

FIRE CURTAINS AND COMPARTMENTATION IN BUILDINGS

Nedim Hodžić ¹
Sanin Džidić ²

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Summary: *In accordance with the development of architectural requirements in design of buildings, application of active fire protection measures is being developed making buildings more functional and safe to use. The aim of these systems is to maximize the freedom of open plan design, minimizing the possibility of developing fire within the building. The system of fire curtains has been present since the 1980s, and due to development of technology, it developed from smoke barriers to fire resistant barriers. This system is an active measure of fire protection, and it is always supported by complementary another system. Fire curtains work when the fire alarm system is activated, creating a fire compartment and thus preventing the spread and development of fire in the building. The application of these systems is very wide. They are applied in specific types of buildings or in a specific and high demanding positions within the building, like air space through floors. It is most often related to open plans where physical barriers, such as walls, create issues in flexibility and actual use. Airports, public garages, hospitals, museums, theaters and other cultural facilities, sports halls as well as other buildings are just some of the examples where this system greatly contributes to the fire protection and freedom of designers in architectural design. A very important aspect of the system is reflected in its application. It is applied within buildings with the aim of creating the fire compartment, but also for external application on the facades preventing the transfer and spreading of fire from one building to another. The system is completely integrated and nonvisible in interior and exterior if appropriately designed and applied. The focus of this paper is to highlight the design possibilities and application of system of fire curtains in buildings.*

Keywords: *Fire Compartment, Fire Curtains, Open Plan Design*

1. INTRODUCTION

In accordance with the development of architectural design requirements, various embedded systems are developed with accompanying equipment to enrich the buildings and make them functional and safe for occupation. Discussing the conditions that

¹ Nedim Hodžić, bacc.ing.arch, University of Sarajevo, Faculty of Architecture, Sarajevo, Bosnia and Herzegovina, phone: +387-61-861-238, e – mail: hodzic_nedim@hotmail.com

² Prof. Dr. Sanin Džidić, Associate Professor, University of Bihać, Technical Faculty, Department of Civil Engineering and International BURCH University, Faculty of Engineering and Natural Sciences, Department of Architecture, phone +387-61-905-480, e-mail: ninsa_d@hotmail.com

buildings need to meet for their technical correctness and readiness for use, a number of requirements is related to the fire protection. In addition to passive fire protection measures that are usually integrated through actual architectural design, a range of active measures is available that improves fire safety in fire scenario.

One of the active fire protection measures is the application of textile fire protection curtains. Textile fire curtains were first time applied at the beginning of the 1980s. In the beginning, they represented only smoke barriers and were integrated in large open spaces only in order to prevent the smoke spread throughout the building and provide sufficient time for evacuation. The development of technology and materials with great success produced non-combustible textiles, i.e., refined curtain that can be resisted on temperatures up to 600 ° C.

The scope of application of this system in buildings is very wide. Such system can be used both internally within the buildings and externally on the facades of buildings, thus preventing the spread of fire from adjacent facilities.

The system of fire curtains can be independent - a separate system or an accompanying fire system, most often in combination with a sprinkler system and a fire alarm system.

2. HISTORY

Textile fire retardant curtains arose a little over 30 years ago, initially as protuberant curtains that made possible to successfully evacuate people from large open areas such as concert halls, theaters, conference halls, amphitheatres, etc. Considering that a large percentage of deaths occurs during the fire due to smoke and in almost 90% of cases, it was necessary to develop a system that would provide an extended period of time for a safe evacuation of occupants. The system was developed in Germany and at the beginning it was system of anti-smoke curtains that protected from the rapid and non-controlled spread of smoke in the area, creating smaller fire compartments.

Due to the simplicity and convenience of the system, this product is rapidly expanded to other markets. In addition to the fact that these systems increasingly appear in newly constructed buildings, they are also very suitable for the remodeling of already constructed buildings.

3. THE PRINCIPLE OF SYSTEM FUNCTIONING

Non-combustible textile canvases are fire barriers with different classifications and designs, that offer many possibilities of application in preventive building fire protection. It is an active fire protection, and the system works in combination with other active fire protection systems, usually combined with a fire alarm system and/or a sprinkler system, and can only act in a particular fire compartment in which the spread of the fire occurs. In short, the task of this system is to enclose a particular compartment, in order to prevent further spread of fire and smoke in the event of a fire when it is detected by a fire alarm system. In this way, the development of the fire will be limited or disabled, and the system will be activated only in the part of the building or in the compartment in which the fire occurs. Because of that, this system has its primary use in

buildings with open plans, with no physical barriers such as walls that shape fire compartments.

The system is based on the curtain with the projected length, which is encased and located at the characteristic position in the building. In fire situation, the curtain can be unwound, making a fire barrier and smoke protection by means of a gravity (springs) or driven by power supply. In addition to the fire alarm system, textile fireproof curtain can also be encountered with sprinkler systems. In this case, there are two operating modes. The first option is that the non-combustible textile curtain encase the area where fire develops and the sprinkler system is activated and fighting against fire directly, while in the other case the sprinkler and the canvas act as one system in which the canvas encloses space and the sprinkler system acts on the curtain with water, thereby lowering the temperature of the curtain itself and allows the curtain to retain its integrity for a longer period of time during a fire. An important fact for this system is possibility of operation by power supply and without it, so in most cases it is not necessary to provide a special source of power for this system that would require additional fireproof wiring. The system is directly connected to a fire alarm system, and in a case of fire detection, it is activated by signal, while the remaining operation is done by gravity or with action of various springs. There are also types of this system that still require power supply. The system can operate as a vertical curtain, a horizontal curtain, or even operate at an arbitrary angle, depending on the characteristic position.

4. APPLICATION

These systems are practical, easy and inexpensive in maintenance, so they are applied in a large number of facilities. Discussing the typology of buildings and facilities that these systems are applied in, the use of this system is quite diverse, but it is most practical in open plans where there is a large cubature of air, as system requires that the space has no physical barriers. This system then, after the fire is detected in open area, creates fire compartment(s) and localizes fire, enabling it from quick and uncontrolled developing and its spread on other compartments afterwards.

Since its inception, the system has undergone a number of different testing, and it has been applied in the following types of buildings: lobbies, airports, insurance companies, automobile industry, banks, barracks, car dealers, parking lots, cinemas, cold storage rooms, commercial real estate, factories and furniture salons, historical monuments, hospitals, hotels, schools, shopping centers, railway stations and many other types of facilities.

These systems are quite adaptable to various requirements in different typologies of facilities. When installing this system, if it is well and timely designed, it is possible to integrate this system so well that it can be almost invisible. Such system does not affect the service life of the building at all. The choice of finishing battens, a wide array of materials and fronts can all contribute to the aesthetics of the plan itself.

Scope of application of such system is not limited to the buildings only, but also to many industries that use this system as protection of their production facilities. In the case of machines with high risk of self-ignition, such as copy machines, there are special keel that are activated so they separate this sector for this machine only, preventing the spread of fire to the rest of the room.

5. POSITIONING OF SYSTEM IN THE BUILDING

The concept of fire resistance implies the ability of a structure or element to fulfill the required function, which is viewed from three aspects:

- R – Mechanical resistance
- E – Integrity
- I – Insulation. [3]

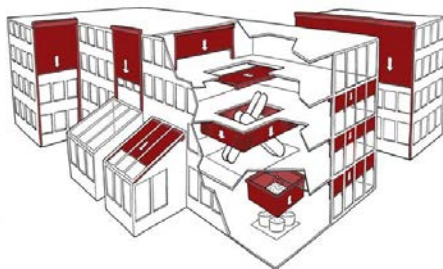


Figure 1. Possible positions of the system in the building [5]

Analyzing the system of fire protection textile curtains in terms of fire resistance, the system or material from which it has been made must satisfy two criteria, namely "E" and "I", which means that there has to be no passage of fire and gases into the neighboring compartment, as well as the requirement of thermal isolation on the unexposed side, the material has to maintain maximal temperature below 180 ° C. Application of the system is diverse both in the typology of the buildings and in the positions within the building. The fireproof textile curtain system is very flexible for all interior conditions. The system can be modular and connections between the modules can be specially designed to satisfy required criteria.

6. ARCHITECTURAL POSSIBILITIES

Due to the high demands on architectural design, fire protection systems are required to be quite flexible, as well as very effective if there is a fire in the building itself. Given the remarkable progress in the field of textile curtain development in terms of flame retardation, these systems now offer some new features that help to increase the aesthetic quality of the building.

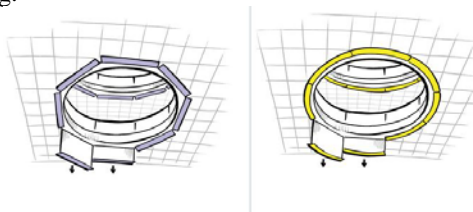


Figure 2. Fire resistant curtains, adjusted polygon (left) and oval shape (right) [5]

When constructing atriums through several floors, it is necessary to focus on fire compartments, especially on how they could affect the creation of fire compartments within the building. The fire protection system can enclose and isolate the atrium as a single unit. The initial development of these positions was done with a set of polygonal curtains where the critical boundaries were polytonally shaped or module couplings type. The problem was later solved with an oval shape where a better contact surface between the two modules is obtained, while the shape can be curved depending on the requirements of the design.



Figure 3. Evacuation paths [5]

Evacuation paths are a very important segment in the design of buildings, in some cases their design can be very limited due to the conditions in which they can be found. Using fireproof curtains, the evacuation paths can be much freely arranged. Curtains placed at larger openings on the wall replace the missing wall in case of fire.

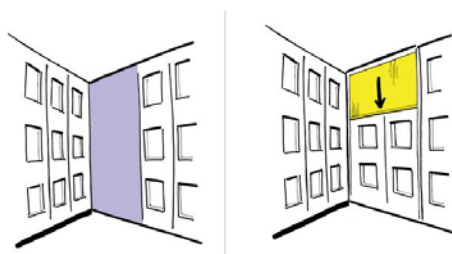


Figure 4. Attached buildings [5]

When designing fireproof contact surfaces of two buildings, where fire can spread from one building to another, textile fireproof curtains can be installed on the facade. In fire scenario they cover a full surface of the entire facade, thus preventing the spread of fire from one building to another.

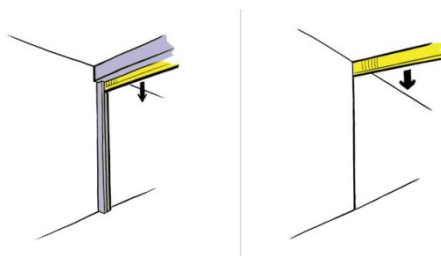


Figure 5. Installation options [5]

During the selection of active fire protection measures during the design phase, it is possible to anticipate and integrate the complete installation of this system inside the mask of the walls and the suspended ceiling. In some cases, most often in remodeling, when doing the afterward installation, a visible frame on the box with rolling curtain can be found.

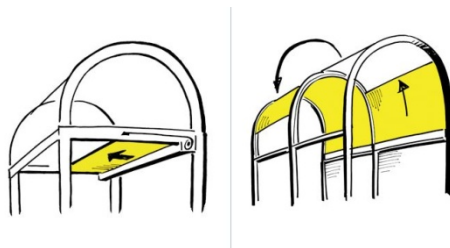


Figure 6. Vaulted constructions [5]

In the original variant of the wrought-up construction, these systems are installed hanged on horizontal beams with a mechanism with a box and a curtain, and close the area moving along the horizontal rails in fire situation. With the development of these systems and need for optimal use of layout without horizontal beams, an option of the so-called curved rails was made. This principle is based on a curtain system that develops curly along the rails. This solution enables maximum utilization of layout in vertical sense, while the system usually needs electric power for its operation.



Figure 7. Possibilities for open plans/lobby [5]

Protection against fire and smoke is especially important when designing a foyer, with the use of invisible fire protection, these spaces can now be segmented without physical permanent barriers and retain their free architecture. Directions of curtain development

should be visually emphasized to secure that no objects endanger the operation of the fire protection system. As already stated, this fire protection system can be completely invisible and integrated into the ceiling and walls of the room. In addition, it can also have an aesthetic role. Finishing moldings can be completely integrated into the ceiling, and various types of decoration are available. They can be of a different appearance and material to fit into the ceiling or even integrate into a ceiling lighting, which makes this system completely invisible during the use of compartment.

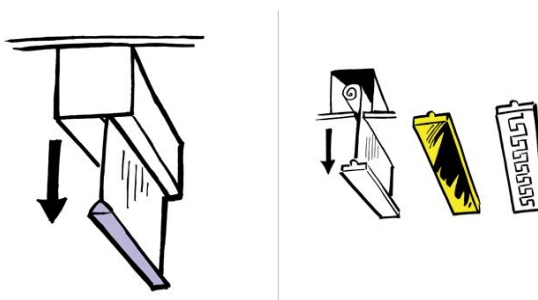


Figure 8. Design of final molding [5]

7. CONCLUSION

Textile fireproof curtains are 30 years in application in buildings and these innovative solutions offer the opportunity for architects to free their imagination and design much more in open layouts. These systems are becoming more and more popular and their application is not limited to buildings only, but they are also applied in production facilities as well. Although generally textile can represent the fire load because of relatively low temperatures of self-ignition, new technologies improved fireproof characteristics of such materials. These systems are always complementary to some other systems such as the fire detection and sprinkler systems, but they enable great possibilities in compartmentation when needed and possibilities for free design.

Both innovative and creative approach allows these systems to perfectly integrate to the enclosure, so it is almost impossible to notice any features of the system during the normal service of the building. These systems are freely used both within the building and on the outside facades, which enables the achievement of better performance of the building itself in terms of fire resistance and fire spread. Such systems greatly assist architects and designers in design of free and attractive arrangements and interiors, without compromising safety of occupants in fire situation.

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ПРОТИВПОЖАРНЕ ЗАВЈЕСЕ И ПОЖАРНА СЕКТОРИЗАЦИЈА У ЗГРАДАМА

Резиме: У складу са развојем архитектонских захтјева у пројектовању зграда, примјена активних мјера заштите од пожара се такође развијала, чинећи објекте функционалнијим и сигурнијим. Циљ ових система је да максимизира слободу у пројектовању отворених простора, уз истовремено минимизирање могућности развоја пожара у објектима. Систем противпожарних завјеса је присутан од осамдесетих година прошлог вијека, а развио се од баријера за дим ка пожарно отпорним баријерама. Овај систем представља активну мјеру заштите од пожара, али увијек у садејству са другим комплементарним системима заштите од пожара. Противпожарне завјесе се активирају по активирању ватродојавног система, креирајући пожарни сектор, те на тај начин спречавају развој пожара у објекту. Примјена овог система је вишеструка. Примјењује се у специфичним врстама објеката или специфичним дијеловима објеката, као нпр. код отвореног простора између спратова. Најчешће се примјењује код отвореног плана, гдје физичке баријере, као нпр. зидови, стварају проблеме у флексибилности простора и самој његовој употреби. Аеродроми, јавне гараже, болнице, музеји, позоришта и друге културне институције, спортске дворане као и многе друге врсте објеката су само неки од примјера, гдје овај систем значајно доприноси заштити од пожара, али и слободи пројектанта у архитектонским пројектовању. Веома значајан аспект овог система се огледа у његовој примјени. Примјењују се у објектима у циљу формирања пожарног сектора, али такође се примјењују и за вањску употребу на фасадама, онемогућајући пренос и ширење пожара са једног објекта на други. Систем је у потпуности интегрисан и невидљив у ентеријеру и екстеријеру, уколико је одговарајуће осмишљен, пројектован и примјењен. Фокус овог рада је да нагласи пројектантске могућности и примјену система противпожарних завјеса у зградама.

Кључне речи: Пожарни сектор, Противпожарне завјесе, Отворени план