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UNIVERSITÀ DI ROMA

Dipartimento di Ingegneria Strutturale e Geotecnica  
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## **Corso di *PROGETTAZIONE STRUTTURALE ANTINCENDIO***

### **AVVISO DI SEMINARIO:**

## **IMPROVEMENTS IN THE INTERFACES BETWEEN FIRE, THERMAL AND STRUCTURAL ANALYSES**

**Dat Duthinh, Ph.D.**

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Lunedì 5 Luglio 2010, ore 15 – 16 / AULA RIUNIONI DIPARTIMENTO

### **Abstract**

This seminar begins with a brief review of the technical investigation of the collapse of the World Trade Center in New York City by the United States National Institute of Standards and Technology. The investigation made clear there was a need to enhance the capability of available computational software to predict the effects of fires in buildings, for use in the design of fire protection systems and the analysis of building response to fires. Following this recommendation, this seminar presents two new interfaces in fire–thermal–structural analysis. The first interface uses adiabatic surface temperatures to provide an efficient way of transferring thermal results from a fire simulation to a thermal analysis. It assigns these temperatures to surface elements of structural members based on proximity and directionality. The second interface allows the transfer of temperature results from a thermal analysis modeled with solid elements to a structural analysis modeled with beams and shells. The interface also allows the reverse, namely the geometric updating of the thermal model with deflections and strains obtained from the structural analysis. This last step is particularly useful in intense fires of long duration, where significant deflections and strains could cause damage to insulation and displace the structure to a different thermal regime. The procedures can be used for a variety of fire simulation, thermal and structural analysis software.

Franco Bontempi

Roma, 18 Giugno 2010

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## **Corso di *PROGETTAZIONE STRUTTURALE ANTINCENDIO***

### **AVVISO DI SEMINARIO:**

## **RISK CONSISTENCY AND SYNERGY IN MULTI-HAZARD DESIGN**

**Dat Duthinh, Ph.D.**

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NIST - National Institute of Standards and Technology, Gaithersburg, Maryland, USA 20899

Lunedì 5 Luglio 2010, ore 16 – 17 / AULA RIUNIONI DIPARTIMENTO

### **Abstract**

Current design procedures in the United States use the envelope of individual hazard demands on a structure to ensure safety against multiple hazards, for example wind and earthquakes. Implicit in this approach is the belief that the standard assures risks of exceedance of the specified limit states that are essentially identical to the risks inherent in the provisions for regions where only wind or earthquakes occur. This belief is, in general, unwarranted, and the American Society of Civil Engineers ASCE 7 provisions are not risk consistent, i.e., in regions with significant wind and seismic hazards, risks of exceedance of limit states can be up to twice as high as those for regions where one hazard dominates. This conclusion is valid even if the limit states due to wind and earthquake are defined differently, as is the case in ASCE 7. A second focus is the issue of multi-hazard design synergy. This talk shows that, for the case study of a ten-story steel frame building, the use of reduced beam section (RBS) connections, intended to enhance ductility in seismic design, does not reduce the risk of structural damage due to exposure to wind alone or exposure to wind or earthquakes.

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Roma, 24 Giugno 2010

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# **DAT DUTHINH, Ph. D.**

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## **EDUCATION**

- 1980 Cornell University  
Ph.D. (Structural Engineering)
- 1975 University of Delaware  
M.Sc. (Structural Engineering)
- 1973 Princeton University  
B.Sc. (High Honors; Civil Engineering)

## **GENERAL**

Dat Duthinh is a research structural engineer with the National Institute of Standards and Technology in Gaithersburg, Maryland. His research activities there aimed at:

- Improving measurement methods and techniques for monitoring the health of the physical infrastructure, under normal service loads as well as accidental loads, in particular fire and wind;
- Improving computational methods at the interfaces between fire, thermal and structural analyses;
- Improving design standards for structures to resist multiple hazards in ways that are risk consistent and synergistic;
- Developing design standards, through experimentation and computation, for new construction materials, such as high performance concrete, and fiber-reinforced polymers.

Prior to joining NIST, Dat Duthinh worked with the offshore oil industry, where he helped:

- improve the understanding of the mechanics of drilling risers through computation and measurements;
- design the first high strength concrete platform conceived to resist iceberg impact (Hibernia, offshore Newfoundland).

## **HONORS**

United States Dept. of Commerce Silver Medal for Scientific / Engineering Achievement, Nov. 2007

Keynote Lecture, 1<sup>st</sup> Int. Conf. on Modern Design, Construction and Maintenance of Structures, Hanoi, Vietnam, Dec. 2007 (Recent Progress in Fire-Structure Analysis)

Best Paper in Civil Engineering, 2006 International ANSYS Conference (Two-way Interface Between Thermal Solid Elements and Structural Beam and Shell Elements)

## **RECENT PAPERS IN INTERNATIONAL JOURNALS**

Duthinh, D. and Simiu, E.: "Safety of Structures in Strong Winds and Earthquakes: Multi-Hazard Considerations," ASCE J. Structural Engineering, Vol. 136, No. 3, March 1, 2010, pp. 330-333.

Coffman, B.F., Main, J.A., Duthinh, D. and Simiu, E.: "Wind Effects on Low-Rise Buildings: Database-Assisted Design vs. ASCE 7-05 Standard Estimates," ASCE J. Struct. Engg. doi:10.1061/(ASCE)ST.1943-541X.0000140] published Fri May 14, 2010.

Duthinh, D., Main, J., Wright, A. and Simiu, E.: "Low-Rise Steel Structures under Directional Winds: Mean Recurrence Intervals of Failure," ASCE Journal of Structural Engineering, vol. 134, no. 8, Aug. 2008, pp. 1383-1388.

Duthinh, D., McGrattan, K. and Khaskia, A.: "Recent Advances in Fire-Structure Analysis," Fire Safety Journal, 43 (2008) pp. 161-167, available online 20 August 2007 at (FISJ1646, Duthinh) <http://dx.doi.org/10.1016/j.firesaf.2007.06.006>

Duthinh, D. and Fritz, W.P.: "Safety Evaluation of Low-Rise Steel Structures under Wind Loads by Nonlinear Database-Assisted Technique," ASCE Journal of Structural Engineering, vol. 133, no. 4, Apr. 2007, pp. 587-594.

Duthinh, D. and Starnes, M.: "Strength and Ductility of Concrete Beams Reinforced with Carbon FRP and Steel", ASCE Journal of Composites in Construction, vol. 8, no. 1, Jan.-Feb. 2004, pp. 59-69.

Bajpai, K. and Duthinh, D.: "Flexural Strengthening of Masonry Walls with External Composite Bars," The Masonry Society Journal, vol. 21, no. 1, Sep. 2003, pp. 69-80.

Duthinh, D.: "Sensitivity of Shear Strength of Reinforced Concrete and Prestressed Concrete Beams to Shear Friction and Concrete Softening according to the MCFT," ACI Structural J., vol. 96, no. 4, Jul-Aug. 1999, pp. 495-508.