Journal of Infrastructure, Policy and Development 2024, 8(7), 3917.
https://doi.org/10.24294/jipd.v8i7.3917

Article

Examination of emergency assembly areas based on planning criteria after the two major earthquakes on 6 February, 2023: A case study from Turkey

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CITATION

Bektaş Y, Doğan G. (2024). Examination of emergency assembly areas based on planning criteria after the two major earthquakes on 6 February, 2023: A case study from Türkiye. Journal of Infrastructure, Policy and Development. 8(7): 3917. https://doi.org/10.24294/jipd.v8i7.3917

ARTICLE INFO

Received: 30 December 2023
Accepted: 27 March 2024
Available online: 30 July 2024

Abstract: This study aimed to examine the compliance of post-disaster emergency assembly areas with their planning criteria in the Battalgazi district of Malatya province. This district is one of the settlements that was most affected by the two big earthquakes that occurred in Türkiye on 6 February 2023. The emergency assembly areas were evaluated qualitatively based on the criterion of "appropriateness", with the sub-variables of "usability", "accessibility", and "safety". They were also evaluated quantitatively based on the criterion of "adequacy" with the sub-variable "per capita m^2". There are a total of 103 neighborhoods in the district. However, there are only eight emergency assembly areas in total within its boundaries. According to the results of this study, only 7.5% of the current population of the district resides within 500 m of the emergency assembly areas. The fact that four emergency assembly areas (Hürriyet Park, Şehit Kemal Özalper High School, the Community Garden, Battalgazi Municipality) are situated next to each other and there are emergency assembly areas in only six of the 103 neighborhoods within the municipal boundaries shows that were significant problems in the decisions made regarding their locations. In addition, it was determined that there were disadvantages in terms of accessibility and usability within the criterion of appropriateness, while there were some positive aspects in terms of safety. When examined with regard to the criterion of adequacy, it was determined that the emergency assembly areas at Mişmiş Park, the Community Garden, Battalgazi Municipality, and Şehit Kemal Özalper High School were most adequate, while the emergency assembly areas at Hürriyet Park, Fırat Neighborhood Mukhtar, Nevzat Er Park, and 100 Yıl İmam Hatip Secondary School were least adequate.

Keywords: earthquake risk; emergency assembly area; planning criteria; urban planning; Türkiye

1. Introduction

The social, economic, and environmental problems caused by natural disasters are among the most important topics on the global agenda today. With the increase in the type, frequency, and severity of disasters, a large number of multidimensional problems have been experienced in recent years. In the last two decades, earthquakes have been the deadliest natural disasters around the world, leading a loss of 721,318 lives and accounting for 58% of total fatalities (Ministry of Agriculture and Forestry, General Directorate of Meteorology, 2021). In Türkiye, according to the AFAD (Disaster and Emergency Management Presidency) Disaster Statistics Report (2020), earthquakes are first in terms of both the number of occurrences and loss of life and property. Approximately 60% of the fatalities caused by natural disasters in Türkiye are due to earthquakes.

To cope with such disasters, planning should focus on mitigation and preparedness. Preparedness, disaster mitigation, response, and recovery form the stages of an "integrated disaster management system", which can also be called a "comprehensive disaster management system". There have been various developments in disaster management globally, and the process has evolved from traditional post-disaster crisis management, which consists solely of the response and recovery stages, to risk management, which focuses on pre-disaster risk mitigation (Kadıoğlu and Özdamar, 2005).

Given that 55% of the world's population currently lives in urban areas and that this is expected to increase to 68% (6.7 billion people) by the year 2050, research on disaster risk in urban areas and how to reduce them is crucial (United Nations, 2019). In Türkiye, where 93% of the population lives in urban areas (Turkstat, 2019), the risks to cities have a significant impact. The 1999 Marmara-Gölcük earthquake, the 2011 Van earthquake, and the 2020 Elazığ-Malatya earthquake are just a few of the natural disasters that have occurred in Türkiye in the last 20 years. The two major earthquakes that occurred nine hours apart on 6 February, 2023, with epicenters in Pazarcık and Elbistan districts of Kahramanmaraş, and magnitudes of 7.7 and 7.6 respectively, have been described as the "disaster of the century". These earthquakes were the most devastating in the country's history. The first had the greatest impact in Kahramanmaraş and Hatay, while the second affected Malatya in particular (AFAD Preliminary Assessment Report, 2023). According to a statement made by the AFAD Presidency on the 61st day after the earthquake, 50,500 people lost their lives and approximately 650,000 independent sections of buildings were severely damaged or destroyed (Grand National Assembly of Türkiye, 2023). Natural events like this that affect cities have made the level of preparedness of settlements in Türkiye for disasters, the issue of disaster management, and the siting of emergency assembly areas important factors in urban planning. The search for a safe place to protect oneself from a natural disaster and any secondary events occurring afterwards is of utmost importance. It is crucial that there be an adequate number of open spaces nearby that people can easily access and where they can feel safe and have their needs for pre-evacuation, shelter, first aid, and basic necessities met (Coburn and Spence, 2002).

The Marmara-Gölcük Earthquake that occurred in 1999 was an important turning point in Türkiye's disaster management policies (Balamir, 2007). The absence of inadequacy of services such as emergency assembly points, emergency transportation, evacuation, and temporary shelter that could be used after the earthquake began to be discussed in a wide-ranging manner. These discussions were generally focused on characteristics such as the number of areas and their size. After the Kahramanmaraş earthquakes on 6 February, 2023, similar discussions once again took place. However, in addition to the number and size of emergency assembly areas, it is also vital that they are accessible, adequate, usable and safe.

The present study aimed to examine the existing emergency assembly areas in the Battalgazi district of Malatya province, which was most affected by the 6 February 2023 Kahramanmaraş earthquakes, in terms of their suitability and adequacy. In this regard, the study focused on two main questions. These were: "*Are the emergency assembly areas in the Battalgazi district sufficient in terms of spatial size and per capita* m^2*?*" and "*What are the levels of accessibility, usability, and safety of the*

existing emergency assembly areas in the Battalgazi district?" This study makes an original contribution to the literature because there is only a limited number of studies on this topic, there is no similar study in Malatya province before the earthquakes, and this is the first study of the region after the earthquakes.

The research consists of six main sections, including the introduction. The second section presents literature review. The third section details the methodology used in the research. In the fourth section, the emergency assembly areas in the Battalgazi district are examined in terms of appropriateness and adequacy. The fifth section gives the research findings. The final section examines the results obtained within the scope of the research questions and provides the authors' recommendations for future research and policies.

2. Literature review

According to the Turkish Language Association's Current Turkish Dictionary, the word "emergency" used as an adjective is defined as "urgent, pressing, immediate, and important", while the noun "assembly" means "coming together, gathering". In the Cambridge Online Dictionary, "emergency assembly points" are defined as "safe areas where people should gather in an emergency". According to the AFAD definition, emergency assembly areas are "safe areas where the public can gather away from the dangerous area to prevent panic and to ensure healthy information exchange until temporary shelter centers are ready after disasters and emergencies" (Republic of Türkiye Ministry of Interior, Disaster and Emergency Management Presidency, Press and Public Relations Consultancy, 2019).

According to the Disaster Prevention/Mitigation Basic Plan in Istanbul including Seismic Microzonation in the Republic of Türkiye (JICA and IMM, 2002), emergency assembly areas, also referred to as pre-/local evacuation areas, are safe locations where people can take shelter and distance themselves from hazardous areas during any disaster or emergency until temporary shelters are prepared. Primary evacuation and gathering places are not only recommended in order to ensure the safety of citizens but also to collect accurate information about the initial damage from the evacuated residents through self-organized community disaster task forces.

As can be understood from the definitions provided by dictionaries and different institutions, emergency assembly areas are safe areas where people can gather during disasters and emergencies. However, in the definitions given, various other features and functions of these areas, such as their accessibility, adequacy, suitability, usability, climatic comfort, etc. have been overlooked. In the literature, assembly areas are often examined under four main headings with regard to their size, classification and the facilities provided. These are emergency sheltering, temporary sheltering, temporary housing, and permanent housing (Quarantelli, 1995). Emergency shelters are a solution that can last from a few hours to a few days (Quarantelli, 1995; Soltani et al., 2014). This period does not usually require extensive preparation of meals or other services and refers to emergency accommodation such as motels, hotels, tents, caravans, etc. Temporary shelters, on the other hand, provide more than just immediate shelter in an emergency. They are planned for longer periods lasting several weeks and may take the form of tents, camps, or collective shelters. Finally, housing, which

can be divided into temporary or permanent accommodation, leads to a return to normal daily life through the reconstruction of habitable residences (Soltani et al., 2014).

According to the Tokyo Metropolitan Government Disaster Prevention Handbook (2020), "evacuation areas" are places where the victims can take refuge after disasters. These areas are grouped into three basic categories, "Temporary Evacuation Areas", "Evacuation Areas" and "Evacuation Centers". Temporary evacuation areas are defined as areas where people gather temporarily and where the existing situation is assessed. Evacuation groups are formed in these locations before moving to a main evacuation area. Temporary evacuation areas are usually a schoolyard, park, or similar location where there is enough space to ensure the safety of the people gathered. Evacuation areas, on the other hand, are large parks or squares where residents can go to protect themselves from secondary hazards such as fire, storm, flooding, and similar risks after an earthquake. These evacuation areas are determined by the municipal authorities according to the type of disaster, such as earthquake, tsunami, flood, etc. Evacuation centers are places offering temporary shelter and are also locations determined by municipal authorities (public facilities such as educational or healthcare buildings and offices). Often, elementary and secondary schools in a neighborhood are designated as evacuation centers. Medical care stations are also set up in these areas for specific numbers of people (usually 500). Citizens whose houses have been destroyed, affected, or damaged due to earthquakes or similar disasters are able to use these areas.

Emergency assembly areas are not only safe places where the disaster victims can gather safely after the disasters but also pre-designated evacuation areas selected based on specific criteria, including the ability to communicate with other teams, provide directions to temporary shelter areas, and determine transportation and distribution routes (Çınar et al., 2018).

Having such safe areas is crucial for determining more suitable and permanent locations for disaster victims to go, enabling people to organize more quickly and efficiently, providing faster access to emergency assistance, facilitating the identification of missing persons, and guiding the necessary search-and-rescue operations. These centers are necessary to ensure coordination between disaster victims and rescue teams during and after the disaster and so that any medical treatment required can begin as soon as possible (Çiçekdağı and Kırış, 2012).

The first 12 to 24 hours after a disaster is a very significant period for people who have been exposed to it. During this time, they need to quickly gather at assembly points where they will feel safe and can access up-to-date and useful information. The most important consideration in this process is that the assembly areas are safe and secure. In these areas, the authorities should provide all necessary information about the disaster to its victims, taking into account any potential issues that may arise (Maral et al., 2015).

According to Zengin Çelik et al. (2017), open spaces in urban areas can be utilized to meet the requirements for gathering, evacuation, and shelter areas necessary after a disaster. These spaces can be in the form of green spaces, including public parks and gardens, as well as town or city squares. Areas that are used as open and green spaces in daily life when there is no extraordinary situation can serve as gathering

areas in the case of a disaster and are defined as “emergency gathering areas” (Xia, 2006).

According to Erdin et al. (2019), parts of the social infrastructure are suitable for use as gathering areas after disasters. These areas may have different features. Some may be easier to access and have more space available, while in some the space may be limited, and there may be barriers such as locks and wire mesh that need to be negotiated before accessing the area. For this reason, such areas are classified into two groups: first- and second-tier areas. In the first group are parks, open sports fields, squares, and open-air marketplaces, while education facilities, health facilities, indoor sports areas, and other institutions are part of the second-tier social infrastructure.

Recent studies have been conducted on emergency assembly areas both nationally and internationally. These have focused on issues such as the selection of locations, their proximity to emergency transportation routes, and logistics. Liu et al. (2011) studied emergency assembly areas in underdeveloped regions and analyzed the principles of site selection for emergency shelters. Cheng and Yang (2012) developed a model for the assessment of emergency shelters after an earthquake. Three evaluation criteria are used in this model. The first is shelter capacity, the second is facility quality, and the third is accessibility. Wei et al. (2012), created a model for the selection of emergency sheltering areas in mountainous or underdeveloped regions. For developing countries, this model provides an appropriate approach to decision-making that fully considers costs and benefits, allowing for informed decisions to be made. Çelik and Erduran (2011) carried out studies on “earthquake parks” and tried to determine the current status of the parks in Kocaeli and whether they were suitable for use. Aksoy et al. (2009), analyzed the adequacy and quality of green spaces in cities that contribute to sustainable development, with the aim of ensuring that the necessary importance was placed on having a sufficient number in each district. Şenol Balaban (2011) studied the accessibility and adequacy of emergency evacuation and temporary sheltering sites in the Fatih district of Istanbul. Buldurur and Kurucu (2015) examined urban transportation studies conducted in Istanbul for earthquake preparedness. They evaluated criteria such as emergency transportation routes, pedestrian crossings, bridges and viaducts, park areas, the use of safety lanes on roads, roadside safety issues, the condition of intersections, connecting roads, planning of bus and minibus routes, and organization of public transportation stops. Kırçın et al. (2017) examined green space designs implemented in other countries and developed recommendations to increase the possibilities of using green spaces as post-disaster assembly sites in Türkiye. Çınar et al. (2018) examined the appropriateness of emergency assembly areas according to planning criteria using a GIS-based analysis method. Mengi and Erdin (2018) formulated design proposals for emergency assembly areas and a system design related to this subject. They also examined standards and design criteria related to disasters and emergencies in Türkiye and in different parts of the world. Bektaş and Sakarya (2020) investigated the adequacy and accessibility of emergency assembly areas in Kadıköy, a high-risk area in Istanbul. In their study, Bektaş and Sakarya (2020) concluded that specific standards for emergency assembly areas should be included in the regulations. Aman’s (2019) study conducted in Istanbul, Türkiye, sought to understand the role of urban open and green areas in disaster preparedness and loss reduction, to determine the selection criteria for safe open and green areas in terms of

earthquake preparedness and mitigation, and to produce a landscape infrastructure model for earthquake refuge area.

2.1. Parameters for planning emergency assembly areas

Although there are no direct planning criteria for emergency assembly areas in the literature, there are various studies at international and national levels that can provide guidelines. For example, the Japan International Cooperation Agency (JICA and IMM, 2002) divides post-disaster gathering areas into two phases: "local evacuation areas" (emergency assembly areas) and "regional evacuation areas". According to this plan, emergency assembly areas are the areas that are used in a local neighborhood within the first 72 hours after a disaster to ensure the safety of citizens and protect their property. In each neighborhood unit (primary school unit, 300–500 households/1500–2000 people), emergency assembly areas are selected from parks, open areas, public lands, and facilities that are easily recognizable to the public, are not hazardous and that have a gross area of 1.5 m² per person. Although public schools and mosques are present in all neighborhoods their use is not recommended due to their lack of seismic resilience. Parks and open spaces with a size of 2000 m² or more are thought to be most suitable for use as pre-evacuation areas. Smaller parks and open spaces are not recommended as gathering areas because they may not provide protection from damage to buildings that may occur during or after a disaster (JICA and IMM, 2002).

Chu and Su (2012) determined three criteria to be considered in choosing sheltering areas in urban evacuations. These three criteria and their sub-headings were as follows:

Disaster risk: Geological hazards, topographic conditions, distance to hazard;

Location and size: Geographical location, evacuation routes to use, available space;

Disaster prevention and rescue facilities: Distance to the health facilities, distance to the Fire Department, the distance to the supply warehouses.

León and Mart (2014) also drew attention to three basic criteria in planning to use urban open spaces as emergency assembly areas. These were accessibility, connectedness and the characteristics of the terrain. Although these criteria vary according to the type of disaster, they are of great importance in the use of public spaces for evacuation and rescue after a major disaster.

Since they have adequate infrastructure, parks, shopping malls, stadiums, and similar areas can potentially be used as assembly areas. Open spaces, especially parks, are the best assembly areas as it is easier to set up tents in these locations. Some criteria are more important than others in selecting assembly areas. Accessibility is an indispensable criterion in selecting a location, because the survivors of any natural disaster should be able to access the assembly areas safely. It is necessary to plan roads and evacuation routes so that such sites are easily accessible to all (Anhorn and Khazai, 2015; ECPFE and OASP, 2002; Forouzandeh et al., 2008).

In addition, assembly areas should be sites that will not be affected by geological hazards. They should be located in places where the ground is rocky or stony, and not in alluvial areas or areas where soil liquefaction may be present. After the 2011 Japan

Earthquake, it was observed that the damage caused by soil liquefaction was significant. In addition, the slope of the land selected as an assembly area should be between 2–4% and should be at least 100 meters away from river beds (Bureau of Urban Development of the Tokyo Metropolitan Government, T.Y.B; Soltani et al., 2014; Kılcı et al., 2015).

The standards for determining emergency assembly areas do not have a direct equivalent in Turkish legislation, but the AFAD has established specific planning criteria for emergency assembly areas during disasters and emergencies. These are:

> *"Population density; accessibility and ease of evacuation; suitability for the transportation* of *people with disabilities and the elderly; areas that are safe from secondary hazards* such *as fire, flooding, tsunami, infrastructure problems, etc., that are not prone to liquefaction and are away from fault lines; preferably flat and obstacle-free terrains; proximity to residential areas but not affected by structural and non-structural elements; proximity to* facilities *where basic needs such as electricity, water, and toilets can be met; preferably suitable publicly-owned areas".*

Çelik and Erduran (2011) examined emergency assembly areas based on criteria such as distance to natural gas lines, distance to fault lines, distance to high-voltage power lines, distance to densely built areas, distance to hazardous facilities, distance to the coastline, fire risk, landslide risk, and flood risk.

Çınar et al. (2018) identified five basic criteria for determining disaster and emergency assembly areas. The first was accessibility. According to this criterion, the maximum distance between people's homes and an emergency assembly area should be 500 meters. The second criterion was the necessity of easy connection with major roads and junctions. In other words, emergency assembly areas should be connected to roads that are not at risk of closure in the event of a disaster. The third criterion was usability and multi-functionality. Open spaces such as parks, active green areas, passive green areas, children's playgrounds, neighborhood recreation grounds, astroturf fields, school gardens, and hospital gardens can be used as assembly areas but these areas should not be smaller than 500 m². The fourth criterion was ownership. According to this criterion, emergency assembly areas should be selected primarily from publicly-owned land. However, if conditions such as accessibility, connection with road junctions, usability and size are met, areas owned by individuals can also be chosen as emergency assembly areas. The fifth and final criterion relates to the size of emergency assembly areas. According to this criterion, these areas should have a minimum gross area of 1.5 m² per person.

Zengin Çelik et al. (2019) evaluated open spaces and areas of social infrastructure within urban regions in terms of their potential for use as emergency assembly areas. They specified the criteria of them being "usable", "safe" and "accessible" areas for all people in that location. There are many different aspects to each of these three criteria. However, in general, the criterion of usability is considered in terms of size, ownership, slope, and climatic features, the criterion of being safe is considered in terms of fault lines, terrain, possibility of landslide, tsunami or flood, technical infrastructure and the features of nearby buildings, while the criterion of accessibility is considered in terms of road gradation, walking distance, etc. (Zengin Çelik et al., 2019).

In addition to the planning criteria listed above, climatic conditions are also an important parameter. In choosing emergency assembly areas, climate and vegetation should be taken into account. In order to protect individuals from the sun during the day in summer and from rain during the winter, and due to the windbreaking features of wooded areas, there should be some vegetation in assembly areas. Airflow is sufficient in the assembly area should be determined with consideration for the prevailing wind direction and speed. For natural drainage and wastewater drainage, the gradient of slope in the areas should be between 2% and 4% and areas with a slope of more than 7% should not be selected. The soil structure of the area, its permeability, thickness, and the possibility of its being affected by further natural events should be taken into consideration. If all these criteria are evaluated together, it is thought that the emergency assembly areas chosen will be better overall (Akdur, 2001; JICA and IMM, 2002; Özdemir, 2004; Sphere Project, 2000; Zengin Çelik et al., 2017).

Furthermore, to minimize potential losses in the event of a disaster and ensure the safety of individuals, it is important to select assembly areas that are located at a distance of at least twice the height of the surrounding buildings. In addition, the roads, bridges, viaducts, and power lines that provide access or are linked to these areas should be durable. It is also important to ensure that emergency assembly areas are not close to flood areas, landslide areas, and active volcanoes (Ünen and Şahin, 2011; Zengin Çelik et al., 2017).

Since roads with a width of less than 7 meters have a high risk (98%) of closure in the event of a possible disaster (JICA and IMM, 2002), it is necessary that emergency assembly areas are accessed by wider roads. The areas selected should be connected to main roads with high accessibility that are not likely to be closed. After a disaster, emergency transportation routes are important for evacuation, information-gathering, and providing medical aid. Evacuation routes should be identified before a disaster, and the designated routes should ensure quick access to assembly areas, healthcare facilities, and areas where tents are located (Aman, 2019; Buldurur and Kurucu, 2015).

3. Methodology

In this study, which involved theoretical framework and field research, both qualitative and quantitative research were used. For the theoretical framework, document review and content analysis were used as the qualitative research methods.

The information obtained from theoretical research was then tested in the context of field research. In the sample field study, the emergency assembly areas were examined in terms of both qualitative and quantitative criteria. They were analyzed qualitatively within the scope of the criterion of appropriateness (usability, accessibility, safety) and quantitatively within the scope of the criterion of adequacy (m^2 per capita) (see **Figure 1**).

This study addressed emergency assembly areas under the main headings of appropriateness and adequacy. The appropriateness criterion was examined qualitatively and the adequacy criterion was examined quantitatively. For the appropriateness criterion, three criteria were determined. These were usability, accessibility, and safety. Usability was examined in terms of the size of the area,

ownership, occupancy/space, slope, climatic characteristics, firm ground/soft ground ratio, vegetation, and first aid materials. Accessibility was examined in terms of the road grading, walking distance, proximity to health facilities, access to the area, access within the area, and the presence of emergency transportation routes. Safety was examined in terms of the issues of fault lines, geological formation, ground characteristics and suitability, landslides, stream flood area, power transmission line, natural gas (line valve, pressure stations), water lines, bridge and viaducts, proximity of hazardous facility, number of floors in surrounding buildings, building structure (separate, block, adjacent) and ground floor use. For the criterion of adequacy, the capacity (m^2 per capita) was determined as the criteria. All the emergency assembly areas in the Battalgazi district were examined according to these criteria and sub-variables.

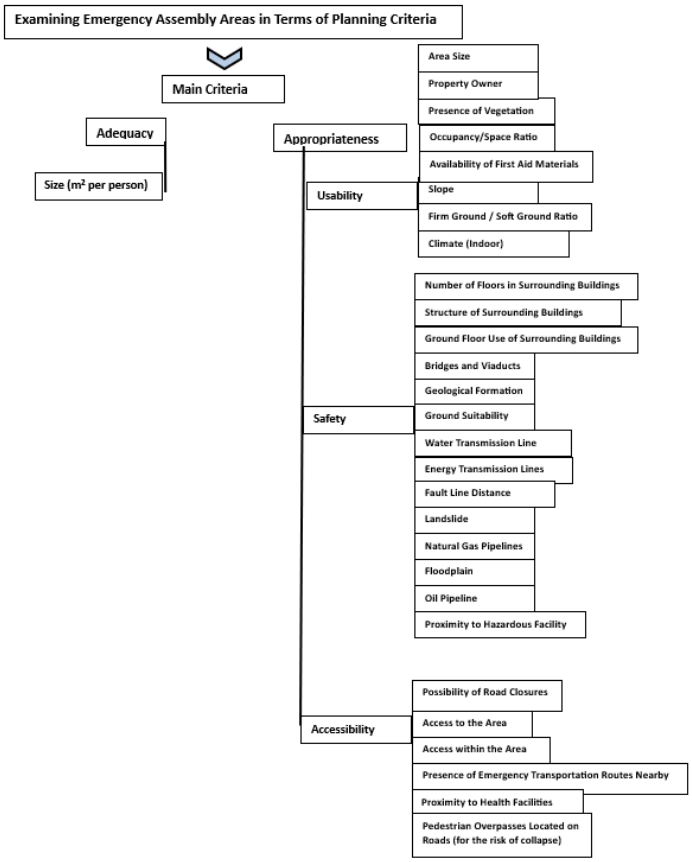

Figure 1. Analysis of emergency assembly areas within the scope of main criteria and sub-variables.

Within the scope of the study, the emergency assembly area planning criteria were created by using various studies (Aman, 2019; Akdur, 2001; Buldurur and Kurucu, 2015; Çavuş, 2013; Erdin et al., 2019; JICA and IMM, 2002; Maral et al., 2015; Özdemir, 2004; Sphere Project, 2000; Ünen and Şahin, 2011; Zengin Çelik et al., 2019).

In the field research, the disaster risks related to the Battalgazi district were interpreted using maps obtained from the National Water Management System. In this section, data on ownership and spatial dimensions of the emergency areas, which fell under the usability sub-variable of the appropriateness criterion, were obtained through one-on-one interviews conducted at Malatya Metropolitan Municipality. During the interviews with the municipality, information about the geology of the

emergency assembly areas, first aid materials available, and other detailed information were obtained. The slope values were calculated using Google Earth. The degree of occupancy/space around the emergency assembly areas was obtained through color coding on images taken from Google Earth. Occupancy/space rates were created by examining the areas using Google Earth's aerial photography.

Since emergency transportation routes had not been determined by the AFAD and Malatya Metropolitan Municipality, and these fell under the accessibility sub-variable of the appropriateness criterion, the widths of the existing roads leading to emergency assembly areas were examined to identify roads at risk of closure. The criterion of proximity to health facilities was calculated based on the health facility closest to the emergency assembly areas. In addition, areas that were within 500 meters were identified using Google Earth. In-area accessibility (at the parcel level) was evaluated in terms of obstacles such as fences or walls around the assembly areas as a result of on-site observations.

Within the scope of the safety sub-variable under the appropriateness criterion, an inspection was made of the structure coefficient and layout, ground floor use, use of hazardous facilities, bridges, and viaducts during on-site observations. Geological and ground condition data was obtained from the Malatya Metropolitan Municipality. In addition, the geological structure of these areas was examined using data from the Mining Technical Exploration Institute. The data regarding the existing water lines within Battalgazi Municipality was obtained from MASKİ (Malatya Water and Sewerage Administration), data regarding the natural gas main line was obtained from Aksa Natural Gas, and data regarding the energy transmission line was obtained using data from the master plan analysis. Stream floodplains were obtained through maps compiled by the National Water Management System. The data regarding landslide and flood situations were gathered through discussions with the General Directorate of State Hydraulic Works (DSİ) 9th Regional Directorate. The adequacy criterion was approached and interpreted comparatively by considering the sizes of the areas studied, and the number of square meters per person.

4. Results

4.1. Examination of emergency assembly areas in Battalgazi district through planning criteria

In this section, the emergency assembly areas in the Battalgazi district are examined in terms of the criteria of appropriateness and adequacy. There are a total of 103 neighborhoods in the district. However, there are only eight emergency assembly areas in total within the boundaries of the district. The neighborhoods with emergency assembly areas are the Üçbağlar, Zafer, Fırat, Orduzu, Taştepe, and Alacakapı neighborhoods (**Figure 2, Table 1**).

Figure 2. Assembly areas in Battalgazi district and their uses.

Table 1. The size and type of assembly areas in Battalgazi district

Emergency Assembly Areas	Size	Type of Use
Mişmiş Park	104,480.50 m^2	Green area
Hürriyet Park	27,090.50 m^2	Green area
Şehit Kemal Öz Alper High School	37,500.50 m^2	School area
Community Garden	40,800.80 m^2	Green area
Firat Neighborhood Mukhtar	1700.30 m^2	Green area
Battalgazi Municipality	29,112.60 m^2	Town hall garden
Nevzat Er Park	3285.20 m^2	Green area
100. Yıl İmam Hatip Secondary School	2770.20 m^2	School area

4.1.1. Appropriateness (Parcel Scale) (Qualitative)

Usability

The extent to which emergency assembly areas can be used was questioned based on their size, ownership, occupancy/space, slope, climatic features, vegetation, firm ground/soft ground ratio, and availability of first aid materials.

The average size of the emergency assembly areas is 30,500.00 m^2. The largest is the Mişmiş Park emergency assembly area with 104,480.50 m^2, while the smallest is the Firat Neighborhood Mukhtar emergency assembly area with 1700.30 m^2. According to the planning criteria, emergency assembly areas should not be less than 500 m^2. All the fields meet the size criterion (**Figure 3**).

The emergency assembly areas have slopes ranging between 0% and 4.6%. The emergency assembly area with the steepest slope is Mişmiş Park (4.6%), while the areas with a 0% gradient include the Fırat neighborhood Mukhtar, Battalgazi Municipality, Nevzat Er Park, and 100. Yıl İmam Hatip Secondary School emergency assembly areas (**Table 2**). All the emergency assembly areas are owned by the State Treasury. The occupancy rates of the emergency assembly areas range from 13% for Mişmiş Park to the 56% for the Fırat Neighborhood Mukhtar area. Only the emergency assembly area of 100. Yıl İmam Hatip Secondary School does not have a soft ground.

Figure 3. Battalgazi district emergency assembly areas.

Table 2. Usability of Battalgazi district emergency assembly areas.

Emergency Assembly Area / **Criteria**	**Mişmiş Park**	**Hürriyet Park**	**Şehit Kemal Özalper High School**	**Community Garden**	**Fırat Neighborhood Mukhtar**	**Battalgazi Municipality**	**Nevzat Er Park**	**100. Yıl İmam Hatip Secondary School**
Size	104,480.50 m^2	27,090.50m^2	37,500.50 m^2	40,800.80 m^2	1700.30 m^2	29,112. 60 m^2	3285.20 m^2	2770.20 m^2
Property Owner	State Treasury	State Treasury	State Treasury	State Treasury	State Treasury	State Treasury	State Treasury	State Treasury
Availability of First Aid Materials	None	None	None	None	None	None	None	None
Slope Ratio	4.6%	4.4%	1%	1.1%	0.0%	0.0%	0.0%	0.0%
Presence of Vegetation	Yes	Green area surrounded by trees	Partial	Partial	Yes	Partial	Green area surrounded by trees	None
Climate (Indoor)	Yes	None	Yes	None	None	Yes	None	Yes
Occupancy/Space Ratio	Empty: 87% Full: 13%	Empty: 68% Full: 32%	Empty: 65% Full: 35%	Empty: 61% Full: 39%	Empty: 44% Full: 56%	Empty: 62% Full: 38%	Empty: 54% Full: 46%	Empty: 48% Full: 52%
Firm ground/soft ground ratio	Firm ground: 34% Soft ground: 66%	Firm ground: 39% Soft ground: 61%	Firm ground: 76% Soft ground: 24%	Firm ground: 12% Soft ground: 88%	Firm ground: 38% Soft ground: 62%	Firm ground: 23% Soft ground: 77%	Firm ground: 59% Soft ground: 41%	Firm ground: 100% Soft ground: 0%

When the assembly areas were examined under the heading of usability, it was determined that:

The emergency assembly areas do not have slopes greater than 7%.

Although Şehit Kemal Özalper High School, Community Garden and Battalgazi Municipality emergency assembly areas have partial vegetation cover, there is no vegetation cover in the 100.Yıl İmam Hatip Secondary School emergency assembly areas.

Since the 100.Yıl İmam Hatip Secondary School emergency assembly area has 100% firm ground, it may pose difficulties during rainy conditions and extreme temperatures.

First aid materials needed in a disaster are not available in any assembly area.

Accessibility

The emergency assembly areas in the Battalgazi district were examined in terms

of access to the area, in-area access, proximity to health facilities, pedestrian overpasses on these roads, emergency transportation routes, and the possibility of road closures.

Out of the 103 existing neighborhoods within the borders of the Battalgazi district, emergency assembly areas have been designated within only six neighborhoods (the Orduzu, Zafer, Üçbağlar, Alacakapı, Fırat, and Taştepe neighborhoods). The fact that four of the designated emergency assembly areas (Hürriyet Park, Şehit Kemal Özalper High School, Community Garden, and Battalgazi Municipality) are located immediately next to each other is an indication of a problem in site selection.

No emergency transportation routes have been determined in any of the emergency assembly areas in the Battalgazi district. Only Şehit Kemal Özalper High School and 100. Yıl İmam Hatip Secondary School have limited access since they are schools (**Figures 4** and **5**). In particular, in both these areas access is not possible at the weekend because the sites are closed and the external doors are locked. In addition, there are no health facilities close to the Mişmiş Park and 100. Yıl İmam Hatip Secondary School emergency assembly areas.

Figure 4. Şehit Kemal Özalper high school emergency assembly area (Photos by authors, 2021).

Figure 5. 100. Year Imam Hatip Secondary School emergency assembly area (Photos by authors, 2021).

When the width of the roads and the probability of closure were examined, it was determined that there are many routes that are narrower than 7 meters wide and that have a high probability of closure (98%). Except for the Fırat Neighborhood Mukhtar emergency assembly area, all the other assembly areas are accessed through roads with a width of 2 to 6 meters and a 98% risk of closure (**Figure 6**). Additionally, only Nevzat Er Park, Fırat Neighborhood Mukhtar, Community Garden and Battalgazi Municipality emergency assembly areas have a healthcare facility within a 500-meter walking distance (**Table 3**).

The Şehit Kemal Özalper High School, Fırat neighborhood Mukhtar, 100. Yıl İmam Hatip Secondary School and Nevzat Er Park emergency assembly areas are at risk of road closures if demolition work is required as a result of a disaster, due to the high density of buildings on the adjacent blocks. This situation could hinder vehicle and pedestrian mobility during disasters.

Table 3. Accessibility of emergency assembly areas.

Emergency Assembly Area / **Criteria**	**Possibility of road closures**	**Presence of Emergency Transportation Routes Nearby**	**Proximity to Health Facilities**	**Pedestrian Overpasses on Roads (for the risk of collapse)**	**Access to the Area**	**Access within the Area**
Mişmiş Park		None	5659.35 m: University Hospital 4880.88 m: Private Malatya Park Hospital	None	Yes	Yes
Hürriyet Park		None	1000 m: Malatya 300-bed State Hospital 1000 m: Malatya State Hospital	None	Yes	Yes
Şehit Kemal Özalper High School		None	700 m: Malatya State Hospital 800 m: Malatya 300-bed State Hospital	None	Yes	None
Community Garden		None	900 m: Malatya 300-bed State Hospital 500 m: Malatya State Hospital	None	Yes	Yes

Table 3. (*Continued*).

Emergency Assembly Area / Criteria	Possibility of road closures	Presence of Emergency Transportation Routes Nearby	Proximity to Health Facilities	Pedestrian Overpasses on Roads (for the risk of collapse)	Access to the Area	Access within the Area
Fırat Neighborhood Mukhtar		None	450 m: Fırat District Polyclinic 750 m: Malatya 300-bed State Hospital	None	Yes	Yes
Battalgazi Municipality		None	500 m: Malatya State Hospital 900 m: Modern Medical Center	None	Yes	Yes
Nevzat Er Park		None	260 m: Battalgazi District Polyclinic	None	Yes	Yes
100. Yıl İmam Hatip		None	1400 m: Nisa Health Cabin 2900 m: Malatya Training and Research Hospital	None	Yes	None

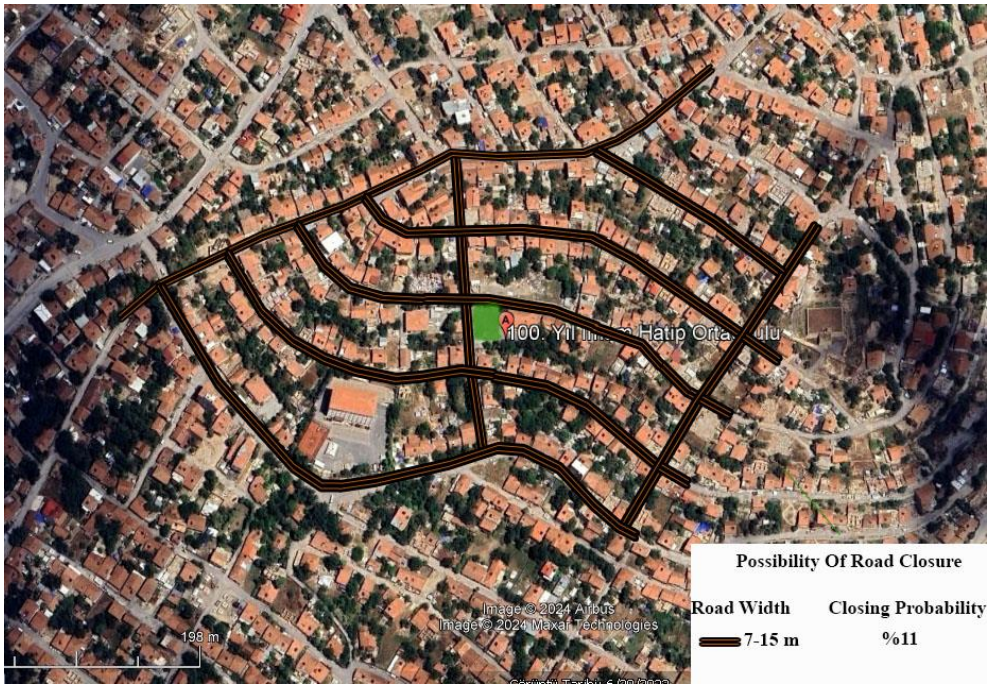

Figure 6. Fırat neighborhood mukhtar emergency assembly area.

Safety

The emergency assembly areas were examined in terms of the safety sub-variable, based on aspects such as the number of floors in surrounding buildings, structure of surrounding buildings, ground floor usage of surrounding buildings, proximity to hazardous facilities, bridges and viaducts, geological formation, ground suitability, energy transmission lines, oil pipelines, main natural gas pipelines, water transmission lines, fault lines, landslides, and floodplain areas.

There are no bridges, viaducts or hazardous facilities around any of the emergency assembly areas. There are no active landslide areas and fault lines close to the areas. According to the criteria of the Ministry of Environment, Urbanization and Climate Change, emergency assembly areas should be located at least 500 meters away from such hazards (URL-1, 2023). All the areas in the research area meet this criterion. Examining the flood areas in the study area, although there is no direct flood risk, there are flood risk areas within the impact radius/walking distance (500 meters). There is a flood risk area immediately adjacent to the Hürriyet Park emergency assembly area, and approximately 25% of the walking distance (500 meters) to the emergency assembly area in front of Battalgazi Municipality is also within an area at risk of flood risk. Approximately 20% of the walking distance (500 meters) to the Community Garden emergency assembly area is within the flood risk area. While the 100. Yıl İmamhatip Secondary School is at risk of liquefaction, Hürriyet Park, Şehit Kemal Özalper School, Community Garden and Battalgazi Municipality are within the impact area of both liquefaction and earthquake fault lines (500 meters). Of the Mişmiş Park emergency assembly area, 60% is located in the liquefaction area, while 40% is in the landslide area and 20% in the earthquake risk. When multiple risk assessments are made, 20% of this area is subject to earthquake, liquefaction and landslide risk, while approximately 10% of it is at risk of liquefaction and landslide

together (**Figure 7**). While the Fırat Neighborhood Mukhtar emergency assembly area has both oil and water transmission lines passing nearby, the other assembly areas are not situated near energy transmission lines, oil pipelines, or water transmission lines. However, in terms of soil structure, the only wholly suitable area is the Fırat Neighborhood Mukhtar emergency assembly area.

Emergency assembly areas should be located at a distance from any surrounding buildings that is at least twice the height of these buildings. When the road widths, distances and building heights around them were examined together, it was determined that none of the assembly areas except Mişmiş Park are appropriately located in this regard (**Table 4**). In addition to this, all buildings around the emergency assembly area, except Nevzat Er Park, are designed in detached buildings. The buildings around the Nevzat Er Park emergency assembly area should be carefully monitored as they may cause road closures in case of collapse after an earthquake.

Table 4. Safety of Battalgazi district emergency assembly areas.

Emergency Assembly Area	**Mişmiş Park**	**Hürriyet Park**	**Şehit Kemal Özalper High School**	**Community Garden**	**Fırat Neighborhood Mukhtar**	**Battalgazi Municipality**	**Nevzat Er Park**	**100. Yıl İmam Hatip**
Criteria								
Number of Floors in Surrounding Buildings	2	3, 4 and 7	3, 4 and 7	4, 5 and 7	4, 5	4, 5	2, 3 and 4	3
Structure of Surrounding Buildings	Single	Single	Single	Single	Single Twin	Single	Block	Single Twin
Ground Floor Use of Surrounding Buildings	Housing	Commercial	Commercial	Commercial	Housing	Housing	Commercial	Housing
Proximity to Hazardous Facility	None	None	None	None	None	None	None	None
Bridges and Viaducts	None	None	None	None	None	None	None	None
Geological Formation	Middle-Upper Eocene	Quaternary-aged Alluvial	Quaternary-aged Alluvial	Quaternary-aged Alluvial	Middle-Upper Eocene-aged Formation Limestone Member	Quaternary-aged Alluvial	Quaternary-aged Alluvial	Pliocene-aged Sultansuyu Formation Pebble Member
Ground Suitability	Precautionary Area 5.1 (PA-5.1): Swelling; Problematic in Terms of Settlement	Precautionary Area 5.1 (PA-5.1): Swelling; Problematic in Terms of Settlement	Precautionary Area 5.1 (PA-5.1): Swelling; Problematic in Terms of Settlement	Precautionary Area 5.1 (PA-5.1): Swelling; Problematic in Terms of Settlement	Suitable Area-2 (SA-2): Rock Environments	Precautionary Area 5.1 (PA-1): Swelling; Problematic in Terms of Settlement	Precautionary Area 5.1 (PA-5.1): Swelling; Problematic in Terms of Settlement	Precautionary Area 5.1 (PA-5.1): Swelling; Problematic in Terms of Settlement
Water Transmission Line	None	None	None	None		None	None	None
Energy Transmission Line	None	None	None	None	None	None	None	None

Table 4. (*Continued*).

Emergency Assembly Area / Criteria	Mişmiş Park	Hürriyet Park	Şehit Kemal Özalper High School	Community Garden	Fırat Neighborhood Mukhtar	Battalgazi Municipality	Nevzat Er Park	100. Yıl İmam Hatip
Fault Line Distance	3000 m	6900 m	6700 m	6800 m	6300 m	6600 m	9400 m	8000 m
Landslide	None	None	None	None	None	None	None	None
Oil Pipeline	None	None	None	None		None	None	None
Natural Gas Main Line			None	None	None	None		None
Floodplain	475 m	730 m	845 m	980 m	1500 m	1200 m	130 m	1600 m

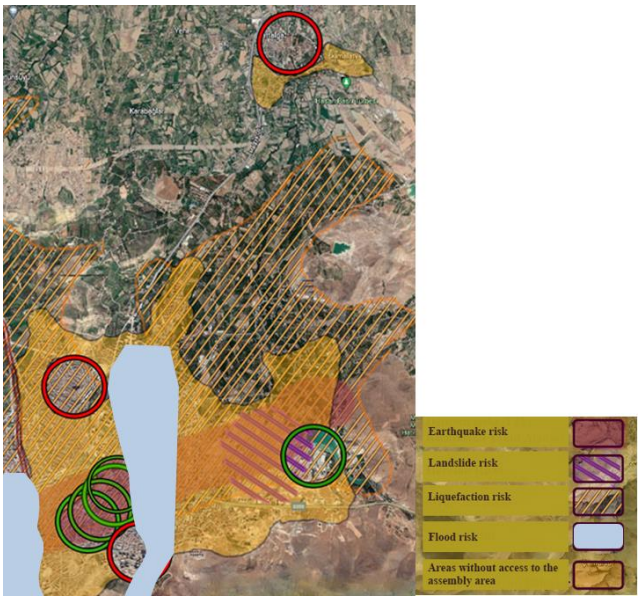

Figure 7. Emergency assembly area locations in terms of safety.

4.1.2. Adequacy (District/Neighborhood Scale) (Quantitative)

Under the heading of adequacy, square meters per capita were calculated both at the neighborhood scale and within 500-meter radii in the Battalgazi district. The Japan International Cooperation Agency (JICA and IMM, 2002), states that emergency assembly areas must be planned with a gross area of 1.5 m² per person.

When examined in terms of m^2 per capita at the neighborhood scale, the Mişmiş Park (7.43 m^2/person), Hürriyet Park (2.07 m^2/person), Şehit Kemal Özalper High School (2.87 m^2/person), Community Garden (8.11 m^2/person), Battalgazi Municipality (5.78 m^2/person) emergency assembly areas are adequate, while the Fırat Neighborhood Mukhtar (0.09 m^2/person), Nevzat Er Park (0.79 m^2/person), and 100. Yıl İmam Hatip Secondary School (0.68 m^2/person) emergency assembly areas are inadequate due to their size.

When examining the m² per capita within 500-meter radii, it was observed that

the Mişmiş Park (2612 m^2/person), Şehit Kemal Özalper High School (2.08 m^2/person), Community Park (2.34 m^2/person), and Battalgazi Municipality (1.7 m^2/person) emergency assembly areas are adequate. However, the Fırat Neighborhood Mukhtar (0.15 m^2/person), Nevzat Er Park (0.69 m^2/person), 100. Yıl İmam Hatip Secondary School (0.34 m^2/person), and Hürriyet Park (1.4 m^2/person) emergency assembly areas are inadequate due to their size (**Table 5**).

Table 5. Adequacy of emergency meeting areas.

Emergency Assembly Area Neighborhood Name	**Adequacy (Neighborhood Scale)**				**Adequacy (Based on a radius of 500 m from the Area)**			
	Area m^2	**Neighborhood Population**	**Adequacy**		**Field**	**500 m Population**	**Adequacy**	
Mişmiş Park Area Orduzu Neighborhood	104,480	14,058	7.43	+	104,480	40	2612	+
Hürriyet Park Zafer Neighborhood	27,090	13,065	2.07	+	27,090	18,204	1.4	-
Sehit Kemal Özalper Zafer Neighborhood	37,500	13,065	2.87	+	37,500	17,990	2.08	+
Community Garden Üçbağlar Neighborhood	40,800	5029	8.11	+	40,800	17,370	2.34	+
Fırat Neighborhood Mukhtar Firat Neighborhood	1,700	17,779	0.09	–	1,700	11,160	0.15	–
Battalgazi Municipality Üçbağlar Neighborhood	29,112	5029	5.78	+	29,112	17,210	1.7	+
Nevzat Er Park Alacakapı Neighborhood	3,285	4,153	0.79	–	3,285	4,750	0.69	–
100. Yıl İmam Hatip Taştepe Neighborhood	2,770	4,059	0.68	–	2,770	7,930	0.34	–

Source: Prepared by the authors.

The population of the Battalgazi district is 810,714 people. The number of people located within 500 m of the emergency assembly area is 94,654. The population able to immediately access the emergency assembly area is thus 7.5% of the district's population. The fact that four emergency assembly areas (Hürriyet Park, Şehit Kemal Özalper High School, Community Garden, Battalgazi Municipality) within the boundaries of Battalgazi district are next to each other and that there are emergency assembly areas in only six of the 103 neighborhoods within the municipal boundaries shows that there are significant problems in the selected locations of these areas (**Figure 8**).

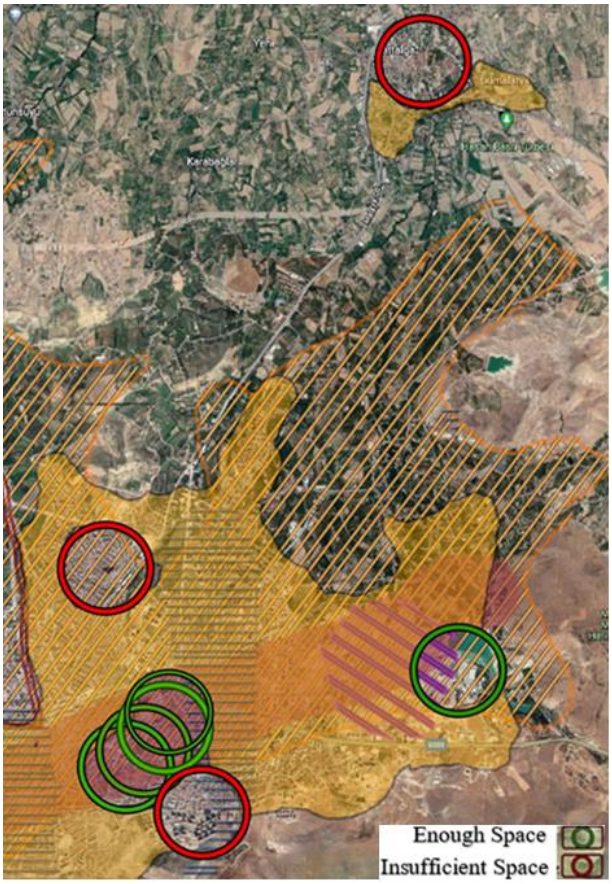

Figure 8. Emergency assembly area's locations.

The red circles with a radius of 500 m in **Figure 4** indicate that the assembly area does not meet the adequacy criterion. Green circles show the assembly areas that are sufficient in terms of size. Finally, the yellow-marked areas are regions that require emergency assembly areas but currently do not have any and that also have no access to gathering areas (**Figure 4**).

5. Discussion

Evaluating the research questions posed at the beginning of the study in light of the study results leads to the following conclusions:

The Mişmiş Park, Şehit Kemal Özalper High School, Community Garden, and Battalgazi Municipality assembly areas fully meet the criterion of adequacy. However, the Fırat Neighborhood Mukhtar, Nevzat Er Park, and 100. Yıl İmam Hatip Secondary School emergency assembly areas do not meet this criterion. The Hürriyet Park assembly area meets the criterion at the neighborhood level, but it does not meet the standard for providing adequate space within a 500-meter distance for the population. Therefore, in the relevant neighborhoods, alternative emergency assembly areas that comply with the standards should be identified both at the neighborhood level and within a 500-meter distance.

When the emergency assembly areas are examined in terms of usability, under the criterion of appropriateness, the Şehit Kemal Özalper High School, Community Garden, and Nevzat Er Park emergency assembly areas meet this criterion at a rate of 62.5%, while the Mişmiş Park emergency assembly area meets it at a rate of 85.7%.

The Hürriyet Park emergency assembly area meets the usability sub-variable at a rate of 75%, while the lowest rate of 43.7% is observed in the 100. Yıl İmam Hatip Secondary School emergency assembly area. Priority should be given in this regard to addressing the most disadvantageous emergency assembly areas, particularly the 100. Yıl İmam Hatip Secondary School and Hürriyet Park emergency assembly areas.

When the assembly areas are examined in terms of accessibility, under the criterion of appropriateness, the Mişmiş Park, Hürriyet Park, and Community Garden emergency assembly areas meet these criteria at 50%. The Battalgazi Municipality and Nevzat Er Park emergency assembly areas meet the accessibility sub-variable at a rate of 66.6%, while the 100. Yıl İmam Hatip Secondary School and Şehit Kemal Özalper High School emergency assembly areas meet it at a rate of 33.3%. The Fırat Neighborhood Mukhtar assembly area meets this sub-variable at 83.3%. Except for the Fırat Neighborhood Mukhtar emergency assembly area, all the assembly areas are accessed through roads with a width of 2 to 6 meters and a 98% risk of closure. In addition, only the Nevzat Er Park, Fırat Neighborhood Mukhtar, and Battalgazi Municipality emergency assembly areas have healthcare facilities within a 500-meter walking distance (**Table 3**). The Mişmiş Park, Hürriyet Park, Community Garden, 100. Yıl İmam Hatip Secondary School, and Şehit Kemal Özalper High School emergency assembly areas are disadvantaged in terms of infrastructure and auxiliary facilities due to factors such as the presence of roads with a high likelihood of closure and their distance from healthcare facilities. Therefore, in these neighborhoods, alternative emergency assembly areas with high accessibility (both to the assembly area and healthcare facilities) should be identified to address these issues.

When examining safety criteria under the appropriateness criterion, Mişmiş Park, Fırat Neighborhood Mukhtar, Battalgazi Municipality, and 100. Yıl İmam Hatip Secondary School emergency assembly areas meet the safety criteria at a rate of 85.7%, while Şehit Kemal Özalper High School and Community Garden assembly areas meet the criteria at a rate of 78.5%. This rate decreases to 71.4% for Hürriyet Park and Nevzat Er Park emergency assembly areas. In general, the emergency assembly areas were more lacking in terms of the accessibility and usability criteria under the appropriateness criterion and better in terms of the safety criteria. Additionally, in terms of the adequacy criterion, Mişmiş Park, Şehit Kemal Özalper High School, Battalgazi Municipality, and Community Garden emergency assembly areas had some positive aspects, while Hürriyet Park, Fırat Neighborhood Mukhtar, Nevzat Er Park, and 100. Yıl İmam Hatip Secondary School emergency assembly areas had more negative aspects.

6. Conclusion

Emergency assembly areas are a topic of extensive discussion in Türkiye, where earthquakes are an inevitable reality. This discussion has become even more pronounced after the Kahramanmaraş earthquakes on 6 February, 2023. When the subject is approached within the framework of the discipline of urban planning, the choice of location, size, and accessibility of emergency assembly areas and their appropriateness and adequacy are the issues that most need to be examined. One of the provinces most affected by the Kahramanmaraş earthquakes, the “disaster of the

century", was Malatya and its surroundings. In this study, the appropriateness and adequacy of emergency assembly areas to be used after an earthquake were examined through the example of Battalgazi, which is the most at-risk district in Malatya.

This study has produced valuable information about the parameters for planning emergency assembly areas not only in districts across Malatya but also in all inhabited areas in Türkiye. For effective disaster risk management, current emergency assembly areas and future proposed sites for all sizes of settlements should be evaluated in terms of the criteria of usability and appropriateness. In this regard, such areas should be planned in safe sites that are accessible to all residents and connected by wide roads. In addition, they must be of sufficient size in relation to the population they will serve. Mandatory standards for the appropriateness and adequacy of emergency assembly areas should be defined through legislation.

After a natural disaster, individuals gathered in emergency assembly areas need to be transported first to regional evacuation areas and then to temporary shelter areas. Therefore, in addition to establishing planning parameters for emergency assembly areas, future studies should also conduct analyses of the usability and appropriateness of regional evacuation areas and sites for temporary shelter. Furthermore, since this study does not focus on the detailed design features of emergency assembly areas, it is necessary in future studies to examine issues related to the usability and design of the space, including for disadvantaged people (the disabled, elderly, children, etc.).

The size, severity and frequency of disasters are increasing day by day, as is the level of risk that such disasters will occur. Since these dangers cannot be completely eliminated, it is of great importance to minimize the damage that disasters may cause. When the adequacy and appropriateness of emergency assembly areas are ensured, the resilience of cities against disasters increases. The novelty of the present study in the literature is that it tests the optimum site selection parameters by examining the local emergency assembly areas after the two major earthquakes that occurred on 6 February 2023. The study contributes to addressing issues around the adequacy and appropriateness of the existing assembly areas in the short term. New local emergency assembly areas planned according to the criteria of adequacy and appropriateness will make significant contributions to reducing disaster risk in the long term.

Author contributions: Conceptualization, YB and GD; methodology, YB and GD; analysis, YB and GD; investigation, YB and GD; resources, YB and GD; writing—original draft preparation, YB and GD; writing—review and editing, YB and GD; visualization, YB and GD; supervision, YB. All authors have read and agreed to the published version of the manuscript.

Conflict of interest: The authors declare no conflict of interest.

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