CEOS.fr
*a French research programme*

# CONCRACK 2

## 2nd Workshop on **Control of cracking in R.C. structures :**

## *Restitution of the International Benchmark "ConCrack"*

*June 20-22, 2011, Paris - France*

Aims

**Cracking** is an inherent phenomenon to concrete structures. However, its control is essential in order to ensure serviceability of structures throughout time and therefore it **is a major concern for durability and sustainability**.

The French national research programme **CEOS.fr** (whose name can be translated as : "Behaviour and assessment of special construction works concerning cracking and shrinkage") aims at dealing with this issue, particularly for special works (specific use, specific shape and size, specific requirements for loading or durability ...), coupling numerical modelling and experimental approaches and those elaborated by engineers/practitioners.

**This programme is** the framework **set up** by French professionals involved in Building and Civil Engineering works **to make a decisive step in the predictive capacity of models to describe the states of cracking**, with the final objective to develop tools for designers **and to give grounds to the evolution of standards**.

In order to open up new relations with the international community a first workshop, "ConCrack1", was organized in Paris on 10-11 December 2009. Among the conclusion of the workshop it was decided, based on the experiment driven from CEOS.fr, to organize an **international benchmark dealing with the modelling of the behaviour of the tested mock-ups** (monotonic and cyclic loading on shear walls – prevented or free shrinkage on large beams).

This benchmark is a success, 19 teams around the world (cf. list below) have submitted their results (blind results) and **ConCrack2 is the restitution workshop of this benchmark**. In that context, the workshop will enable the achievement of a true **"state of the art" on modelling the cracking of concrete structures**. Furthermore, as shown in the program which follows, the workshop will also allow the presentation of results and analysis conducted by French teams related to the research network CEOS.fr. We will also have **presentations from international leaders** (fib, JCI…) **on the expectations of engineering** on the topic of control of cracking and more generally on the **design of sustainable concrete structures**.

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**Location of the Workshop:** SMABTP 114, Av. Emile Zola, PARIS (15ème), France
Métro station: « Commerce » or « Avenue Emile Zola »

# **PROGRAMME** (provisional)

**Monday, June 20**

13:00 Registration

13:45 Welcome address

14:00 – 15:30 **Opening session: The CEOS.fr project** (Chairman, P. Labbé, EDF)
- Framework and objectives, P. Labbé, CEOS programme president
- The experimental programme, L. Demilecamps, Vinci group & P. Rivillon, CSTB

15:30 Coffee break

16:00 – 18:00 **Session 1: Benchmark – part 1** (Chairman A. Pinto, JRC Ispra)
- Synthesis of the results related to Shear Wall (SW)
- Participant presentations

19h15 – Evening on the river **(Banquet and Cruse on the Seine)**

**Tuesday, June 21**

9:00 – 12:30 **Session 2: Benchmark – part 2** (Chairman Prof. M. Fardis, Patras University)
- Synthesis of the results related to large beam (RL & RG)
- Participant presentations

12:30 - Buffet

14:00 – 15:15 **Session 2 again: Benchmark – part 2** (Chairman Prof. M. Fardis, Patras University)
- Participant presentations

15:15 Coffee Break

15:45 – 18:00 **Session 3 : ConCrack Technical session** (Chairman, Prof. G. Mancini, Politecnico di Torino)
- CEOS.fr results on Modelling, CEOS team
- Discussion

20:00 – Free evening for the "**Music day in Paris"**

**Wednesday, June 22**

9:00 – 12:00 **Session 4: from research to engineering practice** (Chairman, Prof. J-A. Calgaro, ENPC Paris)
- Additional results from other experts :
  - A New Concept for The Shrinkage Effect on Shear Strength and Size effect of Reinforced Concrete Beams, Prof. R. Sato, Hirochima University
- From modelling to engineering standards, J. Cortade, P. Bish, IOSIS group
- Activities of *fib* on « Serviceability models »,Prof. G.L. Balazs, Budapest University

12:00 - Buffet

14:00 – 1600 **Session 5: Prospectives** – Chairman, Prof. J.C. Walraven, TU Delft
- Research perspectives - Prof. J. Mazars , Grenoble-INP
- **Round table**: Learning from the benchmark and requirements for engineering

16:00 Closure

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# ConCrack International Benchmark

The French national programme CEOS.fr (whose name can be translated as : “Behaviour and assessment of special construction works concerning cracking and shrinkage”) aims at dealing with the control of cracking, particularly for special works (specific use, specific shape and size, specific requirements for loading or durability ...), coupling numerical modelling and experimental approaches and those elaborated by engineers/practitioners.
Based on the experiment driven from CEOS.fr, the international benchmark ConCrack, deals with the modelling of the behaviour of the tested mock-ups as presented hereafter.

## Base of the study

A/ Shear walls

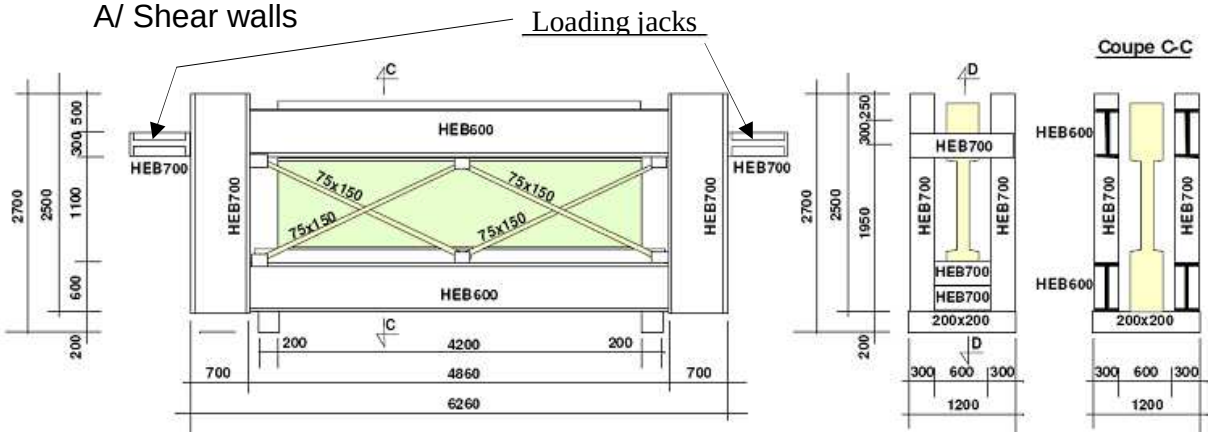


*Figure 1: Shear wall specimens – left: wall on its testing bench - right: sectional elevation of the wall*

The aim of this sub-program is to get data on cracking mechanism and pattern when a wall is submitted to monotonic or alternate loading applied within its symmetry plane (figure 1). The overall dimensions for the testing samples are 4.20 m long by 1.50 m high and 0.15m thick (general scale is 1/3$^{rd}$).
**Two loading configurations are selected for the purpose of this benchmark** (same geometry, same reinforcement scheme):

**1/** specimen under *monotonic* shear loading (test 1)
**2/** specimen under *cyclic* shear loading (test 2)

B/ Large Beam specimens:

Large-scale specimens (L=6.10 m, l=1.60 m, h=0.80 m) have been designed to explore the influence of different "second order" parameters. Once cast, two procedures are used:

- Free shrinkage beams are allowed to set free, slightly protected against the major climatic conditions, for about four weeks, then they are placed on a bending bench (figure 2), tightened to it by prestressing bars and brought to bending limit stage by two rows of four 100 T jacks.
- I-shaped beams have a restrained shrinkage due to struts (cf. Figure 4) and as for free shrinkage beams they are tested at the bending bench after 4 weeks.

**For the benchmark the two types of specimens are considered**: test 3, figure 3 and test 4, figure 4


Figure 2. Large beam, scheme of the test

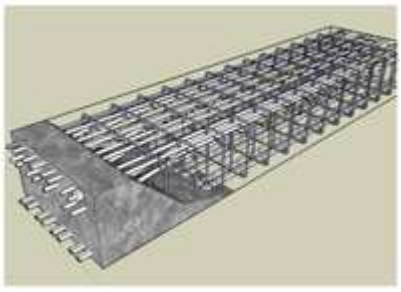

Figure 3. Geometry and reinforcement scheme for the free shrinkage specimens

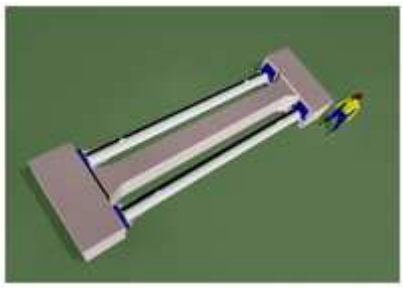

Figure 4. I shape geometry for the restrained shrinkage specimens and restrained system

# ConCrack International Benchmark

## Benchmark participants

| Name (team) | University / Company | Tests* |
|---|---|---|
| - Giovanna LILLIU | TNO Diana BV - Netherlands | 1-3 |
| - Gunther MESCHKE | Rhur University Bochum - Germany | 1–3–4 |
| - Jan & Vladimir CERVENKA | Cervenka Consulting Praha - Czech Republic | 1–2–3 |
| - Stéphanie STAQUET | Université Libre Bruxelles - Belgium | 3–4 |
| - Franck VECCHIO, Seong-Cheol LEE | University of Toronto - Canada | 1–2–3–4 |
| - Rui FARIA | University of Porto - Portugal | 1–2–3–4 |
| - Tony JONES | ARUP – London – United Kindom | 3–4 |
| - Milan JIRASEK | Czech Technical Univ. in Prague - Czech Republic | 3–4 |
| - Eric SCHLANGEN | Delft University of Technology - Netherlands | 3–4 |
| - Michael PERTL | Innsbruck University - Austria | 3–4 |
| - Dorian LINEO, Alfredo HUESPE, Xavier OLIVER | Univ. of Colombia - Colombia, Univ. of Santa Fe, Tech. Polytechnic of Catalonia - Spain | 1–2 |
| - Peter MARK | Rhur University Bochum - Germany | 1 |
| - Bernhard SCHREFLER | University of Padova - Italy | 4 |
| - Daniel KUCHMA | University of Illinois - USA | 1–2 |
| - Sarah BILLINGTON, Yang DANG | Stanford University - USA | 1–2 |
| - Clare BURNS | ETH Zurich - Switzerland | 3-4 |
| - Tony Jefferson | Cardiff University – United Kindom | 3 |
| - Antonio MARI, Jesús BAIRAN | Universitat Politècnica de Catalunya - Spain | 4 |
| - Hikaru NAKAMURA | Nagoya University - Japan | 1-2-3-4 |

*Test : Shear Wall (1=monotonic, 2=cyclic) – Large beam (3=free shrink.(RL1), 4= restr. Shrink. (RL8)

# Social Events

## Monday 20 June evening: Workshop banquet

The Seine River doesn't just flow through the heart of Paris--it *is* the heart of Paris, having supplied water, transportation, and food to the locals since Celtic fishermen of the Parisii tribe built a village on what is now the Île St-Louis more than 2,200 years ago. This means that a cruise on the Seine might be viewed as a kind of historic pilgrimage.

The evening of Monday June 20 will be exceptional. In early evening, the workshop banquet will be held on a boat docked near the Eiffel Tower. Will follow, a cruise on the Seine for an unusual tour of the most famous monuments of Paris.

## Tuesday 21 June evening : Fête de la Musique


The "Fete de la Musique" is a great popular demonstration, free, open to all amateur and professional participants, who may choose to participate each year. It is accessible to millions of people who constitute the most curious and most available public. It is organized every year in the evening of 21 June and for the whole night which is the shortest of the year. Presents in all the streets and everywhere in Paris, it mixes all genres and is aimed at all audiences, aiming to popularize musical practice and familiarize youths and adults from all walks to all musical expressions.