

PUBLICATION NO. 25. 2/2000

NORDIC CONCRETE RESEARCH

**EDITED BY
THE NORDIC CONCRETE FEDERATION
CONCRETE ASSOCIATION OF: DENMARK
FINLAND
ICELAND
NORWAY
SWEDEN**

**PUBLISHER: NORSK BETONGFORENING
POSTBOKS 2312, SOLLI
0201 OSLO**

OSLO, DECEMBER 2000

ISBN 82-91341-41-9

Printed by Helli Grafisk AS, Oslo

CONTENTS

1. Øverli, Jan A. • Sørensen, Svein I. p. 1
ALTERNATIVE STRESS-RESULTANT MATERIAL MODELLING IN
COLLAPSE ANALYSIS OF REINFORCED CONCRETE PLATES
AND SHELLS
2. Takács, Peter F. • Kanstad, Terje p. 21
STRENGTHENING PRESTRESSED CONCRETE BEAMS WITH
CARBON FIBER REINFORCED POLYMER PLATES
3. Ekerfors, Katarina • Jonasson, Jan-Erik p. 35
MATURITY DEVELOPMENT IN YOUNG CONCRETE
TEMPERATURE SENSITIVITY, STRENGTH AND HEAT DEVELOPMENT
4. Gustavson, Rikard • Gylltoft, Kent p. 49
STATIC AND DYNAMIC RESPONSE OF CONCRETE SLEEPERS



NCR homepage: <http://www.itn.is/ncr/>

Nordic Concrete Research (NCR) is a publication of The Nordic Concrete Federation presenting research and practical experience in the field of concrete technology, both from structural and material perspective. The Nordic Concrete Federation is a collaboration organisation of the concrete associations in the five Nordic countries, Denmark, Finland, Iceland, Norway and Sweden.

The Internet version is free of charge, and a subscription on the booklet costs 200 NOK, (~22 USD) two issues a year, postage not included. You can order a single issue of NCR (NOK 150), postage not included, or subscribe on the booklet form of the publication on the NCR web page, or by contacting Norwegian Concrete Association, P.O. box 2312 Solli, N-0201 OSLO 2, Norway. E-mail: lise.lystad@nif.no

Two issues a year

The aim is to publish two issues a year.

The NCR web pages contain among others all the abstracts of the publications from 1986 and search machine to find papers containing particular word or words. A page were one can easily order an issue. Information about the federation, the research committee, calendar of events etc. In the creation of the NCR web pages, emphasis has been made to make them as simple as possible to shorten the access and downloading time. We thus follow the modern trend of electronic communication of knowledge via the Internet, as it is the future to come. Though one feels for the time being that it isn't the same as the good old booklet.

New issue notified by E-mail

You will be able to add your E-mail address on a mailing list at the NRC web-site, and when a new issue of the NCR is publicised, you will automatically receive a notification by E-mail. You will also have the possibility to remove your E-mail address from the mailing list.

Download the papers

If you are interested in a particular paper, you can download the papers in PDF file format and reveal them by use of Adobe® Acrobat® Reader (can also be downloaded free from a NCR web page). This will be available only for papers published in 1998 and later. You will also be able to view abstracts from previous issues of the NCR, but if you are interested in one of those articles, you will have to by that complete issue by filling out an order form on one of the web pages. Price of a single issue, NOK 150,- postage not included.

In addition, the web-site will contain information about the Nordic Concrete Federation, calendar of activities like seminars and conferences in the Nordic countries in the field of concrete technology.

We hope that the Internet version of the NCR will find many readers throughout the world and stimulate the establishment of personal contacts and co-operation between concrete researchers in our part and the rest of the world.

Dr. Dirch H.Bager, Chairman of the Research Committee



Research Committee

Dr. Dirch H. Bager, Chairman for the Research Committee

Dr. Mette Glavind, Chairman for the organizing committee for the XVIII Research Symposium in Helsingør 2002.

Denmark

Dr. Dirch H. Bager
Cement and Concrete Laboratory
Aalborg Portland A/S
Rørdalsvej 44
P.O. Box 165
DK-9100 Aalborg, Denmark
Tel: +45 99 33 77 12
Fax: +45 98 16 47 41
E-mail: db@aalborg-portland.dk

Dr. Mette Glavind
Concrete Centre,
Danish Technological Institute
Gregersensvej
P.O. Box 141
DK-2630 Taastrup, Denmark
Tel: + 45 72 20 22 20
Fax: + 45 72 20 23 73
E-mail: mette.glavind@teknologisk.dk

Finland

Mr. Klaus Söderlund
Concrete Association of Finland
Unionkatu PL11
FIN-00130 Helsinki, Finland
Tel: +358 9 6962 3620
Fax: +358 9 65 11 45
E-mail: klaus.soderlund@betoni.com

Dr. Klaus Juvas
Addtek Research & Development
Box 23
FIN - 21601 Pargas, Finland
Tel: +358 204 55 6424
Fax: +358 204 55 6254
E-mail: Klaus.Juvas@addtek.com

Iceland

Dr. Gisli Gudmundsson
The Icelandic Building Research Institute
Rb – Keldnaholt
IS - 112 Reykjavik
Tel: +354 570 7322
Fax: +354 570 7311
E-mail: gudmundsson.g@rabygg.is

Mr. Gylfi Sigurdsson
c/o Almenna Verkfræðistofan
Fellsmula 26
IS - 108 Reykjavik
Tel: +354 588 8100
Fax: +354 588 0284
E-mail: Gylfi@almenna.is

Norway

Dr. Kjell Skjeggerud
Norcem, FoU Department
P.O.Box 38
N-3950 Brevik, Norway
Tel.: +47 35 57 23 56
Fax: +47 35 57 04 00
E-mail:
kjell.skjeggerud@norcem.scancem.com

Dr. Terje Kanstad
Department of Structural Engineering
NTNU.
N-7491 Trondheim, Norway
Tel: +47 73 59 45 19
Fax: +47 73 59 47 01
E-mail: terje.kanstad@bygg.ntnu.no

Sweden

Professor Johan Silfwerbrand
Dept. of Structural Engineering,
Royal Institute of Technology
SE-100 44 Stockholm, Sweden
Tel: +46 8 7907946
Fax: +46 8 21 69 49
E-mail: johan.silfwerbrand@struct.kth.se

Prof. Per-Erik Petersson
SP Swedish National Testing and
Research Institute
P.O. Box 857
SE – 501 15 Borås, Sweden
Tel: +46 33 16 52 17
Fax: +46 33 13 45 16
E-mail: Pererik.petersson@sp.se

Publishing

Mr. Knut R. Berg
Norsk Betongforening
Postboks 2312 Solli
N-0201 Oslo 2, Norway
Tel: +47 22 94 75 00
Fax: +47 22 94 75 01
E-mail: knut.berg@nif.no

Preface

Four thoroughly reviewed papers on concrete research carried out in the Nordic countries are published in this volume of Nordic Concrete Research, NCR 2000:2, which is number 25 in the series.

The first issue of Nordic Concrete Research was published in 1982. Since then more than 260 papers have been published in the regular volumes of NCR. Besides, special editions have been used for publishing extended abstracts on the ongoing Nordic concrete research in relation to the triennial research symposia. Thus, Nordic Concrete Research indeed has served as a survey of concrete research in the Nordic countries.

The Research Committee invites Nordic concrete scientists to publish their research in Nordic Concrete Research. It is the aim to ensure a quick review and publishing procedure in order to be able to publish the papers while the results are still new. This should make the publication valuable for publishing research results, especially for Ph.D. students.

The main task of the Research Committee is to encourage concrete research in the Nordic countries by stimulating inter-Nordic co-operation. Therefore the main activities for the Research Committee is publishing of the bi-annual publication Nordic Concrete Research, arranging the large Nordic Concrete Research Symposia every third year and supporting organisers of Nordic thematic workshops. These activities further help to provide young scientists with Nordic connections on both a professional and private level, thus stimulating continuation of the inter-Nordic research co-operation.

The economic situation at the Technical Universities in the Nordic countries has for the last decade been very bad. Therefore, attendance of young scientist at the research symposia have been on a surprising low level, in spite of the potential benefit obtainable from participating. The Nordic Concrete Federation has realised this problem. In order to increase young scientists' participation on these meetings, it has been decided to significantly reduce the fee for participation for Ph.D. students from the Nordic countries. Details can be found on the NCR homepage www.itn.is/ncr/ and in the announcements.

As a tool for stimulating inter-Nordic co-operation, it is planned to present ongoing Ph.D. projects on the NCR-homepage. Such easily attainable information might as well enhance international awareness on Nordic concrete research.

Aalborg, December 2000.

Dirch H. Bager
Chairman of the Research Committee