

An Assessment of the Implementation of Passive Fire Safety Measures in Selected Pentecostal Churches in Abuja, Nigeria

Olagunju Omoniyi O., Udeze Dumebi R.*

Department of Architecture, College of Science and Technology, Covenant University, Nigeria

Received May 25, 2025; Revised September 18, 2025; Accepted November 12, 2025

Cite This Paper in the Following Citation Styles

(a): [1] Olagunju Omoniyi O., Udeze Dumebi R. , "An Assessment of the Implementation of Passive Fire Safety Measures in Selected Pentecostal Churches in Abuja, Nigeria," *Civil Engineering and Architecture*, Vol. 14, No. 1, pp. 402 - 413, 2026. DOI: 10.13189/cea.2026.140126.

(b): Olagunju Omoniyi O., Udeze Dumebi R. (2026). *An Assessment of the Implementation of Passive Fire Safety Measures in Selected Pentecostal Churches in Abuja, Nigeria*. *Civil Engineering and Architecture*, 14(1), 402 - 413. DOI: 10.13189/cea.2026.140126.

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Abstract Fire hazard is a threat to lives and property. Field assessments based on national and international fire-safety standards have examined structural fire resistance, compartmentation, egress provisions, signage, corridor dimensions, and emergency-vehicle access, as well as post-occupancy maintenance. This study aims to assess the implementation of passive fire safety measures in three (3) selected churches within Abuja, Nigeria, to identify areas for further improvement. Findings revealed that all facilities feature fire-resistant walls, multiple exits, and wide corridors, indicating a basic commitment to occupant safety. However, none (0) have installed fire doors or smoke-control ducts, and critical elements such as muster points and fire signage are inconsistently provided, as two out of the three (2/3) churches have provided these muster points and two out of three (2/3) have provided fire signage. Compounding these deficiencies, blocked exits, wedged-open doors, and unsealed wall penetrations further undermined the performance of existing passive systems. To strengthen congregant safety and resilience in this type of facility, future church projects should have early integration of passive features, enforce routine third-party safety audits, deliver targeted training for church leadership and contractors, and ensure strict adherence to standards. These measures transform visually impressive worship spaces into safe environments capable of mitigating fire emergencies.

Keywords Abuja, Church Buildings, Fire Safety, Passive Fire Safety Measures

1. Introduction

Globally, fire remains one of the most devastating risks in public assembly buildings, with places of worship, mosques, and temples particularly vulnerable. This is due to high occupancy and limited egress, often resulting in significant loss of life and property [1]. In urbanising regions of Africa, churches face added risks from large congregations, high energy demands, informal construction, and weak enforcement of building and fire codes [2]. Many congregations gather in converted commercial spaces or makeshift auditoria that lack basic fire-rated construction, while aesthetic-driven designs such as expansive glass façades, elaborate roof trusses, and double-height atriums can create chimney effects that accelerate fire spread and obstruct evacuation routes [3].

In Nigeria, these vulnerabilities have led to tragic outcomes. The 2016 Uyo church auditorium collapse, which claimed over 100 lives, was exacerbated by the absence of emergency exits, lack of fire suppression systems, and untrained safety personnel [4]. Abuja's burgeoning "mega-church" complexes, some seating

thousands across mezzanines and balconies, similarly often omit critical safety features. Despite their scale, few engage certified fire-safety engineers or code compliance specialists during design, resulting in under-designed fire-resistant materials, incomplete compartmentation, inadequately protected stairwells, and obstructed vehicle access for emergency crews [5].

Fire protection is broadly categorised into active systems, such as alarms, sprinklers, and extinguishers that require activation, and passive fire protection (PFP) measures. PFP elements, such as fire-rated walls, floors, ducts, fire doors, signage, well-planned egress routes, and designated muster points, are integrated into the building's fabric and cannot be easily retrofitted [6]. Their effectiveness hinges on deliberate inclusion during design and construction phases. Yet in many Nigerian churches, cost pressures, superficial regulatory compliance, and a focus on visual impact led to minimal or non-existent PFP installations. Where building permit processes are loosely monitored or circumvented, these hidden barriers are frequently sacrificed to reduce costs or accommodate unconventional architectural statements [7].

Post-occupancy maintenance further undermines passive measures. Exit paths become blocked by temporary staging or storage; muster points go unmarked; fire doors are routinely wedged open for convenience; and critical penetrations around electrical conduits lack proper fire-stopping, creating unseen avenues for flame and smoke migration [8][9]. In the high-density urban fabric of Abuja, such oversights not only endanger congregants but also expose neighbouring residential and commercial properties to secondary fire risks.

Without compartmentalised zones and protected escape corridors, a seemingly minor ignition, whether from an electrical short, candle, or generator malfunction, can escalate rapidly. Smoke and heat traverse large, open-plan auditoria unchecked, inducing panic and stampedes that inflict more harm than the fire itself. Congregants, often unfamiliar with exit routes and having never participated in drills, face confusion and delay, dramatically increasing casualty potential [10]. Common interior finishes, such as acoustic ceiling panels, carpets, decorative foam, and timber stage elements, can act as accelerants if not properly fire-rated, turning decorative features into deadly hazards [11].

Although the National Fire Protection Association (NFPA) publishes over 275 codes and standards, and Nigeria's Building Code (NBC) prescribes fire exits, smoke detection, and minimum corridor widths, compliance in religious buildings remains sporadic. Enforcement mechanisms are underfunded, poorly coordinated, and often optional in practice, particularly when faith-based organisations self-regulate their building programs [9][12]. Routine audits, third-party reviews, and mandated fire drills are seldom enforced, perpetuating a mindset that prioritises capacity and spectacle over

life-safety integrity.

Therefore, the study aims to assess the implementation of passive fire safety measures in selected churches within Abuja, Nigeria, to identify areas for further improvement. To address the aim of the study, the following research objectives were formulated.

To identify suitable passive fire safety measures relevant to church buildings in the study area, and to evaluate the extent of adoption and implementation of these passive fire safety measures in the selected churches.

The study area for the research is in Abuja. Abuja, one of the few purpose-built capital cities in Africa and the administrative and political hub of Nigeria, has experienced rapid urban expansion and increasing population diversity. Designed to promote unity and ensure the safety of all its residents, the city hosts a wide range of religious and ethnic communities. According to Oloke [13], modern productive activities are found more in capital cities. Given Abuja's fast-paced growth and dense development, the implementation of effective fire safety measures, particularly in public buildings such as churches, is essential to safeguard lives and property.

This study is essential because it seeks to address a critical gap in fire safety adoption within Pentecostal churches. Despite the existence of fire safety codes and guidelines, these measures are sparsely integrated into church design. By investigating the challenges and barriers to implementing fire safety in these religious structures, this research provided valuable insights into how fire safety practices can be improved, adopted, and enforced in church environments. Additionally, it helps to develop a new thought process when engaging in design, as knowledge about these fire safety measures is greatly increased.

With the events of recent times pushing for a more sustainable environment, Sustainable Development Goals (SDGs) 9 and 15, which are "Industry, Innovation and Infrastructure" and "Life on Land" respectively, recognise the significant role of global population growth and its infrastructural needs. This research advocates for the safety of life on land, such as humans and property, whilst ensuring reduced threats from harmful emissions from fire outbreaks.

2. Literature Review

2.1. Fire Risk in Religious Buildings

Religious buildings, especially churches, are among the most fire-sensitive public structures due to the combination of dense occupancy, prolonged use, and frequent congregation of large crowds. These buildings often serve multiple functions beyond worship, including education, social gatherings, and cultural events, increasing both human and material fire load within the space [3]. Services,

vigils, and special events often extend into late hours or early mornings, raising fire risk due to fatigue, reduced vigilance, and reliance on artificial lighting and electrical systems.

The high fire vulnerability of religious spaces is further compounded by the architectural complexity typical of many modern churches. Auditoriums with high ceilings, multiple balconies, and open-plan seating layouts create large, uninterrupted air volumes that can accelerate smoke and heat propagation during a fire event [14]. The use of decorative finishes such as wooden stages, fabric drapes, foams, and acoustic panels without fire-resistant certification adds significant combustible material to the interior. Moreover, many churches utilise powerful lighting and sound systems that are often installed without professional electrical planning, creating numerous points of potential ignition [15].

Fire safety measures have been extensively examined in a variety of public-use buildings, including commercial [16][17][18][19], educational [20][21][22] and residential [23][24] settings, yet religious structures, particularly Pentecostal churches in Nigeria, remain under-investigated. This study, therefore, breaks new ground by delivering a targeted, empirically grounded assessment of passive fire-safety measures in three Pentecostal mega-churches in Abuja, systematically applying both NFPA and Nigerian Building Code criteria to elements such as fire-resistant walls, compartmentation, fire doors, duct-based smoke control, signage, egress planning, and site access. Through on-site observations and side-by-side comparisons, it uncovers pervasive gaps that have not been documented in prior place-of-worship research, thereby filling a critical geographic and typological niche and providing a practical observational guide linking architectural design decisions directly to life-safety outcomes.

Several studies have highlighted the alarming gaps in fire preparedness within religious institutions. A nationwide assessment by Oluwaseyi Adeleye [25] revealed that more than 60% of churches in Nigeria lack basic fire detection systems, including alarms and smoke detectors. Similarly, research in Port Harcourt by Yemi-Jonathan and Obafemi [2] found that while some churches possessed fire extinguishers, fewer than 30% had designated evacuation routes, and even fewer had signage or trained fire wardens on-site.

Another critical shortcoming is the absence of compartmentalisation in building layouts. Compartmentation refers to the division of a structure into fire-resisting sections using walls, doors, and ceilings to contain fire spread. In most Nigerian churches, however, large, open sanctuaries dominate the internal layout, providing no barriers to prevent horizontal or vertical fire transmission [26]. This flaw significantly reduces available safe escape time for occupants and can lead to catastrophic

outcomes, especially when paired with blocked or poorly marked exits. Global incidents further emphasise this vulnerability. The 2013 fire in a Russian Orthodox church in Tomsk and the 2019 Notre-Dame Cathedral fire in Paris both underscored how religious architecture, often aged or historically preserved, poses challenges for modern fire prevention methods [27].

In developing countries like Nigeria, where many churches are constructed informally or without full regulatory compliance, the fire risk is magnified by low awareness, insufficient funding, and the absence of enforcement mechanisms. Importantly, the design of religious buildings often places emphasis on aesthetics and acoustic performance, relegating fire safety to a secondary concern. High ceilings, domes, skylights, and long nave-like corridors common in both classical and modern Pentecostal church architecture create smoke collection zones and impede the natural flow of evacuation, particularly when emergency lighting and signage are absent [9]. Religious buildings represent a unique category of public structures with inherently high fire risk due to their spatial layouts, material choices, crowd densities, and usage patterns. Without deliberate incorporation of fire mitigation strategies, particularly passive design elements, these sacred spaces remain alarmingly vulnerable to preventable fire disasters [28].

2.2. Passive Fire Safety Measures

Passive Fire Protection (PFP) refers to the integrated fire mitigation strategies that are built into the structure of a building to prevent, delay, or contain the spread of fire and smoke without requiring activation or human intervention. Unlike active systems such as sprinklers, alarms, and extinguishers, passive systems are designed to function continuously and automatically, playing a foundational role in ensuring structural integrity and safe evacuation during fire emergencies [29]. For religious buildings, especially those accommodating large congregations, PFP is critical in preventing the rapid escalation of small ignition events into catastrophic fires. Fundamentally, passive fire safety revolves around three core objectives: compartmentalisation of fire, protection of structural elements, and preservation of evacuation routes. These are achieved through the use of fire-resistant walls and floors, protected shafts and ducts, fire-rated doors, fireproof coatings, smoke barriers, and purpose-designed egress corridors and staircases [2]. Effective PFP systems are required by international building codes, including the International Fire Code (IFC) and National Fire Protection Association (NFPA) standards, as well as by the Nigerian Building Code (NBC), which outlines minimum requirements for materials and escape planning in public assembly buildings [30].

In the context of churches, passive fire systems must be seamlessly incorporated during the architectural planning stage to avoid costly retrofitting and functional compromises. Walls, columns, and floors must be constructed using materials with certified fire-resistance ratings, typically ranging from 30 minutes to 2 hours, depending on their role in structural support or compartmentalisation [31].

Fire-rated doors are essential in limiting fire spread between compartments and maintaining egress route viability. Fire doors must be self-closing and installed with intumescent seals to block smoke penetration, particularly in corridor intersections and stairwells [32]. Churches should be divided into fire zones such as the main sanctuary, utility areas, children's sections, and offices using fire-resisting barriers. This spatial separation ensures that a fire in one zone does not compromise the safety of the entire structure [33]. Corridors, staircases, and exit paths must be designed to remain smoke-free during evacuation. This includes pressurised staircases, protected shafts, and the use of fire-rated glazing in exit lobbies where visibility is necessary [34]. Air ducts and ceiling voids must be enclosed with fire-resistant linings and equipped with automatic dampers to prevent smoke circulation throughout the building [35]. Marked and accessible muster points are critical for post-evacuation headcounts. Signage must be illuminated, placed at eye level, and located at all decision points within the escape path [36].

Despite the well-documented importance of these measures, passive systems remain grossly under-implemented in Nigerian churches. A study by Alao [5] found that over 70% of sampled religious buildings lacked basic compartmentalisation or fire-rated doors, and only 18% had protected staircases in multi-storey sanctuaries. While many churches invest heavily in acoustics and lighting design, fire safety considerations, particularly passive ones, are treated as afterthoughts or completely ignored.

There are several reasons for this widespread neglect. First, many architects and contractors in Nigeria are not adequately trained in fire-resilient design, leading to substandard construction practices even in relatively modern churches [37].

The result is that churches, although grand in appearance and symbolic in purpose, often function without essential structural protections. In the event of a fire, the absence of fire-rated doors or protected corridors can cause toxic smoke to infiltrate evacuation routes within minutes, rendering exits impassable and causing widespread injury or death from inhalation and stampede. Moreover, buildings that lack ceiling and duct protection facilitate rapid vertical fire spread, especially dangerous in multi-storey worship facilities. To address these challenges,

religious leaders, designers, and regulators need to recognise that passive fire protection is not an optional luxury but a legal and moral obligation in public safety. Incorporating these elements into the earliest stages of church planning will not only safeguard lives but also preserve the long-term integrity of the sacred spaces that serve as spiritual homes for millions of Nigerians [5].

2.3. Fire Safety in Nigerian Context

The state of fire safety in Nigerian public buildings remains a growing concern, particularly in places of religious assembly where thousands congregate weekly in structures that often fail to meet basic safety standards. Despite the existence of the Nigerian National Building Code (NBC) and other urban development guidelines, the application of fire protection measures, especially passive fire safety, remains inconsistent, unregulated, or poorly enforced in most religious institutions. Churches, in particular, are frequently constructed through private initiatives or community-funded projects that circumvent formal approval channels or receive minimal scrutiny from fire service departments and development control agencies [5].

Unlike commercial or government buildings, which are more closely monitored for code compliance, churches are often seen as sacred or charitable domains and are thus exempt *de facto* if not *de jure* from rigorous fire safety inspections. This regulatory vacuum has allowed churches of a significant architectural scale to emerge in urban centres such as Lagos, Port Harcourt, and Abuja without fully implementing standard life safety provisions [4]. Investigations by fire safety agencies in states like Oyo, Rivers, and the FCT have uncovered widespread deficiencies in church safety features, including obstructed egress routes, absence of fire signage, and the use of highly flammable materials in sanctuaries and auxiliary structures [14].

The Abuja Metropolitan Management Council (AMMC) and Federal Capital Development Authority (FCDA) are officially tasked with enforcing urban building regulations, but coordination with the Federal Fire Service remains sporadic, under-resourced, and heavily reliant on reporting from residents rather than proactive enforcement [38].

Another major challenge is the widespread reliance on unlicensed builders and informal construction practices. Many religious buildings in Nigeria were designed without the consultation of certified architects or mechanical engineers, leading to structures that are aesthetically appealing but structurally unsafe. Moreover, in many churches, religious leaders often serve as *de facto* project managers, prioritising fast completion or visual impact over technical integrity and safety compliance. Fire safety is rarely factored into design briefs or budget allocations unless mandated by donors or foreign partners [39].

Even in cases where churches possess the required infrastructure, such as fire extinguishers or hose reels, poor maintenance culture and lack of training among personnel render them ineffective.

It is not uncommon to find expired extinguishers, blocked exits, or fire doors wedged open for convenience, further compromising safety [4].

Fire drills are virtually non-existent in most churches, and emergency signage is either missing or inconsistent with international best practices. Importantly, the NBC outlines clear requirements for fire protection in public buildings, including minimum corridor widths, the number of exits relative to occupancy load, the use of non-combustible materials, fire rating for doors and walls, and the placement of emergency lighting and signage [40]. However, without a dedicated national agency to enforce compliance in religious contexts, the burden often falls to overwhelmed local authorities or remains unaddressed altogether.

Nigeria lacks a centralised database for fire incidents in religious buildings, making data-driven policymaking difficult. Most incidents may go unreported in official records unless they result in mass casualties or structural collapse. Consequently, no consistent metrics exist to evaluate the frequency, causes, or outcomes of church fires, and this impairs planning, regulation, and insurance provision for religious properties [4].

There is also a growing consensus on the need for clergy and church leadership to undergo basic training in fire risk management and to incorporate fire safety policies into standard church operations [4]. Until these gaps are resolved, fire safety in Nigerian churches will continue to be reactive rather than preventive, leaving millions of worshippers vulnerable to avoidable tragedy.

3. Materials and Methods

This study examined the implementation of passive fire safety measures to identify areas that require improvement. To achieve this, a qualitative research approach was employed. An observation guide was utilised to assess the

extent to which passive fire safety strategies were implemented in the selected churches. Purposive sampling was utilised for systematic selection of churches. The two primary criteria used for this selection include: seating capacity and the construction date of the buildings. Specifically, churches with a seating capacity of at least 3,000 were chosen. The buildings selected were those that were erected within the last 15 years, and they are in an urban location with high public access. These criteria were used to ensure that the churches included in the study represented a modern and diverse sample in terms of size and recent construction practices. This method allowed for practical and efficient access to the sample, given logistical constraints. Table 1 presents the selected churches in Abuja.

The scheduled observation guide was thoughtfully designed with a rationale aligned with NFPA and NBC fire safety guidelines, tailored to focus on observable categories within the church environment. The guide seeks to provide a comprehensive understanding of passive fire safety measures evident in the current state of the churches.

Quantitative descriptive analysis was employed to evaluate the scores assigned to each church, to identify patterns, strengths, and deficiencies in the application of passive fire safety measures. Instead of conducting an in-depth assessment of individual buildings, the study compared multiple churches based on clearly defined passive fire safety indicators. This comparative approach allowed for a comprehensive understanding of how each safety strategy was implemented and its potential role in enhancing fire safety and occupant protection in large-scale Pentecostal churches.

By utilising this structured and contextually relevant methodology, the research provides practical insights into the current application of passive fire safety measures in Nigerian churches and underscores opportunities for improving fire resilience and overall safety through thoughtful architectural design.

The findings were then presented through written descriptions, tables, and visual illustrations to ensure clarity and enhance understanding.

Table 1. The selected churches in Abuja, Nigeria

S/N	Name of Church	Capacity	Location
1.	Family Worship Centre	3000	Plot 648 Idris Gidado Street, Wuye District, Abuja
2.	COZA Auditorium (The Commonwealth of Zion Assembly)	5000	Guzape Hill, Asokoro Extension, Abuja
3.	Summit Bible Church	3000	Kaura District, off Oladipo Diya Road, between Games Village and Prince & Princess Estate, Abuja

4. Results and Discussion

The study investigated the current adoption of passive fire safety measures amongst the selected churches in the study area, and the findings are presented in the subsections below.

4.1. Description and Building Characteristics of the Selected Churches

4.1.1. Family Worship Centre

Family Worship Centre (FWC), situated in Wuye, Abuja, is one of Nigeria's leading Christian megachurches, established in 1993 by Reverend Sam Adeyemi. Over the years, it has grown significantly in influence and size, becoming known for its vibrant worship services, strong emphasis on prayer, and extensive community outreach programs.

FWC features a contemporary design with a large rectangular structure and a high-pitched roof that enhances ventilation, acoustic performance, and rainwater harvesting. The exterior incorporates a blend of modern materials such as glass, concrete, and steel, creating a sleek yet inviting appearance (see Plate 1). Large, energy-efficient windows allow abundant natural light into the space while minimising heat gain, contributing to both comfort and energy savings.

Inside, the expansive worship hall serves as the heart of the building, offering ample seating with clear sightlines to the elevated pulpit and altar. The space is equipped with advanced audio-visual systems and acoustic panelling to ensure clarity during sermons and music performances. Supporting facilities include dedicated children's ministry areas, versatile youth and multipurpose halls, administrative offices, and well-distributed, accessible restrooms. Carefully integrated lighting, both natural and artificial, enhances the serene and uplifting atmosphere, making FWC not just a place of worship but a well-designed and inclusive community space.

Table 2 reveals the elements present in the adoption of passive fire safety measures at Family Worship Centre reflect both positive provisions and notable gaps. The church incorporates multiple well-marked exits, visible signage, wide corridors, and a clearly designated muster point, all of which support safe and efficient evacuation during emergencies. However, the absence of fire-rated doors and ductwork weakens the building's ability to contain fire or control smoke movement, leaving occupants more vulnerable once evacuation begins. This mix of strengths and deficiencies suggests that while basic safety requirements have been addressed, more advanced passive features remain under-implemented.

4.1.2. Commonwealth of Zion Assembly

The Commonwealth of Zion Assembly (COZA), located

in Guzape, Abuja, is a prominent megachurch and the headquarters of the global ministry led by Pastor Biodun Fatoyinbo. Founded in 1999, COZA has expanded from a small congregation into a large, influential church known for its vibrant worship services, contemporary music, and impactful preaching. It attracts thousands of worshippers weekly and has established itself as a centre for spiritual growth, leadership development, and community engagement.

COZA's facility is a striking example of modern church architecture, combining elegance and functionality. The main auditorium, one of the largest Pentecostal worship spaces in Abuja, features a fan-shaped layout with tiered seating that ensures clear sightlines to the altar and stage. The auditorium is equipped with advanced audiovisual systems, including LED screens, professional lighting, and a state-of-the-art sound system, all designed to create a seamless and immersive worship experience.

The building's exterior blends bold geometric forms with expansive glass facades and high-quality materials such as reinforced concrete and steel (see Plate 2). Upon entry, worshippers are greeted by a grand foyer with high ceilings, polished marble floors, and an open, welcoming layout that encourages fellowship and social interaction.

Inside, the worship environment is further enhanced by acoustic panels, concealed lighting, and a visually striking stage backdrop. Additional facilities include bright, engaging children's areas with age-appropriate furnishings, as well as spaces for administrative functions and smaller gatherings. COZA combines architectural excellence with a spiritual mission, making it a landmark church and a hub for faith-based activities in Abuja.

Table 3 shows that the Commonwealth of Zion Assembly demonstrates partial compliance with passive fire safety standards. The facility has made provisions for fire-resistant materials, multiple exits, and obstruction-free escape routes, which enhance evacuation safety. Nevertheless, the lack of adequate fire signage reduces effective wayfinding under emergency conditions, and the site planning does not allow unrestricted access for fire service vehicles. These limitations highlight a gap between occupant-focused safety provisions and the external planning measures necessary to support timely emergency response.

4.1.3. Summit Bible Church

Summit Bible Church, Abuja, is a modern Christian ministry founded by Dr. Andrew Osakwe, known for its vibrant worship, sound biblical teaching, and strong community focus. Strategically located in Abuja, the church features a contemporary multi-story facility designed to support a wide range of religious, social, and administrative functions.



Plate 1. Front Facade of Family Worship Centre Building (Author's Fieldwork, 2025)

Table 2. Passive Fire Safety Measures Adoption in Case Study 1

S/N	Variable	Passive Fire Safety Measures		Remarks
		Present	Absent	
1	Structural Building Components	✓		The Family Worship Centre employs fire-resistant materials throughout its construction, ensuring that the structure can withstand fire hazards and reduce the spread of flames and smoke.
2	Duct Works		✓	Duct work was not installed within the building facility.
3	Fire Doors		✓	Fire doors were not installed within the building facility.
4	Fire Exits	✓		Multiple, well-marked emergency exits are strategically placed throughout the building.
5	Escape Routes	✓		Multiple, clear and obstruction-free escape staircases and routes were provided at different points in the building facility.
6	Fire Signage	✓		The facility has visible and strategically placed fire safety signage installed throughout the building. This includes exit signs, directional arrows leading to emergency exits and muster points, and signs indicating the locations of fire extinguishers, hose reels, and fire alarm points.
7	Muster Point	✓		Presence of clearly marked muster point for users to come to for assembly after escape.
8	Adequate Corridor Sizes	✓		The presence of wide corridors leads to designated assembly points outside the facility during emergencies.
9	Site Planning	✓		The Family Worship Centre is designed to provide optimal access for fire service personnel and vehicles, ensuring a quick and effective response in the event of an emergency. The church compound includes wide, well-paved access roads that allow fire trucks and other emergency vehicles to navigate easily. These roads are designed with ample turning radii to accommodate large vehicles, ensuring smooth entry and exit during emergencies.



Plate 2. Approach View to Commonwealth of Zion Assembly. (Author's Fieldwork, 2025)

Table 3. Passive Fire Safety Measures Adoption in Case Study 2

S/N	Variable	Passive Fire Safety Measures		Remarks
		Present	Absent	
1	Structural Building Components	✓		Commonwealth of Zion Assembly (COZA) church employs fire-resistant materials throughout its construction, ensuring that the structure can withstand fire hazards and reduce the spread of flames and smoke.
2	Duct Works		✓	Ductwork was not installed within the building facility.
3	Fire Doors		✓	Fire doors were not installed within the building facility.
4	Fire Exits	✓		The building is equipped with several emergency exits strategically located throughout the premises.
5	Escape Routes	✓		Multiple, clear and obstruction-free escape routes were provided at different points in the building facility.
6	Fire Signage		✓	The facility does not have a clear presence of marked signage indicating different exit points and other information.
7	Muster Point	✓		Designated muster points are located outside the building at safe distances to ensure that evacuees have a secure location to assemble during emergencies. These areas are marked and easily accessible from all emergency exits, facilitating organised crowd management and accounting for all individuals after evacuation.
8	Adequate Corridor Sizes	✓		The presence of wide corridors leads to designated assembly points outside the facility during emergencies.
9	Site Planning		✓	The Site Planning of Commonwealth of Zion Assembly does not ensure free movement of fire vehicles around the church facility.

The building includes a spacious, tiered-seating auditorium with optimised acoustics, modern AV systems, and accessibility features such as ramps and elevators. Auxiliary spaces accommodate children's ministries, offices, and other church programs. The design emphasises natural light, ventilation, and comfort, with landscaped outdoor areas enhancing the overall environment (see plate 3). The church interiors are sleek and functional, with ergonomic seating, polished floors, high ceilings, and integrated acoustic treatments. The stage area features LED screens, dynamic lighting, and a minimalist pulpit, creating a welcoming and engaging worship atmosphere.

**Plate 3.** Front View of Summit Bible Church. (Author's Fieldwork, 2025)

Table 4 shows that the Summit Bible Church exhibits a fair level of adoption of passive fire safety features.

Structural fire-resistant materials, several emergency exits, and clear escape routes are present, along with visible signage that guides occupants towards evacuation paths. However, the absence of a designated muster point and poor site access for emergency vehicles compromise coordinated evacuation and firefighting efforts. This imbalance reveals that while internal safety has been reasonably considered, external response planning remains inadequate.

4.2. Comparative Evaluation of Passive Fire Safety Measures across Selected Case Study Churches

The passive fire safety strategies in the three churches were assessed by identifying structural components, duct works, fire doors, fire exits, escape routes, fire signage, muster point planning, corridor dimensions, and site access and correlating these to their impacts on occupant evacuation efficiency, fire compartmentalisation, emergency service access, and overall safety resilience.

The Family Worship Centre performed best of all (Table 2), due to its comprehensive provision of multiple, well-marked fire exits and clear, obstruction-free escape routes, visible and strategically placed signage, wide corridors leading directly to a designated muster point, and site planning that ensures unimpeded access for fire service vehicles. It also enjoyed superior wayfinding and rapid evacuation potential compared to Summit Bible Church (Table 4), and more effective external assembly and vehicle access than COZA (Table 3), although none of the churches incorporated ductwork or fire doors.

Table 4. Passive Fire Safety Measures Adoption in Case Study 3

S/N	Variable	Passive Fire Safety Measures		Remarks
		Present	Absent	
1	Structural Building Components	✓		Summit Bible Church employs fire-resistant materials throughout its construction, ensuring that the structure can withstand fire hazards and reduce the spread of flames and smoke.
2	Duct Works		✓	Ductwork was not installed within the building facility.
3	Fire Doors		✓	Fire doors were not installed within the building facility.
4	Fire Exits	✓		The building is equipped with several emergency exits strategically located throughout the premises.
5	Escape Routes	✓		Multiple, clear and obstruction-free escape routes were provided at different points in the building facility.
6	Fire Signage	✓		The facility has visible and strategically placed fire safety signage installed throughout the building, indicating escape routes, fire exits, and the locations of firefighting equipment such as extinguishers.
7	Muster Point		✓	Absence of designated muster point located in this facility.
8	Adequate Corridor Sizes	✓		The presence of wide corridors leads to designated assembly points outside the facility during emergencies.
9	Site Planning		✓	The Site Planning of Summit Bible Church does not ensure free movement of fire vehicles around the church facility.

While Summit Bible Church featured wide corridors and several emergency exits that enhanced internal egress efficiency, its lack of a designated muster point and restricted vehicle access undermined overall evacuation coordination. Commonwealth of Zion Assembly employed fire-resistant materials and clear escape routes, but suffered from absent fire signage and inadequate site planning for emergency vehicles. All three churches omitted duct works and fire doors, critical passive elements for smoke control and compartmentation and did not integrate fire-rated barriers or zonal subdivisions in their layouts.

Also, the absence of duct-based smoke extraction systems and fire doors across every case study significantly reduced their ability to contain fire and manage smoke spread. In short, the findings indicate that passive fire safety measures were implemented only partially and without integration into the overall building design. To achieve enhanced occupant protection and fire resilience, future church designs must combine structural materials, circulation planning, signage systems, compartmentation, and site access into a unified passive fire safety strategy.

4.3. Discussion

This study evaluated whether passive fire safety measures could enhance occupant protection and emergency response effectiveness in large congregational buildings, while also examining the extent to which these strategies have been implemented in three Nigerian churches. The targeted measures include fire-resistant materials, compartmentation, clear egress paths, signage, and site planning work to safeguard users and facilitate

rapid evacuation under fire conditions. Research demonstrates that fire-resistant construction and compartment barriers significantly slow fire spread and structural collapse, buying critical evacuation time [41], and well-installed passive fire barriers can extend safe evacuation times by slowing flame spread and limiting heat transfer. NFPA 101: Life Safety Code recommends fire-rated walls and doors capable of maintaining compartment integrity for at least 60–120 minutes, which can reduce overall evacuation time by up to 25 percent in high-occupancy buildings. Field studies in large assembly venues have shown that continuous fire exit signage and unobstructed escape routes can further cut evacuation durations by as much as 30 percent under simulated fire drills [42][43]. Meanwhile, research in European cathedrals found that the absence of certified fire doors and smoke control ducts often leads to rapid smoke migration and flashover within 10–15 minutes of ignition [44], and hidden penetrations and service voids undermine compartmentation unless specifically sealed [45].

Various levels of passive fire safety adoption emerged across the case studies. All churches incorporated fire-resistant structural components, multiple exit points, and unobstructed escape routes, echoing best-practice recommendations in NFPA 101. However, none progressed beyond these foundational measures to include fire doors or duct-based smoke-control systems, which maintain compartment integrity and keep stairwells tenable through smoke pressurisation. Further, while exterior planning often allowed for fire-service access, designated muster points and coordinated vehicle-access layouts were inconsistently applied, limiting effective post-evacuation

accountability and external intervention.

This discussion underscores that, although the studied churches have implemented key passive fire safety features at a basic level, their application remains fragmented and insufficiently integrated. Future designs must move toward a holistic passive fire safety system combining fire-resistant materials, properly certified fire doors, dedicated smoke extraction or pressurisation ducts, comprehensive wayfinding and muster planning, and optimised site layouts to ensure robust occupant protection and swift emergency response in large-scale worship facilities.

5. Conclusions and Recommendations

Based on the findings of this study, the integration of passive fire safety measures in the three case-study churches was uneven and incomplete. While all buildings employed fire-resistant structural materials and provided multiple exits and clear escape routes, they uniformly lacked key passive containment elements, namely fire doors, smoke-control ducts, and compartmentation barriers that are essential for slowing fire spread and maintaining tenable conditions during evacuation. This patchy adoption creates an overreliance on active systems and compromises both occupant protection and emergency response effectiveness.

To address these shortcomings, church leadership, architects, and fire safety engineers must receive targeted training on comprehensive passive fire protection strategies. Educational programs should emphasise the importance of integrating certified fire doors, duct-based smoke extraction or pressurisation systems, and properly sealed fire-stopping around penetrations into the earliest design stages. Simulations using fire modelling software are indispensable, allowing teams to detect and remediate weaknesses such as unprotected shafts or hidden voids before construction commences.

Moreover, a layered approach combining structural compartmentation, high-visibility wayfinding, designated muster points, and optimised site planning will yield the greatest safety dividends. Local authorities should mandate passive fire safety audits and require that all new worship facilities demonstrate compliance with a unified passive fire protection framework. Existing churches should undergo periodic assessments to verify the performance of passive measures and implement retrofits such as installing fire doors, enhancing signage, and reconfiguring access routes where necessary.

By systematically embedding these passive strategies into both design and operation, church buildings can achieve resilient fire safety, safeguard occupants, and reduce dependence on mechanical firefighting interventions, ultimately fostering safer, more sustainable worship environments.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgements

The authors express gratitude for the assistance extended by the Covenant University Centre for Research, Innovation, and Discovery (CUCRID) in facilitating the publication of this work.

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