BIM and advanced post-tensioning design methods

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Summary

The goal of this paper is to describe one process for developing advanced design techniques for post-tensioned concrete structures. The integration between finite element calculation softwares and different 3D modelling softwares has become more and more important in everyday engineering work. The design of the post-tensioned structures has been a well specialized field in construction business. Different 3D and FEM programmes have been developed in order to enhance the effectiveness of design process. Yet, no practical solution for BIM and post-tension design has been presented. The methods and results of BIM; its advantages, problems encountered, solutions and future prospects will be presented in this paper. The author presents observations gathered during this hectic development process.

Keywords: post-tensioning; anchors; slabs; beams; BIM; FEM; advanced design methods; VBC

1. Introduction

All data needed for the design, construction, use and maintenance of buildings is easier to manage – quickly, in real time, graphically and in digital form – when using the help of a product model. With the help of the product model you can exchange and manage a huge quantity of information more reliably and efficiently than before.

The design of post-tensioned concrete structures is a specialized field in construction business. Structural engineer provides the calculations while draftsmen are preparing drawings and site personnel are executing the actual work. As a result of this, customer will receive durable and good product, concrete structure by means of reliable and cost-effective plans as well as state of the art site production. The increasing use of BIM technology has forced us to take a closer look on this procedure as a whole, how to maximize the effectiveness and how to minimize errors and miss-information. And of most importance, how to maximize the benefits for our customer.

Linking the design and drafting capabilities of various software gives the engineer a completely new set of tools. The design process can be accessed in each phase and the iterative nature of prestressed structure design will show its strength.

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2. Requirements

Fig 1 Created data link between BIM and FEM

After earlier mentioned input data processing, the engineer has normally conducted structural calculations manually or by using in-house developed spreadsheets. If results were shown to be not satisfying, the input data had to be modified.[1] In our project we wanted to enhance the effectiveness of this phase. Post-tensioning calculation is an iterative process and by combining the experience of the engineer with computer calculation power, iteration can be made faster and more effective. Our idea was to create/write a link between input source, static software and BIM environment so that all information could be transferred as automatically as possible and yet the engineer would have possibilities to intervene and control the process. One crucial point for us was of course that this data transfer should work in both directions, a bi-directional data transfer. Of an importance was to notice that if changes in dimensions occurred, these also needed to be included directly in BIM environment.[2] Accordingly also update in input data source had to be done.

3. Discussion, Conclusions and Acknowledgements

This developed new tool and way of working has already proven its effectiveness in everyday design work. Both time consumption and numbers of design errors have been decreased. The quality of design has improved. It enables faster information flow from designer to draftsmen or modeller and it also opens possibilities for further development within BIM.

Virtual building concept

In the future the VBC Virtual Building Concept will become an everyday issue for engineers.[3] The tools developed will offer a powerful way to implement also post-tensioned structures as a vital part of the whole construction process. VBC model can also contain information of structures life-cycle design. Tendons can be measured after laying them on site and this information can be stored in the model and used later for repairs or new openings etc. The VBC can work as data storage for everybody involved in the project, including future users.

4. References

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