



INTERNATIONAL PRESTRESSED
HOLLOWCORE ASSOCIATION



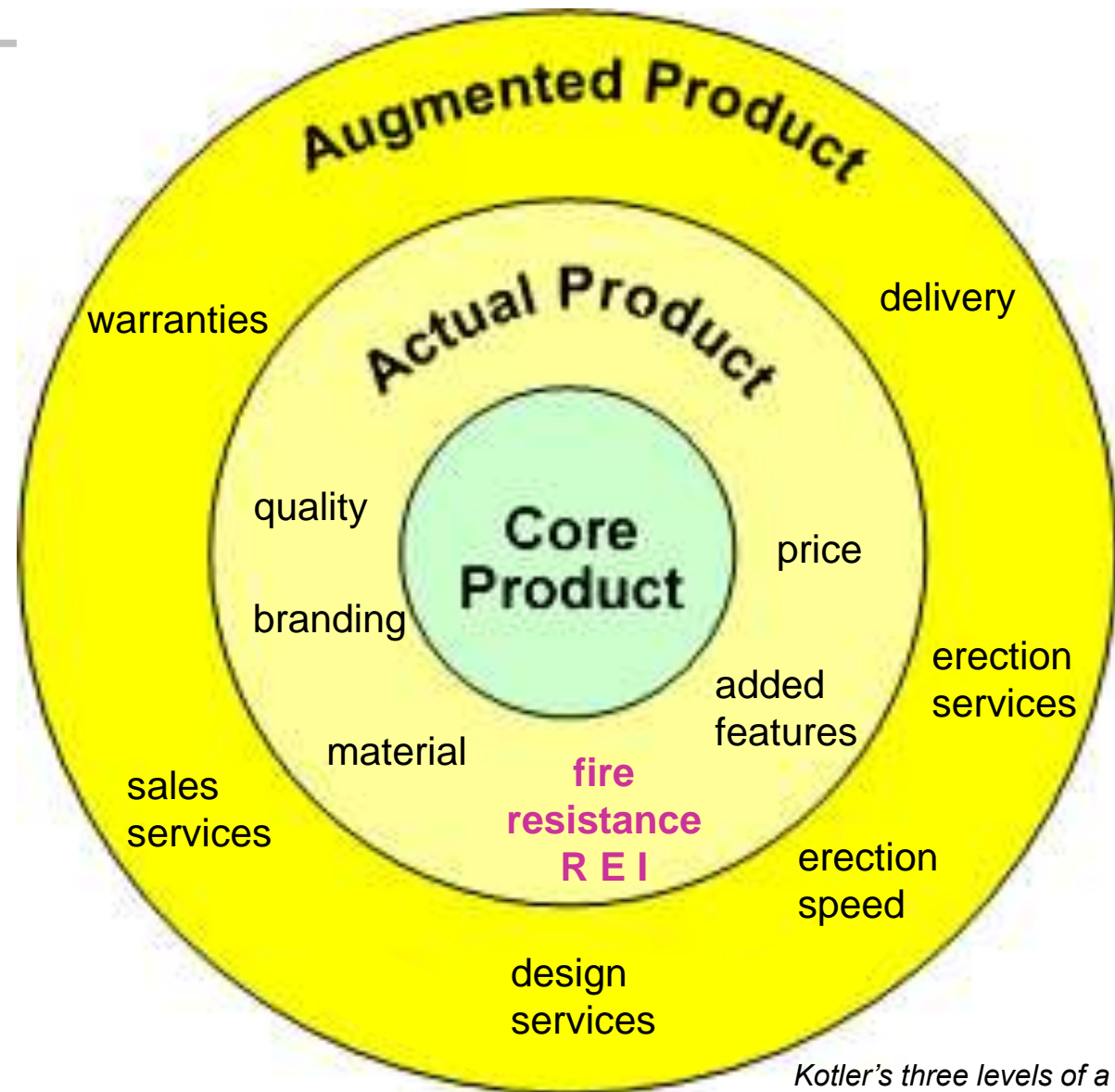
Holcofire project “Lessons learned” Behaviour of prestressed hollowcore floors exposed to fire

Introduction to Holcofire

Wim Jansze

*Projectmanager Holcofire BIBM
Chairman Technical Committee IPHA*

Selling a hollow core floor



Kotler's three levels of a product [1969]

Hollowcores and fire by past performance

- In Europe we erect yearly about 25 million m² of hollow cores
- The total amount of erected stock amounts 1 billion m² in buildings
- We do not know of significant numbers of losses of lives due to whole or partly building or floor collapses or full collapses of floors.

→ Past performance confirms that hollow cores have excellent fire resistance

→ Concrete and strand properties deteriorate under fire conditions. We know how to deal with that.



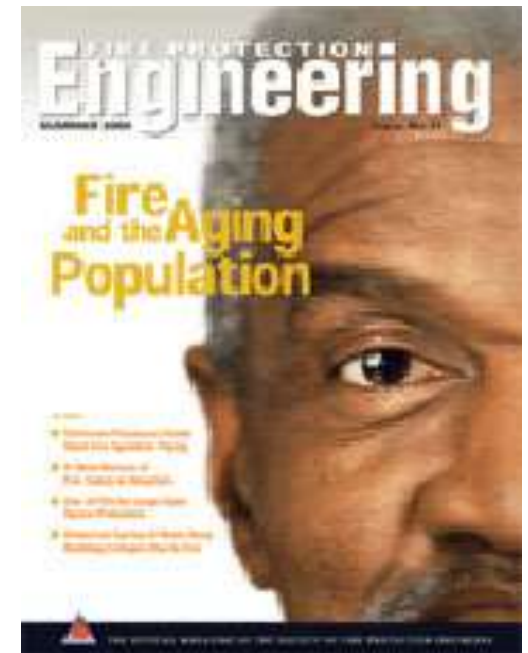
Problems around hollowcores + fire

But clients ask questions in relation to fire on:

- Shear and anchorage
- Horizontal cracks in fire case Rotterdam
- How to deal with flexible supports

Although:

- **Fires are essentially rare and random events**





real fires

bad fire tests

steel industry

fire consultants

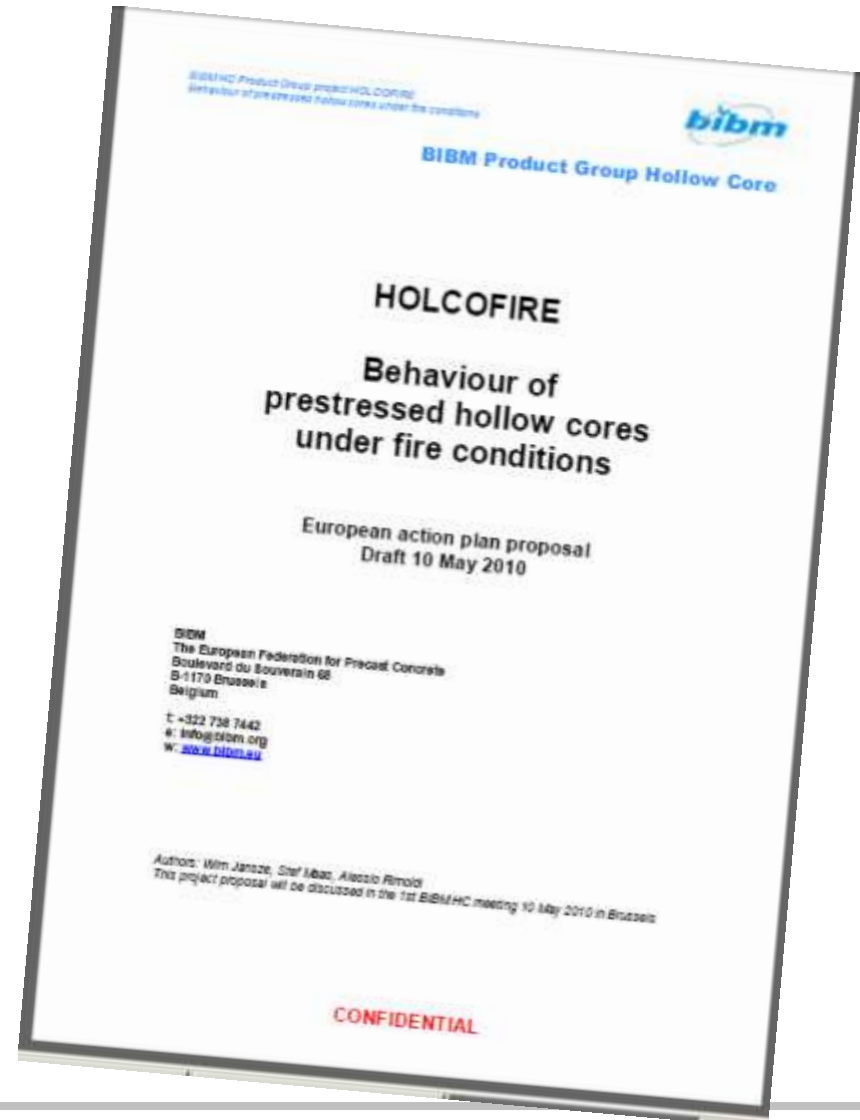
bad communication

bad cooperation

Project Plan May 2010 HOLCOFIRE



→ Cooperation contract signed November 2010



Participants

The following BIBM member organisations participate in “Holcofire”:

- Austria Verband Österreichischer Beton - und Fertigteilwerke, VÖB
- Belgium Fédération de l'industrie du béton, FEBE
- Denmark Betonelement-foreningen
- Finland Finnish concrete industry association
- France Fédération Française de l'industrie du béton, FIB
- Germany Bundesverband Spannbeton-Fertigdecken e.v., BVSF
- Italy Assobeton
- Netherlands Bond van fabrikanten van betonproducten in Nederland, BFBN
- Norway Betongelementforeningen
- Portugal Associação Nacional dos Industriais de Prefabricação em Betão, ANIPB
- Sweden Svensk betong

as well as

- **IPHA** International Prestressed Hollow core Association



Project objective HOLCOFIRE

The main objective is get full *understanding* of the behaviour of prestressed hollow cores under fire conditions which will lead to the full *acceptance* in Europe

Project HOLCOFIRE - strategy

- Get the understanding of the behaviour of hcs under fire on the following three topics:
 1. Shear and anchorage;
 2. Restraints in floors;
 3. Flexible supports.
- Two spearheads in the project:
 - Technical developments and analyses
 - Communication to stakeholders

Holcofire project team

- Wim Jansze – project manager
 - Arnold van Acker - Belgium
 - Bruno Della Bella - Italy
 - Gösta Lindström – Sweden
 - Ronald Klein-Holte – the Netherlands
 - Jean-Paul Py – France
 - Andreas Nitsch – Germany (+2013)
Hermann Benhöfer – Germany (since 2013)
 - Matthieu Scalliet - Cerib
-
- Earlier contributions from Fabienne Robert, Farida Maibeche

Holcofire steering group

- Axel Baumann – chairman, AT, DK, FI, NO, PT, SE
- Luc Bresse – France, Germany, Italy
- Matthias König –Germany, France, Italy
- Ruud van Groesen – the Netherlands, Belgium
- Bert Jongsma – Communication
- Wim Jansze – Project team
- Alessio Rimoldi – BIBM

-
- Earlier contributions from Stef Maas, Olli Korander, Esko Salo

Holcofire project: “Lessons learned”

- In this IPHA seminar we will update you on the technical content of the Holcofire project

Programme

IPHA TECHNICAL SEMINAR 2013
October 30th & 31st • Epernon • France
„Holcofire project: Lessons learned“
In cooperation with BIBM
Hosted by CERIB

October 30th Wednesday

Pre-programme (optional, either A or B)
07:40 A • Guided visit to Hollowcore plant A2C Préfa
09:30 B • Guided visit to CERIB laboratories

13:00 Lunch at CERIB
14:00 Opening *Marc Lebrun, Seamus McKeague, Axel Baumann*
14:15 Introduction to Holcofire *Wim Jansze*
14:30 Fire tests in Holcofire project *Matthieu Scalliet*
15:15 Promethee laboratory with coffee *Matthieu Scalliet*
16:45 Shear and anchorage according to Annex G *Jean-Paul Py*
17:30 Database study *Wim Jansze*
18:30 Trip to l'Epi Hotel by coach
20:30 Dinner

October 31st Thursday

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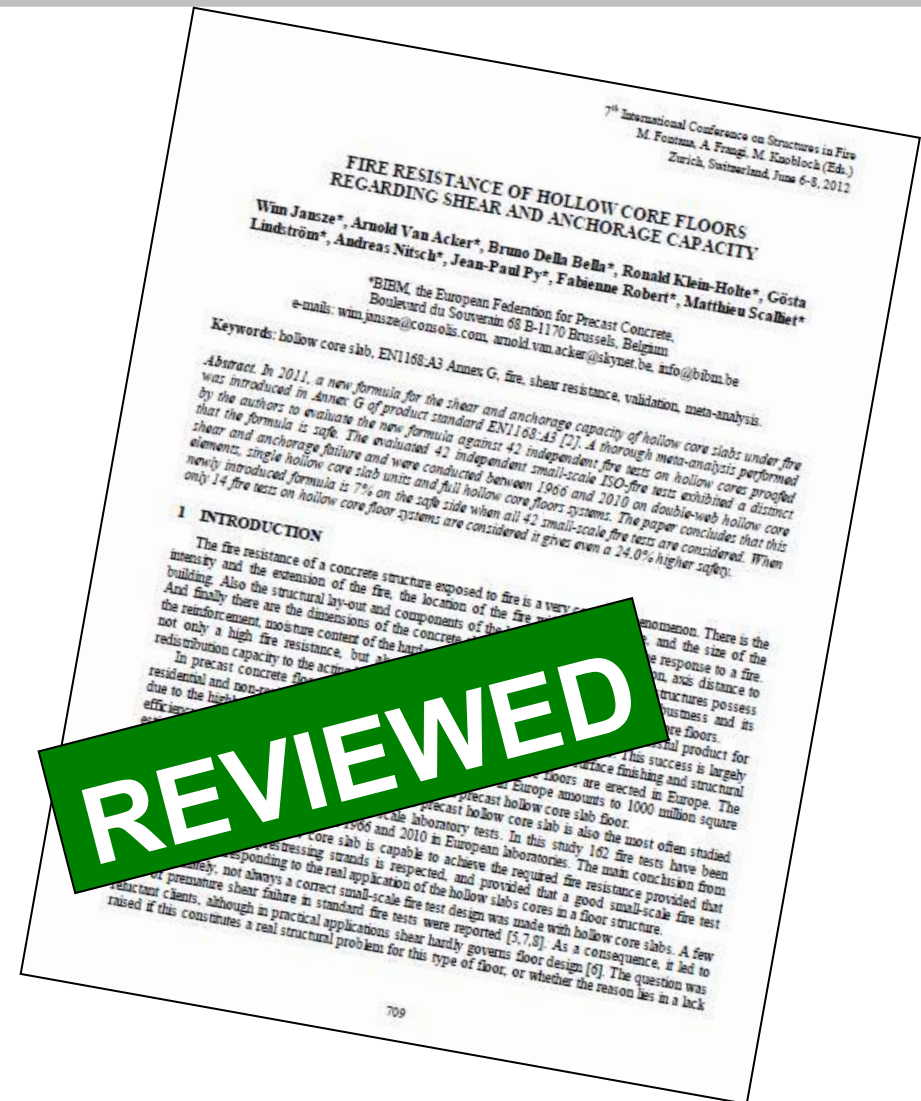
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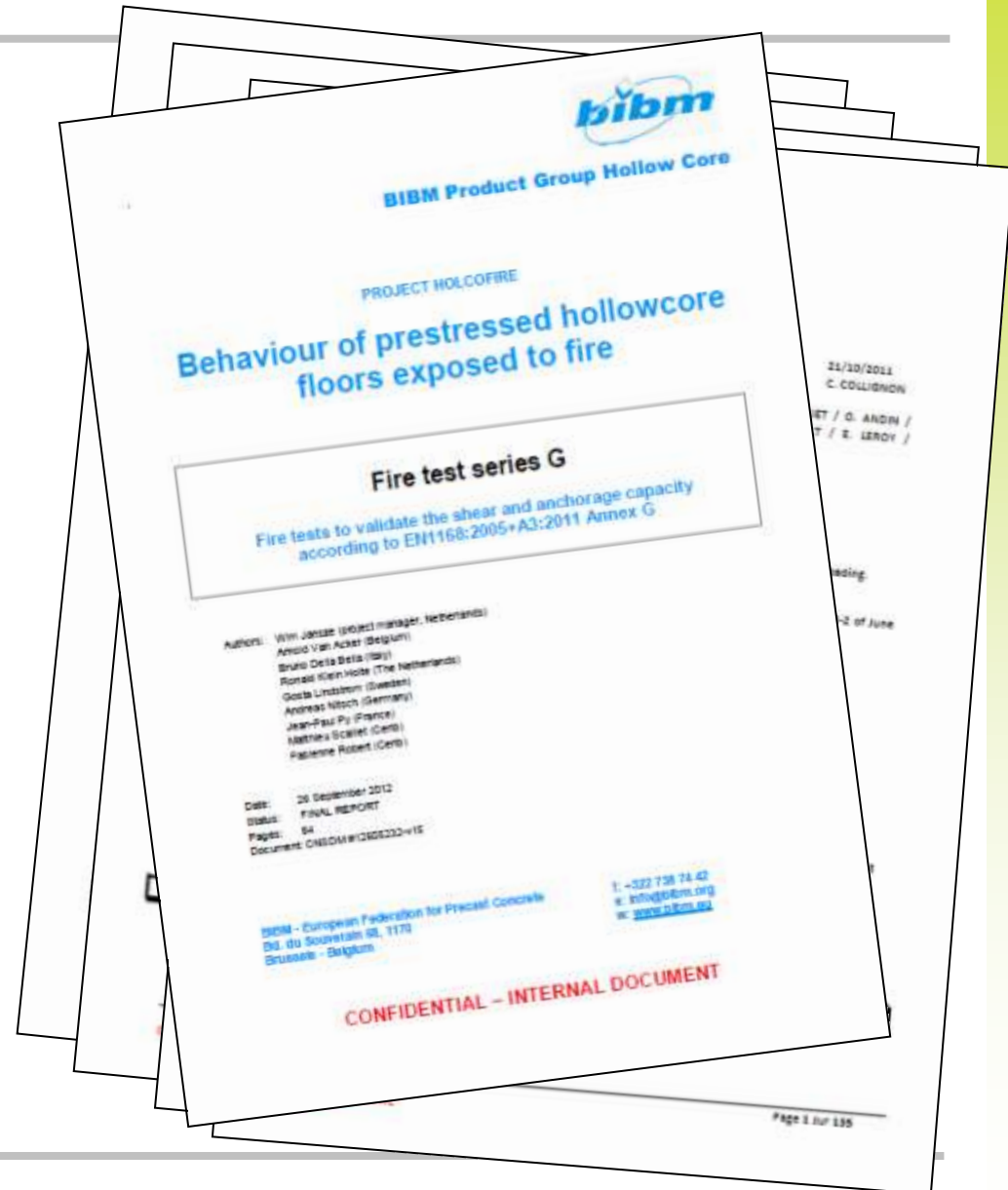
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Database with 42 fire tests

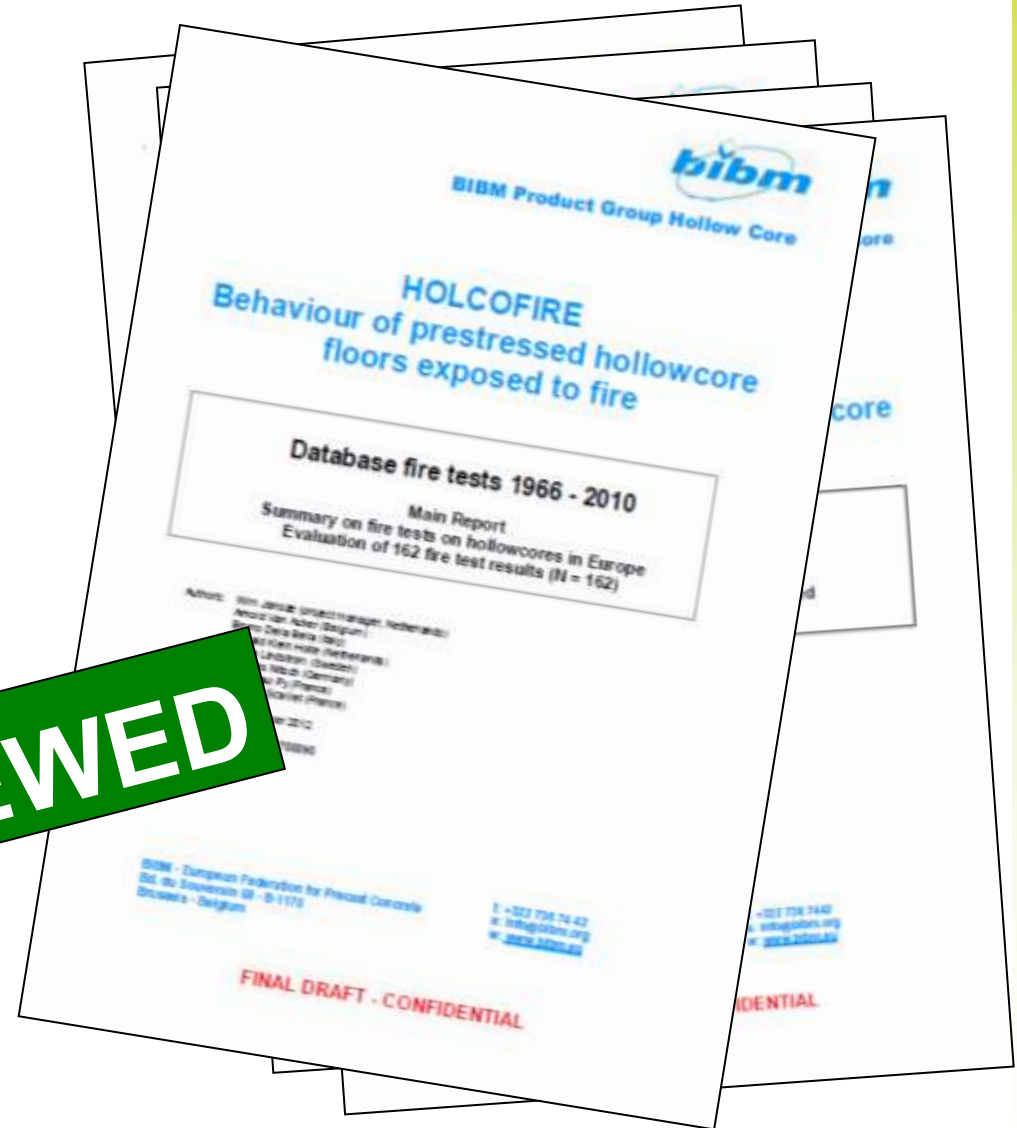
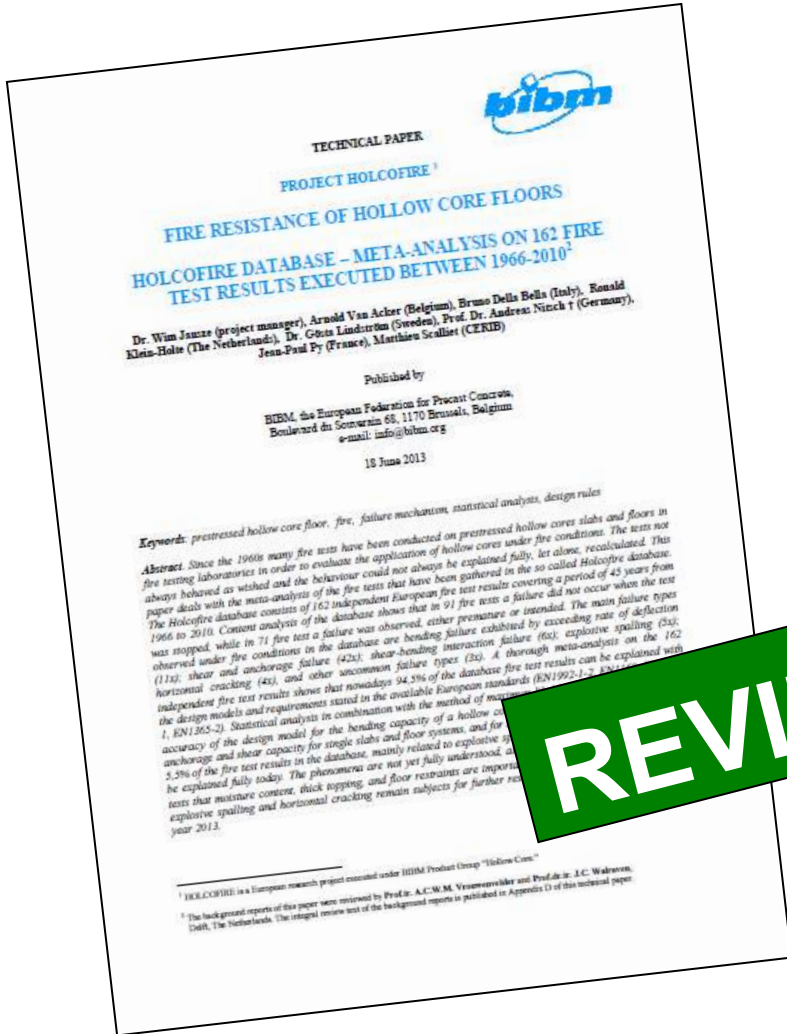


Fire test series G



Full fire tests database

18 June 2013



REVIEWED

Holcofire: “Lessons learned”

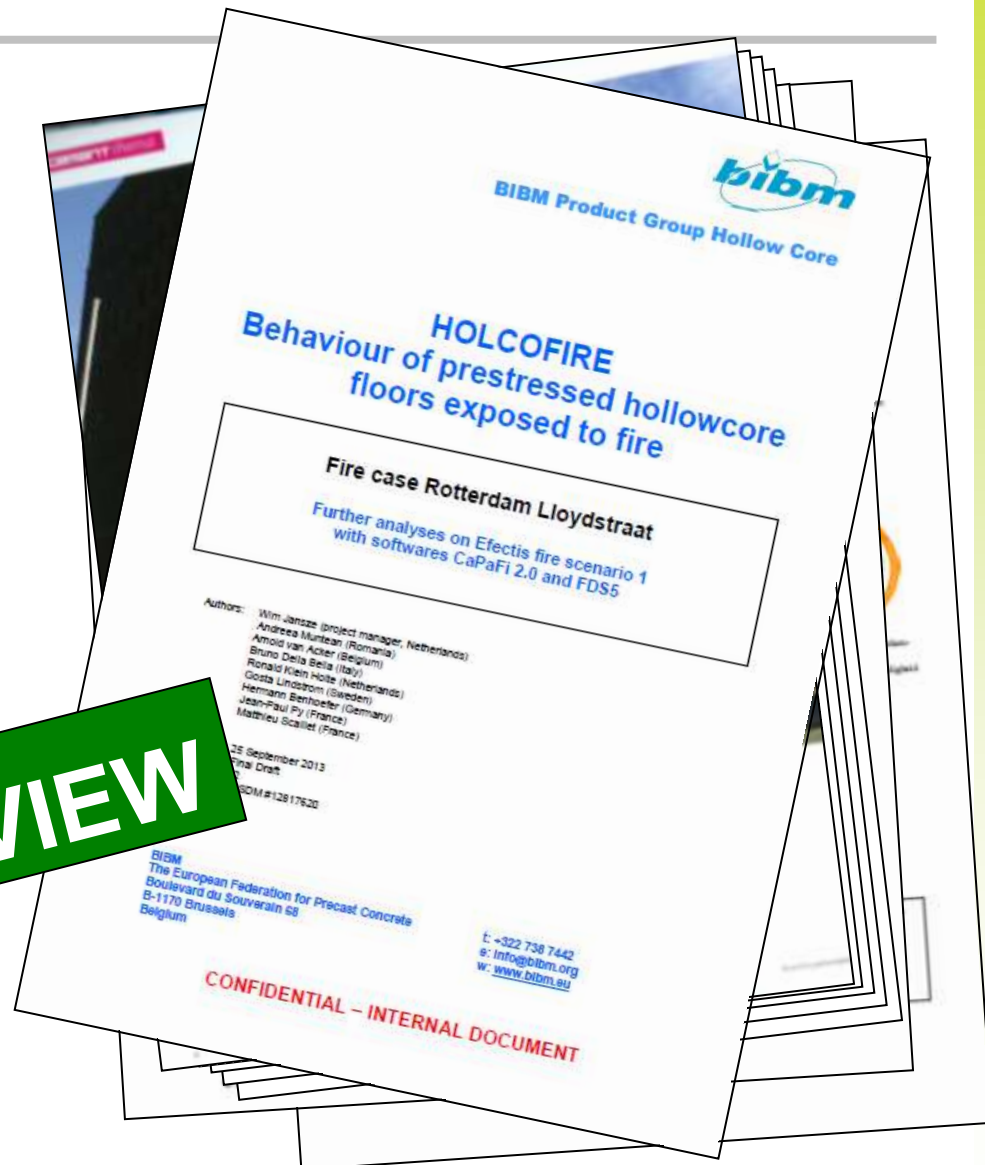
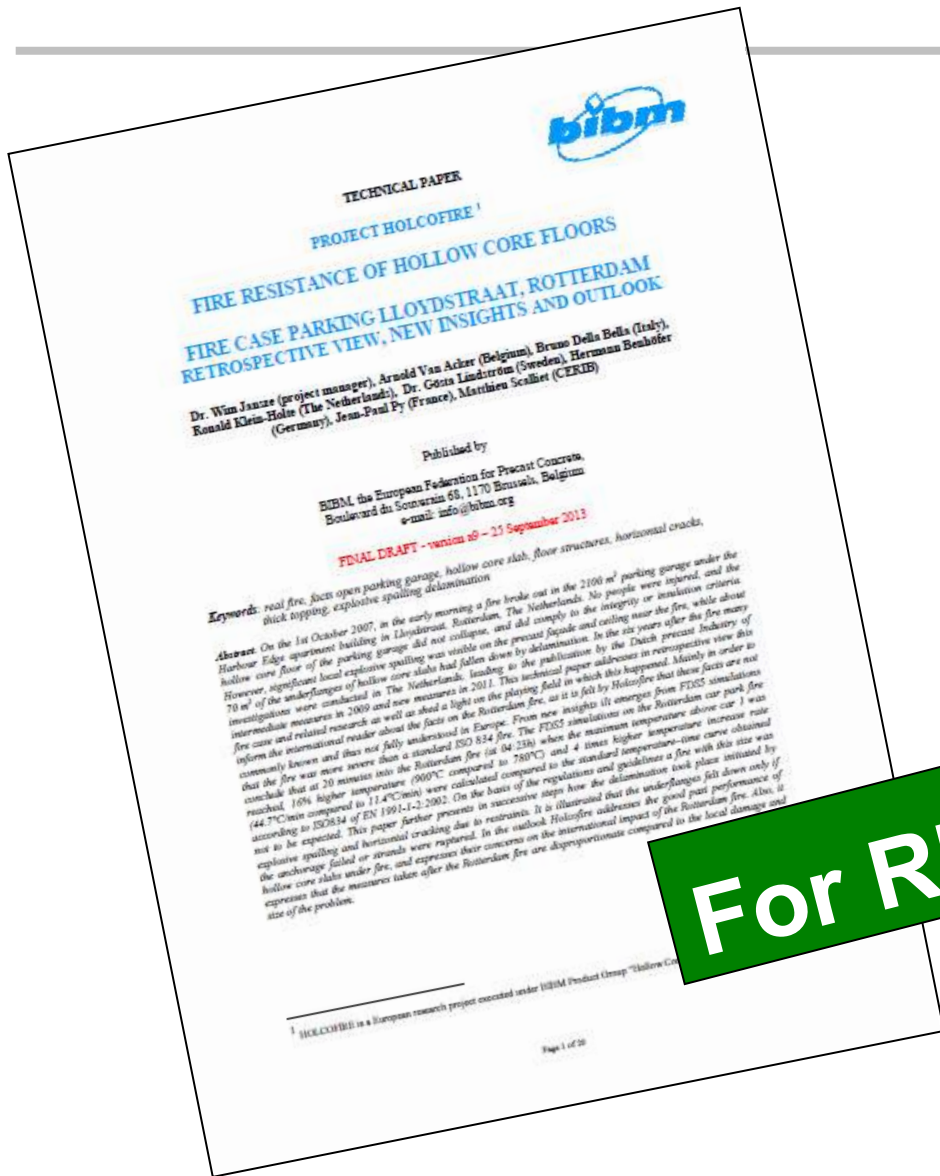
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Rotterdam fire case

Finalizing



For REVIEW

Fire test series R

Finalizing

TECHNICAL PAPER
PROJECT HOLCOFIRE¹
FIRE RESISTANCE OF HOLLOW CORE FLOORS
FIRE TESTS TO VALIDATE THE CAPACITY UNDER RESTRAINED CONDITIONS

Dr. Wim Jansze (project manager), Arnold Van Acker (Belgium), Bruno Della Bella (Italy), Ronald Klein-Holte (The Netherlands), Dr. Gösta Lindström (Sweden), Hermann Benhofer (Germany), Jean-Paul Py (France), Matthieu Scaillet (CERIB)

Published by
BIBIM, the European Federation for Precast Concrete,
Boulevard du Souverain 69, 1170 Brussels, Belgium
e-mail: info@bibim.org

version 1.1 - 3 October 2013

Keywords: fire tests, hollow core slab, floor structures, restraints, horizontal web cracking, spalling

Abstract: In 2007 a fire broke out in Rotterdam that led to delamination of the underflange of a part of the hollow core slab floor. A research conducted by Holcofire concluded that both horizontal cracking and underflange spalling are attributed to high restraints in the floor. In order to understand whether the fire resistance of the floor is jeopardized, 4 fire tests were conducted with high in-floor restraints in order to understand the phenomena of horizontal cracking and underflange spalling. In addition, the fire resistance of the floor is jeopardized. Four fire tests were conducted. In test R1, the fire resistance of the floor was tested after a fire time of 90 minutes. Four tests were conducted, R1 to R3, to obtain the fire resistance of the floor after a fire time of 90 minutes. In order to acquire more information about the capacity of the floor after a fire time of 90 minutes, a fourth test, R4, was conducted. In R4, the fire resistance of the floor was tested after a fire time of 90 minutes. In R1, R2 and R3, the fire resistance of the floor was tested in the short direction of the furnace (L > 5 m). R4 and R2 were conducted on 260 mm deep slabs with 100 mm topping. In R2, horizontal cracks were used to evaluate the continuity of the floor. R3 was conducted with 200 mm deep slabs and a 50-70 mm topping. R4 was executed with 260 mm slabs without a structural topping. Due to the high restraints at the supports in all test set ups, underflange spalling occurred in all fire tests. Horizontal cracks were initiated in R1 to R3. However, the fire test results showed that with a moderate fire load of 1.4 kNm² a fire resistance time of 90 minutes was achievable. When the bending capacity was equalled the theoretical bending moment and shear load was applied, the fire test R1 showed a shear-bending interaction failure at 47 minutes. In fire test R4 at 55 minutes of fire slab an open hole occurred in the top flange, and the fire test was still in progress. This hole was caused by high restraints in the floor, but in R4 the other slabs were still intact. Overall it was concluded that floor restraints due to structural topping and support beam can lead to underflange spalling and horizontal cracking, but that at moderate loads fire resistance times can still be met.

¹ HOLCOFIRE is a European research project executed under BIBIM Product Group "Hollow Core".

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BIBIM Product Group Hollow Core

HOLCOFIRE
Behaviour of prestressed hollowcore floors exposed to fire

Analysis on hollow core cross sections
A model for horizontal web cracking due to restraints

Authors: Ronald Klein-Holte (Netherlands), Wim Jansze (project manager, Netherlands), Arnold Van Acker (Belgium), Bruno Della Bella (Italy), Gösta Lindström (Sweden), Jean-Paul Py (France), Matthieu Scaillet (France)

Date: 26 September 2013
Document: CNSDM #000000
Pages: 45

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Bd. du Souverain 69 - B-1170
Brussels - Belgium

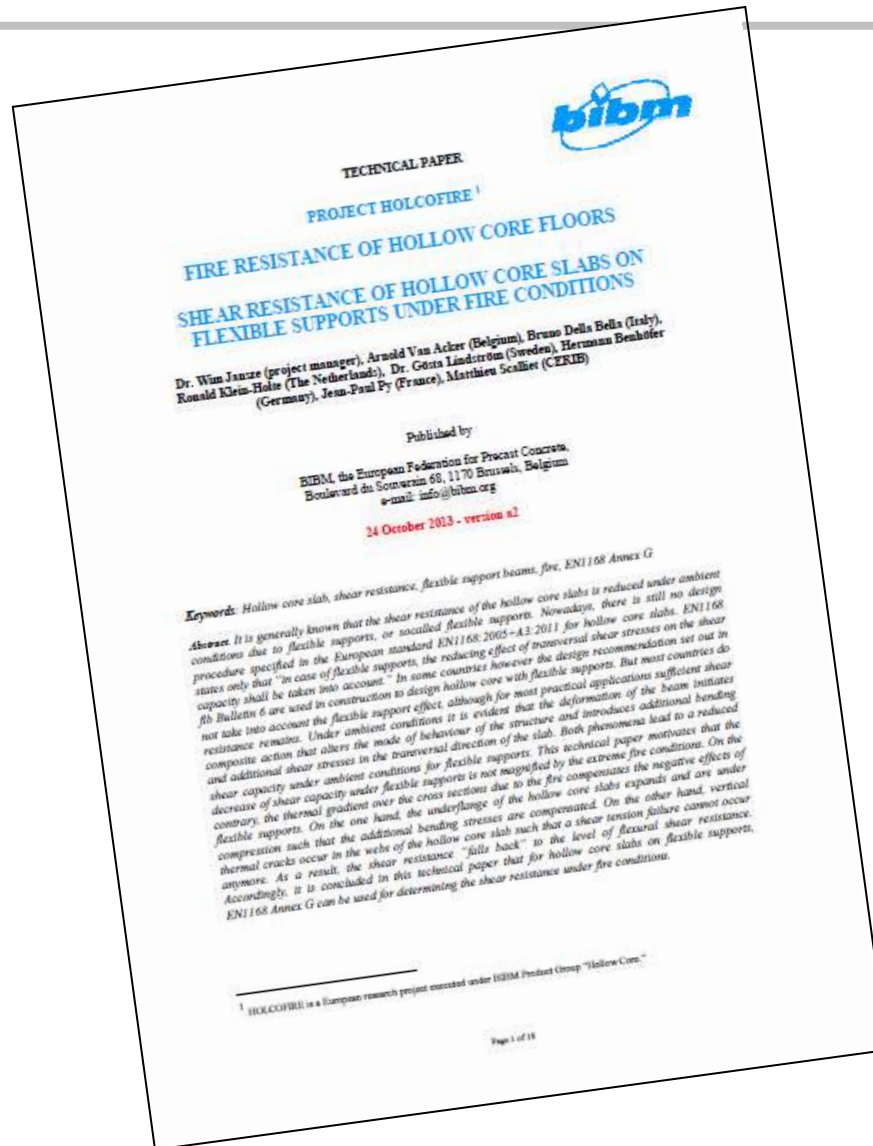
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Flexible supports

Finalizing



Holcofire project: “Lessons learned”

- In this IPHA seminar we will conclude with you on the “lessons learned” from the project:
 1. Scale of real fire
 2. Performance of product
 3. Product and regulations

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wish you an interesting
Technical Seminar 2013