

## ARKITEKTONISK DESIGNPROCES OG PRODUKTMODELLERING - KONCEPTDESIGN MED SYSTEMORIENTERET TILGANG

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The developments in computer technology is in a constant progress and the implementation of IT expands with it – also in the field of the building industry. Incorporation of automate processes and intelligent parametric objects which optimize the workflow lays ahead and the possibilities within this field are numerous. The different parties in the building industry are involved in this with their different aims and needs. Work is going on to create a better integration of data among each party aiming to create consistency and accuracy in the exchange of information in building projects – and this way avoid unnecessary losses of information and data.

Attention is paid to how this kind of communication may be possible. Data processing, file management, layers, and classifications of building components, different software and their internal file formats all have to be able to interchange and work together.

During the 3 years of this Ph.D.-project the development in digital tools and ways to use them has experienced great progress in the building industry. By the 1st of January 2007 guidelines have been made for government construction works. These guidelines are named 'Det Digitale Byggeri', DDB ('The Digital Building Industry'). Government sponsored construction works of a certain extent have to comply to guidelines of DDB. The demand is to create a digital version of the project supporting 3D, calculations, e.g.

At the same time a development has found place among the manufacturers in the building industry, which more and more tend to use automate and optimized processes supported by IT systems. Now it is possible for the manufacturers to offer a product-specific, digital model ready to be implemented during both the design and project planning

phases and this way optimize the workload. The passage "Baggrund" ('Background') provides a general view of the different positions in the building industry as well as an overall description of commonly used software within the relevant professions. All together this creates the context of the doctoral thesis.

The development in the use of IT within the building industry, questions the very process of a building project as well as each party's role and engagement in this. From an architectural point of view it might be questioned how the development and use of IT influences the ways of how to design. The purpose of the thesis is to describe a possible relation between the architectural design process and the digital tools which are already in use -or being developed- by the building industry. This thesis takes its outset in the integration of digital product models and tools in relation to architectural design processes which represents the creative and innovative starting point in a building project.

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In this thesis the concept of 'architectural design process' is used as a term covering both sketching, design and project planning of a building. The concept is also applied to the architectural intentions and aspects which can be experienced in the building itself. The 'architectural design process' is considered as integrated in the building. This way, the thesis approach the design process and the physical result as one concept altogether.

Product modelling is a concept covering the development of a system oriented IT model of any product. A product model is basically a mini-application or system which controls the construction of a product and its parts and variants: a configuration system which returns the specific output of a product determined by adjustable parameters like production data, geometry and calculations.

The thesis, discuss the relationship between an IT based design process and an architectural design process. The relation between these two processes is connected to the idea of the abstract and the concrete. The concept of abstract and concrete is here understood as the type of information used in each of the two design processes. The potentials, limitations and resemblances within the two design processes are discussed. The aim is to find ways to use the potentials of system orientated methods and processes in product modeling by comparing it to architectural design processes – and thereby answer the fundamental question raised in this Ph.D.-project:

How can system orientated methods in the digital design process be used to support the innovative and creative process in architectural design?

The Ph.D. project takes outset in case studies. Each case study represents certain areas of the present digital field and they serve as hands-on experiences in the work with system orientated methods and programming using IT tools. The knowledge gained is put in relation to architectural design processes. The coherence between the case studies is described in the passage 'Udgangspunkt' ('Outset'). Seen from a traditional architectural point of view, each case study inscribes itself at a different scale. The different scales represent specific relations and levels of information. In principle the architectural use of scale may be compared to the object-hierarchic data which appears in IT systems. Both can be seen as levels of information with certain limits or levels of abstraction. The case studies are used to describe coherences between the levels of abstraction in the architectural design process and the IT system orientated design process.

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Case "Modulbad 1" and "Modulbad 2" deals with product modelling and product development of prefabricated bathroom cabins and gives an insight in the actual handling of configuration software as well as organizing product specific needs and product design.

The Ph.D.-project has been connected to the teaching at "Arkitektur, IT og Proces" (Architecture, IT and Process) at the Aarhus School of Architecture. During several terms the students were involved with module-based buildings taking outset in industrialization and mass customization. The experiences from these projects are summarized to a minor case: 'Typificerede huse' ('Typified buildings').

The Ph.D. project also contributed to another project; the 'B-Processor – open digital building model' which deals with the development of a new software. Case 'B-processor' focuses on an integrated design- and data structure. The B-processor is still in the phase of development and it is therefore only partly described – it though serves as a frame of reference in relation to discussing integration between the architectural design process and digital tools.

The last case "G-House" deals with developing a residential housing concept based on the hierarchic data structure from the B-processor. The experiences from the other cases are used in this case as well. The G-House case aims to connect the relevant experiences from the course of research by describing a possible way of how to use system orientated

methods based digital tools which support configuration in an architectural design process.

The conclusion of the thesis is drawn from the experiences made in the case studies. Each of the case studies is summarized with sub conclusions and perspectives which answers to the fundamental questions raised in the project. From the case study-experiences it is concluded that the system orientated methods used in digital design processes can be used to support and enhance the creative and innovative processes in architectural design. This is possible by integrating the two processes. The architectural process itself would have to expand. The system-orientated aspects can be incorporated in the architectural design process and contribute to administrate information from the sketching phases and general architectural aspects in a building concept. Though - the creative and innovative processes in architectural design cannot function without its levels of abstraction. To keep the architectural intentions in any building concept there is a constant need to make place for abstract levels in the design process. A possible way of doing this is described in the sub conclusion of the G-House case. This is considered part of the overall conclusion of the thesis.

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During the course of the Ph.D. project several interesting circumstances and implications have been found which lead to other discussions and possible fields of research. The passage 'Interessante fund og implikationer' ('Interesting findings and implications') discuss the basic differences between the architectural design process based on an IT system-oriented thinking described in this thesis and the initiatives taken by "Det Digitale Byggeri" which is based on building elements and classification systems. In this thesis the approach to this is different - since the object hierarchic structure is used as an organizing element in a system-oriented concept design, whereas the DDB initiative is based on creating a broad platform common for all of the building industry.

The passage 'Diagrammet' ('the Diagram') discuss the diagram as a conceptual tool used for systemizing objects. The diagram represents a possibility to exchange information on both an abstract and a concrete level by visual means. At last 'Modelling' is described as a concept covering both process and result – regarded as one system in the progress of developing architectural design by digital means.

The final passage describes 'Yderligere forhold' ('Further conditions'). Here, the concept of mass customization is discussed in relation to the design-wise result and how user-influence changes the outset of how to



design and communicate architecture. This passage leads on to a description of the possibilities in a design process based on generative IT-system principles and what this demands of the software used in the building industry. This leads to a need for software with an open interface and options of programming and data control. The role of the architect in a digital field of work is also described. The architect in the field of concept and system development may, in a system-oriented design process, become the link between architectural design itself and the programming taking care of by programmers.

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