DIANA Users Association

Annual report 2008

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ir. A. de Boer
Chairman DIANA User's Association

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Contents

1 Aim of the Association

The members of the Association are all users of the DIANA software package of TNO-DIANA BV.
In this capacity, they have a considerable interest in gaining knowledge in the Finite Element Method and (numerical) mechanics, as well as in the further development and extension of DIANA.

To achieve this, the Association fulfils a coordinating role by taking stock of the members' needs in terms of research and development, and initiating new projects.

The Association is also a meeting place for the exchange of experiences with the software package.

Furthermore, TNO-DIANA BV utilizes the Association to inform the Users on the DIANA package development progress.

2 Executive Committee 2008

During this reporting year, the Executive Committee consisted of:

Chairman:	ir. A. de Boer, Centre for Public Works, Ministry of Transport, Public Works and Water Management, Utrecht
Secretary/ Treasurer:	ir. N. Vollema, Royal Haskoning, Nijmegen
Committee member:	dr.ir. F. Galanti, TNO Built Environment and Geosciences

The Executive Committee has mainly dealt with the following:

1. Discussion on continuing new research projects on the basis of a national and international user's wish list.
2. Giving a more international imprint to the User's Association.
3. Organizing of the 5th International DIANA Users Meeting in Trondheim, Norway.
4. Continuing contributing to the set-up a database with publications related to DIANA or FEA.
5. Extending the existing e-mail database with foreign users in the fields of concrete, concrete mechanics, bridges and tunnels.
6. Preparation of general and technical meetings.
7. Association finance.
8. CUR published a new concrete mechanics examples report in collaboration with DIANA Users Association, R report 2008-1, Designing in 3D (Dutch).
9. Inquiry under the members of the Association and participants of the Int. User Meetings, to get a better view on the organisation behind the Users.
10. Installation of an international response/discussion forum around developments now and in the future related to Users Wishes.

3 Actitivities

3.1 General

The association holds a general meeting of members twice a year, followed if possible by a technical meeting (lectures). In 2008 there were held two meetings, a workshop and a lecture evening.

3.2 Workshop Theme: Shear Force in Structures, 16 June 2008

3.2.1 **Introduction shear force and evaluation numeric part RWS-Workshop Shear Force - December 2007**
Jan Rots, Delft University of Technology, Delft, The Netherlands

3.2.2 **Variations by shear force analyses**
Joop den Uijl, Delft University of Technology, Delft, The Netherlands

3.2.3 **Example of benchmark Beam8 from the RWS-Workshop**
Coen van der Vliet, Arcadis, Amersfoort, The Netherlands

3.3 Technical lectures 25 November 2008

3.3.1 A structural shape study of the structural concrete roof structure of a Ferry terminal in Dubai

Jasper Janssen, TU-Delft / Royal Haskoning

The Master Thesis research of Jasper Janssen at the Delft University of Technology was a structural shape study of the structural concrete roof of the Ferry terminal in Dubai. The research has been done in close cooperation with Royal Haskoning, Nijmegen.
The Dubai Creek ferry project consists of a series of four ferry terminals, combined to a ferry line. This ferry line will be constructed as a new layer for public traffic in Dubai; In the future it will be extended to the artificial isles for the coast of Dubai. The Al Ghubaiba ferry terminal is the largest terminal and should become a landmark. The free shaped design of Royal Haskoning Architects combines modern architecture with efficient use of space. To focus the architectonic concept of this design the structure needs a very slender shape. Columns are no option.
The shape of the roof structure proposed by the architect gives some structural problems. The results of FE analyses are used to modify the roof structure. With the help of the graphical models of the package Rhinoceros and extended batch files for the pre-processor of FE different configurations on the basic roof design could be analysed. A lot of deformations of the different roof geometries are basic for alternatives for the final geometry to solve the structural problems.
The Master Thesis shows, how FE models can be built in a way that they are useful in the predesign stage of a structure. Some methods are well described as a helpful optimizing tool for solving the geometry problems with a complex internal force behaviour in the future.

3.3.2 Analysis of steel frames with precast concrete infill panels

Paul A. Teeuwen, Eindhoven University of Technology, Eindhoven, The Netherlands

This paper presents experimental and numerical analyses of a new type of hybrid lateral load resisting structure. This structure consists of a steel frame with a discretely connected precast concrete infill panel with a window opening. The discrete connections are formed by structural bolts on the column and beam in every corner of the steel frame, confining the precast concrete panel within the steel frame. With the finite element program DIANA, the response of 5 full-scale experiments on one-storey, one-bay, 3 x 3 m infilled frame structures, having different window opening geometries, was simulated. The finite element simulations were performed taking into account non-linear material characteristics and geometrical non-linearity. A comparison between the full-scale experiments and simulations shows that the finite element models enable simulating the elastic and plastic behaviour of the hybrid lateral load resisting infilled frame.

3.3.3 Control by the TNO-IBBC method

Henco Burggraaf and Jan Zwarthoed, TNO Built Environment and Geosciences, Delft, The Netherlands

Almost twelve hundred existing infra structures, like solid concrete slabs, culverts, box girders, prestressed beams coupled to concrete decks, T-beams and tunnels, are analysed by consultancy offices with a focus to shear force, based on the unity check method. The recommendation in this analyses stage was the Dutch recommendation of 1995. In most cases this unity check method is a very conservative approach, which leads to a lot of unreliable structures.
After this first stage, TNO research did a study in close cooperation with the Delft University of Technology and Rijkswaterstaat by using an alternative method, the so-called TNO-IBBC method.
This alternative method is developed by TNO in the years ‘70 specific for tunnel design, where a uniform distributed load is acting. With this method the shear behaviour design is controlled of the upper deck and the walls of the Heinenoordtunnel. The most important parameter in this control method is the ratio between the actual moment and shear force in a certain cross section of the wall or deck. So there is a relation between the acting shear force and bending moment.
The tunnel cross section is modelled in the FE package DIANA with quadratic plain strain elements. The loads on this model are dead weight, vertical and horizontal soil and water pressures.
With a linear static analysis the acting stress are calculated and gives by integrating over the thickness of the deck and the wall the resulting bending moments and shear force. With the variation of six water heights the different cross sections are controlled.
The presentation gives an overview of the use and the results of the alternative control method.

3.3.4 Limit analysis of a box girder with a plane stress model

Chantal Frissen, TNO DIANA BV

For this project a plane stress model is setup to model a part of a box girder bridge, consisting of five spans with a total length of 300 meter. The bridge structure is built up with a two-celled box girder, where the thickness of the webs and flanges are variable. The structure will be prestressed by a lot of prestressed cables.
The aim of this project is to determine the actual load factor by using the minimum material parameters, coming form the design stage of 1967. Furthermore the influence of the traffic load cases of the Eurocode recommendations are analysed as well as the remaining lifetime of the total structure.
The analyse scheme consists of all load cases with a load factor of 1.0, added with the stepwise traffic load coming from the Eurocode. The nonlinear material behaviour of the concrete, reinforcement and prestressed reinforcement like plasticity and cracking are the focus of these analyses.
The construction stages of the box girder bridge in 1967 are reason to analyse this structure with the phased capabilities of the FE package DIANA. The effect of adding the embedded reinforcement to the model is also subject of this study.

3.4 International DIANA Users Meeting, 15-16 May 2008, Trondheim, Norway

Lectures

Connection between bubble decks - nonlinear analysis
C. Andersen, H.I. Andersen, K.V. Høiseth, NTNU and
H. Brå, COIN/SINTEF, Norway

Complex Geometry Architecture:
case study roof for a railway station
E. Guse and A. Borgart, Delft University of Technology, The Netherlands

Using DIANA in the education
L. Grepstad and S.I. Sørensen, NTNU, Norway

Design of a ship barrier in Amsterdam
W.H.N.C. van Empel and R.P. Roggeveld, Witteveen & Bos consulting engineers, The Netherlands

Experimental testing and constitutive modelling of concrete
H. Nedrelid, NTNU, Norway

Numerical benchmark for cracking behaviour
C. van der Vliet, Arcadis, The Netherlands

Fibre reinforced concrete
A. Jansson, Chalmers University of Technology, Sweden

Masonry beams -structural behaviour and loadcarrying capacity
H. Svarlien, Norway

Cracking risk analysis of the Bjøvika submerged tunnel at hardening phase
G. Ji, MARINTEK/SINTEF and T. Kanstad, NTNU, Norway

Fire behavior of tunnels
H. Burggraaf, T. van Overbeek and A. Vervuurt, TNO Built Environment and Geosciences, The Netherlands

Numerical simulations of service life cycle of reinforced concrete structures
I. Sæther, NORUT Narvik / NTNU, Norway

Fibre Reinforcement in Load Carrying Concrete Structures
Å. L. Døssland, Multiconsult and T. Kanstad, NTNU, Norway

Rock mechanics problems in Hydrocarbon extraction
P. Fokker, Shell, The Netherlands