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ASSESSMENT OF SECURITY AND DEFENSE CONSIDERATIONS IN THE DESIGN OF CITY OFFICIAL BUILDINGS AND SITES AIMED AT REDUCING VULNERABILITY TO TERRORIST ATTACKS

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RESUMEN: Proporcionar seguridad en la jerarquía de las necesidades humanas es tal que ninguna sociedad puede sobrevivir sin su existencia sin ella. Por lo tanto, varios gobiernos de todo el mundo están haciendo muchos de los costos materiales e inmateriales para asegurar sus sociedades. Hoy en día una de las amenazas a la seguridad que incluye a muchos países del mundo, desde el sudeste de Asia hasta África, Europa y Estados Unidos, es un ataque terrorista. Debido a que en los últimos años, debido a la propagación de la violencia y el extremismo por algunos países regionales y transregionales, Asia Occidental y África del Norte se han convertido en una de las principales áreas de actividad de los grupos terroristas Takfiri, Irán se enfrenta a una amenaza a largo plazo Es de estos grupos. Por lo tanto, es necesario que las medidas de defensa pasiva en el diseño de los entornos urbanos, especialmente de los sitios oficiales de la ciudad que siempre han sido uno de los objetivos atractivos para los terroristas debido a la presencia pública y el bullicio perseguido con importancia para reducir la vulnerabilidad a actos terroristas. El objetivo de esta investigación es la presentación de las consideraciones de defensa de la seguridad y las soluciones de diseño ambiental para reducir la vulnerabilidad de los edificios oficiales de la ciudad y los sitios contra los ataques terroristas. Se trata de una investigación analítico-descriptiva y la información se recoge de documentos de la biblioteca y entrevistas con expertos en seguridad-defensa. Los resultados muestran que para reducir la medida de vulnerabilidad de los edificios y sitios oficiales urbanos, se deben considerar simultáneamente tres capas de protección de seguridad y directrices de diseño en 4 secciones: acceso, entradas y salidas de entrada, separadores y barreras físicas.

Palabras clave: Defensas pasivas, capas de seguridad, directrices de diseño, diseño ambiental, edificios oficiales y sitios

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Abstract: Providing security in the hierarchy of human needs is such that no society can survive without its existence without it. Therefore, various governments around the world are doing a lot of material and immaterial costs to secure their societies. Today one of the security threats that includes many countries in the world from South-East Asia to Africa, Europe and the United States is terrorist attack. Because in recent years, due to the spread of violence and extremism by some regional and trans-regional countries, West Asia and North Africa have become one of the main areas of activity of the Takfiri terrorist groups, Iran is facing a long-term threat. It is from these groups. Therefore, it is necessary that passive defense measures in the design of urban environments, especially of the city's official sites that have always been one of the attractive targets for terrorists due to public presence and bustle pursued with importance in order to reduce the measure of vulnerability to terrorist acts. The aim of this research is presentation of security-defense considerations and environmental design solutions to reduce the vulnerability of city official buildings and sites against terrorist attacks. This is an analytical-descriptive research and information are collected from library documents and interviews with security-defense experts. The results show that in order to reduce the measure of vulnerability of urban official buildings and sites, use of three security-protection layers and design guidelines in 4 sections include access, inputs entrance and exit, separator spaces and physical barriers should be considered simultaneously.

Keywords: Passive defenses, security layers, design guidelines, environment design, official buildings and sites

1. INTRODUCTION

Security is one of the most important human needs and one of the main factors in achieving the desirability of life, comfort and welfare of society. An important aspect of security is the ability to defend citizens against military and armed attacks and threats in urban environments (Ayatollah Ali, 2009). In the meantime, the design and construction of different parts of the city based on the observance of the principles of defense and security is very important in order to provide maximum security, with minimal trouble and cost for people to defend against threats, on the other hand, the enemy will incur the highest costs (such as financial and equipment costs, human costs, etc.) to harm them. Passive defense is a set of actions that can be used to provide much less equipment rather than to military defense by reducing or eliminating the vulnerability, controlling the consequences of invasion and increasing the repairable power against an enemy's surprisingly attacks without the use of weapons and direct clash (Asgharian Jeedi, 1383). Passive defence also have a peaceful concept about ethically, philanthropic and political aspects. The cheapest and low cost way to confronting with the enemy is passive defence and preventive security proceedings

to avoid serious damage to critical and vital centers in country (Dabbagh Moghaddam, 2005).

In recent years, the national power of Iran, specially its defensive power and deterrence have been expands rapidly. Subsequently, political and economic considerations for classical and conventional military attacks shows heavy costs in different aspects. So today, one of the main methods of harming and infiltration of the security of the country is through the spread of terrorists in the middle east region by terrorist groups. Therefore strengthening of urban environments against terrorist attacks is more important than ever.

Protecting the national capital and vital and strategic resources from enemy attacks, with the full implementation of security principles and passive defense precedures, is one of the most important points that should be paid special attention in selecting the location of the project and design the sites and constructions(Dabbagh Moghaddam, 2005).

One of the most effective methods of passive defense in urban environments is the protection of commercial, administrative and educational buildings against terrorist threats and indirect effects of explosions, by observing the defense principles in the design of buildings and public and semi-public areas

and buildings specially in urban main administrative areas (Coaffee, 2008).

Designing of civilian sites and buildings such as office and commercial buildings for durability against attacks and explosions are different from design of military buildings because of the purpose of construct the nature of use, location, usage categories and design requirements(Howard,2012).

Considering of available related requirements and guidelines – for example Chapter 21th National Building Regulations that allocate to passive defense – will cause reducing human casualties, financial and structural losses and accelerating the rescue operations. Site design should be act as a defensive factor against human made threats in addition to architectural aspects such as aesthetics.

2. PROBLEM

Official buildings are paid attention according to their level and rating of importance. Because of these buildings and the areas around them are resort place of people from all over the country, so considering of security-defensive factors are necessary (Howard,2012).

One of the best example at this regard is design of the new embassy building of US in London. This building with Cubic design and its 4 glass facades view in spite to special political, social, security and functional importance would be responsive of varied needs of project, such as archirectural, urban design and etc needs.(Chidiebere,2016).



Figure 1. The new embassy building of US in London (uk.usembassy.gov)

Most important problem that in this research we are looking for the solutions about it is the existence of security holes in main official buildings and sites in metropolises. These buildings are known as a attractive target for terrorists because of daily traffic

of people and psychological and media impact in society. Some parts of these security-defensive holes and weakness can be solved and repaired by design techniques.

In the following of these article we are looking for security-defensive layers in design of official buildings and sites, how to arrangement them and design guidelines.

3. THE AIMS

This research folloe three aims: identification and categorization of security threats of official buildings, identification of defensive layer that should be considered in design and special design guidelines about them.

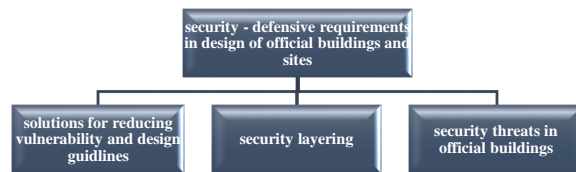


Figure 2. Triple aims and parts in assessment of defensive requirements

4. METHODOLOGY

This research is applicable and is done analytical-descriptive. The study in this research is based on library and defensive expert’s views and then with the use of indicators weighing techniques, security and defense layers and CPTED factors are determined and finally design guidelines are present.

In this research 2 weighing techniques are used. In part 1 that are related to ranking of defencive layer utility indicators, “SMART” techniques is used, while in part 2 “SAW” techniques for determine of degree of security-defensive layers.

5. SENSITIVE AND STRATEGIC OFFICE BUILDINGS

According to ministry of Road and Urban Development description, office spaces are called to spaces that are built collectively or separately to service for professional fiels of organizations (Fallahzadeh, 2014). Office use may be a small office

unit or even an organization campus(Farhoudi, 2001). Office buildings according to scale, type of services, size and sensitivity have different degrees.

From the point view of passive defense, large office buildings are one of importance targets to attack in the wars because they are attractive population centers and a symple of flow of life in communities (FEMA,2007).

Offices are categorized to 5 rate according to domain of services:

Table 1. Ranking of city big offices in according to domain of services(Hoseini, 2010)

category	Related office buildings
Urban district	Distict municipality, documentation office, marriage office, post office, police office, governmental services office and etc.
Urban region	Region municipality, region courts, department of urban facilities, traffic police offices, social security offices, education offices and etc.
Urban zone	Tax offices, health and treatment office, courts and etc.
City	Central municipality, independent organizations, big institutes, central police office and etc.
Country	National broadcasting, ministries, parlaiment, governor's offices, foundations, headquarters of big corporations and etc.

The categories that we will paid attention them in this article include city and country level because their importance. In addition to based on degree of importance buildings protection and passive defence proceedings are different.

Table 2. category of office buildings according to protecting-security levels (ministry of road and urban development, 2011)

Degree	Situation
Vital	Location of a large number of people / location of carry out of key mission of country / mission related to national security
Very high	Over 450 staffs, inhabitants or clientele / multi – level buildings with over 15000 m ² area / smart controlling cwntrs /

	judicial centers
high	151 - 450 staffs, inhabitants or clientele / multi – level buildings with 8000 - 15000 m ² area
Middle	21 - 150 staffs, inhabitants or clientele / multi – level buildings with 400 - 8000 m ² area
low	Until 20 staffs, inhabitants or clientele / untill 400 m ² area / the spaces with low performance

In this research the buildings with “vital” and “very high” level are subject of study, because:

- People’s daily visiting from all over the country.
- High level of protection required.
- Efficiency and effectiveness of passive defence proceedings in these buildings.
- High risk level in these buildings against humanmade threats.

6. OFFICE BUILDINGS; THREAT AND DANGERS AHEAD

6-1- Terrorist attacks:

Study about Terrorist attacks in all over the world show that this problem towards to spreads and dispersion.

Table 3. some of the most important office buildings that are attacked by terrorists (www.wikipedia.com)

Year	Place of occurrence	The target of attack
1983	Lebanon-Beirut	Attack on the US embassy
1992	England-London	Attack on the Baltic exchange
1993	England-London	Attack on property office
1995	The US – Oklahoma	Attack on Murrah Federal building
1998	Kenya - Nairobi	Attack on the US embassy
1998	Tanzania –Dar es salaam	Attack on the US embassy
2012	Libya - Benghazi	Attack on the US embassy

In Islamic republic of iran after 1979 islamic revolution we have seen a lot of terrorist attacks to

Iranian office building inside and outside the country,

specially embassies and diplomatic office buildings.

Table 4. some of the most important terrorist attack to IRI embassies in all over the world (www.wikipedia.com)

Year	Place of occurrence	The target of attack
1980	England-London	Attack on the Islamic Republic of Iran embassy
1998	Afghanistan-mazar sharif	Attack on the Islamic Republic of Iran consulate
2006	Iraq - Arbil	Attack on the Islamic Republic of Iran consulate
2009	Sweden - Stockholm	Attack on the Islamic Republic of Iran embassy
2010	Netherland – The Hague	Attack on the Islamic Republic of Iran representative office
2011	Switzerland - Bern	Attack on the Islamic Republic of Iran embassy
2012	Germany - Berlin	Attack on the Islamic Republic of Iran embassy
2013	Lebanon-Beirut	Attack on the Islamic Republic of Iran embassy
2017	Denmark - Copenhagen	Attack on the Islamic Republic of Iran embassy

The last terrorist attacks in iran was carried out by ISIS terrorists to Iranian Parlaiment in june 2017 that 17 people was killed.



Fig 3. Terrorist attack to IRI Parlaiment-Tehran2017 (www.tasnimnews.ir)



Fig 4. Terrorist attack to IRI embassy-Beirut 2017 (www.tasnimnews.ir)

6-2- Aerial bombardment and missile attacks :

Aerial bombardment in middle east wars in 3 past dicades show that the buildings with vital and very high and high importance degree are from always targets.(Hashemi, 2014). Iran 8 years war with Ba’athist Iraqi regime, the United States attacks to irag in 2003, Israel attacks to Lebanon in 2006 and Saudi Arabia attacks to yemen in 2015 are from most important attacks to these main office buildings.

6-3- Office buildings and explosion danger

The purpose of protecting against explosion every official or public building should be based on prevent from collapse, saving people and evacuation of victims (Bjorgo,2009).

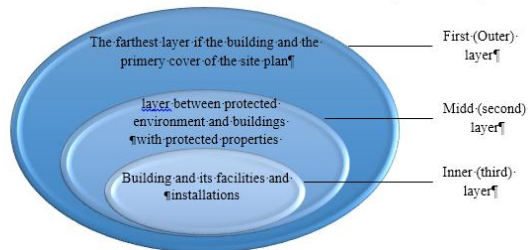
Architectural and structural features will have very important role to determine response of buildings to pressures and blows due to explosion. These features can include adjacent or underground parking, rooms and units, structural frame systems and etc (Glaeser,2012). The probability that a building has destroyed by the hurts through explosion is low, but sometimes the financial costs and human casualties for these buildings and people who are not ready for such incidents are so high (Rothrock,2010).

It is expected terroeist’s bombing in office buildings and sites almost includes 3 parts: bombig in cars and vehiclesuse from explosion packages inside or outside the buildings and suicide attacks (Lutz,2013). Also the resistant design against terrorist attacks are divided into 4 categories:

- Minimize the prerequisite for bombing operation all over the sites.

- Reducing the intensity of vulnerability.
- Facilitating relief and rescue operations.
- Quick repair and return to normal situation (Hillier,2009).

6-4- Defensive layering and protect buildings



Defensive layering is a effective pattern to make appropriate distance between the most vital property and perimation surrounding environment without defense. The purpose of defense layers is provide a deep defense with use of an effective set of barriers that raises caution and reaction time to make security for people and allow to users take shelter to safe spaces of buildings(Eraghizadeh, 2011).

Defense layers are designed to make difficult, commplicated and longer the achievement terrorists to the main targets, purposes and capitals(FEMA,2007). Also these layers can make terrorists confused in achievement to predetermined objectives to attack. For building protection against threats and terrorist attacks 3 layers are defined:

Fig 5. Security layering levels in office sites (FEMA,2007)

First layer is called to neighborhood and surrounding environments that include the number of buildings, physical elements and spaces around.

Separator boundary between first and second layers that have an urban background can make a protected environment which can be walls (concrete and brick), metal or wood fences, rows of trees or shorter plants, rows of temporary or permanent barriers or a combination of all of these.

Everything which placed between first layer and around the building, will make second layer. This layer includes whole distance between around wall untill building and all of factors that are considered in this layer such as inner walls, shelters, fountains, etc (UFC,2013).

The primary strategy for design of second defense layer would be increase of explosion place from building in terrorist attacks and distracting and depreciating of wave of explosions on air attacks, because it is clear that by increasing of distance, the impacts of explosions would be decrease (FSPB,2014).

6-5- The principles of site design based on passive defense requirements

The most important purposes of site design based on passive defense principles are include:

- Quick and safe guiding people to shelter.
- Prevent from debris collapse over people outside of building.
- Use from site facilities and it's furniture to confronting against dangers(Kiani, 2015)

According to comprehensive assessment of unnormal dangers and threats, it is necessary that the sites designed based on decrease risk and vulnerability. Make the areas with controlled access is one of ways to achievement to desirable protection level and confidence of distance between properties and propable threats. These area caused limitation to access to around and near the building(Hosseini amini, 2011). Access to controlled area cab be limited by installation of physical barriers. Although the existence of the area with controlled access is one of best ways to make buffer areas, but somethings like building limitations, construction subsidence and ground limitation don't allow that the area achieve to it's purposes always(Hashemi, 2011).

Some of buildings that are attractive for terrorists categorized on "high risk" types. in these cases we need to present more controlled accesses. Access controlling can includes varity of solutions from full physical barriers in all over the site to least protections to vehicles entrance and simple whatch out the site by electrical equipments (PAT,2005).

6-6- Crime Prevention Through Environmental Design (CTEPD):

Crime Prevention Through Environmental Design or (CTEPD) is called to set of methods that try to minimize incidents and accurrence the threats by design procedures(Atlas,2013).

Some different procedures can suggested as CTEPD such:

- Separation between public and private activities in office area of city can make control spaces and safe them easier.

- Making design limitation in wide direct accesses to streets and main passages in such a way that absence of these limitation can persuade terrorists to have attack.
- Minimize the entrance and exit to buildings and sites.
- Determine the measure of access to crowded centers of city.
- Redistribution of buildings around the city that have similar functions.
- Use the physical elements of sites to make defensive barriers when attacked.
- Presence of and medical and emergency center near the main office buildings and sites (Rothrock, 2010).

6-7- Selecting the terrorist targets in urban environments

The terrorist background on urban environments shows that Selecting the terrorist targets depends on environment features. Terrorists rarely attack to "hard targets" that are equipped by defensive equipments such as military facilities. They almost prefer "soft targets" such as shopping centers and commercial buildings, office buildings, recreational and entertainment places that will have most casualties. Terrorists's attacks to these places caused any achievement like lots of casualties or physical destruction as a symbolic action to make a shock on society (Horgan,2014).

7. FINDINGS

7-1- Effective indicators on occurrence threats and it's domain

7-1-1- The invasion cost

The meaning of invasion cost is the imposed cost to enemies due to attack on their infrastructures or their properties.

7-1-2- Enemy repulsion

The meaning of Enemy repulsion is the features from infrastructures or properties that when attacks can prevent it or make it difficult.

7-1-3- History of threat

Gaining information about repeated use or no previous use from a threat will express enemy's interest to use it again (passive defense organization, 2012).

7-1-4- Enemy's ability and potentials

The ability of attack is the first factor that are considered to determine the nature of threat.in assessment of ability, it should not pay attention only to obvious and direct abilities but it should considered indirect potentials such as ability to organize belligerent groups.

7-1-5- attraction of targets

In evaluation of the attraction of physical spaces for enemies, it should considered to operational objectives and the value of it for them. For example for terrorist groups the combination of effect and vulnerability is an important criteria for attraction of targets.

7-1-5- at least negative consequences

High costs, lots casualties and high demand time are from negative consequences a threat.

As for above items and categorize types of threats, scoring (weighting) table are presented for determine the defensive-security threats priority that have targeted office centers of cities. In this table every indicator can gain maximum 10 scores and if overall score for every indicator is 70% of the total or more, in part of qualitatively degree is placed in row of "very high", for 50-70% "high", for 30-50% "middle" and for under 30% it would be "low". It should be mentioned that the score of every indicator is based on consult with defensive-security exoerts.

Table 5. Scoring and ranking of security-defensive threat

Type of threat	Wa y of thre at	To ol thr eat	L o w c re st o nt f at ta c k	N on - re pe lle cti on tar ge t	Ta rg et att ra of th re at	H is to ry of th re at	E n e m y a l i t y	o v e r a l l s c o r e	Q u a l i t a t i v e g r a d e	
H a r d	se cu rit ive	bo mbi ng	Ex plo siv e ma te ria ls / In tern al and ext ern	6	4	9	9	7	35	Ve ry high

How to scroll to the indicators in SMART technique is that the lowest importance level allocated score 10 and then in relation to this indicator, the higher level will be scored. This operation is will be continued to the highest indicator importance. If necessary, the scores will be reviewed to make sure about their accuracy. In this step thr indicator score will splitted up total score of indicators that through that the weight of each indicatore will be determined. After that each options will be scored in relation to indicators that by multiply in weight of each indicators and total score it's final value will be determined (Asgharpour, 2006).

Based on library study and interview with security-defensive experts and environment designers, among necessary factors to make defensive layers in office sites, 5 criterias was gained the most importance that after weighting by SMART technigque, the weight index chart was determined. In fact, these criterias can improvement the quality of defensive layers:



Fig7. Desirability criterias of security- defensive layers in office building and sites

7-2-2- SWA technique (Simple Additive Weighted)

This technique is used when one of options has preference to others. for this purpose for compare of these options should be considered some indicators and allocated to each options score from 1 to 9. After

indicators weighting and multiplying the score of each option in weight of related indicators, they should sum together to achieve to final score. For calculate the weight of each option the point of each option should split up total of all points (asgharpour, 2006).

number of options = $i, i=1,2,\dots,n$
 number of indicators = $j, j=1,2,\dots,m$
 weight of indicators = $A_j, j=1,2,\dots,m$
 the score that each indicator gained based on each option = B_{ij}
 $i=1,2,\dots,n, j=1,2,\dots,m$
 total score of each option = $F_i = \sum_{j=1}^m B_{ij} * A_j$
 total weight of each option = $F_i / \sum_{i=1}^n F_i$

in the following three introduced layer above are weighted with use of SAW technique and prioritized. The table below shows final table of prioritizing. According this table the first defensive layer that are related to building exterior spaces and placed in the border of each site is the most important defensive layer based on desirability indicators.

Table 6. Scoring to security defensive layers

Indicatore s	No cost increase	Ability of implem entation	Speed of implem entation	Effecti veness	No inv ers e effe ct on soci ety	Sc ore	Tot al wei ght
First layer (exter nal space s)	8	6	7	8	6	7/1 7	0/3 80
Seco nd layer (mid dle space s)	3	6	6	9	6	6/1 5	0/3 27
thi rd layer (inter nal space s)	6	5	5	5	6	5/5 1	0/2 93

7-3- proposed solutions and guidelines to decrease vulnerability of office buildings and sites against terrorist attacks.

After presentation of security – defensive layers and scoring and weighting them, understanding threatening hazards and vulnerability of office buildings and sites and review of CTEPD factors, now operational solutions which can suggested as design requirements are presented:

Table 7. proposed solutions and guidelines to decrease vulnerability of office buildings and sites against terrorist attacks.

Row	Emphasized topic	Solutions
1	Access	<ul style="list-style-type: none"> As much as possible there should not be direct access to office site from main streets. Access point in front of street should be diagonal until acceleration and enter from entrance sections be difficult. Access to site should be controlled by put protection elements and appropriate design make difficult for vehicles that are going to knocking barriers and enter to site. The intelligently Use of bump barrier would be effective. Connection the crowded area of city center office sites and building should be indirect.
2	Entrance and exit	<ul style="list-style-type: none"> The sites and guidelines should have least of entrance and exit. All of entrance and exit points should be controlled (by CCTV camera and etc). The entrances that are same direction with streets should removed to prevent from their speed. As much as possible doors and fences around the site installed out of explosion area.
3	Separator spaces	<ul style="list-style-type: none"> Open spaces should be exist around the building, not around the site and surrounding area. Proceeding for delay on attack such as make step in street design, spiral path, potted barriers and somthings like these to make difficult to enter site.

4	Physical barriers	<ul style="list-style-type: none"> Use from high kerbs, shallow pits, trees, shrubs, and other separating factors to neutralize the effect of bombing in area. Use of boulders as a element to keep the cars away. Lack of making spaces that are proper to hide bombs such as trash bins in front of the buildings.
5	Urban furniture	<ul style="list-style-type: none"> Considering 3 factors in in urban furniture placement: the angle of deployment, mastery on place and explosive -resistant materials
6	other	<ul style="list-style-type: none"> Bus and metro stations will be crowded in front of office buildings entrance that reduce possibility of control. It is prefer that bus and metro stations are placed in appropriate distance from main office building. notable lighting throughout the night in all over the environment.

8. CONCLUSION

In main building design specially office building in urban and national scales a lot of factors are considered by designers. Use of new technology, energy efficiency, functional factors, façade requirements, design creativity and etc.

But because increase terrorist attacks in recent years as most important insecurity factors in many of cities in all over the world and get into trouble one of vital needs of human life, therefore it would be necessary security-defensive considerations paid attention specially in design of office buildings and sites that are attractive for terrorists.

In explanation of security considerations and requirements in office buildings and sites design, at first the type of threat and ways used by terrorists should be recognized correctly and then operate according to these ways in two levels include “security-defensive layers” and “building and site design guidelines”.

It is clear that use from design methods never can prevent from terrorist attacks but they can make delay on attack, reduce speed in arrive to targets, terrorists decreased focus, reduce casualties and injureds, reduce physical damages and improvement the rescue.

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