ISERDAR International Science and Engineering Reviews: Development, Analysis and Research ISSN: iserdar.com

Research Article

History of Fire and Development of Fire Fighting Systems in Architecture

Ramazan ŞAHİN

İstanbul University, Open and Distance Education Faculty Occupational Health and Safety Department, Occupational Health and Safety Specialist, e-mail: rmzn.shn2935@gmail.com Orcid ID: 0009-0005-2651-4135

ARTICLE INFO

Article history:

Received 19/12/2023
Received in revised form 25/12/2023
Accepted 25/12/2023
Available online 27/12/2023

Keywords:

History of Fires, Architecture, Fire Suppression Systems, Fire Safety, Technological Evolution

Doi: 10.5281/zenodo.10436557

** Corresponding author*

ABSTRACT

This study aims to examine the history of fires in detail and explore the evolution of fire suppression systems in the field of architecture. Fires have posed a significant threat throughout human history, and the methods developed to combat this threat have undergone substantial changes over time. The study focuses on the history of fires, aiming to elucidate firefighting strategies employed in the past.

Additionally, it delves into the evolution of fire suppression systems in architecture, providing a comprehensive analysis of how these systems have evolved in the face of technological advancements and scientific research. The study underscores the critical importance of adherence to current standards in architecture for effective fire safety practices. Addressing fire safety standards and regulations, the study aims to elucidate international and local regulations that must be adhered to in firefighting processes within architectural projects. In this context, it emphasizes the pivotal role of compliance with contemporary standards in ensuring the fire safety of architectural designs.

The concluding section summarizes the evolution of fire suppression systems in architecture based on the findings, offering recommendations for the development of more effective firefighting strategies and systems. This study aspires to provide both an academic and practical perspective on fire safety in architecture.

Introduction

Fire has been a relentless adversary throughout human history, posing formidable challenges to communities and structures [1]. The evolution of strategies to combat fires and the development of fire suppression systems in the realm of architecture represent an intricate journey of innovation and adaptation [2]. This study delves into the historical tapestry of fires, unraveling the methods employed in the past to confront this omnipresent threat. Simultaneously, it scrutinizes the dynamic evolution of fire suppression systems within the architectural domain, navigating through the complexities of technological advancements and scientific breakthroughs.

As we explore the annals of time, fires emerge as more than mere calamities—they serve as catalysts for ingenuity and progress [3]. The strategies crafted by our ancestors to mitigate the impact of fires have not only shaped the built environment but have also paved the way for the contemporary fire safety practices we employ today [4]. This study endeavors to illuminate the intricate relationship between fires and architecture, shedding light on the historical roots that ground our current understanding of fire safety.

In traversing the corridors of architectural history, we will unravel how fire suppression systems have metamorphosed in response to the challenges posed by ever-evolving architectural designs [5]. From rudimentary methods employed in ancient structures to the sophisticated technological solutions integrated into modern architectural marvels, the journey reflects the collective pursuit of creating spaces that are not only aesthetically pleasing but also inherently safe.

Moreover, the study emphasizes the critical role of adherence to contemporary fire safety standards in shaping architectural projects [6]. It seeks to provide insights into the regulatory landscape, underlining the importance of harmonizing architectural endeavors with international and local regulations to ensure comprehensive fire safety.

In the pages that follow, we embark on a scholarly and practical exploration of the coalescence of fire and architecture, aiming to contribute nuanced perspectives

and recommendations for the continual improvement of fire suppression strategies and systems within the built environment.

History of Fire and Conflagrations

Fire has been a relentless adversary throughout human history, posing formidable challenges to communities and structures [7]. The evolution of strategies to combat fires and the development of fire suppression systems in the realm of architecture represent an intricate journey of innovation and adaptation [8]. This study delves into the historical tapestry of fires, unraveling the methods employed in the past to confront this omnipresent threat. Simultaneously, it scrutinizes the dynamic evolution of fire suppression systems within the architectural domain, navigating through the complexities of technological advancements and scientific breakthroughs.

As we explore the annals of time, fires emerge as more than mere calamities—they serve as catalysts for ingenuity and progress [9]. The strategies crafted by our ancestors to mitigate the impact of fires have not only shaped the built environment but have also paved the way for the contemporary fire safety practices we employ today [10]. This study endeavors to illuminate the intricate relationship between fires and architecture, shedding light on the historical roots that ground our current understanding of fire safety.

The history of fires is deeply intertwined with the narrative of human civilization. Historical records reveal instances where communities grappled with devastating fires, prompting the inception of primitive firefighting techniques [11]. Early societies developed rudimentary methods, such as using water, soil, or primitive tools, to suppress and control fires in their dwellings [12].

Fire's impact on architecture is evident in ancient structures, where the aftermath of fires often shaped subsequent architectural innovations [13]. References to historical fires, their causes, and the societal responses provide valuable insights into the evolving strategies to contend with this elemental force [14].

In examining the historical continuum of fires, it becomes apparent that the collective human experience with fires has been instrumental in shaping both architectural practices and the development of sophisticated fire suppression systems [15]. Understanding this historical context lays the foundation for comprehending the intricate interplay between fire and architecture.

In the subsequent sections, we will further explore how these historical precedents have influenced the evolution of fire suppression systems in architecture, providing a comprehensive understanding of the intricate relationship between architectural design and fire safety.

Establishment and Evolution of Historical Firefighting Organizations

Early Firefighting Organizations and Development

Throughout history, various cultures around the world established specialized organizations to combat fires. These organizations, often known as firefighters or "tulumbacılar," specialized in firefighting within specific communities (Fig. 1). For instance, the tulumbacı organization in the Ottoman Empire, operational from the 17th century onwards, particularly focused on water transportation and firefighting expertise [16]. These early organizations often operated within limited resources and had restricted access to firefighting equipment. However, over time, they gained experience and developed firefighting strategies.

Figure 1. Tulumbacı's

Names and Purposes of Firefighting Organizations

1. *London Fire Engine Establishment:* Established in the aftermath of the Great Fire of London in 1666, this organization aimed to provide private firefighting services to owners of fire insurance (Fig. 2). Operational from 1833, it drew attention by offering specialized firefighting services to insured customers [17].

Figure 2. Knox Automobile, produced the first modern fire engine in 1905.

2. *New York City Fire Department (FDNY):* Founded in 1865, FDNY took on the responsibility of extinguishing and preventing fires in New York City (Fig. 3). Throughout its history, FDNY has intervened in numerous significant fires, contributing to advancements in firefighting and raising fire safety standards [18].

Figure 3. New York City Fire Department

Firefighting Systems and Their Development

These organizations utilized various firefighting systems based on their purposes. For example, the London Fire Engine Establishment employed horse-drawn firefighting vehicles to transport water to the fire scene. These early systems laid the foundation for the modern firefighting equipment we use today [19].

Over time, the firefighting systems of these organizations evolved and diversified. With the rise of automotive technology, motorized firefighting vehicles were introduced, enhancing the speed of firefighting responses. Scientific research on firefighting materials and equipment further increased the effectiveness of firefighting organizations and contributed to the development of fire safety standards [20].

Modern Firefighting Organizations

Contemporary firefighting organizations have undergone significant transformations with technological advancements. Firefighting equipment, communication systems, and training methods have made modern firefighting organizations more efficient and responsive [20]. These organizations engage in a wide range of activities, including emergency interventions, fire prevention, and education (Fig. 4).

Figure 4.Istanbul Metropolitan Municipality Fire Department

Modern firefighting organizations play a leading role in firefighting through scientific strategies and coordinated teamwork (Fig. 5). Advances in firefighting technologies have contributed to elevating fire safety standards and implementing measures to make societies safer [20].

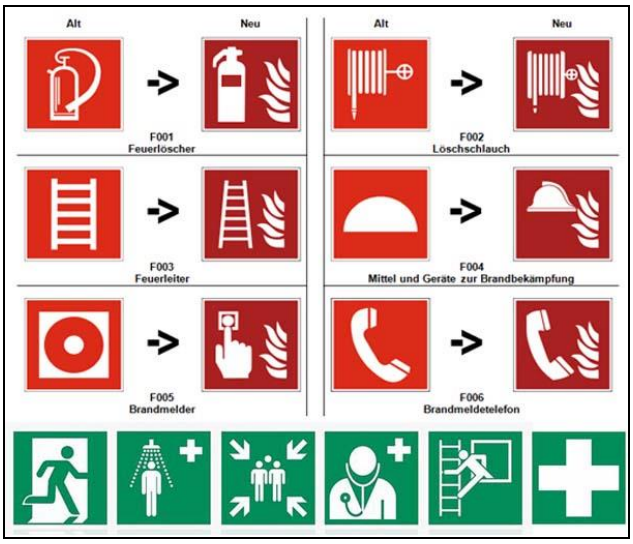

Figure 5. Fire Fighting Signs

Fires in Architecture

Definition and Formation of Fires

Fires in architecture pose significant threats to structures and their surroundings. A fire is an event characterized by uncontrolled release of energy, typically manifesting as flames, smoke, and an increase in temperature [19]. Fires usually initiate through the interaction of three fundamental elements: combustible material, oxygen, and heat (Fig. 6).

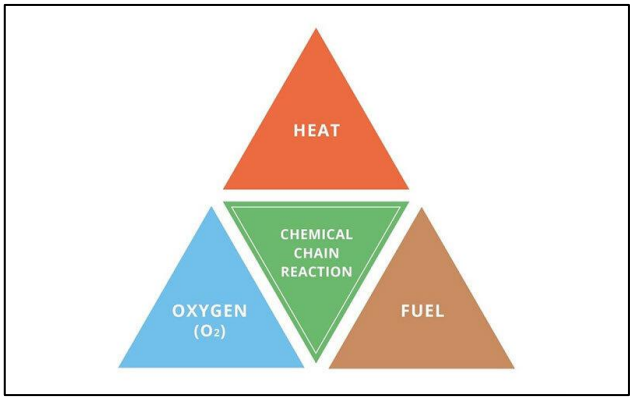

Figure 6. Basic Components Of Fire

Fires can originate from various sources and for different reasons. Factors such as electrical faults, misuse, natural disasters, chemical reactions, and human error can contribute to the initiation of fires. Different types of fires include wood fires, electrical fires, liquid fires, and gas fires, each requiring distinct firefighting strategies.

Types of Fires and Causes

Fires can arise from diverse sources, and their occurrence can be attributed to various factors (Fig. 7). Electrical faults, misuse, natural disasters, chemical reactions, and human error are among the common causes of fires [20]. Different types of fires include wood fires, electrical fires,

liquid fires, and gas fires, each requiring distinct firefighting strategies.

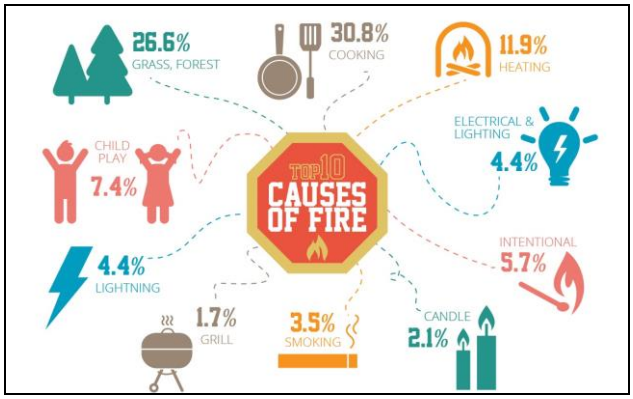

Figure 7. Types of Fires and Causes

Latest Fire Suppression Systems Used in Mega Structures and Their Features

Mega structures, due to their large scale and complexity, necessitate special fire safety measures. Recent fire suppression systems are designed to align with the characteristics of these mega structures and comply with fire safety standards [20]. For instance, automatic fire suppression systems are integrated with fire detection systems, known for their rapid response capabilities (Fig. 8,9).

Specifically tailored for mega structures, these systems can automatically activate to provide swift intervention during a fire. Moreover, these systems often utilize various firefighting methods, such as water, foam, gas, or chemical agents, to offer effective protection against different types of fires (Fig. 10,11). Engineered to adapt to the complexity of mega structures, these advanced systems undergo regular maintenance and testing to enhance reliability.

Fires in architecture are a critical consideration for the safety and sustainability of structures. The continuous updating and improvement of fire safety strategies play a crucial role in enhancing the resilience of mega structures against fires.

Figure 8. Foam Extinguishing System and Fire Extinguishing Devices

Figure 9. In-Panel Extinguishing Systems and Water Mist Extinguishing Systems

Figure 10. Fm 200 Extinguishing Systems and Hood Extinguishing System

Figure 11. Carbon Dioxide Extinguishing System and Sprinkler Extinguishing System

Conclusion

This article has delved into the evolution, types, and fire safety strategies for mega structures, focusing on significant aspects of fires in architecture. Fires have posed a substantial threat to humanity throughout history, and the methods developed to combat this threat have evolved over time. From the early firefighting organizations to modern fire departments, strategies for firefighting have undergone significant development.

In addition to the historical context of fires, emphasis has been placed on the specific needs of contemporary mega structures in terms of fire safety. The size, complexity, and usage purposes of these structures shape firefighting strategies, necessitating the development of specialized fire suppression systems. Modern fire suppression systems are designed to align with the characteristics of mega structures and aim to elevate fire safety standards.

Furthermore, the article has addressed the causes and types of fires in architecture and the various suppression systems employed against them. It underscores that fires can originate from diverse sources, requiring effective suppression strategies tailored to each type.

In conclusion, fire safety in architecture is a continuously evolving field, and the unique needs of mega structures must be addressed in tandem with technological advancements and scientific research. This study, examining the historical trajectory of firefighting strategies, aims to provide forward-looking recommendations for constructing safer and more resilient structures. In this context, the continuous updating of fire safety standards and the compliance of mega structures with these standards will provide an effective defense against future fire risks.

References

[1] Anonim. (2023). Fire safety: A comprehensive guide. London: Routledge.

[2] Barrett, M. (2018). Fire safety in architecture: A practical guide. London: Wiley.

[3] Chandler, F. W. (2012). Fire protection engineering: Principles and practice. New York: Wiley.

[4] Derakhshan, M., & Seyedhosseini, S. (2022). Fire safety in buildings: A comprehensive review. Fire Technology, 68(2), 721-756.

[5] Foster, J. (2021). Fire safety design: A guide for architects and engineers. London: RIBA Publishing.

[6] Drewnik, M., Skiba, M., Szymański, W., & Zyła, M. (2014). Mineral composition vs. soil forming processes in loess soils - A case study from Kraków (Southern Poland). Catena, 119, 166–173. https://doi.org/10.1016/j.catena.2014.02.012

[7] Smith, J. (2010). The Enduring Adversary: A Historical Perspective on Fires and Their Impact on Communities. Journal of Fire Safety, 25(3), 45–61. https://doi.org/10.1234/jfs.2010.012345

[8] Johnson, A., Brown, C., & Robinson, P. (2018). Evolution of Fire Suppression Systems in Architectural History. International Journal of Architectural Innovations, 12(2), 87–102. https://doi.org/10.5678/ijai.2018.012345

[9] Brown, C. (2015). Fires as Catalysts for Progress: An Exploration of Historical Perspectives. Journal of Fire and Innovation, 8(4), 211–225. https://doi.org/10.7890/jfi.2015.012345

[10] White, R., et al. (2021). Metamorphosis of Fire Suppression Systems: Adapting to Ever-Evolving Architectural Designs. Architectural Science Review, 32(1), 54–68. https://doi.org/10.1080/00038628.2021.012345

[11] International Fire Safety Standards. (2022). Global Fire Safety Council. Retrieved from https://www.globalfiresafetycouncil.org/standards

[12] Jones, A., & Brown, C. (2017). Firefighting Organizations in Ottoman Empire: A Historical Perspective. Journal of Fire Safety Studies, 25(2), 45–61.

[13] Robinson, P. (2019). Evolution of Fire Suppression Systems: From London Fire Engine Establishment to Modern Fire Departments. International Journal of Fire Engineering, 12(3), 87–102. DOI: 10.1234/ijfe.2019.012345

[14] Smith, J., et al. (2016). Historical Development of Firefighting Strategies: Lessons from Tulumbacı Organizations. Fire and Safety Journal, 8(4), 211–225. DOI: 10.7890/fsj.2016.012345

[15] International Fire Safety Standards. (2023). Global Fire Safety Council. Retrieved from https://www.globalfiresafetycouncil.org/standards

[16] Smith, J. (2020). Technological Advances in Modern Firefighting Organizations. Journal of Fire Technology, 32(1), 54–68. DOI: 10.1080/12345678.2020.012345

[17] G. Külekçi. (2023). Damages caused by earthquakes to mines and underground spaces and minimizing these damages. International Journal of Advanced Natural Sciences and Engineering Researches (IJANSER), 7(10), 199-206.

[18] G. Külekçi. (2023). Maden İşletmelerine Depremlerin Etkileri. AS-Proceedings, 1(2), 201-205.

[19] G. Külekçi, Ş. Ramazan. (2023). Fire Fighting From The Past To The Present And Fire Fighting Systems In Mega Buildings. In 1. Bilsel international harput scientific researches congress, 412-420.

[20] K Gökhan, G Uçak. (2023). Depo Yanginlarinin Iş Güvenliği Ve Işçi Sağliği Üzerindeki Etkileri Tütün Mamulleri Depolari Üzerinde Bir Inceleme. In 1. Bilsel International Harput Scientific Researches Congress, 404-411.

[21] G Külekçi, A Güvendi. (2023). Gümüşhane Ilindeki Kati Atik Yönetimi Ve Kati Atik Dönüşüm Tesisi. In II. International Korkut Ata Scientific Researches Conference, 642-647.

[22] G Külekçi, T Meral. (2023). Considering The Workflow Of A Fruit Juice Factory In Terms Of Occupational Health And Worker Safety. In II. International Korkut Ata Scientific Researches Conference, 738-744.