



INTERNATIONAL PRESTRESSED  
HOLLOWCORE ASSOCIATION



## *Holcofire project “Lessons learned”*

Behaviour of prestressed  
hollowcore floors exposed to fire

*Conclusion & Communication*

*Wim Jansze, Axel Baumann*

# Problems around hollowcores + fire

- Clients ask questions in relation to fire:
  - Database with 162 fire tests 1966-2010
- Questions on shear and anchorage
  - Fire tests series G1 – G7
  - 42 tests from database
- Questions on horizontal cracks in fire case Rotterdam
  - Fire tests series R1-R4
  - Holcofire frame model
  - Rotterdam studied with CFD simulations
- Questions on how to deal with flexible supports
  - Desk study with Annex G recommendation

# Holcofire project: “Lessons learned”

- In this IPHA seminar we have updated you on the technical content of the Holcofire project and have addressed the “lessons learned”

**Programme**

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

**October 30<sup>th</sup> 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 31<sup>st</sup> Thursday**

07:45 Trip to CERIB by coach  
08:30 Rotterdam fire case *Gösta Lindström, Andreea Muntean*  
09:15 Spalling and horizontal cracking *Ronald Klein-Holte*  
10:00 Break  
10:30 Flexible supports and fire *Bruno Della Bella*  
11:15 Fire Safety Engineering *Mohammad Heidari*  
12:00 Lunch  
13:00 Conclusions and communication *Wim Jansze, Axel Baumann*  
13:15 Discussion, Q&A  
13:45 Closure of the seminar  
14:00 Travel to airport (Charles de Gaulle)

  

INTERNATIONAL PRESTRESSED  
HOLLOWCORE ASSOCIATION

# Holcofire: “Lessons learned”

---

- LESSONS LEARNED

Lesson 1 - Scale of real fire

Lesson 2 - Performance of product

Lesson 3 - Product and regulations

# Lesson 1: Scale of real fire

- 1.1 The dynamic simulation of the fire with FDS5 gave much better insights in the fire development in the Rotterdam parking garage compared to static CaPaFi calculation conducted by Efectis, as it takes into account the real dimensions and environmental conditions
- 1.2 In parking garages the travelling fire concept should be used instead of ISO compartment fire concept which is unlikely to happen for a fire compartment in a garage with cars and measuring 2100 m<sup>2</sup> over several floors
- 1.3 The real fire in Rotterdam was due to the presence of cars and due to present moisture conditions more severe than an ISO fire simulated in laboratory conditions
- 1.4 Real fires in parking garages are accidental, severe and unpredictable and will always cause local damage to any structure: hollow core floors, but also other precast floors as well as cast in-situ floors.
- 1.5 Fire Safety Engineering is a performance based approach that, compared to the prescriptive based approach of ISO fire, should be advocated by the concrete industry (in order to compete with steel solutions as steel industry uses this approach already for years successfully)

# Lesson 2: Performance of product

- 2.1 The 162 independent fire test results from the Holcofire database confirmed that when the nowadays available resistance models are strictly followed (EN1168, EN1992-1-2, EN1363-1, EN1365-2), 94.5% of the fire tests can be fully explained
- 2.2 The executed fire test series G and 42 fire test results from the Holcofire database with shear and anchorage failures confirmed the Annex G model for shear capacity under fire conditions for heights and the positive contribution of the systems effect
- 2.3 The executed fire test series R and the Holcofire frame model explain the mechanism of horizontal cracking, underflange spalling and delamination due to restraints but also confirm the robustness and alternative load paths present in the floor
- 2.4 Fire conditions do not reduce the shear capacity of hollow core slabs on flexible support and for fire the Annex G model can be used to calculate the shear capacity
- 2.5 Past performance of 1 billion m<sup>2</sup> of hollow core floors in Europe confirm the good performance of the hollow core floor

# Lesson 3: Product and regulations

- 3.1 The hollow core floor applied in the Rotterdam garage fulfilled the criteria R, E and I after the fire was extinguished.
- 3.2 In real fires the hollowcore floor proofs to be more redundant than the regulations by virtue of the floor systems effect
- 3.3 A fire resistance time can be appointed to a hollow core slab floor when it is tested conform the acting testing standards EN1363-1 and EN1365-2
- 3.4 All available regulations and requirements for hollow core slab floors under ambient conditions and fire conditions have been derived and verified on the basis of real experiments, what cannot be said by many other products.
- 3.5 Safety with respect to fire is achieved by specifying some safe value at the loading side (duration of the fire) in combination with the recognition that fire in itself has a low probability of occurrence

# Holcofire communication 1 / 3

- Provision of **deliverables** allowing the spreading of the knowledge and the making available of answers to the main questions around hollowcore floors under fire conditions
  1. **Summary** of project findings (2 pages)
  2. **Complete findings** ("Book")
  3. Background **test results**
  4. Standard **presentation** of the project



# Holcofire communication 2/3

---

- Extension of the **support** of both Steering Group and Project Team members to the partners at the end of the technical part
  - Members of the SG and the PT will be made available to **visit all the partners** of the project at least once during period September 2013 – September 2014.

# Holcofire communication 3/3

---

- Additional activities
  - An **informal follow up** of the developments in the different countries
  - The publication of ***fib* recommendations**

IPHA  
BIBM  
Cerib

thanks you all for participating  
in the Technical Seminar 2013