

The Role of Urban Planning in Fostering the Safety of Public Places of Worship

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Abstract Urban safety is vital for sustainable, livable communities, recognized globally as a human right by UN-Habitat and Sustainable Development Goal 11, which promotes inclusive, safe, and resilient cities. Terrorism, a rising urban threat, targets crowded public spaces like worship places, causing significant casualties, property damage, and trauma. In Saudi Arabia, a strategic Middle Eastern hub and home to Islam's holiest sites, recent terrorist attacks have increasingly struck religious institutions, necessitating innovative countermeasures beyond traditional security. This study investigates urban planning's role in mitigating terrorist risks at Saudi places of worship, addressing a research gap in developing contexts. Using a mixed-methods approach, it combines thematic content analysis of peer-reviewed literature, official reports, and media with geospatial mapping of seven attack sites since 2015, using Google Earth and QGIS. These cases, representing the deadliest incidents, account for 86% of fatalities (61/71) and 88% of injuries (197/223) from such attacks. Findings highlight urban design vulnerabilities—direct vehicular access, multiple entry points, and poor sightlines—that facilitated attacks. The study proposes urban planning guidelines, including limiting access points, creating buffer zones, enhancing visibility, and applying defensible space principles to deter attacks and boost resilience. Practically, the guidelines provide planners with tools to retrofit sites, such as narrowing roads and minimizing entries. Socially, they reduce fear, promote equitable access for women and children, and support tourism and community engagement by mitigating terrorism's impact on inequalities. These measures balance security with livability, fostering safer,

inclusive urban environments. This research contributes the first Saudi-specific analysis integrating geospatial tools with counter-terrorism urbanism, offering neighborhood-scale solutions aligned with Saudi Vision 2030's safety goals.

Keywords City Planning, Crime and Terrorism, Places of Worship, Public Safety, Space Resilience, Urban Design

1. Introduction

Urban safety is indispensable for achieving livable communities and sustainable development. Creating safe cities is a fundamental human right, taking center stage in several international summits and declarations. For example, UN-Habitat has published a report on enhancing urban safety and security [1], and the Sustainable Development Goal (SDG) 11 emphasizes the importance of creating inclusive, safe, resilient, and sustainable cities [2]. However, there has been a spate of crimes and violence worldwide, rising from 2,300 to 3,000 crimes/10,000 inhabitants over the 1980-2000 period, representing a 30% increase, with about 60% of city residents in developing and emerging nations being affected by crimes, including homicide, organized crime, and terrorist attacks [1]. Crimes typically exhibit heightened prevalence in urban areas due to elevated population density and the concentration of socioeconomic activities [3,4]. Cities

currently host over half of the global population of eight billion, a proportion projected to increase to nearly 70% by 2050 [5]. Currently, terrorism is one of the major violent crimes experienced in cities, causing mortalities, injuries, and property loss, in addition to trauma and anxiety experienced by terrorism victims [6,7,8].

The recent manifestations of terrorism have become a matter of critical concern for urban safety. Prior to the September 11, 2001, attack on the World Trade Center in New York, terrorist activities predominantly targeted major economic and political centers, primarily utilizing explosive devices [9]. Since then, the targets have expanded to include a wide range of places that can draw large crowds, including public squares, parks, train stations, airports, places of worship, shopping centers, and stadiums [10,11]. Furthermore, the objective of terrorist activities shifted from targeting institutions and individuals associated with financial and political dominance to maximizing casualties and injuries using unconventional methods [4,11].

Crimes tend to concentrate in certain parts of the city, including poor neighborhoods, slums, public institutions and spaces such as schools, hospitals, sports and entertainment centers, train/bus stations, and religious centers. Thus, city size, form, density, and demographic composition influence the occurrence of crime [12,13]. Poor urban planning, design, and governance that shape cities' physical fabric and layout have increasingly been associated with exposing people and their assets to the risk of crimes [14]. In response, crime-inhibiting policies and strategies, including legislation, deradicalization programs, public education, and urban design and governance, have emerged to reduce the impacts and incidence of terrorist attacks [15,16]. However, several cities neglect crime prevention responses from the urban planning perspective. Impediments to urban crime reduction include a lack of urban design guides [17,18], poor urban form [19,20], and inadequate integration of city planning with existing institutional approaches [21,22]. In his renowned work, Newman [23] stated that "crime prevention through environmental design" is crucial to understanding the relationship between the physical environment and security. The urban securitization process, where the public becomes better prepared and more responsible for personal risk management, is also key to improving urban resilience [24,25,26].

Saudi Arabia is among the countries that have been the target of successive waves of terrorist attacks. Within the last decade, the country has seen a surge of terror acts in which several public places of worship were attacked, causing deaths, injuries, and economic losses. To its credit, the government has responded to each attack through social reforms, public dialogues, effective intelligence gathering, and law enforcement [27]. Another strategy in its fight against terrorism is the innovative program to debrief, reeducate and rehabilitate captured terrorists. Also,

the government has strengthened the legal provisions to ensure an effective fight against terrorism [28] and has mandated religious leaders to counter terrorists' propaganda using social media to recruit young people to their network [29]. However, a multi-pronged approach to addressing terrorism, including the role of urban planning, is important but underutilized.

Existing literature suggests that the role of urban planning in mitigating the risks of terrorist attacks in developing countries has been largely overlooked [12,30]. To the authors' knowledge, no studies in Saudi Arabia have specifically examined the potential of urban planning strategies to prevent terrorist incidents. This study seeks to address this research gap. It first analyzes the latest wave of terrorist attacks in Saudi Arabia. Second, it investigates how physical planning features around worship places facilitate or impede terrorist attacks. Lastly, it suggests how urban planning and design measures can help mitigate the risk of vulnerability to similar attacks in the future. The study is pertinent, especially in the wake of the Saudi Vision 2030, which embodies the long-term goals for the national socioeconomic development [31]. The vision, among other far-reaching goals and objectives, emphasizes the safety and security of citizens and assets. Because the incidents occurred in urban areas in specific physical infrastructural settings, it is important to explore the role of redesigning physical features around public places like mosques in impeding terrorist attacks.

2. Literature Review

A crime is "an antisocial act that violates a law and for which punishment can be imposed by the state or in the state's name," and violence is "the intentional use of physical force, threatened or actual, against oneself, another person, or against a group or community that either result in or has a high likelihood of injury death, psychological harm, mal-development or deprivation" [1]. While crime and violence are related, all violence is a crime, but not all crimes involve violence. However, they both negatively impact nations, cities, and individuals in many ways, causing life and property losses [32,33], threats to human security, population displacements, flight of businesses, foreign investments, and tourism [34] in addition to increased cost of healthcare, policing, and other service delivery [35,36]. Crimes result from underlying roots connected to international socioeconomic changes, local conditions, and inequalities. The factors underlying crimes are formal legal rules and regulations, as well as informal socio-cultural and religious values that are powerful motivators or constraints [20,32]. Although poverty and unemployment are significant factors in perpetrating crimes [37,38], several poor communities have exceptionally low crime incidences [39,40].

Terrorism, a form of violent crime with over 50 definitions [41], constitutes a relatively new field of urban

research [22,42]. Chomsky [43] defines terrorism as the deliberate use or threat of violence to achieve some political, religious, or ideological aims via fear and coercion. Hoffman [44] identifies terrorism as "the deliberate creation and exploitation of fear through violence or the threat of violence in the pursuit of political change." Bockstette [45] describes terrorism as "political violence in an asymmetrical conflict that is designed to induce terror and psychic fear (sometimes indiscriminate) through the violent victimization and destruction of noncombatant targets (sometimes iconic symbols)". Finally, the United States Federal Emergency Management Authority [46] states that terrorism is "the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives". The definitions collectively emphasize three core concepts: violence, coercion, and political objectives.

Since the end of World War II, terrorist attacks have been perpetrated by individuals or groups associated with separatist movements (e.g., Basque ETA, Irish Republican Army), right-wing (like in Oslo and Oklahoma), or left-wing (e.g., Baden-Meinhoff, Red Army) political ideologies, religiously inspired ideologies (Om Shin Rikyu, Al Qaida), and single-issue activism [47]. In the 21st century, notable terrorist attacks include the September 11, 2001, attack in New York City, the 2002 Bali bombing targeting tourists in Indonesia, the March 11, 2004, Madrid train bombings in Spain, the 2005 London bombings, and the 2006 Mumbai commuter train bombings in India [1].

Terrorist activities seek to achieve political objectives through violence and coercion targeting governments and civilian populations. Glaeser and Shapiro [3] identified three primary impacts of large-scale violence on urban environments. First, cities, as prominent targets for terrorist acts, may prompt residents to disperse due to heightened security concerns. Second, during periods of violence, cities attract populations seeking enhanced protection from perpetrators, owing to their robust infrastructure and security measures. Third, terrorist threats targeting transportation systems can elevate the effective cost of mobility, thereby promoting concentrated land use patterns. However, Glaeser and Shapiro [3] argued that terrorism typically exerts minimal influence on urban form, a perspective contested by Bevilacqua et al. [19], who suggest a more significant impact.

Paizs [22] investigated the impact of terrorist attacks on urban planning, focusing on physical design features implemented for enhanced security. These features include building mass and setbacks, the installation of bollards, and the use of reinforced glazing in courtyard areas. The author notes that there was no observable change in the legal framework and urban design principles in terror-impacted cities such as Oklahoma, Manchester, and Oslo. Although certain national building codes incorporate provisions to enhance security and promote safe communities, they do

not explicitly address terrorism [48]. Instead, these codes primarily focus on crime prevention, social security, fire protection, and environmental safety. Similarly, Coaffee [9] observes that typically "counterterrorist security managers tended to utilize policing tactics, planning regulations and advanced technology to construct 'security zones' or 'rings of steel' around certain sites, where access was restricted, and surveillance enhanced significantly." This underscores the need for more attention to the role of urban planning in minimizing the threats of terrorist attacks.

Hidek [17] identified two strands of policy response in the USA following the World Trade Center (WTC) attack: preventive measures and disaster preparedness. The author suggests implementing various counter-terrorism measures, such as narrowing city entry roads, incorporating traffic decelerating street planning, installing a considerable number of security cameras, placing concrete medians between lanes or at entry points into the city center and subway stations, and constructing bollards, barriers, and fences. Marcuse [49] argues that the utilization of the terrorism threat, rather than the actual occurrence of terrorism, will have the most significant impact on the configuration of cities and urban life. The author highlights USA's response to the 9/11 terror attack on the WTC, which includes the intrusive and pervasive prioritization of security, the erection of hardened architecture, the promotion of citadelization, the restriction of democracy, the exacerbation of segregation, the increasing privatization of the public sector, and the undermining of cosmopolitanism and urbanity.

Urban terrorism involves highly visible acts of violence deliberately designed to harm, destabilize, and disrupt urban populations and infrastructure, including mass transit systems, public squares, places of worship, schools, hotels, airports, stadiums, and shopping centers [4,50]. Cities are vulnerable to terrorism, especially in public places where people congregate, because of their political, cultural, and socioeconomic functions, dense agglomeration, and image that transcends national boundaries [8,51,52]. Although terrorism is associated with long-term underlying socioeconomic and political situations, urban planning can help reduce the prevalence and impacts of urban terrorism, which has a spatial dimension and increases the resilience of cities [24,25,26].

Several studies have investigated the relationship between terrorist attacks and urban planning and design in cities worldwide. For example, Refaat et al. [53] examined the link between urban form and safety from a crime prevention perspective. They suggested that the safety of public spaces depends mainly on the form and structural components of the urban context. Coaffee et al. [54] investigated the socio-spatial implications of security measures for a large-scale, multi-venue sporting event and suggested setting up peripheral buffer zones surrounding key venues. Katzman [55] employed a semi-quantitative method, analyzed the risk for terrorism-related chemical,

biological, and radio-logical explosives, and suggested using bollards as a technical mitigation measure. Mustafa et al. [56] examined urban safety and security in Greater Cairo Region, focusing on terrorism and crime. They recommended control on access to vulnerable spaces, such as opening mosques only during prayer congregation times. Hillier and Sahbaz [57] studied the relationship between urban safety and urban morphology in terms of space syntax.

Matijosaitie and Petriashvili [26] used a space syntactical approach to analyze the most vulnerable places for terrorist attacks in cities. They found that such places have many access points to buildings, open spaces surrounding buildings, high global integration of streets, unseparated private and public activities, and similar functions concentrated in a few buildings. They recommended the reorganization of site elements and street networks. Petho-Kiss [58] assessed 26 terrorist attacks on Christian churches between 1998 and 2019 based on nine parameters, including weapons used, perpetrator motivation, and spontaneous defensive actions. The study recommended keeping dustbins locked, car parks at a safe distance, and trimming vegetation to make it more difficult to hide explosives. Grebowski and Wrobel [59] conducted experimental testing and numerical analyses to study mitigation measures for terrorist attacks using motor vehicles and recommended passive protection systems involving laminated glass with sufficient thickness in walls. Babalis [60] followed a comparative case study approach and identified strategies to counter terrorist attacks in European cities. The author argued for comprehensive design solutions that balance accessibility, urban quality, and mitigation measures.

Apart from the physical aspects of cities that influence crime incidence, the literature has linked crimes with urban domains such as population density, political factors, and sociodemographic disorders, such as repression, poverty, injustice, and conflict [13,15,39,61,62]. According to McIlhatton et al. [7], counter-terrorism measures from an urban design perspective have been given limited attention in scholarly works, resulting in "a reduced knowledge base for those tasked with protecting crowded places, including cities from the threat, risk, and harm of terrorism". For example, Zhao and Tang [13] study how city size, density, and sociodemographic inequalities influence crime patterns in urban areas. Frevel [15] linked governance, institutional responsibility, public policies, and individual behaviors to the extent of urban crimes and suggested deradicalization programs, public education, and good governance for improving urban security and safety. Injustice and income inequalities have been associated with the rising incidence of domestic terrorism in Africa [61] and globally [62].

High crime rates in Vancouver's Downtown Eastside have been linked to a range of socioeconomic factors, including unemployment, inadequate housing, substance

use, and the decline of local businesses [63]. Similarly, urban poverty has been identified as a contributing factor to elevated crime rates in other international contexts, such as Indonesia [37] and Bangladesh [39]. Van Melik et al. [64] found that the feeling of fear and safety influenced the design and management of two urban public spaces in Rotterdam, the Netherlands. Krasman and Hentschel [6] explored the role of situational awareness in enhancing urban security governance and suggested that training both the security agencies and the public about preparedness and resilience is crucial to lowering the impact of urban terrorism. These studies underscore the importance of several urban domains that complement the role of design features in the urban planning field in enhancing the safety of public places of worship.

2.1. Conceptual Framework

This study builds on established urban design and planning theories to address the specific challenge of mitigating terrorist risks at public places of worship in Saudi Arabia, extending the application of these frameworks to a religious and culturally sensitive context. Central to our approach is Newman's (1972) Crime Prevention Through Environmental Design (CPTED), which emphasizes designing physical environments to reduce opportunities for crime through strategies such as natural surveillance, access control, territorial reinforcement, and maintenance [23]. CPTED principles, originally developed for general crime prevention, are adapted here to address terrorism, a form of violent crime with distinct spatial and ideological dimensions. For instance, our analysis of mosque layouts focuses on enhancing surveillance through clear sightlines and controlling access by limiting entry points, aligning with CPTED's core tenets. However, we extend CPTED by applying it to the unique spatial characteristics of mosques, which are designed for high accessibility and communal gathering, making them "soft targets" for terrorism. This adaptation considers the cultural imperative of openness in Islamic religious spaces, balancing security with the preservation of publicness and spiritual function.

Additionally, this study draws on the space syntax theory developed by Hillier and Sahbaz [57], which analyzes urban morphology through spatial connectivity and integration to understand how street networks influence human behavior, including criminal activities. Space syntax suggests that highly integrated and permeable street networks, while fostering social interaction, can increase vulnerability to crimes by providing multiple access routes for perpetrators. Our geospatial analysis of the seven terrorist attacks in Saudi Arabia applies space syntax to identify how high street integration around mosques (e.g., at Imam Ali Mosque in Qatif) facilitates undetected approaches by attackers. We extend this theory by focusing on religious sites, where spatial integration is deliberately high to accommodate

worshippers, and propose targeted interventions, such as reducing street permeability near mosques through traffic calming or rerouting, to mitigate terrorism risks without compromising accessibility.

By integrating CPTED and space syntax, this study contributes a novel conceptual framework tailored to terrorism prevention in religious contexts. Unlike prior applications that focus on secular public spaces (e.g., city centers, transport hubs), our framework addresses the socio-cultural and religious significance of mosques, which demands a balance between security, inclusivity, and livability. This framework informs our recommendations by linking theoretical insights to practical urban design strategies, such as buffer zones, restricted access points, and enhanced visibility, specifically designed for the Saudi urban context and aligned with Saudi Vision 2030's emphasis on safe and resilient cities. This contribution fills a gap in the literature, as noted by McIlhatton et al. [7], by providing a planning-focused approach to counter-terrorism in culturally sensitive urban settings.

3. Materials and Methods

3.1. Background to Saudi Arabia

Saudi Arabia, located in the Middle East and covering approximately 2.14 million km², occupies a strategic position between the Arabian Gulf and the Red Sea, acting

as a geographic nexus connecting Europe, Asia, and Africa (Figure 1). Recognized as the birthplace of Islam, it is home to two of the religion's holiest cities, Makkah and Madinah. Administratively, the country is divided into thirteen provinces, with Riyadh serving as the national capital [65]. As of 2022, the country had an estimated population of 34 million, with high urbanization and literacy rates of 85% and 96%, respectively, and an unemployment rate of 9.7% [66]. The present study analyzes the recent wave of terrorist attacks on public places of worship in Saudi Arabia.

Since 2015, fourteen of the country's religious institutions have been attacked by terrorists, according to the Global Terrorism Database (GTD) [67]. Of these terrorism incidents, seven cases are selected and analyzed in the present study because (1) they have the highest casualty figures; (2) they are the most recent; and (3) data is available. The legal definition of terrorism as contained in the country's 'Law of Terrorism Crimes and Financing' (Royal Decree No. M/16, 2013) [28] is: "any criminal act committed, individually or collectively, directly or indirectly, by a perpetrator, intending to disturb public order, destabilize national security or state stability, endanger national unity, suspend the Basic Law of Governance or some of its articles, undermine state reputation or status, cause damage to state facilities or natural resources, attempt to coerce any of its authorities into a particular action or inaction or threaten to carry out acts that would lead to any of the objectives above or instigate such acts" [68].



Figure 1. Location of study sites in Saudi Arabia (source: author)

3.2. Material and Methods

This study is based on a mixed method: desktop research and geospatial analysis of neighborhood maps. First, relevant literature and secondary data were collected using the Google search engine and analyzed. Second, peer-reviewed literature, including journal articles, books, and conference papers relevant to the study objective, was collected and reviewed. The literature review was conducted to establish the research context, define constructs, and set the research focus. Also, the motives for and impacts of terrorist attacks on cities and the role of urban planning in mitigating terrorist attacks and improving urban safety and resilience were investigated. Similarly, gray literature from official media outlets such as *Arab News* and *Saudi Gazette* provided details of the terrorist incidents, including the modus operandi of the perpetrators of the attacks and the physical context in which the incidents took place.

The gathered literature and information were analyzed using thematic content analysis. This method of data analysis involved organizing, analyzing, and synthesizing qualitative data. First, the collected literature and newspaper articles were organized according to the similarity of topics, albeit some documents fit into multiple categories. Next, each article was thoroughly examined, and themes relevant to the research objective were extracted. Finally, the themes were collated, synthesized, and summarized [69]. Second, maps of the seven places of worship where the terrorist attacks happened were prepared based on the satellite imagery obtained from Google Earth and geospatially analyzed using the QGIS software. Geospatial analysis involves mapping the arrangements of roads, buildings, and land use within the vicinity of the places. Finally, the themes from the literature review were harmonized with the results from the geospatial analysis. The overall study findings are presented and discussed in the next section, and after that, some measures to help prevent similar incidents are suggested.

4. Results

Urban structure and landscape are influenced by the need to reduce the impacts and prevalence of crime and violence and to defend people and the natural and built environments. This section presents the findings from the analysis of seven recent terrorist attacks on places of worship in Saudi cities, illustrating how physical features around these sites created opportunities for the attacks and how urban planning can help prevent future incidents.

4.1. Terrorism in Saudi Arabia

According to the GTD, from 1970-2020, there were

582 incidents of terrorist attacks in Saudi Arabia, out of which 492 (84.54%) happened just in five years: 2015-2020 [67]. The trend of terrorism shown in Figure 2 can be associated with key regional and global political developments. Alsubaie [70] linked the upsurge in terrorist incidents in the country to the Iranian Revolution of 1979, the Gulf War of 1990, the 2003 Iraq War, and the emergence of the so-called "Islamic State in Iraq and Syria" (ISIS) in 2013.

The first major terrorism incident in modern Saudi Arabia occurred in the aftermath of the 1979 Iranian Revolution, when a group of terrorists proclaiming the arrival of the Mahdi (redeemer of Islam), staged an armed occupation of the Grand Mosque of Mecca, Islam's holiest site, holding the worshippers as hostages [71]. The holy nature of the site and the perpetrators taking refuge in the labyrinthine chambers of the mosque complicated the counter-offensive strategy of the Saudi security forces. Nevertheless, after two weeks, the siege was over, resulting in the death of 127 security personnel, 117 militants, and several civilians, including pilgrims [71]. Ten years later (10 July 1989), the second major incident occurred at the same site, where two bombs simultaneously went off during the Hajj pilgrimage, killing one pilgrim. Twenty culprits were arrested and brought to justice [70].

The 1990s saw the return of veterans of the Afghan campaigns against the Soviet-appointed regimes. In this second phase of terrorist attacks, a spate of incidents occurred in Riyadh, the country's capital, and in Khobar, a major city in the Eastern Province [72]. The third phase of terrorist incidents coincided with the 9/11 WTC terrorist attack and the invasion of Iraq. Major terrorist attacks in this period included a coordinated triple car bombing of apartment complexes housing Westerners in Riyadh on 12 May 2003 [73]. The fourth upsurge followed the rise of the so-called Islamic State (formerly known as ISIS) in an environment of political anarchy that engulfed neighboring Iraq and Syria. With revenues from occupied oilfields and other sources, this terror outfit has used the internet to lure young people to join their campaign of terror and has financed terrorist attacks in various parts of the globe, including Saudi Arabia.

All four waves of terrorist incidents in the country fall under the third of the four categories of motives for terrorism listed by EUROPO [47], which is religiously inspired. However, there are deeper political motivations behind them. Religion has been used as an instrument in a political campaign, conforming to the definitions of terrorism. The latest spate of violence in the country (2013 to date) displays certain traits that distinguish it from earlier incidents. Foremost among those traits is the target of the attacks, which is public places of worship. Since 1970, there have been 14 attacks on public places of worship in various parts of the country, killing at least 71 people and injuring 223 (Table 1). However, apart from the three sporadic incidents at the Grand Mosque in

Makkah in 1979 and 1989, places of worship have been spared from terrorist attacks before 2015, and targets were mainly confined to symbols of state authority (e.g., security forces, government buildings) and Western expatriates [70].

Western expatriates in Saudi Arabia were targeted in many of the earlier terror attacks, and therefore, measures were taken to fortify the gated communities where they reside. These measures included many of those suggested by Hidek [17], as discussed earlier in the paper. However,

visible signs of efforts to protect mosques from potential terrorist attacks have been relatively limited, likely because, unlike gated communities, the accessibility requirements of mosques do not allow the implementation of the typical physical security measures that restrict access and mobility. Nevertheless, there is a need to ensure the safety and security of worshippers congregating at mosques. Analyzing the modus operandi of these attacks may provide insights and lessons on reducing the risk of such attacks in the future.

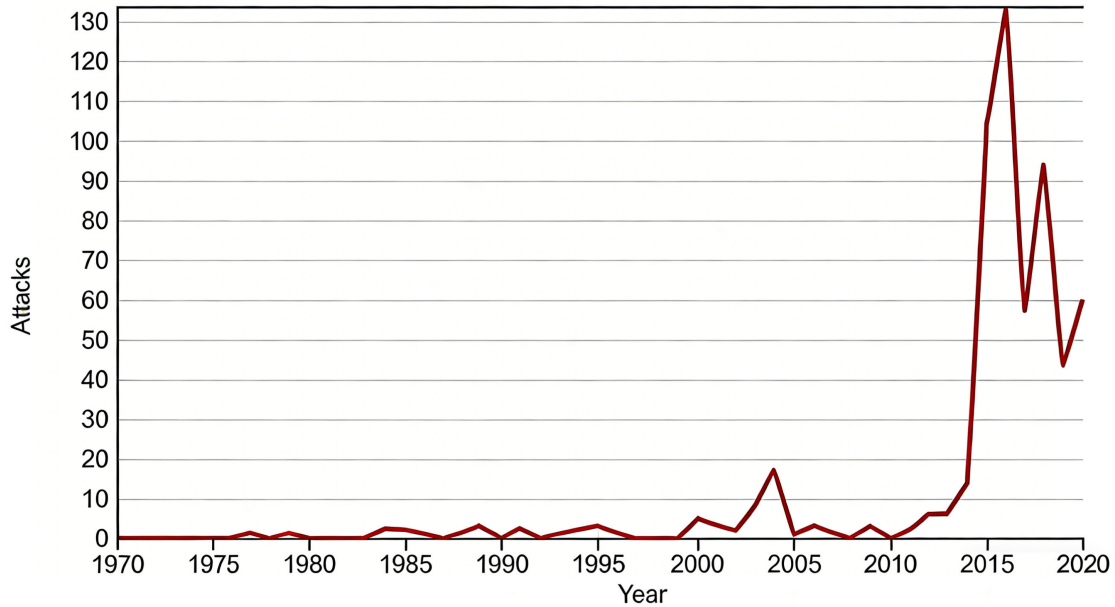


Figure 2. The trend of terrorism incidents in Saudi Arabia, 1970-2020 [67]

Table 1. Terrorist attacks on religious institutions in Saudi Arabia, 1970-2020 [67]

SN	Date	City	Perpetrator Group	Death	Injury
1	2016-08-23	Umm Al-Hamam	Islamic State of Iraq and the Levant (ISIL)	1	0
2	2016-07-04	Qatif	ISIL	1	0
3	2016-07-04	Medina	Hijaz Province of the Islamic State	5	5
4	2016-01-29	Mahasen, Al Ahsa	ISIL	5	34
5	2015-10-26	Najran	Hijaz Province of the Islamic State	2	12
6	2015-10-23	Riyadh	Unknown	0	0
7	2015-10-16	Dammam	Bahrain Province of the Islamic State	6	9
8	2015-08-06	Abha	Hijaz Province of the Islamic State	15	33
9	2015-06-12	Najran	Unknown	2	0
10	2015-05-29	Dammam	Najd Province of the Islamic State	5	4
11	2015-05-22	Qatif	Najd Province of the Islamic State	23	100
12	1989-07-17	Mecca	Unknown	0	0
13	1989-07-10	Mecca	Generation of Arab Fury	1	16
14	1979-11-20	Mecca	Union of the Peoples of the Arabian Peninsula	5	10
TOTAL	71	223			

4.2. Analysis of Recent Terrorist Attacks on Public Places of Worship in Saudi Arabia

This section analyzes the configuration of seven public worship places attacked by terrorists since 2015 through the lens of defensive urban design to explore whether the existing physical features have facilitated the execution of these attacks. This analysis examines the spatial configuration of the mosque's vicinity, focusing on building uses, heights, and the terrorist's path, to identify urban design vulnerabilities that facilitated the attack and inform preventive measures. Four of the study sites are located in the Eastern Province, two in the southern provinces of Asir and Najran, and one in the western province of Medina. Table 2 provides a chronological overview of attacks on public places of worship since 2015.

4.2.1. Imam Ali Mosque, Qatif

The Imam Ali Mosque, located in Al Qudaih, Qatif Governorate, Eastern Province, was the site of a devastating terrorist attack on May 22, 2015. During the first part of Friday prayers, a suicide bomber detonated an explosive device concealed beneath his garments, killing at least 22 worshippers and injuring approximately 100 others [74]. The lone attacker died in the explosion. As the first in a series of attacks on religious sites in Saudi Arabia since 2015, this incident caught both worshippers and security forces off-guard, highlighting vulnerabilities in the mosque's urban design that facilitated the attack.

The mosque is situated on a prominent road near a small roundabout to its north, enhancing its accessibility but also its exposure. Surrounding the mosque are residential and commercial buildings, with a parking lot immediately to its west (Figure 3). The residential buildings, primarily two to four-story structures, consist mostly of small apartment buildings, providing a dense urban fabric with limited open spaces for surveillance. Commercial buildings, also two- to

four-story structures, include small retail shops and offices along the main road, contributing to high pedestrian and vehicular traffic during working hours. The parking lot, directly adjacent to the mosque's western boundary, serves worshippers but lacks a buffer zone, allowing vehicles to approach within meters of the mosque's entrance. No buildings in the vicinity are reported as derelict, indicating active use that may obscure suspicious activities amidst regular urban activity.

Geospatial analysis, supported by Google Earth imagery and QGIS, reveals that the terrorist's path likely began on the public street to the north, a major thoroughfare with high connectivity to the roundabout. From there, the attacker moved south toward the parking lot, which provided immediate access to the mosque's western entrance without significant obstacles. The short distance (approximately 10-15 meters from the parking lot to the entrance) enabled the attacker to enter undetected, as the lack of a buffer zone or physical barriers (e.g., bollards) offered no delay for interception. The multi-story buildings along the street and in the parking lot created partial visual obstructions, with their height casting shadows that potentially concealed the attacker's approach, especially during busy times. The absence of surveillance mechanisms, such as CCTV, and the open layout of the mosque compound, with multiple entry points, further reduced opportunities for security personnel or civilians to spot the attacker's unusual gait or attire, often indicative of concealed explosives.

This configuration—high street integration, proximity to parking, multiple access points, and limited sightlines due to building heights—created an environment where the attacker could blend into the crowd and reach the mosque interior swiftly. The analysis underscores the need for urban design interventions, such as establishing a buffer zone between the parking lot and the mosque, narrowing approach roads, and reducing entry points to enhance surveillance and interception capabilities.

Table 2. Seven major terrorist attacks on public places of worship in Saudi Arabia since 2015




SN	Date	Place of Worship	Type of Attack	Deaths	Injuries
1	22 May 2015	Imam Ali Mosque, Qatif	Suicide bombing	23	100
2	29 May 2015	Al Anoud Mosque, Dammam	Suicide bombing	5	4
3	6 August 2015	Special Forces Mosque, Abha	Suicide bombing	15	33
4	16 October 2015	Al Haidariya Hussainiya, Qatif *	Mass shooting	6	9
5	26 October 2015	Al Mashhad Mosque, Najran	Suicide bombing	2	12
6	29 January 2016	Al Ridha Mosque, Al Ahsa	Suicide bombing	5	34
7	4 July 2016	Prophet's Mosque, Medina	Suicide bombing	5	5
TOTAL				61	197

* Not a mosque per se, but a religious congregation hall

Area surrounding Imam Ali Mosque, Qatif



Legend

-  Residential building
-  Religious building
-  Commercial building

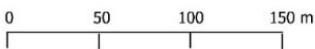


Figure 3. Imam Ali Mosque, Qatif, and its vicinity

4.2.2. Imam Hussain Mosque, Al Anoud District, Dammam

On May 29, 2015, members of the security forces guarding Imam Hussain Mosque in Dammam, the capital of the Eastern Province and one of the largest cities in the country, spotted a suspicious vehicle in the parking lot during Friday prayers. When they approached the car to investigate, an explosion was set off, which killed four people [75]. Official reports indicated that the attacker, disguised as a woman, had attempted to access the mosque's female section earlier. However, upon finding the female section gate closed, he tried to enter the mosque through the male section instead but was intercepted by vigilant civilians and security personnel [76]. This incident highlights how urban design elements, such as the proximity of the parking lot and building configurations, facilitated the attack, while the clear sightlines aided detection. This analysis examines the mosque's spatial context, focusing on building uses, heights, and the terrorist's path to identify vulnerabilities.

The Imam Hussain Mosque is in Al Anoud district, a densely built-up area with a mix of residential and commercial buildings, all ranging from 2 to 3 floors. The mosque is sandwiched between two parking lots and accessible from all directions, which provides vehicular access to its vicinity (Figure 4). The immediate surrounding area comprises predominantly two- to three-story residential buildings, including apartments and houses, which accommodate families and contribute to a moderate level of pedestrian activities (Figure 4). The

parking lot, located immediately adjacent to the mosque's southern boundary, serves worshippers but lacks a buffer zone, allowing vehicles to park within 10-15 meters of the mosque's entrance. No buildings are reported as dilapidated, indicating active use that blends the attacker's movements with regular urban activity. Geospatial analysis, using Google Earth imagery and QGIS, indicates the terrorist's path began on the public street to the south, a high-traffic thoroughfare with direct connectivity to the mosque's vicinity. The attacker likely drove into the parking lot, which provided immediate access to the mosque's southern and western entrances.

4.2.3. Alridha Mosque, Al Ahsa

On January 29, 2016, a suicide bomber blew himself up during Friday prayer near the Al Ridha Mosque (Figure 5) in the Al-Mahasen district in Al Mubarraz city, which is in Al Ahsa area in the Eastern Province of Saudi Arabia and known for its rich history and cultural heritage. During Friday prayers, a suicide bomber detonated an explosive device near the mosque, killing four people and injuring 18 [77]. Security personnel noticed the assailants approaching in a vehicle and intercepted them before they could enter the mosque, limiting the casualties [78]. The explosion occurred outside, as the attacker was prevented from reaching the interior. This analysis examines the mosque's urban context, focusing on building uses, heights, and the terrorist's path, to identify spatial vulnerabilities that facilitated the attack and factors that aided interception.

The Alridha Mosque is situated in a residential

neighborhood, surrounded by two- to three-story residential buildings, primarily single-family homes and small apartment complexes (Figure 5). These buildings, all actively occupied with no reported derelict structures, create a dense urban fabric with moderate pedestrian activity during prayer times. The eastern parking lot, directly adjacent to the mosque's main entrance, allows

vehicles to approach within 10-15 meters, lacking a buffer zone. The southern parking lot, which is slightly farther, also offers proximity. The residential buildings, ranging from two to three floors, partially obstruct sightlines due to their height and close spacing, creating shadows that may conceal suspicious movements, particularly during busy congregational periods.

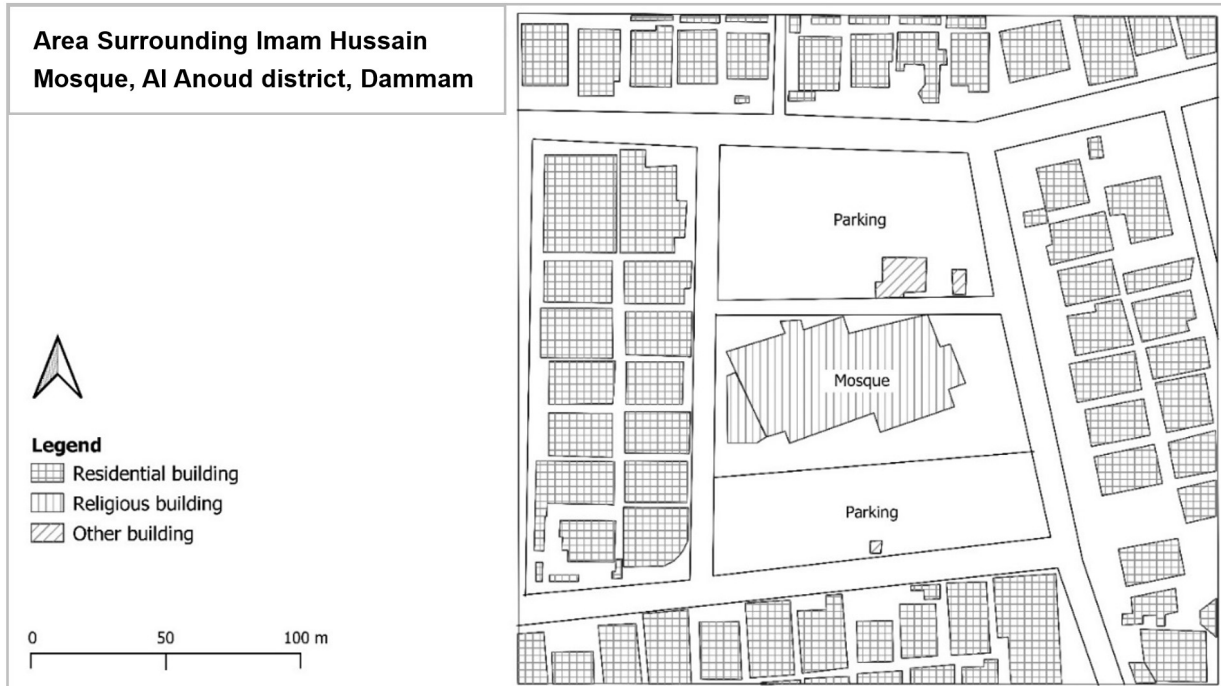


Figure 4. Imam Hussain Mosque, Dammam, and its vicinity

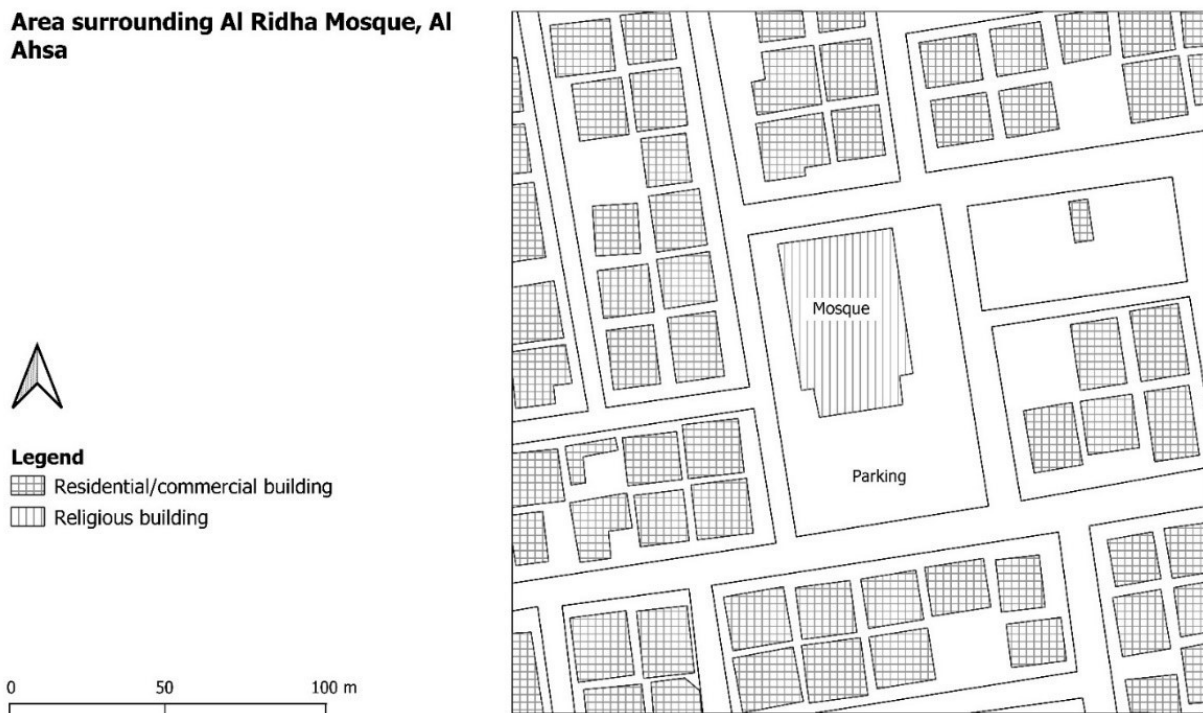


Figure 5. Ridha Mosque, Al Ahsa, and its vicinity

Geospatial analysis, using Google Earth imagery and QGIS, indicates the terrorist's path likely originated from a public street to the north, a major thoroughfare with high connectivity to the mosque's vicinity. The attacker drove into the eastern parking lot, which provided direct access to the mosque's main entrance. The short distance from the parking lot to the entrance, combined with the absence of physical barriers like bollards or a buffer zone, enabled a rapid approach. However, the relatively open layout of the parking lot and limited height of the two- to three-story buildings allowed security personnel to spot the approaching vehicle, facilitating interception. The lack of surveillance systems, such as CCTV, increased vulnerability, though security vigilance mitigated a more severe outcome. The dense residential surroundings likely blended the attacker's vehicle with regular traffic, delaying initial detection.

4.2.4. Special Emergency Forces Centre (SEFC) Mosque, Abha

On August 6, 2015, a lone suicide attacker went to the mosque at the SEFC in Abha in the Asir region, southwest of Saudi Arabia, and exploded a bomb during noon prayers. In this attack, eleven security personnel and four expatriate workers died, while 33 were injured [79]. The attack on this mosque differed from others because access to the compound was restricted. Also, the target was not a public religious building but a mosque inside a facility used only by the security forces. The distinctive characteristics of the attack on the SEFC Mosque suggest a political motive to hit the symbol of the state's authority.

Very few details of this incident have been made public, and no map was released because of the sensitive nature of the mosque's complex.

4.2.5. Al-Mashhad Mosque, Najran City

On October 26, 2015, a lone suicide bomber detonated an explosives-laden belt at Al-Mashhad Mosque in Dahdah neighborhood located in the southeast of Najran city in the Najran province. Two people were killed and 12 people were injured in the attack. Only a single attacker was involved, and he was killed in the explosion. The attack occurred as people were leaving after attending evening prayers. The mosque is surrounded by parking lots from the north, east, and south, which provides vehicular access to its vicinity from 3 sides (Figure 6). To the west, the site is bordered by vacant land and open green spaces, providing accessibility from all directions. The mosque is surrounded by residential buildings and is located approximately a four-minute walk from two public landmarks: the Najran Heritage Village and the Shoaib Dahda Museum. The mosque is situated in the middle of a sparsely developed neighborhood characterized by extensive open spaces and green areas. It is surrounded by one- to two-story residential buildings, primarily single-family homes, and is accessible via more than ten local streets that connect to a major thoroughfare (Figure 6). Geospatial analysis, using Google Earth imagery and QGIS, suggests the terrorist's path likely began on a public street to the north, east, or south, given the high connectivity of these thoroughfares to the mosque's parking lots.

Area surrounding Al Mashhad Mosque, Najran

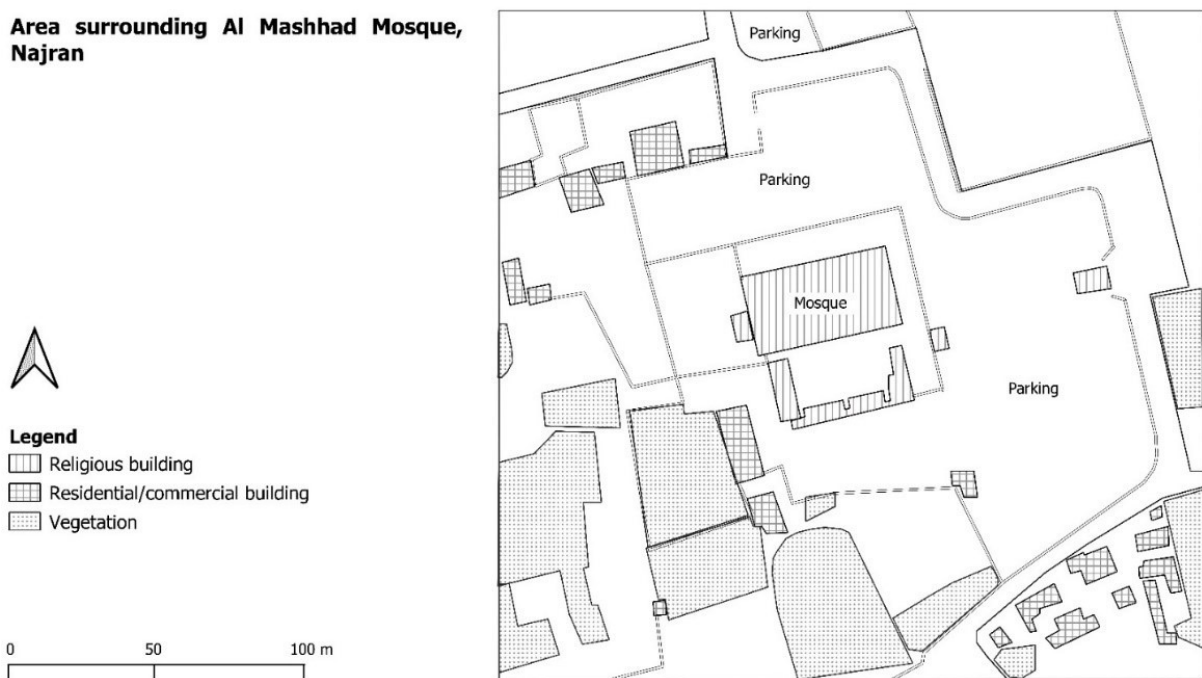


Figure 6. Al-Mashhad Mosque, Najran city, and its vicinity

The attacker likely drove into one of the surrounding parking lots then approached the mosque's respective entrance directly. The short distance from the parking lots to the entrances, combined with the absence of physical barriers (e.g., bollards or buffer zones), enabled rapid access without arousing suspicion. The low height of the single to two-story residential buildings offered clear sightlines, but the sparse population and open green spaces to the west reduced opportunities for natural surveillance by residents or security personnel. The lack of CCTV or other surveillance systems, coupled with multiple entry points, further facilitated the attacker's ability to blend into the post-prayer crowd exiting the mosque.

4.2.6. Alhaidariya Meeting Hall, Saihat

On October 16, 2015, a gunman armed with an automatic weapon opened fire randomly at the Haidariya Hall in the Al Kawthar district of Saihat city, located in the Al-Qatif Governorate of the Eastern Province (Figure 7). The police responded with fire and killed the assailant. Five people died in the attack, and nine were injured [80]. The terrorist and his two accomplices had hijacked a car earlier from an expatriate driver and drove the stolen car to the Hall [81]. In this incident, the attackers did not enter the building but fired from a nearby street. Therefore, it is unclear whether they attempted to gain entry. The vigilance of the security forces prevented a higher number of casualties. The buildings surrounding the Alhaidariya Meeting Hall are exclusively residential, consisting of two to three-story family homes in active use, with no derelict or commercial structures observed. These residential buildings create a dense urban fabric that limits open space but provides a consistent community presence. The height range, approximately 6-12m, partially obstructs sightlines, particularly along the southern and western sides, where buildings create visual barriers. The attacker's path originated from an informal parking lot to the north, where the hijacked vehicle was stationed, and proceeded directly along the public street to the eastern entrance of the hall. The short distance (approximately 20 meters) and lack of physical barriers or surveillance along this path allowed the attacker to approach rapidly without arousing suspicion until the attack commenced.

4.2.7. The Prophet's Mosque, Al-Madinah

On July 4, 2016, a lone suicide bomber detonated an explosives-laden belt at Prophet's Mosque (Masjid An-Nabawi), located in the city of Medina in the Al Madinah Province of Saudi Arabia (Figure 8). The suicide bomber and four security officers were killed and another five were injured in the attack [82]. Security personnel became suspicious of an individual approaching the Prophet's Mosque through a vacant area commonly used as a visitor parking lot [83]. When they attempted to confront him, the individual detonated an explosive belt.

Reports indicate that the explosion occurred at the edge of the vacant land, near a security checkpoint located southeast of the Prophet's Mosque. Fortunately, security officers noticed the suspect and stopped him from reaching his target, the mosque, yet four of them were killed immediately and five others were injured. Their courage and sacrifice effectively thwarted the attack, safeguarding tens of thousands of innocent worshipers from harm [83]. The mosque is situated in a bustling urban area, surrounded predominantly by commercial buildings, including hotels and retail shops, which cater to the high volume of visitors. These structures are mostly concentrated in the north, west, and south of the mosque, with heights of 12 or more floors, forming a dense high-rise commercial skyline. To the east, the site borders a large cemetery, providing an open expanse without built structures. The vicinity includes wide public streets and plazas, with a large vacant area to the southeast used informally as a visitor parking lot, integrated into the surrounding commercial and pilgrimage-oriented urban fabric.

The Prophet's Mosque features multiple grand entrances to accommodate large crowds, with access points from surrounding public streets and plazas, emphasizing openness and accessibility as a religious site. However, security checkpoints are positioned at key approaches, particularly around the southeastern vacant area. The lack of extensive physical barriers around the vast mosque complex allows for high pedestrian flow but increases vulnerability. The eastern cemetery provides a buffer, while the southeastern parking lot serves as an informal buffer and permits direct vehicular and pedestrian access without significant setbacks. The attacker's path originated from a nearby public street, proceeding directly through the southeastern vacant parking area toward the mosque, exploiting the open access and minimal buffers in this direction.

4.3. Summary

What is evident from the analysis of these seven incidents is that terrorists targeted mosques because they are soft targets with weak safety planning measures and design features, as the analysis in Table 3 indicates. Mosques are made accessible by design without the need for bollards or other barriers. They are also open to the public without the constant presence of security personnel. This analysis underscores the vulnerabilities arising from the mosque's high accessibility, minimal buffers in commercial zones, and varying visibility due to high-rise structures, which the attacker exploited via direct street access. The religious site's context highlights the challenge of balancing openness with security, suggesting interventions like enhanced checkpoints and extended buffer zones in parking areas.

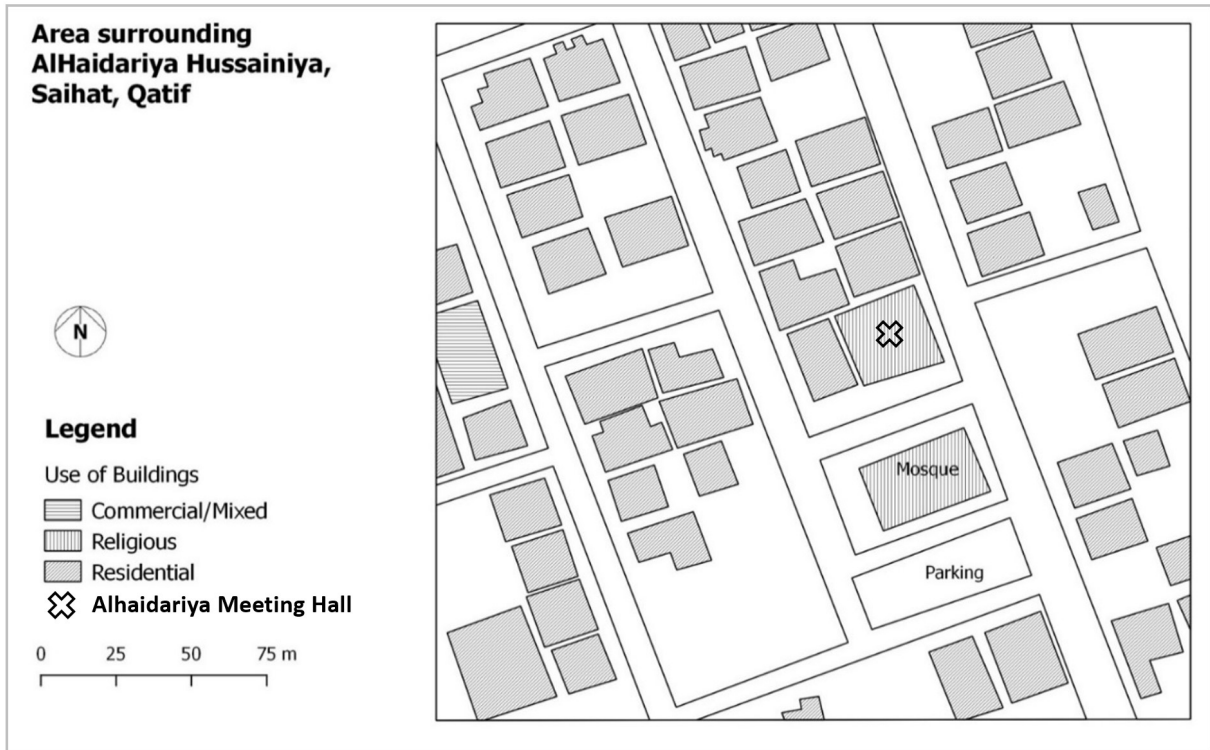


Figure 7. AlHaidariya Hussainiya, Saihat, and its vicinity

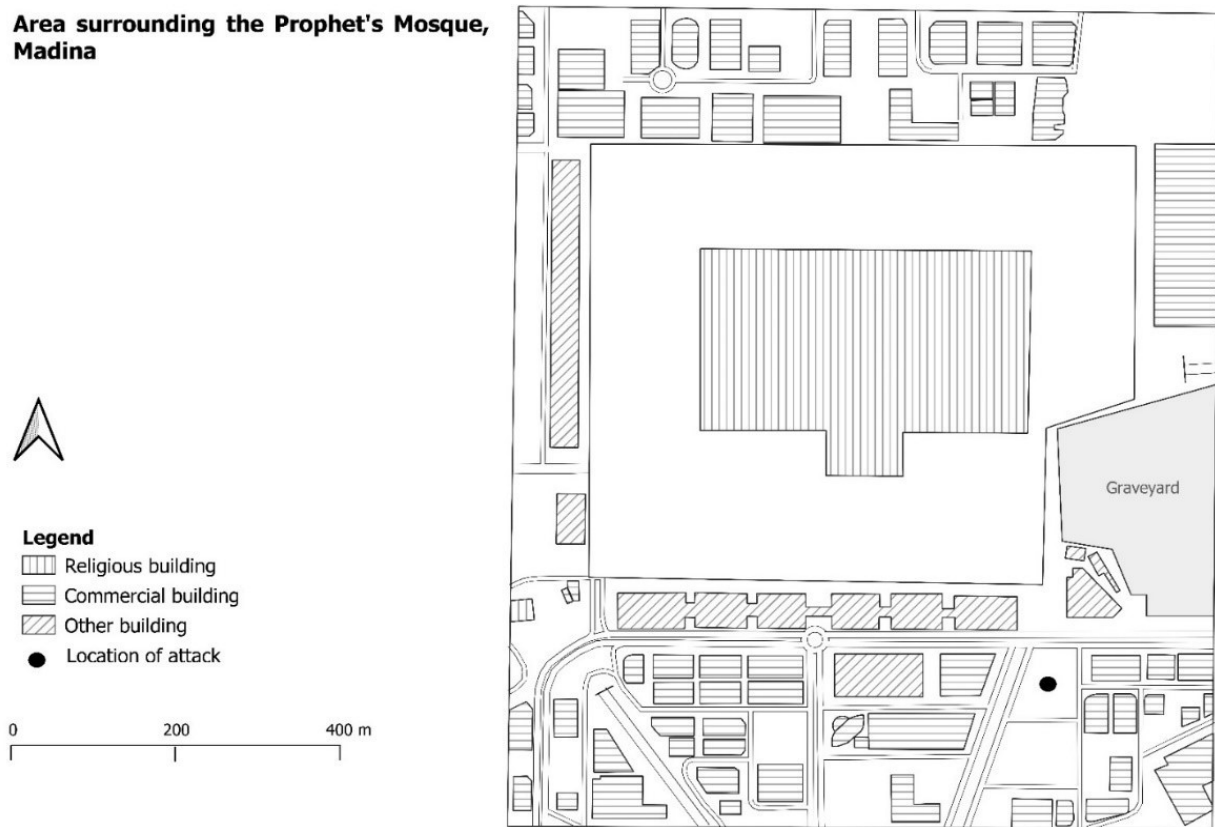


Figure 8. The Prophet's Mosque, Medina, and its vicinity

Table 3. Comparative analysis of safety measures and design features at the seven places studied

Study	Safety measures and design features	Degree of compliance						
		Imam Ali	Al Anoud	Al Ridha	SEFC	Najran	Al Haidariya	Madinah
Cai & Wang [48], Schneider [89], Silva & Li [8], Palace et al. [88].	CCTV monitoring	Yes	Yes	Yes	Yes	Yes	Yes	No
Babalais [60], Piroozfar et al [14].	Adequate lighting	Yes	Yes	Yes	Yes	Yes	Yes	Moderate
Bevilacqua et al. [19], Coaffee [9], Grebowski & Wrobel [59].	Long and straight roads	Moderate	Moderate	Moderate	-	None	Yes	Moderate
Katzman [55], Matijosaitiene & Petriashvili [26], Sinha [87].	Multiple entrances and exits	Yes	Yes	Yes	Yes	Moderate	Yes	Yes
Coaffee et al. [10], Grebowski & Wrobel [59], Matijosaitiene & Petriashvili [26].	Buffers and walls to restrict access to critical areas	Moderate	None	None	-	Moderate	None	None
Katzman [55], Schneider [89], Sinha [87].	Bollards or other physical barriers	None	None	None	-	Moderate	None	Moderate
Coaffee [9], Matijosaitie & Petriashvili [26], Petho-Kiss [58]	Redundant egress paths and open spaces	Moderate	Yes	Yes	-	Yes	Yes	Yes

In the traditional organic Islamic city, the residential quarters are usually located along narrow, tortuous, and dead-end roads away from public spaces [84]. Although this design pattern is made in response to the strict public privacy requirements, it enhances the security of homes.

In contrast, mosques and other religious institutions are made highly visible and easily accessible in the traditional organic Islamic city. These aspects of the mosque are still maintained in 'modern' Islamic cities. Mosques are still located along important streets, sometimes near road junctions. Second, the parking lots are often located next to the mosque, so worshippers can walk only a short distance to reach the mosque's interior.

Moreover, the attacks were carried out mostly during the Friday noon prayer, when the largest number of worshippers congregate at the mosques. Similarly, previous studies reported that crowded places have increasingly become attractive targets for acts of terrorism in the United States, the UK, and Australia [7]. In Wuhan (China), neighborhoods with high permeability (subway station or many intersections), mixed-use land use and old buildings are vulnerable to crimes such as residential burglaries [85].

5. Discussion and Recommendations

Terrorist attacks on public places such as religious institutions increasingly undermine human settlements'

safety, livability, and socioeconomic fabric. According to GTD, from 1970 to 2020, religious institutions worldwide have been attacked at least 5,256 times, equivalent to 2.5% of all terrorist attacks within the same time [67]. Table 4 shows that 27.2% of all terrorist attacks on religious institutions within 50 years happened in the Middle East and North Africa (MENA) regions, followed closely by South and Central Asia (25.6), then Sub-Saharan Africa (14.0%), with Australasia and Oceania the least affected (0.6%). In 2020, there were 104 terrorist attacks on religious institutions worldwide, which only began to rise after September 11 terrorist attack in New York but reached their peak (424) in 2015, after which they plummeted to 190 in 2020. While Southeast and East Asia have seen a notable decline in the number of terrorist attacks on religious institutions from the year 2000 (46.2%) to 2020 (2.1%), Sub-Saharan Africa has recorded a sharp rise within the same period (6.7%-23.7%). Other regions observed a fluctuating trend of such attacks. This trend analysis indicates that terrorist attacks on places of worship in Saudi Arabia are part of the regional and global phenomenon caused by political, religious, and socioeconomic reasons that have been mentioned earlier. Recent studies underscore the evolving nature of terrorist tactics, particularly in far-right extremism [16], and the protracted trajectories of war terminations in Islamist armed conflicts [33], highlighting the imperative for adaptive urban resilience strategies to counter these persistent threats.

Table 4. Worldwide terrorist attacks on religious institutions, 2000-2020 [67]

Region	Frequency and percentage of terrorist attacks					
	1970-2020	2000	2005	2010	2015	2020
Australasia & Oceania	31 (0.6%)	0 (0.0%)	0 (0.0%)	1 (0.8%)	1 (2.6%)	0 (0.0%)
Europe	559 (10.6%)	15 (14.4%)	7 (6.9%)	15 (11.7%)	36 (8.5%)	24 (12.6%)
North America	259 (4.9%)	4 (3.8%)	2 (2.0%)	3 (2.3%)	16 (3.8%)	32 (16.8%)
MENA	1429 (27.2%)	7 (6.7%)	48 (47.1%)	46 (35.9%)	134 (31.6%)	20 (10.5%)
Sub-Saharan Africa	738 (14.0%)	7 (6.7%)	3 (2.9%)	10 (7.8%)	70 (16.5%)	45 (23.7%)
South & Central America	468 (8.9%)	6 (5.8%)	3 (2.9%)	4 (3.1%)	0 (0.0%)	8 (4.2%)
South & Central Asia	1347 (25.6%)	17 (16.3%)	30 (29.4%)	38 (29.7%)	136 (32.1%)	57 (30.0%)
Southeast & East Asia	425 (8.1%)	48 (46.2%)	9 (8.8%)	11 (8.6%)	21 (5.0%)	4 (2.1%)
World Total	5256	104	102	128	424	190

Since terrorist attacks on public places of worship have a spatial dimension, urban planning can contribute to reducing their prevalence and impacts on people and assets, thereby increasing urban resilience and livability. The present study analyzed seven cases to indicate that physical planning features around public places of worship can facilitate or impede terrorist attacks. The literature revealed that most geospatial anti-terrorist measures are implemented at the building level but not at the urban planning level. Even at the planning level, such measures predominantly focus on large areas such as the city center that house public arenas and commercial districts, and are not specific to the context of residential neighborhoods as has been achieved in the present study. Because human activities and the physical aspects of cities are the key dimensions of urban safety, urban planning can provide an opportunity for or deter crimes by influencing the movement of perpetrators and victims [86,87].

This study investigated the role of neighborhood street configuration in facilitating or abating crimes using cases of terrorist attacks on places of worship in Saudi Arabia. The perpetrators of the attacks had taken advantage of the easy access to mosques and attempted to get inside, where an attack would have the maximum impact. Public places of worship, such as mosques, are considered soft targets of terrorist attacks because they have open surrounding spaces, high accessibility and street integration, the concentration of functions in one building, and the presence of multiple access points [26,30]. Therefore, minimizing terrorist attacks on places of worship requires actions and policies to minimize those risks.

Vigilance by state security forces and civilian volunteers can help reduce the occurrence and severity of such attacks, as exemplified in some of the terrorist incidents analyzed in the present study. Vigilance involves keeping an eye on people approaching religious places. This measure can be taken with positioning personnel on the ground and remotely using CCTV

monitoring [88]. Although most mosque visitors wear traditional loose clothing, hiding suicide belts or other weapons often produces visible signs such as an unusual gait or irregular body outline, which can be detected by the trained, alert eyes of security personnel. Consequently, the greater the distance one must walk to the mosque, the greater the chance that a potential terrorist attack would be detected and intercepted.

Many mosque compounds have multiple and even open entrances for people who congregate for Friday noon prayers. Therefore, surveillance can be made easier if the number of entry points is kept to a minimum, which should be fine if the restriction is withdrawn for people departing after prayer. This strategy is feasible because people arrive at the mosque gradually over a long period but leave almost simultaneously at the end of congregational prayers.

Parking lots are another source of risk if they are located next to the mosque. For example, in the Al-Anoud Mosque attack, a bomb exploded in the parking lot. So, there is a need for a safe buffer zone between the mosque building and the parking lot. This measure would also ensure a longer walking distance to the mosque, which increases the possibility of interception. Furthermore, to facilitate visual surveillance, the approach to the mosque should be free from visual obstructions such as large street furniture and big trees [52]. Also, there is a need to implement suggestions by Hidek [17], such as narrowing the approach roads and redesigning roads to force traffic deceleration near mosques. These recommendations are in line with the concept of defensible space, which advocates "designing out crime" by adding or removing certain physical characteristics that can regulate entry, enhance surveillance capabilities, and consequently reduce the likelihood of criminal incidents [18,54].

Enhancing urban safety through crime prevention is valuable because fear of violence reduces people's willingness to live, work, or travel in certain parts of a city, especially at night, in the evenings, or during certain

seasons—leading to social and economic costs [38]. Terrorism and other crimes also exacerbate social inequalities when children or women fear accessing public spaces such as mosques. Thus, crimes and disaster risk reduction and preparedness are also needed to improve the capacity of urban areas to decrease the risks of terrorist attacks and improve the local economy [26,89]. For example, violent crimes have contributed to reduced tourism and foreign exchange earnings in Kenya, Jamaica, Papua New Guinea, Guatemala, El Salvador, and Guyana [1]. In addition, urban design interventions have been reported to effectively enhance the safety of public spaces [76,90]. In Saudi Arabia, the Saudi Vision 2020 aims to promote tourism, which can only be achieved through safe public spaces. Moreover, building urban resilience against terrorism requires integrating socioeconomic factors, such as addressing income inequality and unemployment, which can fuel radicalization and violence [61,62].

Several urban design features play crucial roles in enhancing the safety of public places of worship. For example, CCTV cameras serve as crime deterrents by recording and monitoring people's actions and mobility, discouraging criminal activities due to the perceived risk of being caught [88]. Security personnel and law enforcement agencies can promptly detect and respond to security incidents through real-time surveillance and monitoring. Recorded camera feeds can be used for crime analysis, helping law enforcement agencies identify patterns, hotspots, and trends. This information guides preventive measures such as targeted patrols, enhanced lighting, or changes in urban design to address security vulnerabilities and deter criminal activities. Effective surveillance allows for the early identification of potential terrorist threats, enabling timely intervention and prevention.

Similarly, sufficient lighting aids in surveilling and monitoring people, activities, and the environment, whether by security personnel, law enforcement, or even community members [60]. It creates an increased perception of safety among public space users and enables effective responses to security incidents. When individuals perceive a sense of security, they are more inclined to utilize public places of worship and participate in community activities. This increased presence fosters a sense of collective ownership and vigilance, further discouraging criminal behaviors.

Strategically and well-designed open spaces around religious places can contribute to crime prevention by providing clear sightlines, facilitating people's observation of their surroundings, and detecting potential criminal activities [90,91]. High visibility discourages criminals from targeting public places, because there is an increased probability of individuals being observed and recognized through natural surveillance by the community, which acts as a powerful deterrent. Therefore, public open spaces should be designed to maximize visibility,

minimize hiding spots, and create a sense of space that contributes to crime prevention. Similarly, multiple entrances and exits make it more challenging for criminals to predict or control access and escape routes, increasing the chances of their detection and apprehension. They also provide security personnel and the public with opportunities for surveillance to detect suspicious activities or individuals, reduce blind spots, and increase the perceived risk for terrorists, thereby contributing to a safe environment [92].

Buffers and walls can serve as perimeter protection measures, defining the boundaries of a space and controlling access points. They deter unauthorized entry and restrict potential criminals from easily accessing religious places. In Lahore (Pakistan), gated communities with controlled access points, such as gates or checkpoints, reported crimes 25 times less than non-gated communities due to better monitoring and control of entry and exit [91]. Buffers and walls enhance security by preventing unauthorized individuals from freely entering restricted spaces, consequently, reducing the risk of crimes such as terrorism, robbery, and vandalism [11].

However, it is essential to strike a balance between implementing counter-terrorism design measures and fostering livability in urban decision-making [60,86]. Collaborative approaches involving urban planners, architects, law enforcement agencies, and community stakeholders are needed to integrate security and livability considerations [2]. Design guidelines can be modified to incorporate walkability, green infrastructure, and green spaces that promote social interaction and environmental benefits. These design strategies can also serve as physical barriers against potential terrorist threats, enhancing safety without compromising livability.

Understanding the local context and unique characteristics of urban areas is crucial for enhancing urban safety, resilience, and overall livability. Implementing collaborative, flexible, and adaptable measures can effectively address evolving security needs while incorporating cultural values and norms into urban design without compromising long-term livability [93]. By actively involving the local community in urban space planning and decision-making processes, their inputs and concerns can be sought, incorporated, and addressed [65]. This inclusive approach ensures the creation of safer spaces that align with the community's needs, garner support and ownership, and develop solutions that strike a balance between safety and livability. It is imperative to integrate multiple objectives into design solutions, fostering synergy between livability and security goals to achieve a harmonious balance.

5.1. Balancing Security with Inclusivity and Livability

While the proposed urban design measures—such as restricted access points, buffer zones, and enhanced surveillance—aim to reduce the risk of terrorist attacks on

public places of worship, they must be carefully implemented to avoid undermining the inclusivity and livability of these spaces. Mosques in Saudi Arabia, such as the Prophet's Mosque in Medina, are not only religious sites but also vibrant community hubs where diverse groups, including men, women, children, and the elderly, gather for worship, social interaction, and cultural activities. Overly stringent security measures can inadvertently create barriers to access, particularly for marginalized groups, and alter the spiritual and communal experience of these spaces. For instance, limiting entry points, as recommended for the Alhaidariya Meeting Hall, may disproportionately affect women who rely on gender-segregated entrances, potentially delaying or restricting their access during peak prayer times, as highlighted by Meth [32] in the context of gendered spatial access in urban South Africa. Similarly, extensive surveillance through CCTV and security personnel, while effective for threat detection, may create a sense of intrusion or discomfort, diminishing the spiritual ambiance valued by worshippers, as noted by Van Melik et al. [64] in their study of public space perceptions in Rotterdam.

To balance security with inclusiveness, urban planners should adopt flexible design strategies that accommodate diverse user needs. For example, temporary access controls, such as retractable bollards or staffed checkpoints, can be deployed during high-risk periods (e.g., Friday noon prayers) while allowing unrestricted access at other times to maintain inclusiveness. This approach aligns with Coaffee et al.'s [54] concept of adaptive security measures for large-scale public venues, ensuring safety without permanent barriers. Additionally, incorporating green infrastructure, such as landscaped buffers with low-lying vegetation instead of high walls, can enhance visibility for security purposes while preserving aesthetic and environmental benefits that contribute to livability, as suggested by Aina et al. [24] in their study of urban resilience in Makkah. Community engagement is critical to ensuring these measures reflect local needs. For instance, involving mosque committees and women's groups in planning decisions can address concerns about gendered access, ensuring that security enhancements do not exclude vulnerable groups. This participatory approach, advocated by Abubakar et al. [65], fosters a sense of ownership and aligns designs with cultural and religious values.

Moreover, the lived religious experience must be preserved to maintain the publicness of mosques as communal spaces. Over-securitization, such as excessive surveillance or fortress-like designs, risks transforming sacred spaces into alienating environments, as Marcuse [49] warns in the context of post-9/11 urban securitization. To mitigate this, urban design should integrate elements that enhance the spiritual and social functions of mosques, such as open courtyards or shaded seating areas that encourage communal gatherings while maintaining clear

sightlines for surveillance. For example, redesigning the parking setbacks around Al-Anoud Mosque in Dammam with landscaped pedestrian pathways can serve dual purposes: increasing the walking distance for potential attackers (enhancing security) and creating inviting spaces for worshippers (enhancing livability). By embedding these considerations into urban planning, as supported by Babalis [60], cities can create safe, inclusive, and vibrant places of worship that uphold their role as community anchors while mitigating terrorist risks.

6. Conclusions

Saudi Arabia has witnessed eleven sporadic terrorist attacks targeting public gathering spaces and individuals in the last decade. This article attempted to analyze seven terrorist attacks on religious places that occurred within this period to find out how urban planning and urban design can contribute to curbing future attacks and enhancing urban safety. The analyzed cases are not only half of all terrorist attacks on religious places in Saudi Arabia, but they also resulted in 61 out of the total 71 deaths (86%), and 197 of the total 223 injuries (88%). The study highlights that terrorism and other disaster risks also exacerbate social inequalities when children or women are unable or afraid to access public spaces such as mosques.

The present study analyzed how the attacks happened and conducted a geospatial analysis of the arrangements of roads, buildings, and land use within the vicinity of the places. The study concludes that some components of the urban context, especially the configuration of streets, buildings, and open spaces, are significant in impeding attacks and enhancing urban safety. Therefore, the study recommends measures to deter future terrorist attacks on places of worship in the country. These measures include limiting the entrances and approaches to religious establishments, setting up a buffer zone between them and parking lots, and removing visual obstructions from approach paths.

The country has adopted a multi-pronged approach to minimize the risks of further attacks. The Saudi Ministry of Municipal and Rural Affairs (MOMRA) has a set of standards and design guidelines for different categories of mosques. These guidelines include, among other things, providing open spaces around the mosque and locating parking areas away from the mosque entrance. These instructions are consistent with some of the recommendations made in this study. Other recommendations may also be considered and adherence to the guidelines should be monitored to eliminate the risk of terrorist attacks.

It is expected that urban planning guidelines such as those proposed above, coupled with other security measures, can reduce the risk significantly. Sustainable urban development is impossible without the safety and security of lives, assets, and the environment. However, it

is imperative to achieve a balance between enhancing security and urban livability through integrated planning, flexibility, and a nuanced understanding of the specific context. By considering the needs and aspirations of the community while addressing security concerns, it is possible to create vibrant, safe, and livable urban environments. Future research is needed to explore the role of urban planning in promoting urban safety from the perspectives of urban planners and decision-makers, as enhancing urban safety is key to developing livable communities.

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