

## Shot firing the Plasco Building and Reasons for the collapse

Seyed Mohammad hosein kataeian<sup>1</sup>, Mohsen Gerami<sup>2\*</sup>

<sup>1</sup> MSc Student of Earthquake Engineering, Department of Earthquake Engineering, Semnan University, Iran

And

<sup>2\*</sup> Faculty of Civil Engineering, Department of Earthquake Engineering, Semnan University, Iran

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**ABSTRACT:** With the advancement of science in all fields, particularly the discovery of electricity and gas, that created urban installations, plumbing and power plants with urban life of the people, along with all the advantages and comfort to the human race, had also associated risks. Among these are fire hazards. That this incident alone caused losses of life and property also and it can be imagined that in accompany of earthquakes and fires what kinds of the tragedy occurs. In this article, it can be attempted that first, to introduce Plasco Building and its history to speak briefly to explain the reasons for the collapse of this old and massive structures.

**Keywords:** fire on steel structures, fire, steel special moment frames, progressive collapse

### I. INTRODUCTION

The progress of human knowledge and greater density in towns and development of energy networks and gas into cities has been caused for concern such as fire. This is a problematic subject especially in the modern cities with high and dense buildings. These cities are in the risk of fires with different scenarios.

Several factors that aggravated the effects of the fire will be briefly mentioned:

- In an earthquake, separator wall and cover is damaged which would harm their ability to heat.
- In a fire many traffic paths is disrupted. So, fire engines access to the place of accident is so hard.

In High-temperature, steel behavior is radically different to the extent that the strength of steel at a temperature of 600 ° C loses half of its strength (Fig 1).

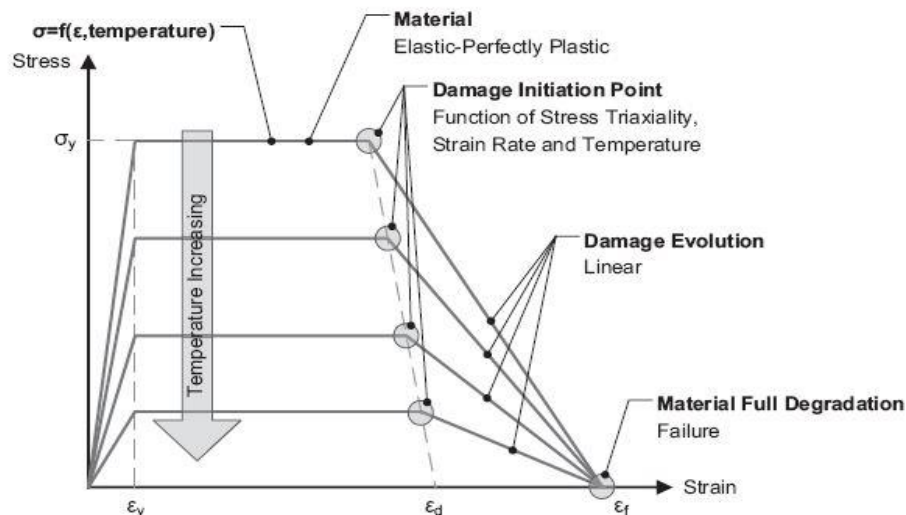


Fig 1: steel resistance changes with rising temperature [1]

\*Corresponding Author: Mohsen Gerami<sup>2\*</sup> [mgerami@semnan.ac.ir](mailto:mgerami@semnan.ac.ir)

Faculty of Earthquake Engineering, Department of Earthquake Engineering, Semnan University, Iran

Based on the third paragraph of Section 18-1-3 National Building Regulations any building which its height (vertical distance between the floor levels of the highest disposable floor to the lowest level of access for fire engines) is more than 23 meters is High-rise building.

Based on this Regulations, buildings Higher than the 7-story are considered high-rise buildings.

## **II. METHODS AND MATERIALS**

To collect the data, library studies was used and documents was identified the various aspects of the subject. Instruments for data collection in the library method was books, articles, dissertations, Internet and in the field study was the documents.

## **III. DISCUSSION AND DATA COLLECTION:**

### **3.1 Plasco Building history**

This building is the second high-rise building and with elevator in Iran and it is the first high-rise building with a steel structure. This 17-story building was built in the years 1960 to 1962 by Israeli engineers and its structure architect was a German engineer. This structure ousted Iranian market from the traditional mode [2]. This building has a basement and a ground floor and 15 floors on it. The total area of the building is 29,000 square meters and the first and fourth floors of the building has more surface area than other classes. Total height of the structure is over 42 meters. This building was intended for distribution and garment manufacturing and have been business users with 560 commercial units. This structure was designed in accordance with Regulation 519 and due to old design Regulations did not consider the impact of fire on the structure.

The roof of this structure was formed concrete slab with simple reinforcement. The function of this building change over time and from place of business had become to the workshop production of clothing so that 70% units change to production units. So, heavy equipment placed on the higher floors of building. So, it causes abnormal heavy of floors. Only 160 units from 560 units of this building were insured. Columns was formed 4 metal cans filled with concrete, so these structures were not protected against fire. All of the Armatures was simple.

### **3.2 Description of Plasco building fire:**

The main cause of this incident was reported Electrical connection in 19 January 2017. It started from one of the production units and caused the fire started from 9th floor to the top. Classes 8 and 9 of the building caught fire in the morning and 4 hours after the fire, the whole of building collapsed at 11:20 minutes. In total its damage is estimated 1700 billion.

Destruction of structures has been started since a vibration in structures and within 15 seconds of progressive collapse, the whole structure was destructed.

It should be noted that the strength of steel at a temperature of 600 ° C is half of its initial strength. If temperature reaches to 1000 ° Strength of steel will tend to zero. In this event, fire temperature under the rubble has been reported 1000 to 1500 ° C because of the presence of flammable materials inside the structure.

### **3.3 Study on collapse factors of Plasco**

#### **3.3.1 The general trend "progressive collapse"**

There is a phenomenon called "Progressive Collapse" or "progressive destruction". In this phenomenon, main elements of the building destroyed [3]. Progressive destruction starts by removing Structural load capacity of a small portion of the structure and more damage occurs in other structural elements. Now everything is ready to broker a column out of the cycle. As soon as one column was loosed, other columns must be bearing that column load. Now the next column loses on the outskirts of the columns and so the progressive collapse process continues until the whole structure collapses.

Yet all of the above we add that steel crisis caused by heat at temperatures of up to 80 percent of normal fire loses his resistance and therefore its duration is much reduced. If the structure was concrete, after the fire began, firefighters had the opportunity to fire off a lot more and not poured down rate structures with this speed. Progressive destruction may be spread in part or extend range of structures. This phenomenon is due to factors such as explosions, fires and etc. in structures. In other words, after the fire and reducing the bearing capacity of steel elements, structures have to be progressive destruction and part or all structures will be destroyed. In this process at first the fire and heat (650 ° C) weaken the steel structure and steel strength were reduced where the trusses bend progressively.

As a result, in addition to the load tolerance horizontally and downwards, also an aggravated extra load enters into the building. This load causes the outer pillars and the inner pillars bend and eventually led to the destruction of structures.

For this reason, according to international standards for fire extinguish on buildings with steel structure, if fire not controlled after 30 minutes, firefighters must leave the building and extinguish fire from out of building.

While firefighters were busy fighting Plasco about 3 hours and 30 minutes. Of course, 30 minutes is for buildings that its structure is fire-proof insulation.

Also pressure from Collapsing upper floors will cause Collapsing lower classes and according to interior design Plasco in the form of U, Collapsing buildings were completely internal and surrounding buildings were not seriously hurt.

### **3.3.2. Scientific phenomenon in the fire called Backdraft**

When the fire is deficient in oxygen and choking incomplete and then for whatever reason it was accessed to oxygen and air, flashover was happened (i.e. the height of the fire) and smoke and hot gases violently hurled. This is same of explosion phenomenon and of course the far less sound. Pressure caused by this phenomenon enters additional stress on the structure under stress, and thus destroy the structures.

### **3.3.3 Water and fire, thermal shock**

This fire is placed in the groups that the fire skyscrapers or high rise fire is said. These fires usually affect the structure of high-rise buildings and off and overcoming it requires much training and use of appropriate equipment [4]. Contrary to rumors that were launched after the September 11 attacks, the Twin Towers were not the only structures that collapsed due to fire. There is a long list of high-rise buildings have taken down due to a fire. Inhibition of fires such buildings, important points must be met. According to a spokesman for the fire department and safety services of Tehran Municipality Seyyed Jalal Maleki A total of 200 firefighters with 15 water tankers and three lifts aided fire Suppression Operations in Plasco's building (Fig 2).



**Fig. 2-** Plasco incident pictures [4]

Use of water for Extensive firefighting in buildings with steel structure is a strategic mistake. Water in addition to adding the building weight, also, causing thermal shock too. In particular, this shock is high in the clothing distribution center. Because of textiles, fire quickly spread and the temperature rises quickly. This will affect the steel structure of building and if the temperature will not collapse the building alone, pouring cold water on the molten metal to cause shock and thermal stress on them. In this way, may be some key components of structures bend, twist or cut under shock and weight gain caused by water. In this way a chain reaction that "progressive collapse" is known to occur. What makes the key components of the structure is disrupted and the shock of the collapse of the upper classes will disrupt components of the lower classes. So, the event is determined that the classic example is the Twin Towers and here in Tehran Plasco building. In the design, structures must be designed with not progressive destruction. Better designing of steel structure connections is one of the strategies to prevent progressive destruction.

### **3.3.4 The lack of fire proof cover**

Old structures of Plasco building was lack of fire proof cover. Materials researchers showed that the metal parts of these structures in the heat and splashing water was collapsed. It does not require steel used in metal structures melt because in high heat metal behavior changes against the force. This seems a combination of temperature, thermal shock, lack of safety (causing a second explosion), the increase in weight because of water; fatigue steel structure and the absence of anti-heating cover caused to collapse buildings due to fire (Fig 3).



**Fig 3.** Plasco Building demolition [4]

#### **IV. CONCLUSIONS AND THE WAY THINGS:**

The useful life of this building was estimated 200 years but it was collapsed 54-year-old due to fire. It collapsed after 4 hours the fire at 11:20 minutes in total damage is estimated 1700 billion.

With all things said, it can be concluded that:

- If in an incident did not disrupt the path of car fire and the streets were open
- If people listen to municipal warnings and organizations in charge
- If authorities reconstruct this kind of buildings before the event
- If owners did not change users from commercial to production and workshop
- If firefighters had needed equipment to turn off this kind of events, they were replaced the water with extinguisher
- If at the time of the accident crisis management was done and the evacuation was took placed instead of firefighters were gone inside the unsafe building
- If all the shops were insured
- If the owners of the stalls were followed safety issues

Maybe none of these events would have happened and firefighters returned safely to their homes However, these bitter events were for a while, the subject of hot virtual world and then less than a month was forgotten and we forget that dozens of buildings with the same attributes throughout Tehran is waiting for a spark to create a new scenario.

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