Reliability based calibration of partial factors for the future evolution of EN 1990 for wind actions

Workshop
CEN/TC250/WG7
JCSS

Organizing committee: Prof. Raphaël Steenbergen, Prof. Ton Vrouwenvelder

February 17-18, Delft



TNO innovation for life

Contents

Introduction

The reliability based calibration of partial factors for the future evolution of EN 1990 for climatic actions is a subject that needs thorough study and evaluation.

Under CEN rules, TC 250/WG 7 will be preparing a new proposal for the partial factors to get the best possible revision of EN 1990.

As starting point for the work in 2013 an expert group was composed with members H. Gulvanessian, S. Leivestad, P. Formichi, P. Luechinger, A. Bond, J. Markova, J. Bregulla, J. Sørensen, P. Croce, P. Spehl, S. Denton, T. Vrouwenvelder and W. Jaeger. They came with a proposal for higher partial factors for snow and wind loads (γ =1.5-1.8). Values larger than 1.5 were proposed in order to satisfy the EN 1990 reliability requirements.

This workshop will be a starting point for discussion among experts involved in different fields, we will probably not be able to get any conclusion at this stage. This workshop is on wind loads, later we might organize also discussions on snow loads and imposed loads.

In the reliability based calibration of partial factors background documentation is needed on statistical characteristics of climatic loads, for instance documentations of measurements of snow loads and wind loads. Also possible hidden conservatisms in climatic load models should be quantified. Therefore collaboration between CEN/TC 250/WG 7 and CEN/TC 250/SC 1/WG 1 "Climatic actions" on these issues is highly necessary.

In this booklet you can find the detailed program of the workshop as well as the abstracts of all contributions.

We hope that this workshop will be fruitful in the exchange of knowledge, knowledge on partial factors, knowledge of (hidden safeties in) the wind loading chain. Finally we hope that you enjoy the stay in Delft with its beautiful spots in the medieval city center! We hope that during your stay you will learn about the famous painter Johannes Vermeer and the famous Delft Blue pottery!

We thank miss Nadieh Meinen for the kind assistance in preparing the workshop.

Raphaël Steenbergen
Ton Vrouwenvelder

General information

Contact information

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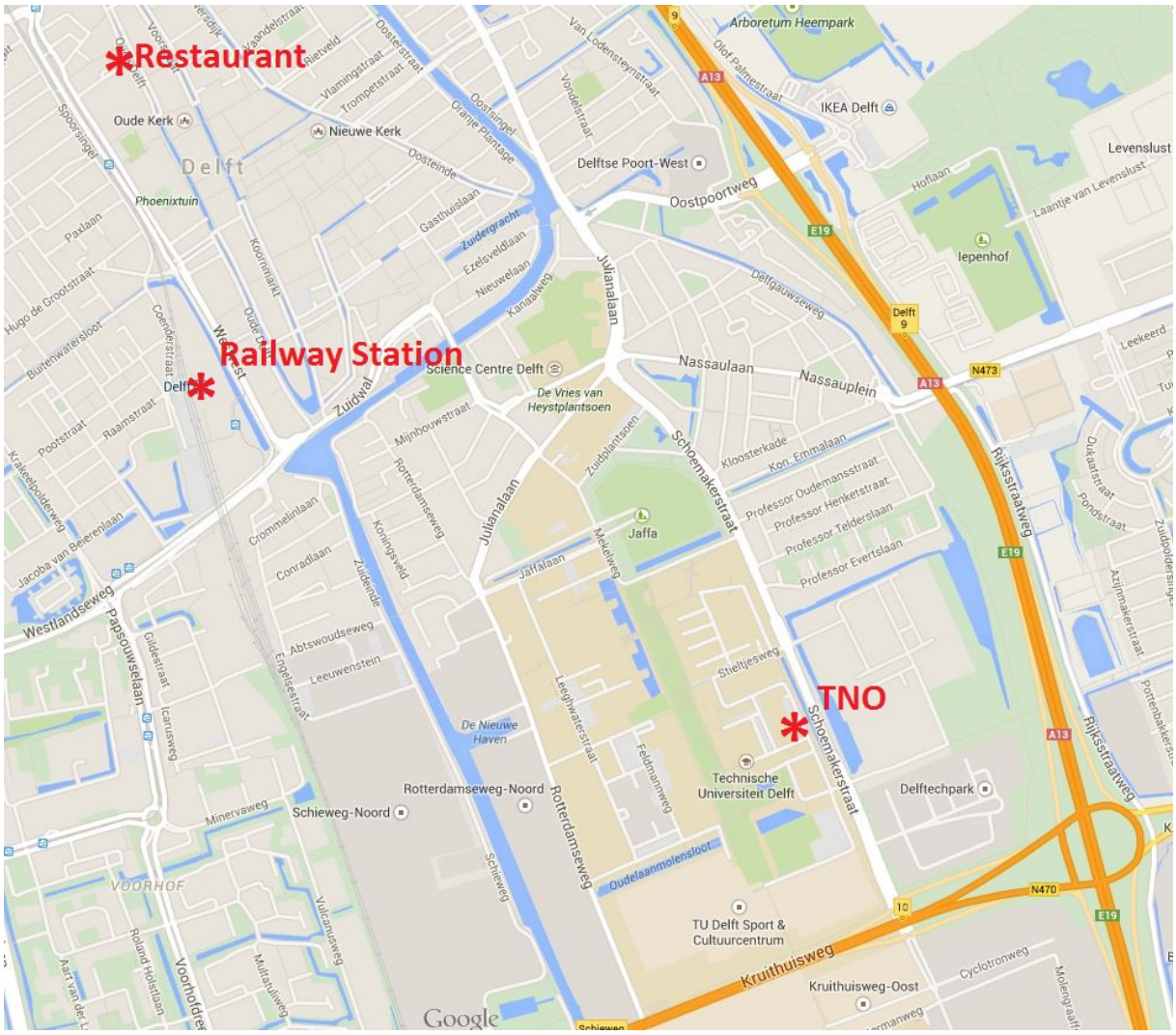
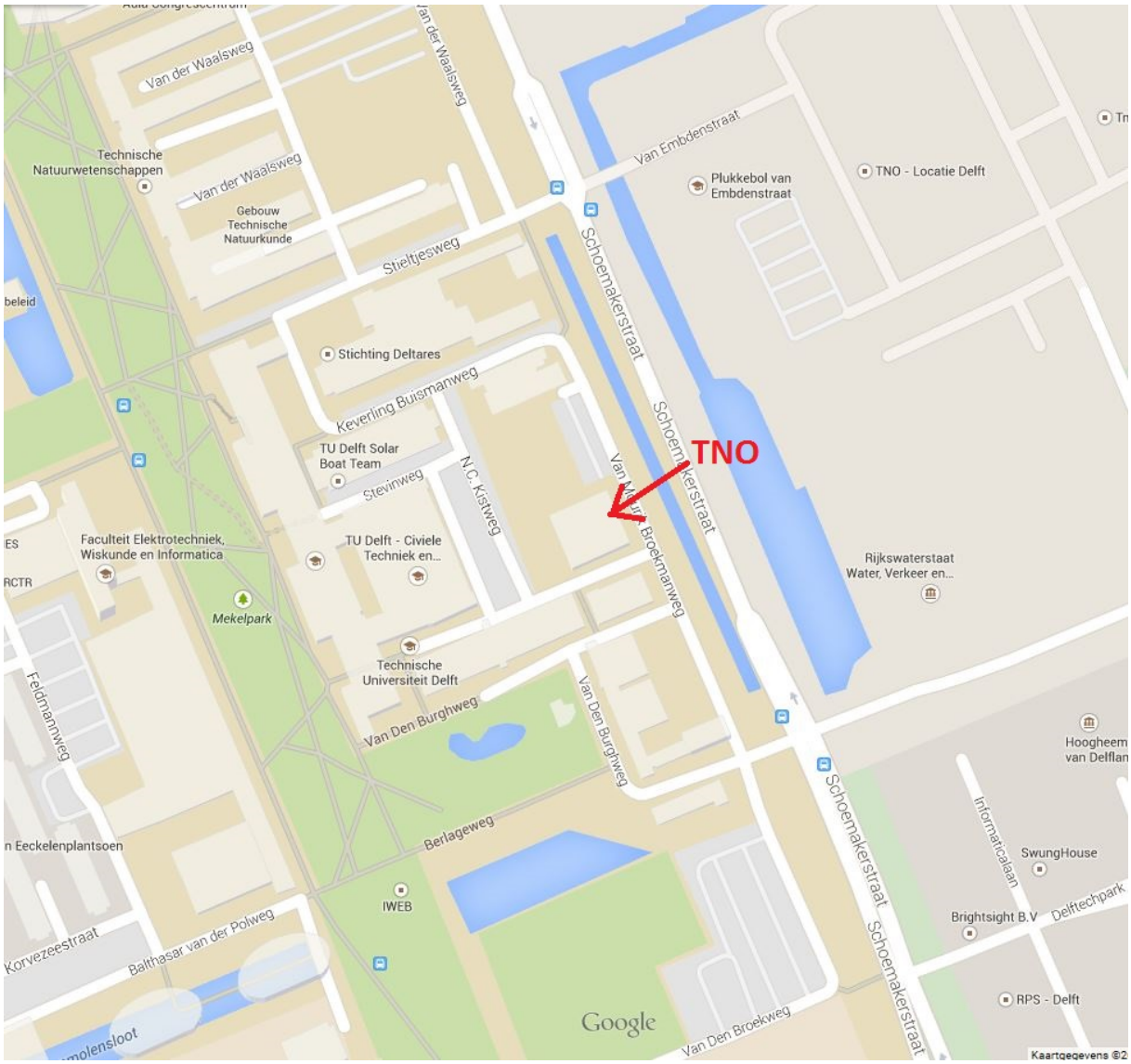
Presentations

Each presentation takes 45 minutes. Please bring your presentation in ppt, pptx or pdf. A laptop is provided by TNO.

Workshop venue

The workshop takes place at TNO - Van Mourik Broekmanweg 6, 2628 XE Delft in meeting room 1.0.05 on the first floor.




TNO
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Technische Natuurwetenschappen
Gebouw Technische Natuurkunde
Van Embdenstraat
Plukkebol van Embdenstraat
TNO - Locatie Delft
Schoemakerstraat
Stieltjesweg
Stichting Deltares
Kevering Buismanweg
TU Delft Solar Boat Team
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N.C. Kistweg
Van Mourik Broekmanweg
Faculteit Elektrotechniek, Wiskunde en Informatica
TU Delft - Civiele Techniek en...
Mekelpark
Rijkswaterstaat Water, Verkeer en...
Technische Universiteit Delft
Van Den Burghweg
Feldmannweg
Berlageweg
IWEB
Balthasar van der Polweg
Korvezeestraat
Informaticalaan
SwungHouse
Brightsight B.V
Delftechpark
RPS - Delft
Van Den Broekweg
Google

Informal dinner

The informal dinner will be held at Restaurant Van Der Dussen, Bagijnhof 118, 2611 AS Delft and will start at 20:00.

Program

Day 1 - February 17th, 2015

13:00 - 13:30 Session I - Opening

- Welcome by Prof. Raphaël Steenbergen
- Welcome by Prof. Paolo Formichi

13:30 - 15:00 Session II

- 13:30 - 14:15 Thunderstorm monitoring, statistics and loading of structures
  (Prof. Giovanni Solari, see Page 10)
- 14:15 - 15:00 Influence of extreme load models for wind pressure on structural reliability
  (Prof. Pietro Croce, see Page 11)

15:00 - 15:50 Coffee break

15:30 - 16:15 Session III

- 15:30 - 16:15 Wind actions on structures; uncertainties and bias of Eurocode estimates
  (Dr. Svend Ole Hansen, see Page 12)
- 16:16 - 17:00 Reliability-based calibration of partial factors for the Danish national annex to EN1990
  (Prof. John Dalsgaard Sørensen, see Page 13)

17:00 - 17:30 Day summary by Ton Vrouwenvelder

20:00 Informal dinner

Day 2 - Feburary 18th, 2015

09:00 - 10:30 Session IV

- 09:00 - 09:45 Assessment on the influence of simplifications on the calibration of partial safety factor for wind loading
  (Ing. Michele Baravalle and Dr. Jochen Köhler, see Page 14)
- 09:45 - 10:30 Reliability of facade panel under wind loading
  (Prof. Raphaël Steenbergen, see Page 15)

10:30 - 11:00 Coffee break

11:00 - 12:30 Session V

- 11:00 - 11:45 Partial factors for wind actions considering time variant and time invariant influences
  (Prof. Milan Holicky, see Page 16)
- 11:45 - 12:30 Development and calibration of SANS 10160-3: *Wind Actions*
  (Ir. Jacques Botha and Dr.. Celeste Viljoen, see Page 17)

12:30 - 13:00 Summary of the workshop, further action needed, by Prof. Ton Vrouwenvelder

Closure

13:00 Lunch

Presentations

Thunderstorm monitoring, statistics and loading of structures

Prof. Giovanni Solari

Department of Civil, Chemical and Environmental Engineering (DICCA) Polytechnic School, University of Genoa, Genoa, Italy

Abstract

The study of thunderstorm loading of structures is a key emerging topic of recent research in wind engineering. This depends on the fact that engineering methods are still mostly referred to stationary phenomena at the synoptic scale, with velocity profiles in equilibrium with the atmospheric boundary layer. Thunderstorms are non-stationary phenomena at the mesoscale with different velocity profiles. This contrast is striking since design wind velocity is frequently associated with thunderstorms. This presentation deals with this issue by providing an overview of a wide research program developed at the University of Genoa on thunderstorm monitoring, statistics and loading of structures. The wind monitoring network and the dataset of the project Wind, Ports and Sea is presented, discussing the classification of intense wind events. The statistical analysis of extreme wind velocities and wind-induced loading in mixed climates is examined, pointing out some shortcomings of classical methods and introducing a novel approach for more rational analyses. The response spectrum technique is introduced as an efficient tool to determine structural loading and response to thunderstorms.

Influence of extreme load models for wind pressure on structural reliability

Prof. Pietro Croce

Department of Civil and Industrial Engineering Structural Division University of Pisa, Pisa, Italy

Abstract

Reliability of structures, whose design is governed by wind action, is depending on the extreme distribution adopted in modeling wind pressure. Generally, Gumbel distribution, Weibull distribution and Generalized Pareto distribution are adopted for this purpose. Aim of the study is to evaluate, using level 3 methods, how the assumptions about the distribution as well as the methods used for parameters estimation influence the probability of failure, also in view of a critical discussion about model uncertainties of wind actions.

Wind actions on structures; uncertainties and bias of Eurocode estimates

Dr. Svend Ole Hansen

Abstract

The presentation describes wind actions on different types of structures, and Eurocode predictions and wind tunnel test results will be compared. The background of the Eurocode on wind actions EN 1991-1-4 will be outlined in detail for both local and global wind actions. Partial safety factors will be discussed based on the uncertainties and bias of Eurocode predictions of both wind actions and snow loads. Typical hidden safeties will be outlined.

Reliability-based calibration of partial factors for the Danish national annex to EN1990

Prof. John Dalsgaard Sørensen

Department of Civil Engineering, Aalborg University, Denmark

Abstract

The presentation describes the background for the reliability level used for calibration of partial factors in the Danish national annexes to the Eurocodes for building structures. This includes aspects related to the load combinations, partial factors for loads and materials, the distribution of reliability be-tween loads and materials, additional hidden safety in the calculation models for climatic actions, and finally the influence of control of design and execution on the reliability level. Special focus is on describing choices made in the Danish national annex to EN1990 Basis of Structural Design for building structures that deviates from the recommended values and models in the Eurocodes.

Assessment on the influence of simplifications on the calibration of partial safety factor for wind loading.

Ing. Michelle Baravalle and Dr. Jochen Köhler

Department of Structural Engineering, Norwegian University of Science and Technology (NTNU), Trondheim, Norway

Abstract

In this presentation the representation of the wind load effect in the eurocode is briefly reviewed and it is assessed how model assumptions and simplifications may affect the corresponding choice of the wind partial safety factor.

Reliability of facade panel under wind loading

Prof. Raphaël Steenbergen

TNO, Structural Reliability, Delft, The Netherlands
UGent, Department of Structural Engineering, Ghent, Belgium

Abstract

In this study the design according to the actual EN 1990 and EN 1991-1-4 is taken as point of departure for the design of a faade panel on a building. Based on this design we will try to determine the reliability corresponding to this design practice. We need the probabilistic description of wind actions in terms of the time variant and time invariant parts. Values from wind speed measurement at Schiphol airport are used in combination with distribution functions from wind tunnel test. The question that arises is also which model uncertainties should be taken into consideration and how? There is need for an agreement on how partial factors should be calibrated and which types of types of uncertainties should be taken into consideration.

Partial factors for wind actions considering time variant and time invariant influences

Prof. Milan Holicky

Czech Technical University, Prague, Czech Republic

Abstract

There is an acute need to improve the probabilistic description of wind actions used in calibration of national standards in order to achieve specified target reliability levels. Presented model for wind actions is developed considering concurrent effect of the time variant and time invariant random influences. A procedure is proposed for determining partial factors assuming various theoretical models describing both types of uncertainties. Resulting models of the extreme wind pressure are used to assess the effects of alternative assumptions concerning basic random influences. It is shown that the standard partial factor method may result in a significantly different wind pressure than the pressure specified using probabilistic approach.

Development and calibration of SANS 10160-3: *Wind Actions*

Dr. Celeste Viljoen and Ir. Jacques Botha

Departement Siviele Ingenieurswese, Universiteit Stellenbosch, Suid-Afrika

Abstract

EN1991-1-4 was used as primary reference for the South African SANS 10160-3: Wind Actions, published in 2011. Differences in scope and target level of reliability between the revised and reference procedures had to be accounted for. Further calibration exercises included the updating of the strong wind data and wind map of South Africa. The dominance of thunderstorms in inland areas of SA differs significantly from the climatic conditions of Europe. The wind climatic information on which the previous version of SANS 10160-3 was based consisted of fairly short data records from a limited number of recording stations, mainly located in large cities, decades earlier. Much longer data records, from a large number of recording stations country wide was available at the time of the revision. Statistical approaches to estimate extreme wind speeds were investigated, to obtain hourly mean wind speeds and wind gust values. The estimation and incorporation of environmental correction factors to the measured wind speeds were necessary as the surroundings of most weather stations did not correspond to the reference Terrain Category. For some of the weather stations it was impossible to compensate for the inadequate exposure and surrounding complex topography, so that a reduced number of weather stations were available for the strong wind analyses. The values estimated for the design wind speeds, adjusted for the short lengths of data records, as well as techniques developed to guide the spatial interpolation of the quantiles, were utilised to develop updated maps of the regional design wind speeds. Currently ongoing calibration exercises include the development of an updated probabilistic wind model for South Africa.