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BUILDING, CONSTRUCTED REGIONS AND THE EARTHQUAKE IN KOCAELI

ABSTRACT

The 1999 Kocaeli earthquake that shook Marmara Region, caused immense loss of life and property, damaged the social and economic structures of this country in a nearly irreparable way, and found its way into the earthquake chapter of history books. It was etched in the people's mind due to the fact that it was the biggest earthquake of the near past in terms of magnitude and it devastated a huge area, thousands of people and the second biggest industrial zone of this country; it was also the first earthquake that led the public to be aware of the phenomenon of earthquake, the authorities to consider scientific studies important, the public to question the relevant measures, and to a large-scale rebuilding process in the aftermath. This study focuses on impacts of earthquakes on buildings and settlements situated within the province of Kocaeli where population increased due to the industrial and urbanization developments that were started in the 1950s and where construction projects were intensively built to meet housing demands of ever-growing population, and evaluates the measures taken after the said.

Keywords: Kocaeli, Earthquake, Building, Habitation Area.

KOCAELİ'DE YAPI, YAPILI ÇEVRELER VE DEPREM

ÖZET

Marmara Bölgesi'ni etkileyen 1999 Kocaeli Depremi; gerek yol açtığı can ve mal kayıpları, gerekse ülkenin toplumsal ve ekonomik yapısında yarattığı giderilmesi zor etkilerle, önceki depremlere de eklenerek ülke deprem tarihindeki yerini almıştır. Yakın geçmişimizde şimdiye dek yaşanan depremlere göre çok daha büyük olması, çok geniş bir alanı, çok kalabalık bir nüfusu ve ülkenin ikinci en önemli sanayi bölgesini etkilemesiyle hafızalarda yer eden bu deprem, kamuoyunda deprem ve deprem bilicinin oluşturulması, bu konuda bilimsel çalışmaların öneminin anlaşılması, geniş çapta sorgulanmaya ve sonrasında büyük bir yapılaşmaya konu olmasıyla da bir ilk niteliğindedir. Bu çalışmada ülkemizde 1950'li yıllardan başlayarak sanayileşme çabalarının yol açtığı kentleşmenin de etkisiyle, hızlı bir nüfus artışına ve bu nüfusun barınacağı yeni yapı gereksinmesinin karşılanması amacıyla büyük bir yapılaşmaya konu olan Kocaeli yöresinde, depremin yapılar ve yerleşim bölgelerindeki etkileri ele alınarak, depremden bu yana geçen sürede bu konuda yapılan çalışmaların değerlendirilmesi yoluna gidilecektir.

Anahtar Kelimeler: Kocaeli, Deprem, Yapı, Yerleşim Alanları.

1. INTRODUCTION (GİRİŞ)

Turkey is situated in a seismically active region and suffers earthquakes at frequent intervals, which cause considerable loss of life and property and have negative impacts on the national economy [1, 2, 3 and 4]. The 1999 earthquake that shook Marmara Region where the biggest industrial facilities of this country are located and which represent the most developed region of Turkey thanks to its population and economic level had its epicenter in Kocaeli, caused immense loss of life and property, damaged the social and economic structures of this country in a nearly irreparable way, and found its way into the earthquake chapter of history books [5, 6, 7 and 8].

Passing through the process of industrialization in 1950s, our country has been introduced the fact of urbanization in 1960s. In this period Kocaeli region gradually becoming a significant industrial zone thanks to its access to overland routes, railways and maritime line and thanks to its location close to Istanbul, exposed to a rapid influx of migrant population along with its own natural population increase. As the existing buildings were inadequate in accommodating the incoming population, the province of Kocaeli witnessed a rapid structuring as in some other similar regions of the country [9]. Throughout this process it was disregarded that the region is seismic and the settlements were on the hills. Agricultural lands and forest areas were plundered and buildings were constructed on those areas obtained by filling the sea. All habitation areas of Izmit and the region integrated with the shore and arranged in a row along with the Gulf, and traditional residence and urban tissues in these habitation areas were rapidly destroyed, and the construction systems and building materials of the past were not used anymore. Multi storey buildings constructed with reinforced concrete and reinforced concrete framework systems which are economical and easy to build in short time took their place instead. Thus, cities lost their own identities and they gained new appearances with new buildings and areas formed by these buildings. The region, of unsystematic settlements full of habitation areas surrounding unhealthy and poor quality industrial facilities, suffered great damage in the earthquake with the effect of inadequate authority of the state in this process, leaving the production largely to market conditions with regard to the private ownership of residences, undervaluing the self developed solutions and land occupations of low income groups, recognizing illegal housing by frequently enforcing zoning ordinances for the sake of populism. In this process, we see that state and the local administrations also participated in this structuring process and constructed mass housing projects and new habitation areas in Izmit. These houses built with tunnel form construction were not affected by the earthquake [10 and 11].

2. RESEARCH SIGNIFICANCE (ARAŞTIRMANIN ÖNEMİ)

In the years after the lived considerable earthquakes, the research will light the way whether the people take precaution against new earthquakes and the precautions satisfy. In addition, it is concerned about precaution, workings of engineering and architecture, structural urbanization after earthquake.

3. EARTHQUAKE AND BUILDINGS (DEPREM VE YAPILAR)

Table 1 shows collapsed buildings and entirely, moderately and slightly damaged buildings in Kocaeli as a result of the earthquake and also the types of buildings.

Upon observations and investigations carried out on damaged buildings and building types after the earthquake it was determined that those buildings constructed between the years 1950 and 1970 and used as houses were old buildings with 2-3 storeys or that those buildings were illegal structures which were given license in 1980s by benefiting from the zoning ordinance and that those constructed after the year 1985 were mostly 4-8 storey buildings. It was also suggested that some of the buildings constructed before 1970 were damaged in the previous earthquake in Adapazarı and repaired and used again.

Apartment house types built with reinforced concrete framework system which collapsed in Kocaeli Earthquake were exposed to collective collapse on a large scale [12 and 13](Picture 1). The reasons for the damage on types of houses collapsed or damaged are given below:

- Concrete with poor strength and use of concrete produced from improper materials (Picture 2)[12],
- Lack of reinforcement in columns and beams constituting the main bearing elements of the reinforced concrete framework system or use of reinforcement with inappropriate sections. Therefore, inadequacy of column and beam connections (Picture 3, 4)[12],
- Poor workmanship,
- Construction of buildings inconsistent with the projects,
- Projecting the buildings contrary to the provisions of the regulation,
- Disregarding the ground properties and ground-building interaction and selecting foundation incompatible with the ground,
- Constructing extensions and additional storeys in violation of the license,
- Making modifications that may damage the bearing system of the building,
- Opening up the ground floors for commercial use (Picture 5)[12],
- Providing reinforcement for buildings that were damaged in early earthquakes [14, 15 and 16].

Table 1. Situation of damaged buildings after the Kocaeli earthquake [12, 13, 14, 15, 16 and 17]
(Tablo 1. Kocaeli depremi sonrası yapılarda hasar durumu)

Types of Buildings	Collapsed/ Entirely Damaged	Moderately Damaged	Partially Damaged	Total
Houses	35839	41100	45111	122050
Workplaces	5478	5861	6122	17 461
Education Buildings	27	65	138	230
Health Buildings	4	2	4	10

Picture 1. A reinforced concrete framework apartment house collapsed in the earthquake in Kocaeli [12]
(Resim 1. Kocaeli'deki depremde yıkılan betonarme karkas bir apartman)

Picture 2. Problems relating to the poor quality of materials
(Resim 2. Malzeme kalitesizliği ile ilgili sorunlar)

Picture 3. Problems at the points of connection of beam end and a column
(Resim 3. Kolon-kiriş birleşim noktalarında problemler)

Picture 4. Column-beam connection problems
(Resim 4. Kolon-kiriş bağlantı problemleri)

Picture 5. Soft storey problems
(Resim 5. Yumuşak kat sorunları)

It appears that public buildings collapsed or damaged in the earthquake have been mostly constructed with reinforced concrete framework system.

It is found out that most of the industrial buildings damaged in the earthquake are those built with reinforced concrete framework system and most of the damage was caused by the connections in columns and beams [18].

It was observed that the most destruction occurred in the buildings which were situated on filled sites and on weak grounds [19, 20 and 21]. Some parts of these fields slid into the sea in regions like Değirmendere and Derince, and caused great damage. Stream beds opened for construction with improvement and development plans designed after zoning ordinances issued in 1980s and buildings constructed on these fields have yielded similar results.

4. SITUATION AFTER THE EARTHQUAKE (DEPREMDEN SONRAKİ DURUM)

After the earthquake, the state enforced the law on building control and made efforts towards ensuring the construction of new buildings in compliance with this law. However, in fact there is criticism on the defects and shortcomings of the establishment of building control companies which have been determined and assigned by this law and it is still too early to see the results of the work carried out by these companies.

It is known that in the center of the province of Izmit, with a loamy and argillo-arenaceous ground structure saturated for groundwater, within the boundaries of the Municipality of Saraybahçe it has been obligatory to carry out the application of ground researches on basis of parcels since the year 1995. "Directorate of Ground and Earthquake Investigation Department" was established under the body of Izmit Metropolitan Municipality after the earthquake with the aims of examining, planning, applying the plans and monitoring Izmit and its vicinity. Appropriate settlement maps were issued by having geological, geophysical and geotechnical research reports prepared for restructuring and revisions of development plans were started in areas within the boundaries of Metropolitan Municipality. Regulations concerning the development were restarted in 2004 upon the expansion of the boundaries of Metropolitan Municipality to include the districts and towns.

Approximately one year after the earthquake, development works were started on hilly areas of the old city whose appropriateness for settlement in terms of the structure of the ground were ensured [22]. On the other hand, efforts were made after the earthquake towards restructuring of the province of Kocaeli where approximately 34000 houses collapsed and 18120 permanent houses were constructed by the state for those having lost their residences in the earthquake. Houses were built on habitation areas selected for this aim in the region generally with 4 storey tunnel form construction system and some with reinforced concrete framework system. Approximately 60% of 4100 moderately damaged houses were repaired after the earthquake, but nearly ten thousand buildings were again inhabited although they have not received proper restoration. Owners of many buildings objected to the degree of damage of their houses and these buildings still exist in the city with their existing damages.

After the earthquake, areas with inappropriate grounds were closed to development, new development areas were formed, the number of storeys and building heights were limited, closed extensions were prohibited in some places and decreased to 1 meter in some places and thus cities were driven into confusion in terms of visual features.

There has been great demand for undamaged buildings and for the habitation areas where these buildings are situated just after the earthquake in Izmit and purchase-sale prices and rents of these buildings have increased excessively. Collapsed and damaged buildings constructed on seashores and filled areas which were the most preferred and thus the most expensive sites before the earthquake, have been depreciated and have nearly been abandoned.

However, after the earthquake it was observed that new agricultural lands were opened for restructuring, some of the permanent buildings were constructed on these lands, those who want to live in safe buildings due to the fear of earthquake started constructing buildings on forest areas and there was an increase in illegal construction.

5. CONCLUSION (SONUÇ)

In years after the earthquake we have been faced with the reality suggesting that those learned from the earthquake were not completely put into practice in real life and that there was no integrity between planning, development, building control and judicial system and local, central administration organizations and universities carrying out studies on this issue. It is put forward that the earthquake and its effects are gradually being forgotten as the information about the issue is gathered separately, the confusion in applications maintain and people again tend to carry out intensive construction activities covering the agricultural fields and forest areas in a very short period of time by attaching priority to their individual interests.

In fact, the necessity to prevent information loss by keeping the matter within the agenda, gathering the information collected by separate organizations and individuals together under a united structure, offering this information to those interested, ensuring the easy access of all concerned organizations and professions is clear and evident. This is possible by establishing a national Geographical Information System (GIS). It is necessary and inevitable to get started with the studies immediately towards this aim.

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