrial Design, Architecture and Communications” which he co-organized. But since the 1970s Chris Jones and Christopher Alexander, two pioneering leaders of design methodology, have criticized this line of research for having produced “deterministic” and “lifeless” methodologies (Bayazit, 2004, p. 24).

This paper assumes this critique on design methods and acknowledges the necessity of a creative interplay between logic and intuition. This kind of interplay is inherent in the creative connotations of the word design. This study makes the case for the possibility of non-deterministic procedures that facilitate design by enhancing both logic and intuition. Rather than as a method this approach is better understood as a way of designing the process. The term “process design” establishes three clear distinctions. Firstly, by inverting the usual order of the well-established term “design process”, it recognizes the conceptual indebtedness to Peter Eisenman and his influential contribution to the theory of architectural design process, as explained below. Secondly, it differentiates itself from the deterministic connotations of the “methods”, by emphasizing the idea of “design”. Thirdly, the term describes more accurately the way of working found in the two offices in case, where, as documented here, most energy is invested in processing and editing multiple ideas rather than in the gradual refinement of a single design idea.
The creative potential that architects can find in the redefinition and exploration of design processes has been a major focus in Eisenman’s theoretical and professional work. However, in his work and in those architects influenced by his theories, the process is often used as both explanation and justification of the final results. A way of using the process that has become a commonplace in contemporary architecture, as Moneo (2004:151) has observed: “How many times have we heard that it is all about recording the process, to take into account these series of formal stages that are shown as a justification for the last and final stage?”

Eisenman’s works are presented as a series of spatial operations (turns, twists, overlappings, etc) whose accumulation produces the complexity of the final architectural object. The projects shown in this paper do not exhibit in their final configurations the complexity of the design process, which confirms the observations by Díaz, C. & García, E. on SANAA’s work (El Croquis, 2004, p. 30): “In contrast to other attempts to turn the process into a sort of new objectivity that makes the procedures omnipresent and the working protocols a sort of guarantee of objective, inter-subjective and universal legitimacy of the final product, in their projects there is not a trace of the rules of formation, nor a desire to feed in complexity”.

Examples of historical scale models
The way in which process design is implemented in Sejima’s and Fujimoto’s offices is intensively based on scale models, as this paper will show. Scale models have been tools for design as old as architecture and it is possible to find examples from almost every historical period. For instance, in Ancient Egypt there were funerary small-scale models of residences (like the one taken from the ninth dynasty tomb of Mehenkwetre found in Thebes), made of coniferous wood painted with gesso or clay (Bourriau, 1988: 85). In ancient Greece the basic form of the temple was predefined, and thus scale models of the whole temple were of little importance. Instead they used paradeigma, study models of specific architectural elements, such as triglyphs or capitals that required a three-dimensional design (Smith, 2004, p. 10). In Imperial Rome, Vitruvius recommends the use of models (Bl. C. 1, Architecture in Ten Books, pp. 7-25).

The English term “model” stems from the Italian modello (plural modelli) (Harper, 2010), which meant a preparatory study or model, usually at a smaller scale, for a work of art or architecture, especially one produced for the approval of the commissioning patron. The term gained currency in art circles in Tuscany in the 14th century. Designs for the decorative details seem often to have been modelled in wax, a practice continued from Roman architects (Smith, 2004:25). During the Renaissance, most architects were also sculptors and they used chalk to build models for both disciplines. Alberti (1404-1472) in “De Re Aedificatoria” writes: “I will always recommend the time-honoured custom of preparing not only drawings and sketches but also models of wood or any other materials” (translated by Rykwert J., 1988, p. 33).

Examples of the 20th century abound. It is well documented that Gaudí relied on small-scale models like plaster devices, hanging wire or chain models to study complex geometric shapes and structures. Tatlin’s model of the Monument of the Third International became one of the centerpieces of Russian avant-garde
constructivism. El Lissitzky, who used models extensively, like those for the Meyerhold Theater and the House of Heavy Industry, wrote, “through working with models, we have the opportunity to become acquainted with the fundamental methods and systems of architectural ideas in drawing and the three dimensions” (Railing, 1990, p.14).

Contemporary models are taking advantage of 21st century materials, such as taskboard, plastics, wooden and wooden-plastic composites, foams and urethane compounds. Architectural publications show that, despite the widespread use of computer graphics techniques, models are still essential design tools for a considerable number of architects.

Contemporary examples: Frank Gehry and OMA
Frank Gehry and OMA can be mentioned as examples of prominent contemporary practices relying on models yet producing architecture of a very different character. In Gehry’s office models are the basic study tools, which must be transferred into plans and sections by sophisticated 3D-scanners. Gehry’s partner and software specialist Jim Glymph, explains that the design process is basically realized in model, and paper documents are mainly produced to “to feed building departments, inspectors, agencies, contractors and the legal system” (Pollack, 2006). Gehry’s office has elaborated a number of ways of scanning or digitalizing models to transform the information into computer data. This automated and direct translation from the three dimensional physical model to two-dimensional drawings has allowed Gehry to be more sculptural.

In the case of OMA, architecture publications often show the multiplicity of models produced during the design phase (clear examples are the Zeebrugge Terminal, the Netherlands Embassy in Berlin, the MAB-Tower, the Y2K house and the Casa da Musica). According to Giargiani one of the earliest examples of model usage strongly influencing the design process was the project submitted at the 1989 competition for the Maritime Terminal at Zeebrugge. The design problem was seemingly too complex to be analyzed in a rational manner and Giargini describes how OMA found itself judging whether one model shape was more beautiful than another (2008, p.165). This can be seen as an example of the interplay of logic and intuition that models facilitate thanks to their visual immediacy. Also in OMA’s work, even if only occasionally, they have a pre-established process design that we can hypothetically classify as relying on formal families or categories (as in Sejima’s office, as discussed in chapter 3). In the case of OMA Giargiani finds eight categories (2008, p.306): 1. Staggered boxes. 2. Boxes with platforms. 3. Transparent towers. 4. Foamy poché masses with inserted boxes. 5. Informal polyhedral solids. 6. Turreted prism with inclined vertical cuts at the base. 7. Folded planes. 8. Wrapped plane to form a continuous enclosure.

This paper contains two case studies. They are meant to gain insights into the specific details of the design process in Sejima’s and Fujimoto’s offices, and not to be the base for a general theory. The cases give specific details to enrich the understanding of the design process of both offices. The general conclusions contained in this paper stem from three sources (besides the two case-studies shown in this paper)
that give evidence of their systematic used of multiple models. The first source is based on the statements made by the architects in architectural publications:

“[…] We build an enormous amount of models, but of course that is not our ultimate goal. The importance of this method is the effort to create the largest possible number of alternative schemes in order to see the different options from many different angles. We ask everybody in the office […] to produce as many options as we can find”. (Ryue Nishizawa interviewed by Díaz, C. & García, E., 2004, p.11).

“The process I follow at the beginning of a project is to make a large amount of study models. […] From these introductory and uncertain solutions, we normally stick to the clearless and ambiguous ones. […]It is true that we made many models and that only through them we can understand the meaning of the project”. (Sou Fujimoto, interviewed by Almazán J. & García T., 2009).

The second source is based on the photographic documents published in several magazines and exhibitions showing the design process. A clear example is the exhibition catalogue self-edited by SANAA (Kazuyo Sejima’s collaboration office with Rye Nishizawa) on their own exhibition in Gallery MA in 2003. The book contains photos of large numbers of study models, laid out in rows or piled up in stacks, which have been produced as multiple alternatives in model. The third source is the authors’ experience, who visited both offices, worked for several projects in SANAA including Holcim Laboratories and Administration Center in Holderbank (2008), Madrid Río (2006), City of Flamenco (2003), Extension of Tel Aviv Museum of Modern Art (2003); and have been involved since April 2009 in design studios taught in Keio University by Sejima and Fujimoto, where similar methodologies are applied. This personal experience has been reinforced by informal interviews that the authors had the chance to conduct among staff of both offices.

**Documentation Method**

Case studies have been carried out for the schematic design of two competitions. The first one is the Hokusai Museum in Sumida Ward (Tokyo) by the office of Kazuyo Sejima. This proposal won the competition and is currently being developed, for which further modifications might happen in later phases. The second one is the National Museum of Norway by Sou Fujimoto.

Every model produced for the schematic design phase was photographed (see Fig. 1), separately and placed into a context model (a 1:200 model, covering in both projects about 10 Ha of the area surrounding the site, see Fig. 2 and Fig.3). The record covers two periods of proposal production (21 days in Sejima’s office and 14 days in Fujimoto’s) and includes materials used, elaboration dates, and the date when meetings were held (weekly at the beginning and daily at the end). In Sejima’s office 5 meetings were held and 10 in Fujimoto’s office (see table 1).

The design process is explained graphicly in Fig.5 and Fig.6. Columns show time, divided according to the meetings dates. Rows show formal categories that have been introduced for the purpose of clarity by the authors of this paper. Other researchers also observed the use of a range of forms. For Sejima’s architecture Contreras (2009) mentions rectangles, circles, flowers and drops. This paper adds another
category, not found in previous projects: the diamond-carve shape. In the same way, Fujimoto’s models have been organized in rows according to formal similarity. The materials used in both cases are mostly fragile and easy to work with, and over 90% of the models are made of Styrofoam (other materials are indicated in Fig. 5 and Fig. 6).

**Reliability of the Documentation**
Sequences of models are often published in architectural magazines as an explanation

<table>
<thead>
<tr>
<th>Office</th>
<th>Kazuyo Sejima</th>
<th>Sou Fujimoto</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project name</td>
<td>Hokusei Katsushika Museum</td>
<td>National Museum of Norway</td>
</tr>
<tr>
<td>Phase of study</td>
<td>schematic design</td>
<td>schematic design</td>
</tr>
<tr>
<td>Project location</td>
<td>Sumida, Tokyo, Japan</td>
<td>Yeubaden, Oslo, Norway</td>
</tr>
<tr>
<td>Time duration</td>
<td>2009/03/19 - 2009/04/03</td>
<td>2009/05/07 - 2009/05/21</td>
</tr>
<tr>
<td>Styrofoam models</td>
<td>61 (95%)</td>
<td>81 (91%)</td>
</tr>
<tr>
<td>Styrofoam and soft plastic models</td>
<td>3 (5%)</td>
<td>8 (9%)</td>
</tr>
<tr>
<td>Models directly related to the final proposal</td>
<td>9 (14%)</td>
<td>6 (7%)</td>
</tr>
<tr>
<td>Models unrelated to the final one</td>
<td>55 (86%)</td>
<td>83 (93%)</td>
</tr>
<tr>
<td>Total of scale models</td>
<td>64 scale models</td>
<td>89 scale models</td>
</tr>
</tbody>
</table>
Figure 2: Context large scale model from Sejima’s study case (Source: Authors).

Figure 3: Context large scale model from Fujimoto’s study case (Source: Authors).
and often justification of the design process. There could be the suspicion that the processes shown here have been modified for publication, especially because Sejima and Fujimoto have become architectural media celebrities. Therefore, it is necessary to stress the reliability of the documents compiled for this paper. The authors received direct approval from Sejima and Fujimoto, who understood the academic nature of this study and the necessity of accuracy.

The collection of data for the Hokusai Museum project started on April 10th 2009, and for the Museum of Norway on September 3rd 2009. The figures show the models in very small drawings that allow recognizing basic forms but do not compromise the confidentiality required by the offices (see Fig. 4 about the method of representation).

Results of Case Studies

Kazuyo Sejima’s Hokusai Museum

What follows is an explanation of the Hokusai Museum design process covering the final phase of the schematic design (fig. 5). There were two basic mandatory design constraints: the five-story height limit and the program size. The first step in the process was to build a 1:200 scale contextual model (fig. 2). This model, purely white in order to focus on volumes and proportions, is the base for testing every prototype into the urban context. As the design process progressed, the number of models did not decrease. On the contrary, for each meeting new models were produced. Some of them were completely new ideas, but others were a result of combining ideas found in different previous models. In Table 1, models counted as “directly related” to the final proposal are those whose combination and edition lead to the final one, as shown in fig. 5 and fig. 6 by the dotted lines.

Scale models influence each other by transferring their geometrical characteristics. These transfers and impacts between models culminating in the final proposal have been plotted in fig. 5 and 6. Model 9 is an edition of model 2 and so on.

For instance, model 37 tested in the meeting 4 is an edition of model 28 shown in meeting 2 but mixed with characteristics of the spine-shaped category. As the figure shows most of the models produced are different from the final chosen proposal, yet they can be considered essential for this way of designing as an object of discussion and comparison to make decisions.

Case Study on Fujimoto’s Museum of Norway

In Fujimoto’s project process (fig. 6) it is possible to observe the same transfers of influence among the vast amount of models. No option is discarded until the very end, for example: models with circular shapes keep being built through the development of the project even if the final chosen proposal belongs to a different
Figure 5: Diagram of Hokusei Katsushika’s study case (Source: Authors).
Figure 6: Diagram of the Museum of Norway study case (Source: Authors).
formal category.

The mutual influence is again present in fig. 6. In model 4 appears the idea of addition and the pyramidal shape for the first time, as a pile of square prisms that together form a pyramid. The same pyramidal shape emerges again in model 26, but as a solid volume. The stacking of volumes of model 4 re-appears in model 52, as a stack of square prisms. Finally, this pile comes out again in the final proposal, as a way to arrange the program of the project. Simultaneously, the soft pyramidal shape with a leaning peak comes out for the first time in model 54, and it keeps developing and gaining importance in models dating from meetings 9 and 10. Finally, the pyramidal shape with a leaning peak becomes the exterior image for the project.

Concurrent influences from the idea of stacking volumes for the program and the pyramidal shape as an ideal exterior lead to the final shape in model 89. The idea of having an inside shape nested within a frame, springs from model 59 that has effect on the concluding model as a way of accommodating the concurrent influences from both models 52 and 54 in model 89.

Conclusions

Description of the Process Design in Sejima’s and Fujimoto’s Offices

According to the references examined and the authors’ experience, it is fair to say that the study cases shown in this paper are typical and not exceptional ways of working in Sejima’s and Fujimoto’s office. The following steps can be generalized as their typical workflow.

1) The objective constraints are clarified (required program, regulatory constraints, budget, etc).

2) A context model is built, showing the surroundings of the site, the urban fabric or landscape, not only the adjacent streets. This facilitates an understanding of the surroundings at a glance.

3) Within the given constraints, the team members start to make individually as many different models as they can imagine, all of them using the same scale as the context model. No previous indoctrination is imposed on the members about the direction to follow, except the objective constraints and the necessity to produce a vast number of options. All possible configurations of the program (e.g. distributed in detached volumes, compacted in a tower, extended in a mat configuration, etc) are systematically represented in model, but imaginative and unexpected approaches are also encouraged.

4) During meetings each member places his or her models on the context model. This allows checking the proportions and relationships with the surroundings and sharing ideas quickly. Almost only models are checked and abstract theoretical discussions are not encouraged.

5) The number of options increases gradually and all of them are kept until the last decision is taken. However, as the process progresses, some options start to capture more attention and different approaches are clarified showing the commonalities and differences among the multiple models.

6) At the very end, the final option is selected. Only then, the team starts to produce final
drawings for the schematic design, typically in the case of the competitions in only one week. Drawings tend to be simple and clear.

The process is characterized by a vast number of options represented in models, which are constructed in fragile and soft materials. As Sejima observed in an interview, in contrast with models seen in the West “the model materials used by Japanese students are very fragile, like sheets of paper or styrofoam panels. But US or European students use wood or plaster, and if they use paper, it is very solid, it is cardboard, which is not paper from a Japanese perspective” (Cortés, 2007). In this process, computers are understood as a mere help to make more models faster. As Nishizawa said in an interview (Cortés 2007), one of the important changes brought by computers is that, when they didn’t use computers, they could only do a few drawings and a few working models a day, but since they began to use computers, they have been able to produce 100 different study drawings on the computer and many study models every day, all very quickly.

Most of the time is invested in searching for the idea, an idea which typically is simple enough to be easily representable, powerful enough to solve many design problems at once and often unexpected and surprising. The activity that occupies most of the schematic design process is the production of multiple options and the development of selection criteria by comparison, a process analogous to the “editing” in the field of media publication. The process is far away from the lineal sequence of design that starts with the vision of the office leader and follows with his or her co-workers helping to achieve the vision, in a process to slowly come closer to the leading architect’s idea. In the “editing” process the design consists mainly in preparing, condensing and organizing options, most of which will be eliminated. There is no particular vision from the beginning of the particular details of the final project (at least overtly stated), but the particular conditions under which the editing process happens lead to certain coherent results.

**Discussion on Disadvantages**

Although this paper aims to stress the innovative potential of the process design documented, particular risks and difficulties have been also observed.

1) Manpower. To develop such amount of models, an equivalent huge amount of manpower must be mobilized. This process can be seen as only possible in large of fi[s]ces (as it is also the case in OMA). The particular working and cultural conditions in Japan could be also considered a cultural prerequisite difficult to transfer into the Western working environment.

2) Risk of reductivist anesthetization. The intangible social aspects of the built environment can be easily overlooked when the main tools of design are models. Also, by reduction to a scale model there is a risk to see architecture only as an object and to loose the human scale. This risk of aesthetization has also been noticed by Gehry: “I always work on two or three scales at once, it keeps me real [...] it keeps me thinking of the real building, and I don’t get obsessed with the object, [...] the model could become the object of desire, which I don’t want it.” (from “Sketches of Frank Gehry” Pollack, 2006). In OMA’s models, there are many human figures
for the same purpose: “The models [...] show a large number of small human figures. OMA uses them at different stages of the design in scales of 1:200, 1:100 and 1:50. [...] OMA believes that these figures are very useful for gauging the scale of space. (Tsukui, N. OMA@work, 2000, p. 74).

3) Excessive abstraction. In the particular case of Sejima and Fujimoto, most of the time is invested in the search of a simple, rotund and unexpected idea. Although the volumes are carefully studied to fit into the physical urban or natural context, the architectural expression tends to be abstract (white finishing, geometrical volumes, etc). This can be explained both as a consequence and as a cause of the process. In any case, the result is an architecture of clarity, sometimes called “diagram architecture” (Ito, 1996), which could be easily put under the criticism of postmodern theory for its limitations to convey meaning and express historical or symbolical contents.

Discussion on Advantages

1) Brainstorming. The fact that the largest amount of work is discarded could be seen as a waste of time, but the discarded models are valuable as a comparison to check the quality of the final one (development of selection criteria) and as a brainstorming technique. The “creative block” (i.e. the incapacity to think new ideas in a design process) is overcome by the simple emphasis on producing more and more in the hope that even randomly new ideas will emerge. Creativity as a quality in design seems to be achieved by the quantity of models. Also, in the long term many of the ideas discarded for one project are recycled for other projects. The office becomes a bank of architectural ideas waiting for the right project to be implemented.

3) Collaborative work. During the schematic design process, a large number of models are made and presented in each meeting. Models transmit architectural intentions beyond verbal communication and easily influence later models. The final proposal is a combination of editing and selecting a process in which the final model is a result of a collective and cooperative work and authorship of specific ideas is not discernible.

4) Prototype-like models. The models are built and checked as ‘prototypes’ or miniatures of the real project and not as an abstract representation. Often the chosen final model is almost a ready-to-be-built project. This means that models are already “prototypes”, in the sense of “a first scaled and usually functional form of a new type or design of a construction” (Webster, 2003). Typically, images for the final presentation panels are photographs of a scaled-up version of the final chosen model.

Summary and Prospects

This paper set the goal of clarifying a process design that is being used by Kazuyo Sejima and Sou Fujimoto based on the use of scale models. Two typical cases were studied and represented graphically for mapping the workflow. The non-linear mutual influence between team members, the continuous process of production and selections was found closer to an “editing process” rather than the conventional linear design process. The architectural quality and character of the work produced by Sejima and
Fujimoto can be seen as a consequence of the process itself. For them, the process becomes an object of design. This particular process-design has advantages and disadvantages and this paper does not claim to have found an optimal method applicable by every practitioner for every project. However, the systematical study presented in this paper is expected to offer new ideas to practitioners on how to integrate scale models in the design process in order to enhance creativity and collaborative teamwork.

References


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