

## Center for Structural Fire Engineering and Diagnostics

**Director:** Venkatesh Kodur

Department of Civil and Environmental Engineering

Telephone: (517) 353-9813

Fax: (517) 432-1827

e-mail: [kodur@egr.msu.edu](mailto:kodur@egr.msu.edu)

Website: [www.egr.msu.edu/cee](http://www.egr.msu.edu/cee)

**Co-Principal Investigators:**

Indrek Wichman, Department of Mechanical Engineering and

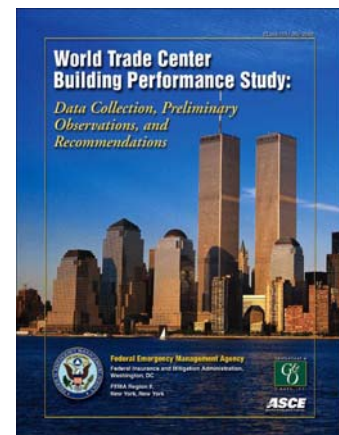
Ruby Ghosh, Department of Physics and Astronomy

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The Center for Structural Fire Engineering and Diagnostics (SAFE-D) was established in 2007 through a Strategic Partnership Grant Award by the MSU Foundation. This center is led by the Department of Civil and Environmental Engineering (CEE) in collaboration with the Department of Mechanical Engineering and the Department of Physics and Astronomy.

Fire represents one of the most severe environmental hazards in the design and fabrication of civil (built infrastructure), mechanical, aerospace and nuclear structures. Unfortunately, the U.S. has one of the worst fire-loss records in the industrialized world, as demonstrated by the large number of deaths and property destruction. Further, a number of recent studies conclude that there is a serious lack of understanding, test data, tools, technologies and qualified personnel to facilitate structural fire safety design. This was mainly attributed to the fact that within the area of fire science, structural fire safety is the least developed.

Presently, design for fire is based on prescriptive approaches, either through standard fire test data or simplified empirical methods. It is widely recognized that this traditional approach does not provide a realistic assessment of structural performance due to a number of serious drawbacks in the methods. There has been no improvement to these methods due to the lack of knowledge on fire characteristics, material properties at high temperatures, and validated simulation models. Hence, current fire protection codes and standards provisions do not account for the realistic response in actual fires and thus will not provide rational and cost-effective designs.



Fire in WTC 2 building    Highway bridge Collapse in OakLand, CA    FEMA report stressing the need

after plane impact                      due to fire

## R &D in Fire Engineering

The Center will address fire issues related to the built environment (civil infrastructure) in the civil, mechanical, and transportation sectors. The research conducted in the center will lead to the advancement of fire safety science, and will produce innovative fire resistant materials, high temperature sensors, engineering design tools, and advanced degree holders who will perform fire resistant design and construction in multidisciplinary engineering applications. Currently efforts are underway to further expand the research activities through the establishment of a self-sustaining research and technology center in the structures fire engineering and diagnostics area.

### Fire Test Facilities

The Center possesses state-of-the-art equipment for undertaking fire experiments on materials and structural systems, critical for research in this interdisciplinary area. This includes a structural fire testing furnace, the first of its kind in an American university, and various material characterization instruments for measuring high temperature properties.

- The fire test furnace housed at the Civil Infrastructure Laboratory is capable of testing loaded structural assemblies (such as columns, beams and floor systems) under extreme fire conditions. The integrated heat furnace-loading system was specially designed and built so that it could produce conditions to which a member might be exposed during a fire, such as fire temperatures, structural loads and heat transfer. It consists of a steel framework supported by four columns with the furnace chamber (fire exposed area) of about 8 x 10 ft inside the framework. The furnace is equipped with six natural gas burners, and can simulate a temperature profile consistent with the standard or realistic fire scenarios. Two small view ports on either side of the furnace wall provide for visual monitoring of the fire-exposed surface during tests.



## Structural Fire Testing Facility

- The material property instruments include: thermal property measurement instruments for thermal property measurements; a cone calorimeter to measure flammability, mass loss, and gas emissions; a mechanical property measurement device for measuring stress-strain response of materials; and chemical composition measurement devices for undertaking material characterization at high temperatures.

### **Students and Staff**

About ten graduate students and two undergraduate students are pursuing research in various fire related projects. Many of these projects are funded by federal agencies (NSF, NIST), Industry (AISC, PCA, PCI) and other sources (MSU Foundation). The Civil Infrastructure Lab Manager, Sia Ravanbakhsh, also manages the Fire Testing Facility.

### **Opportunities for Graduate Studies**

Assistantships are available for students wishing to pursue graduate studies in structural fire engineering. Interested students should send complete applications to the CEE department and should indicate their interest in pursuing research in the structural fire engineering field.