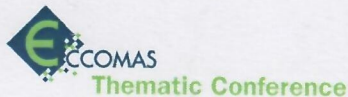


11-12 April, 2019  
Porto,  
Portugal



**SYMCOMP 2019**



**4<sup>th</sup> International Conference on  
Numerical and Symbolic Computation  
Developments and Applications**

**PROGRAM and ABSTRACTS**

**April, 11 - 12,  
ISEP – Instituto Superior de Engenharia do Porto  
PORTO, Portugal**





4<sup>th</sup> International Conference on Numerical and Symbolic Computation: Developments and Applications.

April, 11- 12, 2019, ISEP, Porto, Portugal, ©ECCOMAS.

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Editors: Maria Amélia Loja (IDMEC, ISEL/CIMOSM), Joaquim Infante Barbosa (IDMEC, ISEL/CIMOSM),  
José Alberto Rodrigues (ISEL/CIMOSM) e Paulo B. Vasconcelos (CMUP/FEP-UP)

April, 2019





## 1 – Introduction

The Organizing Committee of SYMCOMP2019 – 4<sup>th</sup> International Conference on Numerical and Symbolic Computation: Developments and Applications, welcomes all the participants and acknowledge the contribution of the authors to the success of this event.

This fourth International Conference on Numerical and Symbolic Computation, is promoted by APMTAC - Associação Portuguesa de Mecânica Teórica, Aplicada e Computacional and it was organized in the context of IDMEC - Instituto de Engenharia Mecânica, Instituto Superior Técnico, Universidade de Lisboa. With this ECCOMAS Thematic Conference it is intended to bring together academic and scientific communities that are involved with Numerical and Symbolic Computation in the most various scientific areas

SYMCOMP 2019 elects as main goals:

To establish the state of the art and point out innovative applications and guidelines on the use of Numerical and Symbolic Computation in the numerous fields of Knowledge, such as Engineering, Physics, Mathematics, Economy and Management, Architecture, ...

To promote the exchange of experiences and ideas and the dissemination of works developed within the wide scope of Numerical and Symbolic Computation.

To encourage the participation of young researchers in scientific conferences.

To facilitate the meeting of APMTAC members (Portuguese Society for Theoretical, Applied and Computational Mechanics) and other scientific organizations members dedicated to computation, and to encourage new memberships.

We invite all participants to keep a proactive attitude and dialoguing, exchanging and promoting ideas, discussing research topics presented and looking for new ways and possible partnerships to work to develop in the future.

The Executive Committee of SYMCOMP2019 wishes to express his gratitude for the cooperation of all colleagues involved in various committees, the Scientific Committee, the Programm Committee, Organizing Committee and the Secretariat. We hope everyone has enjoyed helping to consolidate this project, which we are sure will continue in the future. Our thanks to you all.

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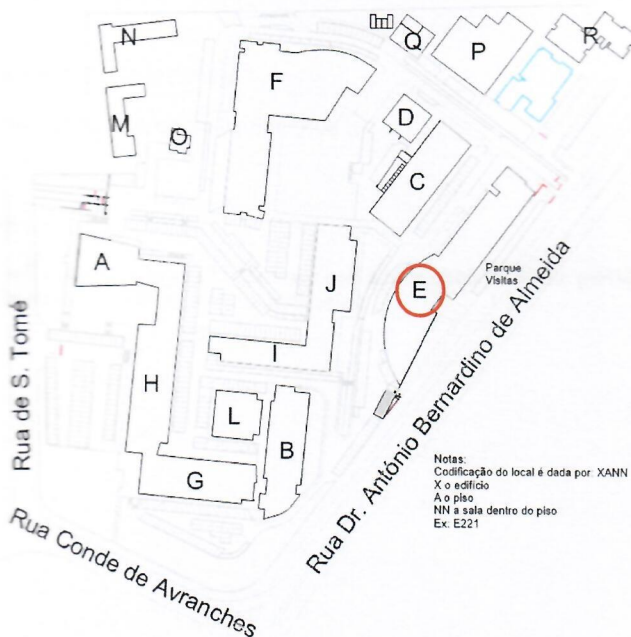
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Rua Dr. António Bernardino de Almeida, 431, Porto

(Building E)



FRIDAY, APRIL, 12, 2019

LOCAL: SALA DE REUNIÕES - ISEP

SESSION IX, Computational Structural and Thermal Safety Engineering 09:45 – 11:00		
CHAIR: <i>Prof. Paulo Piloto and Prof. Elza Fonseca</i>		
ID	COMMUNICATION TITLE	AUTHORS
A04	Numerical simulations of industrial steel portal frames under fire conditions	Nourredine Benlakehal, Abdelkader Bougara, A. Fellouh and Paulo A. G. Piloto
A13	Fire safety of wood-steel connections	Elza M. M. Fonseca, Lino Silva and Pedro A. S. Leite
A14	Critical temperature for the components of composite slabs with steel deck under fire for load-bearing rating	Paulo A. G. Piloto, C. Balsa, F.F. Ribeiro, L. Santos, R. Rigobello and Érica Kimura
A03	Fire performance of partially encased column subjected to eccentric loading	Abdelkadir Fellouh, A. Bougara, Paulo Piloto and Nourredine Benlakehal
A43	Models and numerical methods for marine vehicles trajectory optimization	Miguel Aguiar, Jorge Estrela Silva and João Borges Sousa

SESSION XI: Numerical and Symbolic Computation in Mathematics, Finance and Economics, 11:15–12:30		
CHAIR: <i>Prof. Óscar Afonso and Prof. Jorge Andraz</i>		
ID	COMMUNICATION TITLE	AUTHORS
A29	Dynamic effects of International trade under imperfect competition and economies of scale	Óscar Afonso and Paulo B. Vasconcelos
A20	Estimating the 'Employment Band of Inaction' with Multiple Breaks Due to Labour Market Reforms	Paulo Mota and Paulo B. Vasconcelos
A32	Dynamic and interactive mathematical tools in socio-economic sciences classrooms	Jorge M. Andraz and Ana C. Conceição
A34	An interactive way of analyzing economic concepts using symbolic computation	J. M. Andraz, R. Candeias, Ana C. Conceição and Inês Serafim
A37	Factor distribution meets Industrial Organization: the labor share's behavior under a neo-Schumpeterian environment	Ana Oliveira



## FIRE PERFORMANCES OF PARTIALLY ENCASED COLUMN SUBJECTED TO ECCENTRIC LOADING

**Abdelkadir Fellouh<sup>1\*</sup>, Abdelkader Bougara<sup>1</sup>, Paulo A. G. Piloto<sup>2</sup> and Nouredine Benlakehal<sup>1</sup>**

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**Keywords:** Fire, Composite column, Simulation Method, Analytic Method, Eccentric loading.

*Abstract* In this paper, the advanced and simplified calculation methods are used to evaluate the fire resistance of eccentrically loaded partially encased composite columns (PEC). The work consists in developing an efficient Non-linear 3-D finite element model (ANSTS) to investigate the behaviour of Pin-ended PEC eccentrically loaded at elevated temperature. The columns were tested under standard ISO834 fire. The buckling load is determined for several column heights 3; 4.5 and 6 m, by considering an eccentricity around the minor axis equal to 0,5.B ; 1,0.B and 1,5.B (B base). The numerical method presented here is compared with the simple calculation method Annex G of EN 1994-1-2. The results show that after 50 min of fire exposure, the axial load capacity of PEC is reduced to more than half, which is a fair conclusion to take into consideration in structural fire design. The comparison results show a good agreement between the two methods at high fire ratings (R90 and R120), however at low fire rating (R30), the simple calculation method presents conservative results. It is to be concluded that the eccentricity of loading reduces the loadbearing capacity of the composite column. The shortest column (3m) presents the higher reduction in load bearing.