



**Book of Abstracts of the**  
**International Fire Safety**  
**Symposium 2015**

**Organizers:**

**cib - International Council for Research and  
Innovation in Building Construction**  
**UC - University of Coimbra**  
**albrasci - Luso-Brazilian Association for Fire Safety**

**Editors:**

**João Paulo C. Rodrigues**  
**George V. Hadjisophocleous**  
**Luís M. Laím**  
**Hélder D. Craveiro**

**Coimbra, 20-22 April, 2015**  
**Portugal**



**albrasci**

Luso-Brazilian Association  
for Fire Safety



International Council  
for Research and Innovation in  
Building and Construction



University of Coimbra

**isise**

Institute for Sustainability and Innovation in  
Structural Engineering



OE



OET



OA



ANPC



Hot Disk®

**D+HE**



9 789899 843530



# **Book of Abstracts of the International Fire Safety Symposium 2015**

## **Organizers:**

cib - International Council for Research and Innovation in Building Construction  
UC - University of Coimbra  
Albrasci - Luso-Brazilian Association for Fire Safety

## **Authors:**

João Paulo C. Rodrigues  
George V. Hadjisophocleous  
Luís M. Laím  
Hélder D. Craveiro

**Book of Abstracts of the International Fire Safety Symposium 2015**

held at the Department of Civil Engineering of the University of Coimbra, Portugal  
20<sup>th</sup>-22<sup>nd</sup> April 2015

ISBN 978-989-98435-3-0

A Symposium organised by



albrasci  
Luso-Brazilian Association  
for Fire Safety  
(<http://www.albrasci.com>)



International Council  
for Research and Innovation in  
Building and Construction  
([www.cibworld.nl](http://www.cibworld.nl))



• U • C • University of Coimbra  
([www.uc.pt](http://www.uc.pt))

All rights reserved. No part of the publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopied, recording or otherwise, without prior permission of the Publisher.

No responsibility is assumed by the Publisher for any injury and/or damage to people or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions or ideas contained in the materials herein.

## Organizing Committee

**João Paulo Correia Rodrigues, UC - University of Coimbra, Portugal (Chairman)**

Greg Baker, BRANZ, New Zealand (Co-chairman)

Cristina Calmeiro dos Santos, UC - University of Coimbra, Portugal

C.J. Walsh, Sustainable Design International Ltd., Ireland

Ehab Zalok, Carleton University, Canada

Hélder David da Silva Craveiro, UC - University of Coimbra, Portugal

Hugo Caetano, UC - University of Coimbra, Portugal

Luís Miguel dos Santos Laim, UC - University of Coimbra, Portugal

## Scientific Committee

### **George V. Hadjisophocleous, Carleton University, Canada (Chairman)**

Ahmed Kashef, National Research Council, Canada  
Ali Nadjai, University of Ulster, UK  
Brian Meacham, WPI, USA  
Charlie Fleishman, University of Canterbury, New Zealand  
Dhionis Dhima, CSTB, France  
Ehab Zalok, Carleton University, Canada  
Euripidis Mistakidis, University of Volos, Greece  
Frantisek Wald, Technical University of Prague, Czech Republic  
George Boustras, European University of Cyprus, Cyprus  
Geraldine Charreau, INTI, Argentina  
Gintaris Kaklauskas, Technical University of Vilnius, Lithuania  
Gordon Andrews, University of Leeds, UK  
Guillermo Rein, Imperial College, UK  
Guo-Qiang Li, Tongji University, China  
Jean Marc Franssen, Liège University, Belgium  
João Paulo Correia Rodrigues, Coimbra University, Portugal  
Jose Torero, The University of Queensland, Australia  
Juan de Dios Rivera, Pontificia Universidad Católica de Chile  
Karen Boyce, University of Ulster, UK  
Kathrin Grewolls, Ingenieurbüro Für Brandschutz Grewolls, Germany  
Manfred Korzen, BAM, Germany  
Manuel Romero, Universidad Politecnica de Valencia, Spain  
Maria Cruz Alonso – Instituto Eduardo Torroja, Spain  
Paulo Vila Real, Aveiro University, Portugal  
Pierre Pimienta, CSTB, France  
Pietro Gambarova, Politecnico de Milano, Italy  
Raffaele Landolfo, University of Naples, Italy  
Ricardo Cruz Hernandez, Universidad de Santander, Colombia  
Rita Fahy, National Fire Protection Association, USA  
Rosária Ono, São Paulo University (School of Architecture), Brazil  
Simo Hostikka, VTT, Finland  
Sunil K. Sharma, Fire Research, Central Building Research Institute, India  
Takashi Horiguchi, Hokkaido University, Japan  
Tan Kang Hai, Nanyang Technological University, Singapore  
Ulf Wickstrom, Lulea University of Technology, Sweden  
Ulrich Krause, University of Magdeburg, Germany  
Valdir Pignatta e Silva, São Paulo University (School of Engineering), Brazil  
Venkatesh Kodur, Michigan State University, USA  
Wan-ki Chow, Hong Kong Technical University

<p>COMPRESSIVE STRENGTH OF FIBRE CONCRETES WITH ENHANCED FIRE BEHAVIOR  <i>Hugo Caetano, João P.C. Rodrigues and Armando M. Junior</i></p> <p>.....</p>	125
<p>DETERMINATION OF WOOD THERMAL CONDUCTIVITY  <i>Eduardo Schneid, Carolina da Rosa and Poliana D. Moraes</i></p> <p>.....</p>	127
<p>ULTRASONOGRAPHY APPLIED TO DETERMINE THE CONCRETE RESISTANCE UNDER A          FIRE CONDITION  <i>Armando L.M. Junior, Nádia S. Veiga, Carolina A.N. Alvim, André A. Garcia, Maria C.D. Relvas          and Rafaela Montefusco</i></p> <p>.....</p>	131
<p>FIRE BEHAVIOUR OF LIGHTWEIGHT CONCRETE UNITS BASED ON CORN COB          AGGREGATE  <i>Nuno Alves, Paulo Piloto, Elza Fonseca, Luísa Barreira, Débora Ferreira and Jorge Pinto</i></p> <p>.....</p>	133
<p>THE RELATIONS BETWEEN THE ASSESSED DIAGNOSTIC PARAMETERS AND          MECHANICAL PROPERTIES OF HEATED CONCRETES  <i>Izabela Hager and Tomasz Tracz</i></p> <p>.....</p>	135
<p>COMPRESSIVE BEHAVIOUR OF A TIRE RECYCLED STEEL AND TEXTILE FIBER          CONCRETE SUBJECTED TO FIRE  <i>Cristina C. Santos and João P. Rodrigues</i></p> <p>.....</p>	137
<p>EXPERIMENTAL RESEARCH ON THE RESIDUAL MECHANICAL PROPERTIES OF AN          ORDINARY CONCRETES AFTER FIRE  <i>Cristina C. Santos and João P. Rodrigues</i></p> <p>.....</p>	141
<p>EXPERIMENTAL ANALYSIS ON THE COMPRESSIVE STRENGTH AT HIGH          TEMPERATURES OF A CONCRETE WITH PET CHIPS  <i>Hugo Caetano, João P. Rodrigues and Pierre Pimienta</i></p> <p>.....</p>	145

## **FIRE BEHAVIOUR OF LIGHTWEIGHT CONCRETE UNITS BASED ON CORN COB AGGREGATE**

**Nuno Alves**  
Civil Engineer  
UTAD – Vila Real  
Portugal

**Paulo Piloto**  
Professor  
IPB – Bragança  
Portugal

**Elza Fonseca**  
Professor  
IPB – Bragança  
Portugal

**Lúisa Barreira**  
Mechanical Engineer  
IPB – Bragança  
Portugal

**Débora Ferreira**  
Professor  
IPB – Bragança  
Portugal

**Jorge Pinto\***  
Professor  
UTAD – Vila Real  
Portugal

**Keywords:** Lightweight concrete unit; corn cob aggregate, organic material; masonry; sustainable construction; fire.

### **1. INTRODUCTION AND METODOLOGY**

The search for alternative environmental friendly building solutions has been the goal of the scientific and the technical communities. Affordable, low energy and good quality water consumptions, and small amount of CO<sub>2</sub> emission into the atmosphere are important attributes that these solutions have to fulfil. In general, applying organic products as raw building materials may be a step forward to achieve these attributes because they are likely of being abundant, local and renewable. For instance, rice husk ash blended cement has been proposed as a partial substitute of cement in mortar production.

---

Departamento de Engenharias da Universidade de Trás-os-Montes e Alto Douro, Quinta de Prados. 5001-801 Vila Real. PORTUGAL. Telef.: +351 259 350356 Fax: +351 259 350356. e-mail: [tiago@utad.pt](mailto:tiago@utad.pt)

On the other hand, corn cob has also been proposed as an alternative aggregate for the manufacturing of lightweight concrete for non-structural applications. In these cases, there is an additional advantage because these organic products are treated as agricultural waste.

In this research work, lightweight concrete unit based on granulate of corn cob (LWCUGCC) is proposed as an alternative building material. Granulate of corn cob works as a substitute of the current applied aggregates such as expanded clay. The adopted geometrical and size typologies, composition and manufacturing technology are similar to the ones currently applied in lightweight concrete unit based on expanded clay (LWCUEC). Therefore, this type of unit is used as reference in this study. Taking into account that partition walls are a potential building scenario in terms of the application of the LWCUGCC the respective fire behaviour is fundamental to know. The main goal of this research work consists on giving a contribution in this context by performing an experimental and a numerical analysis of the proposed building material under specific fire conditions. Thus, samples of LWCUGCC and LWCUEC were tested under fire conditions related to the standard fire curve indicated in ISO834. The obtained experimental results allow understanding the behaviour of the units under severe fire conditions and also comparing the two types of solutions. In addition, these results are also used to validate the proposed numerical model of the fire behaviour of the units. Figure 1 shows the experimental test set-up and the numerical results at the end of the fire exposure.

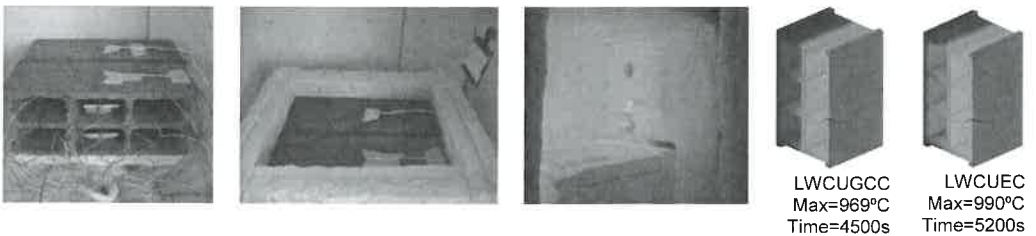


Figure 1: Experimental test: thermocouples, oven fire resistance and numerical results.

## 2. CONCLUSIONS

According to [1], both LWCUGCC and LWCUEC have shown adequate fire behaviour because the fire failure criterion was verified in both cases. In fact, the outer face of the wall (which was no exposed to fire) showed adequate performance and fire resistance. The integrity at 180°C limit temperature was verified under a fire exposure during 4330s and 5004s.

## 3. REFERENCES

[1] CEN, European committee for standardization, EN 1363-1, Fire resistance tests - Part 1: General requirements. 1999. Brussels, Belgium.