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Subject: Comments - "Best Practices for Reducing the Potential for Progressive Collapse in Buildings"
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Attachments: [WFEO-UNESCO Model-Code-Ethics 2001.pdf](#)

2006-09-30.

FireOx International - Technical Submission.

Our Comments on :

'Best Practices for Reducing the Potential for Progressive Collapse in Buildings' (August 2006 Draft)

To Whom It May Concern,

Thank you for this opportunity to comment on the 'Best Practices' Document.

For many reasons, both personnel and technical, I have been closely following the **9-11 Incident** in New York ... and the subsequent investigations and studies in the USA.

Please see our Webpage, where you will find many aspects of **Structural Fire Engineering** discussed in

detail ...

Structural Fire Engineering, WTC Incident (9-11) & Fire Serviceability Limit States

<http://www.fireox-international.eu/fire/structdesfire.htm> .

At the time of writing, the **NIST WTC 7 Final Report** still must be issued.

1. General ...

Having examined the 'Best Practices' Document, we are deeply concerned at the fundamental errors, inadequacies and uncertainties at the heart of the Document, i.e. in Chapters 1 & 2.

Design (and Construction) to Resist Progressive Collapse in Fire MUST be treated separately from Disproportionate Damage caused by other Abnormal Loads / Accidental Actions.

Design for Structural Reliability in Fire requires an entirely different way of thinking.

However, this Document shows little, if any, understanding of Progressive Collapse in Fire, and Design for its Resistance.

In Ireland during the 1980's, considerable multi-disciplinary research and development work relating to 'progressive collapse in fire' was carried out. Three full

scale **Building Fire Tests** took place in 1982, 1983 and 1985.

A Paper was presented at a **1987 International Fire Conference**, organized by me, in Dublin. This can be accessed through the WTC Incident (9-11) WebPage above.

During the late 1980's and early 1990's, I worked as Research & Technical Officer in the Building Control Section of Dublin City, having special responsibility for fire safety related aspects of legislation and building inspections. During this latter period, I was also in charge of the operation of the 1988 Local Government (Multi-Storey Buildings) Act, which resulted from the **Total Collapse (Disproportionate Damage)** of the multi-storey apartment block 'Raglan House' (Dublin), in January 1987, which was caused by a gas explosion. The resulting legislation only applied to buildings of 5 storeys or more. However, in order to eliminate a large area of uncertainty in the operation of the legislation, I had to develop a definition for 'storey', and recommend its inclusion in the Irish Building Regulations.

A section dealing with 'progressive collapse in fire' was also inserted, by me (as a Member of the National Masonry Panel in Ireland), into **Irish Standard I.S. 325 Code of Practice for Use of Masonry - Part 2 : 1995 Masonry Construction**.

2. Structural Reliability in Fire ...

Structural Fire Engineering :

Those aspects of fire engineering concerned with structural design for fire, and the complex interaction between a building's structure and fabric, i.e. non-structure, under conditions of fire and its aftermath.

Progressive Collapse in Fire is a related, but different structural concept to **Disproportionate Damage**.

Progressive Collapse :

The sequential growth and intensification of distortion, displacement and failure of elements of construction in a building - during a fire and the 'cooling phase' afterwards - which, if unchecked, will result in disproportionate damage, and may lead to total building collapse.

Progressive collapse can commence before a breach in the 'integrity' of a fire compartment.

The above definition was first presented, by me, during a Fire Workshop in Stockholm, Sweden, in October 2002.

Progressive Collapse in Fire must be approached in a multi-disciplinary way, i.e. through a coherent and comprehensive collaboration of different design disciplines - particularly architectural, ambient structural engineering and fire engineering - and be solved in a multi-disciplinary way.

Disproportionate Damage :

The failure of a building's structural system ...
(i) remote from the scene of an isolated overloading action ; and
(ii) to an extent which is not in reasonable proportion to that action.

Chapter 1 (Introduction) of the 'Best Practices' Document is inadequate.

3. A Proper Context for 'Risk' ...

Chapter 2 is a rambling text, which comes straight from the mould of 'Pre 9-11' thinking. Seeping through the words and the numerous equations, however, is an impression that everything will revert to 'normal' within a short period ... **and, once again, that Cost Effectiveness will, as in the past, seriously compromise the health of building users and the safety of firefighters/rescue teams in a fire or other emergency.**

Please see our Webpage ...

The 'Precautionary Principle' - A Working Legal Concept in the European Union

<http://www.fireox-international.eu/arch/precautionaryprinciple.htm> .

Internationally, this Principle is also known as the 'Precautionary Approach'.

We have examined 'risk' in its proper, wider context ... and have identified a number of stages -

- Ø Hazard Analysis ;
- Ø Risk Appraisal ;
- Ø Meaningful Consultation (involving Informed Consent) with the Public and/or with Concerned Individuals or Groups ;
- Ø Communication ;
- Ø Effective Implementation & Control.

As far as the general public in the USA (and outside the USA !) is concerned, the **WTC Collapses were not acceptable.**

Chapter 2 (Acceptable Risk Bases) is seriously inadequate. Please re-draft.

4. Design To Resist Disproportionate Damage ...

All new buildings should be designed to resist Disproportionate Damage. In other words, they should be properly designed.

There is no rational reason, except for 'cost-effectiveness', why a minimum height threshold of 3 or 5 storeys should apply.

Design to resist Disproportionate Damage should not proceed on the basis of one 'method' or another, as described in Chapter 4 of the 'Best Practices' Document.

An 'adequate' tie - in ambient **and** fire conditions - between vertical and horizontal structural elements of a building is a fundamental principle of all good structural design.

Structural elements, **including connections**, should have a minimum resistance to specific abnormal loads / accidental actions. This resistance should be set at a high level of performance.

In the event of some structural elements being removed ... 'adequate' alternative paths should always be available for the re-distribution of abnormal loads / accidental actions.

Please also refer to the **NIST WTC 1 & 2 Final Report (presented to Congress in October 2005)**, and consider the following ...

- **The Key 3 R's in the Report** - Reliability, Reality, Redundancy ;
- **Recommendation 1a** - Progressive collapse is addressed only in a **very limited way** in (current) practice, and by (current) codes and standards. NIST recommends that **initiating events at multiple locations** within the structure should be analyzed commensurate with the risks considered in the design ;
- **The Concept of 'Maximum Credible Fire Scenario' introduced by the Report** - Includes conditions which are severe, but reasonable to anticipate ... related to building construction, occupancy, fire loads, ignition sources, compartment geometry, fire control methods ... and adverse, but reasonable to anticipate, operating conditions.

We carried out a search of the 'Best Practices' Document, and could find no reference to the 2005

NIST Report.

It is beyond our comprehension that the NIST WTC 1 & 2 Final Report was not considered during the development of the Document.

5. Ethical Practice of Fire Engineering ...

Many of the catastrophic failures in building practices and procedures, cruelly exposed on 9-11 in New York, have their genesis in the way the many Building Design Disciplines/Professions are educated, and then trained for Practice.

Good Engineering Practice, whatever the particular branch, involves much more than a 'cost-effective' compliance with the minimum performance criteria set down in Building & Fire Codes.

USA - The Society of Fire Protection Engineer's (SFPE) current Canon of Ethics is too limited in scope, and is very much out of date.

Great Britain - The Institution of Fire Engineers (IFE) do not have a current Code of Ethics.

This situation is unsatisfactory.

In contrast, please find the attached copy of the **2001 World Federation of Engineering Organizations' (WFEO) Model Code of Ethics.**

6. Conclusion ...

We are not at all pleased with the 'Best Practices' Document. It will confuse, rather than help, where Structural Fire Engineering is concerned.

Regards.

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