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## **Fire Cause Analysis in Religious Sites**

### **Abstract**

Annually fires destroy many buildings, and among them are religious properties. This paper is related to the dynamics of fires on religious sites and to causes of fires in churches. The main dangers of fires in churches are large number of people, flammable structures, using furnaces for heating and the absence of the second emergency exit. The main causes of fires in churches arise from violations of the rules of installation and power grid, operation careless handling of fire. In order to prevent fires, it is necessary to strictly adhere to the Fire Safety Rules, to keep the electrical and furnace equipment in good working order, and to carry out their inspections and maintenance in a timely manner. Also the building should only be left after making sure that all ignition sources are eliminated.

**Keywords:** fire cause, religious buildings, ignition sources, worshippers, religious properties, religious sites

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## **Analiza przyczyn pożarów w miejscach kultu religijnego**

### **Abstrakt**

Każdego roku pożary niszczą wiele budynków, wśród nich są również obiekty kultu religijnego. Niniejszy artykuł dotyczy charakterystycznej dynamiki pożarów obiektów sakralnych oraz typowych przyczyn ich powstawania. Do głównych zagrożeń w miejscach kultu religijnego zalicza się dużą liczbę zgromadzonych osób, niejednokrotnie łatwopalną konstrukcję, wykorzystywanie pieców do celów grzewczych, ograniczoną liczbę wyjść ewakuacyjnych. Do głównych przyczyn pożarów w tego typu obiektach zalicza się nieprzestrzeganie przepisów przeciwpożarowych (szczególnie w kontekście instalacji, w tym instalacji elektrycznych), nieostrożne obchodzenie się z otwartym płomieniem. W celu zapewnienia właściwej ochrony przeciwpożarowej konieczne jest bezwzględne stosowanie się do przepisów przeciwpożarowych, utrzymywanie urządzeń i instalacji we właściwym stanie technicznym, przede

wszystkim poprzez regularne przeglądy i konserwacje. Co więcej, budynki powinny być opuszczane wyłącznie w sytuacji, kiedy absolutnie pewne jest wyeliminowanie wszelkich potencjalnych źródeł pożaru.

**Słowa kluczowe:** przyczyna pożaru, budynki sakralne, źródła zapłonu, wierni, obiekty sakralne, miejsca kultu religijnego

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## **Аналіз причин пожеж у місцях релігійних культів**

### **Анотація**

Щороку пожежі знищують багато будівель, у тому числі релігійні об'єкти. Стаття пов'язана з динамікою пожеж у місцях релігійних культів та причинами пожеж у церквах. Основна небезпека пожежі в церквах – це велика кількість людей, легкозаймисті конструкції, використання печей для обігріву та відсутність другого аварійного виходу. Основними причинами пожеж у церквах є порушення правил інсталяцій та електромережі, необережне поводження з вогнем. Для запобігання пожеж необхідно суворо дотримуватися правил пожежної безпеки, утримувати електрообладнання та печі у справному стані, своєчасно проводити перевірки та обслуговування, залишати будівлю лише після того, як всі джерела займання ліквідовані.

**Ключові слова:** причина пожежі, релігійні споруди, джерела займання, віруючі, релігійні об'єкти, місця релігійних культів

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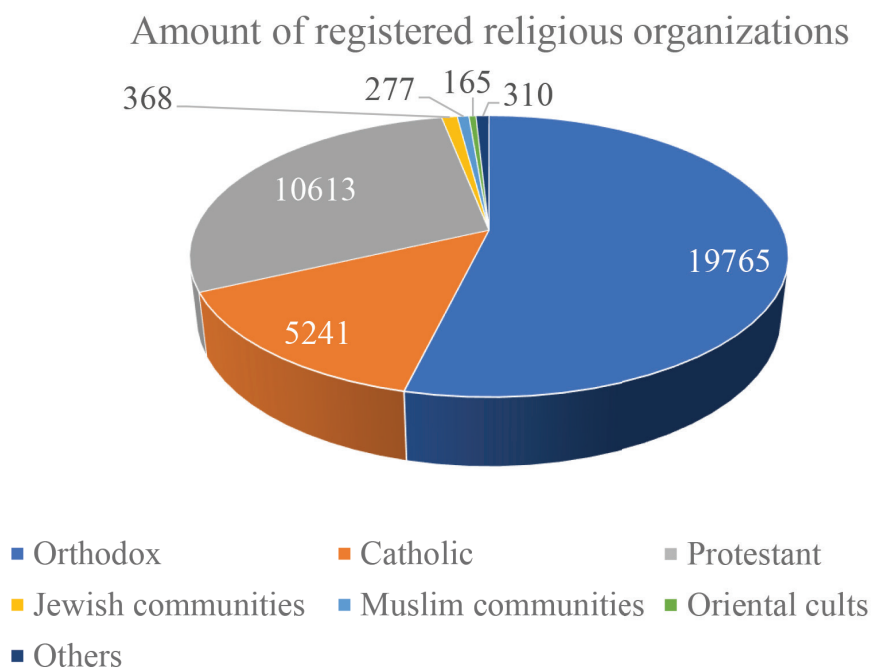
### **Introduction**

The church was and still is an important factor in the development of any civilization. Talking about the role of the Church in Ukrainian society, the fact should be taken into account that the Church in Ukraine is separated from the State in accordance with the Constitution. However, ensuring fire safety during worship, protecting religious buildings from fires is a priority task of the State Emergency Service of Ukraine. The Service cooperates with all religious denominations and tries to reduce fire risk in religious properties.

The purpose of the article is to reveal the peculiarities of fires causes on religious sites in order to develop appropriate measures to prevent fires.

## Results and discussion

According to statistical data as on January 1, 2019 on the territory of Ukraine there was the following number of registered religious organizations: Orthodox – 19765, Catholic – 5241, Protestant – 10613, Jewish communities – 368, Muslim communities – 277, Oriental cults – 165, others – 310. In addition, there were 1327 unregistered religious organizations in Ukraine [1].



**Fig. 1. Number of registered religious organizations in Ukraine**

Source: [1]

The above-mentioned groups use for needs of worship 23495 religious facilities and other buildings adjusted for praying. All these buildings are extremely important for the society; therefore, we have to take care of their safety, and particularly

fire safety. Moreover, some of the religious properties are included in the UNESCO World Heritage List. They include the Saint-Sophia Cathedral and Related Monastic Buildings in Kyiv, Kyiv-Pechersk Lavra, 12 temples that belong to the Ensemble of the Historic Centre in Lviv (the Ensemble of St. Yuri's Cathedral and the Ensemble of Latin Metropolitan Cathedral), Residence of Bukovinian and Dalmatian Metropolitans in Chernivtsi, 8 Wooden *Tserkvas (Churches)* of the Carpathian Region in Poland and Ukraine on the territory of Lviv, Ivano-Frankivsk and Zakarpattia Regions [2]. Especially the latter ones are the most vulnerable to fires. There are also a large number of religious buildings on the territory of Ukraine related to the monuments of national and local architecture.

The largest number of religious properties is located in the Lviv Region. 176 monuments of architecture are declared as monuments of national importance, 563 monuments of architecture have regional importance and 16 belong to UNESCO World Heritage List.

The fire hazard of these buildings for visitors consists in the fact that they can accommodate a large number of people. 40% of all religious buildings can accommodate between 50 and 300 worshipers and visitors, and some of them – even more than 300. There are about 3% of such religious buildings on the territory of Ukraine [3]. In case of a fire, panic may occur and people may be injured during the evacuation.

**Table 1. Number of visitors in religious buildings**

Number of visitors in religious buildings	Number of religious buildings	%
less 50	11872	58
between 50 and 100	3740	18
between 100 and 200	4201	21
more 300	492	3

The specific nature of religious buildings and structures is their large space. Such structures are not divided into fire compartments, smoke zones, etc. It means that

in case of a fire dangerous fire factors (temperature, smoke, oxygen concentration decrease etc.) would be distributed throughout the entire building [3].

**Table 2. Number of religious buildings depending on square of prayer hall**

Religious buildings	Number of religious buildings depending on square of prayer hall			
	less 50 m <sup>2</sup>	between 50 and 250 m <sup>2</sup>	between 250 and 500 m <sup>2</sup>	more 300 m <sup>2</sup>
Orthodox	3336	5511	754	80
Catholic	1069	1282	472	52
Muslim	44	75	4	3
Jewish	19	16	6	1

Some religious buildings and structures can be of a significant height. Consequently, ca. 900 religious buildings and structures in Ukraine have domes situated at an altitude of more than 20 m above the ground level. These structures also include bell towers or minarets in mosques. According to the laws of heat and mass transfer in fire, the heat and smoke will rise up. It gives visitors time to evacuate from the building. Therefore, in such cases there are seldom any victims.

19% of religious buildings and structures are made of wood (about 3500 structures). They are mostly located in Western Ukraine. Only 10% of religious properties are constructed entirely of stones. For the rest of them except stones, bricks, reinforced concrete, in the building constructions wood has been used. For example for overlapping constructions (domes), elements of load-bearing structures or enclosing structures etc. Therefore, in the event of a fire, it quickly spreads through wooden structures.

One of the features of religious buildings is that some of them use furnace for heating. Consequently, ca. 20% of their total number are heated by furnaces. Furnaces are also used in wooden temples. They require maintenance before the heating season, chimney cleaning, plastering, making fire-prevention hindering, etc. In addition, after the heating is completed, it is necessary to check the furnace 2 next hours and only then leave the building. Only about 10% of religious buildings and structures are equipped with central heating [3].

**Table 3. Number of religious buildings depending on type of heating**

Religious buildings	Number of religious buildings depending on type of heating				
	Furnace heating	Central heating	Self-heating	Floor heating systems	Without heating
Orthodox	2886	1065	6219	44	3542
Catholic	309	306	1856	26	1895
Muslim	27	11	78	1	0
Jewish	4	12	23	0	3
Other	477	214	1156	23	119

Another danger in the event of a fire is the absence of the second emergency exit. The number of worship buildings and structures with one emergency exit is 6376 (about 30% of the total amount). If this exit is blocked by fire, there will be no other exit from the building to escape [3].

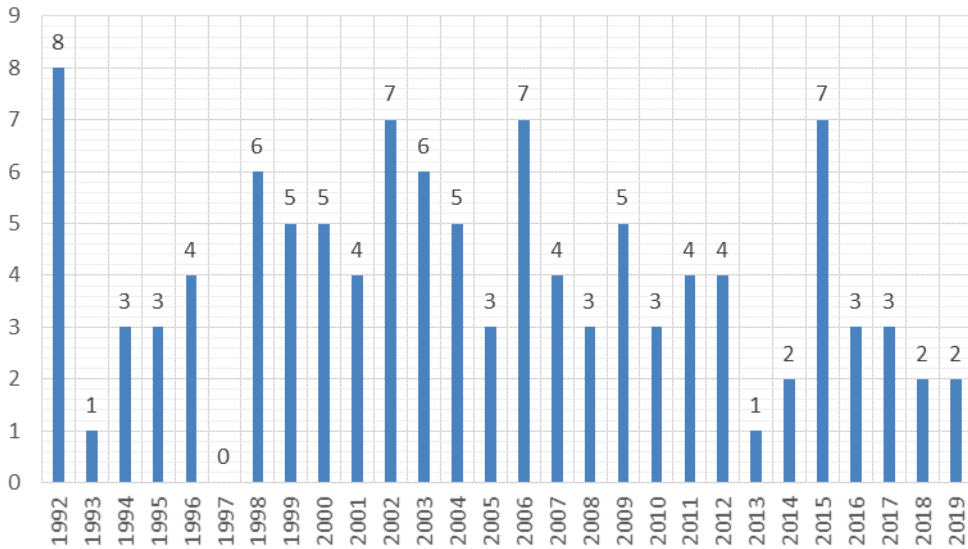
Religious properties are also used for purposes other than worship. Some of them have offices and kitchens inside. Eating, community gatherings, celebrations or other events may also be held in the halls or function rooms. They can also provide religious education.

According to statistics, 30 fires happen annually in religious properties. It is less than 1% of the total number of fires that occur in Ukraine during the year. Fortunately, there were no victims due to these fires in Ukraine. People can be injured only when trying to cope with a fire on their own. Nevertheless, even with such a seemingly small number of fires, the material, spiritual and historical and cultural losses they cause are quite noticeable for Ukraine; they have a resonant character for the society.

Comparing statistical data related to similar fires in the United States, the situation proves to be somewhat worse. US fire departments respond to an average of 1,780 fires in religious and funeral properties each year. The National Fire Protection Association estimates that these fires resulted in an annual average of two civilian fatalities, 19 civilian injuries, and \$111 million in direct property damage. In the

United Kingdom, there is an average of 2,000 fires each year, resulting in losses of 5 million British pounds.

Let us analyse the statistical data pertaining to fires in Lviv region. Those data related to fires were obtained from the Main Department of State Emergency Service of Ukraine in the Lviv Region. Since Ukraine gained independence, 110 fires have occurred in religious properties on the territory of region. Consequently, 28 wooden churches were completely destroyed, 82 were damaged. We should also note that there were 36 fires in wooden religious constructions, which caused full ruin of 28 buildings.



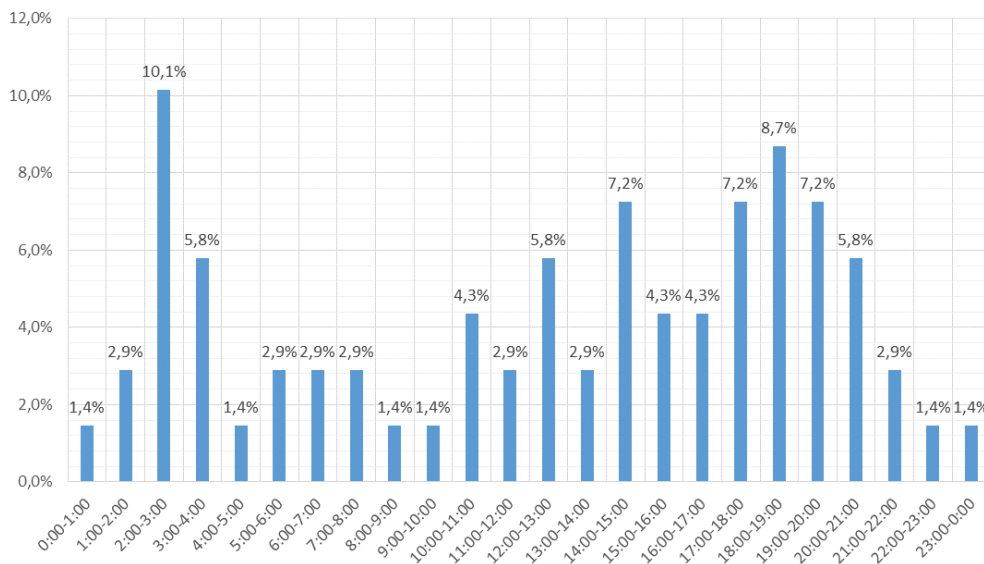
**Fig. 2 Number of fire in religious buildings in the Lviv region**

Source: [own study]

Fires in religious facilities have decreased significantly over the past 27 years, their number falling from 8 per year in 1991 to 2 in 2019. In 1997 no fires in religious properties occurred in the Lviv region.

Information about how fires occur and the factors that contribute to them is essential to work out prevention measures. That’s why we have to consider main causes of fires.

Most often, fires occur between 5:00 pm and 8:00 pm, during the evening liturgies, or after their completion. Also, fires often take place at night between 01:00 and 04:00 am, when no one is in the church.



**Fig. 3 Fires in religious buildings during the day**

Source: [own study]

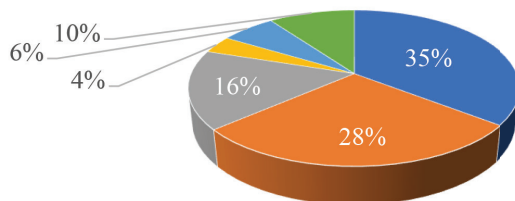
An analysis of statistical data shows that the phone notifications of a fire were most often received on Sunday or Monday at night. The main causes of the fires included careless handling of the fire and violation of the operating rules of the furnaces. The sources of ignition, respectively, were a candle, a furnace, a chimney.

The main causes of fires in churches are:

- violations of the rules of installation and power grid operation, short circuit – 35%,
- careless handling of fire (candle, coking coals, etc.) – 28%,
- arson – 16%,
- violation of fire safety rules when operating furnaces – 4%,
- lightning strikes – 7%,
- others (children playing with fire, violation of fire safety rules while performing fireworks) – 10.

Also, considering fire causes in UK shows are made of different statistical data [8]. Arsons make up almost two thirds of recorded fires. Of the other causes, the most common one was electrical distribution and electrical appliances, cooking appliances and candles. Other causes, in decreasing order of occurrence, were central and water heating appliances, blowlamps, welding and cutting apparatus, space heating equipment, smokers' materials and matches.





- violations of the rules of installation and power grid operation, short circuit
- careless handling of fire (candle, coking coals, etc.)
- arsons
- violation of fire safety rules when operating furnaces
- lightning strikes
- others (children playing with fire, violation of fire safety rules while performing fire works)

**Fig. 4 Causes of fires in churches**

Source: [own study]

For comparison in the US the following causes of fires have been identified:

- 30% of fires were caused by cooking. Most of these fires were minor;
- 16% were caused by heating equipment;
- 16% – intentionally set fires;
- 10% of fires were caused by electrical distribution or lighting equipment;
- 4% were caused by candle;
- 4% due to lightning.

The highest levels of property damage resulted from fires caused by intentionally set fires, electrical distribution or lighting equipment, fires caused by heating equipment and fires caused by lightning strikes.

Such various statistics indicate that fire safety must focus on the causes of fires that characterize a particular area.

All over the world, the causes of arson include the following reasons:

- empty churches are an easy target for pyromaniacs;
- due to church excommunication;
- because of racial hatred;
- sectarian campaign of mass violence;
- as a mean of anonymous demonstration of dissent or anti-religious sentiment.

The analysis of fire statistics in the Lviv region shows that the biggest number of arsons occurred in Catholic churches (15 out of 17 since 1991). This is despite the fact that half of the churches in the Lviv region are Catholic. Despite information about arson of orthodox churches of Moscow Patriarchate in certain regions of Ukraine, only

one case of arson in such churches has been recorded in the Lviv region. Consequently, church arsons in Ukraine are not a cause of inter-religious, racial or ethnic hatred. In most cases, it is not possible to identify the person who set the fire or the cause of arson.

## Conclusion

The major causes of fires are *failures* in the *electricity* network, furnace heating and careless handling. Therefore, in order to prevent fires, it is necessary, first of all, to strictly adhere to the Fire Safety Rules and International standards [6,7], to keep the electrical and furnace equipment in good working order, to carry out their inspections and maintenance in a timely manner. Secondly, the building may be vacated only after making sure that all ignition sources (extinguished candles, smoked coal, unplugged electrical appliances, surface temperature of the furnace and electric heating equipment are not hot, etc.) are eliminated.

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