Council on Tall Buildings and Urban Habitat
Fire & Safety Working Group

Working Group Brief

Introduction

This note is based on feedback from Simon Lay and Jose Torrero (including notes from Simon Lay's Initial Draft Brief document) and some of my colleagues at Arup. It is a preliminary note to outline some thoughts which should be developed into a briefing note for the CTBUH Fire and Safety Committee. The committee will consist of qualified international leaders in the field of fire safety to consider the future of Tall Building design. The role of the Committee will be to respond to the main philosophical questions of our time on fire safety in tall buildings.

Specifically, the outcome desired is that the CTBUH help lead the industry, globally, towards a consensus on designing safe buildings, taking account of modern forms of risk, when and where appropriate. This will be achieved through the Safety Committee producing a definitive strategy and philosophy for tall buildings in fire and extreme events.

There are many committees around the world working in this area, and we need to be clear about what we plan to do and how our group will interface with others.

Background & Objectives

There has been a resurgence of interest in Fire and Life Safety of Tall Buildings following the events of 9/11, but also stimulated by the current vogue in building design to reach greater heights than ever before with schemes of increasing complexity and architectural merit.

The majority of working parties on Fire and Life Safety currently in place are either driven by academics, regulatory enforcers or manufacturers of fire and life safety products. There is a genuine absence of an international cross discipline working party that can review current research and offer guidance and support from the basis of supporting tall building design for the sake of developers, tall building designers and local code enforcement agencies. The structure and mission of the CTBUH makes it an ideal candidate to bring together people from all stakeholders to form a working party to meet this need.

It is suggested that such a working party should be concerned with the following objectives:

1. To review the wide range of existing and future research and guidance documents to 'sift' these into coherent guidance for stakeholders in tall building design.

2. Promote best practice in tall building design from a sympathetic perspective with respect to the demands placed on the design and operation of tall buildings.

3. Offer support and advice to local authorities and prospective clients who are faced with the role of reviewing and approving tall building projects

Current Status

The shocking events of 11 September 2001 challenged perceptions of safety and security in the living and working environment. The viability of tall buildings was questioned. Continuing uncertainty about safety led building owners, occupiers and developers to demand that building designs become more robust.

Tall building design moved out of the technical domain and became part of the realm of public interest, due to the heightened awareness of building performance as a result of 9-11. And other events such as the fire in the Torre Windsor building in Madrid.

There has been a need to provide more reassurance to people living and working in tall buildings. Plus a demand for quantified design approaches for Tall Building clients and Building Code Regulators around the world.

Following 9-11 a number of questions were asked by the many stakeholders in the design process. These questions related to people concerns as well as commercial questions relating to insurance and lettable values. Some examples of these concerns were:

• What are the life safety and insurance issues associated with these extreme events?

• What is the best approach to understanding the buildings real performance in fire or other security events?

• What tools are available to satisfactorily resolve the issues and therefore people's concern?

• Might this type of disaster occur again, even without the extreme cause?

Various bodies around the world have worked on addressing these concerns in the last five years. But it is not unfair to say there has not been one common strategy or move forward.

Some critical issues have been determined, and form the basis of some new tall building designs, with respect to improved safety. But again these tend to be on a project by project basis, if at all, or as a function of the location of the building or the Design Team, or the requirements of a specific Client.

Such issues include:

- The evacuation of tall buildings, in fire or other events. There has been a move away from the traditional approach of phased evacuation (1 -3 floors evacuate in a fire only) with greater emphasis on providing facilities and management techniques to allow safe total evacuation. Importantly accommodating evacuation of mobility impaired occupants has been essential in these new designs.
- The use of lifts in non-fire events is more and more integrated in the design, with specially created protected shafts, power supplies and controls to provide a robust response in an extreme event. Lifts greatly enhance total evacuation times.
- Designing building structures for a robust response in severe fire or other events. The aim being to prevent progressive collapse. Specifically addressing multiple storey fires, aircraft impact, or blast. The role of connections and their importance in maintaining structural stability is a serious focus.
- Detailing robust fire protection materials for building structures to withstand impact of other external influences.
- Providing dedicated fire fighting access, internal stair cores, and emergency lifts, for their use in an emergency. This allows easier and more robust access and less interference with escaping occupants.
- Improved communication devices and facilities for fire fighters to allow swift response and emergency planning.
- Development of building management strategies that contemplate not just fire events, but other emergency scenarios or imminent catastrophic events; with adequate communication facilities and knowledge to allow prompt response to unusual events, should they arise.

Some validated analysis tools exist that allow designers to quantify and understand real building performance, and therefore to provide a robust design for fire or other extreme events. However the basis for the design has not been clearly identified and quantified for use in the commercial environment, and so any changes or improvements remain at an isolated level.

Questions and topics to consider, going forward

A. It is suggested here that any changes to Tall Building design, or any attempt at creating a common basis for design in fire or other extreme events, should always be contemplated in a risk based framework.

As such every building should not require identical safety measures. Each building requires a specific package of safety measures based on its occupancy levels, location, height, use, and realistic threats it may face. Threat and risk assessments can be carried out and provide designers with a suitable framework for moving forward to a robust as well as cost effective design solution. There is no point in spending large sums of money on a protection system that may offer little extra benefit to the safety of building occupiers or fire fighters.

Such an evaluation process can first of all determine the inherent resilience of a building to extreme events, as well as the potential effect on occupants. Based on this understanding it is appropriate then to look at these issues in the context of what is reasonable risk, based upon the identified risks, rather than a simple worst case scenario. Additional mitigating measures, where and if appropriate, can then be developed.

These measures can be based on cutting edge analysis techniques or logical and economical engineering solutions. It is considered essential that client requirements and cost-effectiveness also be taken into account in the overall design solution.

Therefore the concept of Risk Categories should be considered for Tall Buildings in fire events.

B. The aim should not be to increase costs unnecessarily, and in particular by adopting a risk based approach to the final design, many buildings would not require any additional considerations.

C. It is worth considering some form of Safety Rating scheme perhaps: such that in the commercial environment a Client/Building Owner could certify the level of safety provided by the final design of the Tall Building, and therefore clearly quantify for future occupants and tenants, what has been addressed and how. This could improve the value of the building and also provide incentive, internationally, to improve any weak aspects of current construction or design approaches. This is similar to the new approaches to sustainable design for example.

D. Current code recommendations for life safety in fire, where not specifically developed for buildings taller than 20 storeys, and it seems clear now that Tall Buildings needs to be specifically considered for appropriate life safety measures. Namely: means of escape, fire fighting access and facilities, structural fire protection, compartmentation, external fire spread issues, internal fire spread issues wrt internal linings and construction.

E. For means of escape the role of lifts and their design needs to be considered; robust positioning and detailing of means of escape cores; emergency lighting, exit signage, communication devices to aid escape; fire marshalling, and forms of assistance to improve speed and safety, plus allow a flexible approach in the event of an “unplanned for” emergency. The drive forward should emphasise efficient use of space, rather than token measures of apparent rather than real added safety.

F. For fire fighters serious consideration needs to be given to the concept of dedicated fire fighting shafts, for those countries where they are currently not provided; along with communication devices and strategies, fire fighting facilities, emergency command and control centre location and detailing etc

G. For structural fire protection, the behaviour of the structure in reasonable worst case scenarios must be considered, rather than a continuing reliance on code compliant hourly ratings. Through analysis an overall understanding of the strengths and weakness of a cold temperature structural design can be determined, and mitigating measures proposed as appropriate. Within this topic important issues include the role of connections in fire, the robustness of passive fire protection, the real response of concrete in thermal environments, the effect of floor span on overall column performance in fire etc.

H. For compartmentation, external fire spread issues and internal fire spread issues, the role of subdivisions on a storey requires consideration: the balance of subdividing to prevent a fire or else

assuming a large fire and designing the structure accordingly; similarly the role of the façade construction materials, and internal lining materials in propagating fire must be addressed. It may be time to assume a fire may not always remain on a single storey as forms the basis of most Code recommendations, and that designers may need to contemplate, at times, multi-storey fires.

I. Also of interest, particularly relating to the structural design, is how fire can be detailed for and more importantly measures to enhance structural performance in fire can be integrated when other events such as a seismic event or other applied loads are also considered. For example are connections that perform well in fire, causing a weakness in some other form of event that can impact a structure? Or are there already measures in place in a structural design, that in fact enhance its performance in fire but this remains unquantified through the use of applied fire protection without analysis? Of considerable importance is the question of how fire affects progressive collapse mechanisms and design and should it be considered specifically going forward?

J. The NIST recommendations need also to be considered in all of this; quite generic in nature but widely disseminated, a formal approach to these would be very useful internationally. Their conclusions can be summarised as:

- Increased Structural Integrity
- Enhanced Fire Resistance of Structures
- New Methods for Fire Resistance Design of Structures
- Enhanced Active Fire Protection
- Improved Building Evacuation
- Improved Emergency Response
- Improved Procedures and Practices
- Education and Training

It is essential that unnecessary measures do not become widely adopted, without genuinely enhancing safety standards.

K. A short review of current work, internationally, on these new and the traditional fire safety issues, plus any proposed Code changes and considerations, would pose a useful starting point for discussions. e.g. changes proposed to NFPA codes, to the Building Regulations in the UK, to tall building design codes in Singapore, Hong Kong and China.

Other Points

- Defining key Fire Safety challenges for Tall projects: eg;
    - Massing conditions and location of uses.
    - Location of cores.
    - Means of escape.
    - Fire Fighter access.
    - Implications of Extreme-Events.
    - Structural Fire Protection.
    - Atria.
    - Fire Safety Management.
- Agree alternative design concepts and develop Design Notes for each topic, setting out:
    - Design challenges.
    - ‘Code’ options and implications / alternative solutions, key variables and design process
    - Pros, cons and pitfalls of different solutions.
- Establish ‘standard’ modelling requirements.

- Define preferred models and identify typical scenarios.
- Define design parameters (fires, occupancy response etc.)

- Prepare Design Notes and guidance on key topics.

The working party should seek to bring in stakeholders such as developers, Quantity Surveyors, construction experts as well as the traditional design disciplines (fire, structures, MEP, architecture).

Possible Outputs

As well as design notes on key issues and a database of different building types and fire & life safety solutions applied, there is the opportunity to offer other novel products. The CTBUH could seek to establish it's web presence as a portal for accessing the latest, but coherent and consistent advice and interpretations of the many guidance documents which are generated around the world on this topic.

One such idea could be to promote a 'health check' for tall buildings. This could follow a similar format to methods such as those established for energy conservation (eg BREEAM) in so much as the CTBUH could offer a 'certification' of good practice on tall building designs.

It may be possible to introduce 'CTBUH Certification' to City Planning authorities as a standard which developers and designers should seek to achieve. This would have the benefit of ensuring that fire and life safety considerations are taken into account during the earliest stages of design, not inserted into the design at a later date. Such certification could take the form of a simple checklist or points system. Any such system would be entirely voluntary.

Conclusion

The CTBUH is formulating a dedicated Safety committee to contemplate the role of safety in design for fire and other more extreme events.

Building on the extensive expertise of its international membership the Safety committee will formulate a road map for the future design of tall buildings. Some of the things this committee may investigate :

Evaluation of risk in Tall Building design

Analysis of the technical challenges to mitigate against genuine risks

Development of design solutions that provide enhanced safety standards but in an economical

and practical manner