

Entry

Defensible Spaces

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Definition: Defensible space is the concept of creating spaces that include a series of architectural guidelines that are used when designing a new urban residential area to promote both the territorial claim of the residential groups to their surroundings and their ability to conduct natural surveillance of their spaces. Constructing safe environments with safe vocabularies for enhancing well-being is crucial for achieving quality of life in both peace and wartime. Warzone countries that suffer from many changes due to the effect of war (or fourth-generation wars) should be prepared to face those changes with safe spaces as well.

Keywords: defensible buildings; disordered human behavior; resilient environment; total destruction; warzone areas



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1. Introduction

Recently, the idea of weapon-based ordinary wars has been demolished and another age of psychologically based wars has started. Understanding the new psychologically based wars concept is the only way to recover from its effects and consequences. Mass psychologically destructive weapons were used lately on several levels (economic, education, lifestyle, safety, etc.), as they were meant to be weapons to mentally distract citizens and country regimes from all directions [1].

Previous methods of dealing with those destructive acts were poor, ineffectual actions such as building a fence or blocking boundaries around important buildings or assets that should be protected. This points to the need for new design solutions that are supported by the structural and management risk assessment research specifically to help the warzone and threatened areas to protect themselves.

Accordingly, this entry paper is a humble attempt to tackle the problem of the effect of war's destructive images and its effect on inhabitants' psychological perceptions about safety and well-being. This will be achieved through discussing the problem from both construction and architecture views to introduce a diversity of proposed solutions for decreasing the emotional and psychological effects of total destruction of buildings in the warzone and threatened areas.

2. Defensible Buildings for Warzones Recovery

By the end of the Cold War, peace did not occur around the world as everybody thought. On the contrary, the Cold War period generated various new reasons for wars such as civic, ethnic, electronic, psychological, and religious conflicts. These wars are physically destructive, like World War One and World War Two; furthermore, they affect the social, behavioral, and economic situation of many cities targeted and directed in conflicts [2].

As these are new types of wars based on social, economic, and identity conflicts, a particular defined agenda is needed to serve the affected countries after war recovery. A

call for destruction prevention methods could help decrease the destruction of the built environment subjected to war [3].

The authors adopt the point of view that building construction can play a helpful role in creating not only defensible buildings but also defensible spaces and can participate in delivering a more peaceful world [4]. Therefore, this research proposes a thoughtful idea of constructing a defensible building that can maintain its case to avoid complete destruction [5], which could help in enhancing the inhabitants’ perception of safety as well as their confidence and well-being. In order to lay out this proposal, the paper will be defining and discussing the main concepts in the following sections.

2.1. Defensible Environment

As a word, defensible means “capable of being defended”; in other words, the environment can use its features to protect itself from any coming threat that targets the inhabitants’ perception of safety on both scales, the surrounding environment and the building layout [6]. Accordingly, when following guidelines to form a defensible building, this would help to secure a smaller defensible unit followed by a defensible urban settlement resulting in a defensible environment that promotes both safety perception as well as conducting natural surveillance (see Figure 1).

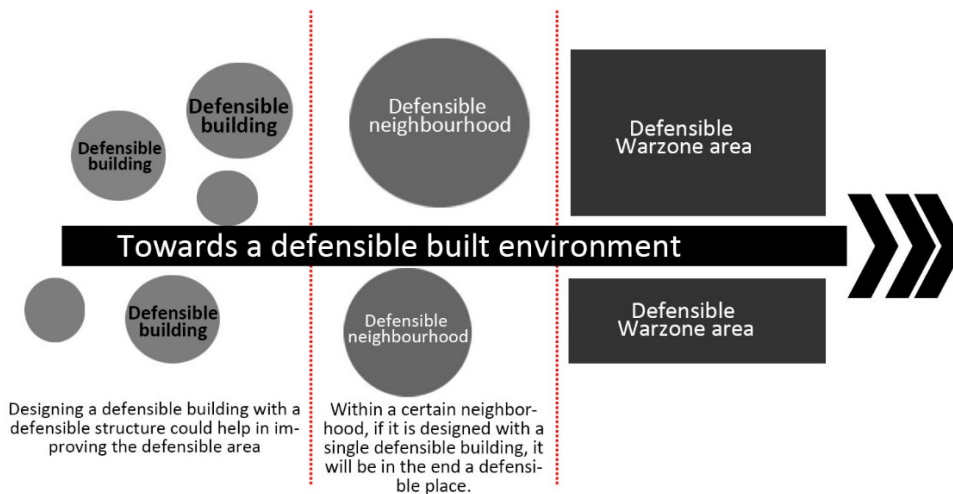


Figure 1. Diagram illustrating the idea of achieving a defensible environment by designing and repeating defensible guidelines on buildings as a smaller scale unit. Source: (Y.M.).

Many buildings today are designed applying the same traditional concepts that ignore the need to be defensible against disasters [7]. However, there is an urgent need to apply changes to the planning and designing process in order to respect the presence of natural and manmade disasters (see Table 1). These changes should be applied starting from the early planning process along with the following phases of the construction system, building materials, building orientation, access control, and visibility, which will help in creating defensible environments.

Table 1. Different natural and manmade disasters that can affect buildings. Adapted from [8].

Natural and Manmade Disasters Classifications	
Natural	Manmade
Natural disasters are caused by natural forces and humans have no hand in stopping them.	Manmade disasters are mainly caused by the activities of humans that are driven by their behavior, mistakes, and needs.
Tsunamis-floods-landslides-hurricanes-wildfires-droughts-volcanoes-earthquakes-storms.	Chemical spills-biological attacks-fires-groundwater contamination-transportation accidents-structure failures-mining accidents-explosions-acts of terrorism.
Some actions can be taken by residents to minimize the effect of those disasters but they cannot prevent them from happening.	Can be avoided with careful planning and prevention techniques.

2.2. Warzone Areas

The dictionary definition of the term warzone is “a complex environment that witnesses weapon or non-weapon-based combat in which the rights of neutrals are suspended with matters varying from conflict stabilization to physical reconstruction” [9]. Warzone areas have two related words that better illustrate their characteristics, which are insecurity and hazard [10].

Cities being subjected to continuous damage causes suffering, massive dislocation of inhabitants, and enormous construction charges as shown in Figure 2. Part of the challenge that faces the built environment while confronting urban warfare is to protect itself and maintain the perception of safety at the highest possible level. In order to increase the ability to defend against and overcome these attacks, one must design a risk management plan depending mainly on the building itself. Accordingly, the surrounding environment will be defensible and minimize the destruction image’s mental and emotional impact on the inhabitants’ perception [11].



Figure 2. Photos showing the post-war destruction images. (a) Nazi plans for the total destruction of Warsaw. Source: [12]. (b) Destroyed street in Warsaw after Nazi air raids. Source: [13].

2.3. The Psychological Effect of Total Destruction Image

In the early days of war, warriors met at the battle away from the city and the citizens so as not to destroy or demolish the city itself. Through time, the shape of war changed, leading to what the world now calls the Cold War and later on the fourth-generation war, which excludes weapon-based battles between soldiers and involves the inhabitants and civilians [14].

That type of war is considered to be a psychological war that destroys the will of defense among civilians so that they become weak, vulnerable, and susceptible to psychological hazards. According to Brian Jenkins, “*Terrorists want a lot of people watching, not a lot of people dead.*” [15]. This destruction has the capacity to create what is known as “dissonant/difficult” sites, places that recall the politics of the past in the present and reveal dark or painful events and then become reminders of pain, loss, and destruction [16,17].

One example of recent destruction that had a psychological effect is the Beirut harbor explosion in Lebanon. The first investigation mentioned that the explosion was due to the presence of old accumulated flammable materials stored in the harbor containers. However, the reason for the explosion itself does not matter. Nevertheless, the final image and the vast destruction had mental consequences (see Figure 3); as the governor of Beirut said, “*This scene reminds us of what happened in Hiroshima and Nagasaki.*” [18].

In addition, the site inhabitants’ comments show how the massive destruction scenes affected their psychological state.

“I haven’t seen massive destruction in my life on this scale. This is a disaster, catastrophe, nothing but a national catastrophe.” [18]

“We don’t know how we are going to deal with this situation at a time when we can’t even walk outside our homes.” [18]

The image of destruction reminds people of the big crises, so the image's impact is doubled. Therefore, if the building could defend itself and the image of destruction could be prevented or even decreased after disasters, those disasters' mental and psychological consequences will be minimized.

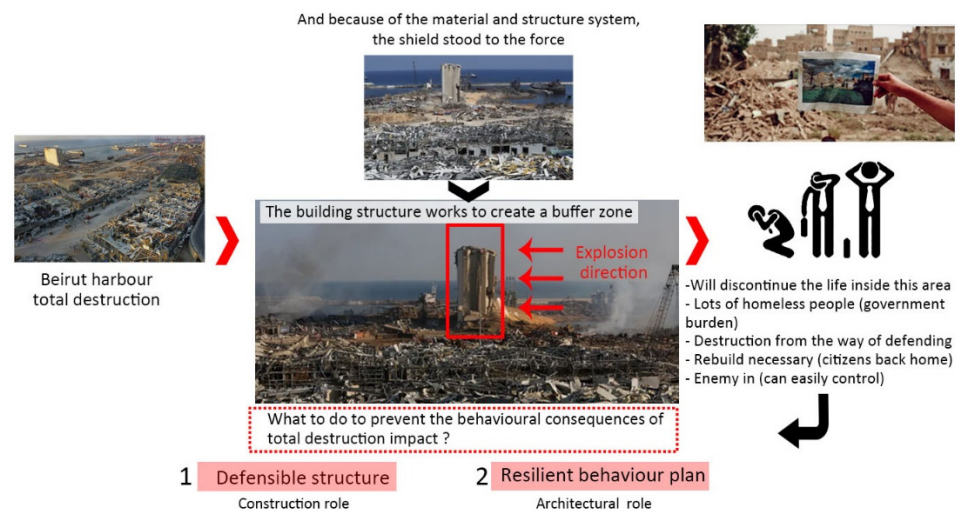


Figure 3. Diagram showing the possible psychological effect of the images of the Beirut harbor explosion. Source: (Y.M.).

This vision supports this research idea of how warzone areas should be defensible and protected as much as possible as part of their building design criteria, which could be applied through enhanced construction systems that improve buildings' structural state when facing disasters.

2.4. Safety and Security during or after Total Destruction Hazards

The most significant and costly effect of the destruction image is the mental and psychological consequence. Despite these consequences on the community and the built environment, few talk about maintaining the case of the building so that it stands up and functions, thus minimizing the negative influence of destruction on the inhabitants' perception [19].

In threat areas, residents' safety perception should influence the decision makers about how the building will be constructed and the materials used to help the structure survive and maintain its case in disasters and war conditions.

Accordingly, the research proposes a risk-related construction system to increase the building's defensibility against hazards. This research agrees with the defensible structure definition as "a building that will stand still under forcible demands to decrease the effect of the destruction image feedback on humans leading to loss of life or homelessness" [20].

2.5. Effect of Blasts on the Building Construction

Decision makers should think more inclusively and consider the building's components, such as materials, roofing, window dimensions, walls, and the building's openings orientation, in order to achieve a building that could defend itself against any attack or disaster. The defensible building will then work effectively with the help of the defensible surrounding environment [21].

Identifying the expected threat type will guide the decision makers in choosing the right type of materials, construction system, and other details concerning the building that could collapse and cause death or homelessness in traditional designing methods.

The choice of linking construction methods with the structural system to form the defensible building should be declared from the beginning. These construction systems are responsible for how materials are combined and joined together to construct the building.

Therefore, they can be determined according to the use and function of the buildings and classified as:

- Heavyweight construction: generally uses reinforced concrete, concrete masonry, or bricks.
- Lightweight construction: mainly uses timber, steel framing, space units as a structural support system.

The idea of protecting the core from explosion comes from the number of explosives and the resultant blast, especially those that target main buildings from outside. Therefore, the possibilities of evaluating the blast effect will help dictate the protection required to prevent a building from collapsing and decreasing the numbers of injuries and deaths of users. Table 2 shows how the United States Department of Defense correlates the type of blast effect and the predicted building damages and injury to be avoided through design [22].

Table 2. The levels of protection of buildings' different components from blast damages. Source: [22].

Level of Protection	Potential Structure Damage	Potential Door and Glazing Hazards	Potential Injury
Below standards	Severely damaged—frame collapse/massive destruction. Little left standing.	Doors and windows fail and result in lethal hazards.	The majority of personnel suffer fatalities.
Very low	Heavily damaged—onset of structural collapse. Major deformation of primary and secondary structural members, but progressive collapse is unlikely. Collapse of non-structural elements.	Glazing will break and is likely to be propelled into the building, resulting in serious glazing fragment injuries. Doors may be propelled into rooms, presenting serious hazards.	The majority of personnel suffer serious injuries.
Low	Damaged—unrepeatable. Major deformation of non-structural elements and secondary structural members and minor deformation of primary structural members, but no likely progressive collapse.	Glazing will break but will fall within 1 m of the wall with no significant fragment hazards. Doors may rebound out of their frames with minimal hazards.	The majority of personnel suffer significant injuries and few fatalities.
Medium	Damaged—repairable. Minor deformation of non-structural elements and secondary structural members and no permanent deformation in primary structure members.	Glazing will break but will remain in the window frame, doors will stay in frames.	Some minor injuries but fatalities are unlikely.
High	Superficially damaged. No permanent deformation of primary and secondary structural members or non-structural members.	Glazing will not break, doors will be reusable.	Only superficial injuries are likely.

As a manmade disaster, explosions cause a pressure wave on buildings' surfaces, harming its envelope from inside out (see Figure 4). However, if the buildings' construction system could equivalently distribute these pressure loads, this will help buildings withstand this catastrophe.

Accordingly, the structural members that equivalently distribute the bombing pressure loads should be relocated from the buildings' outside envelope; also, the buildings' core should be well-isolated against the bombing pressure effect, which helps maintain and protect the building.

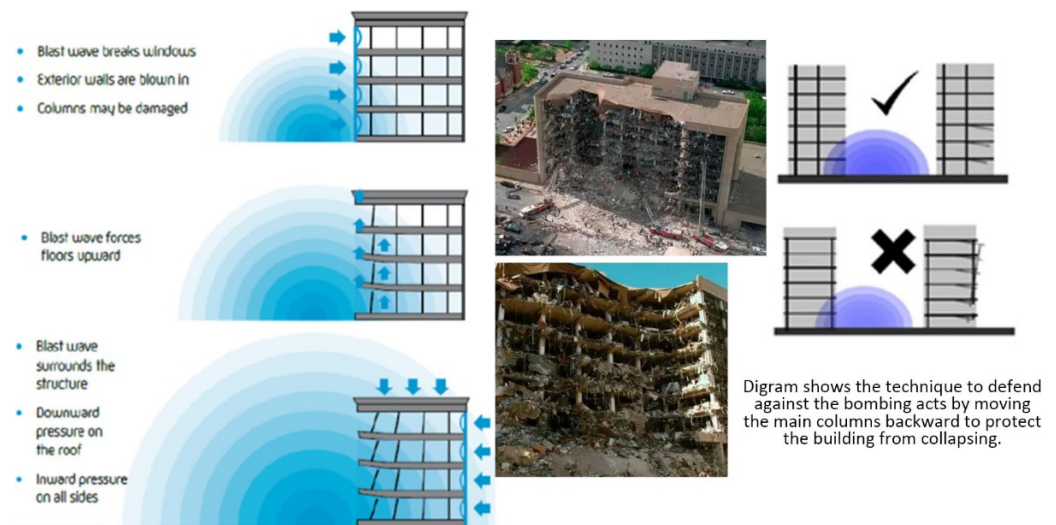


Figure 4. Diagram showing the expected different effects of a bomb blast on the building envelope such as the blast wave forces affecting the elevations and downward pressure affecting the roofs, causing the building's destruction. Source: (Y.M.).

2.6. Proposed Construction System as a Solution for Recovery

The past events prove that even the good and well-designed buildings according to the building codes and regulations are not unavoidably able to resist extreme loads like bombing and blast load.

This study adopts the structural core system with some additions that could solve load distribution and avoid loads produced by the pressure of bombing or blasts. Architecturally, a core is known as vertical space for circulation and services like staircases, elevators, electrical cables, water pipes, and risers. As the core allows people to move between floors safely and distributes the services equally, it is considered the most vital activity for the building's security [23].

From the perspective of the system efficiency, it economically provides adequate stiffness to resist wind and most of the lateral loads affecting the building up to 20 stories [24]. Applying this system to low-rise buildings will make them more resistant to lateral loads and may resist the pressure produced from a blast or bombing.

A building structure that can resist and defend itself from significant explosions can protect inhabitants, equipment, and its skeleton.

Proposing to experiment and analyze the idea of using the core system could highly secure the building's internal vertical circulation while any effect from blasts or dangerous acts stays outside the building. Furthermore, constructing a core with an independent shear wall can leave a space for the slabs to be cantilevered separately away from each other and only connected to the core, moving the loaded columns from outside the envelope to inside, which is safer for the building.

In addition, designing a three-supported layer core with sensitive sensors for heat and pressure could help in minimizing the damages caused by the blast or explosion in a way that helps the main skeleton to stand and leaves the main functional core still intact.

Accordingly, when applying the core system separately in tall buildings the effect of lateral loads from outside will appear, which may cause the failure of the core itself and leave the buildings to hazards (Figure 5a), while connecting the cores in high-rise buildings will act in a defensible manner towards the lateral loads. Figure 5b shows the proposed usage of the connected core in low-rise buildings in defending against the lateral forces from the outside due to the pressure of loads [24,25].

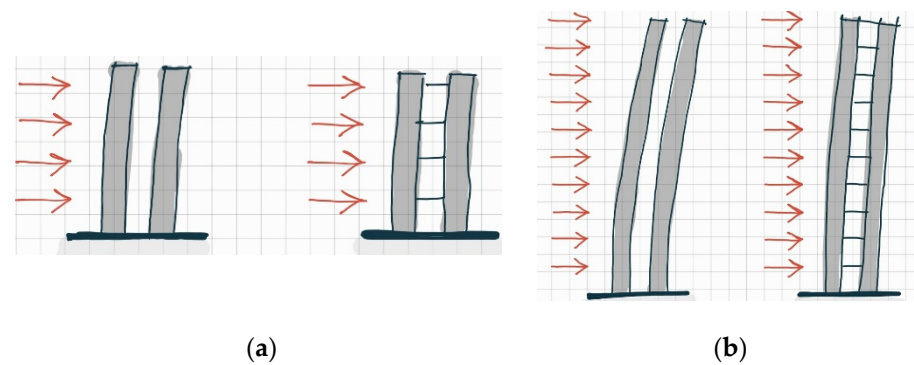


Figure 5. Diagram showing the effect of load pressure on buildings with a case of connected and separated cores to defend against the lateral forces coming from outside. (a) Low-rise building, (b) high-rise building. Adapted from [24].

Furthermore, few openings should take place in the elevation of any building; no columns that really transfer any load should be placed near to the elevations, as shown in Figure 6.

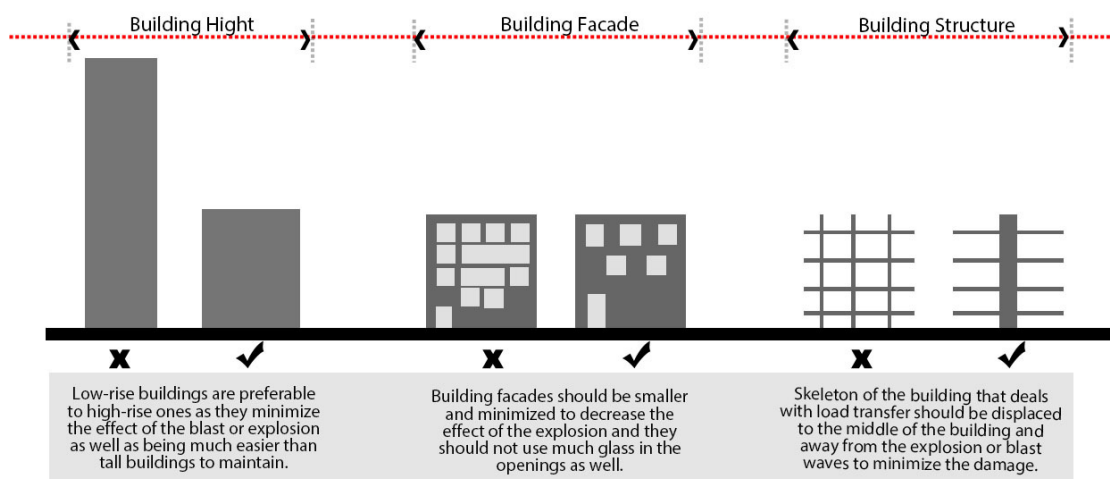


Figure 6. Diagram showing the proposed guidelines for designing buildings within warzone areas, such as; increasing the use of low-rise buildings instead of high-rise buildings, decreasing the number of facade openings for minimizing and resisting the possible destruction effects. Source: (Y.M.).

The three-layered proposed core will be designed as the inner core that functions as the main core of the building that will contain most of the building's main functional contents, such as; mechanical rooms, services, elevators, ventilation connections, firefighting, and stairs. A second layer is to be supported by a specially made metal shield connected to sensors sensitive to sudden, unexpected movements and high heat pressure resulting from explosions. Finally, the core's third outer layer helps protect both inside layers and sensors and keeps the whole skeleton standing still (see Figure 7).

To sum up, the idea in choosing the core as a construction system in the case of warzone area's building proposal is that the core is a fundamental element in buildings (high-rise and low-rise) as it gathers the essential tools in providing visual, physical, and functional vertical circulation. This works effectively to distribute services in the building and could also work as a shield that leads to an underground hideout in other cases of severely dangerous war times [26].

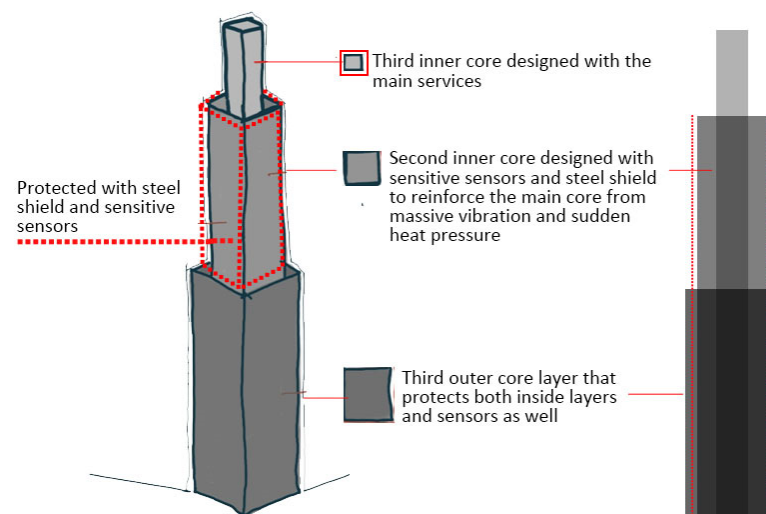


Figure 7. Diagram illustrating the proposed building's three-supported core system for designing in warzone areas. Source: (Y.M.).

3. Strengths and Limitations

This entry paper visits an interesting idea of the effect of war's destructive images on the inhabitants' psychological perceptions about safety and well-being. Furthermore, it proposes some structural solutions to help in protecting the under-hazard buildings and decreasing their possible destruction.

On the other hand, this research has a specific main limitation, in that the research is mainly built on literature review to propose a concept and misses the application part. The findings and the proposed solutions are limited to just a starting point of an idea. The authors understand the importance of including real data or some type of simulation and comparing the data and results obtained by other scholars. However, as this is an entry paper, the authors only aimed to shed light on the problem and its possible solutions by intending and recommending more research efforts about this concept in the future. Nonetheless, the authors believe that this research offers a spotlight and road map for some needed topics in future urban development studies.

4. Conclusions and Prospects

Today, many countries are facing unstable political situations, conflicts, and wars. Most of these attacks target the countries' infrastructure to affect their stability and paralyze inhabitants' daily activities and behavior. The idea behind bombing and blasts in the fourth-generation wars is not only to kill as many people as possible, but it also targets the inhabitants' mental image and health by creating images of destruction of the physical environments.

Therefore, this entry aimed to shed light on the emotional effect of warzone area destruction by preventing "the building" as a part of the target area from being demolished, besides elaborating the importance of the concept of defensible areas by designing many buildings with a defensible attitude to develop real secure areas and, later, a whole defensible environment.

In addition, this entry proposed some solutions that could be applied to buildings lying within warzone boundaries, such as; decreasing the number of elevation's openings, opening sizes, and using more low-rise buildings than high-rise buildings. Furthermore, this entry suggests using the proposed three-layered supported core system for both low- and high-rise buildings to help the buildings facing any expected disaster and to be more resilient.

This entry is the start of future research and proposals related to defensible environments and security perception in warzone areas. Further researches should take place in collaboration with different professions to be developed and escalated to different levels.

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