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The conservation of modern architectural heritage buildings in Turkey: İstanbul Hilton and İstanbul Çınar Hotel as a case study

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ABSTRACT

This article contributes to the conservation of modern architectural heritage buildings by emphasizing the retrofitting of their construction systems. Modern architectural heritage buildings in Turkey are crucial in terms of transferring not only the cultural identity of the nations to further generations but also architectural sustainability of its distinguished period. By time, where these buildings can have constructional problems with its original structural systems, proposing a new system related with new earthquake regulations is inevitable in order to conserve them. Because most of the buildings are under threat of being demolished. The purpose of the research is to evaluate existing modern architectural heritage buildings in terms of its existing structural system and to develop a constructional model for renewal of them. As a case study, two hotel examples in İstanbul as a modern architectural heritage is selected, one is Hilton Hotel and the other is Çınar Hotel respectively. Then, the architectural plans and sections of the buildings as a data has been collected through literature survey by content analysis. At the end, the model proposal has been developed for each hotel buildings according to existing structural systems. The proposed models can be applied to sustain the life of the hotel buildings with a retrofitted structural system. So, the paper tries to conserve/protect the modern architectural heritage buildings by retrofitting its construction via presenting a remarkable study of two hotel buildings.

1. Introduction and research aims

Modern architectural buildings, representing twentieth century are valuable heritage structures that should be sustained as well as historic buildings since the protection of the modern values in the context of conservation is important in terms of a sense of the continuity of the culture. Istanbul Hilton Hotel and Cınar Hotel buildings which have been constructed during the modern architectural period of Turkey, have been selected as the case study of the research. These buildings are significant buildings because Hilton hotel was the first modern hotel built after Second World war around Europe while Cınar Hotel was the second biggest hotel after Hilton in Turkey.

From an architectural point of view, the hotel buildings can not only show the characteristics of modern period in Turkey in 1950s, but also carry cultural and memory values respectively. Since the buildings as an object, precisely the so to say "carrier of modern architectural heritage" in itself also make senses.

The aim of the study is to question structural systems of two selected buildings and to propose a new constructional model for them in particular without any change both in the architectural characteristics and function of the buildings. Preserving the function of the buildings with the original architectural language and concept is the most important subject in this study in terms of conservation. To design a structural system that will increase the strength and similar characteristics of the existing structure to the previous level. Creating the level determined analytical and experimental means within the framework of current regulations and to ensure that the performance of the building is at a level that will prevent wholesale collapse in an earthquake. Therefore the structural systems of buildings are should be rearrenged according to new earthquake regulations.

Earthquake is the heaviest loading situation encountered by the structures during their lifetime. It is known that due to insufficient ductility, insufficient strength and insufficient rigidity in

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reinforced concrete structures, damages occur under the influence of earthquakes and even the structures reach the point of collapse. In order to restore the building safety and to continue the existing architectural functions of the building, the entire structural system and damaged elements must be repaired and retrofitted. Different retrofitting alternatives are suggested in our country where reinforced concrete structures are common and almost all of them are under the risk of earthquakes. Adding reinforced concrete shear walls to the structure in necessary directions, reinforcement with steel braces and steel jacketing, retrofitting with carbon-based fibrous polymers (CFRP), behavior controlled reinforcement with seismic isolators (active or passive control) are among alternatives.

Another reason for the sustainability of these buildings is they are under threat of being demolished. Because of the declaration of weakness of structural systems of buildings, they are considered as ‘‘old” and completed its lifetime. Besides their being old, as being constructional weakness is the reason for its ending life. Especially modern buildings built from 1930s to 1950s were faced to be demolished in Turkey. For example, ‘‘Ankara Bank of Provinces” building, which was built on the modern axis of Ankara city, during the planning of Ankara’s early republican period, in 1937 by famous Turkish architect Seyfi Arkan, had been demolished in 2017 [1]. Another modern heritage building is ‘‘İstanbul Karaköy Passenger Hall” which was designed with an architectural project competition in 1935 by Rebii Gorbon-George Debes, was seen as a reference point for the city, perceived from sea and land transportation axes. It was one of the symbolic assets of the modern period with unique identity. Unfortunately it was also demolished in 2017 [2]. As a matter of fact, the architectural heritage of Istanbul dating to modernist period, constitutes an important part with distinctive buildings. An industrial heritage building ‘‘Mecidiyeköy Liquer Fabric” and ‘‘Atatürk Cultural Center” were other demolished modern heritage buildings in Istanbul [3]. In place of destroying these buildings, they should be sustained since they are evidence of the people’s lifestyle and culture, living in these cities. However the importance of the recent history of construction has largely lost its importance in the modern conservation theory of the 21st century, both on public opinion and on legal regulations. Otherwise representatives of each architectural era must be preserved. The building is a representative and document of the modernist city layer. It is obvious that the era in which it was produced has traces of the production of that age in the field of technology and architecture.

Even though, there are many modern buildings belonging the period, it is diffucult to determine the value critea of them [4]. Otherwise regardless of their value, a number of modern architectural heritage buildings have been transformed irreversible [5].

On the other hand, modern architectural heritage buildings are usually perceived as risky due to the technical and structural systems being weak and unable to carry loads [6]. For that reason these buildings should be reftrofitted with the certain surveys. By retrofitting these buildings, they can help to future generations to understand where they are coming from. The common responsibility to safeguard them for future generations is a sense of feeling. In fact continuity of existing building stock is one of the aspects of sustainable environments.

If the lifetime of the building stock is no longer sustain its construction, convenient structural systems with a various/new methods is inevitable. However, the proposed method must be convenient in terms of retrofitting the constructional significance of the building. When modern architectural heritage buildings are retrofitted, they continue their original functions, sustain their life by preserving the original architectural language/character and concept in order to give information for further generations.

1.1. Literature review

The fact that many buildings, which have an important place in the history of modern architectural consciousness, due to the rise of functional and physical aging faced the danger of destroy, bringing modern architectural products to the scope of cultural heritage. On the other hand, while some buildings are determined to be protected, various problems are encountered in every structure to be intervened. Since the architects and engineers, realizing the possibilities of reinforced concrete, carry out expeerimental studies such as pushing the structural boundaries and researching the different production and usadge patterns of system, it is necessary to determine a method by paying attention to these features in retrofitting of such structures.

Discussing on modern architectural heritage in view of conserving, restorating and repairing, has begun by the beginnig of 1990s that the conservation of modern heritage buildings developed a characteristic area of rehearsal. At the same decade, many international, national and local organizations have played a significant role for the conservation of twentieth century buildings. These organizations are; Docomomo International (DOcumentation and COnservation of buildings, sites and neighborhoods of the MOdern MOvement), APT (Modern Heritage Committee of the Association for Preservation Technology), ICOMOS (International Scientific Committee on Twentieth-Century Heritage, mAAN (modern Asian Architecture Network and various groups [7]. By the beginning of 21st century, an intensive activity by these organizations addressed the conservation of modern heritage buildings.

On behalf of the conservation of buildings, sustaining the original function of the building is the most preferred way. To give an example, the manifesto published by SBAP association, can be seen as a base for modern conservation theory. SBAP, the Society for the Protection of Ancient Buildings, was founded by William Morris and a proconservation group in England, which was a pioneer in making of civil organizations in Europe, started to sign various champaigns in 1877. In the mentioned manifesto, the importance of preserving historical buildings without losing their original values and transferring them to the future with daily maintenance and preventive repairs is emphasized [8]. Morris thinks that, there is nothing complicated to discuss about conservation. According to him, ‘‘protection is nothing more than fulfilling the things that will keep an old building standing” [9]. (p.20).

International guiding documents also supports the current original functions of architectural heritage buildings. One of the most internationally widespread protection documents is the Venice Statute (ICOMOS, 1964), refers to the issue, traditional setting exists must be kept [10]. It is also stated in New Zealand Statute for Places (ICOMOS, 1992) that was revised in 2010 for cultural heritage as ‘‘where the use of a place is integral to its cultural heritage value, that use should be retained.” The original use could be sustained for the future [11].

Actually, modern architectural heritage has been considered totally, except the iconic examples, by the declaration of DOCOMOMO international organization which was esteblished in 1988, after the 1990 Eindhoven Conference [12]. In Turkey, DOCOMOMO working group, studies for the protection and documentation of modern architectural heritage since 2002 [13]. Modern architectural heritage in Turkey is sustained through modernisation process from the early years of the establishment of the Republic (1923) until the 1970s [14].

However, most of the sudies dealing with modern architectural heriage buildings offer new uses for the existing buildings. Revising existing buildings for new functions is a common and widespread phenomenon without question or theoretical reflections. For example industrial modern heritage buildings were reused as

university buildings in Turkey during 2000s years, such as Abdullah Gül University from textile factory and Kadir Has University from tobacco factory [15,16]. Since this article discusses and preserves the original function of heritage buildings. Tha aim is to sustain its authenticity and integrity which could not be definitely adversely affected. Since in the late 20th century and at the beginning of the 21st century, the opinion that working with modern architectural heritage buildings, protecting and restoring them for sustained use has become an original challenge [17,18].

Since many of modern buildings have faced some structural problems by time, suitable methods were applied and put in to sustain their usadge. An example is the famous Falling Water House of Wright, which have pushed the limits of the console considerably. In the mid-1990s, the deflection on the first floor console carrying the second floor was 15 cm and the building faced the danger of collapse. The structure, supported by steel beams in 1997, was restored in 2002. Efforts have been made to preserve the architectural character of the building. The original sandstone slabs on the first floor were lifted to be reinstalled and the cantilever beams were reached, and the steel ropes placed next to the beams were anchored in the concreted area behind the consoles. The stretching process has been completed by slowly pulling with hundreds of tons of force for three days. The building was removed 1.25 cm from the tea side. The increase in deflection in the consoles has been stopped [19].

Another example is Frank Lloyds Wright's landmark building Guggenheim Museum, which's the exterior façade had been painted 12 times, to cover the cracks that have appeared since the first years of the building, were removed from this paint layers and the movement of the cracks were monitored with electronic measuring instruments placed on the cracks of the façade. After removal of coats of paint, treatment of corroded steel structures and repair and reinforcement of the concrete have been applied. Similar work has been done in Netherlands Sonneveld House, the Bauhaus School of Architecture or restorations of the Rotterdam Van Nelle Factories [20,21].

In fact due to the variety of cases, their different historical and cultural value and the differences in damage and deterioration, the solutions required are always non-standard, often unique, and have different applications [22].

Also, the sustainability of historical buildings have advantages in thermal comfort. It was found that the thermal performance of a conserved traditional building was more effective, making it more sustainable than its modern counterpart with the same function Another importance of heritage conservation is essential to keeping identity in its conservation of the past for future generations [23].

2. Materials and methods

Firstly, the data has been collected through literature survey and content analysis has been done to identify the architectural and constructional factors. Factors that affect decision of appropriate structural system for heritage buildings have been figured out in the light of structural analysis program modeling analysis. Relevant research studies for each factor have been analyzed and factors have been identified. So, the study was achieved through some qualitative methods, including collection and analysis of archival data, photos, plans and maps.

3. Case study location and description of buildings

İstanbul Hilton and Cınar Hotels were built in İstanbul in 1955 and 1958 separately. Hilton is located in Harbiye neighborhood at Şişli while Cınar Hotel is located in Bakırköy region at Yeşilköy. Fig. 1 shows the building location, site plans of Hilton and Cınar Hotels with their near neighborhood.

3.1. Definitions of the buildings

3.1.1. İstanbul Hilton Hotel

The construction of İstanbul Hilton Hotel was so striking that it was the first modern hotel building designed in 1952 under the influence of Americanization which influenced other hotel buildings during 1950s in Turkey. So much so that other hotels built after Hilton in many different cities of Turkey are designed in similar modern architecture style within reinforced concrete structure. Eventually, the hotel building affected political, social and architectural atmosphere of Turkey [24].

İstanbul Hilton Hotel was designed by the American architectural firm Skidmore, Owings & Merrill (SOM) with the local Turkish architect Sedad Hakkı Eldem [25]. Many foreign architects were invited to Turkey, to build new modern buildings beginning from 30 s to 60 s [26]. According to Akcan and Bozdoğan, hilton hotel building have certain architectural principles such as, honeycomb façade, horizontal rectangular prism raised on pilots and a transparent entrance block, topped with a roof terrace [27] and the gor-

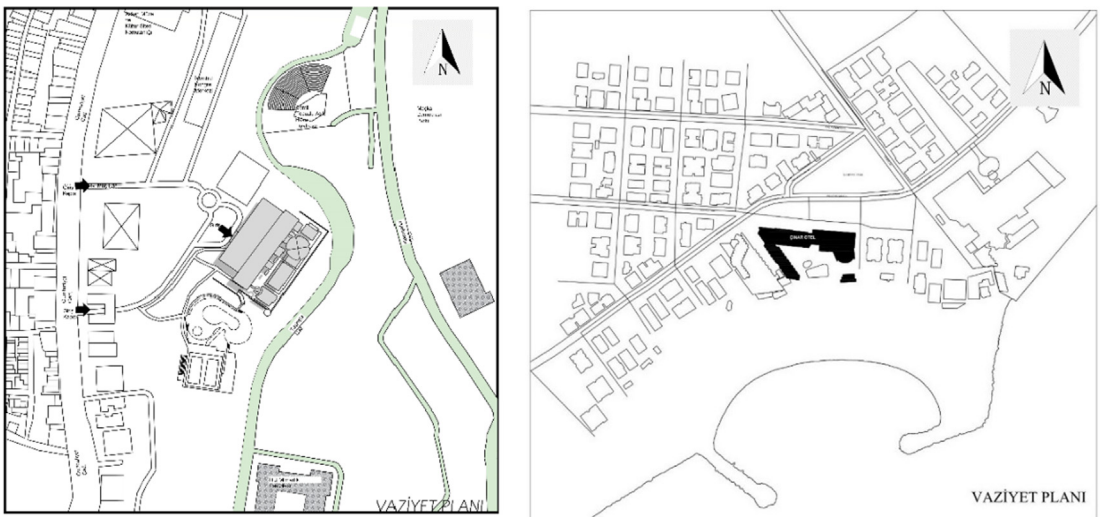

Fig. 1. Site plans of Hilton Hotel and Cınar Hotel.

geous reinforced concrete skeleton on the facade which were reminiscent of Le Corbusier [28]. The building defined the aesthetic standards of 1950s architectural language, which became a symbol as International style of American influence [29]. The location of the hotel must have been chosen so carefully that it has a magnificent Bosporus scenery from the top a hill, standing on its pilots with a rectangular box. Fig. 2 shows the photos of hotel just after it was built.

In 1952, the appearance of Hilton Hotel was declared in Arkitekt journal by the article title of "Touristic Hotel" presenting a comprehensive coverage of the building with plans and models of the building, where is located on the "2nd Park" according to Prost Plan [30], eventually the hotel was opened with great ceremonies in 1955. It has brought new approaches to architecture as mentioned by Sedad Hakkı Eldem, removing the eaves and roof, white concrete surfaces or thin slab coatings [31] (Figs. 3, 4).

However the effects of Hilton Hotel were deliberated contradictory as disapproving or attractive through Turkish architecture [28]. Because there was a tendency that the hotels' architectural language had distributed regardless of function or context throughout the country.

3.2. The structural system of Istanbul Hilton Hotel

In Turkey, which is located on an active seismic belt, devastating earthquakes have occurred in short time intervals. With the development of new technologies, changes were made in the regulations after these earthquakes. In the period when Istanbul Hilton Hotel building was built, the 1949 earthquake regulation was active in Turkey.

2018 Turkish Earthquake Code has been officially enforced as of January 1, 2019. Four different earthquake ground motion levels are specified in Turkey Building Earthquake Code 2018. DD-2: 10% probability of exceeding in 50 years, corresponding to a return period of 475 years [35]. This earthquake ground motion is also called standard design earthquake ground motion.

The structural system of the İstanbul Hotel building is reinforced concrete with frame system. For the coordinates where Hilton Hotel is located, the maximum ground acceleration (PGA) for

Fig. 2. Old photos of Hilton Hotel, just after building two/three years later [32-34].

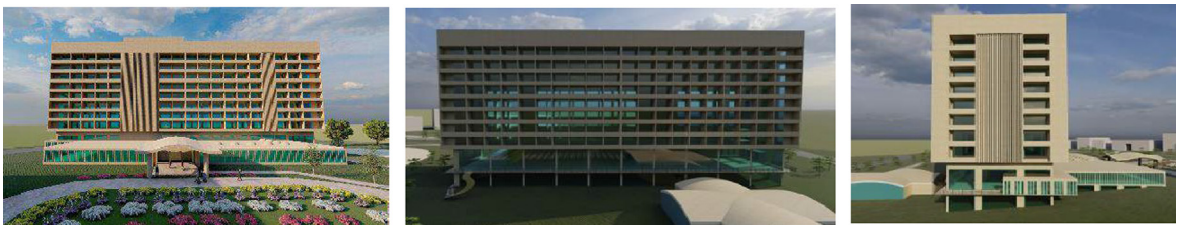

Fig. 3. Architectural renders (front, back and side facades) of hotel.

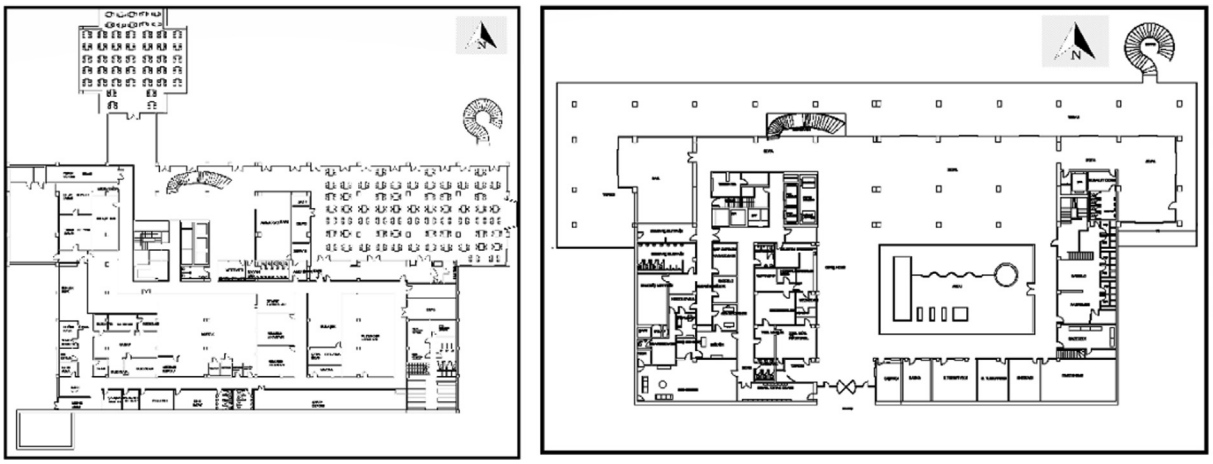

Fig. 4. First basement floor plan and loby floor plan of Hilton Hotel.

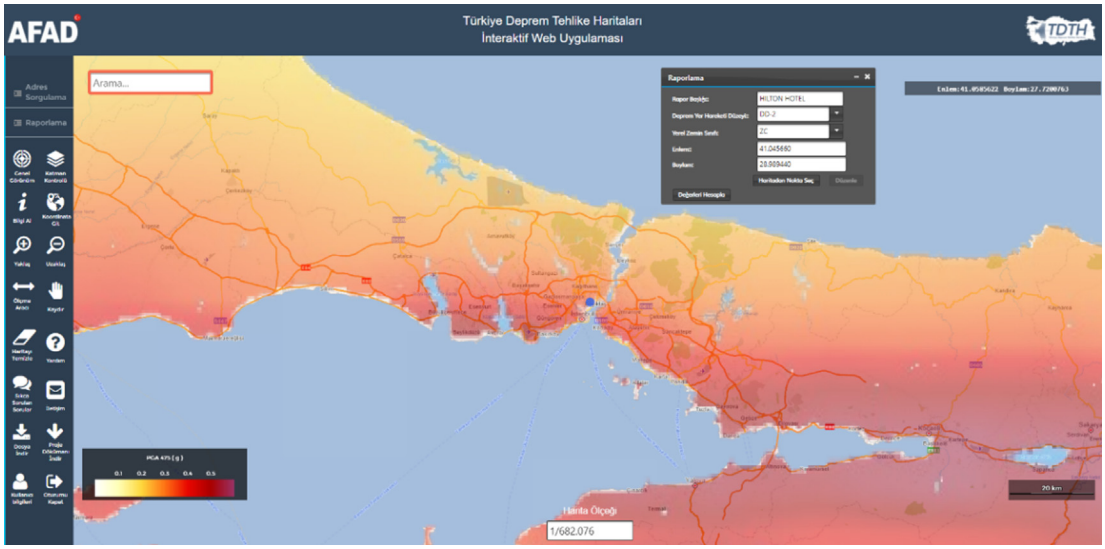

Fig. 5. AFAD Turkey Earthquake Maps Interactive Web Application.

Table 1
General information about İstanbul Hilton Hotel.

Hilton Hotel	Data
The place of hotel	İstanbul/Şişli (1955)
The usadge of the building	Hotel
Altitude	70 mt
Building importance coefficient	1.0
Ground type	ZC (Weak rocks with very fissures, weathered into very tight layers of sand or gravel and hard clay)
Ground safety tension	250 KN/m^2
Foundation depth	6.20 mt
Material	Reinforced concrete
Steel class	S420
Earthquake motion level	DD2 (TBDY 2018 2.2.2. article)
PGA	0.348 g
PGV	21.727 cm/sec
Height of the building	41.43 mt
Floor live load	3.5 KN

ZC soil type (Weak rocks with very fissures, weathered into very tight layers of sand or gravel and hard clay) was determined as 0.348 g from the AFAD Turkey Earthquake Hazard Maps Interactive Web Application. The maximum ground speed (PGV) is 21.727 cm/sec. [36] (Fig. 5).

Table 1 shows the general information about structural system of the building. And Fig. 6 states the structural renders of the building.

3.2.1. İstanbul Cınar Hotel

Cınar Hotel, constructed between 1954 and 1958 years, shows generally similar characteristics on the main formation of the building with an evident influence of the Hilton hotel (Table 2). It was the first hotel built under Hilton Hotel's inspiration, while with an investment of local capital by "Bekercan" company. It was designed by the architects, Rana Zıpçı, Ahmet Akın and Emin Ertam [37].

As stated in newspapers, it was the biggest hotel after Hilton Hotel with 150 rooms, swimming pool and other facilities [38] (Figs. 7, 8). Because of its location on Yesilköy beachside, initial project was made up through beach facilities with a main block. The garden as a continuity of restaurant was used a terrace that stretches to the sea. On the ground floor, there is reception, the bazaar and Bade bar, while there are resting, tea and ceremonial halls on the mezzanine floor, a restaurant, pavilion and kitchen, laundry room and so on in the basement, which is on the same floor with the garden [37]. Fig. 9 shows the architectural plans of floors respevtively.

As a matter of fact, the hotel mainly had basic similarities with Hilton architecture and International Style of the period instead of regional features. Especially the main block with its honeycomb façade was raised off the ground on pilots and horizontal form with balconies on the seaside façade and the roof terrace resembles the Hilton. The main entrance was a separate transparent double-height volume, which was connected to the mezzanine level with a grand staircase. The independent plan, and use of the roof garden,

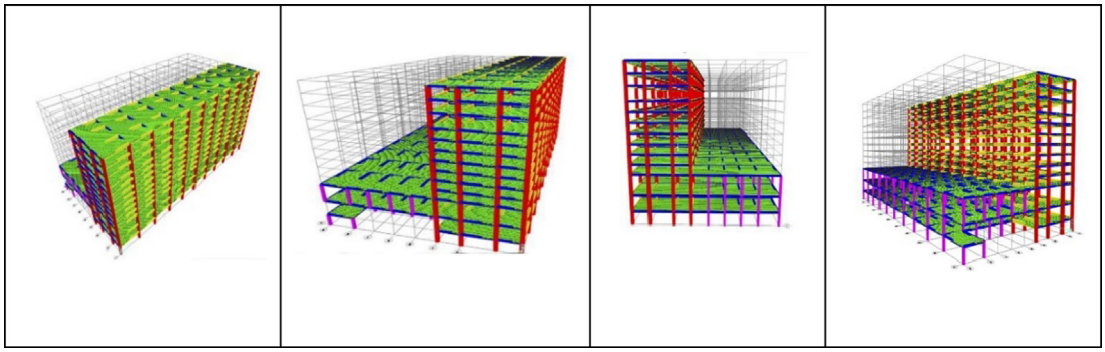

Fig. 6. Renders of structural system of Hilton Hotel.

opening of guestrooms towards to view were obvious principles of hotel design. Nevertheless, in the design of Cınar Hotel, the purism principle was broken with the service staircase placed at the end of the façade and ceramic terracotta was used for the balustrade railings, in contrast to the teakwood balustrades at the Hilton [24,39].

Table 2
General information about İstanbul Cınar Hotel.

Cınar Hotel	Data
The place of hotel	İstanbul/Bakırköy (1958)
The usadge of the building	Hotel
Altitude	14 mt
Building importance coefficient 1.0	
Ground type	ZC (Very tight sand, gravel and hard clay layers or weathered, very cracked weak rocks)
Ground safety tension	45.00 tf/m^2
Foundation depth	6.20 mt
Material	Reinforced concrete
Steel class	S420
Earthquake motion level	DD2 (TBDY 2018 2.2.2. article)
PGA	0.543 g
PGV	33.886 cm/sec
Height of the building	31.20 mt
Floor live load	3.5 KN

3.3. The structural system of Istanbul Cınar Hotel

The structural system of the İstanbul Hotel building is reinforced concrete with frame system.

For the coordinates where Hilton Hotel is located, the maximum ground acceleration (PGA) for ZC soil type (Weak rocks with very fissures, weathered into very tight layers of sand or gravel and hard clay) was determined as 0.543 g from the AFAD Turkey Earthquake Hazard Maps Interactive Web Application. The maximum ground speed (PGV) is 33.886 cm/sec. [35] (Fig. 10) (see Figs. 11 and 12).

Table 1 shows the general information about structural system of the building.

3.4. Analysis of the existing buildings

The structural system was modeled in the structural analysis program (Figs. 13, 14). Analyzed according to Turkish Building Eartquake Code 2018 earthquake code spectrum. The buildings' importance coefficient is I = 1 for hotel buildings according to TBEC 2018. According to the TBEC 2018, the structural system behavior coefficient has been determined as R = 4 and Overstrength factors as D = 2.5 for buildings where all the earthquake effects are covered by reinforced concrete frames with limited moment-transmitting ductility level.

Fig. 7. Old photos of Cınar Hotel [40-42].

Fig. 8. Architectural renders (site scenery from top and front facades) of hotel.

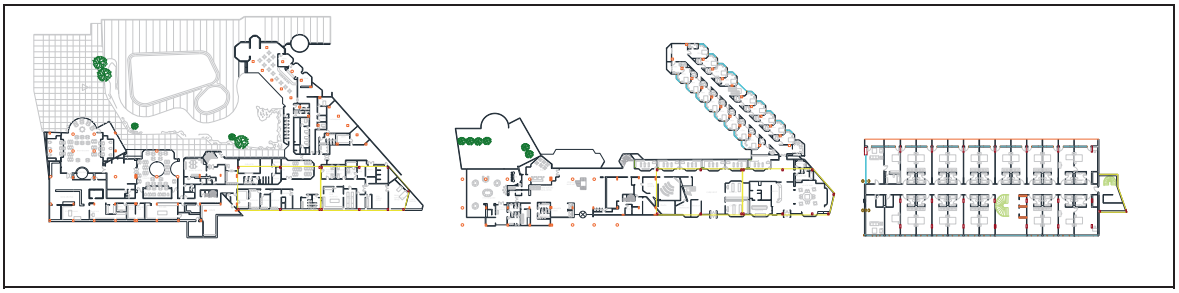

Fig. 9. First basement floor, loby floor plan and bedroom floor plan of Cınar Hotel.

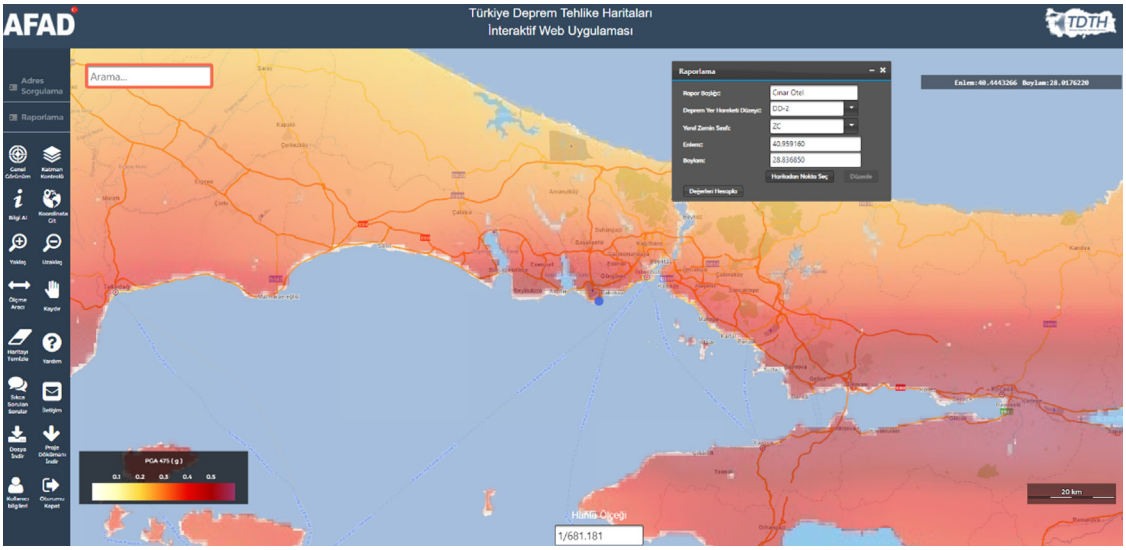

Fig. 10. AFAD Turkey Earthquake Maps Interactive Web Application.

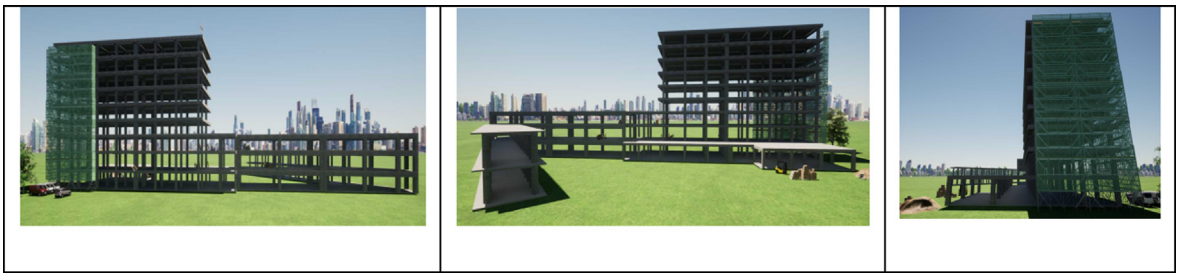

Fig 11. Structural system renders of Cınar Hotel.

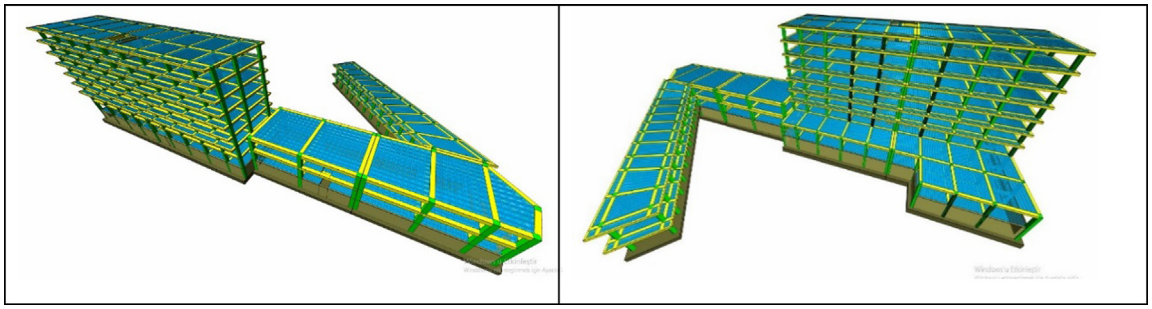

Fig. 12. 3D structural system renders of Cınar Hotel.

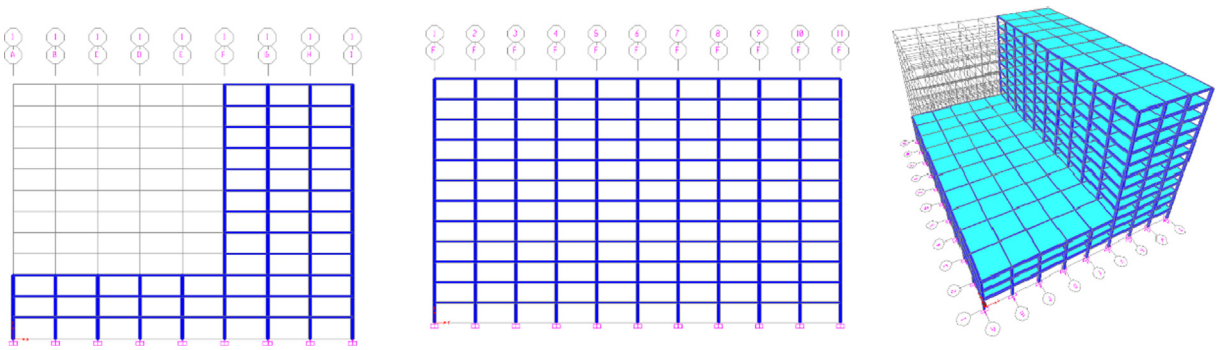

Fig. 13. Structural system model in structural analysis program – X, Y direction and 3D view.

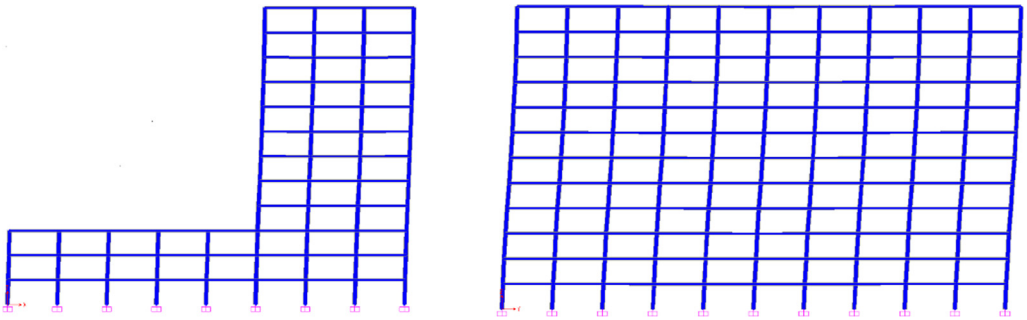

Fig. 14. Structural system model in structural analysis program – X and Y deformed shape.

According to the TBEC 2018, vertical and horizontal irregularities are defined in the buildings. However, such irregularities were not found in the Hilton and Cınar Hotel. As a result of the analysis, it was seen that the torsion mode did not occur in the structure due to the regular structural system. Most recent earthquakes have shown that the irregular distribution of mass, stiffness and strengths may cause serious damage in structural systems. However an accurate evaluation of the seismic behavior of irregular buildings is quite difficult and a complicated problem [43].

When the drifts ratio are controlled, it is calculated to be 3.8 %. This rate is above the permissible limit in 2007 Turkish Building Earthquake Code. According to 2007 Turkish Building Earthquake Code the maximum value of effective relative storey drifts, for columns and structural walls of the any storey of a building for each earthquake direction shall satisfy the condition %2. In the case where the condition specified by this ratio is not satisfied at any storey, the earthquake analysis should be repeated by increasing the stiffness of the structural system [44]. According to Turkey Building Earthquake Code 2018, for each earthquake direction, two conditions are given for the maximum value of the effective relative storey drifts calculated in the columns or walls at any floor of the building within the storey. The interstory drift limits in the 2018 Seismic Code are described for Infills with flexible connections to frame to %1.6 [44].

Earthquake is the heaviest loading situation encountered by the structures during their lifetime. Making existing stock of buildings resistant to earthquake retrofitting and development of repair techniques in order to provide performance targets and reduce the economic losses are essential. The fact that the buildings don't satisfy the conditions in the current regulations, change in the purpose of use of the building, earthquake, impact and explosion effect may cause the need for retrofitting in the buildings.

It is known that in earthquakes, structures reach the collapse zone due to the formation of some of or all of the three main elements; insufficient lateral stiffness, insufficient ductility and insufficient strength.

Unfortunately, devastating earthquakes have occurred in our country, especially in the last century. Building earthquake codes were updated after these earthquakes. Until the 1949 Earthquake Regulations, did not fully mention reinforced concrete buildings in the regulations. Due to the fact that reinforced concrete buildings are not widely used, there are no studies on earthquake calculation in these regulations. Although the first earthquake calculation is very simple, it is available in the 1949 Earthquake Code. In later regulations, earthquake calculations became more and more detailed. Also, in Turkey Earthquake Code 2007, methods for the evaluation and retrofitting of existing structures was introduced. Push-over & capacity spectrum method was introduced.

These two buildings are reinforced concrete buildings with frame system as in most of the building stock in our country. When we look at the years of construction, it is estimated that both buildings were built in accordance with the Turkey Earthquake Code 1949. Due to the fact that earthquake regulations have become more detailed, earthquake safety of existing buildings should be checked and retrofitted according to new regulations.

At the time these structures were built, earthquake effects were considered to be at a lower level due to the low level of knowledge of the regulations. Horizontal seismic effects, idealized for such reinforced concrete frame structures, ranged from 7% to 10% of the building weight. Earthquake regulations were also detailed with the modification of earthquake maps, new studies and the development of technology. In 1998 and 2007 Turkey earthquake regulations, this coefficient reached 15%. In 2018, serious revisions were made in the Turkey Building Earthquake Code by making micro-zoning. Maximum acceleration values are used instead of earthquake zones.

There are different retrofitting alternatives, especially in reinforced concrete structures that constitute the majority of the building stock in our country. Traditional retrofitting methods cannot produce optimum solutions due to long application and construction times, high economy level and changing the architectural functions. New generation retrofitting methods are behaviour-controlled techniques (active and passive dampers etc.) and fibre reinforced polymers. Retrofitting technique with fibre reinforced polymer, one of the new generation methods; it is a system that system that increases the strength, ductility and rigidity capacities of the structure with epoxy etc. of high strength fibres such as carbon, glass, aramid. It is widely preferred today, especially because of its fast and easy applicability compared to traditional retrofitting methods, not creating an obstacle to the architectural functions of the building and being economical.

3.5. The model proposal

The fibres are the load-bearing component with a high modulus of elasticity. It can be based on glass, aramid and carbon. The fibres are attached to the reinforced concrete surface with epoxy etc. bonds with a matrix and creates a composite section behaviour. Fibber reinforced polymers increase the strength and ductility of the building elements and increase the ductility of the structure under the effect of earthquakes (Fig. 15).

Characteristic tensile strengths and modulus of elasticity of FRP components are given in the Table 3 above. Their tensile strength is ten times that of St37 steel. Strength and ductility values of the structure to be retrofitted should be improved on an element basis. For this purpose, after determining the demands of the building under the effect of earthquake and vertical loads, the increase in the element capacities of these demands can achieved with the FRP application. Fig. 16.

Experimental studies carried out in ITU Structural and Earthquake Laboratory were examined within the scope of the research. In order to understand the effectiveness of fiber reinforced poly-

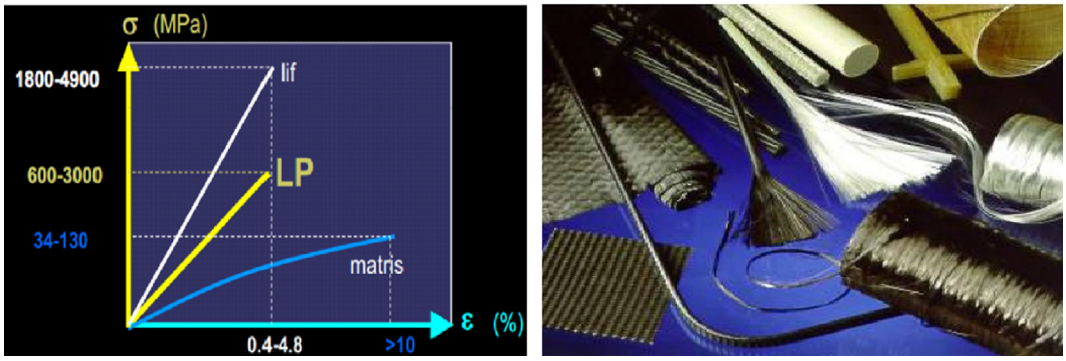

Fig. 15. FRP composite properties and appearance.

Table 3
Characteristics of FRP components.

FRP Type		Modulus of Elasticity (kN/mm^2)	Tensile Strength (N/mm^2)
Carbon		230–640	2500–4000
Aramid		120–130	2900
Glass		70–90	2000
Steel St37	210		370

mers in terms of strength and ductility, experiments were carried out for 2-fold and 4-fold wrapping of glass fibers on cylindrical samples with a diameter of 15 cm and a height of 30 cm. In this study, standard cylindrical samples were wrapped with FRP material and tested under axial compressive stress. Thus, the stress–strain relationship of the wrapped concrete was obtained, and the effect of wrapping in terms of strength and deformation ability was revealed [45-47].

Two of the samples were tested as a reference without wrapping and the other four samples were tested under monotonically increasing axial loads after wrapping. The increase in compressive strength and strain capacity of the samples wrapped with GT1 and GT2 with 2-fold FRP and GT3-GT4 with 4-fold FRP is shown in Fig. 17 [45-47].

The compressive strength was increased approximately 2 times in 2-fold wrapping and 4 times in 4-fold wrapping compared to the reference sample.

Fig. 16. Test samples.

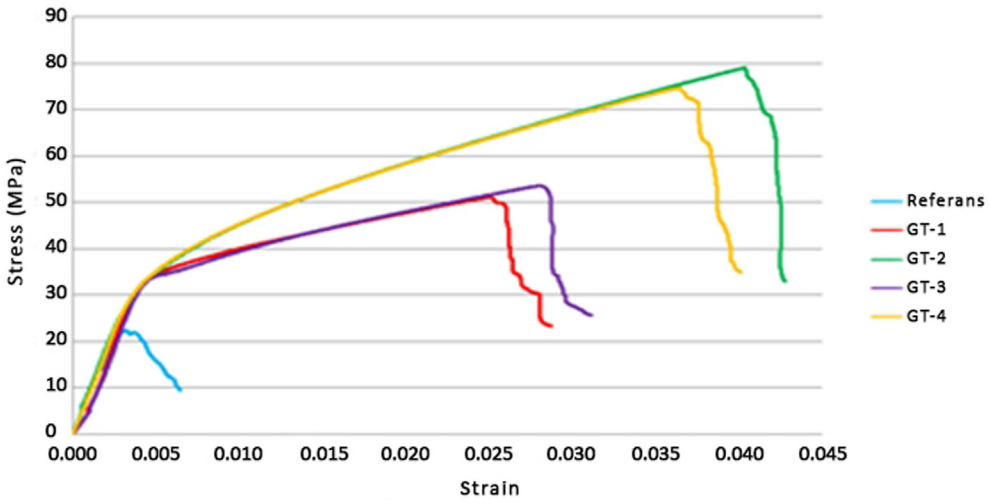

Fig. 17. Stress–strain curves of the experimental study [45-47].

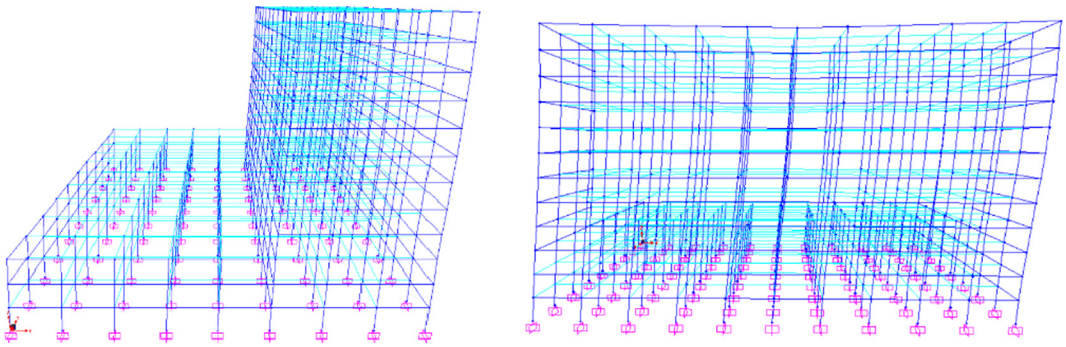

Fig. 18. Reinforced structural system model in structural analysis program – X and Y deformed shape.

According to the results of the experiment, the model of the reinforcement alternative was prepared in the structural analysis program (Fig. 18). The results of the analysis made with the 4 layers of CFRP wrapping of the frame elements were compared with the current situation.

When the drifts ratio are controlled, it is calculated to be 1.4% and this ratio is below the limit ratio given in Turkish Building Earthquake Code 2018.

Also, various methods can be used for strengthening of buildings' constructional materials. Different fibers' flame may have different affects in reinforced composition. The effect of FR on retarding the composite decomposition is found lately which can be used also [48]. Or another example is, strengthening scheme was performed with the help of an epoxy-based resin as a matrix in a hand-up method [49]. Another method is develop sustainable buildings that integrate BIM and multi-criteria decision [50].

4. Conclusion

During the 21st century, conservation of architectural heritage buildings is one of the most significant topics in architecture and civil engineering. The suspected continuity of existing building stock is one of the aspects of sustainable environments. The stability of heritage buildings is an inspiring process since there are many factors that must be concerned with a combined approach. While retrofitting of heritage buildings, the existing fabric should be analysed in depth. It is not only enough to retain the building physically; originality of the buildings must be preserved by giving appropriate function and appropriate users. This paper proposes a comprehensive methodology for development of adaptive continuity strategies for modern heritage buildings. The proposal should have been developed for all types of heritage buildings, as well as hotel buildings or buildings belong to the mentioned modern period, which is unrestrained, unsuitably functioned.

What was common in these two examples, based on different interpretations, was the desire to modernize and the pursuit of the world order. Their approaches to international style were beyond their usages. These hotels were influenced by the International Style and the interior and social life carried by the Hilton Hotel while establishing modern interiors, avoiding oriental agendas and seeking a modernity unique to this culture.

As a result to conserve the heritage buildings they should be strengthen with new earthquake regulations by new methods. Retrofitting of reinforce concrete frame type structure with fibre polymers is a very effective method due to both rapid application and not changing the architectural functions. In buildings that are important in terms of architectural heritage, such as the two hotel buildings examined, this application can be used to ensure earthquake safety.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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