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FROM PARAMETRIC DESIGN TO FULL BIM: ELIMINATING THE NEED FOR 2D DRAWINGS

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Learning Objectives

- Learn how to adopt efficient workflows and to control a process without the use of 2D drawings
- Understand the advantages of parametric design
- See the advantage of using Infraworks as a collaboration tool
- Understand how it is possible to construct without the use of 2D drawings

Description

We live in a world where our major challenge is to get more and more efficient in the way we work. For long, we have used 2D drawings as basis for communication, planning and construction, but we are heading for a new age where tools and software now allows us to eliminate the use of 2D drawings. In project planning, parametric design is one of the new major tools to increase project efficiency. We will show you how to use parametric models to develop projects faster, how models helps increase collaboration and how to control the process all the way to construction, eliminating the use of 2D drawings. We will use real project examples from hydropower to show our work with parametric design in Infraworks, Revit and Dynamo, and how we are now conducting a large construction project in Norway without the use of 2D drawings.

Speaker(s)

Gøran André Hansen

2015 winner of “Rookie of the Year”-award at AU together with Lars Eid Nielsen. For Multiconsult ASA in Norway, Gøran has been one of the key persons implementing new technologies to projects in the Hydropower department. Using Autodesk products such as Revit, Infraworks, Civil 3D, he has ensured the department is leading in the use of BIM softwares within Multiconsult and in Norway in general. He has experience with detail design of both small and large Hydropower plants, and are currently working as project manager for a large Hydropower plant in Norway.

Herman Bjørn Smith

Herman Smith is has the role as project manager for Renewable Energy and Infrastructure projects. For the Smisto HPP, the largest construction of new hydropower in Norway since 2000, Smith has lead the way for a completely model-based design workflow in order to reach the project main goal: Construction directly from models, Zero drawings, through integrated use of BIM tools. Smith has a master’s degree in civil engineering.

BACKGROUND

We live in a world where our major challenge is to get more and more efficient in the way we work. For long, we have used 2D drawings as basis for communication, planning and construction, but we are heading for a new age where tools and software now allows us to eliminate the use of 2D drawings. In project planning, parametric design is one of the new major tools to increase project efficiency.

As BIM models doesn't only take the 2D drawings place in communicating geometry and specified execution information of the design, the whole design process is centered around the BIM models and the industry aim to utilize the model throughout the project value chain.

In order to obtain cost-effective technical solutions, efficient on-site execution, efficient workflows from concept to construction and fulfilment of required plant performance and documentation of the construction works, this entails that it's no longer only BIM coordinators and designers that work with and understand the models. The project managers and process leaders must take control over model utilization and development. Our assertion is that:

Exploitation of BIM in project execution requires full process understanding and control, in addition to continuous interaction drawing less execution

All the way from early phases throughout the value chain, efficiency can be obtained through parametric design, a deliberate approach for level of detail and information and for what purpose the BIM are prepared:

- Enhanced communication throughout the project phases
- Secure constructability in design
- Reduce costs through enhanced quality and reduced amount of on-site changes
- Increase safety

MODEL BASED DESIGN PROCESS

The Virtual Design and Construction (VDC) is a performance model for enhanced management of integrated multi-disciplinary of design-construction projects. The four corners of VDC represents the process, BIM, concurrent design and metrics. This presentation focus on improving the connection between process and BIM, for streamlining project development but also as a prerequisite for taking full advantage of the other two corners.

Even though civil engineering is conducted through projects, a project divers by nature from a design process in the difference between linear and circular thinking. In order to streamlining design projects the necessary iterations needs to be controlled in consequent design steps, controlling developments and interdisciplinary operations.

The following themes will be discussed:

- Deliberate division of project phases throughout the project life cycle
- Consequent utilization of design steps in each phase
- Status as a tool of controlling and visualizing the design steps in the center of the design process – the BIM model. And a prerequisite for exclusion of 2D drawings during construction phase.
- Control levels – How to control the evolution of all model elements
- The importance of backwards thinking of the value chain in order to take decisions in early design phases that has the right effect on the most costly project phases, such as sequencing, constructability, security, economy
- The impotence of involving stakeholders at the right time throughout the process
- Rationalizing the alignment of design, procurement and construction

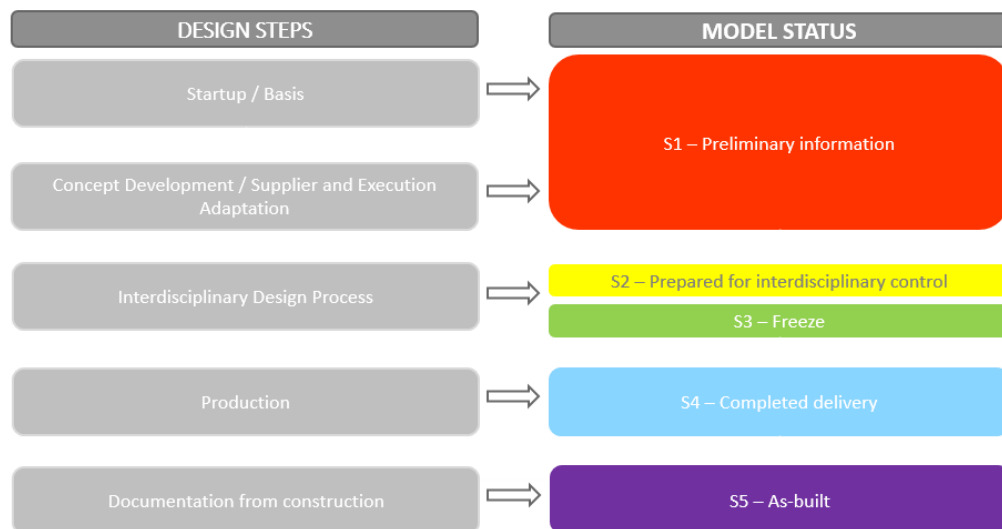


Figure 1: Relation between design steps and model status

STREAMLINING DEVELOPMENT

In design processes, iterations are a prerequisite for obtaining the desired quality in designed solutions. What distinguishes the different phases of design is that the iterations are done on a more detailed level in later stages. No matter what phase, efficiency can be obtained through a deliberate approach for level of detail and information and for what purpose the BIM are prepared. Parametric design have a huge potential for cost effective design, and have emerged into an essential part of early stages of a model based design process, and are making its way also into later design stages.

The following themes will be discussed:

- Why project managers also must understand and utilize LOD (level of development – detail and information) in projects
- Effects of parametric models on design efficiency, visualized through examples from:
 - Conceptualization of transformer stations
 - Design of a buried pipeline
 - Tunnel design with parametric objects
 - Preparation of design basis for construction for pipe foundations within a tunnel for construction

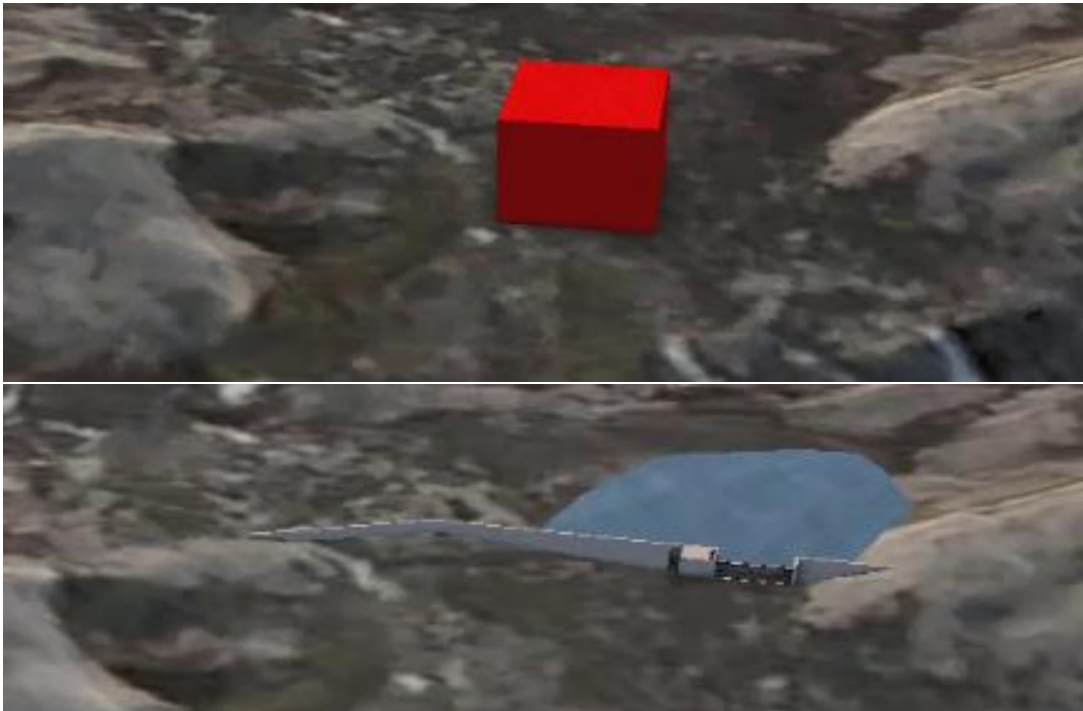


Figure 2: Example of level of detail during project concept phase

A FUTURE WITHOUT DRAWINGS

Digitalization digital transformation, often referred to as the “fourth industrial revolution”, is not only about technology, but about the symbiosis between people, processes and technology. The purpose being to replace or streamline manual of physical operations through computer technological methods and tools. BIM models; a combination of element geometry and information parameters, have had this effect on design works. But there is still a huge potential that are jet to be exploited and an amount of possibilities in how we conduct our projects that we are still not able to see the context of.

Excluding drawings by itself is not the purpose of carrying out projects all the way from design through construction without drawings. In order to benefits from the added value of fully exploiting BIM, excluding drawings is a necessary measure in order to facilitate for the necessary change in culture and habits of the people involved. The need for change challenges people’s identity, and entails bigger challenges then than the need of learning computer programs.

Through examples for the Smisto hydropower project, we aim to visualize *what is really the purpose of constructing without drawings*. The project is one of the major new hydro projects in Norway since the beginning of the 20th century, since 2015 being constructed without the use of conventional 2D drawings. During execution, after the involved parties have attaining a certain competence level in using the software, the direct data flow between the parties through the BIM-models has presented significant improvements, such as:

- Minimized time-consuming manual operations, such as the need of establishing and maintaining a complete set of drawings, which also reduces possible sources of errors
- Rationalization of the way information is transferred from the consultant to the contractor, based on the actual need, not how it’s used to be done
- Excellent platform for exchange and retrieval of information
- Enhanced interdisciplinary coordination and control
- Efficient tool for scheduling, this includes the design as well as the execution works
- Visual tool providing an excellent overview of a construction project
- Direct retrieval of relevant quantities at any given stage of the project and simplified volume calculations

The following themes will be discussed:

- Why design works is in no need of producing drawings
- Enhanced visualization for stakeholders
- Controlling what’s actually being built – and adjusting accordingly
- Quality control of design works
- Why extraction of 2D drawings from a BIM represents a break of value chain – With loss of information, deteriorated overall understanding of new stakeholders in the project
- Requires control of model elements development and revisions
- Adaptation of design basis for the exact execution procedures – geometry, format and information

- As-built information that actually reflects what has been built as basis for future operations



Figure 3: Separation of design basis according to on-site work methods