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Afet Kabinleri: Afetler İçin Yapılarda Panik Odası Modeli

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Ö Z E T

Ülkeleri tehdit eden çeşitli doğa olayları sonucunda dünyada birçok ülke afet anında insanların hayati tehlikelerden korunması için çeşitli boşluklar, yer altı sığınakları vb. alanlar oluşturmuşlardır. İnsan hayatının büyük bir bölümünü geçirdiği konutlarda tehlike anında kendini güvende hissetmesi, gündelik yapılması gereken işlere daha iyi odaklanabilmesini sağlar. Günümüzde hala mümkün olan sıcak savaş senaryolarına çözüm olabilecek bu alanların nükleer sızıntılara, patlamalardan kaynaklanabilecek yangınlara, depremde meydana gelebilecek çökme senaryolarına karşı önlem olması beklenmektedir. Bununla birlikte hâlihazırda binaların bodrum katlarında planlanan ve çoğunlukla işlevsel olmayan (kullanılmayan, atıl kalan ve/veya tehlike anında ulaşılması güç olan) yatay sığınakların, katlarda düşey sığınaklara dönüştürülmesi bu alanların verimli kullanımını sağlayacaktır.

Afetlerin toplum üzerindeki fiziksel ve maddi etkisinin yanı sıra psikolojik etkisi de önemli bir etkendir. Bireyin hayatını tehdit eden bu risklerin düşüncesi, bireyin stres faktörünü artırmakta ve yaşam kalitesini olumsuz yönde etkilemektedir. Konutlarda tasarlanması önerilen bu tür acil konut kabinleri çok sayıda araştırmaya konu olmuştur. Ancak bu çalışmada sadece mimari çözümler değil, bu kabinlerin yönetmeliğe uygun olarak binalara teknik entegrasyonu için mühendislik çözümleri ve senaryolar sunulmaktadır. Özellikle konut yapılarına entegre edilebilecek konut kabinlerinin gereksinimleri, standartları ve entegrasyon senaryoları ele alınmıştır. Çalışmada ortak-sosyal yaşam alanlarına (ofis, otel vb.) uyarlanabilen bu evrilebilir modelin tasarımı için de önerilerde bulunulmaktadır.

Disaster Cabins: Panic Room Model in Buildings for Disasters

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A B S T R A C T

As a result of various natural events that threaten countries, many countries in the world have created various voids, under ground shelters, etc. to protect people from life threats in case of disaster. Feeling safe in times of danger in the dwellings where people spend most of their life, enables them to focus better on daily tasks. These areas, which can be a solution to the hot war scenarios that are still possible today, are expected to be a precaution against nuclear leaks, fires that may result from explosions, and collapse scenarios that may occur in an earthquake. However, converting the mostly non-functional (unused, idle and/or hard to reach in case of danger) horizontal shelters currently planned in the basements of the buildings to vertical shelters on the floors will ensure efficient use of these areas.

Besides the physical and material effects of disasters on society, psychological effects are also an important factor. The thought of these risks that threaten the life of the individual increases the stress factor of the individual and negatively affects the quality of life. Such emergency housing cabins, which are recommended to be designed in residences, have been the subject of many studies. However, in this study, not only architectural solutions are presented, but also engineering solutions and scenarios for the technical integration of these cabins into buildings in accordance with the regulation. In particular, the requirements, standards and integration scenarios of residential cabins that can be integrated into residential buildings are discussed. In the study, suggestions are made for the design of this evolvable model, which can be adapted to common-social living spaces (office, hotel, etc.).

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1. INTRODUCTION

Various natural events, fires, wars, terrorist activities, etc. that threaten countries in the age we live in [1] . In such cases, there is a need to create shelters where the individual can protect himself and meet his basic needs until the danger is eliminated. In researches conducted in this direction, various shelter applications can be made across the country against the danger of hurricanes in some states of the USA, and against the danger of earthquake and tsunami in Japan.

In addition to the material impact of disasters on society, the psychological impact is also significant. According to a study [2], reactions to the earthquake disaster and its aftermath vary based on the severity of the event, personality structures of the victims, social values, and previous experiences. It has been found that a Japanese person living in safe buildings and educated about earthquakes reacts differently than a person living in unsafe buildings and in a country unprepared for earthquakes. However, when faced with the unexpected, life-threatening events such as earthquakes, the human brain responds immediately in two ways: first, to assess the threat, and second, to protect itself from the threat [3, 4]. The threat triggers a "fight or flight" response [5, 6]. As a result of a series of consequences that occur to escape the threat, there may be increased heart rate, breathing rate, muscle tension, fear, disbelief, numbness, sweating, trembling, and nausea [7]. As a result, people's knowledge of the steps to follow in disaster situations often does not match their behavior at the time of the disaster. The stress, panic, and fear they experience at that moment can prevent healthy and logical thinking. In various studies, it was found that the moment of threat, which is the first step of a disaster, is the process of not first perceiving the danger and not distinguishing what is happening. This process is a period in which uncertainty, silence, waiting, and emptiness prevail. When people in a crisis realize that they are being harmed, that there is no other option, or that the available options are inadequate, panic behavior ensues [8, 9]. Therefore, it is obvious that people who live in buildings with disaster preparedness and panic rooms feel safer. Not just in disaster situations, war, theft, terrorist activities, domestic violence, etc. Calling for help with the panic button by using this room in situations where life safety is at risk, and knowing that one can seek shelter in this room until the threat is gone, contribute to the person’s feeling more psychologically comfortable.

In this study, the development process of disaster cabins is mentioned and the integration of these cabins according to the housing construction regulations in Turkey is examined. This model, which was created by considering only the number of people and basic needs, was primarily thought to be integrated into the houses and the carrier system requirements and calculations were made accordingly. Considering its applicability for buildings to be built from scratch, it does not contain a recommendation for its integration into an existing structure. It is suggested for further studies that the model can be developed and integrated into social and mass-use structures.

1.1. Shelters Today

Today, there are cabins, which are defined as safe rooms and created for the purpose of sheltering from various disasters, especially in the backyards of buildings [10]. These cabins can be used or rented with the permission of the cabin owner, not only in disaster situations, but also sometimes for homeless or asylum seekers.

With this, there are ready-made panic room and steel cage solutions in the industry in the form of cells already made of steel material. However, for multi-storey buildings, these and similar solutions have several disadvantages: First, such solutions are person-specific and can be purchased depending on the financial capabilities of the person. Secondly, these cells work together with the building and not separately from it, and in case of collapse of the building, these cells move together with the building, and there is no complete safety. Another reason is that when these prefabricated cells are added to existing buildings, they put more load on the building than it can support, which affects the structural integrity of the existing building. Such an increase in load in only one room of the building will result in greater damage to the heavier portion of the building during an earthquake. For this reason, in today's conditions, it is necessary to find a solution that gives everyone the same right to shelter.

2. DISASTER SHELTER AND LIVING ROOM TECHNICAL REQUIREMENTS

The principle of designing the building so that people can escape from the building before it collapses during severe earthquakes, which is based on the disaster-related building codes of Turkey and many other countries, cannot guarantee people's life safety. This is because it is not economical to build in such a way that the buildings never collapse. An earthquake impact that leads to the collapse of the structure is a situation that the structure will be exposed to only once during its lifetime. According to the predictions of some professors working in the field of seismology in Turkey, an earthquake with a magnitude of M=7.0 and above, which is expected to occur in Turkey in the near future and to greatly affect Istanbul and its immediate surroundings, will have a great impact on the destruction of the existing structure and loss of life. [11, 12]. "Disaster and shelter rooms" [13] used in the mining sector in Turkey are not officially included in construction planning (in legislation). In addition, the shelters that are designed together with the structural design have shelters in the basement of the buildings that provide a collective use environment, a kitchenette and a WC shower, mechanical ventilation and air circulation [14, 15]. However, since they are located in the lower part of the building, they are not suitable for protection during an earthquake. This is because in case of danger, vertical circulation is one of the weakest points and it is not desirable to use it.

There is a need for technical infrastructure to provide housing cabins with physical conditions and equipment to allow living at minimum standards for a specified period of time.

2.1 Physical/Spatial Size

The number and size of rooms in the apartments on each floor of the mass housing depends on the number of users who will be housed there. Technically, there should be functions that satisfy people's basic needs (eating-drinking, sink-toilet, sitting-sleeping).

The main factors and indicators that determine capacity selection;

- ✓ Number of users: Physical space capacity in architecture is determined by the number of users and user requirements. A similar principle is used to determine the minimum dimensions for user requirements in disaster and refuge housing.
- ✓ User requirements: It is based on the basic needs of users in disaster and shelter housing. Sufficient minimum dimensions for an average human size are determined by evaluating each requirement.
- ✓ User accessibility (equal opportunity; needs of disabled and/or disadvantaged persons): Any space to be designed should be such that it can be used by all persons. It is necessary to take into account disadvantaged persons and to consider the specified conditions specifically for them.

2.2. Mechanical Infrastructure

It is not certain how long the disaster will last and how long the users will wait in the space. For this reason, a mechanical infrastructure is needed to meet the demands that will occur during the stay in the cabin.

These;

- ✓ Heating-cooling system
- ✓ Clean water-polluted water-waste water system
- ✓ Ventilation system
- ✓ Electrical installation
- ✓ Communication-telecommunications infrastructure
- ✓ Equipment for basic needs (eating/drinking, sink/toilet, sitting/sleeping).

It is important that the shelters which are mandatory to be installed in the basements of the buildings in the housing complexes, are divided into floors to make them more practical, safe and easily accessible to disadvantaged people. It should be ensured that a safe shelter is provided for all persons without using vertical circulation, as stairs are unsafe and mechanical components such as elevators may not function in the event of a disaster.

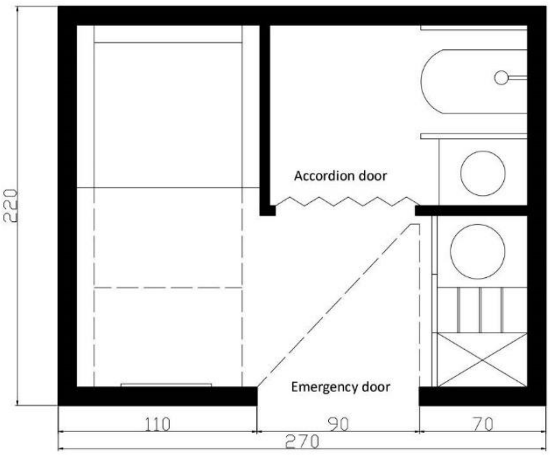
3. MATERIAL AND METHOD

The development of the model is described in two stages, architectural and technical details. In the shelter regulation valid in 2023 in Turkey [16], there is a requirement to leave at least 1 m2 area per person, excluding common areas (wc-shower and kitchen). In the single-person shelter plan developed with this account in mind, as the number of users increases, multiple user alternatives can be created by making some changes in the dimensions of the disaster shelter room. In the plan developed for 2 users given in Figure 3 below, the size of the shelter was increased by adding 1 m2 more area per person (excluding the WC-shower and kitchen area). In these cabins, which will be used for a temporary period, meeting the minimum needs rather than daily comfort is prioritized. With this logic, as the number of users in the residences increases, the cabin area can be enlarged by adding as many square meters as the number of users without increasing the common area size. Afterwards, the spaces created to meet these needs were statically dimensioned. In this dimensioning, Idecad static software was used as the simulation method.

3.1 Architectural Details

The contents of the proposed prototype housing plans were made according to the shelter area calculation given in Chapter 3, and this area was arranged to be increased for multiple use. The room shown in Figure 1 is the architectural plan of the one user disaster and shelter hall. A door with an emergency exit latch has been placed at the entrance of the room. A panic button is located at this point for the person to call for help. For the waiting period until help arrives, there is a wet area where he can meet his needs for a sink, WC and shower, a kitchenette where he can meet his food needs, a microwave oven where he can heat up or cook previously stored dry food, and an under-counter storage area with a sink. There is also a multifunctional single seat that can be used for both resting and sleeping and can be converted into a bed if needed.

Opposite the seating unit is a wall-mounted dining table that can be opened and closed as needed, and a TV, where he can relieve his restlessness and eat the food he prepares. Oxygen cylinders and masks are provided in case the unit's ventilator is damaged when danger is imminent, taking into account the recovery time. This unit has no windows to the outside. The person will not be able to benefit from daylight during this period. However, in such cases, human-oriented lighting systems are recommended in the literature. With artificial lighting technology that simulates the variable dynamics of daylight, the negative effects that may occur in people due to daylight deprivation can be reduced in this way. However, in the event of a disaster, the effects of a temporary absence of daylight will be reduced in a system where the crisis desk and disaster rescue teams work regularly. One of the floor plan diagrams that can be associated with the residential structure to which the building is connected is shown in Figure 2.



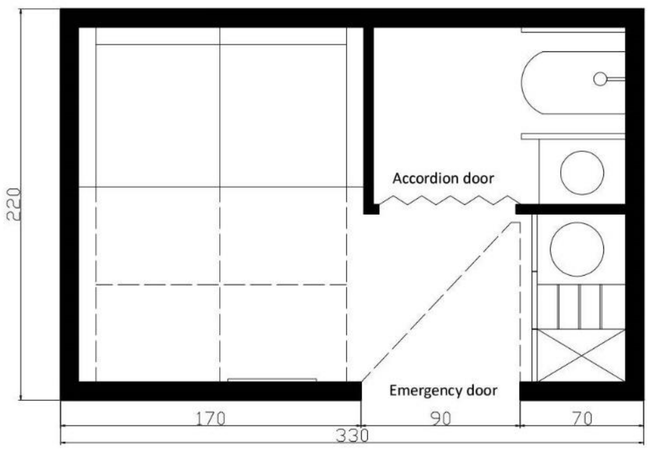


Figure 1. Plan for one user(Erten, ş. Y., AUTOCAD Software). **Figure 2.** Plan for two users (Erten, ş. Y., AUTOCAD Software).

Since the area where this room will be located will become a reinforced core of the structure, the structure will want to rotate towards the reinforced area in case of a possible horizontal load. To minimize the torsional moment, it is important that these chambers be centrally located for a single core and symmetrically located for multiple cores. Figure 3 shows the layout of the shelters for a building block with 4 flats on the floor.

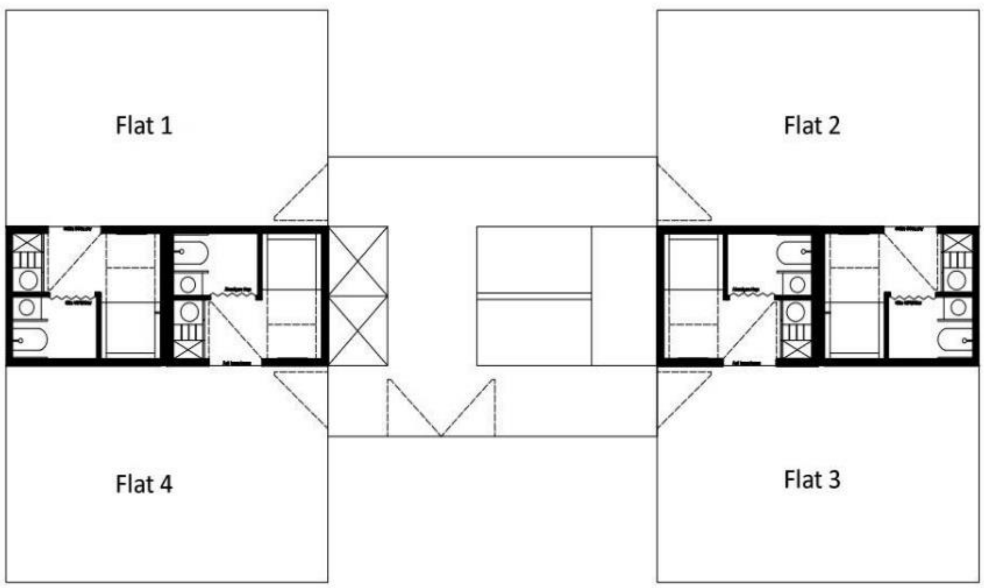


Figure 3. Disaster and shelter Layout chart for 4 flats (Erten, Ş. Y., AUTOCAD Software).

Supplies for two or three people are stored under the seating unit. The floor plans are designed to meet the needs and keep the room size to a minimum. At this point, it is not about the comfort of the person, but about the safety of life. Therefore, it is assumed that the minimum accommodation space is sufficient for this situation.

3.2. Construction and Technical Details

The cost analysis of the disaster shelter and living quarters proposed in the study was performed on a single-user prototype for a building of type 1 basement+1 first floor +4 normal floor. This analysis was carried out using the IDECAD Static Package program and provided results that can be used to roughly calculate the material costs, which are considered the main costs of the project (Figure 5 and Figure 6). The following assumptions were used in the calculation:

- ✓ A building with 1 basement, 1 first floor and 4 normal floors was calculated to be integrated into one building.
- ✓ Since the foundation of the building will cooperate with the foundation of the existing building, the foundations are not included in the calculation.
- ✓ All 4 walls of the building (except the doorway) will be shear walls. The minimum thickness of the shear walls was set at 30 cm.
- ✓ In the calculations, it was assumed that the building is located in the 1st degree earthquake zone (the most dangerous zone in terms of earthquakes).
- ✓ The most severe earthquake load that can occur in this region was assigned to the system, and dynamic analyzes were performed.

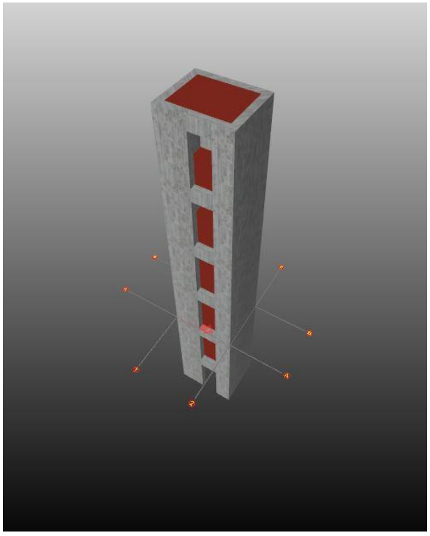


Figure 5. 3D representation of disaster shelter plan (one user) (Erten, Ş. Y., IDECAD Software).

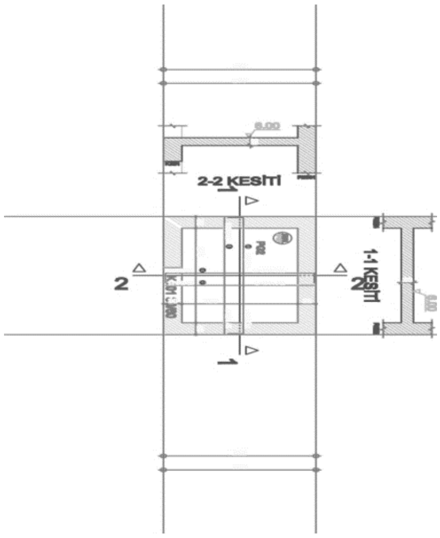


Figure 6. Static plan of disaster shelter (one user) (Erten, Ş. Y., IDECAD Software).

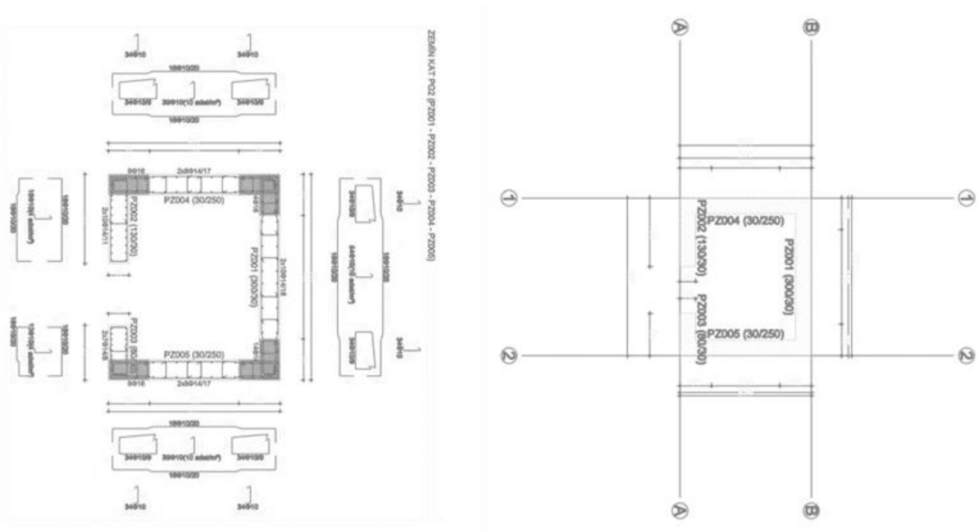


Figure 7. Prototype of a disaster shelter and living room (single user), equipment diagrams (Erten, Ş. Y., IDECAD Software).

It is assumed that the disaster shelter and living quarters will function on the same basis as the building. However, it is envisioned that each portion will be separated from the structure by a dilatation joint after the foundation. If the separation is through a dilatation joint, there will be a hammering effect if there is a difference in time between the shelter and the structure when there is a possible horizontal load. To prevent this effect, a sufficient amount of expansion joint and soft materials such as glass wool, rock wool, etc. should be placed in this joint gap. If the joint remaining after dynamic analysis is not sufficient, the joint spacing is increased. In this way, the safety of the users in the reinforced core, disaster shelter and living quarters is ensured even if damage occurs in the rest of the building.

4. FINDINGS AND DISCUSSION

Although such a requirement exists in today's conditions, there are some difficulties and issues that need to be resolved in its implementation.

- ✓ In terms of planning; central or symmetrical positioning is not possible for every architectural plan. For this reason, during the preliminary discussions with the user, it is necessary to review the wishes taking into account this area. At this point, it can be challenging for the designer/planner to meet employer requests.
- ✓ In the case of field data: In a single-occupant residence in the model obtained in the study, an additional 5.94 m2 is required when spaces are reserved for the minimum requirements for a single-occupancy shelter. This field does not increase linearly based on the number of people. It can be enlarged according to the number of users by increasing 1 m2 per person by keeping the common areas constant as specified in Sections 3 and 3.1. At this point, regardless of economic concerns, the square meters determined for each apartment should be provided depending on the number of users. In city centers where land values are high, this can be challenging for employers. In terms of legislation; The static solution of these cabins is considered separately from the rest of the building. In addition to the cost of materials, the additional precautions that must be taken in the static solution of the project can be a challenge for the employer. To prevent and encourage the employer's withdrawal, the state should provide the necessary support at this point and the legislation should be designed according to this condition. The case of revision can be appealed by the Ministry of Environment and Urbanization.
- ✓ Physical; since living spaces in disaster and refuge sites are completely enclosed spaces, the absence of sunlight has a negative impact on the circadian rhythm of human beings [17]. One of the most important factors in circadian rhythms is light. The light-dark cycle in the external environment is important for regulating the circadian rhythm.
- ✓ Another situation that rarely occurs is that if a disaster and shelter room is provided for each flat and these rooms are easily accessible from the apartments, people may be psychologically affected because they are constantly aware of the existence of this room. If the other parts of the building are completely destroyed and only these rooms remain, the question of how to reach the inside of the building and the lack of a vertical circulation device connected to these rooms is another weak point. The proposed system does not raise legal and regulatory problems. Depending on the wishes of the employer or the user, the designer can easily include the disaster shelter and the living spaces in the project, as the legal requirements are met. However, since these spaces are not yet included in the legislation, these spaces must obviously be added when calculating the predecessor space. Therefore, the net m2 of the user flat will decrease somewhat. If it is officially included in the regulation, the addition of this lost precedent by the building authority to the apartments may favour the situation.

For the time being, a sudden change in technology related to the reinforced concrete building system is not foreseen for the implementation of this project. The design of the project can be updated according to the changes that may occur in the legislation during the process.

5. CONCLUSION

The idea of disaster relief and housing is one that has a moral rather than a financial benefit. In a time when a human life can very easily end, it appears as a place where people can feel safe. It is an achievement that will have a positive impact on human health, not only in terms of physiological but also psychological.

It is possible that in the future these shelters, originally intended to be integrated into residential buildings, will be accepted and used in buildings with multiple uses and social functions. Although it is believed that it is more difficult to teach people this habit later, it is important to revise educational programs to establish this awareness in childhood, starting from the first educational period when it is implemented. The idea of transforming these shelters, which are considered a saving solution for disabled/disadvantaged people, but in reality are horizontal shelters in the basement of the buildings that usually do not work, into personal shelters on the floors is also very positive. In this way, these spaces in the basement can be used for other purposes (parking, etc.).

Another important point to consider is the cost of these shelters. However, the benefit-benefit analysis of such gains cannot be measured as in the commercial sector. Considering the fact that we are talking about human lives on one side and costs on the other, this is a viable solution considering the amount of costs involved.

Such standards can be mandated for buildings above a certain capacity. Considering that shelters and living quarters are also a necessity in disaster situations, it is clear that this solution will be accepted if it is implemented in such a high-risk country, especially in terms of earthquakes.

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