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APPLICATIONS OF STRUCTURAL FIRE ENGINEERING



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Czech Technical University in Prague

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Applications of Structural Fire Engineering**
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Preface

Current European practice in structural fire engineering is tending more and more to acceptance of the benefits to be gained from performance-based approaches to fire-resistant design. These proceedings, from the *Applications of Structural Fire Engineering* conference, presents the state of the art in the development and application of both simple and advanced performance-based design methods for concrete, steel and timber structures. Internationally acknowledged research experts and specialists in design against fire are represented in these articles, offering an opportunity to share contemporary ideas and knowledge within both the background science and practical case studies. The spectrum of relevant research themes covered encompasses fire modelling, heat transfer to structural elements, numerical modelling of thermo-structural behaviour at elevated temperatures, structural fire testing at elemental and structural scales, the development of simplified design methods and studies based on the structural Eurocodes. Practical design case studies demonstrating the ways in which performance-based structural fire safety design methods have been applied to real projects, and the economic and safety implications of using these methods in place of the traditional prescriptive rules, are included.

Ian Burgess

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TWENTY TWO YEARS OF STRUCTURAL FIRE ENGINEERING IN CZECH REPUBLIC

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FIRE DESIGN IN CZECHOSLOVAKIA

The background of the today fire engineering in Czechoslovakia starts in 1965, when the fire engineering solutions were incorporated into the overall architectural and engineering design. The standard related to fire testing, which was introduced in 1967, takes into account the compartmentisation, the fire risks, the escape solutions and the building separation. The whole set of standards, which is marked ČSN 73 08xx and related to fire testing of the construction products, the data of the material properties and the valorisation of structures, was prepared by a new standard committee established in the area of fire safety in 1971. The standard ČSN 73 0810 Fire protection of buildings - Requirements determination in civil engineering was in the set of documents localised at the position between the experimental and design national specifications. The document [10] represents the latest issue of this key provision, which creates the foundation of the structure of the national standards.

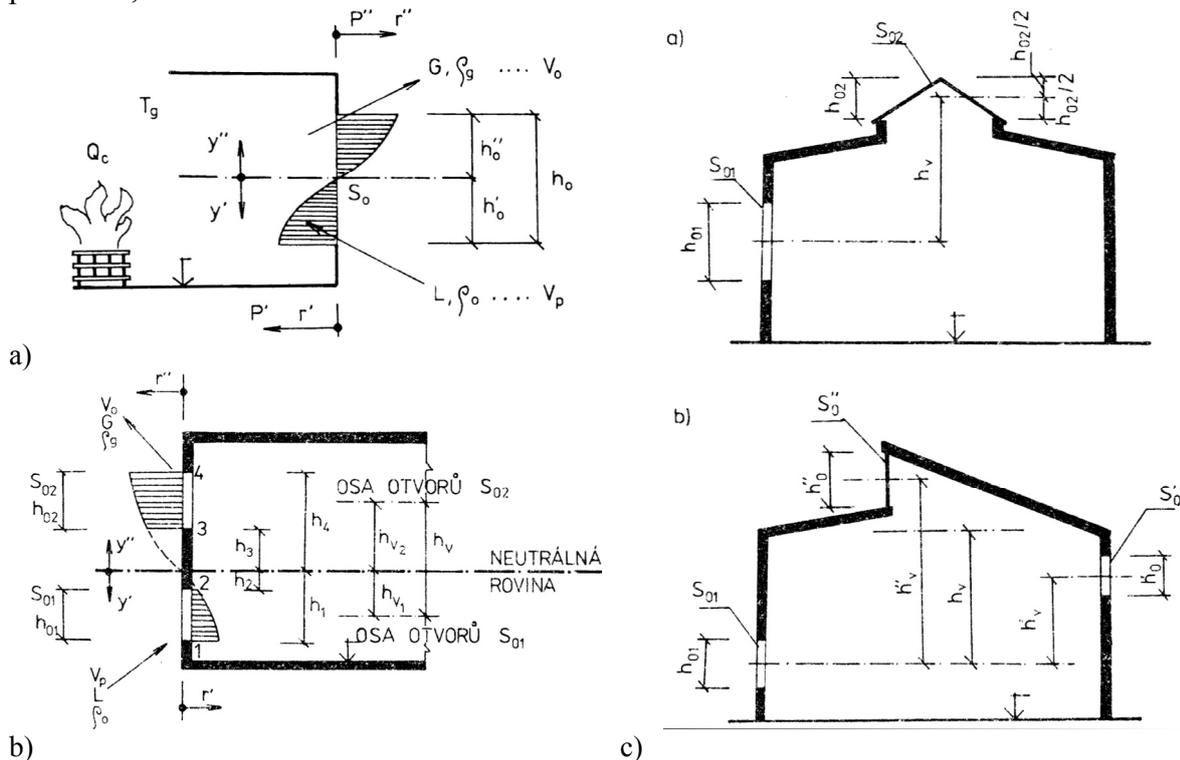


Fig. 1 Example of application of the zone model for prediction of temperature in the industrial building, a) model, b) openings in different heights, c) application to industrial hall, see [4]

The today prescriptive rules are based on the publication prepared by Karpaš and Zoufal, see [1], which brings not only the properties and rules of application of the fire protection, but also the material properties of the structural steel and the basic rules of the design of steel

structures. In the same year was published the first contribution for the fire design by dr. Reichel, see [2], which creates the background of the today compartmentisations, the estimation of the fire load, and most importantly it incorporate the fire risk into the Ultimate Limit State design. The second volume of this book takes care among others of the fire separation walls, the bearing structures and the fire safety distances, see [3].

The important steps for fire safety of structures was the foundation of the research centre in Veselí nad Lužnicí, where the colleagues from PAVUS a.s., see www.pavus.cz, successfully continue to ensure the good level of the products at European market to develop European material fire standards as well as national fire safety regulations and standards. The integral part of the reached level of the fire safety is shearing of knowledge with the young colleagues at the Faculty of Safety Engineering of Ostrava University, see www.fbi.vsb.cz, for forty years already and in the part of the safety and risk engineering related to the structures at Czech Technical University in Prague as well, see www.fsv.cvut.cz/baris.

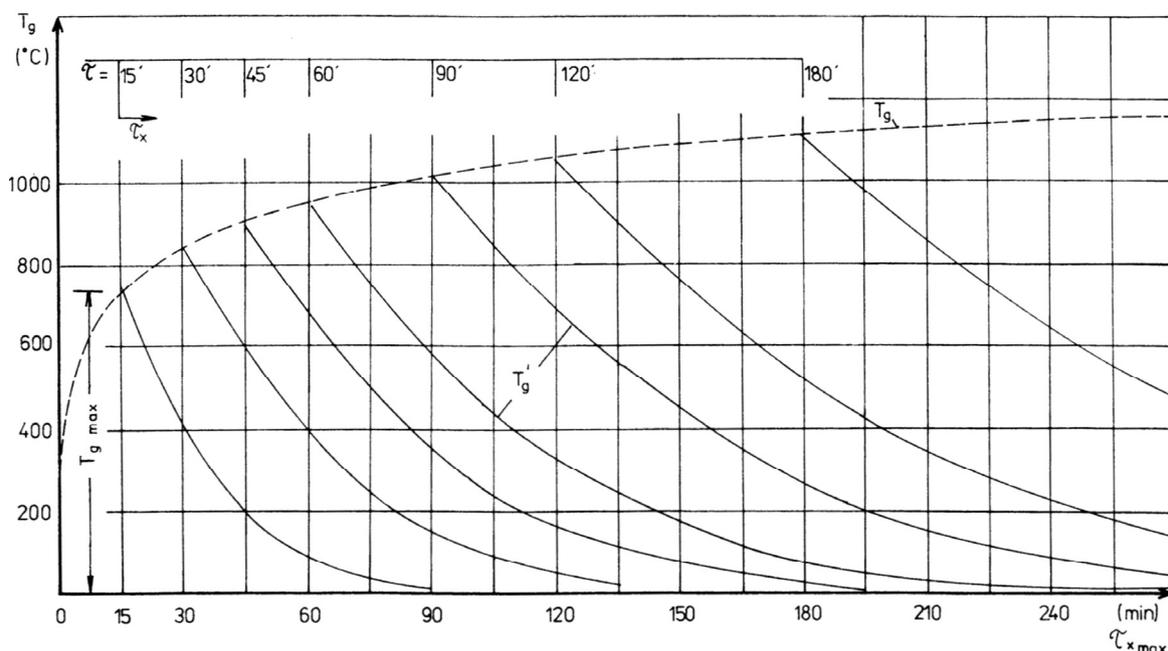


Fig. 2 Structure of the parametrical fire curve based on the time of the maximal temperature, see [4]

The background to the structural fire engineering in Czechoslovakia itself was introduced by the work of dr. Reichel, see [4], in 1987. The publication is contributing to the evaluation of the fire risk, the fire load, the structural behaviour and the economical aspects of the fire hazards. It brings the explanation of the background principles and its application in the current Czechoslovak standards. In the part devoted to the fire load is introduced for the utilisation of the Ultimate Limit State principles. A special chapter is focussed to the heat release and its importance for estimation of prediction of fires. The zone models and parametrical fire curve are used for the fire modelling. The simple zone model allowed predicting of the importance of the openings and its position in the fire compartment in the horizontal and vertical directions. The example of the application of the zone model to the influence of the openings at different height is documented on Fig. 1. The parametrical fire curve, presented in the book, modified the nominal standard fire curve based on the fire load and the ventilation. The simple solution gives a conservative estimation based on an assumed maximal reached temperature, see Fig. 2. Only one cooling speed is assumed. The publication brings useful worked examples for the calculation of the fire load, the equivalent

the specialists with appropriate qualification take care of the fire engineering for constructions. These methods of evaluation do not need to be specified in detail for these specialists. The procedure of evaluation contains basically from the location of fire, type of fire, the potential fire hazard, the systems and features impacting on fire, the people response, the event tree, the consideration of probability, the consideration of consequence, the risk ranking, and the final selection and documentation. These fire scenarios for quantitative analysis will become the design fire. The data related to the risk probability are under preparation at Ministry of Interior.

SUMMARY

The fire engineering in Czech Republic, which is based on a good connection between the prescriptive rules and the performance based solutions, starts in 1965. The reached knowledge in connection with growing application of the active fire measurements and the information technologies in the fire engineering brings the opportunity to keep the good level of the fire safety for the challenging complex structural solutions, e.g. the mixed building technologies, introduction of the new materials, the high raised buildings, as well as the solutions for the sustainable constructions.

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