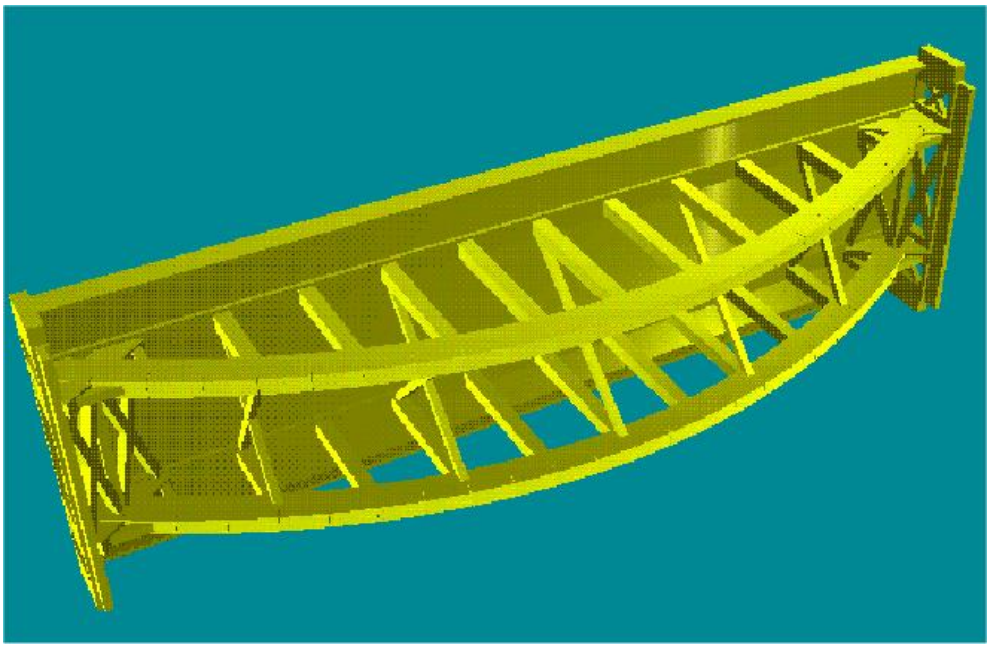
Diana Users Association

ANNUAL REPORT 2003



Concrete slide variant Oosterschelde barrier

A. de Boer
President

ANNUAL REPORT 2003

Content

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 the gaining of knowledge of the Finite Element Method and (numerical) mechanics, as well as in the further development and extension of DIANA. To achieve this, the Association acts in a coordinating role by taking stock of the requirements of the members and by bundling these in the domains of knowledge need and system development. On this basis, the Association initiates 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 2003

During this reporting year, the Executive Committee consisted of:

President:	A. de Boer, Civil Engineering Division, Department of Transport, Public Works and Water Management, Utrecht
Secretary:	A. Borgart, Delft University of Technology, Faculty of Architecture, Delft (until November 2003; thereafter vacancy)
Treasurer:	P. Bierman, Royal Haskoning, Nijmegen

The Executive Committee has mainly dealt with the following issues:

1. Discussion on the start-up of possible new research projects.
2. Preparation of general and technical meetings.
3. Association finances.
4. Guiding concrete mechanics examples report in collaboration with CUR, resulting in the CUR report 2003-3, Avanced analysis of civil engineering structures (Dutch), CUR, Gouda, The Netherlands
5. Guiding TNO-DIANA report Concrete Mechanics, the English edition of the CUR report 2003-3.
6. Upgrading the Association website.
7. Organizing a first International User Meeting – to be held in March 2004 in London, in collaboration with the TNO-DIANA BV sales department.
8. Start-up survey of possibilities for new book of examples, among Association members.

3. Activities

3.1 General

The Association holds a General Assembly twice a year, followed by a technical meeting (lectures).
The current set-up, with the meeting taking place in the afternoon and lectures during the evening, does have a positive effect on the attendance at the evening lectures. Attendance at the General Assembly, however, has remained low also in 2003 (about 50%).

DIANA 8.1.2 was launched in 2003, several different Diana courses were held in the DIANA domain. These mostly took place in Delft, but also in the UK.

3.2 Lectures technical meetings 2003

Lectures May 21, 2003

- Application of fracture mechanics for settlement damage prediction

  Maetee Boonpichetvong, Delft University of Technology, Faculty of Architecture

- Strip method to reinforce skew plates

  Rody van Vulpen, Holland Railconsult

- Computational methodologies for the non-linear analysis of concrete and masonry structures

  Flavio Galanti, TNO Building and Construction Research

- Feasibility study on concrete slides in the Oosterschelde barrier

  Ferdinand Bockhoudt, Civil Engineering Division, Department of Public Works and Water Management

Lectures November 4, 2003:

- Testing is one thing, translating it into a design method something else (Punch research in practice)
  Ab van den Bosch, ABT

- The best-known advantage of the coupling of CAD and FEM is that the drawing will not have to be redone for each programme (Drawing and calculating with the use of ICT)

Andrew Borgart, Delft University of Technology, Faculty of Architecture

- The aim of homogenization is to determine effective parameters on a coarse scale from a spatially oscillating fine-scaled parameter distribution (Homogenization of parameters using discrete analogies)
  Wouter Zijl, Netherlands Institute of Applied Geoscience TNO

- One of the developments within DIANA is the Probab module (Reliable calculations with the use of DIANA)
  Adri Vervuurt, TNO Building and Construction Research

3.3 Summaries of lectures

Maetee Boonpichetvong, Delft University of Technology, Faculty of Architecture
Application of fracture mechanics for settlement damage prediction

Reliable prediction of cracking in the surrounding structures now becomes the inevitable prime issue in soft-ground tunnelling to guarantee the success of projects. This is strongly emphasized for the sensitive situation where bored tunnelling is driven underneath historical buildings.
Following the recent work, this lecture will cover various computational modelling aspects in using the DIANA FE programme to study the building response subjected to tunnelling-induced ground movements. The proper choices in making building, ground model and soil-structure interface are given. This presentation is divided into two parts. First, the uncoupled analysis is introduced, in which the response of underlying ground is simulated separately and its influence is directly imposed on the building model. The second part is devoted to the coupled analysis which enables the consideration of soil-structure interaction on the cracking response. For both parts, the basic foundation lying under continuum and interface crack models together with some experiences in handling this large-scale fracture are emphasized. The ability of fracture mechanics in predicting the resisting mechanism, crack initiation, crack propagation and final failure mode in buildings concludes this presentation.

Rody van Vulpen, Holland Railconsult
Strip method to reinforce skew plates

When designing infrastructure a straight road may be the shortest, but not always the fastest. Because space in the Netherlands is becoming ever more scarce, and the various traffic flows will only increase in size, crossings are inevitable. This means that more skew crossings will occur. What is the influence of skewness on the moment flunctuation and in what way can the reinforcement process be simplified?

Flavio Galanti, TNO Building and Construction Research
Computational methodologies for the Non-linear Analysis of Concrete and Masonry Structures

Despite the general use of the EEM for the analysis of structures, its application in the non-linear analysis of concrete and masonry structures is rendered difficult by a number of numerical and modelling problems.
The most important problems are convergence and stability in the algorithms used to solve the non-linear system equation.
The lecture will address the development of a robust solution method applicable to the non-linear dynamic and static analysis of structures.
The development of consistent material models for concrete and masonry will also be addressed.

Ferdinand Bockhoudt, Civil Engineering Division, Department of Public Works and Water Management
Feasibility study on concrete slides in the Oosterschelde barrier

The development of concrete is still fully on the move. If we still used B37.5 when the Oosterschelde barrier was built, the standard is now B45 to B65. Several years ago various bridges and fly-overs were successfully built with high-strength concrete, whereas recently the first civil engineering application with very-high-strength concrete was realized. The increased strength properties mean that new applications are coming within reach. One of these might be the use of concrete slides in the Oosterschelde barrier.

Ab van den Bosch, ABT
Testing is one thing, translating it into a design method something else (Punch research in practice)

Testing is one thing, translating it into a design method something else. ABT has investigated the punch behaviour of a concrete work floor. These included not only full-scale punch tests, but also pressure tests, sliding tests, ‘pure’ tensile tests and 3-point bending tests. All have also been calculated beforehand and afterwards using DIANA, offering a good insight into the constructive modelling capabilities with 3D solid elements.

Andrew Borgart, Delft University of Technology, Faculty of Architecture
Drawing and calculating with the use of ICT

The best-known advantage of the coupling of CAD and FEM is that the drawing will not have to be redone for each programme. The ICTO project 'Drawing and calculating with the use of ICT' of the Faculty of Architecture of Delft University of Technology shows that through this coupling the entire design process changes. By having the design process take place in an ICT environment an interaction is created between various diciplines, such as spatial design, calculation and construction. The design decisions are taken on the basis of different grounds at various stages, other than with conventional designing. The integration offers better insight into the design process, meaning that the coupling is especially suitable for complex building designs.

Wouter Zijl, Netherlands Institute of Applied Geoscience TNO
Homogenization of parameters using discrete analogies

The aim of homogenization is to determine effective parameters on a coarse scale from a spatially oscillating fine-scaled parameter distribution.
Homogenization techniques have been designed in such a way that the coarse-scale behaviour of the flow mechanism or rock-mechanical processes complies with the same mathematical equations as the fine-scale processes. In other words, we have to homogenize the parameters in such a way that we are able to describe the processes using the well-known equations obtained from laboratory testing. The only difference is to be found in the numerical values of the parameters occurring in the equations. The fine-scale parameter distribution is generally obtained through geological or statistical models. Homogenization enables one to calculate processes using 'discrete analogies' (finite elements/DIANA, finite differences), in which relatively few cells (discretization volumes) occur.

Adri Vervuurt, TNO Building and Construction Research
Reliable calculations with the use of DIANA

One of the developments within DIANA is the Probab module. This module – available only to a limited extent – allows one to make a statement about the reliability of the calculation result and the chance of the structure collapsing. This presentation will address the use and need of probabilistic calculations. Several examples will be presented, and the future will be looked at.