Utilizing 3D-computer visualization for communicating aesthetics of long-span timber structures.

Henrik JANOLS, M.Sc.
Div. of Timber Structures
Luleå Univ. of Tech., Sweden
e.mail: Henrik.janols@ltu.se

M.Sc. in civil engineering 2002. PhD student since 2002 at Div. of Timber Structures, Luleå University of Technology.

Lars STEHN, Ass. Prof.
Div. of Timber Structures
Luleå Univ. of Tech., Sweden
e.mail: Lars.Stehn@ltu.se

Ph.D. in Structural Engineering 1993, Head of the division of Timber Structures at LTU. Lars Stehn has 10 years of experience as a designer of Timber structures.

Summary

The aim of this paper is to investigate whether 3D-computer visualization is a way of communicating the possibilities of building with timber, and in a holistic view present some of the activities important for a successful 3D-model. The result confirm that the use of 3D-computer visualization have great potentials, to influence the decision making process. The study further shows that grade of detailing and lightning are some key activities for a successful 3D-model.

Keywords: aesthetics, computer supported design, construction, timber structures.

1. Introduction

Of the single story long-span buildings built in Sweden each year, only 5-10% are constructed with timber. The low number of timber buildings can partly be deduced to the lack of information about the possibilities when building with timber. There seems to be no existing methods that can communicate the overall impression - the sense of wood - of a long-span structure in timber. A large number of buildings constructed today, like industry-, storage-, sports- and commercial buildings will never be in focus of media or having budget allowing for a detailed architectural design. As a consequence a lot of these buildings are not reviewed with aesthetical aspects. The typical Swedish client values a low cost as the highest priority concerning most long span buildings [1]. The aesthetical features of wood are documented in the literature. Affentranger [2] points out that building of wood creates a feeling of warmth, safety and confidence, as no other material can match. Compared with other materials, timber starts with a distinct aesthetic advantage [3]. Holgate [3] furthermore says that wood has an interesting texture and it is generally considered to be “warm, wholesome and secure”. In this article wood is considered to be a material that has inherent aesthetical features that, if used correctly, can give the final timber structure a competitive advantage over other materials. However, if the structural system is attractive or not is depending on both a personal and a society context that varies over time, for instance historical related trends concerning structural materials and solutions (e.g. timber as domestic, mundane, traditional and steel/concrete as urban, engineered, modern) come and go. The aim of this paper is to investigate whether 3D-computer visualization is a way of communicating the possibilities of building with timber, and in a holistic view present some of the activities important for a successful 3D-model. Further, a review of the expression aesthetics is performed in order to find a relevant definition for this paper.

2. Different perspectives of 3D-visualization

2.1 Aesthetics – the visual appearance

Aesthetics of design is said to be "the study of the effect of product gestalt on human sensations" [4]. To be able to achieve a whole, a product gestalt, Monö [4] further claims that a designer must have knowledge about the basic elements, a knowledge of the way in which parts are made into a whole with the desired effect on human sensations. As a result, the aesthetics of design also includes the study of the way in which human beings read and understand how to interpret the parts and the whole of a visual gestalt.

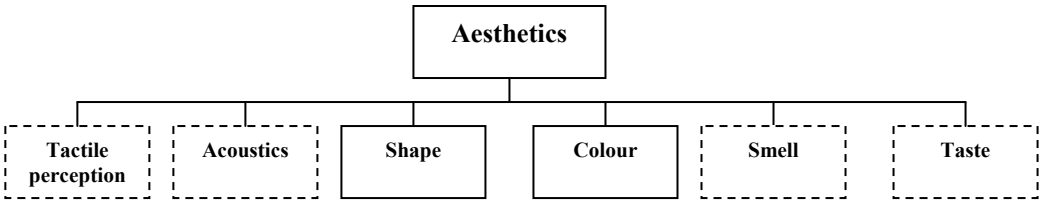

Figure 1: Different forms of aesthetical expressions expressed as an objectives tree.

Figure 1 tentatively describe that aesthetics can be expressed from many different viewpoints, depending on how it is experienced. If a building for example is experienced in reality or on a photo, have influence of the aesthetic impression. It is obvious that expressions as smell and acoustics can't be experienced by a photo. The definition of aesthetics is based on the intention to communicate the visual expression of a structural system with help of computer technology. In this paper we understand aesthetics as the *visual appearance of a structural system*. This definition is based on the idea that structural systems visual appearance is a descriptive attribute based on shape and colour that may be stable. But how this is related to a positive/negative judging and interpretation of the attribute is not considered in the definition.

2.2 Effects of utilizing computer visualization in the early decision making process

The effects of utilizing 3D-computer visualization for decision making were investigated in a qualitative study of a reconstruction project at Luleå University of Technology. The purpose of the reconstruction was partly to create a natural main entrance to the university and partly to create natural meeting places for students, teachers and other visitors. These purposes don't give any clear picture how the reconstruction will look like, but rather give a sense how the future environment will be perceived. The motive for the study was the idea that these two general focuses for the project hardly could be communicated by only using plan drawings, figure 2a. The research question is thus formulated as; can pictures and 3D-animations as a communicator be a support to make easier decisions about previous purposes. Figure 2b is a typical example of a 3D-visualization used for decision support in the qualitative study. In total four respondents were interviewed at two times. In the first part, drawings and sketches of the construction project were used to understand the perceived final result. In the second part computer visualization of the reconstruction was presented to the respondents. The second part was designed to find differences in the respondent's image of the final result. Each interview was started with a look at the short animation made with *3D Studio MAX*. The animation was followed by a discussion about pictures focused on the three main areas, namely the entrance path, the entrance and the reception. Finally the respondents had to answer if they would have changed anything in the project if they have had possibilities to see the computer visualization in an early design phase.

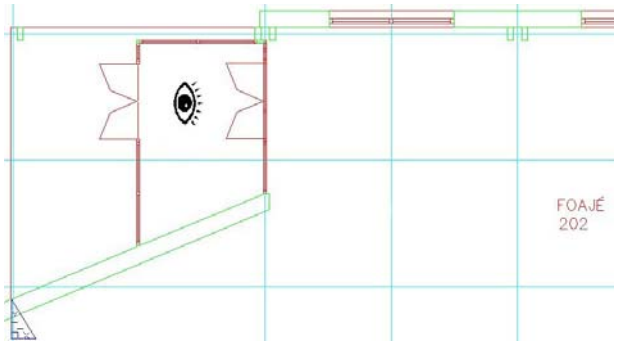

Figure 2a: Plan drawing over the entrance path made with CAD.

Figure 2b: 3D-visualisation of the entrance made with 3D Studio MAX.

The result shows that use of computer visualization during planning process affects the image that those involved creates of the final result. It may not be a new image, but in comparison with traditional plan drawings as figure 2a, the 3D-visualization created an understandable image of the final result. According to figure 2a and 2b it was obvious from the interviews that details such as shape, colour and lightning had the valuable effect to create a general impression, and thus a common picture of the intended final result. The qualitative study also shows that visualization, as a tool, had a clear effect on decisions taken during the planning process. This was especially clear when the interviewees change their opinion about the entrance path and the floor material, Figure 2b, after they had seen the 3D-computer visualizations. It gave all project members a better picture of the problems and therefore it is felt to be a better tool for decision making.

2.3 Trends in visualization

During the Architectural Visualization Conference (AVC 2003) in Copenhagen, 2003, the influence of 3D-computer visualization as a decision support system was discussed among practicing architects. The general attitude during the conference can be summarized as following:

- ✓ The actors in the construction industry prefer to do decisions based on 3D-models instead of hand sketched drawings.
- ✓ 3D-computer visualization is a universal language that all actors in the design development process understand.

The use of computer visualisation in construction can mainly be concretised into two sub groups, namely 3D-visualization for marketing and sales of new project ideas and 3D-visualisation for decision support and production. The differences between these groups are mainly the grade of detail in the visualizations. This was one of the main topics during the conference and will further be discussed in chapter 3.

3. Discussion and further research

The result of the qualitative study and the prevailing trend in practice seems both confirm that the use of 3D-computer visualization have great potentials to influence the decision making process. The result from the qualitative study in chapter 2.2 and trends among practicing architects and designers, both by researchers and professionals in the field, points out the key question for future research. Should the grade of detail in the computer visualization be conceptual or photorealistic? According to this question it would also be of interest to study methods for optimizing the creating of computer visualization models. During AVC 2003, three coupled sub questions were highlighted as key issues, i.e. detail of design, impact of light and effective use of technology. Two of these issues are exemplified in figure 3a and 3b.

Detail of design: One important step in productivity is determining the scope and quality of work required to satisfy the client's expectations within the limitations of time and budget. Not every job requires photo-realistic quality images to communicate the important messages to the client. Figure

3a is an example of a photorealistic picture with lights, shadows, textures and a lot of details of a car "repair" shop where the aim is to illustrate the glulam roof system. Figure 3b illustrates a conceptual model without textures, realistic light and details such as bolts, nails and interior facilities. Again, the central point is the glulam truss. In view of early structural systems selection, the amount of detailing is important. Too much attention on details or material selection may focus unnecessary attention on decisions that are better left for later.

Figure 3a: Example of a photo realistic model.

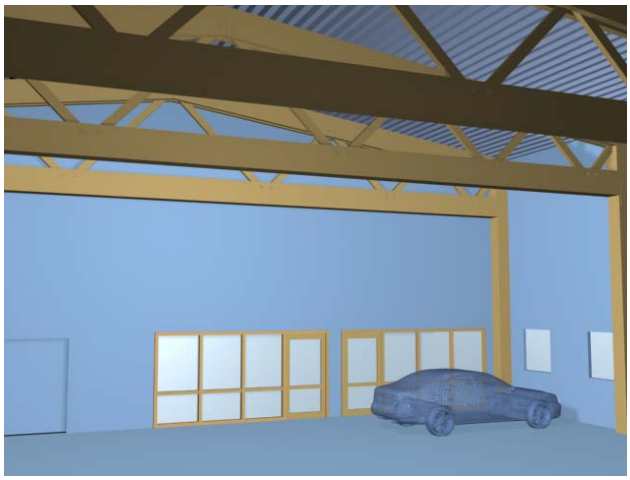

Figure 3b: Example of a conceptual model.

The impact of light in the scene: Lights give the scene a more realistic appearance, and enhance the clarity and three-dimensionality of a scene. If we e.g. compare the sliding door in the left of figure 3a with the same door in figure 3b, the light crate natural shadows around the door in figure 3a. A variation of lights can also be a good "time saver" to hide areas of secondary interests and focusing on the important, i.e. the structural system impression.
Effective use of technology: It is important to focus on the elements of visualization that will impact the output the most and leave the rest by the wayside. Upon reaching a certain level of quality or communication value it is important to be able to stop and move on to the next task. Perfection is an unobtainable goal, worth striving for until it becomes a burden on production.

There seems to be a future of utilizing 3D-computer visualization for communicating the appearance of a building. Trends in visualization are discussed among practitioners and in research and regarded to the possibility to communicate the appearance of timber; these trends are of especially interest. A famous Swedish architect claim for example that timber is best profit-making in evening light. Regarding to the detailing of the model, further research need to be done, to investigate how the appearance of timber is influenced of a decrease in detailing. Related to figure 3a and 3b, the main question to answer is "what will we communicate" and "how will it be perceived"?

4. References

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