BUILD CHANGE

BUILD CHANGE NEEDS ASSESSMENT AND POST-DISASTER RECONNAISSANCE REPORT

2023 TÜRKIYE EARTHQUAKE

MARCH 2023

buildchange.org

1001 Bannock St., Suite 467,
Denver, CO, 80204 USA

+1 303 953 2563
info@buildchange.org

Abstract

A needs assessment and reconnaissance report was conducted by the Build Change team after a destructive M7.8 earthquake hit southeast Türkiye on February 6, 2023. The report found that the disaster caused significant damage to buildings and infrastructure, leaving hundreds of thousands of people homeless and in urgent need of shelter. The team identified key priorities for recovery and prevention interventions, such as mitigating vulnerabilities of non-collapsed buildings and gathering information on local policies, procedures and cultural practices. The report's findings will inform the development of a comprehensive response plan that aims to meet the immediate and long-term needs of the affected population, facilitate the recovery and reconstruction of the impacted areas and enhance the resilience of the affected communities.

Executive Summary

Build Change conducted a mission to assess the impact of the earthquakes that struck the southern part of Türkiye on February 6th, 2023. The seismic events caused widespread devastation, resulting in over 50,000 casualties, 200,000 wounded and significant damage to infrastructure, including the collapse or heavy damage of more than 280,000 buildings across 11 provinces. The purpose of the mission, conducted in early March, was to gather extensive data on the impact of the seismic events, on the needs of the population and on the policies in place, with a focus on the three pillars of Build Change's theory of change: People/Policy, Money and Technology.

A primary point of focus for the team was on assessing the damage inflicted on housing and schools within the earthquake-affected provinces of Adana and Hatay, investigating the underlying reasons for the failure and collapse of these structures, evaluating the structural vulnerabilities of the buildings that remain standing and analyzing the materials used and construction techniques adopted. Additionally, the team sought to identify the factors that contributed to the better performance of buildings that survived the earthquakes.

To gain a deeper understanding of the context and dynamics of the earthquake-affected areas, the team also engaged with local residents and leaders, identified community needs and priorities and learned about existing policies and regulations. A range of stakeholders, including local authorities, governmental entities, NGOs and builders, were interviewed to gain a comprehensive understanding of permitting procedures, vulnerability and damage assessments, construction quality supervision, insurance policies, subsidies, loans and construction costs related to housing.

People. The earthquake has had significant social impacts on the affected provinces. The collapse of the business sector and education infrastructure has led to a mass migration of the local population, with people relocating to other cities or to rural areas in search of economic opportunities and better access to education, provided their financial means allow for it. In this context, vulnerable groups such as women, children and minorities without social support networks are at higher risk.

It also has been noted that there are significant differences between rural and urban living in Türkiye, particularly in terms of family structure and housing. In Hatay rural areas, large families often live together and owning a house is considered a symbol of status and prestige; for this reason, houses in Hatay are larger than in other Turkish regions. On the other hand, urban areas, like Adana, are characterized by smaller families living in apartments. Additionally, there is a marked difference in ethnic diversity between Hatay and Adana, with Hatay being home to various ethnic groups living together, while Adana has a more homogenous population.

Policy. Throughout the years there have been multiple laws implemented in Türkiye for zoning amnesty due to demand from informal settlement residents for property rights and the rising number of individuals residing in non-compliant structures. The ‘Zoning Peace’ legislation allows homeowners residing in buildings without construction permits to legalize the status of their buildings by fulfilling certain

requirements, but the legal responsibility for compliance of the earthquake performance falls entirely on the owner of the building.

In a preventative context, conducting an earthquake vulnerability assessment of a building is not mandatory. However, it can be performed at the request of the Ministry or the homeowner(s) by approved institutions. If a building is deemed at risk and no objection is raised, the municipality sets a demolition date, unless the homeowner requests retrofitting. In this latter scenario, homeowners must provide evidence of their retrofitting plans to the municipality before the demolition deadline. If approved, the homeowners are responsible for covering the costs of both retrofitting and reconstruction.

After a disaster, The Ministry of Environment, Urbanization and Climate Change is responsible for organizing damage assessments, which are conducted by individuals accredited by the Ministry. Buildings classified as moderately damaged have one year to undergo retrofitting, otherwise, they will be reclassified as highly damaged and scheduled for demolition.

Money. The DASK (Turkish Catastrophe Insurance Pool) insurance policy is a requirement for almost every registered building in urban areas of Türkiye. However, the fact that many people underestimate the risks associated with natural disasters, along with a lack of knowledge and awareness, leads to low coverage and reimbursement rates. Homeowners are required to take out private home insurance policies for broader coverage, which is mandatory for obtaining housing loans from banks, since the DASK only covers the property's rebuilding or repair costs due to an earthquake. Nevertheless, in this scenario, people tend to cancel their private insurance policies as soon as they have paid off their credit debts.

Publicly funded programs for retrofitting buildings constructed without any civil engineering services in earthquake-prone neighborhoods are considered to be expensive and complex by national and local administrations due to inconsistent quality of materials used, absence of urban planning and unique structures that require individual assessment and design. In rural areas, homeowners have the option to carry out in-situ transformation through a contractor. However, this often results in the construction of taller buildings with smaller individual units, which may exceed the upper limits of the municipal zoning density permit and pose serious safety hazards.

Also, it has been observed that the government provides loans for rebuilding and retrofitting, while state banks have reduced consumer loan interest rates in earthquake-hit cities to support building new houses. Additionally, there are other subsidies available, such as temporary housing assistance, rental assistance, workplace allocation, interest subsidies and evaluation and demolition subsidies.

Technology. The provinces of Adana, Hatay, Şanlıurfa and Gaziantep were the most densely populated areas affected by the disaster. Within this region, Antakya and Defne, both located in the province of Hatay, account for one-third of the building stock in the province and were the two districts that suffered the most damage. Reinforced concrete frames, with or without infill walls, were found to be the most common structural system in the visited areas, both for commercial and residential use. Unreinforced masonry was observed in some low-rise buildings in both urban and rural areas. In rural areas, however, these types of buildings were primarily used as storage facilities and animal shelters.

Regulated non-ductile RC frames with masonry infill, built before the implementation of modern building codes (pre-1998), and non-regulated low-rise unreinforced masonry or non-ductile frames with infill walls buildings both present common deficiencies, including poor quality of concrete and steel reinforcement, poor rebar detailing, insufficient building separation, weak and/or soft stories and deterioration. New buildings constructed after 1998, that were constructed out of compliance with applicable requirements, exhibit comparable vulnerabilities. This is especially concerning since the national government has provided an amnesty that places the liability for the building's seismic performance on the owner, exacerbating the problem.

The earthquake has resulted in significant damage to the building stock, with around 16% of buildings across all affected areas estimated to have sustained moderate to severe damage or require urgent demolition. Hatay province, the most affected area, has a much higher proportion of buildings with moderate to severe damage, with almost 30% of structures falling under this category. Non-ductile reinforced concrete frames and unreinforced masonry buildings are particularly vulnerable to damage or collapse due to the vulnerabilities they present and to the extremely high shaking intensity they have experienced during the seismic events. Additionally, widespread non-structural damage, caused by out-of-plane failure of unreinforced masonry infill walls and parapets, was commonly observed. Schools located in Adana and Hatay provinces also experienced moderate damage, particularly in non-structural walls and gables, which often failed out-of-plane due to their weak connection to the primary structural system.

Recommendations

Drawing from the key findings presented above, a set of recommendations have been identified to aid the affected communities in their recovery efforts and strengthen their resilience.

To ensure the timely recovery of regions impacted by the February 6th, 2023 earthquakes and avoid permanent resettlement in other cities or areas, it is crucial to intervene promptly, ideally within two years of the initial displacement. First and foremost, vulnerable groups, including women, children and minorities without social support networks, should be provided with adequate support and assistance in the aftermath of the disaster.

Moreover, when initiating the reconstruction and repair/retrofit phase, it is fundamental to consider the disparities between rural and urban lifestyles in Türkiye, particularly with regard to family structure and housing. By taking these differences into account, the rebuilding process can be customized to meet the specific needs of each community, enabling all residents to return to safe and secure homes as soon as possible, without feeling uprooted from their familiar surroundings.

Additionally, to mitigate the devastating impact of the earthquakes, it is essential to increase public awareness of earthquake vulnerability assessments, especially for buildings constructed without permits or those that received an amnesty. Encouraging homeowners to conduct assessments voluntarily is also critical. In addition, regulations related to building construction permits need to be strengthened to ensure that all buildings, particularly those most vulnerable, either existing or new, comply with safety standards and are designed to withstand future seismic events. To promote earthquake-resistant

structures, technical assistance and training should also be offered to local institutions and professionals to enhance their capacity to perform retrofitting works.

It is also important that homeowners consider obtaining house insurance as a wise investment to safeguard their homes and belongings and take advantage of the subsidies already made available by the government to lessen the burden on the affected population. Moreover, State authorities can take steps to make retrofitting of existing buildings more appealing, affordable and easier for homeowners. This could include offering additional subsidies, streamlining the retrofitting process and providing more information and resources.

Finally, to enable interventions at scale, we recommend that retrofit designs be made progressive and prescriptive from a technical standpoint. It is also critical to adopt technical and technological tools that can help reduce the time and effort required for each design, with as much automation as possible. By doing so, the retrofitting process can be made more efficient and cost-effective, with benefits for homeowners, contractors, the government and the environment alike.

Build Change remains committed to its mission of improving the safety and the life quality of communities in disaster-prone areas. We will continue to closely monitor the situation and adapt our operations as needed to ensure that we can provide the maximum benefit to those in need. We are confident that our experience and expertise will enable us to identify specific areas where we can make the most significant impact and we look forward to expanding our support in the coming months and years.

Contents

Abstract **3**

Executive Summary **4**

Recommendations 6

Contents **8**

Acronyms and Abbreviations 10

List of Tables 11

List of Figures 11

1. Introduction **13**

2. Mission Overview **15**

2.1 Earthquake 2023 15

2.2 Objectives 16

2.3 Team and itinerary 18

2.3.1 Team 18

2.3.2 Reconnaissance Itinerary 18

3. Needs Assessment Findings **21**

3.1 People 21

3.1.1 Migration 21

3.1.2 Gender 22

3.1.3 Education, child labor and discrimination 23

3.1.4 House occupancy profile 25

3.1.5 Focus on Hatay region 26

3.1.6 Focus on Adana city 29

3.2 Policy 31

3.2.1 Land zoning and permitting procedures 32

3.2.2 Inspection and quality assurance procedures 34

3.2.3 Zoning amnesty 35

3.2.4 Vulnerability and damage assessment procedures 36

3.3 Money 38

3.3.1 Insurance policies and practices 38

3.3.2 Public programs for retrofitting and reconstruction 39

3.3.3 Cost of materials and labor 41

3.4 Technology 43

3.4.1 Building Stock and Types 43

3.4.2 Materials 50

3.4.3 Buildings Vulnerabilities 52

3.4.4 Damage Assessment 54
4. Conclusions and recommendations **60**
5. References **62**
Annex **64**
Country risk profile 64
Analytical framework 66
Resilience agenda 68
Looking forward 69
Avcılar, Istanbul case study 70
Seyhan, Adana case study 70

Acronyms and Abbreviations

AFAD	AFet ve Acil Durum (Disaster and Emergency Management Authority)
ASKI	Ankara Su ve Kanalizasyon İdaresi (General Directorate Water Quality Center)
BDDK	Bankacılık Düzenleme ve Denetleme Kurumu (Banking Regulation and Supervision Agency)
DASK	Doğal Afet Sigortaları Kurumu (Turkish Catastrophe Insurance Pool)
DRR	Disaster Risk Reduction
EERI	Earthquake Engineering Research Institute
EŞİK	Eşitlik İçin Kadın Platformu (Women's Platform)
FEMA	Federal Emergency Management Agency
GDP	Gross Domestic Product
KEYY	Kendi Evini Yapana Yardım (Subsidies for Building Your Own House)
MGM	Meteoroloji Genel Müdürlüğü (General Directorate of Meteorology)
NDRM	National Disaster Risk Management
NEET	Not in Employment Education or Training
NGO	Non-Governmental Organization
PGA	Peak Ground Acceleration
RC	Reinforced Concrete
SME	Small and Medium-sized Enterprise
TAMP	National Disaster Response Plan (Türkiye Afet Müdahale Planı)
TBEC	Turkish Building Earthquake Code
TL	Turkish Lira
TOKi	Toplu Konut İdaresi Başkanlığı (Mass Housing Development Administration)
UAE	United Arab Emirates
VP	Vice President

List of Tables

TABLE 1 Average cost of materials, Adana

TABLE 2 Labor cost, Adana

TABLE 3 Building stock in earthquake affected provinces

TABLE 4 Building stock in Hatay province

TABLE 5 Earthquake-affected areas damage assessment (updated as of…

TABLE 6 Earthquake-affected areas damage assessment (updated as of…

TABLE A-1 Impact of major earthquakes in the last 50…

TABLE A-2 DRR pillars and intervention themes

List of Figures

FIGURE 1 Known active fault lines in Türkiye

FIGURE 2 PGA map for a return period of 475 years

FIGURE 3 Series of earthquakes between February 6th, 2023 and February…

FIGURE 4 Intensity map following the February 6th, 2023 earthquakes

FIGURE 5 Theory of Change

FIGURE 6 Locations of building assessments in Adana and Hatay

FIGURE 7 Example of windshield survey GPS tracking

FIGURE 8 Residential building construction, legal procedure workflow

FIGURE 9 Building Registration Certificate. Amnesty provided by the National Government…

FIGURE 10 Building stock in Türkiye. Low-rise, mid…

FIGURE 11 RC frames in urban areas in Antakya, Hatay

FIGURE 12 RC frames in rural areas in Defne, Hatay

FIGURE 13 Unreinforced masonry in urban areas (Adana)

FIGURE 14 Unreinforced masonry in urban areas, drawings (Adana)

FIGURE 15 Unreinforced block masonry buildings in Balıklıdere village, Hatay

FIGURE 16 Unreinforced stone masonry buildings in Balıklıdereand and Vakıflı villages,…

FIGURE 17 Roof and floors of an unreinforced stone masonry house in…

FIGURE 18 Pumice concrete blocks used as structural material in unreinforced masonry…

FIGURE 19 Hollow clay bricks mainly used as non structural material in…

FIGURE 20 Stone masonry found in rural areas

FIGURE 21 Poor concrete quality and reinforcement detailing

FIGURE 22 Pounding and soft stories

FIGURE 23 Damage assessment of non-ductile RC Frames with or…

FIGURE 24 Damage assessment of non-ductile RC Frames with or…

FIGURE 25 Damage assessment of unreinforced masonry buildings

FIGURE 26 Schools of Antakya, Hatay

FIGURE A-1 Recorded annual number of climate related disasters (…

FIGURE A-2 Fire risk map of Türkiye

FIGURE A-3 Proactive vs. reactive (D stands for…

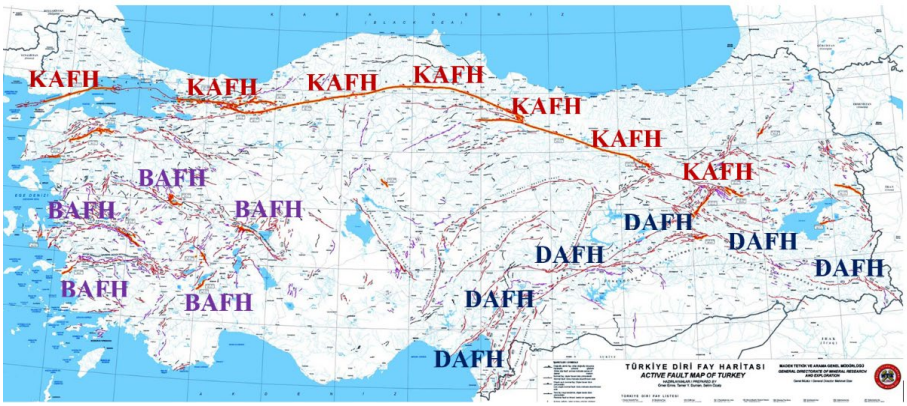
FIGURE A-4 Seismic intensity distribution map for a Mw 7…

FIGURE A-5 Previous earthquakes near Seyhan region

1. Introduction

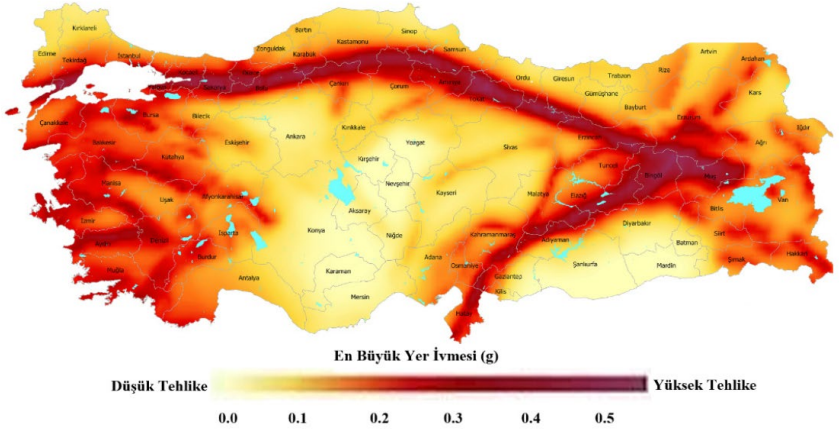
Türkiye is a seismic country, with over 70% of its population living in active seismic zones. Historic records indicate that there is an earthquake of magnitude Mw 6.0 to 6.9 every year and an earthquake of magnitude greater than Mw 6.9 every ten years. Figure 1 shows the known active fault lines and Figure 2 shows the expected Peak Ground Acceleration (PGA) map for a return period of 475 years. While the probability of occurrence is a constant, the increase in population in high-risk areas and inadequate urbanization patterns cause increasing impact on lives and buildings.

FIGURE 1 *Known active fault lines in Türkiye*



SOURCE: GENERAL DIRECTORATE OF MINERAL RESEARCH AND EXPLORATION, 2023[1]

FIGURE 2 *PGA map for a return period of 475 years*



SOURCE: DISASTER AND EMERGENCY MANAGEMENT PRESIDENCY[2]

[1] https://www.mta.gov.tr/v3.0/hizmetler/yenilenmis-diri-fay-haritalari

[2] https://www.afad.gov.tr/turkiye-deprem-tehlike-haritasi

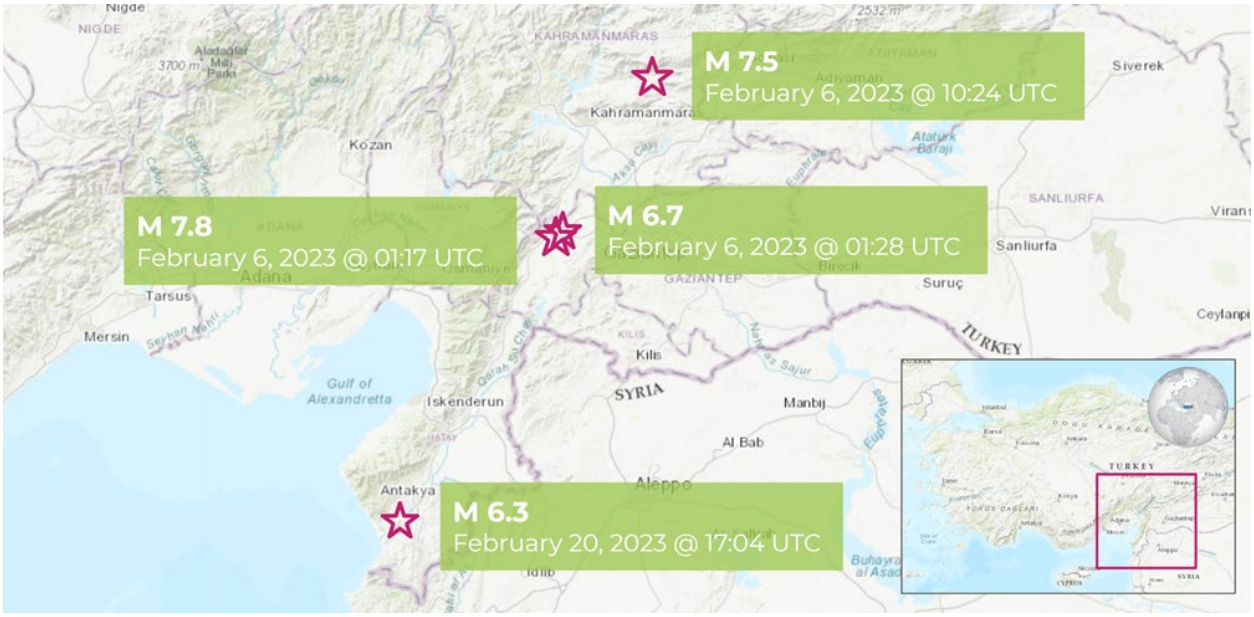
Türkiye is experiencing an increase in the frequency and intensity of adverse climatic events, which are more damaging than earthquakes. Floods, storms, hails, wildfires, drought and heatwaves are the most frequent and destructive disasters. Coastal areas are particularly prone to sea level rise, coastal flooding, and erosion, with Istanbul and Izmir being the most at-risk port cities in Europe. The recent wildfires of 2021 and the 2023 earthquakes indicate a pattern of increasing cumulative risk, which is exacerbated by the ongoing El Niño episode. Communities in Türkiye have different risk profiles and capacities, leading to different postures towards risk management. Some communities are proactive, having more time and resources for risk reduction, while others are reactive, focusing on disaster management and recovery needs. Türkiye has adopted an integrated disaster risk management system in 2009, but more work is needed regarding climatic hazards. For further details, please refer to the Annex.

2. Mission Overview

2.1 Earthquake 2023

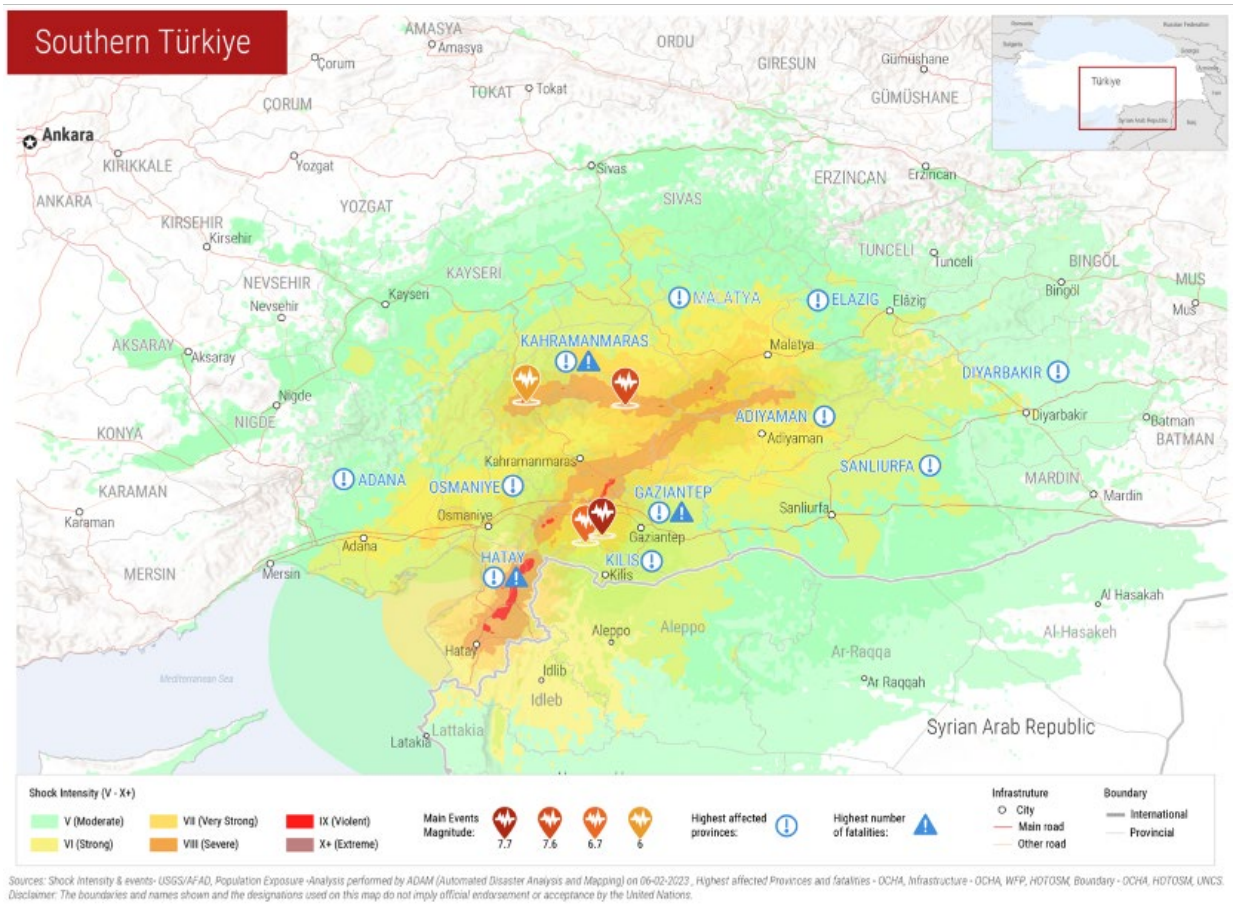
A series of devastating earthquakes shook the southern part of Türkiye on February 6th, 2023, resulting in ground movements exceeding the ones defined in the most recent Turkish building code (TBEC-2018). Two shocks larger than M 7 impacted, 9 hours apart, 11 provinces out of 81 in the country, home to a total population of 15.6 million inhabitants (17% of the national population). The total affected area is estimated to be 110,000 km^2 (14% of Türkiye's total surface area) and represent 10% of the national GDP. Figure 3 shows the epicenter of the earthquakes and Figure 4 shows the intensity map, with an estimated 9.1 million inhabitants in areas shown as "very strong" and above. The human impact is the highest ever recorded in Türkiye's history, over 50,000 casualties and 200,000 wounded. 280,000 buildings collapsed or sustained heavy damage and the total economic impact, damage and loss included, is estimated at 103.6 billion USD (9% of the national GDP). The amount of debris to be removed is estimated at 246 million tons.

FIGURE 3 *Series of earthquakes between February 6th, 2023 and February 20th, 2023*



SOURCE: BUILD CHANGE, USGS

FIGURE 4 *Intensity map following the February 6th, 2023 earthquakes*

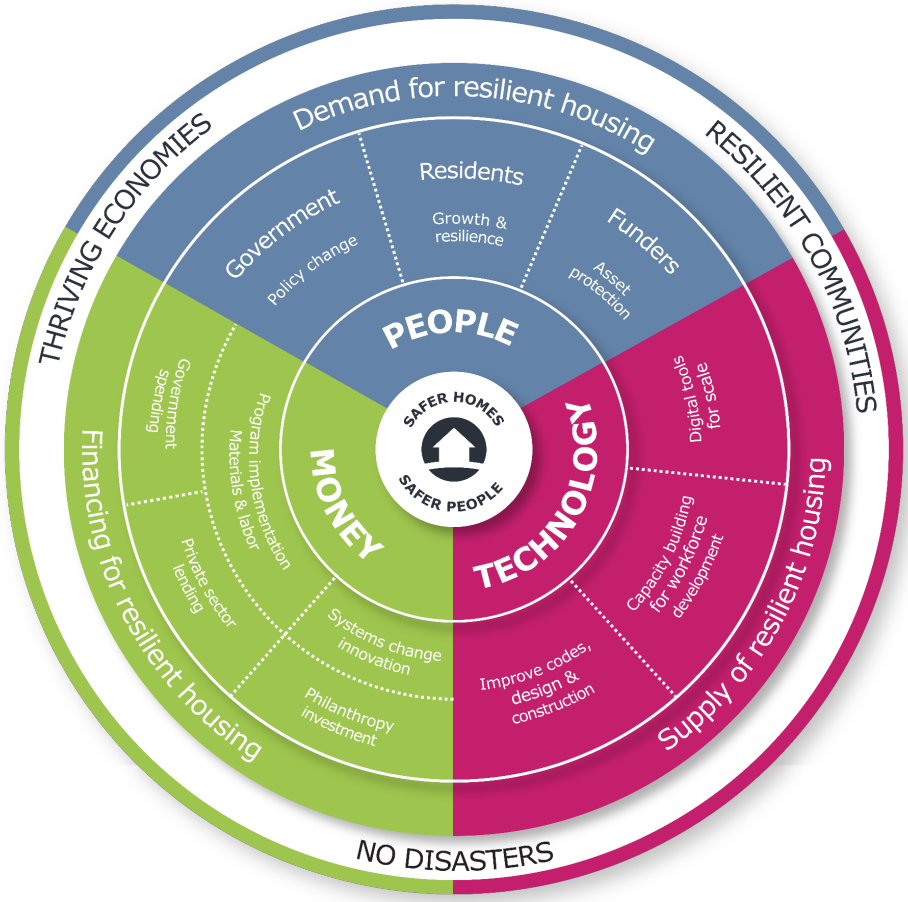


SOURCE: USGS, AFAD, ADAM, OCHA, WFP, HOTOSM

2.2 Objectives

The mission uses a practical approach to analyze opportunities and challenges with a 360-degree perspective, covering People/Policy (P), Money (M) and Technology (T) aspects. This approach allows Build Change to identify niche areas for operations, knowledge products, and decision-making tools, while also providing holistic technical support to relevant stakeholders ranging from guideline drafting to training on best construction practices. Figure 5 shows the scope of activities and how they can interact.

FIGURE 5 *Theory of Change*



SOURCE: BUILD CHANGE

Build Change conducted a reconnaissance mission aimed at gathering holistic information on the impact of the earthquakes that struck Southeastern Türkiye in February 2023, based on the organization's Theory of Change. The mission's main goal is to gather extensive data on the impact, mainly on housing and schools, of the seismic events that affected the region, while focusing on the three pillars in Build Change's Theory of Change: People/Policy, Money and Technology. By building understanding across these three pillars, Build Change aims to identify opportunities to most effectively assist affected communities in their recovery efforts and to contribute to their resilience.

People/Policy. The team engaged with local residents and leaders to gain a deeper understanding of the context and dynamics of the earthquake-affected areas, to identify community needs and priorities, as well as to learn about the existing policies and regulations.

Money. The team consulted with a range of stakeholders including local authorities, governmental entities, NGOs and builders to gain a comprehensive understanding of construction costs, insurance policies, financing, subsidies and loans related to housing.

Technology. The team focused on the assessment of the damage to housing and, to a lesser extent, to school buildings within the earthquake-affected region, investigating the underlying reasons for the failure and collapse of these structures. At the same time, the team evaluated the structural vulnerabilities of the buildings that remain standing, the materials used and the construction techniques adopted, as well as the buildings that have performed well, in order to identify the factors that contributed to their better performance.

2.3 Team and itinerary

2.3.1 Team

A team of eight people, including a local cameraman and two drivers, conducted reconnaissance on the earthquake-affected areas in Türkiye. The team was composed of Alper Altuntop, a senior structural engineer working in Adana, Ferzan Özyaşar, a sociologist and project manager working in Seyhan Municipality in Adana, Sofia Andrade and Stefano Pompei, respectively Lead Structural Engineer for Colombia and Technology for Engineering Project Manager at Build Change, and Şeyma Ertürk, a junior field engineer.

In parallel, a smaller team consisting of Juan Caballero, VP of Programs, Noll Tufani, Senior Business Development, and Erdem Ergin, Türkiye Response Advisor, conducted stakeholder meetings and a field trip to Avcilar, in Istanbul.

2.3.2 Reconnaissance Itinerary

The team carried out post-disaster reconnaissance studies primarily in the Adana and Hatay provinces. This involved conducting windshield surveys, damage assessments, and meetings with authorities, as well as interviewing local people. The locations where building assessments were performed are illustrated in Figure 6.

Antakya Center and Defne District, HATAY - March 9th, 2023

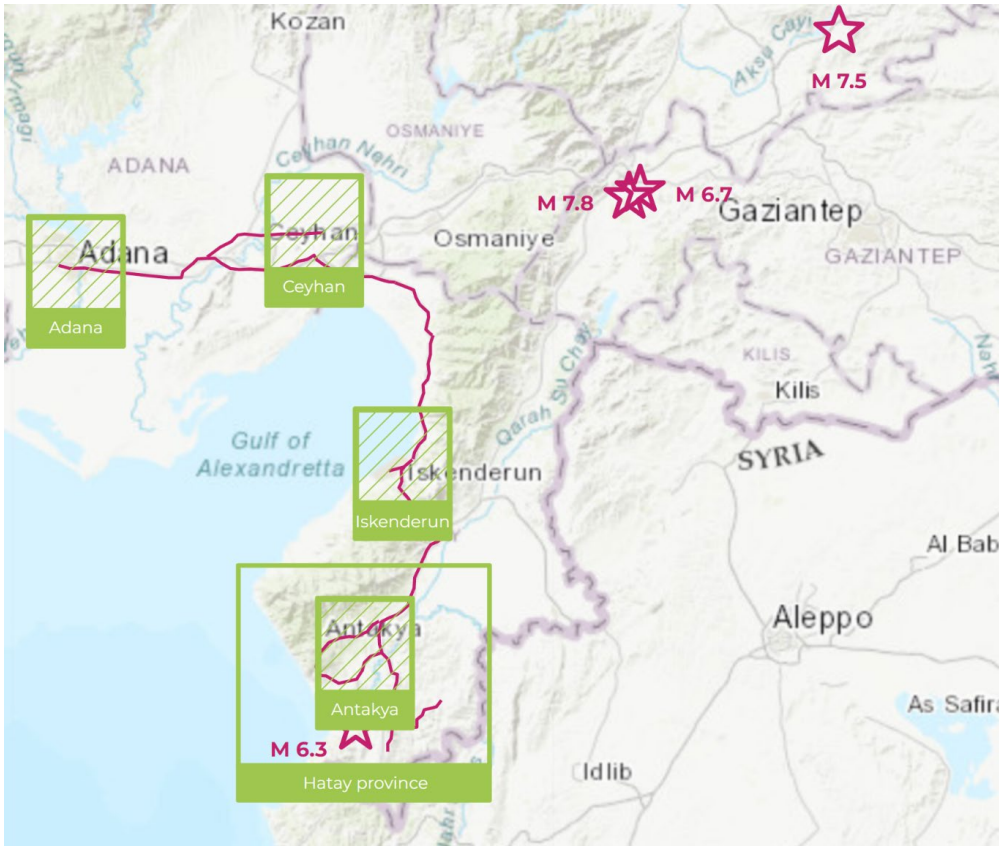
In the center of Antakya, the earthquake caused severe structural damage and almost all the buildings collapsed. For safety reasons, observations were made from a distance via car, and visual data was collected from the destroyed areas. Additionally, on the same day, some visual observations were made in the Defne district to assess the overall level of damage.

The Village of Vakıflı, HATAY - March 9th, 2023, March 14th, 2023

To gain an understanding of the informal structures in the Hatay province, the team visited the Vakıflı village. This village is significant culturally, as it is the last remaining Armenian village in Türkiye and

consists of 35 buildings. Initially, a meeting was held with local leaders to understand the rural structure and how the earthquake affected the village. On March 14, 2023, detailed building assessments were conducted on low-story masonry buildings, which are typical in the Vakıflı village. Additionally, interviews were conducted with local leaders, house owners and producers to gain insight into the concept of informal construction, the materials used and the social structure of the village.

FIGURE 6 *Locations of building assessments in Adana and Hatay*

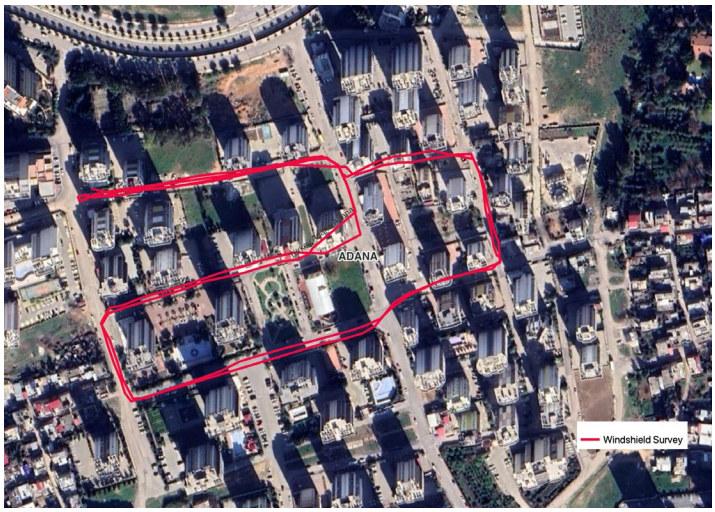


SOURCE: BUILD CHANGE

Seyhan and Ceyhan Districts, ADANA - March 10th, 2023, March 15th, 2023

The team visited Adana city and held meetings with the Seyhan municipality and the Chamber of Civil Engineers of Adana to gather information about the damaged neighborhoods. On March 10, 2023, the team conducted windshield surveys on high-rise, mid-rise and low-rise buildings. An example of a windshield survey path can be seen in Figure 7. The team then performed detailed damage assessments on low-rise buildings in urban areas. Additionally, on March 15, 2023, rapid assessments were conducted on low-rise buildings in urban areas in the Ceyhan district.

FIGURE 7 *Example of windshield survey GPS tracking*



SOURCE: BUILD CHANGE

Payas District, HATAY - March 12th, 2023

The field team conducted both rapid and detailed damage assessments, including schools, in urban areas. These assessments were carried out in conjunction with windshield surveys.

Küçük Karaçay and Balıklıdere Districts, HATAY - March 12th, 2023

The damage assessments of informal buildings were carried out in the region, specifically on low-story buildings of various types. Additionally, interviews were conducted with the local leader of Karaçay and a family in Balıklıdere to obtain more detailed information.

3. Needs Assessment Findings

Build Change Theory of Change guides need assessment findings for earthquake recovery in Türkiye. The need assessment findings of the reconnaissance mission after the earthquake in Türkiye are structured on Build Change Theory of Change[3], which is a holistic approach that considers three major barriers to adoption of resilient housing: People/Policy, Money and Technology. The Theory of Change aims to support governments, homeowners and the private sector to overcome these barriers and transform housing systems in the long term. During the reconnaissance mission, which took place in the Adana and Hatay regions in Southeastern Türkiye, the team conducted various assessments such as windshield surveys, damage assessments, meetings with authorities and interviews with locals, with the purpose of identifying building typologies, deficiencies, vulnerabilities, commonly used materials and construction costs, as well as learning about cultural habits, homeowner preferences, enforced governmental policies, retrofitting/reconstruction programs, permitting procedures and insurance practices. The information gathered from these assessments will be used to inform strategies for the recovery and rebuilding efforts in the affected regions.

3.1 People

The 2023 earthquake has resulted in significant social impacts on the affected provinces. The collapse of the business sector and education infrastructure has led to a mass migration of the local population, especially exposing vulnerable groups such as women, children and minorities without social support networks. Rural and urban areas in Türkiye differ significantly in terms of family structure and housing. In rural areas of Hatay province, large families often live together and owning a house is a symbol of status and prestige. Conversely, urban areas like Adana are characterized by smaller families living in apartments.

3.1.1 Migration

Türkiye's urban population has grown from 30% in 1960 to 76% in 2020, boosting competitiveness and productivity, yet exacerbating ecosystem degradation, socio-economic inequalities and reducing traditional coping mechanisms. Likewise, the shift in demographics, led by the rapid rise of the 65+ population segment from around 3-4% in 1990 to 10% in 2020 (and projected to reach 25.6% by 2080) is a source of concern. Homeownership is traditionally viewed as an important capital asset and social status symbol. But living in multi-storey buildings with multiple property owners is fairly new and effective collective decision making is rare. Occupancy and housing size patterns are dependent on factors such as macro-economics, ethnicity, social class and economic activities.

The collapse of the business sector and the education infrastructure due to the earthquake has led to a significant mass migration of the local population. Most of the enterprises in the earthquake-hit region

[3] For more details please refer to https://buildchange.org/resources/theory-of-change/

are small and medium-sized (SMEs), which are economically volatile and chronically indebted, as reported by the Banking Regulation and Supervision Agency (BDDK) which states that many enterprises in the region heavily rely on credit lines (9%) rather than on savings (5%). The suspension of economic activities due to the earthquake has increased their debt and drained their capital, while the banks have only suspended loan repayments for 6 months. This has forced the SMEs to relocate their businesses to cities like Antalya, using their professional and family ties, to avoid bankruptcy. However, this has made economic recovery harder, as the region has lost its key contributors. Moreover, families engaged in agriculture sent their school-aged children to relatives' houses, with mothers usually migrating with them, while males stayed in the earthquake region.

The decision to relocate is closely tied to the economic capability of the population. Relocating in the aftermath of the earthquake comes at a steep price. With a vast region affected and a significant number of people migrating, the cost of living in the destination cities is continuously escalating. Moreover, the government's subsidy of 10,000 TL per household falls short of covering even the expenses of leaving the city, let alone the high cost of rescuing furniture, which ranges from 8,000 TL to 15,000 TL in the area. Consequently, the least financially stable migrants will likely return first, burdened with debt and without any belongings.

Small-scale producers of all sectors face hardships after the earthquakes. Artisans are the group that migrated most easily. Artisans are among the most mobile groups and can relatively easily migrate with their equipment to tourist hotspots, as stated by Erol Taşsöken, a well known jeweler in Antakya, who recently relocated to Kuşadası, while SMEs rely heavily on their business networks to relocate but face high levels of indebtedness and lack of insurance. The earthquakes have also taken a significant toll on families engaged in agriculture, who lost their assets and means of livelihood. Many of these families did not relocate but lost their farm animals due to the scarcity of animal feed, resulting in famine and a significant reduction in animal prices to nearly half of their original value, as stated by a teacher from the Çekmece village (Defne) and the Yaşar family interviewed in the Balıklıdere village (Defne). Farming activities have been suspended and families face mounting debts and income loss. Those who could not or did not want to migrate to other cities have moved to the villages, creating a dense population in areas already damaged by the earthquakes.

3.1.2 Gender

Women and children without social support networks in unfamiliar cities are particularly vulnerable and at higher risk. According to the post-earthquake gender equality report by the EŞİK Women's Platform[4], disaster management in Türkiye has failed to consider gender at all levels, leading to an increase in gender-related risks such as early and child marriages, domestic violence, and other related problems due to households becoming overcrowded with migrating earthquake-hit relatives. Involuntary reunifications for shelter needs may further aggravate domestic abuse. The loss of family members has resulted in families resorting to marrying off their children to increase financial and social security. Moreover, migration for education purposes is likely to be temporary and poses challenges for children

[4] https://esik.org.tr/s/2547/i/ESIK_DepremRaporu_TCE_BakisAcisindan_GelecegeNotlar.pdf

to maintain their routine and academic performance. Finally, economic factors may lead to an increase in child labor.

It is crucial to prioritize the prompt reopening of education facilities in the earthquake-affected region and to enhance the financial security of women through measures such as micro-credits, vocational education or cash-for-work programs. Interviews conducted with NGOs revealed that even modest financial and technical assistance, such as providing raw materials and equipment costing between 10,000 TL and 15,000 TL, according to Nurhak Kar Öksüz, a lawyer of the Antakya Bar Association, could enable these organizations to resume activities. For instance, the Vakıflı Women's Cooperation in Hatay emphasized the importance of reopening education facilities, along with continuing their operations. Women involved in these NGOs had to relocate to other cities for their children's education, highlighting the critical need for accessible educational opportunities.

"Members of our cooperative initially left the city in fear. Losing our assets, many couldn't pay the rents outside those without children came back. If we can just find 10-15 thousand TL to replace our equipment and buy raw materials we can get back to production and get back on our feet."

Nurhak Kar Öksüz (The Mediterranean Women's Cooperation) - Hatay

3.1.3 Education, child labor and discrimination

Those that are economically unable to relocate, can not find reliable education facilities and teachers. Teachers in the earthquake region are facing difficulties in finding suitable settlements, particularly those with school-aged children. The competitive nature of the Turkish education system means that even a one-year gap in education can result in significant disadvantages for children in the region. According to İnan Yoğun, a school teacher from Hatay, "a one-semester gap is very hard to compensate for, a whole school year would be almost impossible. The children will not have the foundation to compete with their peers in national exams at all levels of their academic life. Many will drop out of school and child labor and child marriages will increase. Even for those who don't marry or work as child laborers, an entire generation may be sitting at home doing nothing".

"They had to go. Some people say they have to go because of their children. For their education. During the pandemic, we could not go out for a year. Then this… Children lost their connection from schools even after. They need psychological help and education. There has to be programs like this for earthquake victims, especially at schools for children."

A woman - Balıklıdere village of Defne, Hatay

Teachers, especially those with school-aged children, are migrating to other cities to save their children's academic and social life. Schools in the city centers are mostly damaged and there's no place for the remaining teachers and students to live. So far, 1,080 teachers have been relocated through assignment, with over 4,000 more still waiting to be relocated[5].

The schools in the villages are in a better condition but teachers, children and their families do not feel ready to get education in a concrete building yet. The migration of families from the city centers to their relatives' houses in villages has significantly increased the rural population. Although the schools in the villages were opened as soon as possible despite their low capacity, they are only sufficient for the original population and cannot accommodate additional children from temporary settlements for their education.

"I am really afraid of going into buildings. My son is 6 years old and goes to kindergarten. When I even ask him about the school, he immediately says 'No!' because he is afraid of the earthquake."

Gülsüm Yaşar - Balıklıdere village of Defne, Hatay

"You can not find a single family that will send their children to a concrete building. Teachers also left to save their own children. Out of the 55 teachers in my school, 22 are left. To be honest, if my son was school-aged, I would also be unable to stay here."

İnan Yoğun, school teacher - Hatay

The first two years after the relocation is decisive. Families with school-aged children, who are also the most economically active age group, are more likely to permanently settle in other cities if they cannot return to their homes within two years. A successful example in mitigating this risk from this perspective can be seen in Van[6], where one year after the 2011 earthquake, a complex consisting of 90 two-story container homes was constructed specifically for teachers at very low rental prices. This initiative made Van an attractive destination for many teachers who wanted to save money while working in a critical area. Similar container complexes that include schools and housing for students would also contribute to the continuation of education in the earthquake-affected region.

Child labor is already on the rise. Due to the widespread destruction of the city, it became challenging and costly to find workers, many of whom had also been displaced due to the loss of their homes. As a result, children from low-income families living in tents have become a source of cheap labor in the construction of container houses.

[5] https://www.memurlar.net/haber/1058412/deprem-bolgesinden-bin-80-ogretmen-tayin-oldu-basvuru-suresi-uzatildi.html

[6] https://www.hurriyet.com.tr/gundem/ercis-te-yeni-hayat-19567733

"Almost every foreman now works together with their school-aged nephews. Many of these children are at the risk of never getting back to education."

İnan Yoğun, school teacher - Hatay

Earthquake migrants face discrimination after settling in unfamiliar cities. After being relocated by the state, earthquake migrants are settled in unfamiliar cities like Antalya and Muğla. However, according to Ümit Yoğun, an insurance agent who recently moved from Antakya to Antalya, the local population has already started to blame the migrants for increasing rents, longer hospital wait times, and not fitting in with the city's culture. This situation is particularly challenging for Arab Alawites and Armenians in Hatay, as they do not have a wide community in other cities where they can blend in culturally.

"We are comfortable here. I mean culturally where else can we live as ourselves. We do not have a community to integrate in other cities. Of course, we want to come back to our city."

Ümit Yoğun, insurance agent - Antakya, Hatay

3.1.4 House occupancy profile

The housing crisis in Türkiye is alarming. The rent costs increased by 425% and house ownership cost by 421% in the last 2 years[7]. The home ownership ratio in Türkiye, which was previously at 58%, has been decreasing since 2012 due to the rising prices in the real estate market. The situation worsened after the earthquake, which led to an increase in internal migration. Many tenants do not have legal contracts, as landlords avoid paying income taxes. This lack of legal certification puts tenants at risk of losing their legal rights.

In the earthquake region, families tend to be large and closely-knit, with housing often seen as a matter of prestige and therefore significantly larger in size. To emphasize social status, people tend to mention the size of their homes even in casual conversations, with the average sizes of houses in Hatay, Adana and Malatya[8] being 155m^2, 160m^2 and 170m^2 respectively, while the average house for sale in Türkiye is 130m^2. In the feudal and tradesmanship culture of the region, people tend to focus more on what they are capable of having rather than what they actually need when it comes to determining the size of their houses.

"The desire for large houses in the region is influenced by the historical mansion culture, where landlords were living in enormous mansions with their extended

[7] https://www.endeksa.com/tr/analiz/t%C3%BCrkiye/endeks/kiralik/konut
[8] https://www.endeksa.com/tr/analiz/t%C3%BCrkiye/endeks/satilik/konut

families and workers. It is very hard to get used to living in a 2+1 house for someone coming from the mansion mentality."

Sema Turan Yapıcı, homeowner - Adana

In Adana and Hatay, large families are common but it is typical for married children to live separately from their parents. Although nuclear families in the region typically have their own flats in a family apartment, it's also common for families to gather frequently at the village homes of elders and stay for the weekend. On the other hand, some nuclear families may choose to sell their flat in order to have more independence from family authority.

Community ties among ethnic and religious minorities are very strong. Among the Arab Alawite community, which is densely populated in Hatay and south Adana, there exists a tradition of having a religion-based family in addition to one's biological family and these ties hold great significance in business relationships and informal loans.

3.1.5 Focus on Hatay region

Hatay is a diverse and inclusive region where people of various ethnic and religious backgrounds coexist, without the risk of losing their distinct identities through assimilation. The major ethnic groups in the region are Arabs, Armenians, and Turks, with each group having its own distinct religious beliefs and places of worship located in close proximity. While there is some spatial segregation of villages and districts based on ethnicity, social and economic ties between these groups are not divided along ethnic lines.

"Through thick and thin, in weddings and in funerals. Here is a place where people succeeded to live together. While walking on a street, now we think: 'Who? Who placed that stone? Agop? Ahmet? Or Mishel?' There is a soul inside these stones. It is the spirit of multiculturalism[9]."

Mişel Atik - Antakya, Hatay

The destruction caused by the earthquake could not diminish the unique spirit of multiculturalism that strengthens people's ties to the land. In Hatay, village belonging is just as significant as ethnicity, religion, or occupation when it comes to shaping one's identity. This community-based mindset has greatly contributed to their psychological resilience and optimism for the future. In our interviews with Hatay locals, all expressed their strong belief in rebuilding their lives. Many of the rumbled walls are covered with writings saying 'We will come back.'

[9] From the documentary 'The Flowers of Süveydiye' Süveydiye'nin Çiçekleri

"We lost, we buried, we lost our houses. We lost everything. If I did not, my brother did. If he did not, my neighbor did. If he did not, the city I live in lost everything. Still I believe we will flourish again."

Yusuf Kocaoğlu - Samandağ, Hatay

Economic challenges faced by the Arab population in Hatay due to dependence on foreign earnings and lack of insurance policies. The Arab population in Hatay relies heavily on earning money through work in Arab countries (e.g. Kuwait, Qatar, Saudi Arabia, UAE, etc.), with much of the earnings typically invested in real estate in their home city in Türkiye. However, due to the lack of insurance policies, this strategy can result in significant economic losses. Also, it resulted that the Arab population in Hatay often favors in-group loans over bank loans when seeking financial support.

The peri-urban lifestyle is a defining feature of Hatay's rural communities. As explained by Yusuf Kocaoğlu, the neighborhood manager (*muhtar*) of the Karaçay village in Defne, Hatay, "as a lifestyle we are villagers, but our culture is affected by the city. Most of our jobs are located in Antakya and Samandag… which are completely ruined now. We prefer to live in the village. Because we were born and raised in rural areas. We manufacture in small scales. In the village, fruits and vegetables are produced. We also have animal breeding. That's why we say we are villagers.".

Lack of collective action among house owners in Hatay creates challenges for large-scale operations. A common practice among homeowners in Hatay is to not engage in collective action for their apartments, meaning that different homeowners living in the same building tend to make independent decisions without a consensus. In other words, individuality in decision making is common for homeowners living in the same building. This is evident in areas like Samandağ, where only one floor's exterior may be painted in some apartment buildings. This lack of collective action can lead to complications when large-scale operations such as inspections and reinforcements are necessary.

The mix of urban and rural life can also be seen in the building designs. Having a ground floor space for storage is essential for village life and this is reflected in both village houses and city center apartments in Samandağ. Typically, the first floor is used for basic living and additional stories are added over time as residents have extra funds. The majority of informal buildings in the villages visited during the reconnaissance mission are constructed by homeowners, with design focused on family values. Based on the interviews conducted in Balıklıdere and Karaçay, it seems homeowners first build one-story homes for themselves and later add more stories to accommodate their children and families. In some cases, additional construction or improvements may be done on a property to create a desirable feature, such as a terrace or a separate housing unit.

"When we first started the construction, we planned on designing a tailor's workspace on the base floor for my wife. And for other rooms we planned on using them as storage areas and ventilation rooms. In the upper storey, there was a

kitchen and a bedroom. We first build these. Later on, when we became stronger financially, we wanted to build bedrooms for the kids in higher storeys. We modified the building by adding storeys. Later on since the view is better on higher elevations, we decided to add another storey. I think it was not a necessity."

Ali Emin Yaşar - Balıklıdere, Hatay

In rural regions of Hatay, homeowners build their houses themselves without the support of professional engineers. Yusuf Kocaoğlu, the local leader of Karaçay District in Samandağ, explains that villagers in the area typically construct their own homes without the help of professional engineers, with building technicians serving as the highest authority in the process. Over time, most homes have undergone extensions and additional floors constructed by local masons, often with the guidance of the homeowner. While some buildings in the area have suffered heavy damage, most are only slightly damaged, and residents plan to remain in their homes despite these challenges. In addition to that, in the Musadagh region of Samandağ, it was observed that in some buildings, different materials and building styles are used on each floor, despite the potential safety risks involved. This is often due to the need for additional housing space for a newly married couple, combined with a scarcity of available land. As a result, there may be a significant age gap between the different stories of the building.

"We started the construction of our house in 1990 and finished it in 2015. It took 25 years to finish the building with all these extensions. Since the family was big, I have built it on a 110 square meter area. As the number of people in the family increased, we made the decision to extend the building. Of course, when we are extending the building, we have got the opinions of technicians."

Yusuf Kocaoğlu - Karaçay, Hatay

Although villagers are hesitant to relocate following earthquakes, they have expressed a willingness to change their building practices. Many locals in the area built their own houses and made modifications over time, such as adding multiple floors to accommodate growing families. However, these modifications were often arbitrary and, following the earthquake, people have become apprehensive about living in mid- or high-rise buildings. Despite this fear, residents generally prefer not to reconstruct their buildings or move elsewhere if their house has suffered little or no damage.

"Before, the general expectation of our people was to have big terraces, huge living rooms, and guest rooms which can only be used once a year. We all changed our minds about those needs now. Now we think if we can manage to live here (showing the greenhouse in which his extended family has been sleeping during

nights since the earthquake) in 50 square meters with 28 people, it is a luxury to live in a 100 square meter area as one family."

Yusuf Kocaoğlu - Karaçay, Hatay

"We do not plan on constructing such tall buildings. Two floors is the maximum. We are here. We have to stay here. We have a farm. We will continue to produce here. We also have no other place to go to."

Ali Emin Yaşar- Balıklıdere, Hatay

"We do not want to pay money to build a house that will one day be our graveyard... We can only feel safe if we know we will not be buried in the rumbles of our homes."

Elene and Vahe Çapar- Vakıfköy, Hatay

People are concerned about multi-story reinforced concrete structures. Locals living in unreinforced masonry buildings are hesitant to move to reinforced concrete structures following earthquakes after seeing the rumbled city centers, but instead consider retrofitting or reconstruction. People in concrete buildings no longer favor multi-stories. Additionally, it seems that local associations such as HAYCAR, the association of Armenian architects and engineers in İstanbul, are willing to provide financial and technical aid for the reconstruction and retrofitting of villages like Vakıflı.

Vakıflı, the sole surviving Armenian village in Türkiye, maintains its distinctive masonry architecture in contrast to neighboring villages. The Vakıflı village, being the only remaining Armenian village in Türkiye, has a different cultural pattern than other regions, with families generally living in low-rise masonry buildings built for practical purposes and often more than a century old, which are typically modified for repair rather than luxury and in which horizontal extensions to the ground floor may occur but the addition of storeys is not common.

3.1.6 Focus on Adana city

Throughout its history, Adana has always been a popular destination for immigrants. With its hot climate, industrial background and fertile land, people from the Middle, East and South-East Anatolia migrated to Adana. New neighborhoods have emerged in the aftermath of all types of disasters, whether natural or man-made. Adana lost its pioneering role in agriculture and industry in the last decades, leading to high rates of unemployment, and poverty. Still it is a relatively inexpensive city with an 'easy to blend in' aura, Adana keeps attracting war and natural disaster immigrants.

Adana is a city where uncertified building workers gained experience while building the unregistered and non-engineered building stock of the city. Seyhan is one of the four central districts of Adana, where

approximately 70% of the building stock of Seyhan is unregistered, due to a never-ending migration flow. It is the administration and business center of the city where the population doubles in the working hours. It has the highest rate of NEET's (young people in neither education nor employment) and high rates of unemployment.

There are three major ethnic groups of Seyhan with approximately equal population: Turks, Kurds and Arabs. All these groups are predominantly former migrants from other parts of Anatolia, who traveled to Adana to work and end up staying permanently. Since the 80's, a pattern of spatial ethnic segregation developed among these social groups. Nuclear units of extended families live very close. Despite clustering in different neighborhoods, all three social groups live and work in harmony.

"In the 60's, Adana was an industrial hotspot. Workers migrated from different parts of Anatolia, established many neighborhoods in Seyhan to live close to the factories. Before the 80's everyone was living and working together. With the neo-liberal transition in the 80's, unemployment and sectarian politics rose. Thus the ethnic groups clustered into separate neighborhoods. Now rents and sales are mostly done in-group in Seyhan."

Mustafa Turan, former neighborhood manager (muhtar) of Şehitduran, Seyhan, Adana

Two highways (D400 and E-5) divide Seyhan to three areas, with different socio-economic characteristics and building patterns. The districts between the two highways in Adana are mostly settled by people who migrated from the peripheral regions and form the most settled population, while the northern part of Adana, above the E-5 highway, is inhabited by the upper and upper middle class living in high rise buildings, whereas the southern part of Adana has a lower socio-economic status and is characterized by a peri-urban lifestyle.

The building styles in Arab and Kurdish districts reflect the different characteristics of their peri-urban lifestyles. The Arab districts in Adana have sufficient space for building new homes, engaging in family-subsistence scale agriculture and expanding their existing houses horizontally, while the Kurdish districts, due to the limited availability of space, incorporate rural elements on their rooftops, such as floor furnaces.

"We all want everything within our arm's reach. Living both the urban and rural life. It is impossible in Seyhan, because the landscape is scarce. This is why we turn our housetops to a village, with floor furnaces and all. Then we build rooms and new floors for our family. Everyone wants to live very close to the family. Family members are like the bricks of a wall. They can't be separated."

Baran Güler - Seyhan, Adana

In Adana rooftops are used as low-cost future investment for the next generation. Adana's houses are traditionally single-story structures designed for nuclear families. However, to create a low-cost future investment for the next generation, people are building single rooms on the rooftops, which can be registered to municipal databases without paying fees in the scope of zoning amnesty. However, the security of these houses is a concern during earthquakes due to the second and third floors being built separately in different periods. In Adana, it is common to use rooftops as living spaces due to the extremely hot summers and people often sleep, socialize and prepare food on their housetops. This rooftop living culture has become a trademark of the city, with add-ons such as henhouses, furnaces and open kitchens being typical.

Although there were no collapsed buildings during the earthquakes and the overall damage was low, Seyhan has the highest count of damaged buildings among all districts in Adana. The buildings that were damaged the most are mostly one or two-story buildings located below the E-5 highway in Seyhan, and the local residents lack the financial resources to rebuild or retrofit their homes; furthermore, these neighborhoods are spatially segregated and the inhabitants are resistant to changing their culture and lifestyle, so any urban transformation must be done in-situ to preserve the central Seyhan's historic and cultural heritage.

”If the urban transformation would not be in-situ, there is a risk of social corrosion especially in the oldest neighborhoods such as: Alidede, Sarıyakup, İstiklal, etc. And there are so many damaged buildings there, below the E-5.“

Sema Turan Yapıcı - Seyhan, Adana

Due to the high influx of earthquake migrants from other cities, the neighborhood's infrastructure is being stretched to its limits and may lead to additional mobilization. There is the risk that Seyhan could experience a similar pattern of social transformation and ghettoization as happened in Avcılar, İstanbul after the devastating 1999 earthquake that prompted a wave of migration to Istanbul. This is because the upper and upper-middle-class population of north-Seyhan are no longer interested in high-rise buildings and are instead seeking out one-story houses. This increased demand has caused estate prices in the already land-scarce district of Seyhan to skyrocket.

3.2 Policy

The Turkish government has implemented laws for zoning amnesty to provide property rights to informal settlement residents and address the rising number of individuals residing in non-compliant structures. The ‘Zoning Peace’ legislation allows homeowners to legalize the status of their buildings by fulfilling certain requirements, but they are solely responsible for compliance with earthquake performance standards. While it is not mandatory to perform an earthquake vulnerability assessment of a building, if a structure is deemed at risk, homeowners can request retrofitting to avoid demolition, however they must

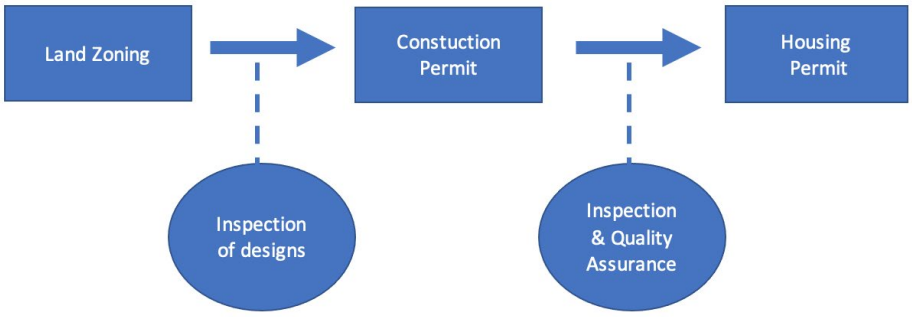
cover the costs of both retrofitting and reconstruction. After a disaster, buildings classified as moderately damaged have one year to undergo retrofitting; otherwise, they will be scheduled for demolition.

3.2.1 Land zoning and permitting procedures

Legal procedures of construction in Türkiye are mainly composed of zoning of land and permitting (Figure 8). The municipalities are in charge of the permitting procedures, which include a construction permit that is linked to the inspection of designs to ensure they conform to land zoning regulations, and a housing permit that is granted based on inspections and quality assurance during and after construction.

The implementation of zoning amnesty laws in Türkiye is a crucial intervention in the legal procedures of building construction, especially in terms of permitting. Zoning amnesty is a law that legalizes structures that were originally built in violation of zoning plans due to changes in land conditions or urban development. It was initially intended for informal settlements with the goal of legalizing and protecting uncontrolled urban development.

FIGURE 8 *Residential building construction, legal procedure workflow*



SOURCE: UNKNOWN

Land zoning procedures are governed by the local municipalities. The municipalities are responsible for creating zoning plans, which are then approved by the municipal councils. These plans make sure that any construction in the area is appropriate for living and follows environmental, scientific, and health standards. Zoned lands have specific rules and limitations set by the municipality, such as building coverage ratio, floor area ratio, maximum height of the structure above ground, total number of storeys and setback distances. The total amount of construction allowed on zoned lands is limited to 20% of the land's total area, while on non-zoned lands, it's limited to just 1% of the land's total area.

The initial building plans are created by the architect in collaboration with the contractor, who is required to hold a Contractor Certificate issued by the Ministry of Environment, Urbanization and Climate Change. This certificate outlines the types of contracting services the company is authorized to perform (such as infrastructure or superstructure) and imposes limits on the company's construction area. Architects and engineers can obtain this certificate through their graduation diploma, while other individuals must demonstrate their previous work experience through financial and registration documents.

To ensure compliance with zoning regulations, the initial building plans must be created according to specific parameters, such as coverage ratio, floor area ratio, maximum height of the structure, total number of storeys and setback distances. If the land has a zoning plan, the total area of construction cannot exceed 200% of the total land area. However, if the land does not have a zoning plan, the total area of construction is limited to 1% of the total land area.

The first step is to submit the initial design plans to the municipality for approval in accordance with zoning regulations. Once the initial design has been approved, the Ministry of Environment, Urbanization and Climate Change selects an inspection firm at random from a pool of eligible firms to oversee the project.

In 2001, a law was passed requiring inspection firms in Türkiye. By 2011, this system was implemented nationwide. Prior to 2019, construction companies were allowed to select their own inspection firms. However, a new law was passed in 2019 which prohibits construction companies and contractors from choosing their own inspectors.

The inspection firm must review and approve the final plans for the architectural, structural, mechanical, and electrical aspects of the project. Additionally, the plumbing design must be approved separately by the ASKI, with submission by the contractor or construction firm. Once the inspection firm has completed their review, fills out the *Project Information Form* and submits all the final documents to the municipality for approval. These plans include the results of the site investigation, structural design and landscape design.

The final design needs to conform with 'Principles on Buildings to be Constructed in Earthquake Zones' detailed by the Ministry. The earthquake design code was lastly updated in 2019 and includes design requirements for different building types including masonry and reinforced concrete buildings. Based on the disaster risk level of the location, the design requirements change.

After the final designs have been approved, the municipality grants a construction permit for the project, which must be signed by the inspection firm. The contractor then uses this permit to apply for water and electricity subscriptions for the site from the relevant authorities. The municipality oversees the *Work Delivery Record*, which is a document that ensures that construction procedures are initiated and completed within the designated time frame.

The municipality also inspects the building to ensure compliance with the approved plans and issues a Housing Permit upon successful completion. Once construction is finished, the *Inspection Firm* prepares a *Completion of Work* document and submits it to the municipality. The transformation of registered land deeds to condominium deeds (i.e., property ownership) also occurs through the issuance of a *Housing Permit* by the municipality, which is then processed by the *Directorate of Land Registry*.

In the earthquake region, all zoning decisions and permits have been currently put on hold. Additionally, there is a possibility that the responsibility for zoning decisions may be transferred from municipalities to ministries in the future.

3.2.2 Inspection and quality assurance procedures

To ensure quality control, inspection firms must be registered with the Ministry of Environment, Urbanization and Climate Change and must have registered architects and engineers. These firms conduct random inspections at the construction site, as well as designated inspections during different stages of construction. Quality control engineers from the contractor and officers from the municipality are also present during these inspections. The main stages of the designated inspections include:

- *Foundation Visa* is the approval of excavation works together with installation of foundation anchorages.
- *Basement Visa* is the approval of concrete works at the foundation and the construction of the basement.
- *Rough Construction Visa* is the approval of structural elements constructed.
- *Fine Construction Visa* is the approval stage of construction of non structural elements together with plumbing and electrical works.

The foundation and basement visa stages account for 20% of the total construction work, while the rough construction visa covers 40% and the fine construction and other works cover the remaining 40%.

The government sets unit prices each year for inspection services, so the contract between the *Inspection Firm* and the *Contractor* has a predetermined total amount that cannot be negotiated. The Contractor pays this amount to the municipality in equal monthly installments. The Inspection Firm receives payments as the construction progresses and reaches certain milestones, such as completing the foundation or constructing all the walls. All testing of construction materials, such as checking the quality of concrete in laboratories, must comply with the Inspection Firm's service requirements.

Main inspections are crucial before and during concrete casting for reinforced concrete buildings or before steel structure installations and are performed by the *Inspection Firm* and the municipality officers. During concrete manufacturing, the inspection firm's engineers must obtain concrete samples to be sent to the laboratory. For instance, for each mixer, four samples are required. The Ministry of Environment, Urbanization and Climate Change also inspects inspection firms multiple times each year - approximately six to seven times in the field and four to five times in the office.

The process of ensuring the quality of materials and construction involves investigation, improvement and assurance of quality from the end of the architectural design stage to the final delivery of the building to the owner. Each construction company must employ a Quality Control/Quality Assurance engineer to work responsible for checking the quality of materials, ensuring the proper implementation of construction works and their conformity to the designs included in the construction permit.

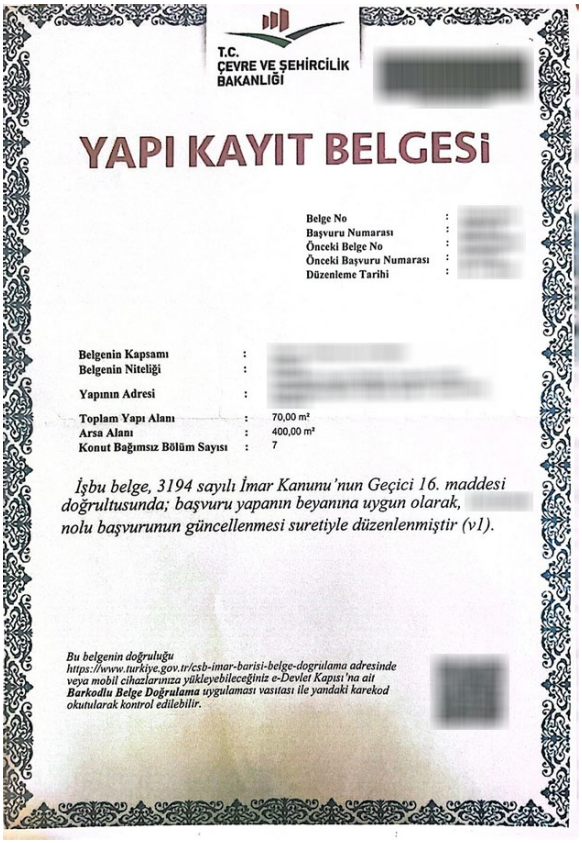
3.2.3 Zoning amnesty

Between 1948 and 2018, there have been 23 distinct laws implemented in Türkiye for zoning amnesty. The reason for the numerous construction amnesties in Türkiye is due to the demand from informal settlement residents for property rights, as well as the rising number of individuals residing in illegal

structures. This increase has had a substantial impact on local elections, making the need for amnesties even more pressing.

The 'Zoning Peace' legislation grants homeowners residing in buildings without construction permits the ability to obtain a "Registered Structure Document" (Figure 9), which serves as a substitute for a housing permit. The recently passed Zoning Amnesty law (numbered 7143) applies to buildings constructed before 2017 and permits individuals to acquire this document by fulfilling two requirements: paying the fee and residing in a building constructed illegally before December 31, 2017. However, the Registered Structure Document only holds power while the building remains standing. If any reconstruction takes place, the building must comply with the zoning plan requirements.

FIGURE 9 *Building Registration Certificate. Amnesty provided by the National Government.*


T.C.
ÇEVRE VE ŞEHİRCİLİK
BAKANLIĞI

YAPI KAYIT BELGESİ

Belge No :
Başvuru Numarası :
Önceki Belge No :
Önceki Başvuru Numarası :
Düzenleme Tarihi :

Belgenin Kapsamı :
Belgenin Niteliği :
Yapının Adresi :
Toplam Yapı Alanı : 70,00 m²
Arsa Alanı : 400,00 m²
Konut Bağımsız Bölüm Sayısı : 7

İşbu belge, 3194 sayılı İmar Kanunu'nun Geçici 16. maddesi doğrultusunda; başvuru yapanın beyanına uygun olarak, nolu başvurunun güncellenmesi suretiyle düzenlenmiştir (v1).

*Bu belgenin doğruluğu https://www.turkiye.gov.tr/csb-imar-barisi-belge-dogrulama adresinde veya mobil cihazlarınıza yükleyebileceğiniz e-Devlet Kapısı'na ait **Barkodlu Belge Doğrulama** uygulaması vasıtası ile yandaki karekod okutularak kontrol edilebilir.*

SOURCE: MUNICIPALITY OF SEYHAN

The registration of buildings that fall under the scope of the zoning amnesty is done through a declaration process, and the legal responsibility falls entirely on the owner of the building. Acquiring a 'Registered Structure Document' eliminates all previous legal restrictions on the building. The certification process does not involve any assessment of the building itself. Instead, the owner must go to the relevant municipality, report the building's current status and provide a photo of the building taken from the street. The permit explicitly states that the owner bears full responsibility for the building. During this process, all previous penalties, including any orders to demolish the building, are canceled.

In several cities, obtaining a construction permit for buildings in rural settlements without a zoning plan is not required. However, with the enactment of the new Metropolitan Law (No: 6360, 2014), the status of all villages in 29 cities, including Hatay, Malatya, Kahramanmaraş, Şanlıurfa, Adana, Diyarbakır and Gaziantep, was changed to "district status." As a result of this status change, villages in these cities lost their rural area designation. For rural settlements with a population of fewer than 5,000 people in these cities, a construction permit is not mandatory for buildings that serve agricultural purposes, provided the following conditions are met:

- There is no zoning plan implemented in the district.
- The village's built-up area is not officially designated.
- The building does not exceed two floors.
- The regional texture is preserved in the construction.

3.2.4 Vulnerability and damage assessment procedures

Conducting an earthquake vulnerability assessment of a building is not a mandatory requirement. It can be performed at the request of either the Ministry or the homeowner by approved institutions and organizations sanctioned by the Ministry of Environment, Urbanization and Climate Change. A construction permit is not necessary to carry out a vulnerability assessment. The overall assessment process usually takes about a month to complete and the cost of it, whether requested by the homeowner or the municipality, is the responsibility of the homeowner. To apply for a vulnerability assessment, the homeowner must obtain the architectural plans of the building from the municipality and submit an application to the relevant Ministry. If the building is deemed at risk, the municipality approves the result and the homeowner is given an objection period. If no objection is raised by the homeowner, the municipality is required to set a date for demolition (homeowners can ask for retrofits, please refer below). Alternatively, if the building's location is designated as an urban transformation zone, it can be publicly announced.

According to the Transformation of Disaster Prone Lands law (No: 6306), homeowners and renters who live in buildings that are deemed unsafe are eligible for government subsidies. If the government decides to demolish the building, or if there is a need for urban transformation, homeowners can receive a rent subsidy. The amount of the subsidy depends on the city and is announced by the Ministry. Currently, as of 2023, homeowners can receive a monthly subsidy of 2,000 TL to 2,500 TL, while tenants can receive a one-time payment of 4,000 to 5,000 TL[10]. Alternatively, municipalities can provide temporary housing or offices.

If a homeowner's building is deemed unsafe, they have the option to retrofit their home to make it safer. To do this, homeowners must provide evidence of their retrofitting plans to the municipality before the demolition deadline. If the municipality approves the retrofitting plans, the project must go through

[10] https://www.csb.gov.tr/bakan-kurum-kentsel-donusumu-desteklemek-amaciyla-kira-yardimini-istanbulda-3-bin-500-liraya-cikariyoruz-bakanlik-faaliyetleri-38472

the necessary legal processes for obtaining a construction permit. The homeowners are responsible for covering the costs of both the retrofitting and reconstruction.

The Ministry of Environment, Urbanization, and Climate Change is responsible for organizing damage assessments after a natural disaster. These assessments are conducted by individuals accredited by the Ministry, but there is no requirement for certification. The damage assessments are carried out by different groups, including a) volunteer members of the Chamber of Civil Engineers, b) civil engineers, construction technicians and architects employed in municipalities and other public institutions, c) personnel of the Ministry of Environment, Urbanization, and Climate Change, and d) military personnel with backgrounds in civil engineering and architecture. Inspection firms or private damage assessment firms are also assigned by the relevant Ministry. To standardize the assessments, the damage assessment teams were given a two-hour briefing course.

After a natural disaster, damage assessments are carried out to classify the level of damage in buildings. There are five categories: no damage, slightly damaged, moderately damaged, heavily damaged, and in need of urgent demolition or already demolished. To determine the level of damage, visual monitoring of structural elements is conducted. If the load carrying elements of the building show no signs of damage, it is considered to be slightly damaged. If there are small cracks in the load carrying elements, it is classified as moderately damaged. However, if there are wide and/or several shear cracks, the building is considered to be heavily damaged. In cases where there is significant displacement in the load carrying elements or partial/total collapse, entering the building, even for eviction, is strictly prohibited.

Buildings that are classified as moderately damaged have one year to undergo retrofitting, otherwise, they will be reclassified as highly damaged and scheduled for demolition. Despite rumors that all moderately and highly damaged buildings will be demolished, there has been no official announcement regarding this plan. This is unlikely to happen due to the high cost involved, which amounts to one-third of Türkiye's annual gross national product, especially given that Türkiye is currently facing a financial crisis. The earthquake has already caused Türkiye to lose 10% of its GDP and it is expected that at least half of the cost of the damage will have to be covered through public borrowing.

After damage assessments have been conducted, objections to the results can be made by anyone living in the building in question within one month. The assessment results are made available online within 24 hours of the official announcement in the neighborhood units (muhtarlık), and the one-month reclamation period begins after the announcement. Owners or residents of the building can make reclamations to the AFAD or the district governorship during this period. Following the reclamations, a second, more detailed assessment is carried out by the Ministry, and the result of this assessment is recorded as an exact decision. Any further reclamations after this stage would require a court process.

3.3 Money

The Turkish Catastrophe Insurance Pool is mandatory for almost every registered building in Türkiye urban areas, but low coverage and reimbursement rates are common due to a lack of knowledge and awareness

about natural disasters. On the other hand, private home insurance policies are required for broader coverage and for obtaining loans from banks. Retrofitting buildings constructed without civil engineering services in earthquake-prone areas is considered expensive and complex due to inconsistent materials, absence of urban planning and unique structures requiring individual assessment and design. In rural areas, in-situ transformation through a contractor often results in taller buildings exceeding municipal zoning density permit limits and posing safety hazards. The government provides loans and state banks have reduced consumer loan interest rates in earthquake-hit cities to support rebuilding the collapsed houses. Other subsidies are also available, such as temporary housing, rental, workplace allocation, interest, evaluation and demolition subsidies.

3.3.1 Insurance policies and practices

The DASK insurance policy is a requirement in urban areas of Türkiye and it is relatively affordable. Practically every building that is registered in the Address-Based Population Registration System is eligible for insurance. There are two types of housing insurance available: DASK (Turkish Catastrophe Insurance Pool) and optional housing insurance. However, these types of insurances are not commonly used as many people underestimate the risks associated with natural disasters. The Turkish Catastrophe Insurance Pool (DASK) has a strong international reassurance base and its budget is separate from the state budget. Its purpose is to provide compensation for the rebuilding and/or retrofitting of damaged buildings. The annual insurance charges are calculated based on the declared square meters of the property. For reinforced concrete buildings, the charge is 36.5 USD per 100 square meters per year, while, for other types of buildings, the charge is 43.7 USD per 100 square meters per year. In the event of rebuilding or retrofitting due to a DASK claim, the compensation provided is 15,500 USD per 100 square meters for reinforced concrete buildings and 10,600 USD per 100 square meters for other types of buildings. The insurance charges and compensation can change based on the location of the specific location of the building and they are updated every year.

Almost half of the buildings do not have earthquake insurance provided by the Turkish Catastrophe Insurance Pool (DASK) due to lack of knowledge, and private home insurance coverage is even lower due to lack of awareness. DASK coverage is compulsory for gas, water, and electricity subscriptions of residential properties. In earthquake-prone areas, the common practice is to declare the minimum square meters required (usually 50 to 80 square meters depending on the location) to pay the minimum charges for subscriptions. This is a primary reason for the low amount of reimbursements. Homeowners must take out private home insurance policies for broader coverage, which is mandatory for obtaining housing loans from banks. In practice, people tend to cancel their private insurance policies as soon as they have paid off their credit debts. Moreover, these private home insurance policies, which have significantly lower premiums than car insurance policies, are not widely known or publicly used.

3.3.2 Public programs for retrofitting and reconstruction

The national and local administrations do not consider public programs for retrofitting buildings as cost-effective. This is because the process of urban transformation in neighborhoods where the buildings were constructed without any civil engineering services is expensive due to several reasons. Firstly, the quality

of materials used in these buildings is inconsistent. Secondly, there are no available engineering calculations or architectural plans to work with. Thirdly, the absence of urban planning in these areas creates challenges in carrying out operations. Lastly, every building in such neighborhoods has a unique structure that requires individual assessment and planning, which adds to the overall complexity and cost of the process.

The municipalities have the authority to initiate urban transformation or retrofitting programs after obtaining a permit from the Ministry. The typical process involves several steps, which are:

1. The municipalities prepare a zoning plan that identifies the risky areas such as old or damaged buildings, unstructured urbanization, etc.
2. The zoning plan is then reviewed and approved by the municipal council.
3. Next, an urban transformation plan is prepared for the risky areas.
4. The Ministry grants a permit for the urban transformation plan of the risky area, which includes developing the project and working with a contractor.
5. The municipality signs a protocol for the urban transformation and, after signing, their role is to assist in the process, such as dealing with expropriation, eviction of risky buildings and canceling the infrastructure.

In Türkiye, the primary contractor for urban transformation is the Housing Development Administration (TOKi), but municipalities have the option to sign protocols with other entities if they secure outside funding. The Municipality Law No. 5363 provides a legal basis for the reconstruction of historic heritage buildings and the transformation of unstructured urbanized areas (Article 73). However, the law does not consider housing construction as one of the core functions of municipalities. Consequently, municipalities cannot finance urban development from their own budgets. As a result, most urban transformation protocols are signed with TOKi, which has already constructed around 10% of Türkiye's building stock. If municipalities obtain funding from sources outside their budget, they are entitled to open a tender to collaborate with contractors other than TOKi.

In urban areas, owners are not allowed to rebuild their own houses, unlike in rural areas where "Subsidies for Building Your Own House" (Kendi Evini Yapana Yardım - KEYY) can be utilized by homeowners. In urban areas, either TOKi or the Ministry will undertake the building process. KEYY policy aims to keep farmers and ranchers close to rural areas. According to the law, if a building is going to be demolished in a rural area, the owners have the right to reconstruct it in the same location, and the government covers a certain percentage of the reconstruction costs. For the remaining costs, villagers can apply for loans.

When planning retrofitting and reconstruction projects, municipalities must consider whether the settlements are rural or urban. In 2020, a change in the Metropolitan Law granted municipalities the authority to convert their neighborhoods back to village status through municipal council decisions. An example of this is the Adana's Seyhan Municipal Council decision No. 40 (dated April 9th, 2021), which

restored the rural status of 30 areas. However, many former villages' residents do not want to revert to rural status as it would limit them to building only 1-2 story structures.

Homeowners have the option to carry out in-situ transformation through a contractor without involving the public sector. In this scenario, the contractor can be paid directly by the homeowners for the demolition and reconstruction of the building. However, a common practice is to offer some of the newly built housing units or shops to the contractor as compensation. This often results in the construction of taller buildings with smaller individual units, which may exceed the upper limits of the municipal zoning density permit.

To determine the financial regulations for retrofitting and reconstruction in earthquake-affected buildings, the Ministry conducts a damage assessment and the results of this assessment determine the applicable regulations.

LEVEL OF DAMAGE	STATE SUBSIDIES	DASK	HOUSING INSURANCE	STATE CREDITS	BANK CREDITS
Not Damaged	**NA**	**NA**	**NA**	**Retrofitting credits by AFAD***	**State Banks provide retrofitting credits***
Slightly damaged	**10,000 TL per household**	**Insurance refunds****	**Some firms provide insurance refunds****	**Retrofitting credits by AFAD***	**State Banks provide retrofitting credits***
Moderately Damaged	**Cash aids for rent, moving and basic needs******	**Insurance refunds****	**Insurance refunds****	**Retrofitting credits by AFAD* Right owner process*****	**State Banks provide retrofitting and rebuilding credits**
Highly Damaged	**- Cash aids for rent, moving/ furniture and basic needs****** **- Container house**	**Insurance refunds****	**Insurance refunds****	**Right owner process*****	**At least 70% of the building process must be finished to apply for mortgage loans**
Needs Urgent Demolition or Demolished	**- Cash aids for rent, furniture and basic needs****** **- Container house**	**Insurance refunds****	**Insurance refunds****	**Right owner process*****	**At least 70% of the building process must be finished to apply for mortgage loans**

*To obtain retrofitting credits, estate owners must obtain a "risky area certificate" from the Ministry.

**The amounts of DASK and Housing Insurance payments are determined by insurance expert reports.

***To use rebuilding credits or have one of the estates built by the state, the "Right owner process" must be completed. This is a debiting process managed by AFAD that begins following the assessment phase. Having DASK and private insurance does not exempt homeowners from this process.

****The amount of basic needs cash aid per household has not yet been announced. Furniture aid is provided for homes that cannot be entered for furniture removal. Moving aid is 15,000 TL per household. Homeowners who apply for and receive a container house cannot receive rent subsidies.

Under the Disaster Prevention and Related Subsidies Law No: 7239, buildings that are not damaged or only slightly damaged are not eligible for rebuilding. For buildings that are moderately damaged, the state budget should provide subsidies for retrofitting, although there has been no announcement yet regarding this matter. If the state provides rebuilding loans, they should be provided "at cost".

The government provides loans and subsidies for rebuilding and retrofitting. The maximum amount of subsidy for retrofitting is 600,000 TL per housing unit and the repayment period is up to 10 years. For rebuilding, there is a grace period of 2 years and the total repayment period is between 20 to 30 years. Additionally, there are other subsidies available, such as temporary housing assistance, rental assistance, workplace allocation, interest subsidies and evaluation and demolition subsidies. To clarify, mortgage loans are not available for building new houses in earthquake-hit areas. To address this, state banks have reduced consumer loan interest rates to 0.99% in these cities (except for Adana).

3.3.3 Cost of materials and labor

At the start of each year, the Ministry of Environment, Urbanization, and Climate Change sets the prices for construction materials and labor (Table 1). However, these prices may vary depending on the location and time of the year. These announced prices reflect the current market value and are used as a reference by those involved in construction projects. It's important to note that the contractors' profit and value-added taxes are not included in these prices.

TABLE 1 *Average cost of materials, Adana*

MATERIALS	UNIT	TURKISH LIRAS	USD
Concrete Grout (C30-37)	**m^3**	**1,230**	**64.17**
Concrete Grout (C35-45)	**m^3**	**1,310**	**67.77**
Smooth Rebars (8-10-12 mm) (S220)	**kg**	**11.6**	**0.61**
Ribbed Rebars (8-10-12 mm) (S220)	**kg**	**12.35**	**0.64**

Pumice Concrete Block (15 cm thickness)	**m^2**	**62**	**3.21**
Hollow Clay Bricks (19*13*19 cm)	**unit**	**2.4**	**0.13**
Formwork	**m^2**	**297**	**15.49**

SOURCE: ADAPTED FROM CONSTRUCTION UNIT PRICES BY MINISTRY OF ENVIRONMENT, URBANIZATION AND CLIMATE CHANGE

The hourly wages for workers involved in concrete, pumping, masonry, formwork and steel vary between 70 to 90 Turkish Liras. Below is Table 2 that shows the labor cost of various construction works.

TABLE 2 *Labor cost, Adana*

LABOR	UNIT	TL	USD
Concrete Pumping (C30-37)	**m^3**	**2,016**	**104.29**
Hollow Clay Bricks Laying	**m^2**	**227**	**11.74**
15 cm Thick Pumice Concrete Blocks Laying	**m^2**	**178**	**9.21**
Mortar	**m^2**	**183**	**9.55**
Cement Mortar Plastering	**m^2**	**121**	**6.26**
Gypsum Plastering	**m^2**	**165**	**8.54**
Stone Masonry	**m^3**	**405**	**21.13**
Concrete Formwork	**m^2**	**238**	**12.31**
Tunnel Concrete Formwork	**m**	**297**	**15.36**

SOURCE: ADAPTED FROM CONSTRUCTION UNIT PRICES BY MINISTRY OF ENVIRONMENT, URBANIZATION AND CLIMATE CHANGE

3.4 Technology

The most densely populated areas affected by the 2023 earthquake were Antakya and Defne, both located in the province of Hatay, which suffered the most damage. Reinforced concrete frames were found to be the most common structural system in the affected areas, followed by low-rise unreinforced masonry buildings. Non-ductile reinforced concrete frames and unreinforced masonry buildings were particularly vulnerable to damage or collapse due to the vulnerabilities they presented, such as poor quality of concrete and steel reinforcement, insufficient building separation and weak or soft stories, and to the high shaking intensity they experienced during the earthquake.

Around 16% of buildings across all affected areas sustained moderate to severe damage or require urgent demolition, with almost 30% of structures in Hatay province falling under this category. Widespread non-structural damage, caused by out-of-plane failure of unreinforced masonry infill walls and parapets, was commonly observed. Schools located in Adana and Hatay provinces also experienced moderate damage, particularly in non-structural walls and gables. Similarly, the new buildings constructed after 1998, that were constructed out of compliance with applicable requirements, exhibit comparable vulnerabilities and the national government amnesty 'Zoning Peace' exacerbates the problem.

3.4.1 Building Stock and Types

Adana, Hatay, Şanlıurfa and Gaziantep are the most densely populated areas, accounting for 59% of the total building stock across the 11 provinces, as shown in Table 3. The table below also presents data on the distribution of building stock in 11 provinces in Türkiye that were affected by earthquakes. The table shows that the largest portion of the building stock in these areas consists of residential buildings, which account for between 86.1% and 90.9% of the total stock in each province. Workspace buildings make up the second-largest category of the built environment, ranging from 4.1% to 8.2%. Public buildings and other categories are relatively minor, ranging from 1.8% to 5.3% and 1.1% to 5.7% respectively. The data provided represents the situation before the earthquake occurred.

TABLE 3 *Building stock in earthquake affected provinces*

PROVINCE	RESIDENTIAL	WORKPLACE	PUBLIC	OTHER	TOTAL
Adana	**404,502**	**29,920**	**8,916**	**7,779**	**451,117**
Adıyaman	**107,242**	**5,765**	**4,370**	**3,119**	**120,496**
Diyarbakır	**199,138**	**11,412**	**11,964**	**3,165**	**225,679**
Elazığ	**106,569**	**7,221**	**2,872**	**7,051**	**123,713**
Gaziantep	**269,212**	**22,829**	**5,480**	**8,162**	**305,683**
Hatay	**357,467**	**33,511**	**10,382**	**5,489**	**406,849**

PROVINCE	RESIDENTIAL	WORKPLACE	PUBLIC	OTHER	TOTAL
Kahramanmaraş	219,351	12,358	6,879	4,565	243,153
Kilis	33,399	1,526	1,651	736	37,312
Malatya	159,896	8,370	6,670	4,051	178,987
Osmaniye	128,163	9,428	3,105	2,384	143,080
Şanlıurfa	347,902	18,847	11,790	4,089	382,628
TOTAL	2,332,841	161,187	74,079	50,590	2,618,697

SOURCE: 2023 KAHRAMANMARAŞ AND HATAY EARTHQUAKES REPORT BY PRESIDENCY OF STRATEGY AND BUDGET

In Adana city, around 94.5% of the structures can be classified as low-rise, 3.8% as mid-rise and 1.7% as high-rise buildings according to the information provided by the Adana Municipality. Buildings with less than three floors were classified as low-rise, those with four to ten floors as mid-rise, and those with more than ten floors as high-rise (Figure 10).

FIGURE 10 *Building stock in Türkiye. Low-rise, mid-rise and high-rise buildings*

SOURCE: BUILD CHANGE

Antakya and Defne, two districts located in one of the most heavily hit areas by the earthquake, account for 34% of the building stock in the entire Hatay province. Table 4 shows the distribution of building stock

among residential, public, workspace and other buildings in Hatay province before the earthquake. The data shows that the largest portion of the built environment in Hatay province is residential, accounting for 75.5% of the total building stock. The other category follows, with 16.2%, and the workspace category has 7.2%. Finally, the public category represents 1.1% of the total built environment. Among the districts in Hatay province, Defne has the highest number of buildings in the other category, which represents a significant proportion of the total building stock in the district. On the other hand, Antakya has the highest number of buildings in the public and workspace categories. The majority of the houses in the residential category are distributed across all districts, with İskenderun and Antakya having the highest number of houses.

TABLE 4 *Building stock in Hatay province*

DISTRICTS of HATAY	RESIDENTIAL	WORKSPACE	PUBLIC	OTHER	TOTAL
Altınözü	21,183	543	294	1,028	23,048
Antakya	56,630	11,633	967	4,463	73,693
Arsuz	30,588	1,217	328	1,508	33,641
Belen	9,745	477	125	153	10,500
Defne	23,915	819	269	52,902	77,905
Dörtyol	26,942	3,439	507	3,572	34,460
Erzin	13,916	913	199	633	15,661
Hassa	14,925	724	288	511	16,448
İskenderun	38,096	4,044	562	421	43,123
Kırıkhan	26,577	1,717	487	1,230	30,011
Kumlu	5,042	156	82	267	5,547
Payas	6,794	2,130	176	141	9,241
Reyhanlı	20,718	1,627	240	966	23,551
Samandağ	27,103	1,651	233	3,012	31,999
Yayladağı	11,215	491	235	688	12,629
TOTAL	333,389	31,581	4,992	71,495	441,457

SOURCE: ADDRESS REGISTRATION SYSTEM (JUNE 5TH, 2020), HATAY IRAP 2021 REPORT[11]

Reinforced Concrete (RC) Frames, with or without infill walls, were found to be the prevailing structural system in the earthquake-affected provinces. Low-rise buildings in urban, peri-urban and rural areas predominantly used RC frames with or without infill walls and unreinforced masonry. Mid-rise buildings in urban and peri-urban areas and high-rise buildings in urban areas used a variety of systems, including RC shear walls and RC frames, with or without infill walls, as well as tunnel form buildings.

Reinforced Concrete (RC) frames with or without infill walls

The most common structural typology for both commercial and residential buildings in the urban and rural areas visited is multi-story RC frames with infill walls (Figure 11 and Figure 12). The structural system consisted of RC columns and beams creating moment resisting frames in both directions, RC floors and roofs and unreinforced masonry infill. Buildings located near principal roads typically had commercial spaces on the ground floor, which often resulted in soft/weak story irregularity. Occupied cantilevers at both ends of the beams were also frequently observed in both urban and rural areas.

FIGURE 11 *RC shear walls and beam-column frames in urban areas in Antakya, Hatay*

SOURCE: BUILD CHANGE

In both rural and urban areas, pumice concrete blocks and hollow clay bricks were commonly used for infill walls. Regulated structures always had RC foundations, while non-regulated ones were constructed using both RC foundation and stone masonry footing. In rural areas, stone masonry was frequently used for infill walls, usually at the foundation and ground level.

[11] https://hatay.afad.gov.tr/kurumlar/hatay.afad/HATAY-İRAP-2022.pdf

FIGURE 12 *RC frames in rural areas in Defne, Hatay*

SOURCE: BUILD CHANGE

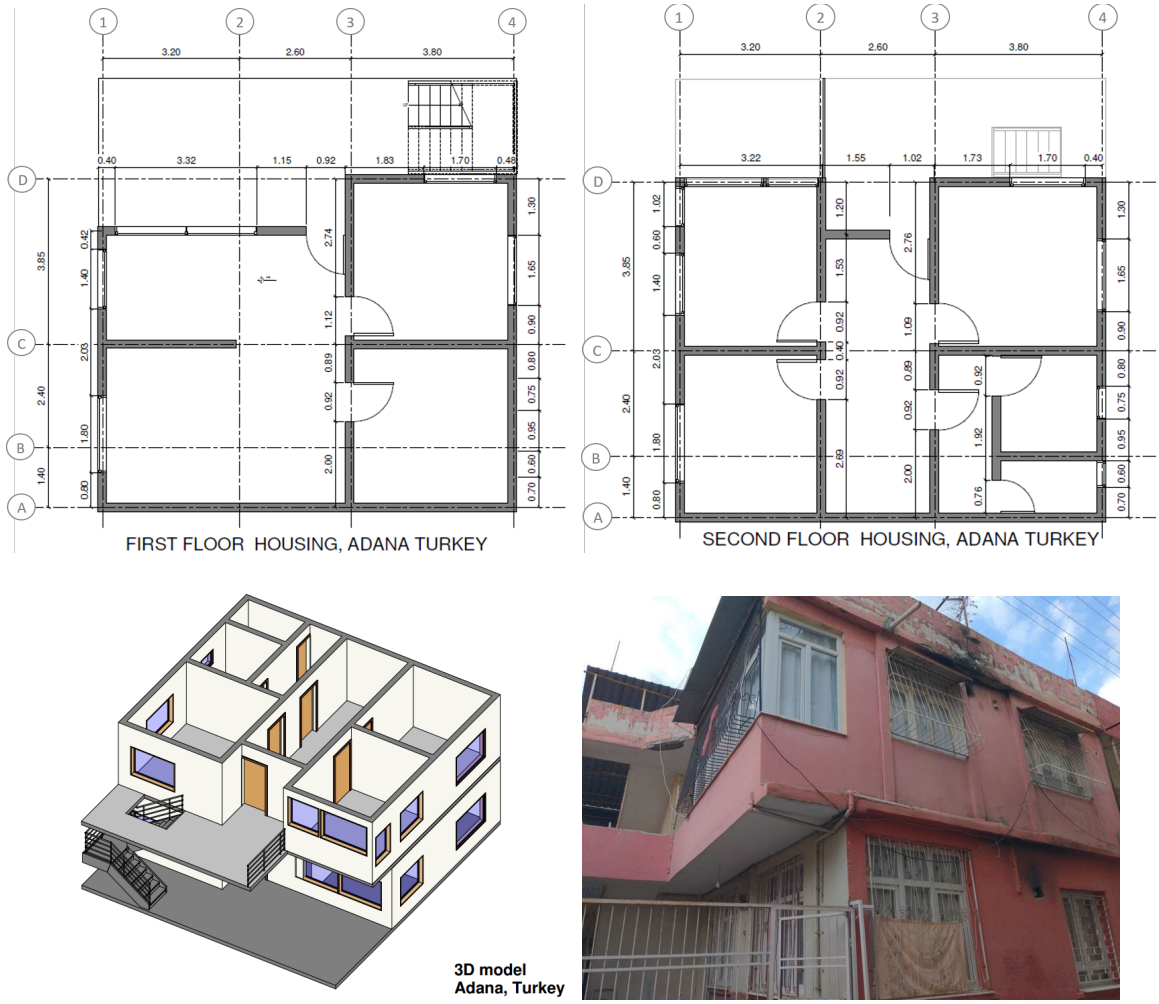
Unreinforced masonry

In the urban areas visited, particularly in non-regulated neighborhoods, low-rise buildings made of unreinforced masonry can be found (Figure 13) but are not the most common structural typology. These buildings are constructed using hollow clay bricks and pumice concrete blocks, with cement mortar and wall thickness varying between 12 cm and 15 cm, depending on the material used. The floor system of these buildings consists of solid reinforced concrete slabs that are supported by the walls. The roof system is lightweight and can be made of metal or wood purlins or a solid reinforced concrete roof. A typical house distribution of the visited areas, comprising two or three floors with open spaces, is shown in Figure 14.

FIGURE 13 *Unreinforced masonry in urban areas (Adana)*

SOURCE: BUILD CHANGE

FIGURE 14 *Unreinforced masonry in urban areas, drawings (Adana)*



SOURCE: BUILD CHANGE

During the visit to rural areas, it was observed that unreinforced masonry buildings are predominantly used as storage facilities and animal farms (Figure 15). The common roofing system in these buildings consists of wood purlins and clay roof tiles. In the Samandağ district of Hatay province, stone masonry foundations and walls, particularly for the ground floor, using mud or cement as mortar, were frequently found (Figure 16). The buildings in this region typically have wood-framed floors with a thin layer of concrete or RC slabs resting on the walls and wood-framed roofs with clay tiles (Figure 17). In some cases, pumice concrete blocks and/or brick walls were constructed above the stone walls.

FIGURE 15 *Unreinforced block masonry buildings in Balıklıdere village, Hatay*

SOURCE: BUILD CHANGE

FIGURE 16 *Unreinforced stone masonry buildings in Balıklıdereand and Vakıflı villages, Hatay*

SOURCE: BUILD CHANGE

FIGURE 17 *Roof and floors of an unreinforced stone masonry house in Vakıflı Village, Hatay. Pictures of a one-story house. The figure on the left shows the roof at the first floor and the figure on the right shows the basement.*

SOURCE: BUILD CHANGE

3.4.2 Materials

The locals in the area commonly use pumice concrete blocks for infill walls in ground floors of RC frame structures and unreinforced masonry. This material is not preferred for use in upper floors due to its weight and, despite the availability of different sizes, the typical 39x20x18 cm vertically perforated block is often used. After conducting site visits, it was identified that certain areas displayed substandard masonry. Additionally, there were cases of incorrectly oriented (horizontal instead of vertical) pumice concrete blocks, as shown in the first picture of Figure 18. The blocks are usually laid using cement mortar. All the materials are generally locally available, according to builders in Adana, Hatay and Istanbul.

FIGURE 18 *Pumice concrete blocks used as structural material in unreinforced masonry buildings and as non structural material in the infilled walls of RC Frames.*

SOURCE: BUILD CHANGE

Hollow clay bricks (Figure 19) are frequently used in both regulated and non-regulated buildings as infill walls. In the rural regions of Hatay, hollow clay bricks are preferred to be used in upper floors due to its

low weight. The standard size is usually 14x19x19 cm[12] and cement mortar is commonly used to lay the bricks.

FIGURE 19 *Hollow clay bricks mainly used as non structural material in infilled walls in RC Frames.*

SOURCE: BUILD CHANGE

Stones are a prevalent building material in the unreinforced masonry buildings found in rural areas (Figure 20), particularly limestones. The walls of these structures are typically constructed using a combination of mud mortar and cement mortar. Stone sizes and shapes vary from house to house, with some stones being rectangular and closer in size to bricks, while others are larger in size.

FIGURE 20 *Stone masonry found in rural areas*

SOURCE: BUILD CHANGE

3.4.3 Buildings Vulnerabilities

The most common deficiencies identified across all building types are poor quality of concrete and steel reinforcement, insufficient separation, and weak and/or soft stories. The visual evaluation of building vulnerabilities was conducted in the areas affected by the earthquakes as well as in those where damage

[12] http://ozdemirtoprak.com/tag/tugla-basinc-dayanimi/

was not observed. The reference used for this screening was FEMA-154. The following are the most common vulnerabilities observed:

- Liquefaction: In some areas, liquefaction affected the building's foundation resulting in structures settlement and overturning, according to reports from the Earthquake Engineering Research Institute (EERI) and other agencies.
- Poor concrete and reinforcement quality and workmanship/detailing: The quality of concrete in heavily damaged and collapsed buildings was poor, evident from the uneven distribution of aggregates and disintegration of the material upon handling. Additionally, plain rebars that could be easily bent by hand were frequently found. Material deterioration and inadequate rebar detailing (e.g. short lap splices, inadequate concrete confinement, longitudinal rebars buckling due to lack of stirrups, 90-degree-end hooks in stirrups) were also observed. (Figure 21).
- Pounding: In the areas evaluated, insufficient separation between buildings was a common problem. In heavily affected areas, structures pounded together during the ground shaking, resulting in severe damage (Figure 22).
- Weak and/or soft story: Mixed use buildings (residential and commercial) often have open and/or taller ground floors with fewer columns or walls, creating a weak and/or soft story with significantly less stiffness compared to the rest of the floors. Soft-story collapses occurred in heavily damaged areas (Figure 22).

FIGURE 21 *Poor concrete quality and reinforcement detailing*

SOURCE: BUILD CHANGE

FIGURE 22 *Pounding and soft stories*

SOURCE: BUILD CHANGE

According to the Municipality of Adana and some members of the Chamber of Civil Engineers in Adana and Istanbul, the building stock in Türkiye has several vulnerabilities due to how and when they were constructed. The vulnerable structures can be classified into three categories:

- Old buildings built before the implementation of modern building codes (pre-1998). Many of these buildings can be classified as non-ductile RC frames with masonry infill and have irregularities such as soft story and deficiencies like poor rebar detailing and low-quality materials.
- Non-regulated low-rise unreinforced masonry or non-ductile frames with infill walls buildings. These structures were constructed by homeowners without proper technical assistance or quality controls during construction. The deficiencies include poor rebar detailing, low-quality materials, deterioration, open front in low-rise unreinforced masonry structures, captured columns, non redundant configurations in non-ductiles frames and specific orientations of the columns making one of the orthogonal directions weaker than the other.

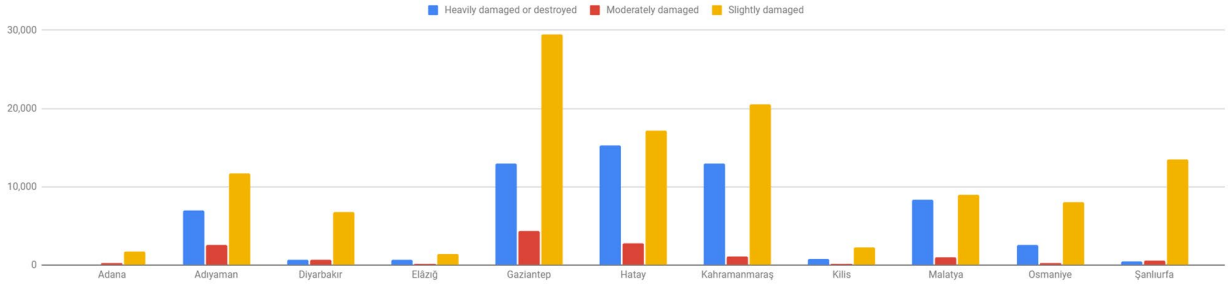
- Regulated new buildings that comply with modern construction codes in design, but were built without following the specifications in the drawings. These buildings were approved by municipalities under the amnesty provided by the national government (please refer to chapter 3.3 for more details), which places responsibility for the building seismic performance on the owner.

3.4.4 Damage Assessment

Around 16% of the total building stock across all the provinces impacted by the earthquake is estimated to have sustained moderate to severe damage, collapsed or require urgent demolition (Table 6). However, when looking specifically at Hatay province (Table 5), which was the most affected area, the proportion of buildings with moderate to severe damage is much higher, with almost 30% of the structures falling under this category.

TABLE 5 *Earthquake-affected areas damage assessment (updated as of February 16th, 2023)*

PROVINCE	HEAVILY DAMAGED OR DESTROYED	MODERATELY DAMAGED	SLIGHTLY DAMAGED	UNDAMAGED	TOTAL
Adana	0.1% 59	2.2% 304	1.4% 1,688	2.3% 5,313	7,364
Adıyaman	11.3% 6,990	18.8% 2,613	9.6% 11,694	4.1% 9,310	30,607
Diyarbakır	1% 643	5.2% 718	5.5% 6,725	7.9% 18,039	26,125
Elâzığ	1.1% 664	1% 138	1.2% 1,460	0.3% 723	2,985
Gaziantep	21% 12,964	31.3% 4,361	24.3% 29,471	38.9% 89,092	135,888
Hatay	24.7% 15,248	20.3% 2,827	14.2% 17,212	12.7% 29,188	64,475
Kahramanmaraş	21% 12,980	7.6% 1,058	16.9% 20,556	11.1% 25,420	60,014
Kilis	1.3% 812	1% 137	1.8% 2,208	1.2% 2,849	6,006
Malatya	13.6% 8,365	6.8% 945	7.4% 8,960	3.3% 7,463	25,733
Osmaniye	4.1% 2,531	1.9% 266	6.6% 8,034	9.6% 22,041	32,872
Şanlıurfa	0.8% 466	4% 550	11.1% 13,507	8.6% 19,585	34,108



SOURCE: HURRIYET.COM.TR WEBSITE[13]

TABLE 6 *Earthquake-affected areas damage assessment (updated as of March 6th, 2023)*

STATUS	NUMBER OF BUILDINGS
Undamaged	**860,006** 50%
Lightly Damaged	**431,421** 25%
Moderately Damaged	**40,228** 2%
Severely Damaged	**179,786** 11%
Collapsed	**35,355** 2%
Requiring Urgent Demolition	**17,491** 1%
Not Assessed	**147,895** 9%
TOTAL	**1,712,182**

SOURCE: MINISTRY OF ENVIRONMENT, URBANIZATION AND CLIMATE CHANGE[14]

The damage to non-ductile and ductile Reinforced Concrete (RC) frames, with or without infill walls, was observed to have several common causes in the most affected areas (Figure 23 and Figure 24). These include insufficient connection between structural elements, poor quality of materials, beams stronger than columns, deterioration of materials, partial infill walls at both sides of a column or damage in a portion of the infill wall creating short column failure, soft/weak story, and in some cases non redundant configurations and specific orientations of the columns making one of the orthogonal directions weaker than the other. Additionally, non-structural damage caused by out-of-plane failure of

[13] https://www.hurriyet.com.tr/gundem/depremlerden-etkilenen-illerde-61-bin-722-binanin-acil-yikilmasi-gerekiyor-42220807

[14] 2023 Kahramanmaraş and Hatay Earthquakes Report published by the Presidency of Strategy and Budget.

unreinforced masonry infill walls and parapets was commonly observed. Excessive stirrup spacings in frame elements was also noted as a reason for damage.

FIGURE 23 *Damage assessment of non-ductile RC Frames with or without infill walls.*

SOURCE: BUILD CHANGE

FIGURE 24 *Damage assessment of non-ductile RC Frames with or without infill walls.*

SOURCE: BUILD CHANGE

Deficiencies in design solutions, quality of materials, and construction practices are common in unreinforced masonry buildings (Figure 25). Unreinforced masonry houses are particularly susceptible to

damage or collapse due to a range of factors, such as lack of masonry confinement, insufficient connection between elements, poor workmanship in the masonry wall, tall and slender walls prone to out-of-plane failure and low-quality materials.

FIGURE 25 *Damage assessment of unreinforced masonry buildings*

SOURCE: BUILD CHANGE

The non-structural walls and gables were the primary components that sustained damage in schools located in the most earthquake-affected areas (Figure 26). The schools located in Adana and Hatay

provinces rely in most cases on reinforced concrete (RC) frames with infill walls. During seismic events, these buildings experienced moderate damage, particularly in non-structural walls and gables, which often failed out-of-plane due to their weak connection to the primary structural system.

FIGURE 26 *Schools of Antakya, Hatay*

SOURCE: BUILD CHANGE

4. Conclusions and recommendations

The February 6th, 2023 earthquakes in Türkiye have resulted in widespread displacement and damage to buildings and infrastructure. To ensure the timely recovery of affected regions and prevent permanent resettlement in other areas, prompt interventions are crucial, ideally within two years of initial mobilization. The reason for this is that the longer people are displaced from their homes, the more difficult it can become to ensure that they are able to return to their previous lives and livelihoods.

One of the main priorities should be to provide adequate assistance to vulnerable groups who may have been particularly affected by the earthquake. These groups include women, children and minorities who may not have access to social support networks that can help them through this difficult time. Providing support can take many different forms, depending on the specific needs of the individuals and communities. It may involve providing access to shelter, food and water, as well as medical care and psychological support. It may also involve helping people to rebuild their homes and communities and supporting them in finding new sources of income and employment.

Another key step is to increase public awareness of earthquake vulnerability assessments. This involves educating people about the risks posed by earthquakes and encouraging them to conduct assessments of their buildings to identify any vulnerabilities. This is particularly important for buildings that have been constructed without permits and those that received an amnesty, as they may not have been subject to the same safety standards as permitted buildings. Encouraging homeowners to conduct assessments voluntarily is also critical. This can be achieved through education campaigns and by making it easier for people to access the resources they need to conduct assessments.

In addition to increasing awareness and encouraging voluntary assessments, it is also essential to strengthen regulations related to building construction permits. This means ensuring that all buildings, particularly the most vulnerable, both existing and new, comply with safety standards and are designed to withstand future seismic events. This can be achieved through stricter enforcement of building codes and regulations and by imposing penalties on those who violate safety standards. To promote earthquake-resistant structures, technical assistance and training should also be offered to local institutions and professionals. This will enhance their capacity to perform retrofitting works and ensure that buildings are designed and constructed to safely perform during future earthquakes.

Finally, investing in house insurance is a smart decision that can help safeguard the financial investment in a home and personal belongings in the unfortunate event of an earthquake. Additionally, state authorities should take measures to make the process of retrofitting existing buildings more accessible, affordable and attractive for homeowners. This can be achieved by offering additional subsidies, streamlining the retrofitting process and providing more information and resources to homeowners. By doing so, homeowners will be more likely to invest in retrofitting their homes to make them more earthquake-resistant. In addition to that and in order to enable interventions at scale, as much as possible, retrofit designs should be made progressive and prescriptive from a technical standpoint. This means that the designs should be standardized and stakeholders provided with clear guidelines for retrofitting different types of buildings and technological tools to make the process more efficient and cost-effective.

5. References

AFAD (2021). *İl Afet Risk Azaltma Planı (İRAP).* https://hatay.afad.gov.tr/kurumlar/hatay.afad/HATAY-I%CC%87RAP-2022.pdf

Alomaliye.com (2023). *Depremden Etkilenen İllerde DASK Sigortası Yaptıranların Alacakları Avans ve Tutarlar.* https://www.alomaliye.com/2023/02/28/depremden-etkilenen-illerde-dask-sigortasi-olanlarin-alacaklari-avans-ve-tutarlar/

Build Change (2021). *The Build Change Guide to Resilient Housing: An Essential Handbook for Governments and Practitioners*. https://buildchange.org/guide-to-resilient-housing

ClimateChangePost (2023). *Forest fires Turkey.* https://www.climatechangepost.com/turkey/forest-fires/

Endeksa (n.d.). *İstanbul Avcilar kiralik konut m² birim kiralari.* https://www.endeksa.com/tr/analiz/istanbul/avcilar/endeks/kiralik/konut

Endeksa (n.d.). *Türkiye kiralik konut m² birim kiralari.* https://www.endeksa.com/tr/analiz/t%C3%BCrkiye/endeks/satilik/konut

Eşitlik İçin Kadın Platformu (2023). *6 Şubat 2023 Depremleri: Toplumsal Cinsiyet Eşitliği Bakış Açısından: Geleceğe Notlar.* https://esik.org.tr/s/2547/i/ESIK_DepremRaporu_TCE_BakisAcisindan_GelecegeNotlar.pdf

Hürriyet.com.tr (2011). *Erciş'te yeni hayat.* https://www.hurriyet.com.tr/gundem/ercis-te-yeni-hayat-19567733

Hürriyet.com.tr (2023). *Depremlerden etkilenen illerde 61 bin 722 binanın acil yıkılması gerekiyor.* https://www.hurriyet.com.tr/gundem/depremlerden-etkilenen-illerde-61-bin-722-binanin-acil-yikilmasi-gerekiyor-42220807

Memurlar.net (2023). *Deprem bölgesinden bin 80 öğretmen tayin oldu, başvuru süresi uzatıldı.* https://www.memurlar.net/haber/1058412/deprem-bolgesinden-bin-80-ogretmen-tayin-oldu-basvuru-suresi-uzatildi.html

T.C. Çevre, Şehircilik ve İklim Değişikliği Bakanlığı (2023). *Bakan kurum: kentsel dönüşümü desteklemek amaciyla kira yardimini İstanbul'da 3 bin 500 liraya çıkarıyoruz.* https://www.csb.gov.tr/bakan-kurum-kentsel-donusumu-desteklemek-amaciyla-kira-yardimini-istanbulda-3-bin-500-liraya-cikariyoruz-bakanlik-faaliyetleri-38472

T.C. Çevre, Şehircilik ve İklim Değişikliği Bakanlığı (2023). *İklim ve Zirai Meteoroloji Dairesi Başkanlığı Araştırma Dairesi Başkanlığı.* https://mgm.gov.tr/FILES/iklim/yillikiklim/2021-iklim-raporu.pdf

T.C. Cumhurbaşkanlığı Strateji ve Bütçe Başkanlığı (2023). *2023 Kahramanmaras and Hatay Earthquakes Report.* https://www.sbb.gov.tr/wp-content/uploads/2023/03/2023-Kahramanmaras-and-Hatay-Earthquakes-Report.pdf

T.C. Doğu Akdeniz Kalkınma Ajansı (2015). *Süveydiye'nin Çiçekleri.* https://www.youtube.com/watch?v=Oae7zg36VHQ

Annex

Country risk profile

Türkiye is located in an earthquake-prone region and has experienced several major earthquakes throughout its history, leading to significant casualties and extensive damage to buildings. The data in Table A-1 reveals that Türkiye has experienced several devastating earthquakes over the years, with the 1999 Marmara's one being the second deadliest in the country's history, claiming 20,000 lives and destroying over 90,000 buildings. Other notable earthquakes include the 1975 Lice earthquake, which had a magnitude of 6.6 and caused more than 2,000 casualties and, one year later, the Muradiye earthquake causing 4,000 victims.

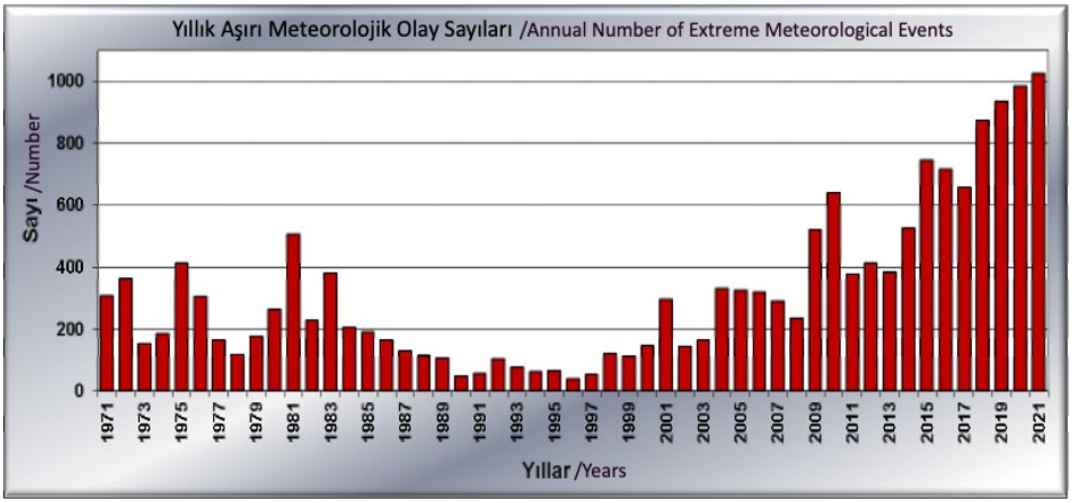
TABLE A-1 *Impact of major earthquakes in the last 50 years*

YEAR	LOCATION	MAGNITUDE	CASUALTY	DESTROYED BUILDINGS
1975	Lice	6.6	2,311	8,149
1976	Muradiye	7.5	4,000	unknown
1983	Erzurum	6.9	1,342	3,241
1992	Erzincan	6.7	498	8,057
1995	Dinar	6.1	90	14,156
1998	Adana Ceyhan	6.3	146	31,463
1999	Marmara	7.6 and 7.2	20,000	90,593
2003	Bingöl	6.4	177	7,800
2011	Van	7.2	604	1,966
2020	Elazığ	6.7	41	1,965
2020	Aegean Sea	7.0	117	506
2023	Kahramanmaraş	7.8 and 7.5	50,000	232,000

SOURCE: TÜRKIYE PRESIDENCY STRATEGY AND BUDGET COMMISSION[15]

In addition to earthquakes, Türkiye is experiencing an increasing number of adverse climatic events. While the frequency and intensity of earthquakes remain the same throughout the years, climatic hazards are stronger and more frequent. The General Directorate of Meteorology (MGM) reports how climate patterns are changing, and the increase in climate-related disasters. According to their data, there is a long-term increase in the number of summer days and tropical days in Türkiye. The average temperature in Türkiye increased by 1.5°C in 2017 compared to 1970. The annual average of 100 climate related disasters (1940 to 2000) first rose to 300 (2000-2010) and exceeded 900 in recent years[16]. Floods, storms and hails are the most frequent climate-related disasters (Figure A-1). Water stress related events such as wildfires, drought and heat waves are the most damaging ones. Landslides, avalanches and cold waves are less frequent and intense. Climate change risks are particularly pronounced in the coastal areas, due to a combination of sea level rise, coastal flooding and erosion. Studies indicate that Istanbul is the most at-risk port city in Europe (with Izmir listed as third most at-risk) in terms of economic damage and loss due to climate change.

FIGURE A-1 *Recorded annual number of climate related disasters (1971-2021)*



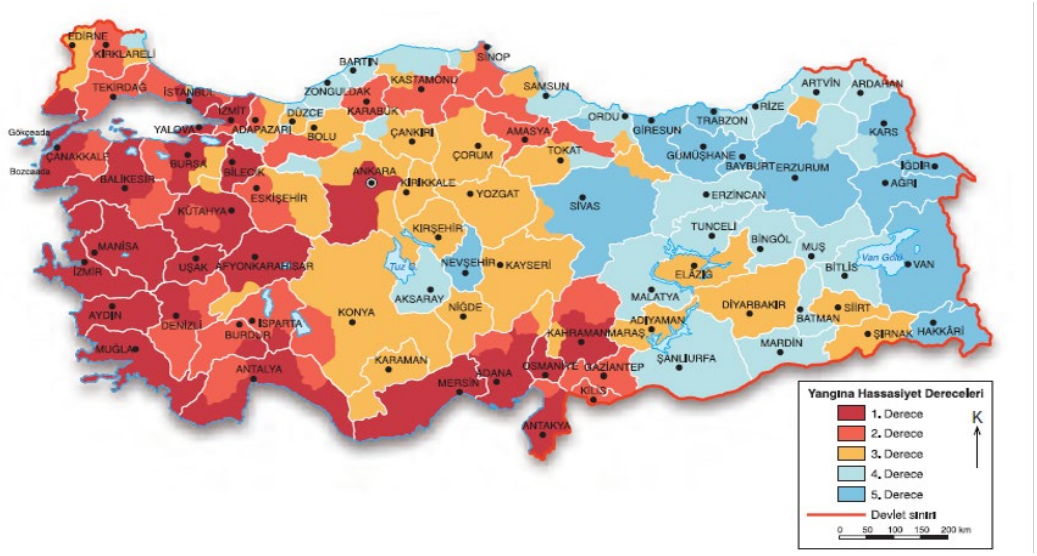
SOURCE: GENERAL DIRECTORATE OF METEOROLOGY[17]

The wildfires of 2021 are one in a 100-year event, similar to the 2023 earthquakes, and indicate a pattern of increasing cumulative risk. To put things in perspective, on average 20,760 hectares of forest burned annually between 2008 and 2020. In 2021, 170,000 hectares of forest were destroyed in 15 days (between July 28 and August 13)[18]. These fires were exacerbated by high temperatures (3 to 6 degrees higher than seasonal), low humidity (as low as 1% instead of seasonal 7-9%) and high wind. Unfortunately, the current 2023 campaign shows striking similarities to 2021 and an ongoing El Niño episode means the

[15] https://www.sbb.gov.tr/wp-content/uploads/2023/03/2023-Kahramanmaras-ve-Hatay-Depremleri-Raporu.pdf
[16] MGM. 2021 Yılı İklim Değerlendirmesi, 2022 https://mgm.gov.tr/FILES/iklim/yillikiklim/2021-iklim-raporu.pdf
[17] For detailed information on climate of Türkiye please see relevant webpage of the Turkish State Meteorological Service at https://www.mgm.gov.tr/files/en-US/climateofturkey.pdf
[18] https://www.climatechangepost.com/turkey/forest-fires/

temperature will be higher than 2021. And there are other events affecting Türkiye. The Syrian refugee crisis has caused the largest mass movement in modern history and Türkiye is now the country with the most refugees and migrants. The crisis triggered an unprecedented humanitarian operation that lasted for years. In 2020, strong earthquakes in Elazig and Izmir in 2020 killed 41 and 116 people respectively. In 2021, floods in the Black Sea region killed 83 people and most recently, floods in Urfa in March 2023 claimed another 21 lives. The loss of life and extent of economic damage from floods is primarily caused by inadequate urbanization. These events, together with the Covid-19 pandemic (with an estimated toll of 200,000 lives in Türkiye over 2019-2022), have impacted the lives and livelihoods of many, and overstretched the capacity of response and recovery. Knowledge on the economic impact of disasters is limited to general damage assessments and limited climate impact projections. It is thus insufficient to clearly decide the priority intervention areas, by sector or region. And knowledge on the social and environmental impact of disasters is sporadic. Figure A-2 shows how some of the provinces worst affected by the earthquake also have a high risk of forest fire.

FIGURE A-2 *Fire risk map of Türkiye*



SOURCE: GENERAL DIRECTORATE OF FORESTRY, 2020

The socio-economic impact of disasters is among the top challenges for development. The 1999 Marmara earthquake had an estimated economic cost of approximately 7% of the gross national domestic product (GDP) and it took the affected cities years to recover[19]. The recovery was relatively fast due to the high-level of industrialization and the port connection of the region. In contrast, the 2011 Van earthquake had a much lesser impact on the national GDP but is estimated to have impacted 60% of the local GDP. It took the land-locked, less industrialized region close to ten years to recover. The longer the recovery process, the higher the likelihood of families, communities, businesses to face another event

[19] https://www5.tbmm.gov.tr/sirasayi/donem21/yil01/ss308.pdf

while recovering. Whether on preventive work or reconstruction, it is critical to understand where the community is, i.e. were they recovering from a previous shock when the earthquake happened?

Analytical framework

The national Disaster Risk Reduction framework is aligned with the international framework for Disaster Risk Reduction and climate change adaptation. Disaster Risk Reduction (DRR) framework is also commonly used for the climate change adaptation agenda and is the reference of the national entities for civil protection and climate change adaptation. The risk profile of cities may differ in terms of hazards they face, their exposed population and assets, as well as their vulnerabilities and impact from most recent events. But the aim of communities, and of Build Change, is to build resilience, which can be defined as "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions." Building resilience happens through various interventions of the DRR framework, covering before (risk management), during (disaster management) and after (recovery management) as shown in Table A-2. Build Change's expertise can contribute specifically through risk assessment, prevention, impact assessment and reconstruction (highlighted in magenta in the table).

TABLE A-2 *DRR pillars and intervention themes*

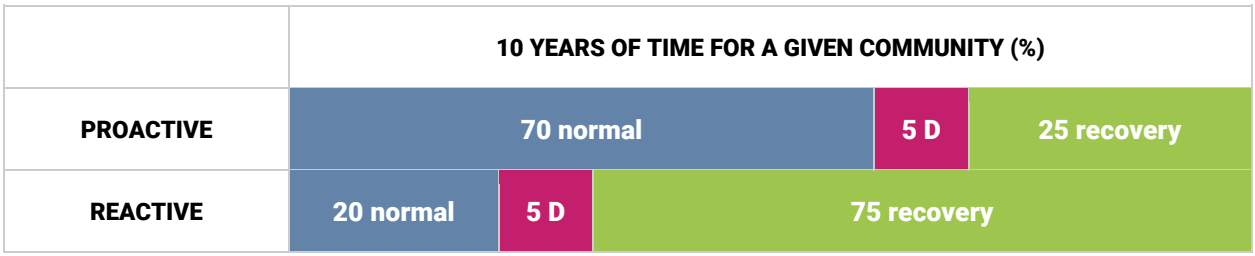
DISASTER RISK REDUCTION / CIVIL PROTECTION		
RISK MANAGEMENT **Before**	**DISASTER MANAGEMENT** **During**	**RECOVERY MANAGEMENT** **After**
Risk assessment	**Early warning**	**Impact assessment**
Risk reduction (prevention, mitigation)	**Mobilization and coordination**	**Socio-economic recovery**
Risk transfer	**Response operations**	**Reconstruction**
Preparedness	**Communication**	

SOURCE: UNITED NATIONS OFFICE FOR DISASTER RISK REDUCTION

Communities show significant differences in their risk profile and their capacities, which leads to a fundamental difference of posture. This difference in posture stems from the strong differences in the stress and shocks they face and the resources they have. Communities vary in terms of: (1) whether they have strong norms and regulations and whether these are better enforced or not, (2) indicators such as GDP per capita, % of population with a university degree, number of registered civil society organizations

per 1,000 habitants, etc., (3) availability and access to formal and informal safety nets (such as insurance, social services, civil society led campaigns, etc.) which reduces risk but also improves recovery capacity and (4) degree of trust and collaboration between neighboring cities, regions, countries. These differences lead to a fundamentally different posture: some communities experience long periods of normality, disrupted by brief crisis periods, and followed by relatively faster recovery periods. These communities will be more proactive, having more time and resources to allocate to risk management (before) and will deal with lesser adverse impact. Other communities will be more reactive, experiencing much shorter periods of normality, disrupted by brief but more frequent crisis periods, and followed by longer periods of recovery. These communities will focus their resources on disaster management (during) and on recovery needs (after) and will have far less time and/or resources for risk reduction (before). Figure A-3 provides a sample illustration of the difference between the proactive and reactive communities.

FIGURE A-3 *Proactive vs. reactive (D stands for disaster management)*



SOURCE: EUROPEAN COMMITTEE OF REGIONS, 2023

Resilience agenda

Türkiye has adopted an integrated disaster risk management system in 2009 and is in the process of implementing the necessary institutional and operational changes. Türkiye was one of the first countries in the region to establish a civil protection system, with the first law promulgated in 1958. The civil protection system has evolved out of necessity to adapt to its changing risk profile and was most recently redesigned with the establishment of AFAD, the Disaster and Emergency Management Authority, in 2009, marking the transition to an integrated disaster management system. AFAD has been leading the change towards a system covering (1) multiple hazards, (2) multiple phases, and (3) multiple target groups. In terms of hazards, the focus tends to move with emerging threats. There is better capacity regarding earthquakes, refugees, and pandemic than other hazards. And AFAD, by its own reckoning, needs to do more work regarding climatic hazards. In terms of phases, AFAD has developed in 2014 the national response plan (TAMP), which identifies the actors involved for life safety, their respective duties and the coordination mechanism. Over the years, each of 81 provinces has developed its own plan and tested it. AFAD has also completed in 2022 the risk reduction plans of 81 provinces but they have not yet been approved or implemented. And AFAD is in the process of developing the national recovery plan. In summary, the National Disaster Risk Management (NDRM) is strongest during a disaster (disaster management) and is building its capacity to manage the before (risk management) and aftermath

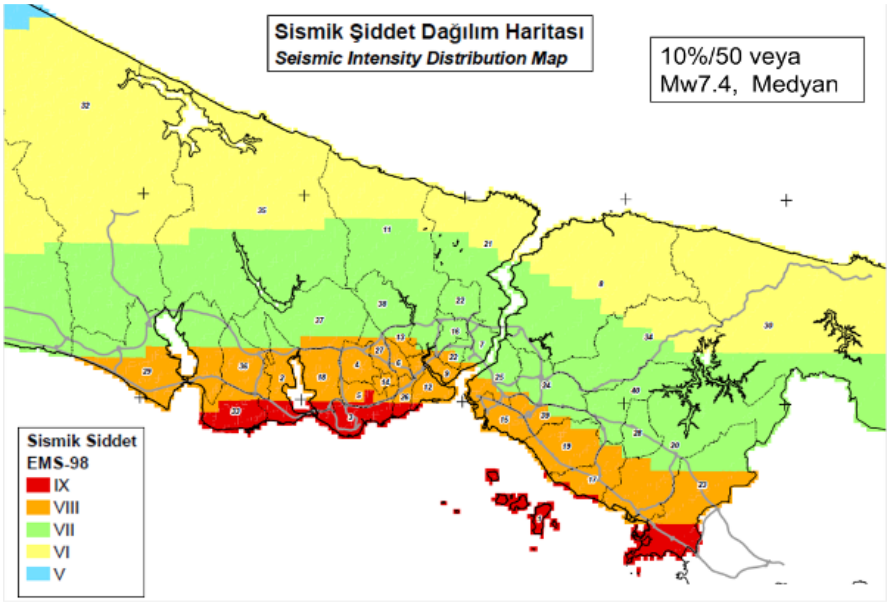
(recovery). In terms of the target group, the focus is on life safety and citizens. Businesses, governance structure, infrastructure, and ecosystems are not yet fully integrated.

Türkiye collaborates with multilateral and bilateral organizations with a priority to develop or strengthen the missing aspects of its integrated approach. There is a long-standing partnership, ranging from local projects to national programs, aiming to bring new knowledge or technology, facilitate the alignment with European or international standards, develop and test pilot models, and/or support the large-scale implementation of proven solutions. The most important collaborators and their projects focus on complementing the current expertise of the country. The World Bank Istanbul Seismic Risk Mitigation and Emergency Preparedness Project (focus on earthquake, risk management, social infrastructure), the Seismic Resilience and Energy Efficiency in Public Buildings (focus on earthquake, risk management, governance structure), the Disaster Risk Management in Schools Project (focus on multiple hazard, risk management, social infrastructure), and the Türkiye Earthquake, Floods and Wildfires Emergency Reconstruction (focus on multiple hazards, risk/disaster management/recovery, municipal infrastructure). The Japanese International Cooperation Agency has conducted seismic risk assessment studies (risk management) and financed numerous large scale infrastructure projects resilient to multiple hazards. The French Development Agency has worked over 10 years to develop and test pilot solutions on integrated forest management and related economies.

Looking forward

The Istanbul earthquake scenario is a serious risk for national development and is currently a top priority for the government and the municipality. Based on the models developed by the Kandilli Observatory, the official institute monitoring and carrying research on seismic activity, Istanbul should plan for an earthquake of magnitude Mw 7.4 (similar to 1999 Marmara earthquake), with a high probability of occurrence in the next 20 years. The expected human impact is 50,000-200,000 casualties and several hundreds of thousands of wounded. While the casualty number is high, it is around 1% of the total population. Further human impact will come from the buildings: with 2% of the building stock destroyed, 5% heavily damaged, 19% mild damage and 30% lightly damaged, an expected 50-60% of the population will likely be without shelter and sleeping rough. The main challenge will thus not be only search and rescue but also tending to the needs of people without shelter. As it was observed in recent earthquakes (Marmara, Van, Elazig) and the pandemic, people tend to move out of the city quickly, particularly to bring women, children and elderly to safety. The economic impact of the Istanbul earthquake is difficult to estimate, with projections ranging around 300 US$ billion. The city accounts for over 30% of the national GDP, 40% of the tax revenues and 50% of the supply chains. And it is a critical hub for international transit. Figure A-4 shows the seismic risk map of Istanbul.

FIGURE A-4 *Seismic intensity distribution map for a Mw 7.4 Earthquake*



SOURCE: ISTANBUL GREATER MUNICIPALITY, 2020

Avcılar, Istanbul case study

Avcılar, one of the 39 municipalities of Istanbul, is among the most at-risk municipalities and is taking concrete steps in urban renewal. The district municipality lies on the Marmara coastline, in close proximity to the fault line and is composed mostly of soft soil. 86% of the buildings in Avcilar are at risk because they are old, unregulated or both. The residents have very limited or no resources to mitigate and recover from earthquake risks. Out of the 448,000 residents in Avcilar, 84% come from culturally diverse backgrounds and 59% have either no schooling or primary education only. A Socio-Economic Segmentation analysis showed that socially excluded groups - considered socio-economically poor and under-privileged - account for 40% of Avcilar's population. In the long-term, Avcilar hinders the national economy: one of the main ports of Türkiye, an international railway, three major highways, five Organized Industrial Zones, several hospitals and logistic hubs are within a 10 km radius. If the problem is not addressed, residents that can leave will leave, the ones left with no choice risk their lives and Avcilar will become a liability for the city and national economy. The municipality of Avcilar has taken bold steps for urban renewal and managed to address a staggering 1,800 buildings at risk over the past 2.5 years, an unparalleled figure for any municipality in Türkiye.

Avcılar has been a district of migrants since its establishment in the 1800's. Avcılar's native population was formed of 3 major groups: refugees from Balkan countries, and post 1980's economic migrants from the Black Sea region and Sivas. Despite getting significant economic migration, it did not have underserved communities and the city planning was based on grid street plans.

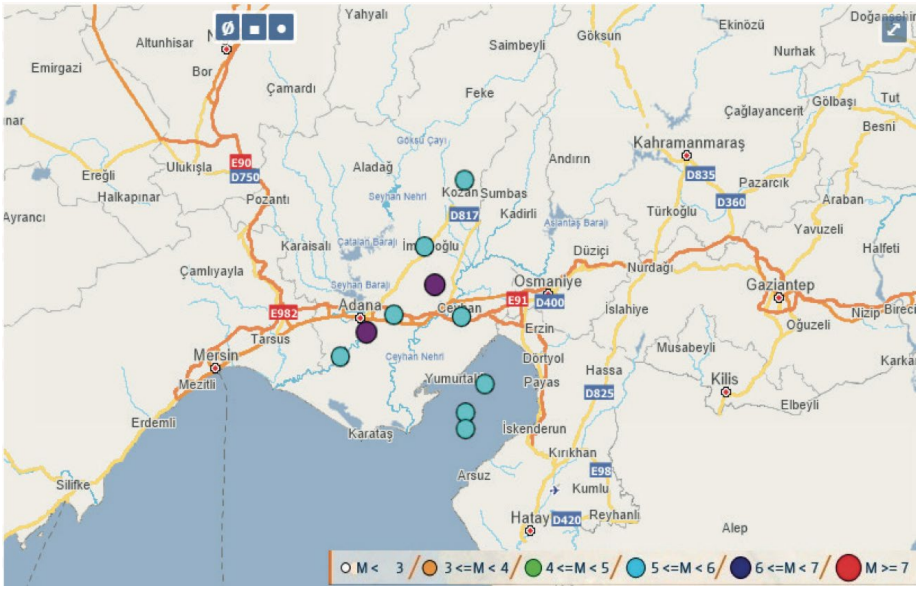
Avcılar was significantly impacted by the 1999 Marmara Earthquake, and social marginalization happened as the middle income group left the district. The highly damaged buildings were mostly

demolished. The moderately damaged buildings were evacuated by the middle class house owners. The rent dropped significantly lower than the surrounding districts, and the district attracted the low income marginalized groups. The most recent example for this is the Syrian refugee influx to the district after 2015. The gradually marginalized demography and risk of earthquake sets the rental and sales prices of houses lower than the average prices of İstanbul. The average rental cost in Avcılar is 30% lower than the average rental cost in İstanbul. In case of sales, an average house in Avcılar costs 21% less than the average house price in İstanbul[20]. There is a significant price gap between the buildings made before and after the 1999 earthquake. Currently there is an urban transformation trend on the rise in the district.

Seyhan, Adana case study

Seyhan county located in Adana city is designated as vulnerable to earthquakes due to the existing building stock and geological location. According to the Disaster Risk Reduction Report for Adana published by AFAD, building stock in the region is mostly located on alluvial soil and it is ignored in urban transformation. The informal construction is common in the area and the location of the county to the fault lines makes Seyhan vulnerable to earthquakes (Figure A-5).

FIGURE A-5 *Previous earthquakes near Seyhan region*



SOURCE: ADANA IRAP, AFAD

Previous earthquakes in Adana have shown that both soil properties and poor-quality construction have had a devastating impact on the level of damage sustained. On June 27, 2018, an earthquake with a magnitude of 5.9 occurred in the Adana-Misis region, causing significant damage to 10,368 buildings and moderate damage to 49,997 more. As a result of the seismic event 145 people lost their lives and 1,200 people were injured. According to the Disaster Risk Reduction Report for Adana, published by AFAD,

[20] https://www.endeksa.com/tr/analiz/istanbul/avcilar/endeks/kiralik/konut

the main reasons behind the destructive effect of the earthquake are unfavorable soil properties of Adana region, flaws in the design of buildings and low quality construction practices and unskilled workmanship.

Seyhan county is characterized by a prevalence of informal construction, which can be attributed to the significant increase in population resulting from immigration. With a population density of 2,066 people per km^2, Seyhan is the most densely populated county in Adana region. This high population density is largely due to the agricultural and industrial development that has occurred in the region over the past 30 years, which has led to a significant increase in population. Furthermore, Seyhan county is home to a large portion of Adana's immigrants, which has resulted in the emergence of informal settlements in the area.

In the event of the most likely earthquake scenario, the Seyhan region would be significantly impacted in terms of population, health, economy, and environment. AFAD's report suggests that the most likely earthquake scenario would have a severe impact on the southern part of Seyhan county. This is due to a variety of factors, including liquefaction, uncontrolled and informal construction, low-quality building materials, and a lack of construction inspections. Unfortunately, there is currently no information available regarding the building stock in Adana. While it is part of the risk reduction planning to identify the existing building stock in Adana, this process is not expected to be completed until 2026.