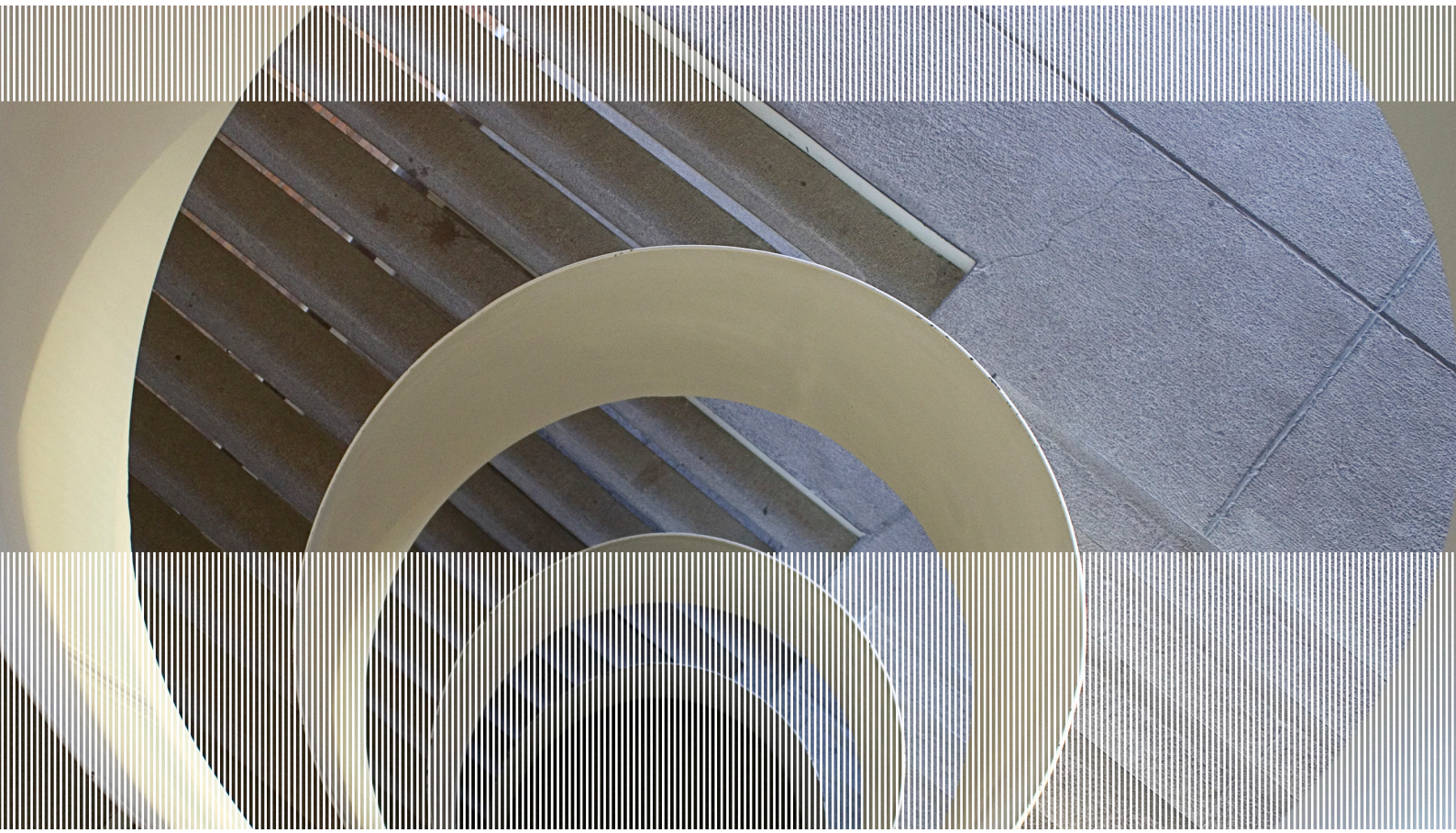
www.coinweb.no

SINTEF Building and Infrastructure

COIN – Final report 2015



SINTEF Building and Infrastructure

COIN – Final report

2015

COIN – Final report 2015

Keywords:
Concrete

Project no.: 978-82-536-1480-9 (pdf)

Photo, cover: «Spiral», Photo: iStock

ISSN 1891–1978 (online)
ISBN 978-82-536-1462-5 (pdf)

Address: Forskningsveien 3 B
POBox 124 Blindern
N-0314 OSLO
Tel: +47 73 59 30 00
Fax: +47 22 69 94 38

www.sintef.no/byggforsk
www.coinweb.no

Cooperation partners / Consortium Concrete Innovation Centre (COIN)

Kværner Engineering
Contact: Jan-Diederik Advocaat
Email: Jan-Diederik.Advocaat@kvaerner.com
Tel: +47 67595050

Saint Gobain Weber
Contact: Geir Norden
Email: geir.norden@saint-gobain.com
Tel: +47 22887700

Norcem AS
Contact: Terje Rønning
Email: terje.ronning@norcem.no
Tel: +47 35572000

NTNU
Contact: Terje Kanstad
Email: terje.kanstad@ntnu.no
Tel: +47 73594700

Mapei AS
Contact: Trond Hagerud
Email: trond.hagerud@mapei.no
Tel: +47 69972000

SINTEF Building and Infrastructure
Contact: Tor Arne Hammer
Email: tor.hammer@sintef.no
Tel: +47 73596856

Skanska Norge AS
Contact: Sverre Smeplass
Email: sverre.smeplass@skanska.no
Tel: +47 40013660

Norwegian Public Roads Administration
Contact: Kjersti K. Dunham
Email: kjersti.kvalheim.dunham@vegvesen.no
Tel: +47 22073940

Unicon AS
Contact: Stein Tosterud
Email: stto@unicon.no
Tel: +47 22309035

Veidekke Entreprenør ASA
Contact: Christine Hauck
Email: christine.hauck@veidekke.no
Tel: +47 21055000

Foreword

The report presents the work and achievements of COIN. COIN - Concrete Innovation Centre - was established in 2007 as a Centre for Research-based Innovation (CRI), the Research Council program to strengthen innovation capacity in the industry by focusing on long-term research in close collaboration between R & D active companies and prominent research groups.

The consortium partners and subcontractors represent the value chain of the business sector; material suppliers, concrete producers, contractors and users. They represent leading multinational companies in the cement and building industry. It is shown in the report how the partners cooperated in order to achieve good results and efficient knowledge transfer.

It has not only been a success in terms of technical achievements and innovations, but also in terms of other gains as result of working in a centre. In fact, the Partners were so satisfied that they decided to continue with similar innovation arena also for the future. The work resulted in 8 innovations within the CRI-period of 8 years and more than 10 possibilities of future innovations. Many of these are presented in the report, along with the other gains of collaborating in the centre.

The work is presented in more than 200 publications; reports, papers in international magazines and conferences and in 16 PhD-theses. An overview is given in www.sintef.no/coin, including free downloads of all reports. Also, results and much other information can be found in the Annual reports (to be downloaded from the same web-page).

Tor Arne Martius-Hammer
Centre Manager

Summary

In 2006 the Research Council of Norway established 14 Centres for Research-based Innovation, CRI, as a tool to stimulate the industry to further innovation (http://www.forskningsradet.no). The purpose is to build up and strengthen Norwegian research groups that work in close collaboration with partners from innovative industry and innovative public enterprises, through long-term research. COIN – Concrete Innovation Centre is one of these 14 CRIs, and was the only one within materials and structures. COIN ran as a CRI from 2007 to 2014.

The consortium partners of COIN represent the value chain of the business sector, and they represent leading multinational companies in the cement and building industry. The main measures to establishing links and integration between the partners, and to ensure competence transfer between the partners, are to have joint activities from project initiation and planning to report.

The research work was performed by the staff at SINTEF, the Norwegian Institute of Science and Technology (NTNU) including 16 PhDs, and by the industrial partners (in-kind). The technical activities in COIN are organized based on the social, environmental and industrial needs, as well as on the innovation strategies anchored in the corporate management of the industry partners. The work was organized in three focus areas:

1) Environmental friendly concrete structures
2) Economically competitive construction
3) Technical performance

COIN has become well known, also worldwide, and the display window for concrete research in Norway. Hence, this centralisation, and the fact that most of the results are public, has made it considerably easier for the environment outside the COIN partners, public authorities included, to have access to concrete research results (e.g. via www.sintef.no/coin), and to see the importance of concrete. Also, the direct use of the results in the education at NTNU contributes to educate engineers with state of the art knowledge, to the benefit of the industry and society.

I 2006 etablerte Forskningsrådet (www.forskningsrådet.no) 14 sentre for Forskningsdrevet Innovasjon, SFI, som et verktøy for å stimulere industrien til mer innovasjon. Formålet er å bygge opp og styrke norske forskningsmiljøer som jobber tett med partnere i innovativ industri og innovative offentlige selskaper gjennom langsiktig forskning. COIN – Forskningssenter for innovativ betong – er ett av disse 14 sentrene, og det eneste innen materialer og konstruksjoner. COIN ble drevet som et SFI fra 2007 til 2014.

Konsortiepartnerne i COIN representerer hele verdikjeden i byggebransjen, og de representerer ledende multinasjonale selskaper i sement- og byggesektoren. Hovedgrepene for å etablere nettverk samt samarbeid og sikre kunnskapsoverføring mellom partnerne har vært å ha felles aktiviteter. Dette gjelder fra prosjektidé til planlegging og rapportering.

Forskningen har blitt utført av forskere ved SINTEF og NTNU inkludert 16 doktorgradsstudenter, og av industripartnerne som egeninnsats. Det faglige arbeidet i COIN har vært organisert på grunnlag av sosiale, miljømessige og industrielle behov i tillegg til innovasjonsstrategiene til de industrielle partnerne. Arbeidet har vært delt inn i tre fokusområder:

1) Miljøvennlige betongkonstruksjoner
2) Konkurransedyktig utførelse
3) Estetikk og teknisk ytelse

COIN har blitt godt kjent, også ute i verden, og er utstillingsvindu for betongforskning i Norge. Denne samorganiseringen og det faktum at det meste av resultatene er tilgjengelige for alle, har gjort det atskillig lettere for utenforstående, også offentlige myndigheter, å ha tilgang til forskningsresultater innen betong (for eksempel via nettsiden www.sintef.no/coin). Det synliggjør også viktigheten av betong. Resultatene har blitt brukt direkte i undervisningen ved NTNU og nyutdannede ingeniører er dermed i kunnskapsfronten – til fordel for både industrien og samfunnet.

COIN's turnover is nearly NOK 250 mill. The Research Council contributed with NOK 76 mill., and the rest was financed by the Partners, approx. 80 % as in-kind. COIN financed 16 PhD's. The Partners were: Borregaard Ligno Tech (until 2009), Kværner Engineering, Mapei AS, Norcem AS, NTNU, Saint-Gobain Weber, SINTEF Building and Infrastructure (host), Skanska Norge AS (from 2008), Spenncon AS (from 2007 to 2011), the Public Norwegian Roads Administration, Unicon AS and Veidekke Entreprenør ASA.

The work is presented in more than 200 publications; reports, papers in international magazines and conferences and in 16 PhD-theses. In the midterm and final self-evaluation, the partners of COIN said that it is important to have a central research centre and that it contributes to a number of benefits also outside the technical achievements, such as:

- Increased and more active R&D and strengthened innovation strategy among the user partners
- Shorter communication lines between industry and competence centres
- New liaisons and extended network
- Strengthened collaboration between industry and SINTEF/NTNU
- Short way from industry relevant research to education
- Extended international cooperation

COIN organised the international conference CIC2014 – Concrete Innovation Conference - in Oslo, 11-13 Juni 2014, presenting COIN-results along with more than 100 other presentations, with approx. 200 attendees from nearly 40 countries. COIN also co-organised the International Durability Conference, ICDC, in 2012 in Trondheim. In addition, COIN organised 7 international workshops.

COIN har hatt en omsetning på nærmere 250 millioner kroner. Forskningsrådet har bidratt med 76 millioner kroner, det resterende har partnerne finansiert. 80 % av partnerbidraget har vært egeninnsats. Partnerne har vært: Borregaard Ligno Tech (til 2009), Kværner Engineering, Mapei AS, Norcem AS, NTNU, Saint-Gobain Weber, SINTEF Byggforsk (vert), Skanska Norge AS (fra 2008), Spenncon AS (fra 2007 til 2011), Statens Vegvesen Vegdirektoratet, Unicon AS og Veidekke Entreprenør ASA. COIN har finansiert 16 doktorgradsstudenter.

Arbeidet er presentert i mer enn 200 publikasjoner; rapporter, artikler i internasjonale tidsskrifter og konferanser og i 16 doktorgradsavhandlinger. I midtveis- og sluttevalueringen har partnerne i COIN sagt at det er viktig å ha et samlende forskningssenter, og at dette bidrar til flere fordeler i tillegg til faglige resultater. Eksempler som nevnes:

- *Økt og mer aktiv FoU og styrkede innovasjonsstrategier hos brukerpartnerne*
- *Kortere kommunikasjonslinjer mellom industrien og kompetansesentrene*
- *Nye samarbeidskonstellasjoner og utvidet nettverk*
- *Styrket samarbeid mellom industrien og SINTEF/ NTNU*
- *Kort vei fra forskning som er relevant for industrien til utdanningen*
- *Utvidet internasjonalt samarbeid*

COIN arrangerte den internasjonale konferansen CIC – Concrete Innovation Conference (Innovasjonskonferanse for betong) i Oslo 11.-13. juni 2014. Her ble resultater fra COIN presentert sammen med over 100 andre foredrag. Ca. 200 personer fra nesten 40 land deltok. COIN var også med å arrangere en internasjonal konferanse i bestandighet, ICDC, i 2012 i Trondheim.

The work contributed to eight innovations within the CRI-period of 8 years, summarised below, and more than 10 possibilities of future innovations.

Products:

- Norcem's environmental friendly cement, contributing to a considerable reduction of concrete's CO_2-footprint
- Mapei's patented hardening accelerator, contributing to remove one of the typical disadvantages (slow strength development) associated with the use of environmentally friendly cements
- Saint Gobain Weber's calcined clay, as another way of making environmental friendly binder (cement)

Services:

- CrackTestCoin, a commercially available engineering tool to plan construction of heavy concrete structures with a minimum of crack risk
- Guide for structural design and execution of fibre reinforced concrete in load carrying structures, which opens for design of concrete structures with a minimum of the traditional and very resource intensive rebar reinforcement

Production processes/applications:

- Fibre reinforced walls with basaltic minibars as replacement for the traditional and very resource intensive rebar reinforcement
- Artic sea structures without abrasion casing, helping Kværner to design the exposed ice zone of artic offshore concrete shafts without the expensive steel lining.
- Manufacturing processes of sand from crushing rock and corresponding concrete mix design technology that allows sustainable production of concrete without natural sand. This is needed because the natural sand resources are depleting rapidly.

Forskningen har bidratt til åtte innovasjoner i løpet av de åtte årene som SFI, se liste under, og over 10 mulige framtidige innovasjoner.

Produkter:

- *Norcems miljøvennlige sement, et vesentlig bidrag til reduksjon i CO_2-avtrykket til betong*
- *Mapeis patenterte herdeakselerator, som eliminerer den typiske ulempen ved bruk av miljøvennlige sementer (sen utvikling av styrke)*
- *Saint-Gobain Webers kalsinerte leire, et alternativt miljøvennlig bindemiddel (sement)*

Tjenester:

- *CrackTestCoin, et kommersielt tilgjengelig beregningsverktøy for å minimere oppsprekking av massive betongkonstruksjoner*
- *Veiledning for dimensjonering og utførelse av fiberforsterket betong i bærende konstruksjoner med et minimum av tradisjonell og veldig arbeidskrevende stangarmering*

Produksjonsprosesser/ anvendelser:

- *Fiberarmerte vegger med minifiber av basalt som erstatning for tradisjonell og arbeidsintensiv stangarmering*
- *Konstruksjoner uten kapper i arktiske havområder, til hjelp for Kværner i konstruksjon av offshore plattformer med betongskaft uten kostbar ståloverdekning i sonen som utsettes for isskuring*
- *Produksjonsprosess for sand ved knusing av stein og tilhørende betongresepter som åpner for å produsere betong uten natursand. Dette er nødvendig siden naturlige sandforekomster er i ferd med å brukes opp.*

Table of contents

1 Vision / Goals

The vision of COIN is creation of more attractive concrete buildings and constructions. Attractiveness implies aesthetics, functionality, sustainability, energy efficiency, indoor climate, industrialized construction, improved work environment, and cost efficiency during the whole service life. The primary goal is to fulfil this vision by bringing the development a major leap forward by more fundamental understanding of the mechanisms in order to develop advanced materials, efficient construction techniques and new design concepts combined with more environmentally friendly material production.

The corporate partners are leading multinational companies in the cement and building industry and the aim of COIN is to increase their value creation and strengthen their research activities in Norway. Our over-all ambition has been to establish COIN as the display window for concrete innovation in Europe.

Ivar Aasen-tunet in Sunnmøre, Western Norway. Foto: Informasjonspartner

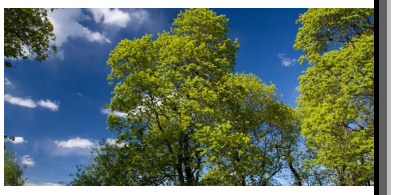
2 Basic facts about COIN

The research has been divided into three focus areas and 8 sub projects:

Focus area 1:

Environmental friendly concrete structures

- Binders with low emission and reduced resource consumption
- Insulating and energy preserving concrete



Focus area 2:

Economically competitive construction

- Robust and highly flowable concrete with controlled surface quality
- Ductile high tensile strength concrete (15 MPa)
- High quality manufactured sand for concrete

Focus area 3:

Aesthetic and technical performance

- Crack free concrete structures
- Reliable design and prolongation of service life
- Structural performance

1.1 Centre management

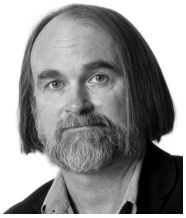
Dr. Tor Arne Martius-Hammer, Centre manager

COIN has been located in Trondheim with SINTEF Building and Infrastructure as host institution. Senior researcher Dr. Tor Arne Martius-Hammer has been Centre Manager with Chief Scientist Professor Harald Justnes as Assistant Centre Manager. Together with the centre manager, the project managers have constituted the management group. The Consortium has had a Board of Directors with seven members from corporate partners, one from NTNU and one from SINTEF. To prioritize within each of the three focus area and ensure anchorage in the industrial partners, representatives from relevant partners have constituted three Technical Advisory Committees. The Centre's manager reports to the Board.

Each Focus area has had a Thematic Advisory Committee (TAC) with members from the partners. The TACs were responsible for establishing the innovation objectives and criteria, prioritizing and reporting within their focus are. The TACs were also to break down the overall objectives into manageable and adequate action plan and tasks.

1.2 Project managers

There have been some exchanges of PMs throughout the centre period. The PMs at the end of the project were:



Assistant Centre Manager and
Project manager Focus area 1.1:
Binders with low emission and reduced resource consumption

Harald Justnes
Chief scientist SINTEF, Adjunct Professor NTNU

Project manager Focus area 1.2:
Insulating and energy preserving concrete

Olafur Wallevik
Senior researcher, SINTEF

Project manager Focus area 2.1:
Robust and highly flowable concrete with controlled surface quality

Klaartje De Weerdt
Senior researcher, SINTEF

Project manager Focus area 2.2:
Ductile high tensile strength concrete (15 MPa)

Terje Kanstad

Professor, NTNU

Project manager Focus area 2.3:
High quality manufactured sand for concrete

Børge Johannes Wigum

Technology manager Norcem AS/ Adjunct professor, NTNU

Project manager Focus area 3.1:
Crack free concrete structures

Knut O. Kjellsen

R&D manager, Norcem AS

Project manager Focus area 3.2:
Reliable design and prolongation of service life

Mette Geiker

Professor, NTNU

Project manager Focus area 3.2:
Structural performance

Jan Arve Øverli

Associate Professor, NTNU

1.3 Research Partners, Company and Public Partners

The consortium partners have represented the value chain of the business sector; various material suppliers, contractors and users. They represent leading multinational companies in the cement and building industry. Two new partners have joined the consortium during the centre period, two partners have withdrawn and three companies have been attached as sub-contractors.

Research partners	SINTEF	**SINTEF** has hosted COIN. SINTEF is the largest independent research organisation in Scandinavia. Over the last 60 years, SINTEF have created value and innovation through knowledge generation and development of technological solutions that are brought into practical use.
	NTNU – Trondheim Norwegian University of Science and Technology	**Norwegian University of Science and Technology (NTNU)** offers a range of bachelor's, master's and doctoral programmes. The specialization is in technology and the natural sciences. Out of 48 departments, the two departments Structural engineering and Chemistry have been involved in COIN.
Public partner	Statens vegvesen Norwegian Public Roads Administration	**Norwegian Public Roads Administration** (NPRA) is an autonomous agency subordinated the Norwegian Ministry of Transport and Communication. In COIN the tunnel division has been engaged. They have their own research staff and laboratories, and are among other things responsible for the planning, construction and operation of the national and county road networks in Norway.
Industrial partners	NORCEM HEIDELBERGCEMENT Group NORBETONG HEIDELBERGCEMENT Group NORSTONE HEIDELBERGCEMENT Group	**Norcem AS** is Norway's sole producer of cement. Associated company NorBetong (ready-mixed concrete company) and subsidiary NorStone (Norway largest producer of concrete and aggregates) as well as the parent company the Heidelberg Cement Group (DE), one of the world's leading producers of cement ,have also been part of the consortium
	MAPEI	**Mapei AS** is a part of the Mapei Group (Italy), one the world's leading producers of admixtures and additives for concrete as well as adhesives and chemical products for the building industry. Mapei has laboratory and research staff in Norway.
	KVÆRNER	**Kvaerner** is an international knowledge-based company. The headquartered is in Oslo, Norway, and has offices and fabrication facilities in several of the world's main oil and gas regions. In the market segment "Concrete Solutions", Kvaerner has a global leader in marine concrete structures.
	SKANSKA	**Skanska Norge AS** is a part of Skanska, which is one of the world's leading construction groups with expertise in construction, development of commercial and residential projects and public-private partnerships. Partner from 2008
	unicon///	**Unicon AS** is a part of Unicon A/S (Denmark), which is the largest ready-mix concrete producer in Scandinavia and a subsidiary of the Italian corporation Cementir SpA, a world leader in production of white cement.

		**Veidekke Entreprenør** ASA is a part of Veidekke Group, a leading building contractor and property developer in Scandinavia. In the COIN project on High quality manufactured sand for concrete, Veidekke Industry has been involved.
		**Saint-Gobain Byggevarer AS**, called Weber in the market, is the market leader in Europe on dry mortar, lightweight aggregates and building chemicals products. Weber is present in 43 countries. They have their own laboratory and research staff.
		**Borregaard LignoTech** is the world's leading producer of lignin-based products, i.a. as concrete admixtures, and is a part of Borregaard. They were partner in COIN in 2007 through 2009.
		**Spenncon AS** is part of Consolis SAS (BE) which is one of the largest manufacturers of prefabricated concrete products in the world. Spenncon was partner of COIN in 2008 through 2011, and acted on behalf of the Scandinavian Branch of Consolis; Spenncon, Parma and Strängbetong, as well as of Consolis Technology.
Subcontractors		**Velde AS, subcontractor to Skanska,** has been engaged in COINs activities within Self compacting concrete and high quality manufactured sand. Their quarry in Sandnes, Norway, we have one of the world's most modern and environmentally friendly production plant for aggregates, asphalt, concrete and recycling.
		**ReforceTech** is developer and producer of non-corroding reinforcement solutions for concrete, made from basalt fiber composite. As subcontractor to Kvaerner, ReforceTech joined COIN in 2011 in the project High ductile tensile strength concrete on fibre reinforced concrete.
		**Metso Corporation**, Finnish company and leading provider of processing equipment for rock crushing, subcontractor to Norcem, has been involved in the project High quality manufactured sand.

The partners cooperated through the work in the projects (technical work and joint projects meetings) and in TAC. Four partners or more were represented in all projects, and four partners had personnel taking part in the Master of Science education at NTNU.

1.4 Cooperation within the centre

The main strategy for knowledge transfer has been to have joint activities and to involve many persons from each industrial partner. The partners cooperate through the work in the projects (technical work and joint projects meetings). All projects have had project members from four or more partners. Project groups have consisted of PhD candidates, researchers from SINTEF and NTNU and personnel from the other partners. More than 60 persons from the industrial partners are on the list of personnel being involved in COIN work. Four partners had personnel taken part in the Master of Science education at NTNU, and one partner has been supervising Master students at Oslo University College. The majority of the PhD students have had co-supervisors from the industry. The centre has utilized NTNU's and SINTEF's laboratory facilities. In addition, some of the experiments have been performed at the industrial partners' laboratories, both in Norway and abroad.

2 Financing through the life of the centre

Summary sheet for the main categories of partners (MNOK)
Below tables show the distribution of COIN's funding from the various categories of partners and the expenditure divided into type of activities.

Contributor	Cash	In-kind	Total
Host	0	11	11
Research partners	0	58	58
Companies	30	59	89
Public partners	4	6	10
RCN	76	0	76
Total	**110**	**134**	**243**

Type of activity	MNOK
Research projects	226
Common centre activities	9
Administration	8
Total	**243**

3 Results - Key figures

	2007	2008	2009	2010	2011	2012	2013	2014	Total
Scientific/scholary publi-cations (peer reviewed)	2	38	11	42	35	17	32	48	221
Dissemination measures for users	28	27	26	19	8	10	16	34	168
Dissemination measures for the general public	3	4	3	8	2	19	4	9	52
Number of new/improved methods/models/proto-types finalised					1		3	1	5
Number of new/improved products/ processes/ services finalised				1		1	5	1	8
PhD-degrees completed					3	2	3	1	9
Master degrees		12	13	11	15	15	13	10	89

See appendix 2 for PhD candidates and Master degrees and appendix 3 for publications. 12

3.1 Patent

The research within COIN has resulted in one patent:
#WO2013066192 (A1) "Hardening accelerator and a method for accelerating the hardening of hydraulic binders and mixtures thereof." The patent is on a new mixture of admixture for concrete that makes concrete harden more rapidly in cold climate. It is especially beneficial when a great share of the cement is replaced with fly ash. The fly ash replacement makes the concrete more environmentally friendly than traditional concrete, but also slower hardening, and the patented accelerator compensates this and ensures a quicker building process

Mapei is the owner of the patent, and Kien Hoang is inventor. As a PhD candidate, Kien Hoang did the necessary experiments, both in NTNU's laboratory and in Mapei's labs in Norway and Italy. Supervisors Harald Justnes and Mette Geiker, prior supervisor Roar Myrdal (SINTEF/ NTNU) and Mapei's representative Espen Rudberg have made important contributions and are co-inventors. The work was part of COIN's project 1.1: Binders with low emission and reduced resource consumption.

Front page of data sheet for Mapei's patented hardening accelerator.

4 Research

The construction industry is one of Norway's largest, and concrete is the dominating construction material in buildings and infrastructure. COIN's research plan has been based on the social, environmental and industrial needs addressed by the Consortium Partners in the application process. At the start of COIN, the plans were made more specific in a 2-days workshop (March 2007). Innovation potential, image and customers' needs, productivity, sustainability, environment and high performance concrete for harsh climate have been topics addressed. The work has also been anchored in the demand from the society and the ECO-serve thematic EU network. ECO-serve's main objective was to identify the needs of the European Construction Industry in its endeavor towards sustainability of the industries' products and production processes involving cement, aggregate and concrete production.

The status discussed in the original project description was valid throughout the project period. However, as time went by, it turned out that the many wishes from the partners resulted in too many, and partly fragmented activities. To fulfil the objectives and success criteria of COIN, it was recognized that the work should be more concentrated. The project structure was therefore reorganized, and valid from 2010, the technical activities were more grouped into three focus areas (FA) as presented in "Facts about COIN". In the same process, the Board established a set of selection criteria for new activities. The criteria were to ensure industrial relevance, secure scientific quality and ensure an annual budget of new projects of minimum NOK 500 000.

In the midterm evaluation, COIN was advised to set aside an amount of "seed money" for rapid funding of funding of pre-projects that may involve higher risks. We did so a couple of years, funding ideas popping up during the year. The last year, some of the funding was put aside for PhD students completing their thesis after the COIN project period.

The midterm evaluation also requested "some more interaction with the structural side", as they found COIN to be concentrating predominantly on material properties and development. Our activity on Ductility of lightweight concrete is an example of this. Here we looked into the structural aspects of the material research performed on fibre and lightweight concrete.

4.1 Research methodology

The overall research method, described in the original proposal, was *to achieve practical applications through fundamental understandin*g. The methodologies have varied between the research tasks. Firstly, the mechanisms underlying the behaviour of cementing materials are of high chemical and physical complexity which is yet not fully understood. Therefore, there is need for investigations on a nano-/micro-scale level. This includes theoretical studies combined with laboratory investigations. The SINTEF group and NTNU together hold the equipment and laboratory facilities required for advanced materials research ranging from nanometre to meters, as well as for advanced research on structural (reinforced) elements. The results have been verified in test productions and case study constructions by the industry partners.

Secondly, the research revealed a lack of reliable and relevant test methods to be an obstacle for innovation. (E.g. fibre reinforced concrete and utilisation of aggregate resources because of risk of alkali-silica-reactions). Hence, further development of test methods has been an activity in some tasks.

Thirdly, the present research identified a lack of field data to be an obstacle for innovation (e.g. chloride penetration and energy consumption as well as thermal indoor climate connected to the thermal mass concept). Hence, systematisation of field data versus laboratory data has been an activity in some tasks.

As recommended in the midterm evaluation in 2011, COIN established a set of international advisors. The international advisors' task was to ensure that COIN performs high quality research within the

field described in the COIN-project. Thematically, the activities in COIN covered a wide area and seven advisors were selected to cover the whole range of topics. Our international advisors:

- Fred Glasser, University of Aberdeen: Focus area 1.1 Binder systems with low emission and reduced energy consumption
- Otto During, CBI: Focus area 1.2 Utilization of concrete in low energy building concepts
- Olafur Wallevik, ICI Rheocenter: Focus Areas 2.1 Robust highly flowable concrete and 2.3 High quality manufactured sand for concrete
- Steffen Grünewald, TU Delft: Focus area 2.2 Ductile high tensile strength concrete and focus area 3.3 Structural performance
- Jan Erik Jonasson, Luleå TU: Focus area 3.1Crackfree concrete structures
- Mike Thomas, New Brunswick University: Focus area 3.2 Reliable design and prolongation of service life (AAR)
- Bernhard Elsener, ETH: Focus area 3.2 Reliable design and prolongation of service life (chloride corrosion)

Testing from small to full scale:From the left:Scanning Electron Microscope (SEM) image of cement paste with fly ash, Thermogravimetric analysis (TGA) and to the right: Delivery from concrete-mixer truck in the laboratory at SINTEF/ NTNU. Photos by Giedrius Zirgulis

4.2 Research achievements

4.2.1 Focus Area 1.1: Binders with low emission and reduced resource consumption

In the description in the final COIN proposal, Task 1 was focusing on "Advanced cementing materials and admixtures" and it was decided to write state-of-the-art reports on

- Cements with lower CO_2 emission during production
- Admixtures to control hydration development
- Cements and admixtures to prevent cracking
- Alternative pozzolana
- Cements with lower porosity

In the first bullet point, the target was to make "an all-round cement with at least 30% reduced CO_2 emission relative to average outlet of 900 kg CO_2 per on clinker" at the time. It is the outcome of FA1.1 that is summarized below:

Firstly, the focus was to utilize the synergic reaction between fly ash (waste from coal fired powerplants) and limestone in cement as postulated in the original COIN proposal and this was then thoroughly documented and expanded in the PhD study of Klaartje De Weerdt; "Blended Cement with Reduced CO_2 Emission - Utilizing the Fly Ash-Limestone Synergy" NTNU, Dr. thesis 2011:32. In Figure 1 it is illustrated how a combination of 30% fly ash (FA) and 5% limestone replacing cement gives higher strength than 35% FA (+9% strength) and even higher than when one only replace 30% cement with FA (purple square).

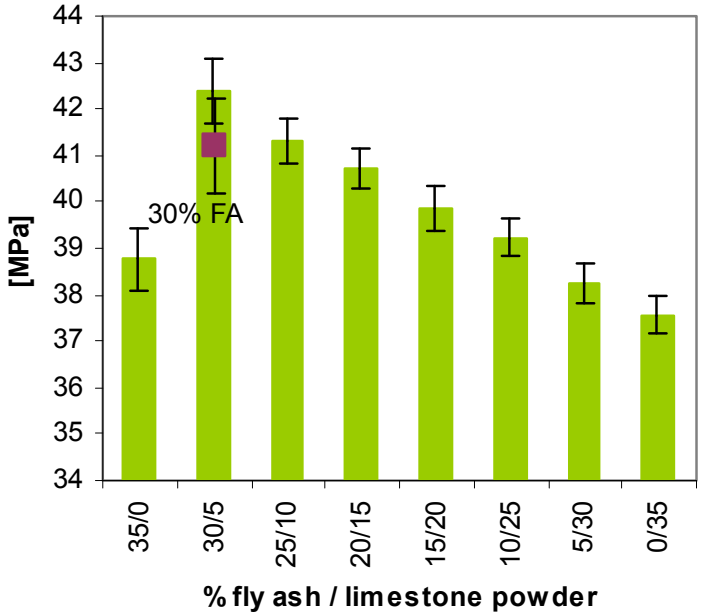


Figure 1 Compressive strength of mortars at 28 days where 35% cement has been replaced by a combination of fly ash and limestone. The work contributed to Norcem now selling such cement.

Secondly, it was realized that the fly ash was very slowly reactive and that cements blended with fly ash needed to be accelerated by admixtures, which then was successfully developed during the PhD of Kien Ding Hoang as a ternary blend of chemicals; "Hardening Accelerator for Fly Ash Blended Cement" NTNU Dr. thesis 2012:366. The admixture is now in Mapei's, the owner of the patent, product portfolio.

Thirdly, an alternative approach was to find a supplementary cementing material (SCM) that was much faster reactive than fly ash, but still abundant. It was then found within the project that calcination of ordinary blue clay and even marl (blue clay containing calcium carbonate) gave excellent results when replacing cement up to 50%. The challenge was then workability and suitable plasticizer became a topic for research as well. Calcined clay as SCM became so interesting for the partner Saint-Gobain Weber that it was taken out of COIN and a separate industrial financed PhD study was established and performed by Tobias Danner; "Reactivity of Calcined Clays" NTNU Dr. thesis 2013:218. As a result, Saint-Gobain Weber now uses calcined clay in their pre-mix production in Portugal.

The three preceding research areas became then the most important ones in development of environmental friendly binders as seen from the list of publications. Another dominating research topic has been gypsum-free cement which can lead to lower porosity and low energy cement, as well as cement that can withstand heat curing better than cement where gypsum is used as set regulator.

4.2.2 Focus Area 1.2: Insulating and energy preserving concrete

The project has been divided into three activities:

- ThermCon: Pilot buildings to demonstrate thermal mass technology
- NanoCon: Concrete and possibilities with nanotechnology for improved thermal resistance
- ZEBCon: Environmental calculation of building structures in concrete (LCA)

COIN has followed up three pilot buildings in terms of post-occupancy evaluations of office buildings using fair-faced ceilings. . The work included also a workshop with approximately 30 attendees, to discuss the role of thermal mass in energy calculations. The experiences gained from the work

constitutes basis for future guidelines on how to take thermal mass into account in energy calculations and LCA (Life Cycle Assessment)

After different approaches in project named NanoCon, we ended up with thermally insulating structural concrete, incorporated aerogel as insulation. Aerogel are nanoparticles from about 100 nm or less. The gel is relatively strong, but low in strength. This is compensated by use of UHPC (Ultra High Performance Concrete).

ZEBCon concerns energy use in concrete construction as well as carbon footprint during lifecycle, and includes comparison of energy use in concrete and other structures during lifespan. The activity has run parallel in COIN and ZEB (a research centre for Zero Emission Building,).EPDs (Environmental Product Declaration) for the LCAs have been used in order to feed more accurate parameters into the calculation tool "SimaPro" for the LCAs. The results show that the CO_2-emission associated with the production phase of a building can be considerably reduced by choosing the most environmental friendly concrete.

Figure 2: Utilisation of thermal mass of heavystructures, here in Guyajuruinene, China. Photo: pftcdayelise (from Wikipedia)

4.2.3 Focus Area 2.1: Stable and Robust Highly Flowable Concrete with controlled Surface Quality

The work performed within COIN FA 2.1 can be divided into two main activities:

- Design and testing of stable and robust highly flowable concrete
- Development of a concrete surface classification tool and contributing to a concrete surface specification.

Use of highly flowable concrete (such as self-compacting concrete) is a way to reduce the workload on the building site, in that concrete can be placed without or with a minimum of external compaction. However, since such concrete is very flowable, there is an increased risk of segregation of the part materials in concrete; the stability is impaired. One of the research activities regarding robust highly flowable self-compacting concrete is a practical test method and criteria to evaluate the stability (risk of segregation) of such concretes. This was done in 2014 by combining both laboratory and field testing. Figure 3 shows a picture of the field test.

Figure 3: In search for a test method and criteria to evaluate the stability of SCC
Picture of the field test – flow of concrete over a longer distance might provoke the concrete segregate resulting in an inhomogeneous concrete element with inferior structural and durable properties

In order to fill the formwork concrete has to flow over a longer distance. This might provoke the concrete to segregate resulting in an uneven distribution of coarse aggregates and the finer matrix. The resulting concrete element will as a consequence have inferior structural and durable properties.

A laboratory testing method as well as criteria was developed in order to classify the concrete regarding its tendency to segregate. The findings are reported in a COIN report. The laboratory test allows concrete producers and contractors to tailor concrete mixes for casting operations which might be specially demanding regarding concrete stability.

Besides the test method for stability of SCC mentioned above, a fundamental test method to evaluate the stability of matrix (consisting of cement paste and fines) was developed within the PhD study of Ya Peng at NTNU/Dept. of Structural Engineering 2010-2014. The test principle is based on the measurement of pressure gradients caused by particle sedimentation. This method allows the study of the fundamental mechanisms affecting stability of matrix and to investigate the impact of additives on stability.

Many researchers have been involved in the activities related to robust highly flowable concrete is the course of the project: Hedda Vikan (former SINTEF employee), Sverre Smeplass (Skanska), Tor Arne Martius-Hammer (SINTEF Byggforsk), Knut O. Kjellsen (Norcem), Espen Rudberg (Mapei), Kari Aarstad (former Unicon, SINTEF Byggforsk), Olafur Wallevik (ICI, Reykjavik University), Jon Wallevik (ICI), Stefan Jacobsen (NTNU), Ya Peng (NTNU), Klaartje De Weerdt (SINTEF Byggforsk) and many others.

Within the research activities of COIN FA 2.1 related to esthetics of concrete surfaces an objective tool for evaluation of smooth concrete surfaces was developed, and currently introduced to the market for testing. Currently, there is a lack of objective tools, meaning that if a building owner or architect wishes a specific esthetical expression of the concrete, they have to refer to other projects or cast trail elements. The verification of the result lies in the eye of the beholder. A classification tool and classification classes including an objective evaluation tool, are needed to help to align expectations between architects, contractors and owners and to resolving time consuming and expensive conflicts between the different parties.

The tool developed within COIN FA 2.1 consists of an image taking procedure and an image analysis software called “BetongGUI”. The tool assesses the pores in the concrete surface more precise the amount and the size distribution. Figure 4a shows a screen shot of the image analysis program. No additional licenses are required to run this software. A range of challenges were met during the development of the tool: uneven lighting, reflections, selection of reference objects etc. However, by the end of 2014, a thoroughly tested beta version of the software and a manual for the image acquisition are available.

The next step is to use the tool to define classification classes and criteria which will be incorporated in national regulations and recommendations for concrete surface classification such as the Norwegian Concrete Surface Specification NB9. In addition, the tool has to be introduced to the potential users e.g. architects, contractors and concrete producers.

Many researchers have contributed to the development of this concrete surface classification tool: Hedda Vikan (former SINTEF employee), Sverre Smeplass (Skanska), Mari Bøhnsdale Eide (former MSc student at NTNU and former SINTEF employee), Ingrid Hegseth (former MSc student at NTNU), Kristin Kaspersen (SINTEF ICT), Kari Aarstad (former Unicon, SINTEF Byggforsk), Klaartje De Weerdt (SINTEF Byggforsk) , Tone Østnor (SINTEF Byggforsk) and many others.

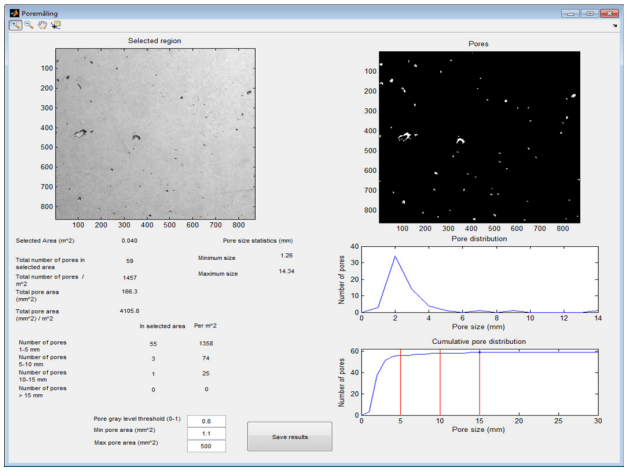


Figure 4a:
Screen shot of BetongGUI image analysis program

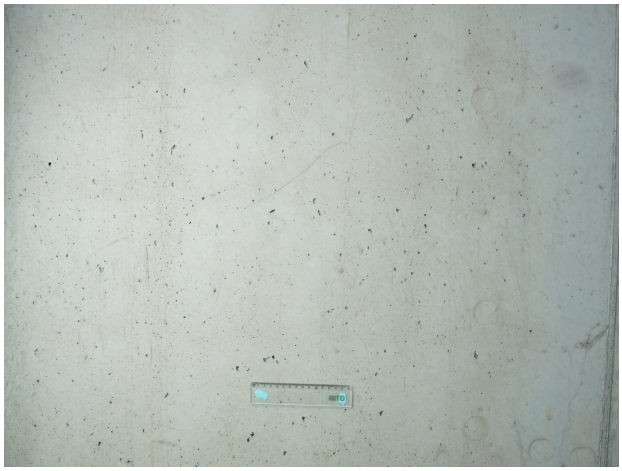


Figure 4b:
Picture of pores on a concrete surface.

4.2.4 Focus Area 2.2: Ductile high tensile strength concrete (15 MPa)

Fibre reinforcement has large potential for improving the effectivity of the construction process and the general quality of concrete structures. The last decade considerable progress has been made within both research and pre-normative work which both prepare the ground for innovation and increased use of fibres in concrete structures. COIN has contributed by increasing the focus on fibres, and through research on the following topics:

- Test methods to characterize the material, ranging from strength testing to X-ray Computed Tomography (CT) of hardened concrete
- Development of more efficient materials
- Investigation of casting procedures and selected parameters to fully understand and control the effects of the flow process on the material properties in the structures
- Work on design methods and implementation of a material model in a program for advanced finite element analysis of structural behavior
- Load testing of structural elements and full scale structures
- Use of fibre reinforced concrete in reference projects, see Figure 4

It was shown by Sandbakk (PhD-thesis in 2011, Figure 2) that comparable stress-strain relations for structural design can be extracted from all relevant test methods, ranging from pullout of individual fibres to energy absorption of sprayed concrete slabs. This work has been followed up by two other PhD candidates in the project, Giedrius Zirgulis and Elena Vidal Sarmiento (photos below) who both have paid large efforts to determine the key parameters for structural design of fibre concrete.

Figure 5: PhD-candidates and researchers within the fibre reinforced concrete project. From the left: Sindre Sandbakk, Giedrius Zirgulis, Elena Vidal Sarmiento, Gunrid Kjellmark and Håvard Nedrelid.

In the initial phase of COIN (2008) an objective to develop a fibre concrete with residual tensile strength of at least 15MPa was stated. Based on research work by Sandbakk, several master students, and the SINTEF researchers Gunrid Kjellmark (Figure 5) and Tor Arne Martius-Hammer, a concrete with average residual flexural tensile strength close to 20MPa has been developed. This material has large ductility as illustrated in Figure 6. Several fullscale elements have been made of this concrete, of which the results are currently under evaluation (Sarmiento PhD-thesis to be completed in 2015).

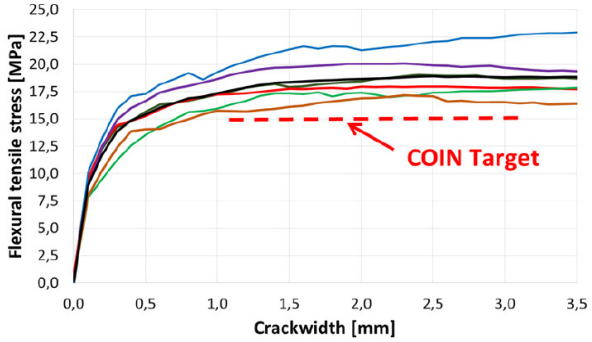


Figure 6: Materials development, concrete w/b=0,35 and 2,0 vol % (160 kg/m3) 60 mm steel fibres.

The flow of concrete and its influence on fibre orientation and distribution was studied in beams, slabs and walls.Slabs cast from one point are chosen to illustrate the effect and the achievements of the

project, Figure 7. The main results is that the flow pattern influences the fibre orientation and distribution to a large extent, and that the reinforcement bars change the flow pattern significantly, but contributes to a more robust material with less scatter. This is confirmed by numerical simulations of the flow, by CT and by strength testing of sawn beams. The experience and the findings will be included in Norwegian Guidelines for execution and design of fibre reinforced concrete published by the Norwegian Concrete Association in 2015.

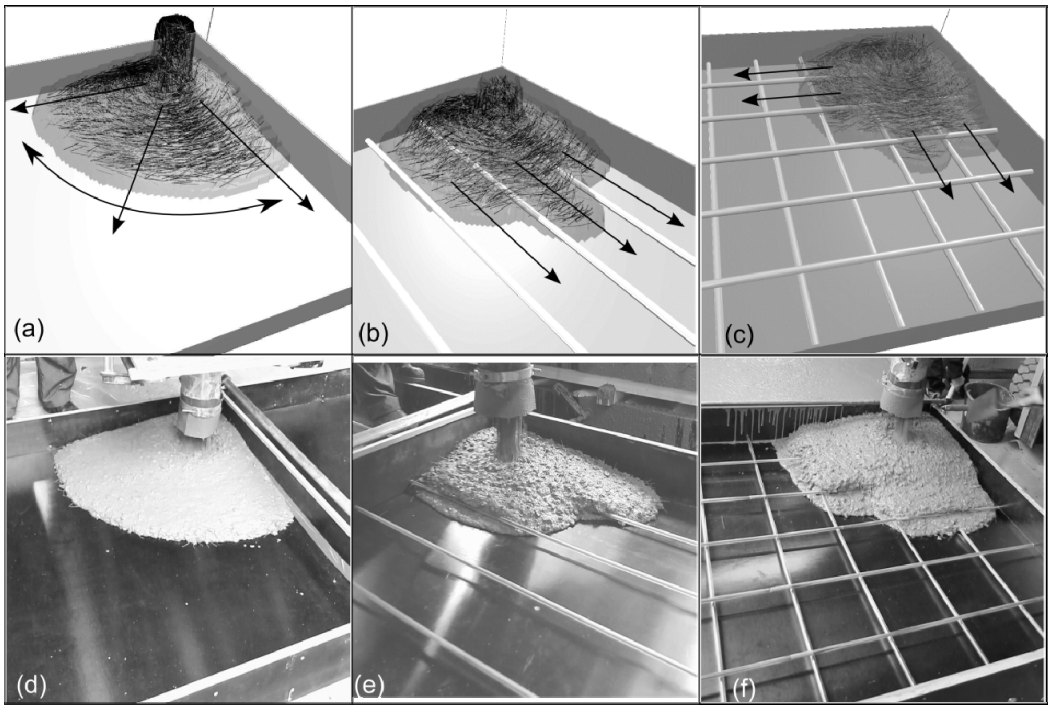


Figure 7: Influence of reinforcement on the flow process and the fibre orientation in slabs.

Structural elements and reference projects

Veidekke and Reforcetech are pushing borders with their project applications of fibre reinforced concrete. In two recent projects (Veidekke headquarter at Rudshøgda (Figure 1a) and Chocolate factory in Oslo) most of the conventional reinforcement bars in the walls have been replaced by composite basaltic fibres (Minibars). These fibres are to a large extent made more efficient during the COIN-period. Because rebar corrosion, and thus concrete cover, is no longer an issue, the wall thickness can be reduced, and therefore also the total cost.

A full scale test with post tensioned fibre reinforced slab was carried out in Spjelkavik led by Dr. ing. Steinar Trygstad Thilt/ Spennteknikk Construction AS, (Figure 6b). The test was successful and afterwards a reference project has been carried out in Trondheim, and a "Technical approval" of the system is in process.

Figur 8: Reference projects (a) Veidekke's headquarter at Rudshøgda in Hedmark, and (b) Fibre reinforced post-tensioned slab in Spjelkavik.

Other examples of investigated elements are, amongst others, beams with circular openings, and beams with dapped ends as shown in Figure 7. The general finding is that for both cases a substantial part of the transversal reinforcement can be replaced by fibres, and that there are clear advantages by the fibre reinforced solution.

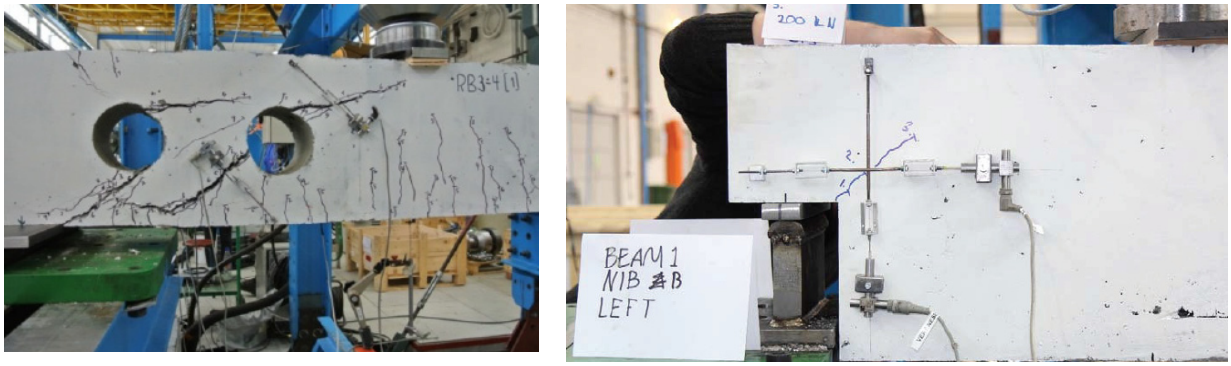


Figure 9: Fibre reinforced structural concrete elements tested to verify design methods proposed in pre-normative publications.

4.2.5 Focus Area 2.3 High quality manufactured sand for concrete

The natural resources of sand is running out, and the objective within this project has been to develop a technology platform for production, mix design and use of manufactured sand giving concrete equal or better properties than concrete with natural sand. The conclusion of the work is that the finest part of the crushed sand should get most of the further research attention. One of the main research directions, with a direct link to industry and society, would thus be to develop a crushing and processing technique that would allow improving the quality of crushed fine aggregates. This was addressed by studying how the crushing process parameters, influence the fresh state properties (rheology) of concrete. The results revealed the principal differences between different types of crushers used, and it was mapped out some crushing parameters that can have crucial effect on the fresh concrete rheology. The work constitutes the basis for guides to crusher producers and crush processing and concrete producers. Figure 10 illustrates the difference between low quality manufactured sand (top right picture) and high quality manufactured sand (bottom picture), which is very similar to the natural sand (top left picture).

Figure 10: Different sand types: (1) High quality 0/8 mm natural sand from Årdal; (2) Low quality 0/8 mm by-product of coarse crushed aggregate production (should not be called manufactured sand); (3) High quality 0/8 mm manufactured sand.

4.2.6 Focus Area 3.1 Crack free concrete structures

The issue is risk of early age cracking (thermal cracking) in heavy structures where the hydration generated heat may cause large temperature differences. A new special purpose early age concrete calculation program, "CrackTest COIN", has been developed within the project by Prof. Jan-Erik Jonasson, Luleå University. This is a tool that will help consultants and contractors planning execution of concrete works with a minimum of risk for such cracking. The software was launched to the industry in 2012 and is now in use in the education at NTNU.

The use of "low-heat concrete" is favourable (also for sustainability reasons). Fly ash is used here to reduce heat of hydration. So far it seems like the optimum fly ash content is around one third of the total binder content. When higher dosages of fly ash are being used, the negative effect of the loss in tensile strength seems to be larger than the positive effect of reduced hydration heat.

4.2.7 Focus Area 3.2 Reliable design and prolongation of service life

Much emphasis is placed on means of ensuring a long service life of reinforced concrete structures. Improved durability leads to increased structural reliability, less maintenance and repair, and overall increased sustainability. Possible solutions improving service life and/or sustainability, however, are difficult to evaluate, since current service life models are not based on detailed descriptions of the processes. Collaborative projects has taken place with the support from COIN to establish improved methods for compliance testing of aggregates for concrete and improved tools for prediction of reinforcement corrosion in concrete structures.

- Alkali-silika reactions
- Chloride induced reinforcement corrosion in concrete
- Chloride ingress and electrical resistivity

Through the PhD study of Jan Lindgård, COIN has aimed to evaluate whether concrete prism tests (CPTs) developed for assessment of alkali-silika reactivity of aggregates (ASR) might be suitable for general ASR performance testing of concrete. Focus has been on the internal moisture state in the test prisms and extent of alkalis leaching out from the prisms during the ASR exposure. The work has given important input to the work in RILEM TC-219 ACS-P (2007-2012), where the objective was to develop a reliable performance testing concept. Based on our results, the RILEM committee immediately withdrew two of the three RILEM methods.

Figure 11: Alkali-silika"worms" swellling out from concrete tested in lab:
The chemical reaction releases silika (SiO2)in the aggregates and creates alkali-silika gel.
The gel can absorb water and expand, and the concrete may crack.

The critical chloride content (the amount of chlorides penetrated into concrete, e.g. from sea water, that may give corrosion of the steel reinforcement) is a decisive parameter for service life predictions or condition assessment. In general, the variable is nowadays still based on experience dating back to the 1960s–1980s. A thorough literature review has shown that although a lot of research efforts have worldwide been made during the last fifty years, the present state of the art does not allow improving current practice. Moreover, values for the critical chloride contents used by consulting engineers (and scientists) are based on experience with Portland cement; critical chloride contents for modern binder types (compare other activities within COIN and numerous research groups all over the world) are in general unknown. The experimental work performed by Ueli Angst in his PhD study indicated how measuring setups for the critical chloride content can be improved so that the results are more reliable and realistic. On the basis of theoretical, probabilistic considerations he also suggested how laboratory results might be transferred to practice.

A thorough literature review by PhD student Karla Hornbostel has shown that the present state of the art does not allow improving current practice. Moreover, values for theoretical chloride contents commonly used are based on experience with Portland cement; critical chloride contents for modern binder types are in general unknown. Our experimental work indicated how measuring setups for the critical chloride content can be improved so that the results are more reliable and realistic. On the basis of theoretical, probabilistic considerations it is suggested how laboratory results might be transferred to practice. A correlation could be expected between the corrosion process of steel embedded in concrete and the electrical resistivity of concrete. A literature review shows however, that the dependency varies between studies of different concretes, and one single relationship cannot be established between corrosion rate and conductivity.

Figure 12: Karla Hornbostel preparing for investigations on the rate limiting steps for reinforcement corrosion

4.2.8 Focus Area 3.3 Structural performance

The work in this project has looked into:

- Lightweight aggregates (LWA)
- Lightweight aggregate concrete (LWAC)
- Combination of concrete types
- Ice abrasion

There is a general scepticism regarding the use of LWAC in heavy loaded structures because of the more brittle post-peak material behaviour and smoother crack surfaces. The work has proved that the strength and especially the ductility of structural concrete members depend on local multiaxial stress conditions that develop within the compressive zone prior to failure. Experiments also demonstrated that a reinforced LWAC structure may satisfy requests for energy dissipation and controlled behaviour, and even a capacity increase, in the post-peak response when steel fibre reinforced.

Using LWAC in combination with normal weight concrete is another possibility of structural optimisation with respect to weight and load capacity. The beams studied were composed by a bottom

layer of fibre reinforced LWAC and a top layer of normal weight concrete either cast wet-on-wet or at different times. The results confirmed that a considerable weight reduction can be achieved without compromising the load bearing capacity.

Development of high performance LWA is a parallel activity to further improve competitiveness of LWAC. PhD student Markus Bernhardt tested different strategies to improve the mechanical properties of expanded clay aggregates and showed that it is possible to achieve a considerable strength increase without compromising the density of the LWA. New understanding of the strength determining factors as the fracture behaviour of LWA was achieved.

PhD student Egil Møen has studied ice abrasion of concrete: A purpose-built rig was used to simulate the effect of ice sliding against concrete surfaces. The rig allows variation in different parameters such as ice-pressure, temperature, velocity and material qualities. By exposing new materials for the same test conditions as materials collected from structures with long-term field exposure, we can estimate the expected design the ice zone of artic offshore concrete shafts without expensive steel lining.

4.3 Highlights of scientific results - innovations

Products:

- Norcem's environmental friendly cement, contributing to a considerable reduction of concrete's CO2-footprint
- Mapei's patented hardening accelerator, contributing to remove one of the typical disadvantages (slow strength development) associated with the use of environmentally friendly cements
- Saint Gobain Weber's calcined clay, as another way of making environmental friendly binder (cement)

Services:

- CrackTestCoin, a commercially available engineering tool to plan construction of heavy concrete structures with a minimum of crack risk
- Guide for structural design and execution of fibre reinforced concrete in load carrying structures, which opens for design of concrete structures with a minimum of the traditional and very resource intensive rebar reinforcement

Production processes/applications:

- Fibre reinforced walls with basaltic minibars as replacement for the traditional and very resource intensive rebar reinforcement
- Artic sea structures without abrasion casing, helping Kværner to design the exposed ice zone of artic offshore concrete shafts without the expensive steel lining.
- Manufacturing processes of sand from crushing rock and corresponding concrete mix design technology that allows sustainable production of concrete without natural sand. This is needed because the natural sand resources are depleting rapidly.

4.4 Possible innovations

Products:

- Calcined marl: Our published research on clay and marl (clay with calcium carbonate) as well as the synergy reactions of limestone and fly ash (any alumina containing pozzolan) is likely to have inspired the new project on low carbon cement at EPFL, Switzerland; "Limestone Calcined Clay Cement, LC3" (see www.lc3.ch)
- Admixtures
- Low thermal conductivity structural concrete
- Technology for production of advanced lightweight aggregate (LWA)

Services:

- Surface classification system
- Guidelines
- Utilization of thermal mass
- LCA; reliable input values
- Performance based specification (e.g. ASR)

Production processes/applications:

- Fibre reinforced LWAC
- Hybrid concrete
- Self-compacting concrete (SCC)

Figure 13: Ground limestone, fly ash and clinker – components in cement

4.5 Awards

- Klaartje De Weerdt received the Ardex award for best student presentation at 29th Cement and Concrete Science conference in Leeds, UK, 2009
- Harald Justnes, Christian Engelsen and Kåre Helge Karstensen were accredited High Merit for their paper at 11th NCB International Seminar on Cement and Building Materials in New Dehli, India, in 2009.
- Ueli Angst was awarded Norwegian Concrete Association's research Prize 2009 for his PhD work on chloride induced reinforcement corrosion in concrete
- Best paper award at 12th NCB International Seminar on Cement and Building Materials, 15.18n November 2011 in New Dehli, India, o Roar Myrdal, Kåre Reknes Christian Engelsen and Harald Justnes for their paper *" The role of chemical admixtures in blended cement and concrete and ongoing new developments"*
- Kien Hoang was awarded Norwegian Concrete Association's Research Prize 2013 for his PhD work, which resulted in a patent owned by partner Mapei.
- At the annual Norwegian concrete day, Oslo, 30th of October 2014, Ya Peng was awarded the Research Price from the Norwegian Concrete Association for the research performed within her PhD study on "Sedimentation and Bleeding of Cement Paste".
- Indian Concrete Institute (ICI) best paper award in ICI Journal: "How to make concrete more sustainable", awarded to Harald Justnes during 2nd International Congress on Durability of Concrete (2nd ICDC), 4-6 December 2014, New Delhi, India.
- Invited lecture by Justnes and Ng: "Concrete Admixtures – Interactions with Cement, Supplementary Cementing Materials and Fillers" at SCC Conference 2014 in Xiamen, China, June 5-8, 2014
- Harald Justnes was in 2014 honoured with Norwegian Concrete Association's Achievement Award. Justnes' publication merits and organisation of international conferences around the world was emphasised, see also publication list in appendix 3.

- Also Tor Arne Martius-Hammer received Norwegian Concrete Association's Achievement Award in 2014. The jury gave proof of Martius-Hammer position as center manager of COIN, and acknowledged that he through COIN has contributed strongly to putting Norwegian concrete technology back in the position as world-leading.

Figure 14: Ya Peng receiving the Norwegian Concrete Association's Researcher price for 2014 from steering committee leader Kjersti Kvalheim Dunham (Picture from Byggeindustrien).

5 International cooperation

As recommended in the midterm evaluation in 2011, COIN has established international advisors. Several of the industrial partners are multinational corporations, and their research employees working outside of Norway have also been involved.

Many of the PhD students had had co-supervisors from collaborating universities abroad. Both PhD and senior researchers have been active in international commissions and committees in fib, RILEM, CEN, ACI and ISO. This is also the case for personnel from the industrial partners. This has allowed discussions on the research activities within COIN in an international arena as well as comparison of the research results with the state of the art.

SINTEF, and the last three years: NTNU, has been a member of the network Nanocem. Nanocem is a consortium of 24 academic partners and 11 industry partners from all over Europe, all interested in fundamental research in the nanoscale science of cement and concrete. Three PhD projects have been COIN's contribution to the network.

Over the eight years of the project, COIN has had more than 20 guest researchers, post docs and visiting PhD students. The collaboration has resulted in several joint publications. Several of the COIN projects have also supported student exchange. Examples: During 2011-2012, PhD student Michaela Wirthova, BRNO University of Technology (BUT) visited NTNU Department of Structural Engineering through the Erasmus scheme as part of her training on rheology of Self Compacting Concrete. In 2013, PhD student Albertas Klovas (Kaunas University) visited NTNU/SINTEF for 3 months and worked with concrete surface classification.

Geiker has since 2010 been working together with Professor Henrik Stang, DTU, and Assistant Professor Mike Lepech, Stanford University linking service life modelling and sustainability assessment. After his PhD Michel joined this group and further work is undertaking to enable multi scale modelling of deteriorating reinforced concrete structures.

Partners and key persons represent broad international cooperation by virtue of local networks within the multinational partners, personal networks and committees. 17 COIN researchers participate in more than 30 such bodies (e.g. within fib, Rilem, CEN, ACI, ISO). The network is utilised to find relevant cooperation partners for the work in COIN, and resulted in that COIN participates in presently two international projects and 16 agreements of cooperation with entities or persons. Also, some of the partners COIN-projects are integrated in international projects in which their international parent organisation participates (Kværner, Heidelberg Cement, Rescon Mapei, Unicon and Saint Gobain Weber).We have had several applications to the EU's framework programme; unfortunately without success.

Also within the project work the international cooperation has been extensive, for instance in the project *High quality manufactured sand for concrete*. COIN has opened for collaboration between Metso Minerals in Tampere, Finland and National Institute of Science and Technology (NIST) in Gaithersburg, MD, USA. Two joint publications are on the list of deliveries for 2014: A review report on dry and wet classification of filler materials for concrete and one journal article in Cement and Concrete Composites Journal. The collaboration will continue, and there are two more papers to be published during the 2015 as the result of the work performed in collaboration with. Also the collaboration between Assistant Professor Jon Spangenberg from the Danish Technical University (DTU) and the industrial PhD student Rolands Cepuritis will continue after COIN.

3 Training of researchers

All PhD candidates within COIN have been accepted as students at NTNU. Compulsory courses give students the formal research training before they start their research under guidance of one or more supervisors.

The first year as a center, eight PhD candidates were engaged. This was a period of high peak in the Norwegian industry, but still six of the students were Norwegian. Throughout the period, a total of 16 students were hired, but it was more difficult to recruit Norwegians candidates.

COIN has supported many MSc-projects each year (5-15), and some topics within the courses are also updated in accordance with results from COIN. COIN facilitation of recruitment of new personnel is also important for this question. The partners are to a large extent involved in teaching and supervision in the last two years of the master study.

COIN has facilitated recruitment of tenured personnel, post docs and well-qualified PhD-candidates. This statement also holds for recruitment of women in these positions. In 2012 we interviewed Linn Grepstad Nes to tell about her experiences as a PhD student at COIN:

5.1 Interview with PhD student Linn Grepstad Nes

In her PhD study, Linn Grepstad Nes has chosen focus on a concrete element which is composed by layers of different types/ qualities of concrete reinforced with conventional steel bars and/or fibres. The beams studied in her thesis are beams composed by different layers of concrete, see focus area 3.3 Structural Performance.

Photo: G. Zirgulis

In what way (if any) have you cooperated with others in the center?
Most of the specimens and beams were tested were cast at Weber's factory in Lillestrøm. Steinar Seehus and Ove Loraas, who works in the laboratory at NTNU, were in charge of the mixing and casting with help from the workers at the factory. An exchange of knowledge and experience was made during the days of casting. Also, the fibre reinforced lightweight concrete that in is developed by Weber. Other COIN PhD candidates have not been directly involved in my project, but I have had

many useful discussions with Håvard Nedrelid, e-mailing with Elena Vidal Sarmiento and Sindre Sandbakk (defended his PhD thesis in 2011) helped me execute the small-scale testing in the lab.

What potential does your work represent for the partners/ industry?
A structural optimisation with respect to weight has been made, using lightweight concrete in combination with normal weight concrete. Situations where such a combination might be suitable are structures with a long span, e.g. bridges and slabs. When the height of the cross-section increases, the self-weight of the structure also increases leading to a need for more reinforcement. This type of hybrid structure utilises the favourable low self-weight of lightweight concrete which results in a reduction of concrete and reinforcement. The project also includes an extensive study of basic material properties of fibre reinforced lightweight concrete. The study revealed that the fibres improve the performance of the lightweight concrete in terms of tensile strength.

Have you been involved in the master program at NTNU, and if yes: In what way?
I have been cooperating with four master students. Two of them were involved in the first test series, and two helped me carry out the last series. I was their supervisor for writing the master thesis and they helped me doing practical work such as building moulds, casting and beam testing.

Which (if any) advantages do you experience by doing your PhD study within COIN?
Being a part of COIN has made it possible for me to carry out a lot of laboratory work without having to worry too much about the financial part of the project. Also, I have had the opportunity to cooperate with Weber benefiting from their expertise and using their factory.

Figure 15: Concrete casting at Weber's plant: Knowledge transfer NTNU and Weber personnel

5.2 Interview with PhD student Giedrius Zirgulis

Giedrius Zirgulis moved to Trondheim, Norway and started his PhD study in September 2010.

Why did you start a fellowship at COIN/ NTNU?
After getting a diploma I started to work in a precast concrete elements factory which is a company of Consolis. Everything is interesting when you are freshly graduated. And practical experience knowledge I got while working in industry helps to see issues (studied in the university) in different point of view. But after some time the need to broaden your knowledge appears again. So I used my chance and started to work in Consolis' research and development laboratory Consolis Technology,

located in Finland. This was a very good start in research field. Now I can see that practical experience and material knowledge do supplement each other. So when I got proposal to study in NTNU I didn't think long. That is another step for me in broadening knowledge.

Can you briefly describe your PhD work?
Generally speaking my PhD work is concentrated on fibre concrete. Before I started getting into this topic I had some doubts if it is possible to find something new about a material which has been around concrete industry for decades already. But even after few weeks when I have started to know more about it, it have become clear how many unsolved issues about fibre concrete there still exist. At this stage of research my supervisor Terje Kanstad proposed me to concentrate on possibility of using fibres together with ordinary reinforcement in load bearing elements. To research the opportunity of reducing reinforcement by using steel fibre reinforced concrete. Of course it is not possible to replace steel rebars with fibre reinforced concrete. But when it comes about production of precast elements, in some cases they can be very heavily reinforced. It takes a lot of time and steel to produce such reinforcement (a beam for example). In this context fibre reinforced concrete looks very attractive. Even if small amount of rods can be reduced it can give a major labour and steel savings in the long run, same time indirectly contributing to reduction of CO2 emission due to steel production.

What is your relation to the industrial partners within COIN?
As I mentioned above I have come to NTNU from Consolis Technology, and Consolis is one the industry partner in the COIN project. Though I am employee in NTNU now, I still keep close contacts with Consolis Technology (Finland) and other Consolis business units like Spenncon (Norway), Betonika (Lithuania) and 25% of my study time I work for small projects for Consolis. This relation is great support in my research since I can have discussions on topics with my supervisor, professors and colleagues in NTNU as well as with experts in Consolis. Same time full scale factory castings can be planned in Spenncon factory in Verdal which brings test results closer to reality. I think access to full scale testing is very important in a research like this.

Which advantages do you experience by doing your PhD study within COIN?
I like being part of COIN as a centre. Lots of things are going on here and everything is organised so that you will get as much information as possible. Various meetings and presentations are held where you can present your work and get to know what others are working on. This really helps to see the big picture and not to be captured in your own thesis only.

The biggest advantage, however, is the close collaboration of COIN and industry partners. In my opinion this can be a key factor for breakthrough in developments or new discoveries. Industry always needs a research in order to continue development and universities are strong in fundamental knowledge, which sometimes is not treated properly by industry. So doing PhD within COIN gives a high chance that the research will contribute for society. Besides this project is very international, I can meet and work with PhD students from other countries, which give strong background for future collaborations.

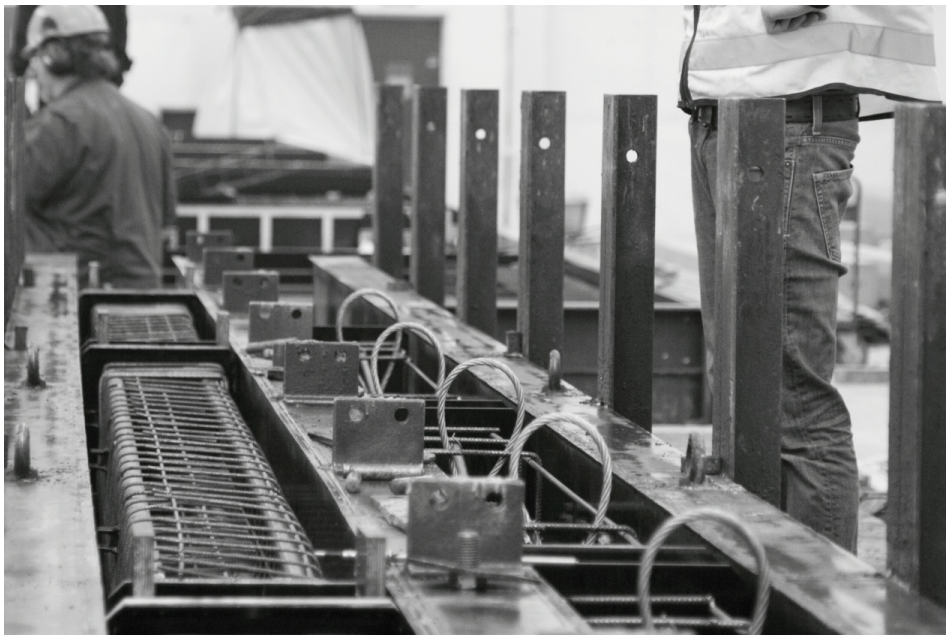


Figure 16: Moulds for concrete beams ready for casting. Photo: Giedrius Zirgulis

Employment of PhD-candidates (2015)
Nine of COIN's 16 PhDs have achieved their degrees, and the rest will most probably defend their theses in 2015. Those who have completed are now working at various employers:

Employment of PhD-candidates (number)	
By centre company	2 employees
By other companies	2 employees
By university	3 employees
Outside Norway	2 employees
Total	9 employees

6 Communication / Popular dissemination of knowledge

Communication and publication has been followed up through a communication plan of five levels ranging from scientific publication to dissemination to the Norwegian industry. Through our website and logo, COIN is established as a brand that has gained both national and international attention.

As a scientific "grand finale" COIN initiated CIC – Concrete Innovation Conference, in Oslo in June, 2014. 20 of the 130 papers were related to COIN, including seven keynote speakers. Themes ranged from "Environmentally friendly concrete structures", "Efficient construction" and "Structural design and performance" to "Prolongation of service life". The conference also included an innovation contest and four papers were awarded, one within each theme. Throughout the project period COIN has also organized seven workshops and published more than 200 papers and reports, with more journal papers the last years.

Whereas the researchers have had their main focus on scientific publication, the board has had the focus on dissemination to the Norwegian Industry. COIN has put effort in informing the Norwegian building industry of its research and results through presentations for the various trade associations and articles in trade magazines, such as "Norsk betongdag", "Fabeko-konferansen", in internal meetings of partners and "NB temamøter", as well as in articles in trade magazines. The trade journal

Byggeindustrien has been the preferred media to reach the industry, and a popular scientific annex to the journal in November 2014 summed up some of the work in COIN. Some articles also in daily press and in special issues.

We organised COIN-internal annual seminars with up to 50 attendees from the partners, and concluded with a 2-day closing seminar in December 2014 in which persons from collaborating organisations also attended.

Nearly all COIN reports are available for free downloading at the website www.sintef.no/coinweb . The website will exist also in the years to come.

Annually the various projects have organized one-two workshops and seminars. This way the COIN researchers have had valuable input and discussions with affected parties that are not joining COIN such as contractors, architects and property owners in addition to other researchers.

Figure 17: COIN's summary report "Betonginnovasjon i Norge to the Norwegian industry. COIN was also presented in page 40-52 i Norwegian Concrete Association's 60th anniversary publication.

7 Effects of centre for the host institution and research partners

7.1 SINTEF

COIN made it possible for us to maintain a long term relationship with important clients throughout the value chain. Establishing COIN was critical to keep our position as one of the world leading institutes within concrete technology. The work in COIN, together with the work in another centre that SINTEF is currently engaged in, ZEB – Zero Emission Buildings (FME/RCN), have both been important in creating a R&D strategy for the institute. Environmental technology is one of four areas chosen to be the institute's main priorities in coming years, this is much based on the work in COIN.

Our learning about the industry partner's innovation and R&D strategies were improved, including the possibilities and limitations it represents concerning risk level and time from research to market. Also, the initial and mid-term workshop to form projects, contributed to better understanding their basis for and priority of problem areas.

We have recruited new researchers and we have increased the number of researchers holding a PhD grade. COIN has also contributed to strengthen the collaboration with sister institutes in SINTEF.COIN has also to some degree engaged in common activities with ZEB.

COIN has given us the possibility of being more visible, within SINTEF, nationally and internationally, which is good marketing and contributes to easier access to international project consortia.

We are currently leading or partner in four spin off projects of COIN (BIA-projects), that were initiated by the partners at the end or shortly after conclusion of COIN. Also, a fifth project was initiated, between Saint-Gobain Weber and SINTEF on further development of calcined clay as a pozzolan. This project has a PhD student paid by Saint-Gobain Weber outside COIN. The international display of COIN gave us two international projects; one in Spain and one in South-Korea.

Mobility of researchers between COIN and the user partners have however not been easy to utilize. But the partner interest in specific topics has resulted in three of the SINTEF researchers in COIN being employed by user partners. Furthermore, 2 COIN-researchers from SINTEF are adjunct professors at NTNU. In addition, SINTEF and Skanska established a successful part time exchange of one SINTEF employed COIN researcher. A leading expert on concrete rheology from Iceland, Olafur Wallevik, has chosen to work part-time for SINTEF, mainly as COIN FA1.2 manager the latter years.

COIN was an innovation driven centre, much aimed at practical solutions. This taken into account, it has been somewhat disappointing that the creativity from partners was rather low, especially regarding long term risk-bearing research.

7.2 NTNU

For NTNU, COIN has contributed to increased competence within the research team, and improved research facilities. The existing collaboration has been strengthened. It has led to establishment of new collaboration relations, and the number of research partners has been increased.

For the department of Structural Engineering, financial support released internal financial support (from NTNU), which enabled engagement of more PhDs funded by NTNU by in-kind. COIN opened up for better funding of experimental work and better travel possibilities for researchers.

The centre has also generated several additional R&D projects, so the cooperation will continue beyond 2014.

The international activity within the research group has increased considerably due to COIN and recruitment of new tenured personnel. This is due to increased research volume and funding. The network for NTNU permanent staff and Phd students is improved, and the international exchange of researchers has increased thanks to COIN. Overall, the increased international activity and research volume has improved the acknowledgement of Norwegian concrete technology abroad.

8 Effects of centre for the company partners, public partners and society at large

A questionnaire at the end of the project period sums up the partners' effects of COIN. Many expressed that COIN has been a valuable arena in keeping the active sector together focusing on R&D. Moreover has identification and implementation of key issues and ideas functioned well. Short way to competence, as well as the importance for technology transfer to students was also mentioned.

The partners seem to agree that COIN contributed to make Norwegian concrete technology more known internationally. An example quoted from Aker Solutions, now Kvaerner, in COIN's Annual Report 2009:

"COIN has strengthened the knowledge base in our company, improved our access to competent personnel and knowledge institutions and improved our networking with other partners, says Jan-Diederik Advocaat. He continues: "Results from COIN projects have been used in ongoing commercial projects within our company. We have also created new ideas for products and methods of execution in Aker Solutions based on this partnership."(...) .The partnership with COIN is valuable in our work to win new projects for harsh environments in Norway, Canada, Russia and other areas around the world, and to strengthen the Norwegian concrete cluster".

8.1 Review of what is considered the most important effects

- Influence on R&D and Innovation strategy of the partners
  The following was mentioned: Improved network and cooperation, investment in R&D infrastructure, improved competence in core business areas, strengthened reputation as a knowledge based actor, also contributing to improved business, academia and industry at the same table
- Development of new or improved products, processes or services
  COIN resulted in many new or improved products, processes or services, as presented elswere in the report. Some indicate, however, that many of these would have been developed through other projects, e.g. RCN/BIA-projects, without COIN.
- COIN contributed toeasy and effective access to competence.
- None of the user partners mention that COIN has contributed directly to recruitment, except one that employed one of the PhDs. NTNU naturally increased their staff with most of the PhDs, and added that COIN contributed also to easier recruitment of reputed tenured personnel. Many mention the good contact with master students working on core areas
- Improved network to other partners
  Many partners mentioned this point as an important result of COIN, and new collaborations have been created through the joint work which has revealed common interests among partners and cooperation on projects outside COIN:
  - Norcem and Mapei: Grinding aid
  - Saint-Gobain Weber and SINTEF: Calcined clay
  - NPRA and NTNU: Service life modelling
  - Norstone and Mapei: Sands and fillers for self-compacting concrete

We have interviewed two partners to hear about COIN from of the industrial partners' view. First: Trond Hagerud, general manager of Mapei AS:

What have been your main interests in COIN?
Mapei's main interest in COIN has been to increase our knowledge on concrete science and develop concrete admixture products based on innovative research. This project has also increased our R&D activity in the Mapei Group.

Mapei was involved when hiring PhD student Kien Hoang within the work of admixtures. Could you tell something about this?
In our laboratory we started screening admixtures which might have an accelerating hardening effect on blended cements. From the first results we saw that this work was quite comprehensive, so we needed a supplement from COIN. When Kien was engaged, we sent our work to him, and together with his supervisors he brought in new ideas which ended in an admixture which had the wanted effect on the hardening development of cement with as much as 30% fly ash.

Mapei is part of the Mapei Group. Has COIN influenced the Norwegian company's position in the international group, and if so: In what way?
COIN has induced new technology and knowledge to the Mapei Group. Other Mapei R&D groups are quite interested in the work on the hardening accelerators.

How was the cooperation with other industrial partners within COIN?
The cooperation has been very valid for Mapei. We have now more knowledge in what challenges and possibilities the concrete industry has; from the cement production to the casted concrete. Together with Norcem, Mapei is developing quality improvers added in the cement production to enhance the 1 day strength in Norcem cements with higher amount of fly ash. We have cooperation with aggregate suppliers and concrete producers to develop robust self-compacting concretes with normal aggregates and crushed aggregates. Meanwhile we have gained good relationship with the partners.

From Mapei's point of view: What has COIN meant for the Norwegian concrete industry as a whole?
We think that COIN has been a necessary step doing the Norwegian concrete industry more acknowledged. The concrete development around the start of the Norwegian oil industry was tremendous, but it has since then been weaker. We believe this project will increase the concrete production in Norway.

We have also asked Knut O. Kjellsen, R&D manager in Norcem R&D, to tell about their involvement in COIN as a centre.

What have been your main interests in COIN?
Norcem's main interest in COIN has been to contribute to a strong and united national effort to strengthen research and development of cement based materials in Norway, and to strengthen the concrete industry.

What –if any- impact has COIN had on Norcem's position in the Heidelberg Cement corporation?
COIN has been an important part of the R& D strategy of Heidelberg Cement Group Norway. COIN has been well anchored in Heidelberg Technical Center (HTC) in Germany, and is well regarded at HTC. We inform and discuss COIN with HTC, and COIN strengthens our position towards HTC. In association with Klaartje De Weerdt's COIN PhD work, Dr Maciej Zajac of HTC joined several meetings, and Klaartje was invited to HTC in Germany to present her work.

Norcem has contributed with more in-kind and considerably more cash funding than the agreement. What is the reason for this?
The research plan and the increased joint activities have enabled us to include more of our research tasks into COIN than planned. In addition, other companies within Heidelberg Cement Group Norway, have seen the opportunities of participating in COIN. Thus, NorBetong and NorStone have joined the team.

Norcem does research directly with other industrial partners within COIN. Could you tell a little more about this?
COIN has been an important incubator for the direct co-operation with other industrial partners; for example the activities we have with Mapei and Consolis/Spenncon within Focus Area 1.2 was initiated within the COIN project. We have also co-operation with Skanska and the Norwegian Road Directory within sub-projects in COIN. COIN has strengthened this co-operation.

From Norcem's point of view: What has COIN meant for the Norwegian concrete industry as a whole?

As a member of COIN we have appreciated the enthusiasm and dedication of the COIN research team. This positivism and optimism that COIN has brought about, shall not be underestimated. We see that COIN research has furnished new and improved products and processes. Furthermore, the knowledge of the industry partners and the COIN researchers has increased. Several of the COIN PhD students will afterwards have specialist positions in the concrete business, thus COIN will have provided a basis for recruitment to the industry, institutions and authorities. Held together, all these aspects will strengthen the Norwegian concrete industry considerably.

4 Future prospects

The competence being built up remains available for the concrete industry in that the SINTEF employees who worked in COIN remains in SINTEF, and the PhD-supervisors remains in their NTNU-positions. Furthermore, COIN-results are already implemented in the NTNU Master-education.

Many of the COIN-partners are already part of 4 new RCN (BIA)-projects, resulting from ideas developed in COIN. And more BIA-proposals are planned already in the current year. Also, some of the partners purchase services from both SINTEF and NTNU in other projects.

COIN attracts attention to research and innovation from broad range of the industry and is referred to by e.g. BNL (Federation of Construction Industries) and “Næringslivsringen” (the partnership between the construction industry and NTNU). This attention appears to motivate the industry to enhance its research efforts even in others fields than concrete. The COIN-partners decided to continue collaboration on a COIN-similar platform, and other important actors in the concrete industry were invited by the COIN-partners to discuss organisation of such a platform. A working committee was established to prepare a proposal for organising of the future concrete R&D.

The international reputation of the research institute has definitively increased, through increased publication and conferences attendance presenting catching papers, as well as participation in international committees. COIN's home page has obviously attracted many since quite a few has contacted us referring to it (and not SINTEF's home page).

COIN have made it easier for the industrial partners to promote the Trondheim research community in their parent company with headquarters outside Norway, e.g. Heidelberg (D) and Mapei (I) COIN was the direct reason for SINTEF, and later NTNU, to become member of the European research network NANOCEM.

9 Conclusions

The CRI-scheme has through COIN proven to be a good tool to stimulate innovation, create an active co-operation between user partners and between user partners and research institutions, create internationally leading research environments, and to stimulate education of researchers in important fields for the industry. Many innovations and possibilities for future innovations were achieved. COIN has provided a new valuable meeting place for the partners, NTNU and SINTEF on a more strategic level. It enables more homogeneous policy and co-operation on research and innovation within value chain of the industry. The improved collaboration and engagement is demonstrated through the many RCN-proposals by the partners at the end of and after conclusion of COIN, as well as the joint initiative to establish a similar platform for future collaboration.

Appendix 1 Statement of accounts for the complete period of centre financing-Funding

CRI Annual Work Plan 2007-2014 - Funding (All figures in 1000 NOK) - Actual

Item	Type of Research*	Incentive effect****	Bonus Category***	RCN Grant	Host*****	Skatte-FUNN	Other Private	AKT/ Kværner	Borregaard	Mapei	Norcem	NTNU	Rescon	Skanska	Spenncon	SVV	UNICON	Veidekke	Weber / maxit	Total state aid	Total funding	State aid/total funding
Type of partner**					R			L		L	L	P		L		L	L		L			
Project 1.1	F	1101	100	7 963	2 374	0	12	107	1 095	1 440	7 202	697	2 139	142	175	74	0	0	4 174	**11 034**	**27 594**	**40 %**
Project 1.1	I	1101	65	1 088	226	0	0	0	0	594	1 587	0	0	0	0	0	0	0	494	**1 314**	**3 989**	**33 %**
Project 1.2	F	1101	100	3 038	0	0	3	0	0	0	71	0	0	0	240	0	1 530	0	0	**3 038**	**4 882**	**62 %**
Project 1.2	I	1101	65	739	0	0	0	0	0	0	78	0	0	0	233	0	2 529	0	0	**739**	**3 579**	**21 %**
Project 1i	I	1101	65	633	0	0	0	0	1 986	0	428	0	2 027	0	238	2	0	0	2 145	**633**	**7 459**	**8 %**
Project 2.1	F	1101	100	10 880	217	0	300	0	0	751	2 353	7 657	1 042	2 628	768	957	228	1 730	786	**18 754**	**29 935**	**63 %**
Project 2.2	F	1101	100	7 287	0	0	108	7 128	0	159	0	7 894	122	13	1 135	261	212	2 120	0	**15 181**	**26 439**	**57 %**
Project 2.3	I	1101	65	2 250	0	0	76	0	0	649	3 450	3 318	521	741	106	53	505	1 079	0	**5 568**	**12 748**	**44 %**
Project 3.1	I	1101	65	3 401	426	0	0	0	0	83	2 328	3 808	92	1 285	0	1 492	919	731	0	**7 635**	**14 565**	**52 %**
Project 3.2	F	1101	100	8 286	5 285	0	0	0	0	0	8 817	11 814	543	1 824	237	5 839	175	0	0	**25 385**	**42 820**	**59 %**
Project 3.2	I	1101	65	79	313	0	0	0	0	0	870	1 734	0	188	0	580	0	0	0	**2 126**	**3 764**	**56 %**
Project 3.3	F	1101	100	12 919	0	0	0	3 059	0	0	9	18 228	0	112	0	709	443	1 596	3 719	**31 147**	**40 794**	**76 %**
Project 3i	I	1101	65	2 196	25	0	0	1 035	0	0	22	587	0	0	130	0	93	1 776	585	**2 808**	**5 584**	**50 %**
Project 5f	F	1101	100	936	644	0	0	0	0	0	81	0	0	93	144	0	1 192	0	0	**1 580**	**3 090**	**51 %**
Equipment				568	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**568**	**568**	**100 %**
Adm.				15 129	0	0	15	127	0	0	1 360	0	0	0	226	992	86	0	0	**15 129**	**17 935**	**84 %**
Total budget				**77 392**	**9 510**	**0**	**514**	**11 456**	**3 081**	**3 676**	**28 656**	**55 737**	**6 486**	**7 026**	**3 632**	**10 959**	**7 912**	**9 032**	**11 903**	**142 639**	**245 745**	**58 %**
																				0	0	

* **Type of Research**: *F= Fundamental research **I=Industrial Research

** **Type of partner**: R=Non-for-profit research organisation, P=Other public, L=Large Enterprise, SME=Small and medium sized enterprise
*** **Bonus Category**: Large Enterprises in cooperation with non-for-profit research org. 65, SMEs in cooperation with non-for-profit research org 75,
**** **Incentive effect,** 1=OK, 0=Not present, First digit: Increase in *Project size,* Second digit: *Scope,* Third digit: *Speed,* Fourth digit: *Total amount R&D*

*****IPR - Funding from "Non for profit research organisations" should not be included as state aid if they receive ownership to IPR according to their contribution

Statement of accounts for the complete period of centre financing- Cost

CRI Annual Work Plan 2007-2014 - Cost (All figures in 1000 NOK) Actual

Item	Host	AKT/ Kværner	Borregaard	Mapei	Norcem	NTNU	Rescon	Skanska	Spenncon	SVV	UNICON	Veidekke	Weber	Total cost
Project 1.1	18 489	0	0	1 504	4 114	2 949	1 293	42	175	74	0	0	2 838	**31 478**
Project 1.2	6 363	0	0	0	149	35	0	0	33	0	1 879	0	0	**8 459**
Project 1i	1 044	107	1 986	0	128	14	1 977	0	58	2	0	0	2 145	**7 461**
Project 2.1	11 856	0	104	751	1 703	10 290	992	934	148	517	228	1 730	786	**30 039**
Project 2.2	5 375	7 128	0	159	0	10 769	122	13	546	261	212	1 853	0	**26 438**
Project 2.3	2 518	0	0	649	2 838	3 956	521	622	106	53	405	1 079	0	**12 747**
Project 3.1	4 770	0	0	83	1 851	5 091	92	639	0	1 092	264	681	0	**14 563**
Project 3.2	21 041	0	0	0	3 022	17 575	543	1 521	45	2 842	0	0	0	**46 589**
Project 3.3	8 670	1 374	0	0	9	26 317	0	12	0	609	193	1 596	1 866	**40 646**
Project 3i	1 529	444	0	0	22	1 081	0	0	30	0	243	1 684	701	**5 734**
Project 5f	2 836	0	0	0	81	0	0	29	144	0	0	0	0	**3 090**
Equipment	568	0	0	0	0	0	0	0	0	0	0	0	0	**568**
Adm.	15 118	127	0	0	1 360	29	0	0	226	992	86	0	0	**17 938**
Total budget	**100 177**	**9 180**	**2 090**	**3 146**	**15 277**	**78 106**	**5 540**	**3 812**	**1 511**	**6 442**	**3 510**	**8 623**	**8 336**	**245 750**

Appendix 2 List of Postdocs, Candidates for PhD and MSc degrees during the full period of the centre

Postdoctoral researchers with financial support from the Centre budget

Name	Gender	Nationality	Scientific area	Years/period in the centre	Scientific topic	Main contact
Lee, Siaw Foon	F	Malaysian	Competitive constructions	2007-2010	Rheology, microfibers	Stefan Jacobsen
De Weerdt, Klaartje	F	Belguim	Environmentally friendly concrete structures	2012-2013	Improved service life modelling of reinforced concrete structures	Mette Geiker

Postdoctoral researchers working on projects in the centre with financial support from other sources

Name	Gender	Nationality	Source of funding	Scientific area	Years in the centre	Scientific topic	Main contact
Michel, Alexander	M	German	DTU	Technical performance	2011-2013	Modelling of service life	Mette Geiker
Flint, Madeleine	F	American	Stanford University	Technical performance	2012-2013	Service life modelling: A probabilistic framework for performance-based durability engineering	Mette Geiker
Schlicke, Dirk	M	Austrian	Graz University of Technology	Competitive constructions/ Technical performance	2013	Fibre concrete and crackfree concrete structures	Terje Kanstad
Peng, Ya	F	Chineese	NTNU	Competitive constructions	2014	Self Compacting Concrete	Stefan Jacobsen

PhD candidates who have completed with financial support from the centre budget

Name	Gender	Nationality	Scientific area	Years/period in the centre	Thesis title
De Weerdt, Klaartje	F	Belgian	Environmentally friendly concrete structures	2007-2011	Blended cement with reduced CO_2 emission - utilizing the fly ash-limestone synergy
Lindgård, Jan	M	Norwegian	Technical performance	2007-2013	Alkali-silica reaction (ASR) - Performancetesting
Sandbakk, Sindre	M	Norwegian	Competitive constructions	2007-2011	Fibre reinforced concrete: Evaluation of test methods and material development
Angst, Ueli	M	Swiss	Technical performance	2007-2011	Chloride induced reinforcement corrosion in concrete: Concept of critical chloride content - methods and mechanisms
Nes, Linn Grepstad	F	Norwegian	Technical performance	2007-2013	Experimental and numerical study of hybrid concrete structures

Name	Gender	Nationality	Scientific area	Years/period in the centre	Thesis title
Nedreli, Håvard	M	Norwegian	Technical performance	2007-2012	Towards a better understanding of the ultimate behavior of lightweight aggregate concrete in compression and bending
Hoang, Kien	M	Vietnamese	Environmentally friendly concrete structures	2009-2012	Hardening accelerator for fly ash blended cement
Bernhard, Markus	M	German	Technical performance	2010-2013	Development of high performance lightweight aggregates
Peng, Ya	F	Chinese	Competitive constructions	2010-2014	Sedimentation and bleeding of cement paste

PhD candidates who have completed with other financial support, but associated with the centre

Name	Gender	Nationality	Source of funding	Scientific area	Years in the centre	Thesis title
Hagelia, Per	M	Norwegian	NPRA	Technical performance	2008-2009	Deterioration Mechanisms and Durability of Concrete with Emphasis on Sprayed Concrete in Aggressive Ground and the Expansion Mechanism of Alkali-Silica Reaction
Sæther, Irina	F	Norwegian	Norut	Technical performance	2008-2009	Numerical life cycle simulation of corrosion damaged and retrofitted concrete structures
Døssland, Åse Lyslo	F	Norwegian	NTNU	Fibre reinforced concrete	2007-2009	
Ji, Goumin	M	Chinese	NTNU	Concrete technology		Volume stability and crack tendency
Alexander Michel	M	French	DTU	Technical performance	2012-2014	Service life modelling: Prediction of reinforcement corrosion
Madeleine Flint	F	American	Stanford University	Technical performance	2012	Service life modelling: A probabilistic framework for performance-based durability engineering
Denisa Orsakova	F	Czhec	University of Brno	Technical performance	2013	Improved service life modelling of reinforced concrete structures
Arnaud Müller	M	French	EPFL	Technical performance	2013	Service life – Moisture measurement
Albertas Klovas	M	Lithuanian	Kaunas University	Competitive constructions	2013	Concrete surfaces
Oldrich, Svec	M	Austrian	DTU	Competitive constructions	2013	Simulation of fibre concrete casting
Wirthova, Michaela	F	Czech	BRNO University of Technology	Competitive constructions	2011-2012	Rheology of self-compacting concrete

PhD students with financial support from the centre budget who still are in the process of finishing studies

Name	Gender	Nationality	Scientific area	Years in the centre	Thesis topic
Zirgulis, Giedrius	M	Lithuanian	Competitive constructions	2010-2014	Fibre orientation in steel fibre reinforcement concrete: Quantification methods and influence of formwork surface and reinforcement bars in structural elements
Sarmiento, Elena V.	F	Spanish	Competitive constructions	2011-2014	Flowable concrete/ fibre concrete
Cepuritis, Rolands	M	Latvian	Competitive constructions	2011-2014	Industrially produced aggregates
Klausen, Anja B. E.	F	Norwegian	Technical performance	2011-2014	Early age crack assessment of concrete structures
Kiumarsi, Mahdi	M	Iranian	Technical performance	2011-2014	Structural effects of reinforcement corrosion
Møen, Egil	M	Norwegian	Technical performance	2007-2014	Ice abrasion
Hornbostel, Karla	F	German	Technical performance	2009-2015	Electrical resistivity

MSc candidates with thesis related to the centre research agenda and advisor from the centre staff

Name	Gender	Nationality	Year	Thesis title
Andersen, Harald I.	M	Norwegian	2008	Connection between bubble decks - experiments and nonlinear analysis
Ask, Morten	M	Norwegian	2008	Fibre
Berg, Stein Are	M	Norwegian	2008	Self compacting fibre reinforced concrete
Bolduc, Sam	M		2008	Production process
Braten, Christian	M	Norwegian	2008	Connection between bubble decks - experiments and nonlinear analysis
Dyrhaug, Geir	M	Norwegian	2008	Synthetic fibre reinforced concrete Casting techniques, fibre orientation and distribution
Gjone, Arne	M	Norwegian	2008	Fibre - literature study
Kalogiannidis, Evangelos	M	Greek	2008	Workability
Løvstad, Lars	M	Norwegian	2008	Fibre
Sørhøy, Christoffer A.	M	Norwegian	2008	Synthetic fibre reinforced concrete Casting techniques, fibre orientation and distribution
Zyck, Theresa	F		2008	Fibre
Aasprong, Øystein	M	Norwegian	2008	Fibre
Bjørlin, Jens Erik	M	Norwegian	2009	Calculation of structures during hardening period
Eiane, Helga Undheim	F	Norwegian	2009	Fibre or mesh reinforcement in solid ground floors
Eide, Mari Bøhnsdalen	F	Norwegian	2009	Classification system for formed concrete surfaces
Engesæther, Rune	M	Norwegian	2009	Structures in fibre reinforced lightweight concrete
Hegseth, Ingrid	F	Norwegian	2009	Classification system for formed concrete surfaces
Mortensvik, Øystein	M	Norwegian	2009	Powder characterization/ nanotechnology and packing of binders
Myhre, Martin N.	M	Norwegian	2009	Structures in fibre reinforced lightweight concrete
Nesje, Bendik Riseng	M	Norwegian	2009	Numerical simulation of fibre reinforced beams subject to shear loading
Saga, Petter	M	Norwegian	2009	Restraint shrinkage in fiber reinforced concrete using AASTHO PP34-98
Sandven, Kjetil	M	Norwegian	2009	Design of slender pedestrian bridge made of composite materials and high strength concrete

Name	Gender	Nationality	Year	Thesis title
Strandgård, Åsmund	M	Norwegian	2009	Structures in fibre reinforced lightweight concrete
Østvold, Andreas	M	Norwegian	2009	Restraint shrinkage in fiber reinforced concrete using AASTHO PP34-99
Aamot, Erik	M	Norwegian	2009	Structures in fibre reinforced lightweight concrete
Kjellmark, Gunrid	F	Norwegian	2010	Superlett betong – anvendelse m.m.
Hansson, Anders	M	Norwegian	2010	Hybrid Concrete Structures – Experimental testing and numerical simulation of structural elements
Skjølberg, Ole Georg	M	Norwegian	2010	Hybrid Concrete Structures – Experimental testing and numerical simulation of structural elements
Heggen, Runar	M	Norwegian	2010	Ground bearing concrete slabs subjected to…
Seglem, Frode	M	Norwegian	2010	Ground bearing concrete slabs subjected to…
Nikolaisen, Eirik	M	Norwegian	2010	Fordeling av fiber i fiberarmert betong
Schmidt, Andre	M	Norwegian	2010	Støpetrykk ved bruk av selvkomprimerende betong
Hanson, Simon	M	Norwegian	2010	Støpetrykk ved bruk av selvkomprimerende betong
Strand, Martin	M	Norwegian	2010	Støpetrykk ved bruk av selvkomprimerende betong
Bjerve, Tor Øystein	M	Norwegian	2010	Hybride betongkonstruksjoner
Moe, Hans Andreas H.	M	Norwegian	2010	Hybrid concrete structures. Experimental testing and determination of shear capacity
Cepuritis, Rolands	M	Lithuanian	2011	Effects of concrete crushing on rheological properties of concrete and matrix
Fernandez, Belen Maria	F	Spanish	2011	Influence of fibres in lightweight aggregate concrete
Hamstad, Bjørnar	M	Norwegian	2011	Fiberarmerte betongkonstruksjoner: Prøving av bjelker med oppleggsnese
Hansen, Tore Backe	M	Norwegian	2011	Fiberarmerte betongkonstruksjoner: Prøving av bjelker med oppleggsnese
Ihme, Tor Harald	M	Norwegian	2011	Betongkonstruksjoner i herdefasen analysert med elementmetoden: Bestemmelse av risiko for riss i Møllenberg løsmassetunnel
Jakobsen, Bjørn Eirik	M	Norwegian	2011	Fibre reinforced concrete structures: Shear capacity of beams and slabs
Marstrander, Brit Blom	F	Norwegian	2011	Stabilitet av materix for selvkomprimerende betong: Effekt av filler og VMA
Nordhus, Ørjan	M	Norwegian	2011	Fiberarmerte betongkonstruksjoner: Prøving av bjelker og plater av selvkomprimerende fiberarmert betong
Pedersen, Tor	M	Norwegian	2011	Betongkonstruksjoner i herdefasen analysert med elementmetoden: Bestemmelse av risiko for riss i Møllenberg løsmassetunnel
Sandvik, Christian	M	Norwegian	2011	Crack Risk Assessment of Møllenberg “Løsmasse” tunnel. Verification of the new computer software Cracktest COIN.
Simpson, Thomas	M	Norwegian	2011	Fiberarmerte betongkonstruksjoner: Prøving av bjelker og plater av selvkomprimerende fiberarmert betong
Skjølsvik, Oliver Berget	M	Norwegian	2011	Beregning og evaluering av rissrisiko pga fastholdingseffekter i støpeskjøter
Steinnes, Eivind	M	Norwegian	2011	Fiberarmerte betongkonstruksjoner: Prøving av bjelker og plater av selvkomprimerende fiberarmert betong
Støyva, Erling	M	Norwegian	2011	Hybride fiberarmerte betongkonstrusjoner: tverrsnitt med fleire betongtyper
Sæther, Martin	M	Norwegian	2011	Hybride fiberarmerte betongkonstrusjoner: tverrsnitt med fleire betongtyper
Bakken, Lisa	F	Norwegian	2012	Ductility of lightweight aggregate concrete
Sagosen, Kristine B.	F	Norwegian	2012	Ductility of lightweight aggregate concrete
Lang, Fredrik Tørud	M	Norwegian	2012	Ductility of lightweight aggregate concrete

Name	Gender	Nationality	Year	Thesis title
Rønningen, Øystein	M	Norwegian	2012	Ductility of lightweight aggregate concrete
Øfsdahl, Ellen	F	Norwegian	2012	Fibre-reinforced Self-compacting Concrete - Prediction of Rheological Properties
Skadal, Karsten Lie	M	Norwegian	2012	Basalt Reinforced Concrete in Load Carrying Structures: Structural Behaviour in the Serviceability and Ultimate Limit State
Olimb, Ane Marte	F	Norwegian	2012	Testing of fibre reinforced concrete structures: Shear capacity of beams with openings
Hansen, Siri Weydahl	F	Norwegian	2012	Testing of Fibre Reinforced Concrete Structures: Shear Capacity of Beams with Corbel-End
Nordbrøden, Hanna	F	Norwegian	2012	Testing of Fibre Reinforced Concrete Structures: Shear Capacity of Beams with Corbel-End
Tordal, Kristian Nesse	M	Norwegian	2012	Testing of Fibre Reinforced Concrete Structures: Structural Behaviour in the Serviceability and Ultimate Limit States
Flakk, Øystein	M	Norwegian	2012	Testing of Fibre Reinforced Concrete Structures: Structural Behaviour in the Serviceability and Ultimate Limit States
Knudsen, Eirik	M	Norwegian	2012	Basalt Reinforced Concrete in Load Carrying Structures: Structural Behaviour in the Serviceability and Ultimate Limit State
Høie, Truls Holm	M	Norwegian	2012	Vurdering av basalt- og stålfibres effekt og mekaniske egenskaper i jetpeler
Vermedal, Andreas	M	Norwegian	2012	Vurdering av basalt- og stålfibres effekt og mekaniske egenskaper i jetpeler
Ollendorff, Margrethe	F	Norwegian	2012	Powerhouse – Innebygget energi og klimagassregnskap for bæresystemene
Aspås, Øyvind	M	Norwegian	2013	Testing of Fibre Reinforced Concrete Structures. Shear Capacity of Beams with Openings
Colombo, Alessia	F	Spanish	2013	Chloride ingress and binding
Hallberg, Malin	F	Norwegian	2013	Posttensioned fibre reinforced flatslabs
Hanssen, Håvard E	M	Norwegian	2013	Posttensioned fibre reinforced flatslabs
Hoff, Stian	M	Norwegian	2013	Duktilitet av lettbetong
Moreno, Angel Arcadi Sorni	M	Spanish	2013	Improvement in the ductility of lightweight aggregate concrete
Nesse, John Nordseth	M	Norwegian	2013	Testing of fibre reinforced concrete: Shear capacity of I beams
Oskarsson, Johann Helgi	M	Norwegian	2013	The effect of fibres on the compressive ductility if Lightweight aggregate concrete
Roca, Miguel Boix	M	Spanish	2013	Fibre Reinforced Concrete: Optimization of fibre content and capacity of dapped-end beams shear
Rød, Anders	M	Norwegian	2013	Testing of Fibre Reinforced Concrete Structures. Shear Capacity of Beams with Openings
Seljen, Andreas	M	Norwegian	2013	Testing of fibre reinforced concrete: Shear capacity of I beams
Steen, Torgeir	M	Norwegian	2013	Duktilitet av lettbetong

Name	Gender	Nationality	Year	Thesis title
Usama Abbas			2013	Materials Development of Steel-and Basalt Fiber-Reinforced Concretes
Ytterdal, Silje Gystad	F	Norwegian	2014	Impact of phase changes on chloride profiles in concrete
Røer, Henrik	M	Norwegian	2014	Fibre reinforcement
Østberg, Jon Henrik	M	Norwegian	2014	Fibre reinforcement
Kristoffersen, Øystein	M	Norwegian	2014	Fibre reinforcement
Kittelsen, Erik	M	Norwegian	2014	Fibre reinforcement
Landbø, Linda	F	Norwegian	2014	Fibre reinforcement
Moltubakk, Øyvind T.	M	Norwegian	2014	Fibre reinforcement
Jettli, Daniel	M	Norwegian	2014	Ductility lightweight concrete
Sæther, Gøran	M	Norwegian	2014	Ductility lightweight concrete
Larsen, Tor Jørgen	M	Norwegian	2014	Ductility lightweight concrete

Appendix 3 List of Publications

Journal Papers

H. Justnes, P.A. Dahl, V. Ronin, J-E. Jonasson and L. Elfgren: *"Mictrostructure and Performance of Energetically Modified Cement (EMC) with High Filler Content*", Cement & Concrete Composites, Vol. 29, 2007, pp. 533-541

H. Vikan and H. Justnes: "*Rheology of cementitious paste with silica fume and limestone*", Cement and Concrete Research, Vol. 37, 2007, pp. 1512-1517.

Egil Møen, Stefan Jacobsen et. Al: *"Ice abrasion data on concrete structures – overview"*. Nordic Concrete Research 2008

Esko Sistonen, Stefan Jacobsen: *"Probabilistic service life modelling of ice abrasion on concrete structures"*. Nordic Concrete Research 2008

Stefan Jacobsen: *"Aggregate packing and -void saturation in mortar and concrete proportioning"*. Materials and Structures 2008

Tor Arne Hammer: *"COIN - Concrete Innovation Center".* Concrete International 2008

Gro Markeset, *"Critical chloride content and its influence on service life".* Materials and Corrosion, pp 593-596, Vol. 60 2009, 0947-5117

Jan Lindgård, Philip J. Nixon, Ingmar Borchers, Björn Schouenborg, Børge Johannes Wigum, Marit Haugen and Urban Åkesson, *"The EU "PARTNER" project- European standard tests to prevent alkali reactions in aggregates. Final results and recommendations"*. Cement and Concrete Research 2009, 0008-8846

Siaw Foon Lee, Arild Monsøy, Hilde Lea Lein and Stefan Jacobsen, *"Sample preparation of steel fiber reinforced mortar for ITZ-porosity and microstructure study using BSE-IA"*. Cement and Concrete Research 2009, 0008-8846

Stefan Jacobsen, Lars Haugan, Tor Arne Hammer and Evangelos Kalogiannidis, *"Flow conditions of fresh mortar and concrete in different pipes".* Cement and Concrete Research, pp 997-1006, Vol. 39 2009, 0008-8846

Ueli Angst, Øystein Vennesland and Roar Myrdal, *"Diffusion potentials as source of error in electrochemical measurements in concrete".* Materials and Structures, pp 365-375, Vol. 42 2009, 1359-5997

Xiao H Wang, Stefan Jacobsen, Jian Y He, Zhi L Zhang, Siaw F Lee and Hilde L Lein, *"Application of nanoindentation testing to study of the interfacial transition zone in steel fiber reinforced mortar".* Cement and Concrete Research, pp 701-715, Vol. 39 2009, 0008-8846

Angst, Elsener, Larsen and Vennesland: *"Potentiometric determination of the chloride ion activity in cement based materials"*. Journal of Applied Electrochemistry, pp 564-573, Vol. 40, No. 5 2010, ISSN 1572-8838

Angst, Elsener, Myrdal and Vennesland: *"Diffusion potentials in porous mortar in a moisture state below saturation"*. Electrochimica Acta 55 2010, pp 8545-8555, ISSN 0013-4686

De Weerdt, Sellevold, Kjellsen, Justnes: *"Fly ash -limestone ternary composite cements: Synergetic effect at 28 days"*. Nordic Concrete Research, Vol. 2 2010, ISSN 0800-6377

De Weerdt: *"A comparison of separate and joint grinding of cement and additives. A review of literature"*. Cement, No 6 2010, pp 82-87, ISSN1607-8837

De Weerdt*:"Separate grinding versus inter grinding"*. Cement, No 5 2010, pp 113-116, ISSN1607-8837

Haha, De Weerdt, Lothenbach: *"Quantification of the degree of reaction of fly ash"*. Cement and Concrete Research, pp 1620-1629, Vol. 40, Issue 11 2010, ISSN 0008-8846

Helland, Maage and Aarstein: *"In-field performance of North Sea offshore platforms with regard to chloride resistance".* Structural Concrete, pp 15-24, Vol 11 2010, ISSN 1464-4177

Justnes: “Acceleration by retardation”. Journal of Chinese Ceramic Society, pp 1618-1622, Vol 38, No 9 2010, ISSN 0454-5648

Lee and Jacobsen: *“Sample preparation, image acquisition and image analysis on interfacial transition zone of steel fiber-reinforced mortar”.* Nordic Concrete Research 2010; Volum 41

Lee, Wang and Jacobsen: *“Mix design and the effect of silica fume and steel fiber on rheological and mechanical properties of mortars”*. Nordic Concrete Research 2010, Vol. 41, ISSN 0800-6377

Lindgård, Nixon, Borchers, Schouenborg, Wigum, Haugen and Åkesson: *“The EU “PARTNER” Project — European standard tests to prevent alkali reactions in aggregates: Final results and recommendations”*. Cement and Concrete Research, pp 611-635, Vol. 40 2010, ISSN 0008-8846

Lindgård, Pedersen, Bremseth, Dahl and Rønning:*”Experience using the Norwegian 38°C CPT to evaluate the alkali reactivity of aggregates, concrete mixes and binder combinations”*. Nordic Concrete Research, December 2010, pp 31-50, ISSN 0800-6377

Nguyen, Melandsø and Jacobsen: *“Capillary suction in concrete with analytical pipe model - part 1: numerical study of flow conditions”*. Nordic Concrete Research 2010, Vol 42 pp. 71-87

Nguyen, Melandsø and Jacobsen*:”Time dependant surface heat transfer in light weight aggregate cement based materials”*. Engineering 2010 Vol. 2, pp 307-317, ISSN 1947-3931

Nguyen, Melandsø, Jacobsen: *”Capillary suction in concrete with analytical pipe model - part 2: expansion-, contraction- and random sized sections compared with experiments”.* Nordic Concrete Research 2010 (42-06) s. 89-107

Wang, Jacobsen, Lee, He and Zhang: *”Effect of silica fume, steel fiber and ITZ on the strength and fracture behavior of mortar”.* Materials and Structures 2010; Volum 43.(1-2) pp. 125-139

Angst, Rønnquist, Elsener, Larsen and Vennesland *"Probabilistic considerations on the effect of specimen size on the critical chloride content in reinforced concrete*". Corrosion Science 53, 2011, pp 177-187

De Weerdt, Haha, La Saout, Kjellsen, Justnes and Lothenbach: "Hydration mechanisms of ternary Portland cements containing limestone powder and fly ash". pp 279-291, Cement and Concrete Research Vol 41 2011, ISSN 0008-8846

De Weerdt, Kjellsen, Sellevold and Justnes: "Synergy between fly ash and limestone powder in ternary cements". Cement and Concrete Composites pp 30-38, Vol 33 2011, ISSN 0958-9465

De Weerdt, Sellevold, Kjellsen and Justnes: "Fly ash–limestone ternary cements: effect of component fineness". pp 203-214, Advances in Cement Research No. 23/2011, ISSN 0951-7197

Jelle: *"Traditional, State-of-the-Art and Future Thermal Building Insulation Materials and Solutions - Properties, Requirements and Possibilities",* Energy and Buildings, 43, ISSN 2549 2563, 2011

Østnor and Justnes: *"Anodic corrosion inhibitors against chloride induced corrosion of concrete rebars".* Advances in applied ceramics pp 131-136, Vol 110 2011, ISSN 1743-6753

Justnes, Harald: *"Acceleration by retardation, 4 pages in Cement and its Applications"* (in Russian), September-October issue 2012, ISSN 666-9-015-42

Lindgård, Andiç-Çakır, Fernandes, Rønning, Thomas: *"Alkali–silica reactions (ASR): Literature review on parameters influencing laboratory performance testing",* Cement and Concrete Research, 42 (2012) 223-243

Spangenberg, Roussel, Hattel, Sarmiento, Zirgulis, Geiker:*"Patterns of gravity induced aggregate migration during casting of fluid concrete",* pp 1571-1578, Concrete and Concrete Research Vol 42 Dec. 2012, ISSN 0008-8846

Baghban, Hovde, Jacobsen: *"Analytical and experimental study on thermal conductivity of hardened cement pastes",* Materials and Structures 2013; Volume 46.(9) pp 1537-1546

Bernhardt, Tellesbø, Justnes, Wiik: *"Mechanical properties of lightweight aggregates"*, Journal of European Ceramic Society, 33 (2013), pp 2731-2743

Hornbostel, Larsen, Geiker: "Relationship between concrete resistivity and corrosion rate - A literature review", Cement & Concrete Composites 2013; Volume 39. pp 60-72, http://authors.elsevier.com/sd/article/S0958946513000383

Jacobsen, Cepuritis, Peng, Geiker, Spangenberg: *"Visualizing and simulating flow conditions in concrete form filling using pigments"*, Construction and Building Materials 2013;Volume 49, pp 328-342

Ji, Kanstad, Bjøntegaard, Sellevold: *"Tensile and compressive creep deformations of hardening concrete containing mineral additives"* Materials and Structures: Volume 46, Issue 7 (2013), pp 1167-1182

Lee, Lein, Jacobsen: *"Sample preparation technique on interfacial transition zone of steel fiber reinforced mortar",* Concrete Research Letters 2013; Volume 4.(4) pp 696-715

Lindgård, Sellevold, Thomas, Pedersen, Justnes, Rønning: *"Alkali-silica reaction (ASR) - Performance testing: Influence of specimen pre-treatment, exposure conditions and prism size on concrete porosity, moisture state and transport properties"*, Cement and Concrete Research 53 (2013), pp 145-167

Lindgård, Thomas, Sellevold, Pedersen, Andiç-Çakır, Justnes, Rønning: *"Alkali-silica reaction (ASR) - Performance testing: Influence of specimen pre-treatment, exposure conditions and prism size on alkali leaching and prism expansion"*, Cement and Concrete Research 53 (2013) pp 68-90

Michel, Nygaard, Geiker: *"Experimental investigation on the short-term impact of temperature and moisture on reinforcement corrosion",* Corrosion Science 2013, Volume 72, pp 26-34, DOI 10.1016/j.corsci.2013.02.006

Michel, Solgaard, Pease, Geiker, Stang, Olesen: *"Experimental investigations of the relation between damage at the concrete-steel interface and initiation of reinforcement corrosion in plain and fibre reinforced concrete"*, Corrosion Science 2013, Volume 77. pp 308-321 http://dx.doi.org/10.1016/j.corsci.2013.08.019

Peng Y., Jacobsen S., Pedersen B., Rudberg E.A., De Weerdt K.: *"Filler and plasticizer effects on sedimentation and bleeding of cement paste",* submitted to Materials and Structures, Dec. 2013

Peng Y., Jacobsen S.: *"Influence of water/cement ratio, admixtures and filler on sedimentation and bleeding of cement paste",* Cement and Concrete Research, V.54, 2013, pp. 133-142

T. Gao, B. P. Jelle, A. Gustavsen, Stefan Jacobsen and Harald Justnes: *"Aerogel-Incorporated Concrete: An Experimental Study",* Submitted for publication in Cement and Concrete Research, 2012 Justnes: "Aspects of replacing gypsum with other calcium salts in Portland cement", Advances in Cement Research, Vol. 25, Issue 1, February 2013, pp. 44-50

De Weerdt, Justnes, Geiker: *"Changes in the phase assemblage fo concrete exposed to sea water",* Cement and Concrete Composites Volume 47, 2014, Pages 53–63, Special issue: Durability of concrete

De Weerdt, Orsakova, Geiker: *"Effect of sulphate and magnesium on chloride binding in Portland cement paste",* Cement and Concrete Research, Volume 65, November 2014, Pages 30–40

Justnes, H., Ng, S.: *"Future Challenges for Concrete Admixtures (Part I*)". International Analytical Review Alitinform 1, 2014, ISSN 1998-1295, pp. 48-57

Justnes, H., Ng, S.: *"Future Challenges for Concrete Admixtures (Part II)"*. International Analytical Review Alitinform 2, 2014, ISSN 1998-1295, pp. 30-41

Justnes, H.: *"Properties of gypsum free Portland Cement",* Journal of Sustainable Cement-Based Materials 3, 2014, ISSN 2165-0373, pp. 128-139

Peng Y., De Weerdt K., Pedersen B., Jacobsen S.: *"Measuring sedimentation and bleeding of fresh paste with hydrostatic pressure"* for Nordic Concrete Research 2014, pp.27-38

Peng Y., Jacobsen S., De Weerdt K., Pedersen B **.:** *"Model and test methods for stability of fresh cement paste"*, ASTM-Advances in Civil Engineering Materials, V.3, 2014, pp. 1–24, doi:10.1520/ACEM20130097, ISSN 2165-3984

Østnor, T., Justnes, H.: *"Durability of mortar with calcined marl as supplementary cementing material"*. Advances in Cement Research 26 No 6, 2014

Conference presentations/ proceedings

H. Justnes: "Kalcijev nitrat kot mnogo-funkcianalni dodatek betonu" *("Calcium Nitrate as Multifunctional Concrete Admixture"* in Slovenian), 14th Slovenian colloquium on Concrete, Ljubljana, Slovenia, 29th May, 2007, pp. 21-28 (English version available upon request).

P.A. Dahl, H. Justnes, G. Norden and O. Hyrve: *"Lightweight Aggregate Fines as Pozzolanic Additive for High-Performance Concrete"*, Proceedings of the 9th CANMET/ACI International Conference on Fly Ash, Silica Fume, Slag and Natural Pozzolans in Concrete, ACI SP-242, Ed. Mohan Malhotra, Warszawa, Poland, 21-25th May, 2007, SP-242-26, pp. 333-350.

H. Justnes: "Principle and Performance of Latex-modified Mortars", Proceedings of the Jean Péra Symposium on Special Cements and Sustainability Issues, Ed. Kamal H. Khayat, held in conjunction with the 9th CANMET/ACI International Conference on Recent Advances in Concrete Technology, Warszawa, Poland 23-25 May, 2007, pp. 37-52.

Steinar Helland:*"Aging Factor Concept – Chloride intrusion",* 8th International Symposium on Utilization of High-Strength and High-Performance Concrete - Tokyo, Japan, 2008

Sindre Sandbakk:*"An Investigation of Bond Strength between Fibre and Concrete",* XX Symposium on Nordic Concrete Research - Bålsta, Sweden, 2008

U. Angst, Ø. Vennesland, C. K. Larsen, B. Elsener:*"Critical chloride content for corrosion in reinforced concrete",* XX Symposium on Nordic Concrete Research - Bålsta, Sweden, 2008

Øystein Vennesland, Tor Arne Hammer, Ueli Angst:*"COIN – and durability of concrete structures",* Workshop on: Nordic Exposure Sites - Input to revision of EN 206-1 - Hirtshals, Denmark, 2008

Klaartje De Weerdt, Harald Justnes:*"Comparing Intergrinding and Separate Grinding of Blended Cements",* XX Symposium on Nordic Concrete Research - Bålsta, Sweden, 2008

Christian John Engelsen:*"Concrete Innovation centre (COIN) - Advanced cement materials and the use of bio-admixtures",* 4th International Symposium on the Marine Biotechnology and Advanced Materials, Korea, 2008

Hedda Vikan:,*"Concrete Surface Quality - An Overview",* XX Symposium on Nordic Concrete Research - Bålsta, Sweden, 2008

Harald Justnes, Sindre Sandbakk:*"Concrete with Reduced Cracking",* XX Symposium on Nordic Concrete Research - Bålsta, Sweden, 2008

Hedda Vikan:*"Concrete Workability and Fibre Content - An Overview",* XX Symposium on Nordic Concrete Research - Bålsta, Sweden, 2008

Christian Bråten, Harald I. Andersen:*"Connection between bubble decks - experiments and nonlinear analysis",* The 5th International DIANA Users Meeting - Trondheim, Norway, 2008

Guomin Ji, Terje Kanstad:*"Cracking risk analysis of the Bjøvika submerged tunnel at hardening phase",* The 5th International DIANA Users Meeting - Trondheim, Norway, 2008

Ueli Angst, Øystein Vennesland:*"Critical chloride content in reinforced concrete - state of the art",* 2nd Int. Conf. on Concrete Repair, Rehabilitation and Retrofitting - Cape Town, South Africa, 2008

Ueli Angst, Øystein Vennesland:*"Detecting critical chloride content in concrete using embedded ion selective electrodes – effect of liquid junction and membrane potentials",* Workshop on: Critical chloride content in concrete, Trondheim, Norway , 2008

Claus K. Larsen: *"Durability of surface protection systems in harsh marine climates" ,* 11th International Conference on Durability of Building Materials and Components- Istanbul, Turkey, 2008

Christian John Engelsen, Roar Myrdal:*"Environmental Characterisation of Concrete Products in View of the Ongoing European Standardisation Work",* XX Symposium on Nordic Concrete Research - Bålsta, Sweden, 2008

Terje Kanstad, Åse Døssland, Sindre Sandbakk, Helge Brå:*"Experience with different fibre types and fibre volumes in laboratory testing of structural concrete",* 7th international congress. Concrete: Construction's sustainable option - Dundee, Scotland, 2008

Håvard Nedrelid:*"Experimental testing and constitutive modelling of concrete",* The 5th International DIANA Users Meeting - Trondheim, Norway, 2008

Terje Kanstad:*"Fiberarmering i bærende konstruksjoner:Status og aktuelle forskningsresultater",* Dansk Betongdag - Haderslev, Denmark, 2008

Åse L. Døssland, Terje Kanstad: *"Fibre Reinforcement in Load Carrying Concrete Structures",* The 5th International DIANA Users Meeting - Trondheim, Norway, 2008

Hedda Vikan: *"Fresh Fibre Reinforced Concrete – A State of the art report",* International Workshop & Nordic Miniseminar Fibre Reinforced Concrete - Trondheim, Norway , 2008

Roar Myrdal: *"From Set Retarders to Hardening Retarders: A New Concrete R&D Challenge",* XX Symposium on Nordic Concrete Research - Bålsta, Sweden, 2008

Stefan Jacobsen, Jan Lindgård: *"Frost dilation measurements on concrete cores from a dam with ASR",* 13th ICAAR - Trondheim, Norway, 2008

Stefan Jacobsen, Jan Lindgård: *"Frost dilation measurements on concrete cores from a dam with ASR",* XX Symposium on Nordic Concrete Research - Bålsta, Sweden, 2008

Tor Arne Hammer: *"Future HPC - driven by industrial need for innovation as well as environmental and social needs?",* 8th International Symposium on Utilazation of High-Strength and High-Performance Concrete - Tokyo, Japan, 2008

Justnes, H,, Wuyts, F. and Van Gemert, D: *"Hardening Retarders for Massive Concrete (Awarded best paper at the conference)",* 5th ACI/CANMET International Conference on High-Performance Concrete Structures and Materials - Manaus, Brasil, 2008

Egil Møen, Stefan Jacobsen: *"Ice abrasion on concrete; data and testing" ,* XX Symposium on Nordic Concrete Research - Bålsta, Sweden, 2008

Egil Møen, Stefan Jacobsen: *"Ice abrasion on concrete; data and testing" ,* Nordic Concrete Research Workshop: Ice abrasion on concrete structures -Helsinki, Finland, 2008

Kjell Tore Fosså: *"Improvement of the Ice Zone on Concrete Structures for Sub Arctic Areas",* Nordic Concrete Research Workshop: Ice abrasion on concrete structures -Helsinki, Finland, 2008

Steinar Helland, Ragnar Aarstein, Magne Maage: *"In-field performance of north sea hsc/hpc offshore platforms with regard to chloride resistance",* Nordic Concrete Federation Workshop - Hirtshals, Denmark, 2008

Håvard Nedreli, Svein Ivar Sørensen, Helge Brå: *"Lightweight Aggregate Concrete under Triaxial Compression",* XX Symposium on Nordic Concrete Research - Bålsta, Sweden, 2008

Klaartje De Weerdt, Harald Justnes: *"Microstructure of binder from the pozzolanic reaction between lime and siliceous fly ash, and the effect of limestone addition",* 1st Int. Conf. Microstructure Related Durability of Cementitious Composites - Nanjing, China, 2008

Roar Myrdal: *"Non-chloride Accelerating Admixtures for Concrete: An Overview and Current Norwegian Research",* XX Symposium on Nordic Concrete Research - Bålsta, Sweden, 2008

I. Sæther: *"Numerical simulations of service life cycle of reinforced concrete structures" ,* The 5th International DIANA Users Meeting - Trondheim, Norway, 2008

Gro Markeset: *"Operation Service Life Design - A Focus Area in COIN",* XX Symposium on Nordic Concrete Research - Bålsta, Sweden, 2008

Stein Are Berg, Stefan Jacobsen: *"Packing of fibres and aggregate reviewed and calculated with Westmans equation" ,* International Workshop & Nordic Miniseminar Fibre Reinforced Concrete - Trondheim, Norway , 2008

Klaartje De Werdt, Tone Østnor, Harald Justnes: *"Pozzolanic activity of sintered clay and interaction with limestone powder",* Cement and Concrete Science - Manchester, UK, 2008

Esko Sistonen, Stefan Jacobsen: *"Probabilistic Service Life Modeling of Ice Abrasion on Concrete Structures",* Nordic Concrete Research Workshop: Ice abrasion on concrete structures -Helsinki, Finland, 2008

Sindre Sandbakk, Åse Døssland, Terje Kanstad: "*Pullout testing of different fibre types",* International Workshop & Nordic Miniseminar Fibre Reinforced Concrete - Trondheim, Norway , 2008

Stefan Jacobsen: *"Pumpability of mortar and concrete as related to rheology",* XX Symposium on Nordic Concrete Research - Bålsta, Sweden, 2008

Harald Justnes: *"Rapid repair of airfield runway in cold weather using CAC mortar",* Centenary Conference 2008; Calcium Aluminate Cements - Avignon, France, 2008

Christian John Engelsen: *"Recent advances in modelling of the constituent release from recycled concrete aggregates with different degree of carbonation",* International Conference Sustainable Concrete Construction - Ratnagiri, India, 2008

Terje Kanstad, Yngvil H. Øvrelid, Sindre Sandbakk, Stefan Jacobsen: *"Recent experience with load carrying concrete structures containing large amounts of synthetic and steel fibres",* International Workshop & Nordic Miniseminar Fibre Reinforced Concrete - Trondheim, Norway , 2008

Magne Maage: *"Shore Approach - 26 years' experience with high quality concrete in XS3 exposure",* Nordic Concrete Federation Workshop - Hirtshals, Denmark, 2008
Øystein Vennesland, J. I. Kvamme, H. H. Bjørnsen and Marte Næss: *"Stainless steel as reinforcement in concrete",* Eurocorr - Edinburgh, UK, 2008

Stefan Jacobsen: *"Sustainable cement and concrete industry – an overview of the international conference in Lillehammer, Norway 2007",* 2008 International Expert Workshops on Cement & Concrete Technology for Sustainable Development -Beijing, Shenyang and Jinan, China, 2008

Tor Arne Hammer: *"The Norwegian Concrete Research Progamme COIN",* XX Symposium on Nordic Concrete Research - Bålsta, Sweden, 2008

Klaartje De Weerdt, Harald Justnes: *"The reactivity of Fly Ash and Limestone in Cementitious Systems",* Cement and Concrete Science - Manchester, UK, 2008

Klaartje De Weerdt, Harald Justnes: *"The reactivity of Portland cement containing limestone and fly ash",* Cement and Concrete Science - Manchester, UK, 2008

Siaw Foon Lee, Jianying He, Xiao Hui Wang, Zhiliang Zhang and Stefan Jacobsen: *"Study of P-h curves on nanomechanical properties of steel fiber reinforced mortar",* 3rd International Symposium on Nanotechnology in Construction, Prague, Czech Republic, 1 June 2009

Siaw Foon Lee, Xiao Hui Wang and Stefan Jacobsen: *"Effect of steel fiber on the rheological and mechanical behaviour of self-compacting mortar",* 2nd European Asian Civil Engineering Forum, Langkawi, Malaysia, 4 August 2009

Siaw Foon Lee, Xiao Hui Wang and Stefan Jacobsen: *"Effect of steel fiber on the rheological and mechanical behaviour of self-compacting mortar",* 7th Asia Pacific Structural Engineering and Construction Conference, Langkawi, Malaysia, 6 August 2009

Igor Sartori: *"Night flushing and ceiling acoustic solutions: the effect on summer thermal comfort and energy demand",* CISBAT, Lausanne, Switzerland, 2 September 2009

Hedda Vikan: *"Influence of temperature, cement and plasticizer type on the rheology of paste",* pp 371-380 in Design, Performance and Use of Self-Consolidating Concrete, SCC'2009 (Proceedings PRO065), Rilem Publications, 978-2-35158-073-8

Hedda Vikan, Lars Haugan and Stefan Jacobsen: *"Rheology and pumpability of mortar",* pp 88-96 in Rheology of Cement Suspensions such as Fresh Concrete: Proceedings of the 3rd International RILEM Symposium (RILEM Proceedings PRO 68), Rilem Publications s.a.r.l., 978-2-351580912

Siaw Foon Lee and Stefan Jacobsen: *"Backscattered electron imaging analysis on interfacial transition zone between steel fiber and cement paste in steel fiber reinforced mortar",* European Congress and Exhibition on Advanced Materials and Process, Glasgow, UK, 8 September 2009

Klaartje De Weerdt and Harald Justnes: *"Synergic Reactions in Triple Blended Cements",* 11th NCB International Seminar on Cement and Building Materials, New Dehli, India, 18 November 2009

Roar Myrdal: *"Development of Chemical Admixtures for Early Hardening of Blended Cements",* 11th NCB International Seminar on Cement and Building Materials, New Dehli, India, 19 November 2009

Terje Kanstad, Gunrid Kjellmark, Anja B. E. Klausen and Øyvind Bjøntegaard: *"Updated Temperature-Stress-Testing-Machine (TSTM): Introductory test results and determination of material properties development"*, Proceedings XXI Nordic Concrete Research Symposia pp 211-214, ISBN 978-82-8208-025-5

Kien Dinh Hoang, Mette Geiker, Harald Justnes and Roar Myrdal: *Effect of chemical admixtures on the early strength development of fly ash blended cement at low temperature"*, Proceedings XXI Nordic Concrete Research Symposia pp 273-276, ISBN 978-82-8208-025-5

Klaartje De Weerdt, Harald Justnes and Knut O. Kjellsen: *"Synergetic effect between fly ash and limestone powder in Portland composite cements"*, Proceedings XXI Nordic Concrete Research Symposia pp 297-300, ISBN 978-82-8208-025-5

Rolands Cepuritis, Stefan Jacobsen, Bård Pedersen, Hedda Vikan, Espen Rudberg, Klaartje De Weerdt, Ya Peng and Børge J. Wigum: *"Rheology of matrix with different crushed mineral fillers and admixtures"*, Proceedings XXI Nordic Concrete Research Symposia pp 359-362, ISBN 978-82-8208-025-5

Terje Kanstad and Sindre Sandbakk: *"Ductile high tensile strength concrete"*, Proceedings XXI Nordic Concrete Research Symposia pp 395-398, ISBN 978-82-8208-025-5

Terje Kanstad and Sindre Sandbakk: *"Panel- beam testing of fibre reinforced concrete"*,: Proceedings XXI Nordic Concrete Research Symposia pp 399-402, ISBN 978-82-8208-025-5

Gunrid Kjellmark and Terje Kanstad: *"Autogenous deformation of concrete: Introductory tests with 7 new temperature controlled dilation rigs"*, Proceedings XXI Nordic Concrete Research Symposia pp 481-484, ISBN 978-82-8208-025-5

Linn Grepstad Nes ans Jan Arve Øverli: *"Investigation of material parameters and structural performance of hybrid concrete beams"*, Proceedings XXI Nordic Concrete Research Symposia pp 509-512, ISBN 978-82-8208-025-5

Mari Bøhnsdalen Eide, Hedda Vikan, Kristin Kaspersen and Helene Schulerud: *"Classification system for formed concrete surfaces"*, Proceedings XXI Nordic Concrete Research Symposia pp 521-523, ISBN 978-82-8208-025-5

Stefan Jacobsen: *"Ice abrasion by hydraulic pore pressure at rough concrete surface-ice indentation"*, Proceedings XXI Nordic Concrete Research Symposia pp 163-166, ISBN 978-82-8208-025-5

Østnor, De Weerdt, Justnes and Bjøntegaard: *"Reactivity and Microstructure of Ternary Cement Pastes"*, pp 296-303, Cementing a sustainable future XIII ICCC International Congress on the Chemistry of Cement Madrid, 3-8 July, 2011, pp 296-302, ISBN 847-29-2399-7

De Weerdt, Justnes, Lothenbach and Haha: "*The Effect of Limestone Powder Additions on Strength and Microstructure of Fly Ash Blended Cements",* pp 219-226, Cementing a sustainable future XIII ICCC International Congress on the Chemistry of Cement Madrid, 3-8 July, 2011, ISBN 847-29-2399-7

Mullick, A.K., Justnes, H., Fidjestøl, P. and Harsh, S.: *"Ternary cement blends for improved sustainability"*, Cementing a sustainable future XIII ICCC International Congress on the Chemistry of Cement Madrid, 3-8 July, 2011, pp 297-300, ISBN 847-29-2399-7

Jacobsen, Vikan and Haugan: *"Flow of SCC along surfaces"*, Springer, pp 163-173: Design, Production and Placement of Self-Consolidating Concrete", ISBN 978-90-481-9663-0

Berg and Jacobsen: *"Packing and aggregate/ fibre – void saturation to proportion self compacting fibre reinforced concrete"*, 2nd International conference on sustainable construction materials and technologies – proceeding of honorary sessions, pp 265-276, Italy: Universita Politecnica delle Marche 2010 ISBN 978-1-4507-1487-7

Tor Arne Hammer: *"COIN – Concrete Innovation Center"*, Proceedings XXI Nordic Concrete Research Symposia pp 7-10, ISBN 978-82-8208-025-5

Ya Peng and Stefan Jacobsen: *"SCC Stability affected by fillers and VMA"*,: Proceedings XXI Nordic Concrete Research Symposia pp 73-76, ISBN 978-82-8208-025-5

Hedda Vikan and Klaartje De Weerdt: *"Rheological properties of self-consolidating concrete stabilized with fillers or admixtures"*, Proceedings XXI Nordic Concrete Research Symposia pp 77-80, ISBN 978-82-8208-025-5

Stefan Jacobsen, Rolands Cepuritis and Ya Peng: *" SCC flow visualization in formfilling with black and grey concrete"*,: Proceedings XXI Nordic Concrete Research Symposia pp 95-98, ISBN 978-82-8208-025-5

Ueli Angst, Øystein Vennesland, Claus K. Larsen and Bernhard Elsener: *"Results from the Norwegian COIN project on chloride induced reinforcement corrosion in concrete"*,: Proceedings XXI Nordic Concrete Research Symposia pp 111-114, ISBN 978-82-8208-025-5

Karla Hornbostel, Claus K. Larsen and Mette Geiker: *"The electrical resisitivity on concrete as service life parameter"*: Proceedings XXI Nordic Concrete Research Symposia pp 123-126, ISBN 978-82-8208-025-5

Angst, Elsener, Larsen and Vennesland: *"Considerations on the effect of sample size for the critical chloride content in concrete",* Proceedings of 2nd International Symposium of Service Life Design for Infrastructure, Delft, The Netherlands. Vol. 1. Ed: van Breugel K et al. RILEM Publications S.A.R.L., 2010, pp. 569-576. ISBN 978-2-35158-113-1

Østnor, Justnes and De Weerdt: *"Calcined Marl as Alternative Pozzolan"*, Proceedings of the Cement and Concrete Science Conference, Sept. 13-16 2010, Birmingham, UK, pp 37-40, ISBN 978-070442-797-6

Jacobsen: *"Moisture flow into concrete exposed to frost and ice*: *Freeze-thaw testing of concrete - input to revision of CEN test methods*." Denmark: Nordic Concrete Federation 2010 ISBN 978-82-8208-020-0. pp 119-132

Jacobsen, Vikan and Haugan: *"Flow of SCC along surfaces"*, SCC 2010, Montreal 26-29 September 2010

Vikan, Hammer and Kjellsen: "*Drying shrinkage of SCC – influence of the composition of ternary composite",* SCC 2010, Montreal 26-29 September 2010

Angst, Larsen, Vennesland and Elsener: *"Influence of casting direction on chloride induced rebar corrosion",*Concrete under Severe Conditions, Environment and Loading, Volume 1. Ed: Castro-Borges P et al. CRC Press, 2010, pp 359-366. ISBN 978-0-415-59316-8

Angst, Larsen, Vennesland and Elsener: "Concrete under severe conditions, environment and loading", Mexico: Published in Proceedings (not presented), 2010

Justnes: *"Acceleration by retardation"*, Proceedings of the 7th International Symposium on Cement and Concrete, May 9-12, 2010, Jinan, China

De Weerdt: *"Ternary cements containing limestone powder and fly ash"*, 3rd GEMS Workshop on Thermodynamic Modelling in Cementitious Systems, Dübendorf, Switzerland 28-29 June 2010

De Weerdt and Justnes: *"The synergetic interaction between limestone powder and fly ash in ternary cements – evaluation over time and temperature"*, Cement and Concrete Science Conference, Sept. 13-16 2010, Birmingham, UK

Markeset and Skjølsvold: *"Time dependent chloride diffusion coefficient – field studies of concrete exposed to marine environment in Norway"*, Service Life Design for Infrastructure, Delft, The Netherlands 4-6 October 2010

Tor Arne Hammer: *"COIN – Concrete Innovation Center"*, Proceedings XXI Nordic Concrete Research Symposia pp 7-10, ISBN 978-82-8208-025-5

Ya Peng and Stefan Jacobsen: *"SCC Stability affected by fillers and VMA"*,: Proceedings XXI Nordic Concrete Research Symposia pp 73-76, ISBN 978-82-8208-025-5

Hedda Vikan and Klaartje De Weerdt. *"Rheological properties of self-consolidating concrete stabilized with fillers or admixtures"*,Proceedings XXI Nordic Concrete Research Symposia pp 77-80, ISBN 978-82-8208-025-5

Stefan Jacobsen, Rolands Cepuritis and Ya Peng: *" SCC flow visualization in formfilling with black and grey concrete"*,: Proceedings XXI Nordic Concrete Research Symposia pp 95-98, ISBN 978-82-8208-025-5

Ueli Angst, Øystein Vennesland, Claus K. Larsen and Bernhard Elsener: *"Results from the Norwegian COIN project on chloride induced reinforcement corrosion in concrete"*,: Proceedings XXI Nordic Concrete Research Symposia pp 111-114, ISBN 978-82-8208-025-5

Karla Hornbostel, Claus K. Larsen and Mette Geiker: *"The electrical resisitivity on concrete as service life parameter"*,: Proceedings XXI Nordic Concrete Research Symposia pp 123-126, ISBN 978-82-8208-025-5

Terje Kanstad, Gunrid Kjellmark, Anja B. E. Klausen and Øyvind Bjøntegaard: *"Updated Temperature-Stress-Testing-Machine (TSTM): Introductory test results and determination of material properties development"*, Proceedings XXI Nordic Concrete Research Symposia pp 211-214, ISBN 978-82-8208-025-5

Kien Dinh Hoang, Mette Geiker, Harald Justnes and Roar Myrdal: *Effect of chemical admixtures on the early strength development of fly ash blended cement at low temperature"*, Proceedings XXI Nordic Concrete Research Symposia pp 273-276, ISBN 978-82-8208-025-5

Klaartje De Weerdt, Harald Justnes and Knut O. Kjellsen: *"Synergetic effect between fly ash and limestone powder in Portland composite cements"*, Proceedings XXI Nordic Concrete Research Symposia pp 297-300, ISBN 978-82-8208-025-5

Rolands Cepuritis, Stefan Jacobsen, Bård Pedersen, Hedda Vikan, Espen Rudberg, Klaartje De Weerdt, Ya Peng and Børge J. Wigum: *"Rheology of matrix with different crushed mineral fillers and admixtures"*, Proceedings XXI Nordic Concrete Research Symposia pp 359-362, ISBN 978-82-8208-025-5

Terje Kanstad and Sindre Sandbakk: *"Ductile high tensile strength concrete"*, Proceedings XXI Nordic Concrete Research Symposia pp 395-398, ISBN 978-82-8208-025-5

Terje Kanstad and Sindre Sandbakk: *"Panel- beam testing of fibre reinforced concrete"*,: Proceedings XXI Nordic Concrete Research Symposia pp 399-402, ISBN 978-82-8208-025-5

Gunrid Kjellmark and Terje Kanstad: *"Autogenous deformation of concrete: Introductory tests with 7 new temperature controlled dilation rigs"*, Proceedings XXI Nordic Concrete Research Symposia pp 481-484, ISBN 978-82-8208-025-5

Linn Grepstad Nes ans Jan Arve Øverli: *"Investigation of material parameters and structural performance of hybrid concrete beams"*, Proceedings XXI Nordic Concrete Research Symposia pp 509-512, ISBN 978-82-8208-025-5

Mari Bøhnsdalen Eide, Hedda Vikan, Kristin Kaspersen and Helene Schulerud: *"Classification system for formed concrete surfaces"*, Proceedings XXI Nordic Concrete Research Symposia pp 521-523, ISBN 978-82-8208-025-5

Stefan Jacobsen: *"Ice abrasion by hydraulic pore pressure at rough concrete surface-ice indentation"*, Proceedings XXI Nordic Concrete Research Symposia pp 163-166, ISBN 978-82-8208-025-5

Østnor, De Weerdt, Justnes and Bjøntegaard: *"Reactivity and Microstructure of Ternary Cement Pastes"*, pp 296-303, Cementing a sustainable future XIII ICCC International Congress on the Chemistry of Cement Madrid, 3-8 July, 2011, pp 296-302, ISBN 847-29-2399-7

De Weerdt, Justnes, Lothenbach and Haha: "*The Effect of Limestone Powder Additions on Strength and Microstructure of Fly Ash Blended Cements",* pp 219-226, Cementing a sustainable future XIII ICCC International Congress on the Chemistry of Cement Madrid, 3-8 July, 2011, ISBN 847-29-2399-7

Mullick, A.K., Justnes, H., Fidjestøl, P. and Harsh, S.: *"Ternary cement blends for improved sustainability"*, Cementing a sustainable future XIII ICCC International Congress on the Chemistry of Cement Madrid, 3-8 July, 2011, pp 297-300, ISBN 847-29-2399-7

Justnes, H.: *"Concrete Durability – Where do we stand in service life predictions?"*, Proceedings of 12th NCB International Seminar on Cement and Building Materials, 15-18 November 2011, New Delhi, India, pp. 30-74

Myrdal, R., Reknes, K., Engelsen, C.J. and Justnes, H.: *"The role of chemical admixtures in blended cement and concrete and ongoing new developments"*, Proceedings of 12th NCB International Seminar on Cement and Building Materials, 15-18 November 2011, New Delhi, India, 324 pp

Nes and Øverli: *"Investigation of material parameters and structural performance of a concrete sandwich slab element"*, fib Symposium, Prague, Czech Republic 8-10 June 2011

Kanstad and Sandbakk: *"Fibre reinforced superlight concrete: Testing of materials and full-scale beams"*, fib Symposium, Prague, Czech Republic 8-10 June 2011

Martius-Hammer, Pedersen, Wigum, Tellesbø, Bernhardt and Jan Lindgård: *"Innovation in aggregates for concrete; manufactured sand, LWA and AAR"*, 7th Central European Congress on concrete engineering, Balatonfüred, Hungary 22-23 September 2011

Hauck,C.J., Bathen,L., Mathisen,A-E.: *" The effect of air entraining admixture on sprayed concrete fresh and hardened properties"* , Proceedings of the Sixth International symposium on sprayed concrete- Modern use of wet mix sprayed concrete for underground support, Tromsø, Norway September 2011

Mathisen, A-E, Nikolaisen, E.B., Bathen,L., Hauck,C.J.: *"Distribution of fibres in fresh fibre reinforced concrete"*, Proceedings of the Sixth International symposium on sprayed concrete- Modern use of wet mix sprayed concrete for underground support. Tromsø, Norway September 2011

Bjøntegaard, Ø., Myren, S.A.: *"Fibre reinforced sprayed concrete panel tests:revised test and analysis procedure in NB7: Sprayed concrete for rock support*", Proceedings of the Sixth International symposium on sprayed concrete- Modern use of wet mix sprayed concrete for underground support. Tromsø, Norway September 2011

Kanstad, Terje; Sandbakk, Sindre: *"Fibre reinforced superlight concrete: testing of materials and full-scale beams"*, fib Symposium 2011: Concrete Engineering for excellence and efficiency. Prague: fib-International Federation for Structural Concrete 2011 pp. 277-280, ISBN 978-80-87158-29-6

Engelsen, C.J., Justnes, H., Thakur, V. and Myrdal, R.: *"The Indo-Norwegian initiative on sustainable utilization of alternative materials in cement and concrete"*, Proceedings of the Roving National Seminars pp 30-36, January 10-14 2011, Bengaluru, Jaipur, Nagpur and Kolkata, India

Justnes, H.: *"Concrete with high volume of supplementary cementing materials and admixtures for sustainable and productive construction"*, Proceedings of the Roving National Seminars pp 30-36, January 10-14 2011, Bengaluru, Jaipur, Nagpur and Kolkata, India

Engelsen, C.J., Arora, V.V., Gedam, V., Kumar, S., Mullick, A.K., Srinivasan, I., Myrdal, R., Labhasetwar, P.K., Fidjestøl, P., Reknes, K., Justnes, H. and Thakur, V.: "The Indo-Norwegian Project on Alternative Materials in Cement and Concrete – Systematic accumulation of material properties" Proceedings of 12th NCB International Seminar on Cement and Building Materials, 15-18 November 2011, New Delhi, India, 347 pp.

Harsh, S., Engelsen, C.J, Mullick, A.K., Justnes, H., Arora, V.V. and Fidjestøl, P.: " The Indo-Norwegian Project on Alternative Materials in Cement and Concrete – Coal based bottom ash properties according to Indian Specifications", Proceedings of 12th NCB International Seminar on Cement and Building Materials, 15-18 November 2011, New Delhi, India, 351 pp.

Justnes, H.: *"Concrete Durability – Where do we stand in service life predictions?"*, Key-note lecture, Proceedings of 12th NCB International Seminar on Cement and Building Materials, 15-18 November 2011, New Delhi, India, pp. 30-74

Myrdal, R., Reknes, K., Engelsen, C.J. and Justnes, H.: "The role of chemical admixtures in blended cement and concrete and ongoing new developments", awarded Best paper Proceedings of 12th NCB International Seminar on Cement and Building Materials, 15-18 November 2011, New Delhi, India, 324 pp

Jelle, Gustavsen, Time, Skogstad, Dalehaug: Properties, Requirements and Possibilities for Traditional, State-of-the-Art and Future Thermal Building Insulation Materials and Solutions, Proceedings of the 9th Nordic Symposium on Building Physics (NSB 2011), pp. 593-600, Tampere, Finland, 29 May – 2 June, 2011

Jelle, Tilset, Gao, Sandberg Gustavsen: Nanomaterials for Thermal Building Insulation, Norway China Workshop on Nanotechnology for Renewable Energy Materials, Trondheim, Norway, 31 August - 1 September, 2011

Nes, Linn Grepstad and Øverli, Jan: Presentation on BEFIB in Guimaráes, Portugal, September 19-21, 2012

Lindgård, Rønning, Thomas: Development on an ASR performance test: Preliminary result from a PhD study, Proceedings of the 14th International Conference on Alkali-Aggregate Reactions in Concrete, Austin, Texas, May, 2012

Peng, Ya and Rudberg, Espen: Presentation at 10th CANMET/ ACI in Prag, Chezh Republic, October 28-31, 2012

Martius-Hammer, Tor Arne and Kanstad, Terje: Presentation at ERMCO in Verona, Italia, June 20-22, 2012

Geiker, Mette: Presentation at International RILEM Workshop on Present and Future Durability Challenges of RC structures, Zürich, Switzerland April 17-18, 2012

Justnes, Geiker: A critical view on service life predictions based on chloride induced corrosion, Keynote, 2nd international conference on Microstructure related Durability properties of Cementitious Composites, Amsterdam, April 11-13, 2012

Flint, Michel, Gussiås, Larsen, Østvik, Billington, Geiker: Overview of US-Norway collaboration on bridge repair sustainability, Proceedings of the 1st International Congress on Durability of Concrete (ICDC), Trondheim, Norway, June 18-21, 2012, ISBN 978-82-8208-031-6

Hornbostel, Larsen, Geiker: Relationship between concrete resistivity and corrosion rate – a literature review, Proceedings of the 1st International Congress on Durability of Concrete (ICDC), Trondheim, Norway, 18-21 June, 2012, ISBN 978-82-8208-031-6

Geiker, Justnes: Prediction of chloride induced corrosion for service life modelling, Keynote, Proceedings of the 1st International Congress on Durability of Concrete (ICDC), Trondheim, Norway, June 18-21, 2012, ISBN 978-82-8208-031-6

Østnor, Justnes, Rudolfsen: Strength development and durability of mortars with calcined marl as supplementary cementing material, Proceedings of the 1st International Congress on Durability of Concrete (ICDC), Trondheim, Norway, June 18-21, 2012, ISBN 978-82-8208-031-6

Østnor, Justnes, Rudolfsen: Strength development and durability of mortars with calcined marl as supplementary cementing material, Proceedings of the 32nd Cement and Concrete Science Conference, Belfast, UK, 17-18 September 2012, 5 pp

Justnes, Østnor, Rudolfsen: Calcined Marl as Alternative Pozzolan, Proceedings of 5th International Conference of Asian Concrete Federation, Chonburi, Thailand, 24-26 October 2012, Paper no. 154, 5 pp

Justnes: Aspects of Gypsum-free Portland Cement, Proceedings of 10th (former CANMET/ACI) International Conference on Superplasticizers and Other Chemical Admixtures in Concrete", Prague, Czech Republic, October 28-31 2012, SP-66, 15 pp

Danner, Østnor, Justnes: Calcined Marl as Pozzolana for Sustainable Development of the Cement and Concrete Industry, Proceedings of the 12th CANMET/ACI International Conference on Recent Advances in Concrete Technology and Sustainability Issues, Prague, Czech Republic, October 30 – November 1, 2012, 12 pp

De Weerdt, Geiker: Changes in the phase assemblage of concrete exposed to seawater - case study, Proceedings of the 1st Conference on Durability of Concrete (ICDC), Trondheim, Norway, June 18-21, 2012, ISBN 978-82-8208-031-6

Lindgård: Development of an ASR performance test - some results from a PhD study, presentation at the RILEM TC 219-ACS seminar/workshop, Izmir, Turkey, 11th October 2012

Jacobsen, Bekker, Uvarova, Pomnikov, Kim, Fosså: Concrete Ice Abrasion: Deterioration Mechanisms, Testing and Modeling, Proceedings ICDC 2012 International Congress on Durability of Concrete Trondheim Norway, June 18-21. ISBN 978-82-8208-031-6

Jacobsen, Kim, Pomnikov: Concrete Destructure due to Ice-Indentation Pore Pressure, Proceedings of the Twenty-second (2012) International Offshore and Polar Engineering Conference. International Society of Offshore & Polar Engineers 2012 ISBN 978-1-880653-94-4, pp 1258-1263

Jacobsen, Ollendorff, Geiker, Tunstall, Scherer: Predicting AEA dosage by Foam Index and adsorption on Fly Ash, Durability Aspects of Fly Ash and Slag in Concrete Workshop Proceedings from a Nordic Mini seminar Oslo - Norway, February 15-16, 2012. Oslo: Nordic Concrete Federation 2012 ISBN 978-82-8208-034-7, pp 103-120

Kim, Jacobsen, Bekker, Fosså: Ice-concrete abrasion study, NORTRIB 2012 - 15th Nordic Symposium on Tribology; 2012-06-12 - 2012-06-15

Nguyen, Jacobsen, Melandsø: Capillary Suction Model as Pipes of Different Sizes: Flow Conditions and Comparison with Experiments, Proceedings ICDC 2012 International Congress on Durability of Concrete Trondheim, June 18-21, 2012, ISBN 978-82-8208-031-6

Peng, Jacobsen, De Weerdt, Pedersen, Marstrander: Overview of Rheological Parameters Affecting Stability of SCC, Tenth International Conference on Superplasticizers and other Chemical Admixtures, Proceedings ACI SP-288, Prague October 2012. American Concrete Institute 2012 ISBN 0-870-31775-X. s. 481-496

Justnes, Ng: *"Chemical Admixtures – The way forward"*, invited paper at Innovations in Concrete Construction (UKIERI), 5-8 March 2013, Jalandhar, Punjab, India

Justnes: *"Properties of Gypsum-free Portland Cement"*, invited paper at 8th International Symposium on Cement and Concrete (ISCC), 20-23 Sept 2013, Nanjing, China

Øverli: *"Ductility of LWAC structures"*, Proceedings of the 2013 fib Symposium, April 22-24 2013, Tel-Aviv, Israel

Rønning, Lindgård, Bremseth*: "ASR Assessment – Concrete prism testing within a regulatory framework"*, Proceedings of 11th Interational Conference on Modern Building Materials, Structures and Techniques, 16-17 May 2013, Vilnius, Lithuania

Danner, Østnor, Justnes: *"Thermally activated marl as a pozzolan for cementitious based products"*, *Proceedings of* 5th International Conference on The Concrete Future, 26-29 May 2013, Covilhã, Portugal

Justnes: *"How to make concrete more sustainable"*, 1st International Conference on Concrete Sustainability (ICCS13), 27-29 May 2013, Tokyo, Japan

De Weerdt, Østnor, Justnes, Haha, Kjellsen: *"Fly-ash limestone synergy in triple cement"*, 1st International Conference on Concrete Sustainability (ICCS13), 27-29 May 2013, Tokyo, Japan

Østnor, Justnes, Rudolfsen: *"Strength development and durability of mortars with calcined marl as supplementary cementing material"*, 1st International Conference on Concrete Sustainability (ICCS13), 27-29 May 2013, Tokyo, Japan

Lepech, Geiker, Stang: *"Assessing the role of limit state selection in the design and maintenance of sustainable concrete structures"*, 1st International Conference on Concrete Sustainability (ICCS13), 27-29 May 2013, Tokyo, Japan

Lepech, Geiker, Stang: *"Probilistic design framework for sustainable civil concrete infrastructure",* 1st International Conference on Concrete Sustainability (ICCS13), 27-29 May 2013, Tokyo, Japan

Cepuritis, Jacobsen, Wigum: *"Crushed aggregate fines for SCC: specific surface and pore size study"*, SCC2013 5th North-American Conference on the Design and Use of Self-Consolidating Concrete; 12-15 May 2013, Chicago, USA

Cepuritis, Jacobsen, Wigum: *"SCC aggregate particle size, porosity, absorption and density: surface & pore size assessment"*, Fifth North American Conference on the Design and Use of Self Consolidating Concrete, 12-15 May 2013, Chicago, USA

Martius-Hammer, Kjellmark, Kanstad: *"Mix design of structural fibre reinforced self-compacting concrete with high fiber content"*, 12-15 May 2013, Chicago, USA

Peng, Jacobsen, De Weerdt, Pedersen: *"Conceptual model and test methods for fresh cement paste"*, Fifth North American Conference on the Design and Use of Self Consolidating Concrete, 12-15 May 2013, Chicago, USA

Cepuritis, Jacobsen, Pedersen: *"SCC matrix rheology with crushed aggregate fillers:effect of physical and mineralogical properties, replacement, co-polymer type and w/b ratio"*, 7th International RILEM conference on Self-Compacting Concrete, 67th RILEM week; 1-6 September 2013

Zirgulis, Geiker, Oldrich, Kanstad: *"Potential methods for quality control of fibre distribution in FRC SCC",* Paris SCC 2013, 1st International RILEM Conference on Rheology and Processing of Construction Materials, 7th RILEM Conference on Self-Compacting Concrete, 2-4 September 2013, Paris, France

Justnes, De Weerdt, Geiker: *"Chloride bindings in concrete exposed to sea water and salt solutions"*, Proceedings, Seventh International Conference on Concrete under Severe Conditions - Environment and Loading. Rilem publications 2013, ISBN 978-2-35158-124-7, pp 647-659

Hornbostel, Geiker, Larsen: *"Application of segmented rebars for studying corrosion of steel in concrete"*, EuroCorr 2013, 1-5 Sept 2013, Estoril, Portugal

Ng, Justnes: "Influence of Lignosulfonate on the Early Age Rheology and Hydration Characteristics of Cement Pastes", 8th International Symposium on Cement and Concrete (ISCC), 20-23 Sept 2013, Nanjing, China

Justnes, De Weerdt, Geiker: *"Chloride binding in concrete exposed to seawater and salt solutions"*, 7th International Conference on Concrete under Severe Loading (CONSEC), 23-25 September 2013, Nanjing, China

Justnes, De Weerdt, Geiker: *"10 year old concrete wall in tidal zone examined by SEM-EDS"*, 14th Euroseminar on microscropy applied to building materials, 10-14 June 2013, Helsingør, Denmark: Book of extended abstracts : EMABM 2013. Helsingør: Danish Technological Institute 2013 ISBN 978-87-996246-0-7, pp 144-147

Hisdal, Zirgulis, Vidal Sarmiento, Kanstad: *"Strut and tie models for disturbed regions: Steel fibre reinforced concrete dapped end beams",* Research and applications in structural engineering, mechanics and computation: Proceedings of the 5th International Conference on Structural Engineering, Mechanics and Computation, SEMC 2013. CRC Press 2013, ISBN 978-1-138-00061-2, s. 1573-1578

Justnes, Ng: *"Future Challenges for Concrete Admixtures"*, II Global Conference on Chemistry and Technology of Concrete, 26-27 November 2013, Moskva, Russia

Justnes: *"Properties of Gypsum-free Portland Cement Using Calcium Nitrate as Set Regulator"*, II Global Conference on Chemistry and Technology of Concrete, 26-27 November 2013, Moskva, Russia

Bjøntegaard, Klausen, Kanstad: *"On materials testing and crack risk evaluation of hardening concrete structures"*, Workshop Proceedings "Understanding the Fundamental Properties of Concrete" Celebrating Professor Erik J. Sellevold on his 75th birthday, 25th-26th April 2013, Trondheim, Norway. Trondheim: NTNU-trykk 2013 ISBN 82-7482-101-7. s. 203-221

Peng, Jacobsen: *"Effect of materials on sedimentation of cement paste",* Workshop Proceedings "Understanding the Fundamental Properties of Concrete" Celebrating Professor Erik J. Sellevold on his 75th birthday, 25th-26th April 2013, Trondheim, Norway. Trondheim: NTNU-trykk 2013 ISBN 82-7482-101-7. p. 183-202

Justnes: *"Gypsum free cement",* Workshop Proceedings "Understanding the Fundamental Properties of Concrete" Celebrating Professor Erik J. Sellevold on his 75th birthday, 25th-26th April 2013, Trondheim, Norway. Trondheim: NTNU-trykk 2013 ISBN 82-7482-101-7

De Weerdt, Colombo, Geiker: *"Impact of the associated cation on chloride binding of Portland cement paste",* Workshop Proceedings "Understanding the Fundamental Properties of Concrete" Celebrating Professor Erik J. Sellevold on his 75th birthday, 25th-26th April 2013, Trondheim, Norway. Trondheim: NTNU-trykk 2013 ISBN 82-7482-101-7, p. 119-126

Lindgård: *"Alkali-Silica reactions (SR) – PhD study on performance testing",* Workshop Proceedings "Understanding the Fundamental Properties of Concrete" Celebrating Professor Erik J. Sellevold on his 75th birthday, 25th-26th April 2013, Trondheim, Norway. Trondheim: NTNU-trykk 2013 ISBN 82-7482-101-7

Patnaik, Miller, Adhikari, Standal: *"Basalt FRP Minibar reinforced concrete"*, Fibre Concrete 2013, September 12-13, 2013, Prague, Czech Republic

Justnes, H., Østnor, T.: *" Durability and microstructure of mortar with calcined marl as supplementary cementing material",* Proceedings of 13th International Conference on Durability of Building Materials and Components, São Paulo, Brazil, 2-5 September, 2014, ISBN 978-2-35158-149-0

Justnes, H., Østnor, T.: *"Designing Alternative Binders Utilizing Synergic Reactions",* Proceedings of 5th International Conference on Non-traditional Cement and Concrete (NTCC2014) Brno, Czech Republic. ISBN 978-80-214-4867-4, pp. 101-104

Justnes, H.: *"Alternatives to gypsum as set regulator of Portland cement clinker",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway.

Justnes, H.: "*Properties of Gypsum-free Portland Cement",* Nordic Concrete Research 50: Proceedings of the XXII Nordic Concrete Research Symposium, Reykjavik, Iceland 2014, ISBN 978-82-8208-043-9, pp. 259-262.

Justnes, H.: *"Rheology of Plasticized Cement with Fillers",* Proceedings of the 6th International Conference of the Asian Concrete Federation (ACF), 21-24 September, 2014, Seoul, South Korea, pp. 637-640.

Justnes, H.: *"Durability Aspects of Replacing Gypsum as Set Regulator in Portland Cement Clinker",* Proceedings of the 2nd International Congress on Durability of Concrete (2nd ICDC), 4-6 December 2014, New Delhi, India, Paper 28.

Peng Y., de Weerdt K., Pedersen B., Jacobsen S : "Hydrostatic pressure to measure sedimentation and bleeding", Proceedings of the XXII Nordic Concrete Research Symposium, Reykjavik, Iceland 2014, ISBN 978-82-8208-043-9

Klausen, Kanstad and Bjøntegaard: "Updates temperature-stress testing machine (TSTM): Introductory tests, calculations and verification", Proceedings of the XXII Nordic Concrete Research Symposium, Reykjavik, Iceland 2014, ISBN 978-82-8208-043-9

Dirk Schlicke et al.: *"Structural analysis and crack assessment of restrained concrete walls-3D FEM-Simulation and crack assessment",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Martius-Hammer: *"COIN – main finding",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Ng and Justnes: *"Effect of PCE superplasticizers on the rheological and early age hydration properties of blended cements",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Østnor and Justnes: *"Durability and microstructure of mortar where cement is replaced by calcined marl",,*Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Østnor et al: *"Classification of Exposed Concrete Surfaces",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Peng, De Weerdt, Pedersen, Sellevold, Jacobsen: *"Measuring sedimentation and bleeding of fresh paste with hydrostatic pressure",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Nedrelid, Kanstad: *"Structural behaviour / design of FRC",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Kjellmark, Martius-Hammer, Kanstad: *"Fibre concrete materials development",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Patnaik, Miller, Standal: *"Fiber reinforced concrete made from Basalt FRP MInbar",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Trygstad, Kanstad: *"Fibre reinforced posttensioned flatslabs",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Cepuritis: *"From MANU"CTURED to ENGINEERED sand for concrete",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Schlicke, Klausen, Bjøntegaard, Kanstad: *" Crackfree concrete" ,*Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Geiker, De Weerdt, Hornbostel, Kioumarsi, Hendriks, Larsen, Angst: *"Prediction of reinforcement corrosion in concrete structures",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Nes, Øverli: *"Hybrid Concrete Structures – Beams Combining Normal Density Concrete and Fibre Reinforced Lightweight Aggregate Concrete",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Møen, Fosså: *"A new design- and construction method for the ice abrasion zone on marine concrete structures",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Øverli, Jensen: *"Confinement Effects of Fibers in Lightweight Aggregate Concrete Structures",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Bernhardt, Tellesbø, Justnes, Wiik: *"Development of high performance lightweight aggregates",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Nedrelid: *"Towards a better understanding of the ultimate behaviour of lightweightaggregate concrete in compression and bending",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Jacobsen: *"The Norwegian Concrete-Ice Abrasion Laboratory",* Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway, ISBN 978-82-8208-0415

Sarmiento, Hendrix, Kanstad:*"Impact of fibre orientation and volume fraction on the mechanical properties of",* Proceedings of the XXII Nordic Concrete Research Symposium, Reykjavik, Iceland 2014, ISBN 978-82-8208-043-9

Kanstad, Trygstad: *"Fibre reinforced posttensioned flatslabs",* Proceedings of the XXII Nordic Concrete Research Symposium, Reykjavik, Iceland 2014, ISBN 978-82-8208-043-9

Kjellmark, Martius-Hammer, Kanstad:*"COIN's 15 MPa Target concrete - Materials development",* Proceedings of the XXII Nordic Concrete Research Symposium, Reykjavik, Iceland 2014, ISBN 978-82-8208-043-9

Nedrelid, Kanstad:*"Tests and design of FRC beams with dapped ends",* Proceedings of the XXII Nordic Concrete Research Symposium, Reykjavik, Iceland 2014, ISBN 978-82-8208-043-9

Zirgulis, Geiker, Kanstad: *"Characterization and observation of fibre orientation",* Proceedings of the XXII Nordic Concrete Research Symposium, Reykjavik, Iceland 2014, ISBN 978-82-8208-043-9

Kioumarsi, Hendriks, Geiker:*"Residual service life modelling",* Proceedings of the XXII Nordic Concrete Research Symposium, Reykjavik, Iceland 2014, ISBN 978-82-8208-043-9

Peng, De Weerdt, Pedersen, Sellevold, Jacobsen: *"Measuring sedimentation and bleeding of fresh paste with hydrostatic pressure",* Proceedings of the XXII Nordic Concrete Research Symposium, Reykjavik, Iceland 2014, ISBN 978-82-8208-043-9

De Weerdt, Geiker: *"Chloride binding",* Proceedings of the XXII Nordic Concrete Research Symposium, Reykjavik, Iceland 2014, ISBN 978-82-8208-043-9

Nes, Øverli: *"Structural Behaviour of Beams with Fibre Reinforced LWAC and Normal Density Concrete",* Proceedings of the XXII Nordic Concrete Research Symposium, Reykjavik, Iceland 2014, ISBN 978-82-8208-043-9

Geiker:*"Service life design of civil infrastructure in the Nordic countries",* key note speaker at 3rd International Conference on Service Life design for Infrastructure,15-17 Oct, 2014 Zhuhai, China

Sarmiento, Hendriks, Kanstad: *"Accounting for the fibre orientation on the structural performance of flowable fibre reinforced concrete",* EuroC – Conference,StAnton, Austria, 27-29 March, 2014

Møen, Høiseth, Høyland, Fosså, *"Long term resistance of marine concrete structures to ice abrasion - A field study of lighthouses in the gulf of Bothnia",* 10th fib International PhD Symposium in Civil Engineering,Quebec, Canada; 21-23 July 2014

Vidal Sarmiento, Hendriks, Kanstad: *"Accounting for the fibre orientation on the structural performance of flowable fibre reinforced concrete",* Computational Modelling of Concrete Structures. Volume 2. Proceeding of EURO-C 2014, St. Anton am Arlberg, Austria, 24-27 March 2014. CRC Press 2014 ISBN 978-1-138-00145-9. s. 609-618

Østnor, T., Justnes, H., 2014: Durability and Microstructure of Mortar where Cement is Replaced by Calcined Marl. Proceedings of the 1st Concrete Innovation Conference (CIC), 11-13 June 2014, Oslo, Norway

Østnor, T., Justnes, H., 2014: *"Durability and Microstructure of Mortar where Cement is Replaced by Calcined Marl",* Proceedings of the 2nd International Congress on Durability of Concrete (2nd ICDC), 4-6 December 2014, New Delhi

Østnor, T., Justnes, H., 2014: *"Calcined Marl as a Supplementary Cementing Material (SCM)",* Nordic Concrete Research 50: Proceedings of the XXII Nordic Concrete Research Symposium, Reykjavik, Iceland 2014, ISBN 978-82-8208-043-9, pp. 317-320
Ng, S., Justnes, H: *"Effect of PCE Superplasticizer on the Rheological and Early Age Hydration Properties of Blended Cements", Proceedings of the 1st Concrete Innovation Conference* (CIC), 11-13 June 2014, Oslo, Norway.

Ng, S., Justnes, H.: *"Rheological Properties and Early Hydration of Blended Cement Pastes with a PCE Superplasticizer",* Design, Performance and Use of Self-Consolidating Concrete SCC' 2014, ISBN 978-2-35158-143-8.

Ng, S., Justnes, H.: *"A Comparison on the Roles of Plasticizers in the Rheology and Hydration of Blended Cements",* Proceedings of the 6th International Conference of the Asian Concrete Federation (ACF), 21-24 September, 2014, Seoul, South Korea, ISBN 978-89-89499-08-4.

Ng, S., Justnes, H.: *"SCMs and plasticizers: A study on their effects on the rheology and early age hydration of blended cements",* Nordic Concrete Research 50: Proceedings of the XXII Nordic Concrete Research Symposium, Reykjavik, Iceland 2014, ISBN 978-82-8208-043-9, pp.189-192.

Books

Åse Lyslo Døssland: "*Fibre reinforcement in load carrying concrete structures. Laboratory investigations compared with theory and finite element analysis",* 2008

Guomin Ji: *"Cracking risk of concrete structures in the hardening phase. Experiments, material modelling and finite element analysis",* 2008

S.F. Lee, J.Y. He, X.H. Wang, Z.L. Zhang and S. Jacobsen: *"Study of P-h curves on nanomechanical properties of steel fiber reinforced mortar",* pp 281-286 in Nanotechnology in Construction 3, Springer Berlin Heidelberg, 978-3-642-00980-8

Sellevold, Erik Johan; Maage, Magne; Smeplass, Sverre; Kjellsen, Knut O.; Lindgård, Jan; Myrdal, Roar; Bjøntegaard, Øyvind; Jacobsen, Stefan: Betongteknologi 1 (4215) kompendium. Trondheim: Institutt for konstruksjonsteknikk

De Weerdt, Klaartje: *Blended cement with reduced CO2 emission- utilizing the fly ash-limestone synergy,* Series/Report: Doktoravhandlinger ved NTNU, 1503-8181; 2011:32

Sandbakk, Sindre: *Fibre Reinforced Concrete: Evaluation of test methods and material development,* Doctoral thesis, Series/Report: Doktoravhandlinger ved NTNU, 1503-8181; 2011:297

Angst, Ueli: *Chloride induced reinforcement corrosion in concrete: Concept of critical chloride content – methods and mechanism,* Doctoral thesis, Series/Report: Doktoravhandlinger ved NTNU, 1503-8181; 2011:113

Hoang, Kien Dinh: *Hardening Accelerator for Fly Ash Blended Cement,* Doctoral thesis, Series/Report: Doktoravhandlinger ved NTNU, 1503-8181; 2012:366

Nedrelid, Håvard: *Towards a better understanding of the ultimate behaviour of lightweight aggregate concrete in compression and bending,* Doctoral thesis, Series/Report: Doktoravhandlinger ved NTNU, 1503-8181; 2012:123

Bernhardt: *"Development of high performance lightweight aggregates"*, Doctoral Theses at NTNU, 2013:223, August 2013, ISBN 978-82-471-4565-4

Nes: *"Experimental and Numerical Study of Hybrid Concrete Structures"*, Doctoral Theses at NTNU, 2013:259, September 2013, ISBN 978-82-471-4645-3

Lindgård: *"Alkali-silica reaction (ASR) – Performance testing"*, Doctoral theses at NTNU, 2013-269, October 2013, ISBN 978-82-471-4666-8

Peng, Ya: *Sedimentation and Bleeding of Cement Paste,* Doctoral thesis, Series/Report: Doktoravhandlinger ved NTNU, 1503-8181; 2014:89

Reports

Sindre Sandbakk, *Influence of fibers on cracking due to plastic and drying shrinkage,* SINTEF Report SBF BK 07027, ISBN 978-82-536-0991-1, 2007

Hedda Vikan, *Quality of concrete surfaces - State of the art,* SINTEF Report SBF BK A07013, ISBN 978-82-536-0966-9, 2007

Harald Justnes, *Principles of making cement with reduced CO2 - emission,* SINTEF Report SBF BK A07019, ISBN 978-82-536-0982-9, 2007

Christian J. Engelsen, *Making cement with less clinker content,* SINTEF Report SBF BK A07020, ISBN 978-82-536-0983-6, 2007

Christian J. Engelsen, *Effect of mineralizers in cement production,* SINTEF Report SBF BK A07021, ISBN 978-82-536-0984-3, 2007

Klaartje de Weerdt, *Separate grinding versus intergrinding,* SINTEF Report SBF BK A07022, ISBN 978-82-536-0986-7, 2007

Klaartje de Weerdt, *Ternary blended cements with fly ash and Limestone: Part 1,* SINTEF Report SBF BK A07023, ISBN 978-82-536-0987-4, 2007

Harald Justnes, *Ternary blended cements with fly ash and Limestone: Part 2,* SINTEF Report SBF BK A07024, ISBN 978-82-536-0988-1, 2007

Roar Myrdal, *Accelerating admixtures for concrete,* SINTEF Report SBF BK A07025, ISBN 978-82-536-0989-8, 2007

Harald Justnes, *Reduced cracking by modifying matrix with admixtures or additives,* SINTEF Report SBF BK A07026, ISBN 978-82-536-0991-4, 2007

Sindre Sandbakk, *Influence of fibers on cracking due to plastic and drying shrinkage - State of the art,* SINTEF Report SBF BK A07027, ISBN 978-82-536-0991-1, 2007

Harald Justnes, *Reduced cracking by internal curing of concrete,* SINTEF Report SBF BK A07028, ISBN 978-82-536-992-8, 2007

Hedda Vikan, *Concrete workability and fibre content - State of the art,* SINTEF Report SBF BK A07029, ISBN 978-82-536-0994-2, 2007

Mattias Haase / Inger Andresen, *Review of Thermal Mass Concepts STAR 1,* SINTEF Report SBF BK A07030, ISBN 978-82-536-0995-9, 2007

Tone Østnor, *"Alternative pozzolans" as supplementary cementitious materials in concrete,* SINTEF Report SBF BK A07032, ISBN 978-82-536-0993-5, 2007

Roar Myrdal, *Retarding admixtures for concrete - State of the art,* SINTEF Report SBF BK A07035, ISBN 978-82-536-0998-0, 2007

Ueli Angst / Øystein Vennesland, *Critical chloride content - State of the art,* SINTEF Report SBF BK A07037, ISBN 978-82-536-0997-3, 2007

Harald Justnes, *Low water permeability through hydrophobicity,* COIN report No 1, ISBN 978-82-536-1018-4, 2008

Christian J. Engelsen, *Quality improvers in cement making – State of the art,* COIN report No 2, ISBN 978–82–536–1071–9, 2008

Thale Sofie Wester Plesser, *Effect of surface treatment on chloride ingress and carbonation in concrete structures – State of the art,* COIN report No 3, ISBN 978-82-536-1020-7, 2008

Gro Markeset, *Stainless steel reinforcement in concrete structures – State of the art,* COIN report No 4, ISBN 978–82–536–1079–5, 2008

Stefan Jacobsen, Jon Håvard Mork, Siaw Foon Lee, Lars Haugan, *Pumping of concrete and mortar – State of the art,* COIN report No 5, ISBN 978–82–536–1069–6, 2008

Gro Markeset, Øystein Vennesland (Editors), *Critical chloride content in reinforced concrete. COIN workshop, 5-6 June 2008, Trondheim, Norway,* COIN report No 6, ISBN 978–82–536–1081–1, 2008

Gro Markeset, Roar Myrdal, *Modelling of reinforcement corrosion in concrete structures – State of the art,* COIN report No 7, ISBN 978–82–536–1081–8, 2008

Hedda Vikan, *Means of improving concrete construction productivity – State of the art,* COIN report No 8, ISBN 978–82–536–1068–9, 2008

Tore Myrland Jensen, *Diffusion tight concrete – Preliminary study,* COIN report No 9, ISBN 978–82–536–1075–7, 2008

Igor Sartori, *Night flushing and ceiling acoustic solutions. The effect on summer thermal comfort and energy demand,* COIN report No 10, ISBN 978-82-536-1142-6, 2009

Ola Skjølsvold, *Kloriddiffusjon i betong. Vurdering av aldringseffekten ved felteksponering,* COIN report No 11, ISBN 978-82-536-088-7, 2009

Børge Johannes Wigum, Svein Willy Danielsen (editors), Odd Holtvedt, Bård Pedersen, *Production and utilisation of maufactured sand - State of the art,* COIN report No 12, ISBN 978-82-536-1094-8, 2009

Harald Justnes, *Low porosity through optimized particle packing of concrete matrix,* COIN report No 13, ISBN 978-82-536-1096-2, 2009

Magne Maage, Steinar Helland, *Shore approach high quality concrete. Results of inspection over 26 years,* COIN report No 14, ISBN 978-82-536-1105-1, 2009

Terje Kanstad, *Fibre reinforced superlight concrete: Testing of materials and full scale beams,* COIN report No 15, ISBN 978-82-536-1122-8, 2009

Harald Justnes, *Pozzolana from Minerals - State of the art,* COIN report No 16, ISBN 978-82-536-1126-6, 2009

Anja Klausen, *Steel fibres in load-carrying concrete structures. Guildeline survey and practical examples,* COIN report No 17, ISBN 978-82-536-1127-3, 2009

Sigrun Bremseth, Norcem, *Fly ash in concrete. A literature study of the advantages and disadvantages,* COIN report No 18, ISBN 978-82-536-1128-0, 2009

Sigurd Hveem, *Design improvements of acoustic properties,* COIN report No 19, ISBN 978-82-536-1143-3, 2009

Harald Justnes, *Combined setting and hardening accelerator for concrete,* SINTEF Report SBF BK F09030, 2009

Harald Justnes, *Gypsum free and low porosity cement,* SINTEF Report SBF BK F09031, 2009

Catherine Grini (editor), *Concrete ideas for passive houses,* COIN report No 20, ISBN 978-82-536-1141-9, 2010

Hedda Vikan, Stefan Jacobsen, *Influence of rheology on the pumpability of mortar Pumping test report,* COIN report No 21, ISBN 978-82-536-1158-7, 2010

Roar Myrdal, *Inhibitorer - State of the art,* COIN report No 22, ISBN 978-82-536-1168-6, 2010

Sindre Sandbakk (SINTEF), Terje Kanstad (NTNU), Øyvind Bjøntegaard (NPRA) Lucie Vandewalle (KUL) and Benoit Parmentier (BBRI), *International Round Robin Testing of Circular FRC slabs: Reporting and Evaluation of Test Results from Norway and Belgium,* COIN report No 23, ISBN 978-82-536-1172-3, 2010

Gunrid Kjellmark, *Autogenous deformation and relative humidity in concrete,* COIN report No 24, ISBN 978-82-536-1184-6, 2010

Hedda Vikan, Klaartje De Weerdt, *Stability of SCC - chemical stabilizers versus filler,* COIN report No 25, ISBN 978-82-536-1185-3, 2010

Michael Klinski, *Gode detaljer for betongkonstruksjoner i passivhus,* COIN report No 26, ISBN 978-82-536-1195-2, 2010

Harald Justnes, *Mechanisms of calcined clay as pozzolan,* SINTEF Report SBF BK F10006, 2010

Jan Lindgård (main autor and editor), *RILEM TC 219-ACS-P: Literature survey on performance testing,* COIN report No 27, ISBN 978-82-536-1209-6, 2011

Hedda Vikan, Sindre Sandbakk og Terje Kanstad, *Material properties influencing concrete residual bending strength– Experimental study,* COIN report No 28, ISBN 978-82-536-1222-5, 2011

Hedda Vikan, Sindre Sandbakk, Terje Kanstad, *Material properties influencing concrete residual bending strength – Experimental study,* COIN report No 28, ISBN 978-82-536-1222-5, 2011

Terje Kanstad et al., *Forslag til retningslinjer for dimensjonering, utførelse og kontroll av fiberarmerte betongkonstruksjoner (fiberveiledning),* COIN report No 29, ISBN 978-82-536-1223-2, 2011

Catherine Grini, *Post-occupancy evaluation of a recent energy efficient office building,* COIN report No 30, ISBN 978-82-536-1235-5, 2011

Øyvind Bjøntegaard, *Basis for and practical approaches to stress calculations and crack risk estimation in hardening concrete structures. State-of-the-art report.,* COIN report No 31, ISBN 978-82-536-1236-2, 2011

Børge Johannes Wigum, *Classification and Particle Properties of Fine Aggregates (< 63µm) Applied as Concrete Aggregate,* COIN report No 32, ISBN 978-82-536-1245-4, 2011

Børge Johannes Wigum, *Classification and Particle Properties of Fine Aggregates (< 63µm) Applied as Concrete Aggregate,* COIN report No 32, ISBN 978-82-536-1245-4, 2011

Børge J. Wigum (NTNU), *Hokksund Quarry - - Review of the aggregate production,* COIN report No 33, ISBN 978-82-536-1247-8, 2011

Bård Pedersen (NorStone), *Manufactured sand in concrete - effect on particle shape on workability,* COIN report No 34, ISBN 978-82-536-1248-5, 2011

Klaartje De Weerdt (editor), *Nordic Concrete Rheology Workshop,* COIN report No 35, ISBN 978-82-536-1249-2, 2011

Thale Eng Kalbakk, *LCA on case study- concrete. Preliminary results,* COIN report No 36, ISBN 978-82-536-1250-8, 2011

Klaartje De Weerdt, *Geopolymers - State of the art,* COIN report No 37, ISBN 978-82-536-1251-5, 2011

Klaartje De Weerdt, Hedda Vikan, *Rheological properties of stabilized SCC using fillers, admixtures or a combination,* COIN report No 38, ISBN 978-82-536-1252-2, 2011

Klaartje De Weerdt, Mari Bøhnsdalen Eide, Sverre Smeplass, Micheala Wirthova, *The effect of stabilization with either filler or chemical stabilizer on the surface quality of concrete elements,* COIN report No 39, ISBN 978-82-536-1264-5, 2012

Øyvind Bjøntegaard og Knut Kjellsen, *Property development and crack tendency i hardening concrete: Effect of cement type and fly ash content,* COIN report No 40, ISBN 978-82-536-1279-9, 2012

Rolands Cepuritis, *Physical properties of Norwegian mineral fillers investigated by different methods,* COIN report No 43, ISBN 978-82-536-1296-6, 2012

Rolands Cepuritis, *Rheology of Matrix and SCC with Different Mineral Fillers and Admixtures,* COIN report No 41, ISBN 978-82-536-1288-1, 2013

Rolands Cepuritis, *A preliminary study on using manufactured sand from Jelsea Quarry for the production of plastic concrete mixes,* COIN report No 42, ISBN 978-82-536-1291-1, 2013

Kristin Kaspersen, Tone Østnor, Mari Bøhnsdalen Eide, Klaartje De Weerdt, *Characterisation of concrete surfaces in Askimporten tunnel,* COIN report No 45, ISBN 978-82-536-1311-6, 2013

Klaartje De Weerdt, Tone Østnor, Harald Justnes, *Fly ash - Limestone synergy in triple cements,* COIN report No 46, ISBN 978-82-536-1322-2, 2013

Tor Arne Martius-Hammer, Sverre Smeplass (Skanska), Klaartje De Weerdt, Ya Peng (NTNU), *Stability of SCC – robustness for changes in water content and sand grading,* COIN report No 47, ISBN 978-82-536-1348-2, 2013

Bjøtegaard, Myren, Skjølsvold, *Round Robin Test program on Energy Absorption Capacity of Round Panels according to Norwegian Concrete Associations Publication No. 7:2011,* COIN report No 48, ISBN 978-82-536-1349-9, 2013

Tone Østnor and Harald Justnes, *Durability of mortar with calcined marl,* COIN report No 49, ISBN 978-82-536-1370-3, 2013

Tore Myrland Jensen, Jan Arve Øverli (NTNU), *Experimental study on flexural ductility in over-reinforced lightweight aggregate concrete beams,* COIN report No 47, ISBN 978-82-536-1348-2, 2014

Tone Østnor, Harald Justnes, *Duraility of mortar with calcined marl as pozzolan 2 year results,* COIN report No 50, ISBN 978–82–536–1388–8, 2014

Tone Østnor, Kari Aarstad, Kristin Kaspersen og Klaartje De Weerdt, *Brukermanual for BetongGUI - analyse/karakterisering av porer på betongoverflater,* COIN report No 51, ISBN 978-82-536-1405-2, 2014

Kari Aslaksen Aasly and Svein Willy Danielsen (SINTEF), Børge Johannes Wigum (editor, Norstone), Sven-Henrik Norman (Velde), Rolands Cepuritis (NTNU) and Tero Onnela (Metso), *Review report on dry and wet classification of filler materials for concrete,* COIN report No 52, ISBN 978-82-536-1412-0, 2014

Anja B.E. Klausen (SINTEF/ NTNU) and Øyvind Bjøntegaard (NPRA), *Temperature development in on-site curing boxes,* COIN report No 54, ISBN 978-82-536-1429-8, 2014

Tore Myrland Jensen, Jan Arve Øverli (NTNU), *Experimental study on flexural ductility in over-reinforced lightweight aggregate concrete beams,* COIN report No 59, 2014, ISBN 978-82-536-1459-5

Kjellmark, G. Klausen, A.B.E., *Mechanical properties and calculation of model parameters for concrete with Norcem cement and variable fly ash content,* COIN report No 55, 2015, ISBN 978-82-536-1454-0

Kjellmark, G. Klausen, A.B.E, *Mechanical properties and calculation of model parameters for concrete with Aalborg cement and variable fly ash content,* COIN report No 56, 2015, ISBN 978-82-536-1455-7

Skjølsvik, O., Haram, E., Smeplass, S., *Beregning av rissrisiko ved bruk av CrackTeST COIN,* COIN report No 57, 2015, ISBN 978-82-536-1457-1

Serina Ng, Harald Justnes, *Rheology of blended cements with superplasticizers,* COIN report No 58, 2015, ISBN 978-82-536-1458-8

Martius-Hammer, T.A., Kjellmark, G., Smeplass, S., De Weerdt, K., *Practical methods to assess segregation risk of SCC on site FA: Competitive constructions,* COIN report No 59, 2015, ISBN 978-82-536-1459-5

Serina Ng, Hernan Mujica, Espen Rudberg, *Characterisation of fillers < 0.125 mm used in Case study Velde.,* COIN report No 60, 2015, ISBN 978-82-536-1460-1

Serina Ng, *Characterisation of fillers with plasticizers: Zeta Potential measurements.,* COIN report No 61, 2015, ISBN 978-82-536-1461-8

Smeplass, S.(Skanska), Mørtsell, E. (NorBetong), *Flyplassdekke med maskinsand. Værnes APRON vest,* COIN report No 62, 2015, ISBN 978-82-536-1462-5

Smeplass, S. (Skanska), Skjølsvik, O. (Skanska), Mujica, H. (Velde), *Mikroproporsjonering med fillere fra Velde: Effekt av fillersammensetningen på matriksens flytmotstand,* COIN report No 63, 2015, ISBN 978-82-536-1462-5

Kjellmark, G., Øverli, J.A., *LWAC Flatdekker Verdal,* COIN report No 64, 978-82-536-1464-9, 2015

Micheala Wirthova, Klaartje De Weerdt and Stefan Jacobsen (NTNU), *Static yield stress measurements on SCC, mortar and matrix,* COIN report No 65, ISBN 978-82-536-1465-6, 2015

Håvard Nedrelid (NTNU), *Structural FRC - Design approach and experimental results,* COIN report No 66, ISBN 978-82-536-1466-3, 2015

Jan Arve Øverli (NTNU) and Tore Myrdal Jensen, *Confinement effect of fibres on the behaviour of lightweight aggregate concrete beams,* COIN report No 67, ISBN 978-82-536-1467-0, 2015

Tone Østnor, Harald Justnes, *Alternative binders based on lime and calcined clay,* COIN report No 68, ISBN 978-82-536-1468-7, 2015

Klaartje De Weerdt, Tone Østnor and Harald Justnes, *Microstructure of clinker - fly ash interactions,* COIN report No 69, ISBN 978-82-536-1469-4, 2015

Tore Myrland Jensen and Jan Arve Øverli, *Experimental study on flexural ductility in over-reinforced lightweight aggregate concrete beams,* COIN report No 70, ISBN 978-82-536-1470-0, 2015

Harald Justnes and Serina Ng, *Hardening accelerators for fly ash blended cement,* COIN report No 71, ISBN 978-82-536-1471-7, 2015

Kari Aarstad (editor), *Summary report Binders with low emission and reduced resource consumption,* COIN report No 72, ISBN 978-82-536-1472-4, 2015

Kari Aarstad (editor), *Summary report Utilisation of concrete in low energy building consepts,* COIN report No 73, ISBN 978-82-536-1474-8, 2015

Kari Aarstad (editor), *Summary report Robust and highly flowable concrete with controlled surface quality,* COIN report No 74, ISBN 978-82-536-1475-5, 2015

Kari Aarstad (editor), *Summary report Ductile high tensile strength concrete,* COIN report No 75, ISBN 978-82-536-1476-2, 2015

Børge J. Wigum (editor), *Summary report Production of high quality manufactured aggregate for concrete,* COIN report No 76, ISBN 978-82-536-1477-9, 2015

Kari Aarstad (editor), *Summary report Crack free concrete structures,* COIN report No 77, ISBN 978-82-536-1478-6, 2015

Kari Aarstad (editor), *Summary report Reliable design and prolongation of service life,* COIN report No 78, ISBN 978-82-536-1479-3, 2015

Articles in trade magazines/ presentations to the industry

"Betongrevolusjon". Vegen og vi 2007

"Styrkeløft for betong". Theme supplement to Dagens Næringsliv, 2007

"CONCRETE Strickes Back – Hard ". Tellus, 2007

"Betongmiljøet slår tilbake". Forskning, 2007

"COINs barndom hvordan var den?", Norsk Betongdag, Trondheim, Norway 23 October 2007

Tor Arne Hammer: *"COIN - Attraktive betongbygg"*, SINTEF/NTNU Informasjonsdag, Trondheim, Norway 24 October 2007, SINTEF Report SBF BK A07011, ISBN No. 978-82-536-0964-5

Hedda Vikan: *"Forbedrede konstruksjonsteknikker"*, SINTEF/NTNU Informasjonsdag, Trondheim, Norway 24 October 2007, SINTEF Report SBF BK A07011, ISBN No. 978-82-536-0964-5

Helge Brå: *"Nyskapende konstruksjonsløsningner",* SINTEF/NTNU Informasjonsdag, Trondheim, Norway 24 October 2007, SINTEF Report SBF BK A07011, ISBN No. 978-82-536-0964-5

Gro Markeset: *"Operasjonell levetidsdesign",* SINTEF/NTNU Informasjonsdag, Trondheim, Norway 24 October 2007, SINTEF Report SBF BK A07011, ISBN No. 978-82-536-0964-5

Gro Markeset: *"Energieffektivitet og komfort",* SINTEF/NTNU Informasjonsdag, Trondheim, Norway 24 October 2007, SINTEF Report SBF BK A07011, ISBN No. 978-82-536-0964-5

Harald Justnes, Roar Myrdal: *"Avanserte bindemidler og tilsetningsstoffer",* SINTEF/NTNU Informasjonsdag, Trondheim, Norway 24 October 2007, SINTEF Report SBF BK A07011, ISBN No. 978-82-536-0964-5

Steinar Helland: *"Aging Factor Concept – Chloride intrusion",* Nordic Concrete Federation Workshop - Hirtshals, Denmark, 2008

Tor Arne Hammer:*"COIN - Concrete Innovation Center",* Borregaard Symposium - Lofoten, Norway, 2008

Tor Arne Hammer:*"COIN - Concrete Innovation Center",* Norsk Betongdag - Oslo, Norway, 2008

Tone Anita Østnor: *"Forskning på alternative bindemidler innen COIN",* CBI-Informationsdag 2009, Stockholm, Sweden, 12 March 2009

Catherine Grini: *"Tung og deilig"*. Mur-dagen, Oslo, 12 March 2009

Einar Aassved Hansen: *"Attraktive betongbygg".* Byggedagene, Oslo, 26 March 2009

Tor Arne Hammer, Fabrikkbetongkonferansen, 26-29 March 2009

Tor Arne Hammer, NB's informasjonsdag, 12 October 2009

Catherine Grini: *"Bruk av betongens termiske egenskaper - norske forhold",* SINTEF-NTNU Betonginformasjonsdag 2009, Trondheim, 14 October 2009

Tor Arne Hammer: *"COIN - erfaringer og utfordringer",* SINTEF-NTNU Betonginformasjonsdag 2009, Trondheim, 14 October 2009

Terje Rønning and Jan Lindgård: *"Internasjonal samarbeid - hvordan ivaretar vi norske interesser?",* SINTEF-NTNU Betonginformasjonsdag 2009, Trondheim, 14 October 2009

Tone Anita Østnor: *"Kalsinerte leire - fremtidens pozzolan?",* SINTEF-NTNU Betonginformasjonsdag 2009, Trondheim, 14 October 2009

Mari Bøhnsdalen Eide: *"Klassifiseringssystem for forskalte betongoverflater",* SINTEF-NTNU Betonginformasjonsdag 2009, Trondheim, 14 October 2009

Ueli Angst: *"Kritisk kloridinnhold i betong – finnes det?",* SINTEF-NTNU Betonginformasjonsdag 2009, Trondheim, 14 October 2009

Geir Norden and Terje Kanstad: *"Nytt produkt av fiberarmert, superlett betong",* SINTEF-NTNU Betonginformasjonsdag 2009, Trondheim, 14 October 2009

Sindre Sandbakk: *"Økt bruk av fiberbetong",* SINTEF-NTNU Betonginformasjonsdag 2009, Trondheim, 14 October 2009

Grepstad Nes: *"Experimental and numerical comparison of test methods for fibre reinforced concrete"*. 7th international DIANA Users Meeting 17-18 June 2010, Italy

Lindgård: *"Recent developments in AAR"*. RILEM TC 219-ACS, 11 March 2010, Azores, Portugal

Justnes:*"Calcined marl"*. Norsk Betongdag, Oct. 21 2010, Stavanger, Norway

Vikan:*"Innovasjonssenteret COIN: Utvikling av mer attraktive bygninger og anlegg i betong, hva har vi oppnådd"*, Byggenavet/ Næringsforeningen, Trondheim, Norway 2 Nov 2010

Haugan and Kjellmark: *"Rissfrie betongkonstruksjoner"*, Byggeindustrien 2010, No. 13, ISSN 0332-7086

Myrdal: *"Vannavvisende betong lever lenge",* Rust og Råte 2010

Vikan, Eide and Hegseth: *"Spesifikasjon av forskalte betongoverflater"*, Mur + Betong 2010, No. 2

"Bjørvika-betongen sparer miljøet: Brenner sement med søppel", Vegen og vi No 4 2010

Betre på betong. Betongbransjen brukar 200 millionar på å utvikle betong som både er bra for miljøet og lommeboka", Vegen og vi No. 62010

"Hva er betong?", Teknisk Ukeblad 2010, No 32, ISSN 0040-2354

"Sement+ mergel", www.bygg.no, published 2010-10-21

"God stemming på betongdagen", www.bygg.no, published 2010-10-21

Justnes, Østnor and Rudolfsen: *"Veien mot mer miljøvennlig betong",* Byggeindustrien No. 14 2011, ISSN 0332-7086

Seehusen: *Foreslår pukkverk under byen"*, Teknisk Ukeblad/ tu.no 2011-11-16

Kanstad, Terje: *"Status for norsk regelverk for dimensjonering og utførelse av fiberarmert betong",* Danish Concrete Day, 8 November 2011

Tone Anita Østnor: *"Kalsinerte leire - fremtidens pozzolan?",* SINTEF-NTNU Betonginformasjonsdag 2009, Trondheim, 14 October 2009

Mari Bøhnsdalen Eide: *"Klassifiseringssystem for forskalte betongoverflater",* SINTEF-NTNU Betonginformasjonsdag 2009, Trondheim, 14 October 2009

Ueli Angst: *"Kritisk kloridinnhold i betong – finnes det?",* SINTEF-NTNU Betonginformasjonsdag 2009, Trondheim, 14 October 2009

Geir Norden and Terje Kanstad: *"Nytt produkt av fiberarmert, superlett betong",* SINTEF-NTNU Betonginformasjonsdag 2009, Trondheim, 14 October 2009

Sindre Sandbakk: *"Økt bruk av fiberbetong",* SINTEF-NTNU Betonginformasjonsdag 2009, Trondheim, 14 October 2009

Grepstad Nes: *"Experimental and numerical comparison of test methods for fibre reinforced concrete"*. 7th international DIANA Users Meeting 17-18 June 2010, Italy

Lindgård: *"Recent developments in AAR"*. RILEM TC 219-ACS, 11 March 2010, Azores, Portugal

Justnes:*"Calcined marl"*. Norsk Betongdag, Oct. 21 2010, Stavanger, Norway

Vikan:*"Innovasjonssenteret COIN: Utvikling av mer attraktive bygninger og anlegg i betong, hva har vi oppnådd"*, Byggenavet/ Næringsforeningen, Trondheim, Norway 2 Nov 2010

Haugan and Kjellmark: *"Rissfrie betongkonstruksjoner"*, Byggeindustrien 2010, No. 13, ISSN 0332-7086

Myrdal: *"Vannavvisende betong lever lenge",* Rust og Råte 2010

Vikan, Eide and Hegseth: *"Spesifikasjon av forskalte betongoverflater"*, Mur + Betong 2010, No. 2

"Bjørvika-betongen sparer miljøet: Brenner sement med søppel", Vegen og vi No 4 2010

Betre på betong. Betongbransjen brukar 200 millionar på å utvikle betong som både er bra for miljøet og lommeboka", Vegen og vi No. 62010

"Hva er betong?", Teknisk Ukeblad 2010, No 32, ISSN 0040-2354

"Sement+ mergel", www.bygg.no, published 2010-10-21

"God stemming på betongdagen", www.bygg.no, published 2010-10-21

Justnes, Østnor and Rudolfsen: *"Veien mot mer miljøvennlig betong",* Byggeindustrien No. 14 2011, ISSN 0332-7086

Seehusen: *Foreslår pukkverk under byen"*, Teknisk Ukeblad/ tu.no 2011-11-16

Kanstad, Terje: *"Status for norsk regelverk for dimensjonering og utførelse av fiberarmert betong",* Danish Concrete Day, 8 November 2011

Martius-Hammer, Tor Arne: "*COIN - hva har vi oppnådd?*" Presentation at Norwegian Concrete Association Day, Oslo, Norway, October 25, 2012

De Weerdt: *"Hva har bransjen fått ut av COIN-programmet?"* Presentation at Norwegian Concrete Association meeting in Grimstad, Norway, October 2012

Klaartje De Weerdt and Mette R. Geiker: *"On the application of thermodynamic modelling for the prediction of the hydrate assemblage formed by blended cements",* Proceedings of Nordic Concrete Federation Workshop "Durability aspects of fly ash and slag in concrete", Norw. Public Roads Adm. Oslo, 15th - 16th of February 2012

"Ny superlett betong" – article based on an interview with Tor Arne Martius-Hammer in Gemini No. 1-2012, ISSN 0802-085X

"Supersterk lettvekter" –article by Christina Benjaminsen, SINTEF, on forskning.no: http://www.forskning.no/artikler/2012/februar/312909

Sterk og lett – article in Lofotposten 2012-02-12: http://www.lofotposten.no/bolig/article5923424.ece

Sterk og lett – article in Romerikes blad 2012-02-11: http://www.rb.no/bolig/article5924227.ece

Ny lettbetong utviklet i Trondheim – article in Betre gardsdrifts internet pages 2012-02-10: http://www.gardsdrift.no/id/52635.0

Sterk og lett – article in Hardanger Folkeblad 2012-02-10: http://www.hardanger-folkeblad.no/bolig/article5922878.ece

Sterk og lett – article in Glåmdalen 2012-02-10: http://www.glomdalen.no/ipad_siste/article5922884.ece

Sterk og lett – article in Arbeidets rett 2012-02-10: http://www.retten.no/bolig/article5922878.ece

Un nouveau béton super léger –article on territorial.fr: http://www.territorial.fr/PAR_TPL_IDENTIFIANT/62677/TPL_CODE/TPL_ACTURES_FICHE/PROV/RSSRESEAU_SIT_TERRITORIAL/PAG_TITLE/Un+nouveau+b%E9ton+super+l%E9ger/302-actu.htm

Press release on De Weerdt's PhD thesis: 50 prosent mindre CO2-utslipp med lavkarbonsement 2012-02-02: http://www.sintef.no/Byggforsk/Nyheter/50-prosent-mindre-CO2-utslipp-med-lavkarbonsement/

Lavkarbonsement – 50% mindre CO2 – article on Nyhetskanalen Innovasjon og design's internet page 2012-02-11: http://www.innodesign.no/nor/Bygg-Anlegg/Lavkarbonsement-50-mindre-CO2

Halverer CO2-utslippet – article on Grønn Byggallianse's internet pages: http://www.byggalliansen.no/nyheter_d.html

50 prosent mindre CO2-utslipp med lavkarbonsement – article on VVS forum's internet pages: http://www.vvs-forum.no/index.php?id=5015954&showtipform=1&cat=165391

Halverer CO2-utslipp med lavkarbonsement - article based on bygg.no: http://www.bygg.no/2012/02/84006.0

Magasinet Tekna*, 2012, No 1. Ny sement halverer CO2-utslipp.*

Radio interview with Klaartje De Weerdt and Per Brevik, Norcem, in "Ekko – Nyhetsrunden - Klima" – NRK P2 2012-02-22

Uutnyttet ressurs blir miljøbetong – article by Christina Benjaminsen on Marl on forskning.no: http://www.forskning.no/artikler/2012/februar/314728

Skal lage miljøvennlig mur – article on marl in Bergens Tidende 2012-03-10

Uutnyttet ressurs blir miljøbetong: www.start-siden.net/news.php?news_id=2765734
(and many more)

"Future fibre reinforced concrete", Technical seminar in connection with Norwegian concrete association's annual meeting in Oslo, April 2013

"Rik på fiber – nytt om materialutvikling i COIN", Byggeindustrien No. 18 2013

"Viktig forskning om fiberbetong", Byggeindustrien No 18, 2013

"Vil hindre kostbare betongskader", Byggeindustrien 2013

"Nytt analyseverktøy gir bedre betongkonstruksjoner", Byggeindustrien No. 3, 2013

Kanstad: *"Rik på fiber"*, SINTEF/ NTNU Betonginformasjondag, SINTEF Byggforsk 2013, ISBN 978-82-14-05426-2

Cepuritis: *"Fra maskinsand til høykvalitets tilslag for betong"*, SINTEF/ NTNU Betonginformasjondag, SINTEF Byggforsk 2013, ISBN 978-82-14-05426-2

Kaspersen, Østnor: *" Veien mot et klassifiseringssystem for betongoverflater"*, SINTEF/ NTNU Betonginformasjondag, SINTEF Byggforsk 2013, ISBN 978-82-14-05426-2

Geiker, De Weerdt, Hornbostel, Kioumarsi, Max: *"Levetid av armerte betongkonstruksjoner"*, SINTEF/ NTNU Betonginformasjon Informasjonsdag, SINTEF Byggforsk 2013, ISBN 978-82-14-05426-2. p. 26-29

Martius-Hammer: *" Hva med betongforskningen etter 2014?"*, SINTEF/ NTNU Betonginformasjon Informasjonsdag, SINTEF Byggforsk 2013, ISBN 978-82-14-05426-2. p. 26-29

Sandbakk, Kanstad, Leirud: Two presentations at Trondheim group of Norwegian concrete association

De Weerdt, Geiker: *"Hva skjer med flygaske - og slaggbetong ved langtidseksponering i sjøvann? Erfaringer fra Solsvik feltstasjon"*, Teknologidagene; 21- 24 October 2013

Press release 2013-10-11: "Vil hindre kostbare betongskader"

Press release 2013-11: "Hybrid betongkonstruksjon like god"

"Grønnere betong" chronicle by Tor Arne Martius-Hammer, published in Dagens Næringsliv 2014

"COIN-prosjektet må videreføres", Byggeindustrien No. 19, 2014, pp 84-86

"Betongsamarbeidet fortsetter", Byggeindustrien No. 16, 2014, p 40

"Kortreist stein løser knipe", Dagens Næringsliv, 2014-11-07, p 39

"Betong-partnere ønsker å fortsette samarbeid etter COIN", Byggeindustrien No. 16, 2014, p 82

"Betong gleder og engasjerer", bygg.no 2014-12-04

"Norsk Betongforening 60 år", pp 40-53, publication made by Byggeindustrien for Norwegian Concrete Association

Concrete under the Nothern lights, publisher: Byggeindustrien for Norwegian Concrete Association,:

Martius-Hammer: *"Research and development"*, p 45

Møen: *"Arctiv concrete offshore structures – R&D activities within ice abrasion"*, pp 56-58

Kanstad, Sandbakk, Geiker, Martius-Hammer: *"Materials development, fibre distribution and structural properties"*,pp 60-5

Hoang, Rudberg, Geiker, Justnes, Myrdal: *"A new hardening accelerating admixture for fly ash blended cement"*, pp 68-70

"Betonginnovasjon i Norge - Resultater fra COIN (2007–2014)", annex to Byggeindustrien November 2014 (20 pages), ISBN 9978-82-536-1415-1 (pdf)

SINTEF Building and Infrastructure is the third largest building research institute in Europe. Our objective is to promote environmentally friendly, cost-effective products and solutions within the built environment. SINTEF Building and Infrastructure is Norway's leading provider of research-based knowledge to the construction sector. Through our activity in research and development, we have established a unique platform for disseminating knowledge throughout a large part of the construction industry.

COIN – Concrete Innovation Center is a Center for Research based Innovation (CRI) initiated by the Research Council of Norway. The vision of COIN is creation of more attractive concrete buildings and constructions. The primary goal is to fulfill this vision by bringing the development a major leap forward by long-term research in close alliances with the industry regarding advanced materials, efficient construction techniques and new design concepts combined with more environmentally friendly material production.