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## Aspects of Fire Regulations and Standards in the Atrium

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### Abstract

Fleksibilities of open spaces in modern public buildings, organized by and around large atriums is increasingly sought after in architectural practice. Along with this increase and the requirements for fire safety and timely evacuation. They develop building codes, regulations and standards. Different countries treat problem variant in development, but with a common logic. What is the problem of the large and multi-storey atriums and what similarities and differences in protection of people and property in case of fire in different regions of the world. Various methodologies, technologies and materials. The development of thought and methodology is the development of technology. Examples of author and world practice. Specific features of local standards for fire safety and evacuation. A brief overview of the development of thinking on the issue.

### Keywords

atrium, fire regulations, evacuation, architecture, fleksibility

The theme is developed based on built in 2007-2010 year BBC building located on the boulevard Tsarigradsko Shosse in the town Sofia. The main parameters are: 32,000 m<sup>2</sup> footprint area, 16 floors, 66 meters high. Immediately from the main entrance people pass to the atrium area of 220 m<sup>2</sup> and passing through the entire height of the building in the 14th levels to elevation 53.45 meters. At the rear there second and third small atriums in 5 levels. The research team is led by Arch. S. Dobrev with the participation of Arch. L. Grigorov - the report's author and architect D. Paz. - 2006-2007 years, Figures 1, 2, 3, 4, 5, 6.

Existing main regulations (in Bulgaria) about atrium spaces now are:

#### Atrium buildings

- Art. 304. (1) In building with an atrium, inclusive three or more floor levels, subject to these requirements.  
(2) Not allowed to design atriums in hospitals and outpatient care in medical centers, diagnostic and consultative centers, hospices and others. Similar buildings with residents who need medical care.
- Art. 305. (1) The buildings with an atrium designed by I or II degree of fire resistance.  
(2) Wall, ceilings and floors in the volume of the atrium and involve him space constructed by building materials of reaction to fire no lower than A1 or A2 (A1FL or A2fl).
- Art. 306. (1) The bearing roof over the atrium is performed with fire resistance of at least R 30.  
(2) Glazing and other transparent coatings in the roof of the atrium are provided with class reaction to fire A1 or A2.  
(3) Products for window frames on the facades of the atrium and facilities to create shade is of reaction to fire not less than C.
- Art. 307. (1) Glazing and other transparent coatings in the roof of the atrium are provided with class reaction to fire A1 or A2.  
(2) For the glazing of staircases and panoramic elevators Atrium using fire resistant matte with fire resistance of EI 30.
- Art. 308. The maximum distance from any of the locations in the atrium at the entrance to evacuation staircase or the final evacuation exit should not exceed 20 m for the text exceeds the

character limit. One-way evacuation routes and 40 m at two or more routes, taking into account the requirements of this atrium.

Art. 309. Atriums are designed so that they are directly accessible from the outside in hallways or lobbies.

Art. 310. (1) For protection from uncontrolled spread of smoke and heat in buildings with an atrium designed systems to remove smoke and heat as follows:

1. natural ventilators Smoke and heat (EVDT) - smoke vents located in the cover of the atrium or directly below it, and openings for air intake and for equalization of pressures at the base of the atrium that have at least the same size; or
2. mechanical ventilation to differentiate pressures fire in the atrium and adjacent areas.

(2) Systems to remove smoke and heat are controlled manually - remote and in buildings with automatic fire detection and extinguishing systems - and them.

Art. 311 (1) Securing atriums in case of fire, depending on the class of functional fire-hazard construction, the height of the atrium and the type of separating the atrium from the adjacent floor areas to provide the following technical solutions:

1. automatic fire alarm system in the adjacent atrium floors in the atrium;
2. the automatic firefighting system in the adjacent atrium floor;
3. smoke hatch on top of the atrium area equal to 10 % of the area's largest atrium opening in the inter-floor structures;
4. mechanical ventilation to remove smoke and heat volume atrium, sized according to EN 12101, Part 10;
5. shaping flue reservoir on top of the atrium;
6. systems for voice notification in construction;
7. controlled combustible load at the base of the atrium.

(2) The specific technical solutions for securing atriums in case of fire are given in Annex № 9.

At the time of the design of that building these standards did not exist yet. The design team examined the existing rules in Europe, Britain and the USA. Mainly based on the European standards which are not saying that something be impossible to build, but gave an algorithm in which to solve the problem. Bulgarian fire services have adopted this concept and approved the project. This project served as a precedent and subsequently the subject of multi-storey atriums entered as a separate chapter in the new fire regulations and standards in Bulgaria. Later a report carried by a representative of German fire services had commented in their opinion that the current fire regulations and standards in Bulgaria are probably the most restrictive in the world now.

How things were solved in our building?

A major problem was the decision of Architects have open atrium spaces at all levels. This meant that the appearance of fire somewhere on the floors choking smoke could penetrate virtually anywhere .

The decision vklyuchvasha several components:

1. Glass partitions that hang suspended from the ceiling to a height of 210 cm above the floor. Thus formed fume-exhaust baskets below the level of the suspended ceiling.
2. From there fume exhaust system sucks the smoke and took him to the roof.
3. Of course the whole building is armed with a fire alarm system.
4. Fight it selectively only for sites reported. Thus isolating the damage in case of fire due to firefighting.
5. Carefully calculated all locations and design of evacuation routes and exits.
6. Avoided are combustible materials.

Decisions on smaller atriums - smaller as the number of floors are organized in other ways and requirements are a little lighter. Typical cases are the numerous built everywhere multifunctional shopping centers. High requirements are oriented multi-storey atriums - over 5 floors.

Characteristic research example is hanging from the ceiling glass partitions organizing the collection of lighter than air smoke before discharging him out of the building. Another easier solution is practiced as isolated interior spaces of the building atrium walls through the entire height of the floor which completely isolate the possible infiltration of smoke from the atrium to the offices or retail space. We are tempted to quote and show the famous 33-storey atrium in Jin Mao Tower, which is below the ceiling of 55 floor.



Fig. 1. BBC – building



Fig. 2. BBC – building

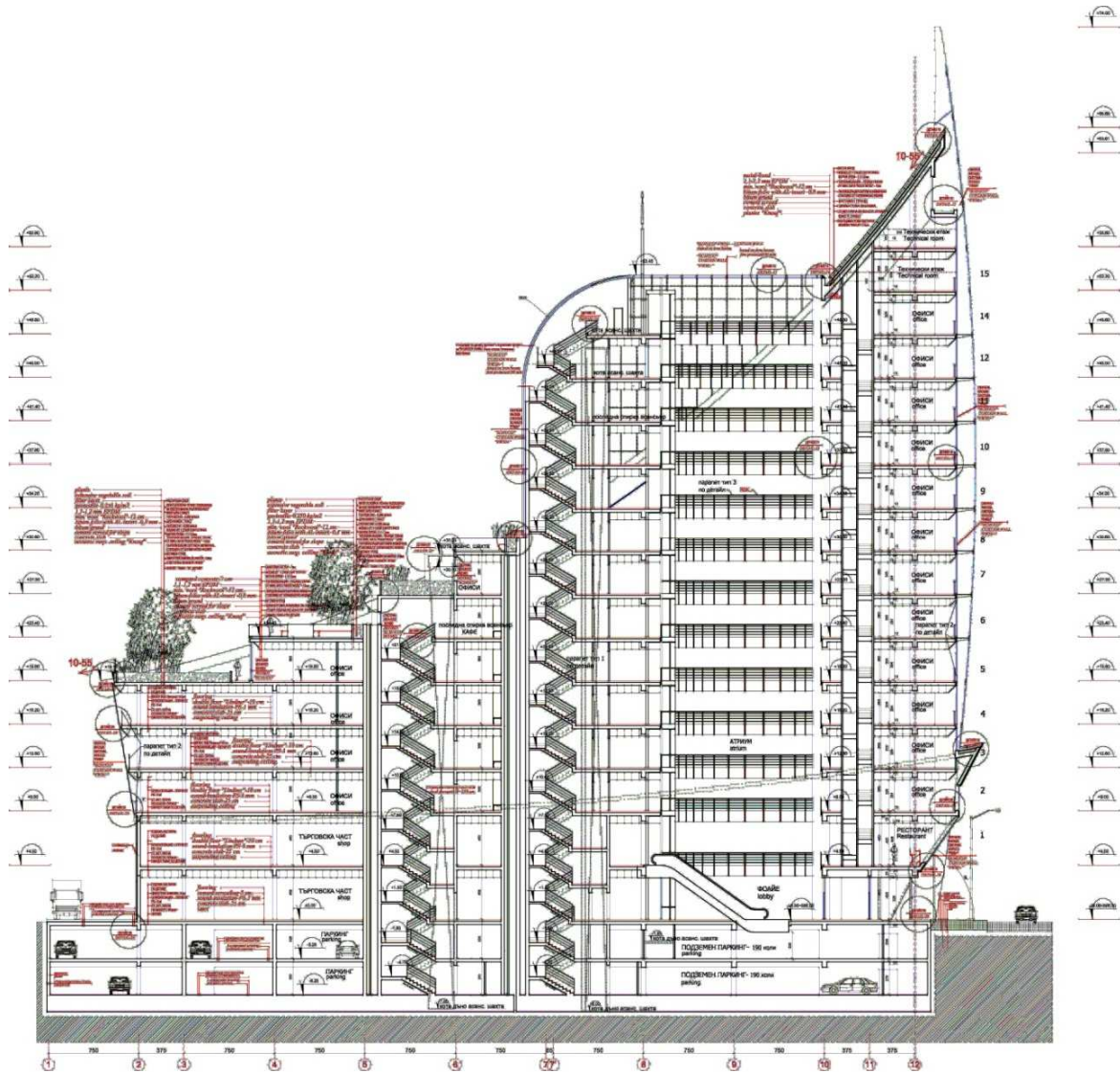


Fig. 3. BBC – Main section



Fig. 4. BBC – Evacuation through atrium space under doom



Fig. 5. BBC – The view of atrium from down to up

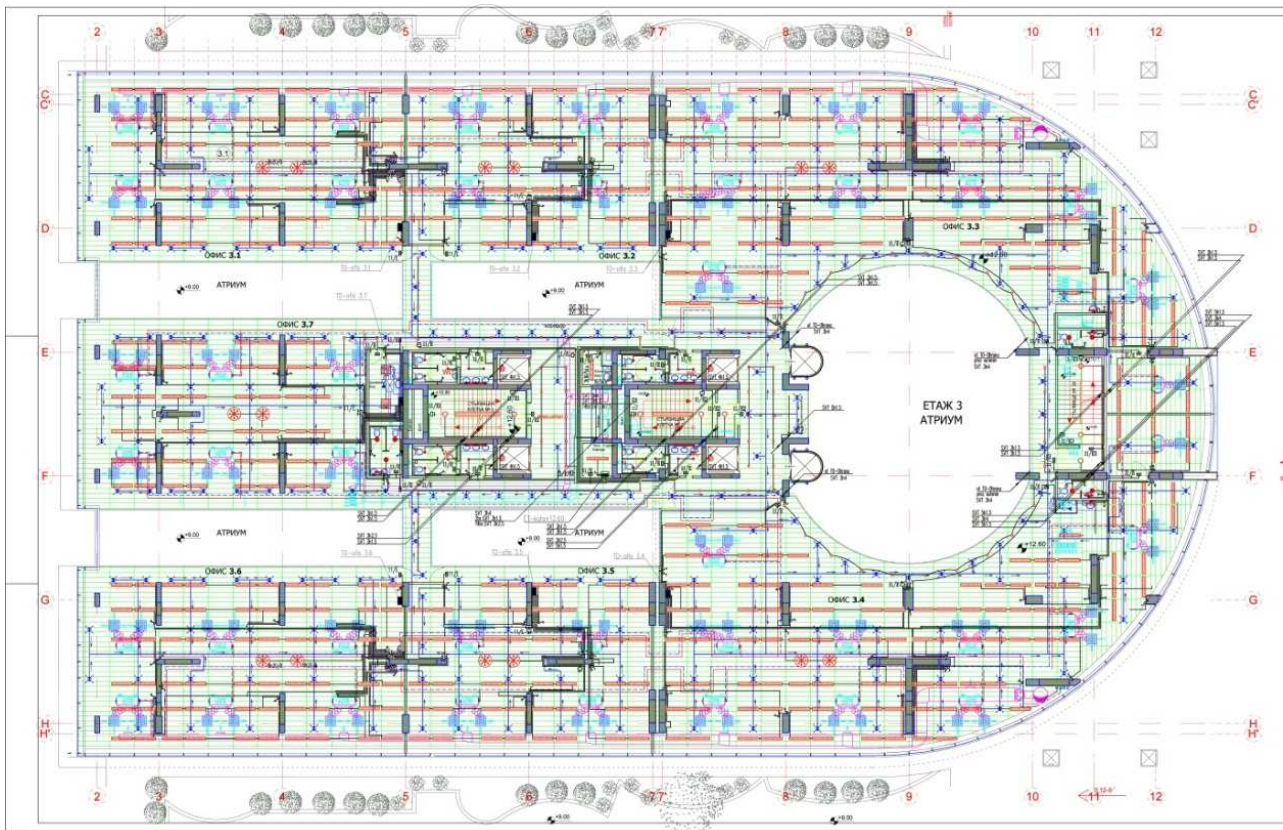


Fig. 6. BBC – Level 3

In this example, it applied the rule to totally isolate the working and residential zones of the space of the atrium through walls.

The main atrium between axes: 8 and 10 and elevation of 0.00 to 53.45. Small atriums between axes: 3 and 5. Fume in the space between the double roof - Figures 1 and 2. In the basement level -2 is provided water tanks for fire extinguishing.

In the atrium space under a glass dome cross three bridges carrying out evacuation staircase to the second - level 13 and level 14.

Elevators are panoramic and their route passes through the atrium volume.

The main facade is shaped by double-skin facade system. Rear roof areas are gardens and roof of the lower body, as evidenced by Figures 1 and 2.

**Remark**

Used original photos and drawings in the preparation of which took part the author of the report.