PROTECTION OF HISTORIC BUILDINGS AGAINST FIRE

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Summary

Fire-fighting in historic buildings must be in comparison with other buildings realized much more sensitively and very often individually without using standard principles. Action of firemen is complicated not only because of smoke and heat development but specifically because of church height. Good selection of signalling and extinguishing procedures is in these cases very substantial. One of common used measures is well designed ventilation combined with electric fire signalling. Sprinklers are used not so frequently, because splashing water can cause inconceivable damages on both precious interiors with paintings and surfaces of old wooden load-bearing elements.

Keywords: fire, smoke, ventilation, protection, detection, historic buildings

1 Introduction

Smoke and heat development in churches and its often height cause that ladders and extinguishers do not suffice in current cases. Smoke is very dangerous – its development is very fast and it can accumulate in big spaces of church sooner than fire manages to penetrate further through constructions. Therefore one of natural and the most important measure preventing destruction of church and its equipment is good ventilation and outlet of smoke and heat from the affected area of church. Unlike other buildings, churches are not permanently used and there are fire detectors placed only seldom here [1].

2 Risk of smoke and heat development in churches

Large churches with big volumes (domes, basilicas and city-churches) can contain considerable amount of air to dilute smoke and heat. But it is still fuel for fire; therefore the fire-fighting action should start shortly after fire-outbreak. It assumes the installation of automatic fire detectors and the possibility of smoke and heat outlet.

Consequences of smoke and heat development can be divided into 3 groups:

1. ***Poisoning of persons present in spaces affected by fire and smoke***
   Compared to other buildings, persons occur only seldom at churches during first phases of fire development, therefore poisoning by smoke is negligible. The risk rises during rescue and extinguishing actions when smoke is not lead away.

2. ***Smoke concentration***
   These phenomena cause: delay of fire fight; putting in action larger number of firemen and equipment; necessity of tactical task change; difficulty with location of fire.
3. ***Damages of the building and even internal facilities***
   Remaining smoke, gases and heat damage especially: frescos, paintings on ceiling and walls; stuccowork and ornaments; pipes of organ; altars, statues and pictures; benches and pulpits.

In order to liquidate or minimize the damages caused by smoke, fulfilment of three following requirements is recommended:

a) To prevent smoke distribution to other parts of church

Particular parts of church (tower, church nave, sacristy etc.) must be separated by fire wall and incombustible ceiling (Fig. 1). All doors of church nave leading into adjacent rooms must be tight, fire resistant and equipped with a self-closer. This requirement also pays for basement if technical spaces are accessible from first floor. Fire door with self-closer must be also installed between attic and tower and between tower and gallery. Usually used wooden door leading from tower into attic above church nave does not protect spread of smoke and heat (Fig. 1G) and it is unacceptable.

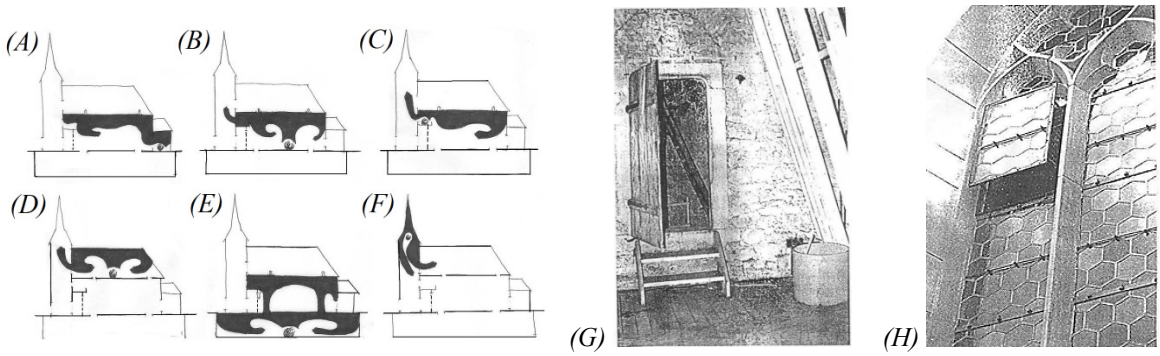

Fig. 1 *Spread of smoke without ventilation when the fire starts in: (A) sacristy, (B) nave,(C) surrounding of organ (gallery), (D) attic space, (E) basement, (F) tower; (G) usually used wooden door leading from a tower into an attic above a church nave; (H) permanently opened parts of windows on the both longitudinal sides of church*

b) Outlet of smoke and combustible gases from church partitions filled with smoke

To assure natural ventilation in church partitions accessible by people, some of these technical solutions are recommended: hand-operated windows; permanently opened parts of windows (Fig. 1H); barred openings without glazing; smoke flues of constant section; ventilated openings in walls with drawing off shafts (Fig. 2A); mechanically secured outlet of smoke and heat – chimneys (Fig. 2B).

All parts of church should be equipped with those types of openings, which are able to let the developing smoke and heat escape from the affected church partition. And also it must be prevented from spreading to other parts of church. If it is from static point of view possible, it is recommended to raise a smoke curtain in the attic. In other cases, when it is not possible due to higher load or missing load-bearing elements, it is necessary to set at least division walls made of incombustible materials.

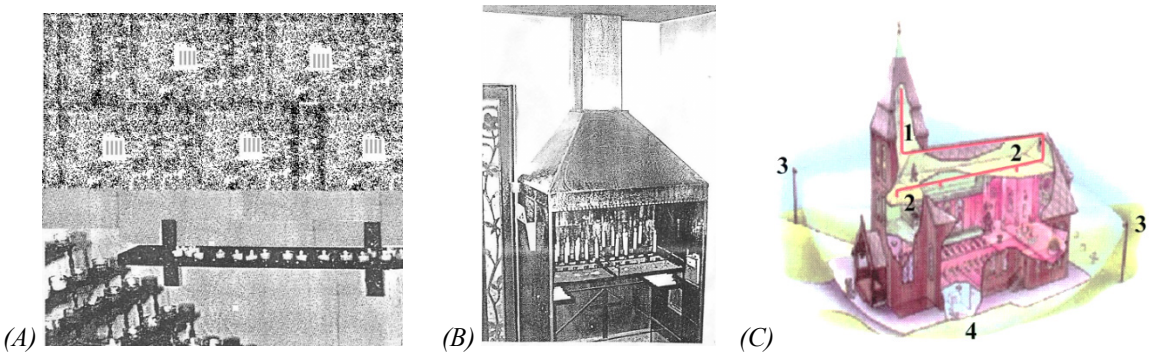

Fig. 2 *(A) drawing off shafts above a candle stand in chapels securing outlet of smoke and heat; (B) overlapping of a candle stand by a cover for outlet of smoke and heat; (C) intake system of smoke detection in church (1 – intake pipe for tower, 2 – intake pipe with capillary pipes pervading through a ceiling of a church nave, 3 – detection by a thermo vision camera, 4 – electric fire signalling exchange); [2]*

c) Escape and fire-fighting routes

Stairs from towers, galleries or upper chapels should be connected with external environment by stairs and they should be separated from church nave by incombustible and very well sealed wall.

3 Fire safety system in historical buildings

Historical buildings can be equipped with these systems: systems of fire detection; systems of burglary detection (primary protection against arsonists); permanent CCTV surveillance; internal fire hydrant systems; external fire hydrant systems with frost-resistant hoses; internal automatic sprinklers and systems of water fog; external sprinkler or spray systems for roof and facades protection; systems of lighting conductors [2].

Electric fire signalling is essential fire equipment in historical wooden buildings. But it is necessary to solve some problems connected with detectors at their application. The installation, maintenance or renewal of electric fire signalling can cause: non-returnable damage if building interior and its decoration; aesthetical disruption of historical environment; excessive difficulties with alarms (optical smoke detectors are sensitive e.g. for dust stuck to cobwebs); increased fire risk by lighting hit due to cable installations.

In relation with electric fire signalling it must be said, its efficiency varies from situation to situation. System is quite expensive, it can be also eliminated by lightning hit and, for example, some of the detectors have slower response time.

4 Types of detectors

4.1 Classic dot photoelectric smoke detectors

These types are relatively bulky and together with feeding cable disturb appearance of building-interior. They often start a false alarm, because they can react on dust developed in surrounding (for example during reconstruction or dust stuck on cobwebs).

4.2 Thermal detectors

These types are dot detectors which are regularly distributed alongside of ceiling or wall--height in determined distance. They belong to the oldest types and two types can be found.

- first type reacts when temperature of environment exceeds adjusted maximum temperature – mostly 57–74 °C,
- second type records a temperature growth and triggers alarm when the adjusted speed is exceeded.

4.3 Intake smoke detectors

Intake smoke detectors are detectors with forced flow of air that is checked. These detectors must be placed so that their noisy ventilators do not disturb environment of buildings. Advantage is, they quickly detect fire and it is easily replaceable. Two types can be found. The first type applies standard dot smoke detector which forced smoke flows along. The second type applies laser detection chamber and it is capable to detect light intensity decrease caused by smoke in extent 0,005–2 per cent per metre. This type is more expensive, but it also enables detection in higher spaces and it is substantially more reliable. In historical interiors, it is advantageous to install inconspicuous plastic pipes with relatively small diameters (Fig. 2C) instead of disturbing dot smoke detectors. These pipes are perforated to draw the air in. The probability of false alarm is low.

4.4 Detection of smoke by video surveillance

There is also possibility to combine closed circuit TV surveillance, which is quite common for security systems in present day, with smoke and heat detections. However, it is necessary to install to the switchboard new software which is capable to analyse optical phenomena accompanying fire development. Presence of CCTV with this system intimidates not only thieves but also arsonists (Fig. 2C).

5 Conclusions

Smoke detection systems become with the development of computer technology very efficient. Along with detection of fire, it is significant part of electric fire signalling. However for perfect function of the detection system, regular testing and maintenance is necessary.

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