A NEW PROCESS TO IMPROVE TALL BUILDINGS HEAT RESISTANCE

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Abstract

A building system for improving heat resistance is describe. The system is a combination of load-bearing metal frame with spraying liquid supply to sprinklers. In this way, the system ensures, that during a blaze, the liquid supply cools the frame to maintain its mechanical properties. Apart from the technical and economical aspects this technique provides delay in heat transmission and therefore gives more time for rescues in the case of a blaze, to enter the building for saving life.

Keywords: Tall buildings, Life-safety, Structural integrity, Security, Fire-fighting, Load-bearing metal frame.

1. Introduction

The World Trade Centre disaster in New York is an unprecedented event in tall buildings history. Practical lessons can be drawn for this tragedy so as to prevent the total collapse of tall buildings in the future and not to see such a high numbers of victims again.

Majority of records pointed to blaze in the collapse, rather than the impact of plane crash.

Despite having been struck first, Tower N°1 fell down after Tower N°2. A possible explanation stems from the location of the impact on Tower N°2, roughly halfway up; which has brought about an excessive force on the load-bearing metal sections that, as a result, needed less thermal energy to buckle; this extra force, added to the thermic energy increased as well, can explain why the curve of metal sections and partial melting have appeared more quickly and led to a faster collapse than in Tower N°1.

Obviously, the thermal energy contributed to the collapse of the towers. The following piece of work takes this observation as its starting point.

2. Design considerations

The overall design of the invention is based on the straightforwardness of implementation, and results directly from elementary observations and professional metal knowledge. It refers to existing systems, such as the car cooling system; or, to very basic phenomena, known by everyone, such as welding pipe containing liquid; or, even to daily observations; for example, an empty saucepan left on the fire is quickly bent out of shape; this would never occur if it contains some liquid.

The lessons learnt from these simple observations have been integrated in the design and application to a system for load bearing metal framework.

The aim is to take advantage of existing devices and materials and current and simple technologies, and combine them in the most effective way, to propose a system suitable for present-day industries,
both technically and economically. The result is a combination of load-bearing frame in construction and heat resisting system. The metal frame is being used to convey the cooling liquid to the sprinkling outlets.

This concept can prevent the load bearing structure from softening, bending and melting, and avoid the total collapse of the buildings and allows the rescue party to intervene without major risks.

![Diagram of load bearing system]

A: Reserve of spraying liquid  
B: Pump  
C: Fire-fighting spraying liquid  
D: Links  
E: Two-core metal section  
F: Plug

Fig. 1

3. The load bearing system

The process can be applied to any conventional metal structures materials similar to those currently used. Two-core metal sections as HPE, HPN, IPN, IPE, etc. or metal sections are specifically designed to convey fluids, can ensure the flow of cooling liquid within the framework. Rigid or flexible tubing fitted on aisles or cores of metal sections ensures the interconnection and platens are used to make up the loss of material due to the drilling. The mechanical performances will not be different from conventional systems. There is no need for specific thermal features of steel, since the cooling fluid serves as heat conductor in case of blaze.

For tall buildings, the only concern is about the volume and pressure necessary (due to the high water column) for flow in the metal sections. These may be sorted out in different ways: such as adopting

(i) Large metal sections to ensure volume of flow inside the metal sections;

(ii) Use of smaller metal sections, set up into bundles and interconnected in order to reduce the internal pressure;

(iii) The combination of the above two systems.
4. The cooling system

The innovation is the synthesis of three components:

(i) Storage of fire-fighting liquid;
(ii) Load-bearing metal frame used for spraying liquid supply;
(iii) Automatic start-up of the fire-fighting system - that gives automation to the whole system.

The sprinkling outlets are fitted on the metal frame that conveys fluid - and eventually serves as fire-fighting system.

If a blaze occurs the fire-fighting system starts running and the cooling liquid flows inside the load bearing metal frame. It prevents the system from overheating and ensures it to keep its mechanical performances.

An important feature of the system is that the liquid flow increases with the blaze. As fire increases more outlets will start spraying the cooling liquid, i.e. the volume of fluid flowing in the metal frame is proportional to the extent and intensity of the blaze.

The liquid supply is originated from usual ground reserves by means of pumps, but also by gravimetry from reserves on the roof. These roof tanks can be multipurpose, and be used as counterbalances for earthquake resistance, or as swimming-pools.

The ground and roof reserves can be connected - to reduce the pumping work and get a faster automation reaction-, or disconnected - to give each of them specific purposes.

Simple drain plugs at the base of the metal sections, or of a set of metal sections, ensure the system maintenance. The whole system will remain in operation without any problem of corrosion.

5. Operational procedures

If a blaze occurs the bulbs of fire-fighting outlets break and control the automatic start-up. The fluid sprayed on the flames is supplied by the metal frame, which is cooled by the liquid flowing and constantly refilled from the ground or roof reserves. These operation extinguished the blaze while cooling the frame.
6. Discussion

The system is expected to be heat resistant since the liquid flowing inside the load bearing metal frame maintains the mechanical properties of the whole structure by cooling it. The flow and cooling is provided by a large number of sprinkling outlets designed for the frame.

This is a simple process where common metal sections are only slightly altered to make up the construction system. These can be manufactured conveniently in a production line. The construction of the system is faster than current ones as the installation of the fire fighting devices consist of only fitting the sprinkling outlet on to the metal frame.

In term of economics, it is less expensive than current systems; as it removes the large pipes for conveying liquid and reduces man power and perhaps adding new architectural possibilities.

As a result, the overall cost of the building is significantly reduced. There is no estimation of cost yet as there is no prototype been constructed so far.

Conclusions

The proposed system ensures a load bearing metal frame resistant to heat. The performances of the buildings built in this way are significantly improved, in terms of safety and providing a secure environment for fire fighters to put out the fire or rescue occupants.

Construction is faster than current systems, since common materials such as two-core metal sections with simple alterations are used and installation of fire-fighting device simply consists of fitting sprinkling outlets on load bearing metal frame.

The straightforward implementation is reliability, and does not lead to extra costs in comparison with the conventional building equipped with sprinklers.

The proposed system is a concept and further studies and tests is required to:

(i) Examine specific metal sections, with regards the shape (to optimise the flow of internal fluids) or the capacity for faster cooling;

(ii) Suitable materials for passive masses to be fitted inside the large metal sections.

The whole process is currently covered by a patent issued by the French Patent Office (I.N.P.I.), with international extension (O.M.P.I.).

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