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MASTER THESIS

EVALUATION OF SUSTAINABILITY OF HIGH RISE BUILDINGS IN IZMIR: MISTRAL TOWERS

GAMZE DEVRAN

THESIS ADVISOR: ASST. PROF. DR. ECEHAN ÖZMEHMET

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We certify that, as the jury, we have read this thesis and that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

Jury Members:	**Signature:**
Assist. Prof. Dr. Ecehan ÖZMEHMET Yaşar University	.....
Assist. Prof. Dr. Eray BOZKURT Yaşar University	.....
Assoc. Prof. Dr. Müjde ALTIN Dokuz Eylül University	.....

Prof. Dr. Cüneyt GÜZELİŞ
Director of the Graduate School

ABSTRACT

EVALUATION OF SUSTAINABILITY OF HIGH RISE BUILDINGS IN IZMIR: MISTRAL TOWERS

Devran, Gamze

Msc, Interior Architecture

Advisor: Asst. Prof. Dr. Ecehan ÖZMEHMET

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Since their existence, people have begun to build high-rise buildings with a desire to go higher, especially under the influence of their religious beliefs.

Today, high rise buildings represent prestige and power from a social perspective. In cities with population density, economically developed and with increasing potential for development every day, higher structures are being built more. As the migration to the city centers increased, land plots to be constructed decreased and therefore land prices increased. As the population density increases in the city centers, the necessities have increased in this direction and new needs have started to be formed. Multifunctional structures have emerged to meet all the needs of people. The buildings are functional according to the needs potential of people and the environment and serve not only the residents but also the environment. High rise buildings are buildings with a large human population and 7/24 living. High rise buildings consume more energy than traditional buildings. The increase in global warming and the decrease in natural resources have been a major factor for the ecological awareness of the people. Since people spend most of their lives indoors, the importance given to health and comfort in buildings has increased. In this respect, the sustainability of buildings and their impact on the environment is very important.

İzmir is a city center with its multifaceted economic activities and rich natural resources. Population density is increasing day by day and is a city that continues to develop socioeconomically. İzmir is an important center of attraction in the Aegean Region and the country with its logistics infrastructure, qualified human resources, multi-sector structure and high standard of living. These factors have caused the

population density to increase day by day. A new city center has been established in order to meet the needs of people and to ensure that the center of İzmir is stuck as a result of the migrations, the roads and parking lots are insufficient for the city center. Bayraklı district has been a solution for meeting all these needs and relaxing transportation. High buildings constructed and designed in Bayraklı contribute to the city skyline. Furthermore, it plays an active role in eliminating the problems arising from the increase in population density. Problems arise when high-rise buildings start to be experienced during the project phase, implementation and building. Within the scope of these problems, the Mistral towers, which were built in İzmir and could serve as an example for the high rise buildings that will continue to be constructed, were discussed in this thesis. One of the most important objectives of this thesis is the impact of new buildings on the environment, energy-efficient structures and structures that give importance to human health and comfort. Another objective of the thesis is to provide sustainability in high-rise buildings, to minimize the damages to the environment, and to design and implement buildings where renewable energy is used at maximum level.

As a case study of the selected Mistral high-rise buildings, it was found that the contributions of high-rise buildings to the city can meet the needs of the environment. It is thought that the ecological balance can be prevented by the construction of such buildings. In line with the results obtained, it was determined that the costs spent in order to be sustainable structure during the project and implementation phase were recovered in a very short time and this information was aimed to contribute to the new high-rise buildings.

Key Words: LEED certification, Multi-storey buildings, energy efficiency, sustainability, multifunctional structures

ÖZ

İZMİR'DEKİ BINALARIN KRİTERLERİNİN SÜRDÜRÜLEBİLİRLİK DEĞERLENDİRMESİ: MİSTRAL KULELERİ

Devran, Gamze

Yüksek Lisans, İç Mimarlık

Danışman: Yrd. Doç. Dr. Ecehan ÖZMEHMET

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İnsanlar varolduğundan beri özellikle dini inanışlarının etkisiyle, daha yükseğe çıkma arzusuyla yüksek yapılar inşa etmeye başlamışlardır.

Günümüzde yüksek yapılar sosyal yönden bakıldığında prestij ve güc olarak görülmektedir. Nüfus yoğunluğu olan, ekonomik yönden gelişmiş ve her geçen gün gelişme potansiyeli artan şehirlerde yüksek yapılar daha fazla inşa edilmektedir. Şehir merkezlerine göç arttıkça, inşaat yapılacak arsalar azalmış ve bu sebeple arsa fiyatları artmıştır. Şehir merkezlerinde nüfus yoğunluğu arttıkça ihtyaçlar da bu doğrultuda artmış ve yeni ihtiyaçlar oluşmaya başlamıştır. İnsanların tüm ihtiyaçlarına karşılık verebilmek için çok fonksiyonlu yapılar ortaya çıkmıştır. İnsanların ve çevrenin ihtiyaç potansiyeline göre binalar işlevlendirilmiş ve sadece bina sakinlerine değil çevreye de hizmet etmektedir. Yüksek yapılar insan popülasyonu çok fazla olan ve içerisinde 7/24 yaşam olan binalardır. Geleneksel binalara göre yüksek yapılar daha fazla enerji tüketmektedir. Küresel ısınmanın artması ve doğal kaynakların gün geçtikçe azalması insanların ekolojik yönden bilinçlenmesi için büyük bir etken olmuştur. İnsanlar yaşamlarının büyük bir bölümünü kapalı alanlarda geçirdiği için binalarda sağlık ve konfora verilen önem artmıştır. Bu açıdan bakıldığında binaların sürdürülebilirliği ve çevreye olan etkileri çok önemlidir.

İzmir, çok yönlü ekonomik faaliyetleri, zengin doğal kaynakları olan bir şehir merkezidir. Gün geçtikçe nüfus yoğunluğu artmakta ve ekonomik yönden gelişmeye devam etmektedir. İzmir, başta lojistik altyapısı, nitelikli insan kaynağı, çok sektörlü yapısı ve yüksek yaşam standardı ile Ege Bölgesi'nde ve ülkede önemli bir çekim merkezi oluşturmaktadır. Bu etkenler nüfus yoğunluğunun gün geçtikçe artmasına sebebiyet vermiştir. İzmir merkezinin, yaşanan göçler sonucunda sıkışması, yolların

ve otoparkların kent merkezi için yetersiz kalması ve insanların ihtiyaçlarına karşılık verebilmek için yeni bir kent merkezi oluşturulmuştur. Bayraklı ilçesi tüm bu ihtiyaçları karşılama ve ulaşımı rahatlatmak için bir çözüm olmuştur. Bayraklı'da yapılmış ve projelendirilmiş yüksek yapılar kent siluetine katkıda bulunmaktadır. Ayrıca nüfus yoğunluğunun artmasından kaynaklı sorunların giderilmesinde etken rol oynamaktadır. Yüksek binaların proje aşamasında, uygulamasında ve binada yaşanmaya başlandığında problemler oluşmaktadır. Bu problemler kapsamında, tez çalışmasında İzmir'de yapılmış ve yapılmaya devam edecek yüksek yapılara örnek olabilecek olan Mistral kuleleri ele alınmıştır. Yeni yapılacak olan yüksek yapıların çevreye olan etkisi, enerji etkin yapılar olabilmesi, insan sağlığı ve konforuna önem veren yapılar olması tezin amacıdır. Yüksek binalarda sürdürülebilirliğin sağlanabilmesi, çevreye verilen zararların minimuma indirilebilmesi, yenilenebilir enerjinin maksimum seviyede kullanıldığı binaların tasarlanıp uygulaması tezin bir diğer amacıdır.

Seçilen Mistral yüksek yapı yapılan analiz ve değerlendirmeler sonucunda yüksek yapılaşmanın şehre olan katkıları, bulunduğu çevrenin ihtiyaçlarını karşılayabildiği tespit edilmiştir. Bu tür binaların inşa edilmesi ile ekolojik den genin bozulmasına engel olunabileceği düşünülmektedir. Ortaya çıkan sonuçlar doğrultusunda proje ve uygulama aşamasında sürdürülebilir yapı olması için harcanan maliyetlerin işletme aşamasına geçildiğinde geri kazanımın çok kısa sürede olduğu tespit edilmiş ve yeni yapılacak olan yüksek yapılara bu bilgilerin katkı sağlaması amaçlanmıştır.

Anahtar Kelimeler: LEED sertifikası, Çok katlı yapılar, enerji etkinliği, sürdürülebilirlik, çok fonksiyonlu yapılar

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Gamze Devran

İzmir, 2019

TEXT OF OATH

I declare and honestly confirm that my study, titled "**EVALUATION OF SUSTAINABILITY OF HIGH RISE BUILDINGS IN İZMİR: MİSTRAL TOWERS**" and presented as a Master's Thesis, has been written without applying to any assistance inconsistent witnh scientific ethics and traditions. I declare, to the best of my knowledge and belief, that all content and ideas drawn directly or indirectly from external sources are indicated in the text and listed in the list of references.

Gamze DEVRAN

Signature

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November 22, 2019

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SYMBOLS AND ABBREVIATIONS

ABBREVIATIONS:

ASHRAE American Society of Heating, Refrigerating and Air-Conditioning

CASBEE Comprehensive Assessment System for Built Environment Efficiency

ÇŞB Çevre ve Şehircilik Bakanlığı

DGNB Deutsche Gesellschaft für Nachhaltiges Bauen

ETKB Enerji ve Tabii Kaynaklar Bakanlığı

HVAC Heating, Ventilating and Air Conditioning

LEED Leadership in Energy and Environment Design

NRDC Natural Resources Defense Council

USGBC US Green Building Council

CHAPTER 1
INTRODUCTION

Today, with the development of technology, there have been changes in the quality of life of the people. Due to the increase in ecological problems and the fact that most people spend their lives indoor areas, structures with sensitivity to the environment have been started to be developed to improve the quality of life. In the past, any building with any environmentalist feature was defined as environmentally conscious and sustainable, however under the umbrella of sustainability, economy and community as well as environment need to be taken into account. (Özmehmet, 2017) Developing systems that evaluate structures according to environmental impacts, social awareness and shifting the construction sector towards this direction have begun to occur due to changes in the preferences and environmental sensitivity of the occuponts. Human and environmental impact of the sustainable building are ensured to be an urbanization and sustainable living spaces. Building sector has an increasing global effect on social, environmental and economic sustainability. The building sector rapidly increased and the use of finite fossil fuel resources have already raised concerns over supply difficulties, exhaustion of energy resources and heavy environmental impacts-ozone layer depletion, carbon dioxide emissions, global warming, climate change. This built environment is one of the most resource-intensive sector and sustainable building model is the key factor that is a primary issue for protecting the environment. Sustainability is the main aspect in this context. The first time sustainability was introduced by United Nations Bruntland Report as; “Humanity has the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs”. (Bruthland Report, 1987)

Izmir has a rich development potential, rich natural resources and qualified quality of life. The outstanding features of İzmir can be summarized as; economy, industry, tourism, logistics, tourism, logistics infrastructure, population employment, education and foreign direct investment etc. İzmir has been an important center of attraction in Aegean Region and in the country with its logistic infrastructure, qualified human

resources, multi-sectoral structure and high standard of living. As the new city center of Izmir, there are high buildings in Bayraklı district of İzmir. These high-rise buildings are multi-functional and 7/24 living building environments. There are 6 high-rise buildings in the Bayraklı mucipalitiy area. There are 3 high-rise buildings with the same location and the same functions. According to the September 2019 data, Folkart Towers than Ege Perla multifuntional building complex and Mistral Towers. Since life in these buildings never stops, energy consumption, health, comfort and management are important factors for people's quality of life as well as enviromental, social, economic and sustainability of the region, city of İzmir from the micro to the macro scale.

In this study; energy consumption in multifunctional high rise buildings, ways to keep the damage given to the environment in minimum, selection of the location of the building to be constructed and its contribution to the environment, its importance in the design phase, the construction phase and the aftermath are examined.

1.1. Aims and Problem Definition

The purpose of this research; to reveal the analysis and importance of evaluating sustainability performance for high-rise buildings constructed and to be constructed in Bayraklı district of İzmir. A new city center is being established in Bayraklı district of İzmir. Bayraklı as a combined and a mixed city center that holds living&working environments as well as commercial spaces. It is important to correctly perceive the needs of the new structures in this region and to function accordingly.

There is limited construction site for new structures and buildings in the city centers. The reason for this is the increasing human population and imigration from other cities and rural areas in Izmir.

The aim of this thesis is to reveal the benefits of high rise buildings for İzmir and the benefits of sustainability. There are many high-rise projects planned to be done in İzmir. It is important that these buildings be able to serve the environment in which they are located and designed as environmentally sustainable buildings. There are high

buildings built in Bayraklı of district and where life started. The impact of these high-rise buildings in the city should be observed and should be a reference to the new high-rise buildings. It adds to the positive contribution of the city of high rise buildings should be determined and set forth limitations. In this way, the new high rise buildings are environmentally sensitive with improved occupant indoor comfort. The fact that a building can serve the environment and people begins with its being a sustainable structure. A sustainable building should be decided at the design stage. Sustainable design of the tall building increases the cost during the construction phase. This prevents the employer from looking at this sustainable building approach positively. Increasing construction costs is a major problem. However, it should be determined by numerical values that this cost will pay for itself immediately when the building is operational and shared with the employer.

Therefore, the design phase is important for sustainable high rise buildings from this point on, in this research, Mistral Towers structure built in Bayraklı district of İzmir was investigated and the findings were evaluated. For this purpose phases from project phase to operational phase have been examined and it has been observed how the decisions taken during the project phase have an impact on the operational phase in order to ensure sustainability in high structure, and researched and discussed how to benefit more in new buildings. The positive aspects of the sustainable structure are shown and the benefits of the sustainable structure are indicated.

1.2. The Scope and Method the Research

The research study is a quantitative method that focus on high rise buildings in İzmir. In this study, systematic literature reviews and observation methods were used in the design, implementation and operation phases, that take part in the team of Mistral Towers project. Literature research of books, theses and articles on high rise structure and sustainability has been conducted. The views of the engineers working in the Mistral Towers application phase were consulted and the applications were observed one on one. Information about Mistral Towers were collected by e-mail and face-to-face meetings with the LEED representative. After the researches on this thesis, the

sustainability context which are important in high rise buildings and which affect the design were determined. All information was collected and evaluated using synthesis method. In the second phase, the strategy of sustainable building design on high rise buildings was examined. The effects of the certification system in high rise buildings were examined and articles written on this subject were investigated. The application and benefits of energy efficient design in high rise building structures have been investigated. With the combination of technology and structural system, the ease of constructing the tall building is explained and the thesis and articles written on this subject are examined.

Mistral Towers, built in İzmir Bayraklı, were examined in the third phase. After the analysis and observations, the criteria examined in the second phase were examined on Mistral Towers. The reason for examining the Mistral Towers were the location of the building in İzmir. Because Bayraklı region has been chosen as the new urban center and high rise buildings will be built in this region. The Mistral Towers were a LEED certified structure and has been preferred. It is targeted that it will serve as an example for the high rise buildings to be constructed in the upcoming years.

In the conclusion phase, in accordance with the information obtained from the Mistral Towers structure researched and shown as an example in the thesis stage, the positive values and difficulties of the high rise structure have been revealed to the new high rise buildings to be constructed.

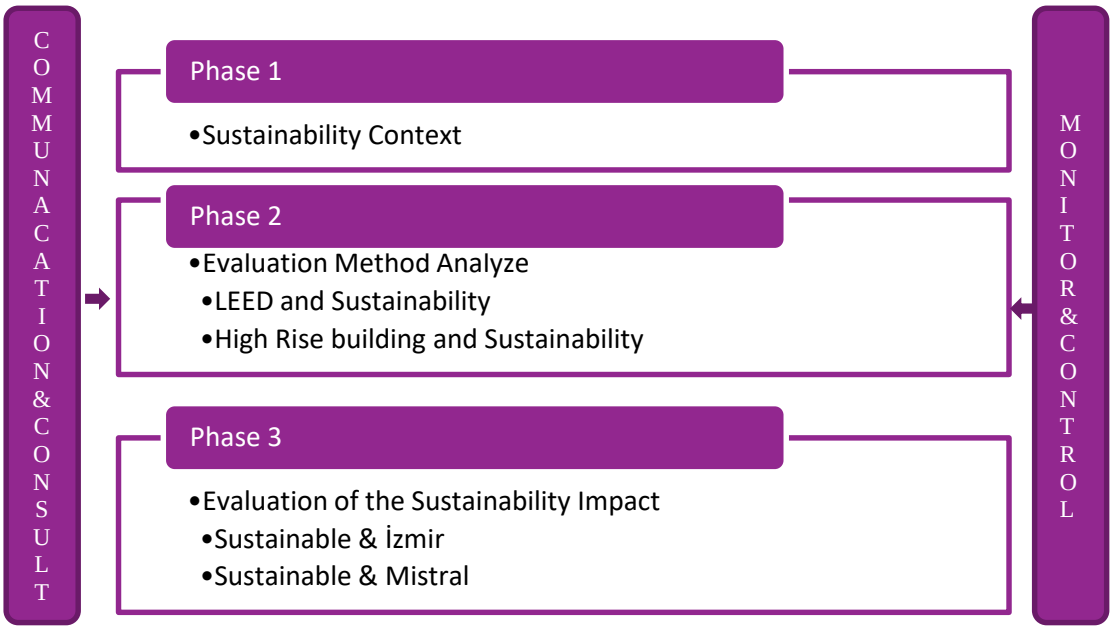


Figure.1.1 Phases of Methodology (designed by; G. Devran, 2019)

CHAPTER 2
SUSTAINABLE BUILDING DESIGN STRATEGIES IN HIGH RISE BUILDINGS

2.1. Introduction

Demand for natural resources and energy has increased as a result of population growth, industrialization, rapid progress in technology and globalization in the world. Conventional high rise buildings spend high of energy than other buildings on the other hand, reduction in non-renewable energy sources is one of the major problems of today's society. For this reason, Architects and engineers are committed to design buildings that consume minimum amount of energy. Designing and constructing high rise buildings is a combination of building; Heating, Ventilating and Air Conditioning (HVAC), architectural components and communication systems.

The concept of sustainability was first introduced in 1972 at the Human Environment conference in Stockholm. In 1987, the Bruntland Report issued by the World Commission on Environment and Development revealed the definition of sustainability used today. (Erdede & Bektaş, 2014)

For the first time, the concept of sustainable development was defined in the Brundtland Report, prepared by the World Commission on Environment and Development in 1987, as development that meets today's needs without compromising the ability to meet the needs of future generations ".

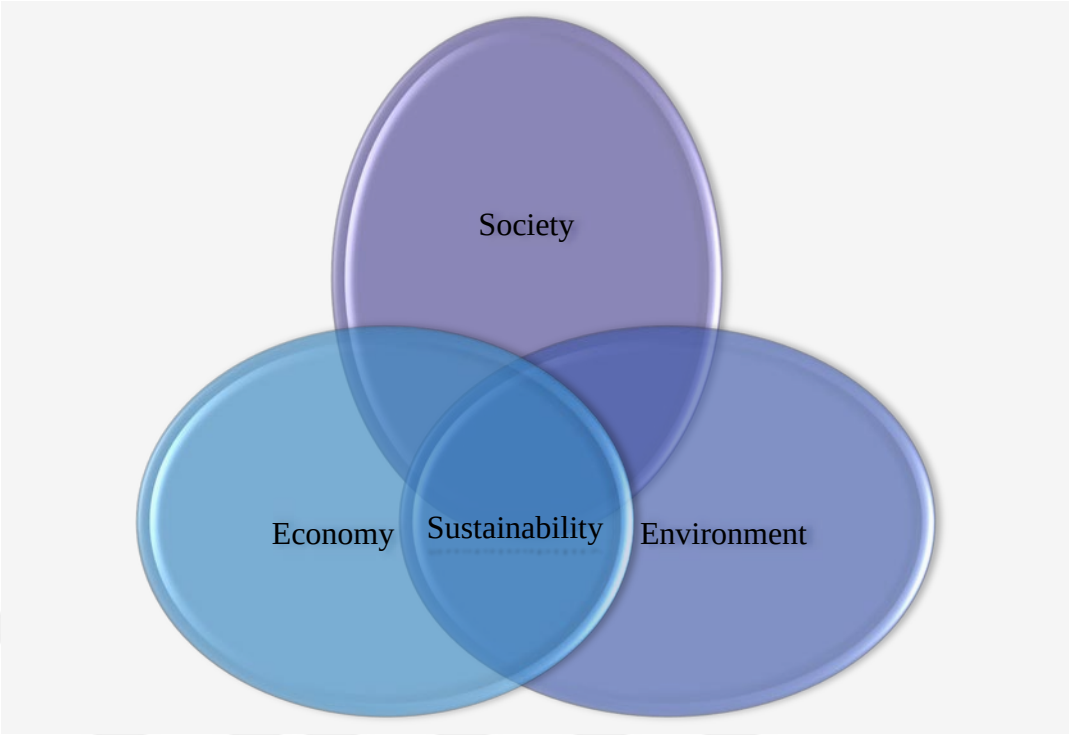


Figure.2.1 Interrelations of Economic, Social and Environmental Dimensions of Sustainable Development (Lounsbury, 2017) (redesigned by; G. Devran, 2019)

According to Newman; "*Sustainable architecture is environmentally conscious, energy-saving, and utilizes responsive and renewable materials and systems. Big cities can be more sustainable. Contrary to many popular conceptions, there is a worldwide pattern within nations that bigger cities. Despite the bigger cities consuming, less per capita energy, water, land, forest products, and building materials and producing lees per capita air, water and solid waste, the bigger cities are likely to sooner meet natural environment capacity constraints in their local areas*." (Newman, 2001)

Although sustainability is a social issue, the most important issue discussed in the construction sector is economic and environmental indicators. The aim of the construction sector today is to ensure that construction costs are minimized. After the construction cost, the operating cost is also important. Social aspects are not evaluated in short and long term planning. Is the largest energy-consuming buildings high-rise buildings, it is important to the energy performance of these buildings. Increased economic performance is directly proportional to sustainability performance. Nowadays it is very important to increase sustainability. Because the basis of sustainability is to improve the quality of life of people. (Ozmehmet, Yüksel, 2019)

The criteria of sustainable structure are efficient use of energy design and building construction, land use suitable for the environment, human health sensitive, selecting the right materials, working correctly. The use of materials in a sustainable structure is also important. The use of domestic materials, renewable material selection, non-toxic material and recyclable material selection help to ensure sustainable structure. In order to use energy efficiently, maximum use of solar energy, ventilation, garbage and wind energy should be taken into consideration. Due to the depletion of water resources, the use of rainwater and wastewater in the structure is essential for sustainability.

Sustainable building design is primarily human-oriented and then discusses its impact on the environment. The benefit to the environment today is the protection of natural resources and the use of recyclable materials. The post-construction benefits of sustainability give businesses an advantage and are therefore considered prestigious structures. The cost spent in practice earns in the enterprise in a short time.

Materials and energy consumption are very high in the construction sector. The destruction of forests, the deterioration of clean water resources, etc., cause's buildings to wear out globally. Approximately 50% of the natural resources are used in the construction sector. When these figures are taken into consideration, it is seen that there is a consumption above the sustainability level. (Ozmehmet; 2007)

High rise structures have become widespread with the development of the economy and technology and have become more preferred. The transition from the masonry wall system to the skeleton system led to the construction of the high-rise building. After the industrial revolution, an immigration from villages to cities started in the world. Population density of urban centers increased with this migration. It has ensured that the masses of people need new residential areas for housing and working areas. Meeting the need for superiority in people, the desire to rise in buildings representing power has increased as well. Because of the traffic problem in large cities and the intensity of working life, people prefer multi-functional structures. Having many functions within the same structure is something that makes human life easier.

Concerns about the environment and human health have arisen after the construction of higher structures and in direct proportion to human awareness. High structures; since they consume many materials and energy, they need to be designed as sustainable.

Social and business life in the city centers began to be preferred. People spend most of their lives indoors. Therefore, the comfort of these structures is important. Comfortable buildings that give importance to human health are preferred more than other buildings. For a building, it is important for the harm and benefits to the environment other than the internal use. Since people take a more conscious approach, the location, function, impact on the environment, preference of renewable materials, energy-saving, etc. of the buildings they spend time in attaches importance to things. As the certification and control of these criteria are formulated, the certification system has been developed and spread universally. These certificates provide prestige and reliability for the building. These certification systems provide environment-friendly, sustainable design on building and urban scale and raise awareness of sustainability.

2.2 The Meaning of Sustainable Building and LEED Certification

Sustainable building can be defined as, “green” or high-performance, or energy and resource efficient structures. Sustainable buildings use energy, water and other natural resources effectively and they provide an efficient indoor environment. These buildings aim to minimize the environmental impacts in the use of energy and resources. (Karaosman, 2006)

“Green building” is a sustainable approach to a building that minimizes the negative effects on the environment and the inhabitants and tries to eliminate it. High rise buildings should be designed as structures where sustainable technologies are used for the most efficient use of building functions. The US Green Building Council defines “the total economic and environmental impact and performance of a building as material extraction and product manufacturing to building design and construction, operation and maintenance, and reuse or disposal of the building”. (USGBC, 2000) Sustainable buildings aim to use natural resources efficiently and construction and subsequent operation will serve as a model for a healthy environment.

Rapid and uncontrolled depletion of natural resources, global warming, environmental pollution and so on factors have revealed the concept of sustainable building. Sustainable buildings certified according to certain standards; In the construction sector, they have become a structure that uses natural resources more efficiently, attaches importance to human health, cares about human comfort and tries to minimize energy consumption. Energy is consumed for heating, cooling, ventilation and lighting

of buildings. This spent energy corresponds to 30% of the energy used all over the world. Considering the energy used for the production and processing of materials used in buildings, the energy used increases to 40%. When energy consumption is examined, sustainability aims to keep the building phase, material and natural resource usage to minimum. (Erdede & Bektaş, 2014)

Buildings are important for sustainable investment, because the most important consumers of natural resources in the world are buildings. The buildings consume CO2 emissions, environmental impacts and energy and are at the top of the list. Therefore, consideration should be given to environmental factors and energy efficiency in the improvement of new constructions and existing buildings. (Görgün & Yılmaz, 2012)

The concept of sustainable building is important for the development of the city in the sustainable context. It has been realized that precautions should be taken due to air and environmental pollution caused by buildings. The healthier and more efficient use of buildings are the first precautions taken. (Şimşek, 2012)

There are different rating systems that assess the sustainability of buildings, varying by country. To list some of these; Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Methodology (BREEAM), Comprehensive Assessment System for Building Enviromental (CASBEE) etc.

LEED, a Sustainable Building Certification system, was founded in 1994 by USGBC and NRDC and it is a non- profit system. LEED certified Sustainable buildings with high efficiency, location of the building, design, construction phase, demolition stage, maintenance, repair, renovation, resulting from the calculation of all details, such as building the human life and environment throughout the life of the building, using natural resources positive for human health buildings that provide floors. It has been determined that buildings with "Sustainable Building Rating System" increase efficiently in measurable rates.

2.3. Effects of LEED Certification on High Rise Buildings

Today, global warming, reduction of water resources, environmental pollution and depletion of natural resources are a major problem for human life. Buildings produce energy consumption and carbon dioxide gas. This causes global warming. 35% of the

total energy consumed in our country; it belongs to the building sector consisting of residential and commercial buildings. (Ministry of Energy and Natural Resources, 2012). Energy consumption is increasing day by day. When the reasons for this increase are examined; increasing population, urbanization, residential and commercial buildings are shown to increase. 50% of the electricity used in Turkey are spent on the building. (ETKB, 2013) On the other hand, 18% of carbon dioxide emissions are caused by buildings. (ÇŞB, 2013) When these rates are considered, buildings are the biggest factor affecting global warming.

Urbanization has accelerated with increasing population. Therefore, the demand for city centers has increased in the recent years. In line with this demand, land prices in the city centers has been increasing. It has become difficult to find land for new constructions. Vertical construction started due to the increase in land prices and the lack of land. As the population growth will be even greater in the coming years, higher structures will be more preferred building types. On the other hand, economic growth and social development as well as ecological balance should be considered. Since economic growth and social development are fast and unstoppable, environmental and human sensitivity should be given importance. The rapid increase of buildings and consequently the increase in energy demand and consumption caused the CO2 emission to increase rapidly and took the first place among the causes of global warming. Design and implementation of buildings should be controlled. The construction sector is constantly renewing itself and developing because of the human needs for shelter.

Buildings should be constructed with rules that are universally accepted as accurate. Global warming and the rapid depletion of natural resources have caused the concept of sustainability concerns all developed and developing countries. Sustainability has started to take its place in every sector. Awareness in people and have led to the emergence of the concept of sustainability. The sector which is continuously developing and the most common field of application is the construction sector. Sustainability in the construction sector has formed the concept of sustainable building. Green buildings are defined as environmentally sensitive and sensitive to human health. Green building certification systems evaluate the structure over the whole life cycle. Design, construction, use and destruction are the lifecycle of a building and interact with people and the environment. Sustainable buildings are evaluated with universally

valid certification systems like LEED, BREEAM, DGNB. LEED certification system is widely used in the world. (Yılmaz, 2014)

It is aimed to design and implement these buildings as sustainable buildings with the increasing and widespread application of high rise buildings. When the high structures started to be evaluated with the LEED certificate, many awareness emerged. Many problems have arisen for the application of sustainable building conditions in high buildings.

In high rise buildings; design, planning, technology, materials and application, interaction with the environment, human health, energy efficiency should be focused more. It was realized that the use of different materials were needed when going out of tradition during construction. If you need to give an example; skeletal structures emerged with the transition to high structures. In order to reduce the load of the structure, thin walls were started to be applied and plaster materials providing thermal insulation from thin wall application were used. In this way, less load was placed on the building and there was no loss of human comfort. High buildings can be designed as environment-friendly, energy efficient and sustainable. However, at every height where the height increases, the applicability of these qualities effectively in structure decreases. (Aydın, Mıhlayanlar; 2017)

High rise structures continues to consume energy throughout the life cycle of the building. This energy is used in the building for heating, cooling, ventilation, lighting for comfort needs. In high-rise buildings, the amount of energy spent per square meter is higher than in other types of buildings. Therefore, it is necessary to use energy efficient systems that will reduce energy consumption in high buildings. When the first high rise buildings began to be constructed, they were constructed as reinforced concrete and steel structures. However, it has been continued using traditional methods. The outer walls were built thick and the building was continued to be loaded. Single glazed joinery and artificial lighting were used. As a result of these applications, it has been determined that energy loss in buildings is high. As a result of these traditional applications, heat losses occur in buildings. In the first high rise buildings, the indoor ventilation was made from openable windows. With this system, no energy was used for natural ventilation. But there was a huge energy expenditure for heating. Window cavities cover 30% of the outer surface of the building. For this reason, it could not be used more than daylight. As the windows were designed and applied as single glass,

heat loss occurred. The development of technology has also affected the construction sector. In high rise buildings, the carrier system and the façade are separated from each other. In the construction of buildings, light exterior systems have been used. The reason for the change in the exterior façade typology of high buildings is the separation of the façade system and the carrier system. In later years, much larger surfaces were designed as transparent in exterior systems.

With this design and construction approach, daylight entered the building more and natural lighting was used. In the 1970s, glass surfaces on the facade reached 60% during this period. High rise buildings has become an indicator of economic development. The glass surfaces used in the exterior façade became popular in the 1970s. However, the facades of the buildings are made of glass surfaces without considering factors such as the location of the land where the building is located and the climate. In the high-rise buildings with external facades covered with glass; too much heat in summer, and heat loss in winter, and energy consumption increased. In order to lose the effects of heat loss and overheating in the buildings, mechanical ventilation has consumed more energy. The development of technology in the construction sector has severed its connection with the environment. But this caused more energy to be spent. The location of the land, the climatic conditions did not affect the application and comfort of the building, but the energy consumption was too high to provide this comfort. It has been recognized by people that this energy consumption should be controlled.

New methods to minimize energy consumption have started to be investigated. The building and the environment have begun to be re-associated. Issues such as the use of natural resources, energy consumption and recycling have been raised in the construction sector. When the building is associated with the environment, the concept of sustainable building has emerged. Energy and environment-friendly structures should be built. People have realized that buildings play an important role in the environment and human health. Through this awareness with the concept of environmentally friendly sustainable building, healthy, has set in motion for the construction of recycled structures. Certification systems have been developed to classify these buildings and prove that they are environmentalist. Certification systems have begun to give buildings a new identity prestigious position and popularity. Since high buildings are accepted as indicators of the development of technology and

economic situation, a new identity has been formed with the certification system. Another contribution was made to the preference of high rise buildings.

The most common of this certification system is LEED certification. LEED certification through the buildings began to be sold more quickly. LEED certification system is aimed at healthier interiors, buildings that give importance to human comfort and health, buildings with less natural resources and environmentally sensitive buildings. Energy used in high buildings, material usage, human health and environmental impacts are minimized with LEED certificate. High buildings with LEED certification aim to improve the quality of life of people. In high-rise buildings designed as offices; business productivity is increasing. In high buildings, it is given importance to have American Society of Heating Refrigerating and Air Conditioning Engineers (ASHREA) standards ventilation system in interior spaces, to make indoor air quality controls and to use maximum daylight in maximum level. The use of these standards indoors is a major factor in increasing employee productivity.

High rise buildings are seen as a big rent in the construction industry. Therefore, the fact that it is a sustainable building is anoth er reason to be preferred. People living in sustainable buildings increase the quality of life and provide economic savings. High buildings represent strength and prestige. The first tall buildings were only spoken with their outer shell and height. It has fueled the feeling that people are always higher. The development of technology, the importance of people's quality of life has increased. The comfort of the interior has enabled the buildings that attach importance to human health. High rise buildings with a sustainable building certificate is more preferred than high rise buildings built by other conventional methods.

2.4. The Reason of LEED Certification on High Rise Buildings

Global warming, climate change and reduction of natural resources are now being observed. The decrease in natural resources is a danger for future generations. Energy consumption is the highest in the construction industry. Considering all these negative factors, changes have been made in the construction sector in order to solve these problems.

The construction sector has started to design buildings that are sensitive to human health and the environment. The environmental sensitivity of buildings is in important aspect. Global warming, transferring natural resources to future generations, and

preventing climate change are important for building and environment. High structures emerged with the use of steel in construction. High buildings have been seen as solutions to the problems caused by rapid urbanization and the increase of the urban population. The problem of lack of land in city centers has disappeared. Vertical construction provides more sustainable areas in the environment. High buildings were designed as offices when the first application was started. After the Second World War, it was designed and implemented as a residence. The functions of high rise buildings have also changed according to the comfort and needs of people.

The development of materials and the development of construction methods have facilitated the construction of high-rise buildings. In the construction sector, with the development of ventilation systems, the presence of an elevator and the presence of a booster, comfortable high-rise structures have started to be built. Construction; with the development of technology, it has started to be built without being connected to the environment. Buildings were started to be built without preserving the ecosystem and biodiversity. The use of energy has been brought to the standards required for human comfort and health in indoor spaces in buildings. Artificial lighting was provided in the building and no attempt was made to use natural lighting. Energy consumption for indoor heating and cooling has increased. Every decision made for all comfort has led to an increase in energy consumption. The large-scale use of energy and materials has led to the environment in which the building is located and the rapid depletion of its natural resources. When the energy and resource consumption in the construction sector is considered, high-scale buildings attract attention.

High rise buildings have become indispensable elements of city centers and big companies. People prefer high rise buildings because it represent technology and prestige. There are two different reasons for the formation of tall buildings. These are social and psychological reasons. The reason for the formation of socially high structures is the rapid and unstoppable population growth. It is difficult to find land in city centers because of the rapidly growing population. The need for land has increased in the city centers due to population growth. The need for land has led to an increase in land prices. Migration to the city has increased with the increase in the population and working people of the city. The phenomenon of high structure occurred with this migration. The first important element in high buildings was the external aesthetics and visual comfort of the user. From the past to the present, people have always had a

passion to reach higher. Places of worship were always built high. Today, the passion of humanity to be higher has been met with high rise buildings. In high buildings, the floor space was kept low and vertical construction allowed for a sustainableer area around the building. The awareness of human beings arose when it was realized that these buildings, which were built with the benefits of technology, lead to the environment and the consumption of natural resources.

It has been seen that energy consumption is more used in constructions made using traditional construction methods. With the development of technology, it is considered that the commitment to the environment is not very important. It has been recognized as a great luxury in the construction industry. Buildings can be built regardless of the environment and climatic conditions. Since the climatic conditions were not taken into consideration, more energy was used for heating and cooling. As energy consumption increases, depletion of natural resources has accelerated. The building and the environment must always be considered together. It has been found that buildings constructed regardless of environmental conditions and climate conditions have negative effects for the future.

There are dense human populations in high rise buildings. There are working, living and social activities in high rise buildings. In these buildings where these needs are met, architectural design and application have an important place. But only these two elements are not enough. In order for the building to be sustainable, it is necessary to look at human health, comfort, interaction with the environment, energy consumption and recyclability. These criteria are important for quality of living conditions and the transfer of natural resources to the next generation. Therefore, certification systems for sustainable buildings have been established to evaluate buildings and inform people. Together with this certification system it will be known that the building has been checked from the design stage. Before starting the design in the high buildings, the selection of the place is checked and the harmony of the building with the environment is considered. The most important element in high buildings is the soundness of the ground on which the construction will be made. After looking at the settlement area geologically, attention is paid to the transportation facilities. Nearby settlements and businesses should have roads that can be integrated into the city center. Planned and controlled way of urban growth. Material selection and building height are determined according to the strength of the ground. In order to create a conscious urbanization,

the centers where previously high buildings can be built are determined. This center is firstly geologically examined. Afterwards, the skyline of the city is taken into consideration. High rise buildings take shape according to the climatic conditions of the environment. The design varies according to these climatic conditions. Material selection and location are determined according to climate conditions. It is designed in such a way that the daylight can be used to the maximum extent of the building. There are design approaches that encourage the use of renewable energy. All these criteria are the factors that make a building a sustainable building. It is important to evaluate the sustainable buildings with the certification system and inform the people. A building with a sustainable building certificate allows people to choose this building. The certificate system adds reliability and prestige to the building. This makes these structures sold faster.

High rise buildings with sustainable building certificate are preferred more than traditional buildings. The most popular and widespread LEED certification gives the building higher prestige. It is important for people to sit in structures that are controlled, sensitive to the environment and sensitive to human health and comfort. LEED certification ensures the correct use of rapidly developing technology in high-rise buildings. It helps the rapidly developing and growing cities to form new urban centers. Prevents condensation in city centers. It provides a balanced distribution of human population. High rise buildings have solved the problem of land scarcity and rapid population increase. It helps the development of urban centers in a controlled manner. These are the environmental effects of tall buildings. There are also people-oriented effects. places where people spend healthier and quality time. Working hours are more efficient in these confined spaces. High buildings with LEED certificate increase the cost more during application. However, it is paid in a very short time when the operation part is started. It is very important that the money spent in the application is gained in the short time when it is transferred to the operating part. This demonstrates the sustainability of the building. Therefore, life is more preferred in LEED certified buildings. Living in these high buildings should not be regarded as prestige only. The preference of these structures gives more importance to human health and comfort and increases the awareness of the environment.

2.4.1 Energy Efficiency in High Rise Buildings

Energy consumption has increased day by day with the development of technology and the use of this technology in buildings. People's living standards have changed with technology. Structures use natural energy sources throughout their use. These structures have negative effects on water, air and soil which are necessary for human and other living beings. The building sector raises environmental and energy problems. These negative effects lead to the loss of irreversible natural resources. Buildings are considered as ecological, economic, social and cultural with the concept of sustainability. In this context, ecological sustainability covering a wide range of ecosystem conservation, economic sustainability, long-term use and use of resources social and cultural costs, sustainability of human health and comfort the protection of social and cultural values. (Dikmen, 2011)

The main focus of sustainability is environmentally sensitive, energy efficient structures, the quality of life for people. Today, energy efficient designs are of great importance in new high-rise buildings. Energy efficient building design is first discussed in the architectural design process. Uses environmental data in order to make energy efficient structures in architectural design process climate, direction, wind. Energy-efficient building design Active and passive control facilities suitable for the building are created, heating-cooling-ventilation-natural lighting issues to increase building performance and provide energy conservation control, design criteria and architectural designs within this scope. (Dikmen, 2011)

The criteria listed below are considered in energy efficient building design. (Utkutuğ, 1999)

- forming and positioning the building shell and form in accordance with physical environmental data,
- the use of forms in building design to distribute the controller and the controlled air by taking in the outside air and creating a buffer zone between the inside and outside of the building,
- designing to include nature and sustainable in order to soften the external atmosphere conditions and to include them in the structure,

- supporting the design of the building in a way that makes optimum use of solar energy and using energy efficient façade systems on the building façade,
- selection of materials and components that make up the structure from materials that use renewable energy sources, provide energy conservation, are environmentally sensitive and require low maintenance.

Prior to the energy efficient design approach, material selection, operation and climatic conditions were not considered during the design phase of the buildings. In the traditional construction approach, buildings are constructed without paying attention to building and environmental harmony.

Today, buildings that consume minimum energy and use natural resources at maximum level are more preferred. The construction sector has started to build sustainable buildings because of the preferences in this direction. There are universally accepted parameters for building energy efficient structures (Lakot, 2007);

- site selection of the structure,
- distance and positioning of the structure to other structures,
- form of the building,
- the direction of the structure,
- physical properties of building crust affecting heat transfer,
- outdoor light level,
- barriers that may affect external climatic and visual comfort,
- physical properties of building internal volume,
- dimensions and structural properties of building elements such as windows and glass,
- properties of the components of the artificial lighting system,
- solar control and natural ventilation systems.

The choice of location of the structure and energy efficiency should be considered as a whole. The choice of location and direction of the structure to be designed should be the maximum benefit from the heat and radiation of the sun. Therefore, effective use of natural light in the building will be ensured. Natural ventilation in the design of the building contributes to the energy used for heating, cooling, ventilation and air conditioning of the building.

2.4.2 Technology and Carrier Systems on High Rise Buildings

Housing has been the most important factor in people since the beginning of life. Structuring emerged with the self-improvement of humanity. For this reason, construction is of great importance for humanity. Religious beliefs of people and people always want to reach higher structures have emerged high. There are factors that lead to the formation of high-rise buildings today and are listed as follows;

- decrease of construction area in city centers,
- increase in land prices,
- growth of companies,
- prestige,
- technology.

Technology is the most important factor in the emergence of high rise buildings. Technology and high rise building are integrated. The link between technology and the high rise building is very strong. It is the technology that enables the formation of high rise buildings. Because, vertical circulating system, building construction method, the outer shell of the building, building automation systems have been developed to technology and have become whole with high rise buildings.

An important factor that accelerates the development of high rise buildings is the elevators that provide vertical circulation. The use of steel in the structural system and the use of elevators in vertical circulation have enabled high structures to be constructed.

Height, steel frame and elevator elements are combined Home Insurance Building. This high rise building was built in Chicago in 1883-1886 by

architect William Le Baron Jenney. This high-rise building has been recognized as the world's first skyscraper by the international Council on Tall Building on Urban Habitat. (Öke, 1989) (see figure 2.2)

Figure.2.2 Council on Tall Building
(https://www.britannica.com/place/Home-Insurance-Company-Building)

In parallel with the development of technology, high-rise buildings started to spread in Europe and Far East countries and many high-rise buildings were built. It began to be built in high buildings in 1950 in Turkey. Until the 1970s, 25-storey high-rise buildings were built.

The development of vertical circulating technology in high buildings has led to an increase in the number of floors in buildings. Vertical circulation vehicles in high buildings; stairs, escalators and elevators. Normal stairs can only serve buildings of a certain height. The height of these buildings also depends on the

speed and density of the circulation. Moving vehicles are needed for vertical transportation as the number of floors increases in the buildings and the living population increases. Escalators and elevators found with the development of technology are an important development for high rise buildings. Elevators and escalators are most commonly used in high rise buildings. Nowadays, fire regulations and human safety should be in the normal ladder in high rise buildings. The presence of normal stairs in high buildings is mandatory due to the safety element. Escalator technology benefits from high buildings. It is used in multi-function high structures. The lower floors of the high buildings are evaluated as those with commercial areas. Escalators are used to feed the density of the adjacent floors and facilitate transportation between the floors. As the number of floors of high buildings increases, the number of elevators and elevator speeds to be used inside the building increases. Elevators are a must for high rise buildings. The higher the number of floors, the more important the proportional increase in the elevator. Planning of elevators in high buildings should be done at design stage. The number of floors and the human population should be calculated to determine the number and speed of the lift. The speed of the elevator has accelerated with the technology. In this time when human time is important, the speed of the vertical means of transport is important for daily life.

The development of the carrier system technology in high-rise buildings has made the spread of high-rise buildings more convenient and easier to construct. The materials that make up the carrier system can be listed as follows;

- reinforced concrete,
- steel,
- composite materials.

Reinforced concrete is a material obtained by placing reinforcements that will work together in concrete. In the reinforced concrete, which consists of the proper combination of concrete and steel bars, the properties of the concrete and reinforcing bars as well as the combination of these to complement each other's weak sides. It is important. (Celep, Kumbasar, 2001) Reinforced

concrete is the most widely used carrier system in high buildings. Reinforced concrete was first used in buildings in the early 20th century.

The favorable properties of reinforced concrete compared to other building materials are high, making them preferred in most buildings. Some advantages of reinforced concrete are (Yılmaz,2006);

- compressive strength of reinforced concrete is higher than other building materials,
- it is the best building material in buildings with continuous water since it has high resistance to fire and water.
- reinforced concrete structures are very rigid,
- the maintenance costs of reinforced concrete structures are less than others,
- it has a longer lifetime compared to other materials. Under proper conditions, reinforced concrete structures can be used forever without decreasing their carrying capacity.
- foundations, such as curtains, large-volume elements in most cases is an economic material,
- it is easy to give desired shape in reinforced concrete in places such as belts, shells and slabs,
- less skilled workers are needed compared to steel structures.

Advances in reinforced concrete technology and the advantages of reinforced concrete to the building enable easy construction of high structures. The improvement in the strength of the concrete enables the construction of higher-rise structures. Reinforced concrete has disadvantages compared to climatic conditions where the structure is located. In an environment with bad weather conditions, there are disadvantages that are listed below;

- construction slowdown,

- excess workmanship,
- extension of construction time.

Steel material has an important position in high rise structures. The high structure made with steel is more than the reinforced concrete and composite structure. Approximately 60% of steel structures industrial structures produced in Turkey. Including towers and energy infrastructure investments, this rate reaches 90%. (Altay, G., & Güneyisi, E. M. 2005)

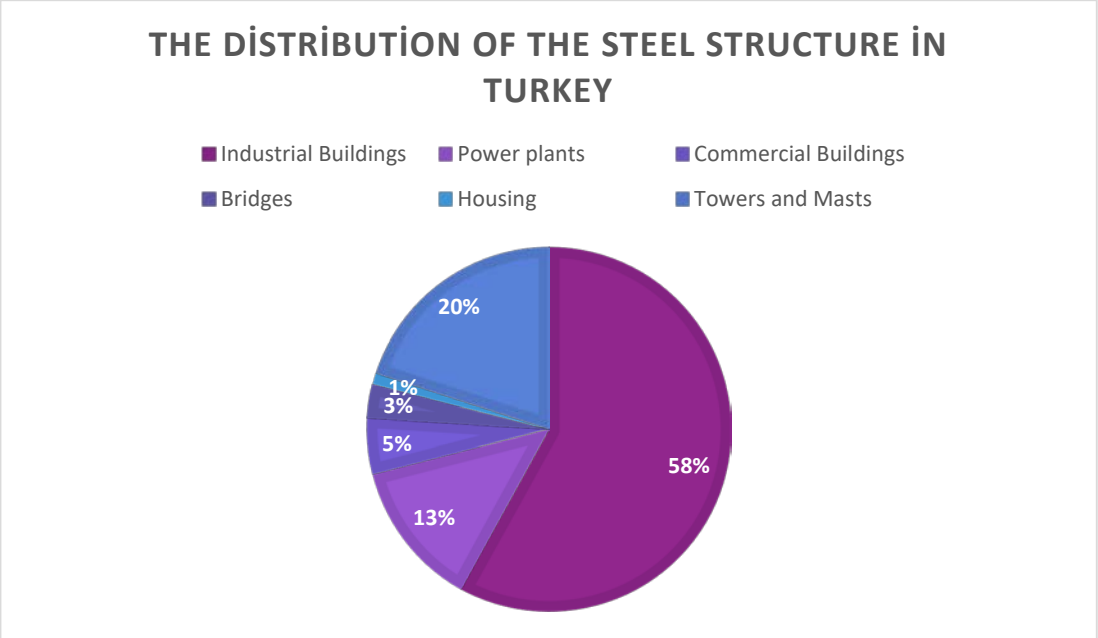


Figure.2.3 The Distribution of the Steel Structure in Turkey (Altay, G., & Güneyisi, E. M. (2005). (redesigned by; G. Devran, 2019)

The advantages of steel can be listed as follows;

- light material,
- possibility of crossing large openings,
- short construction time,
- independent of weather conditions.

The disadvantages of the steel material can be listed as follows;

- no fire resistance,
- non-corrosive.

It has become usable in steel structure systems with the development of fire safety technology. Steel structure technology to reduce the human load and using the fast construction methods to be done in a very short time. In addition, weather conditions and seasons, winter conditions the fact that construction can be done included, increases the construction speed. Consequently, all indirect costs (construction site, labor, rent, etc.) are all significantly reduced. Steel carrier system is very light, basic costs reduced by about 15% - 25%. Steel is a 100% recyclable and reusable material and this advantage of steel must be taken into account in the calculation of the total construction cost. For sustainability, the total life cycle cost of each building should be calculated and economic efficiency should be considered together with the environmental impact assessment. When we say the total life cycle cost, energy conservation and social costs should be considered.

Technology is needed more in the construction system of high rise buildings. Today, it is not possible to build high rise buildings with traditional building systems. The construction systems are directly linked to the building system. Therefore, technological developments in carrier systems are important for high rise buildings.

Another important technological development for high rise building construction is the outer shell system of the building. All the elements surrounding the high rise buildings from the outside are called the outer shell of the building. The shell system is important for energy saving and human comfort in high rise buildings. Because the desired conditions in the building are solved by the shell system. The system works as follows. Outdoor conditions are kept outside the building and necessary ones are taken in accordance with certain standards. This system separates the external environment from the internal environment. Technological developments in the shell system have affected both functional and visually high rise buildings. After the World War II, the glass and metal sector developed with technology and started to be used in high rise buildings. Glass and metal materials were used as exterior coating materials in high rise buildings.

2.4.3. Health and Comfort

Sustainable buildings are built to increase the productivity of the employees, to ensure that people are united with nature, who care about the health of the people living inside. (Kıncay, 2014)

Sustainable buildings are technology-integrated structures that minimize the impact of buildings on the environment and human health.

Due to the migration of people to the city center and the population increase in the city centers, the construction areas in the city centers have decreased. Decreasing construction sites and demand for city centers have increased and new solutions have been sought. Vertical construction has arisen due to the increase in land prices and the decrease of land plots. Too many people live in high rise buildings. The tall buildings were initially designed as offices, and later on, with the increase in the need for housing, they gained the function of housing. The lack of land in the city centers has led a high building to function as a multifunctional building. Multifunctional structures have been structures with 24/7 life. Human circulation in these buildings never stops. People spend most of their life in these buildings, building comfort and health are important.

People spend most of their time indoors, indoor air pollution becomes even more important in schools, homes and workplaces. Due to the frequent use of central heating and cooling systems in buildings, indoor air exchange and fresh air entering the building have become limited. Therefore, indoor air pollution importance has increased. The indoor air quality inside the building is important for human health and comfort.

Today, people living in indoor space are the most complaining people about health. It forms a complex matrix related to internal health, medical, psychological and engineering. The engineering concern in buildings is the quality of the internal environment. Indoor air quality is the most important factor affecting indoor environment quality. Sound, light and water quality constitute the quality of the environment. (Çilingiroğlu, 2010)

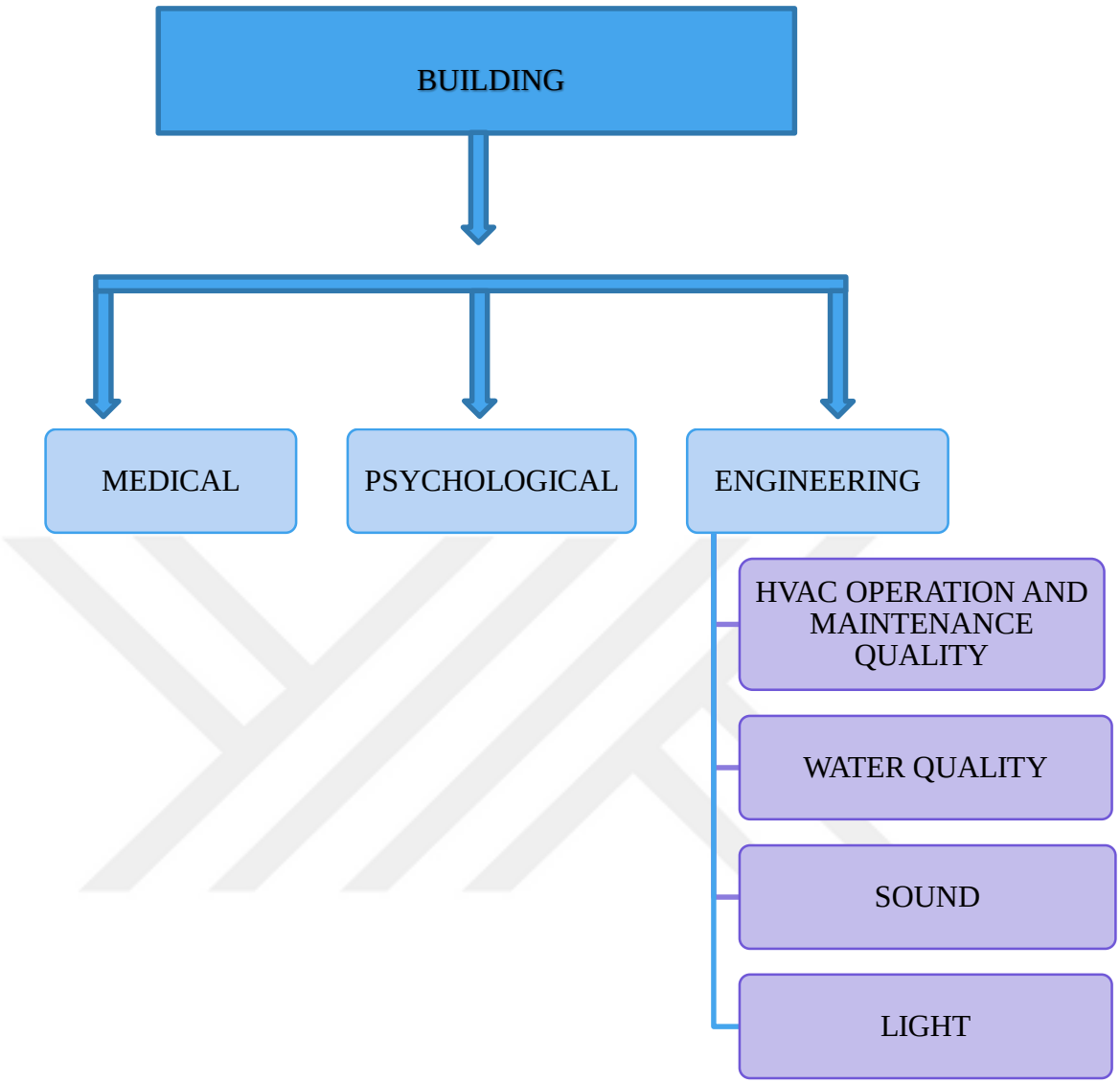


Table.2.1 Examination of the building with 3 factors (Rajasekaran, 2014)

As seen in Table 2.1, the indoor air quality in the building is related to engineering. Indoor air quality is influenced by HVAC operation and maintenance quality, water quality, sound and light. All of these should be considered when designing the building and human health should be considered.

Overheating, cooling, sound, insufficient light in the building are related to both design and operation. ASHRAE standards should be considered during the design phase. When the building is in operation part, internal automation systems should be used. The indoor air quality must remain in compliance with ASHRAE standards with the automation system.

Building disturbances are divided into two. These; Building related illness and Sick building syndrome. Building ailments adversely affect the health and comfort of people.

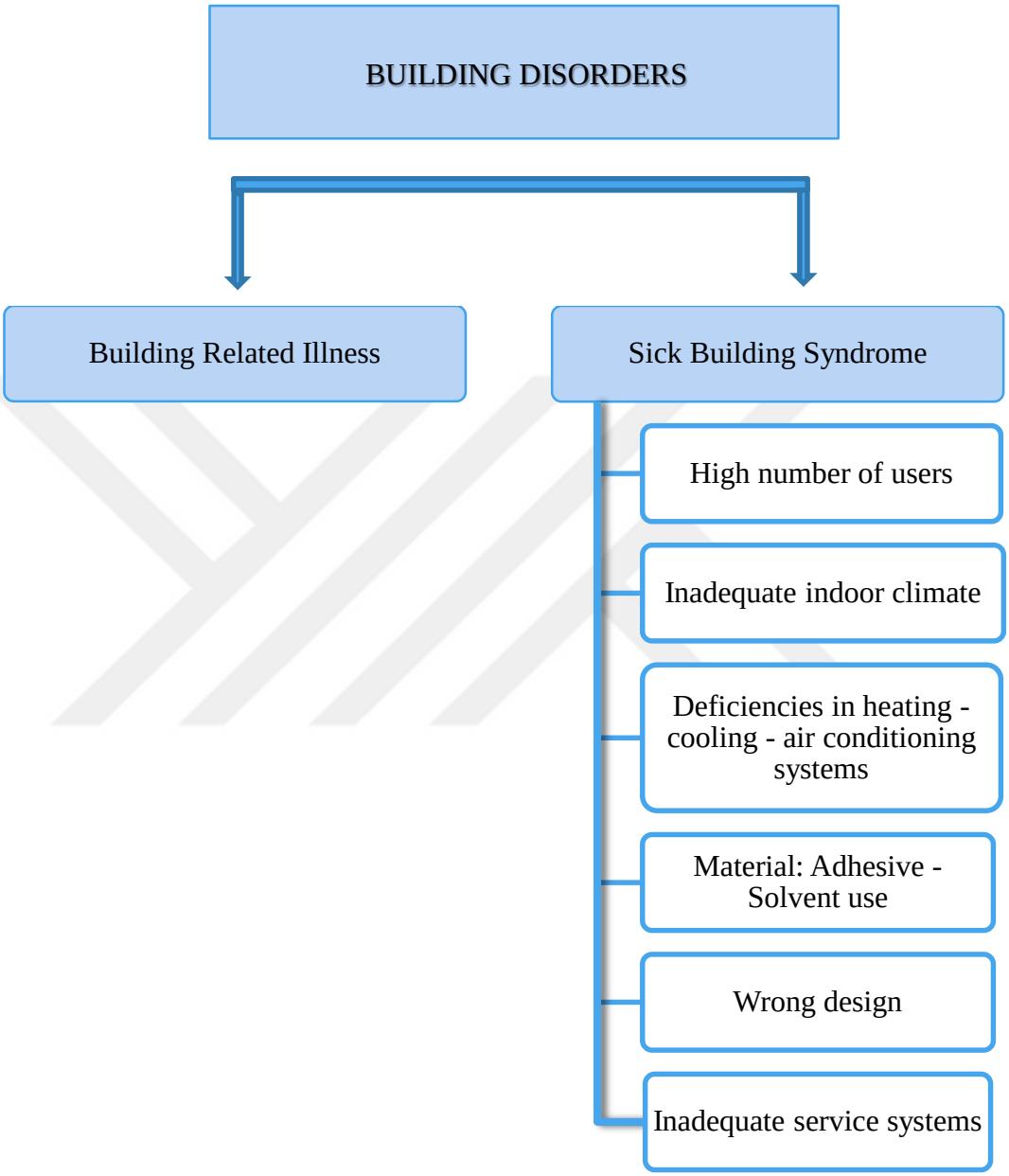


Table.2.2 Building Disorders ((Rajasekaran, 2014)

As shown in Table.2.2; There are many reasons for the formation of sick building syndrome. These can be listed as follows; high number of users in the building, inadequate air quality, adhesives and solvents used in the construction phase, wrong design, inadequate and uncontrolled operation of the service.

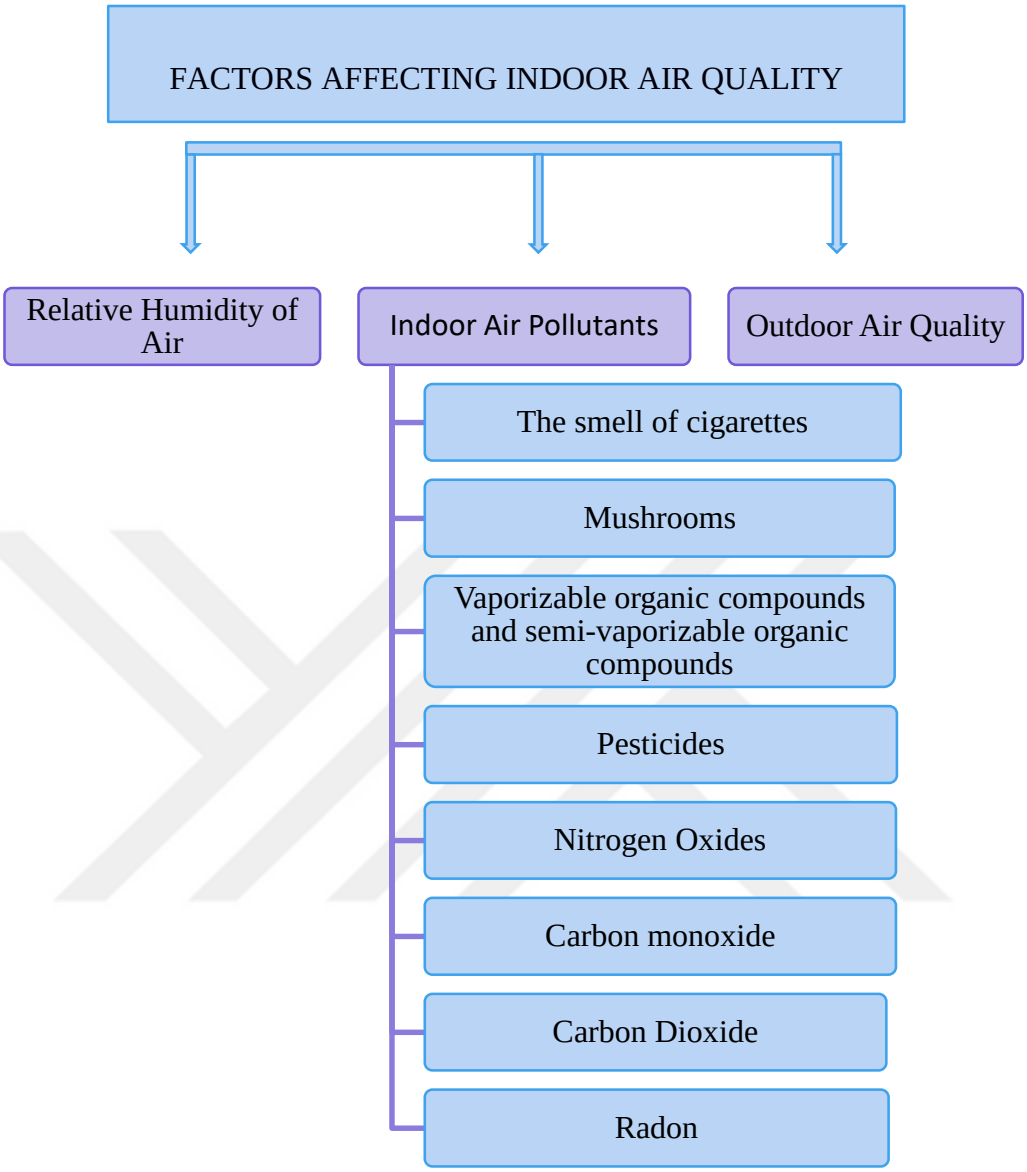


Table.2.3. Factors Affecting Indoor Air Quality (John P. Lapotaire, Building Envelope & IAQ Consultant at Indoor Air Quality Solutions, IAQS www.FloridalAQ.com) (redesigned by, G. Devran,2019)

As seen in Table.2.3; The relative humidity of the air, indoor air pollutants and outdoor air quality are factors that affect the indoor air quality of the building. Indoor air quality is important for human comfort and health. It affects the design phase of the building. In the application phase of the building, the materials used should be considered. The

use of materials that affect human health should be avoided. When the building is in operation, indoor air quality control should be performed. For this control to be healthy and regular, automation system should be used. As the control becomes more difficult in high rise buildings, it will be easier to control with the automation system.

Daylight is another factor that affects human health and comfort. Buildings should provide sufficient amount of daylight to their users. The reduction of fossil resources and the energy obtained from these resources benefit the environment as much as possible to benefit from daylight.

The amount of daylight entering a building is mainly determined by the window openings that provide the dual function of admitting light to the indoor environment for a more attractive and pleasing atmosphere, and allowing people to maintain visual contact with the outside world (Li and Tsang, 2008) There are parameters to meet daylight requirements in high rise buildings. These parameters can be listed as follows;

- geometry,
- lease span,
- planing module.

Buildings with symmetrical plans are less susceptible to lateral wind impact than unsymmetrical buildings, and are more efficient than curved and irregular shapes. This is particularly important in high rise buildings (Ho, 2007).

The two main critical factors determining the daylight entering a building are the window size and type in daylight calculations, these two factors are directly proportional to the indoor daylight performance. Consider window size first. According to the ASHRAE standard and IECC, the recommended window area is 50% of the wall area (ASHRAE) and the maximum window area should be 40% of the above-grade wall area (IECC) (ASHRAE Standard, 2004; IECC, 2006).

High efficiency glasses are used in the outer shell of the building to prevent light transmittance, the effect of solar heat on interior spaces and heat loss.

Natural lighting helps to increase the concentration of employees and provide a healthier atmosphere. It is important that the outer shell of the building is covered with a maximum amount of glass, or that the windows are too large, in order to obtain

daylight. Thus, with the increase of interaction with the outside, a healthier, happier and more productive working environment.

People spend most of their lives indoors, care must be taken to ensure that buildings are healthy and comfortable. Indoor natural lighting and indoor air quality should be at certain standards. Lighting strategies should be developed to minimize lighting loads and provide a comfortable working environment and these strategies should be able to use the maximum level of daylight. In this way, people spend their time indoors in a more efficient and healthy way.

CHAPTER 3
HIGH RISE BUILDINGS AND SUSTAINABILITY IN İZMIR

3.1. Introduction

The sustainability, which has become a mandatory application in a large part of the world, is important in urban centers. According to the 2018 Turkey Statistical Institute research; The proportion of people living in urban centers is 92.3%. The proportion of people living in towns and villages was 7.7%. While the proportion of residents in provincial and district centers was 92.5% in 2017, this ratio decreased in 2018 and there was a transition from urban centers to rural areas. Turkey Statistical Institute as a result of his research in 2014; While the proportion of residents in urban centers was 91.3% in 2013, this ratio increased to 91.8% in 2014. The proportion of people living in towns and villages was 8.2%. Therefore, the most important places for the environment and economy are city centers. It has become important to pass on the quality to the next generations to the same standards and people have become aware of this issue. The aim of sustainable urbanization is to create healthy and comfortable living spaces and to transfer this to the next generation as mentioned in Bruntland Report in 1987.

Sustainable construction practices in Turkey is increasing day by day. There is widespread use of incentives and sanctions for sustainable construction in Turkey.

Sustainable Building Design in the scale and scope of this study will be discussed legal regulations in Turkey are as follows (Karaca & Çetintaş, 2015):

- TSE 825 thermal insulation rules in buildings,
- regulation on thermal insulation in buildings,
- regulation on energy performance in buildings,
- construction materials regulation,
- sustainable buildings and sustainable settlements,

- regulation on certification.

In addition, the public sector that will increase the demand for sustainable construction needs to be created. It is necessary to make people demand more and to emphasize the practicality of sustainable architecture. In order to achieve this, sustainable design of institutional buildings will make it widespread. (Arsan, 2008)

In accordance with the research made by the Statistical Institute of Turkey in 2018, it has been identified third largest city Izmir and also in Turkey. Therefore, it is one of the cities where people prefer mostly the most to sustain their livings. It gradually began to adapt the implementation of sustainability to the city. The first important element for sustainable urbanization is the right decision on the use of the land building site. İzmir has taken further steps in this regard, and has started to create a new city center. In this way, evaluated vacant areas in line with the demands of the population. Consequently, it encourages the construction of new buildings that give importance to the living comfort and health of the people living in this place.

3.2. Sustainable Analysis of High Rise Buildings in Urban Centers

In order to increase the quality of life, the city center is targeted with new healthy comfortable settlements, social facility areas and transportation facilities. The concept of sustainability is linked to the socio-economic structure. Therefore, the higher the socio-economic level of a city, the easier it becomes for sustainable urbanization. İzmir is a socio-economically developed city. So it can adapt more quickly to sustainable urbanization. Economic growth is accelerating with sustainable urbanization. Thus, employment increases. In order for the new city center to be sustainable, İzmir needs to consider certain data. These can be sorted as follows (Ertaş, 2011);

- efficient use of topographic data,
- efficient use of natural resources,
- efficient use of microclimatic data,
- energy and material conservation,
- sustainable recycle, materials and reusable systems.

The structuring made according to the substances listed above will provide a great live in comfort for human life. Sustainable urbanization will begin in this manner. Bayraklı

district of İzmir has been chosen as the new urban center and the settlement is being tried to be moved there. Sustainable urbanization is being created in the new urban center.

In order to meet the needs of the constantly growing population and to raise the living standards, high rise building construction model was seen as a solution. Vertical construction systems gain more landscape area. In addition, high rise structures are provided with multiple functions to meet the needs of people.

3.3. Sustainable Analysis of High Rise Buildings in İzmir

Many high rise buildings were built in İzmir and the first high rise building was built in 1986. Hilton is the first high-rise building in Izmir. It was built in 1986 in Çankaya district, in İzmir. This hotel has 35 floors and 5 stars. When Turkey has taken the title of tallest high rise building. The building is 142 meters long and is still in service today. After 2000, the high rise building was started to be built more in İzmir. Until 2014, 9 high rise buildings were built in İzmir. When we list them by years; Heris Tower (2001), Wyndam Izmir Ozdilek (2002), Gurel Residence (2006), Sunucu Plaza 1 (2009), The Port Residence (2009), Ege Park Balcova (2010), My Plaza (2011), Megapol Tower (2012)), Bayraklı Tower (2013).

After 2014, there is an increase in high-rise construction. Many high-rise buildings have been built since 2014 and are all in the same area. The high rise buildings in this region can be listed below;

- Folkart Towers
- Mistral Towers
- Ege Perla
- Novus
- Ventus
- Atek Adress

The selection of this region as the new city center and the attempt to direct people here are a major factor in the construction of these high rise buildings. İzmir is an important center of attraction in the Aegean Region and the country with its logistics

infrastructure, qualified human resources, multi-sector structure and high standard of living.

Many high rise buildings have been built in İzmir. Bayraklı of İzmir district has been designated as the new urban center. New places are needed to serve the growing population of İzmir. İzmir is a city with a multidimensional economic activity, rich natural resources and receives constant migration. İzmir is an important center of attraction in the Aegean Region and the country with its logistics infrastructure, qualified human resources, multi-sector structure and high standard of living. Therefore, new needs arise. New residential centers, business centers and social areas are needed increase population of compose district. It is difficult to find the construction site in the city centers for the new living places, the high rise building has been seen as a solution. In Bayraklı region, high rise buildings were planned and many projects were designed. These high rise buildings are designed as multi-functional building complexes to meet the needs of the increasing population. Multifunctional buildings are both residential and business centers where people can survive. In a single structure, many needs are met and vertical construction is directed. In these vertical constructions, sustainable areas are provided in the environment. In addition, these structures serve the environment. The shopping center also serves its surroundings. According to year 2019; the high rise building complexes in Bayraklı district can be started as;

- Bayraklı Tower
- Folkart Towers
- Ege Perla
- Mistral Towers

Among the high rise buildings listed above, Bayraklı Tower has only one function as an business building block. All other high rise buildings are multi-functional structures that keeping in commercial business centers and residential spaces. High rise buildings are very close to each other as location. Built in new developing places. Mistral Tower has implemented the sustainability certificate model.

3.3.1. Bayraklı Tower

Bayraklı Tower

Location: İzmir

Function of Building: Office

Land Area:40.000 m2

Evaluation method used: certificate method is not used

Table.3.1 Bayraklı Tower (http://www.mirayinsaat.com/portfolio/bayrakli-towers/)

General information about the building: It is the first high-rise building built in Bayraklı region. Reinforced Concrete + Framed, Walled System Built on 3 floors and 24 floors on a land of approximately 6840 m2, the building is 97 meters high. The system has been completed conventionally within 24 months with formwork, and due to new ground conditions, bored pile and jet grout ground improvements have been made. There are 166 offices, 17 stores and 1 two-storey gym in the project. The form and location of the building are designed according to the conditions of the location. Wind and sound tests were performed. The offices designed inside the building are designed in different sizes. There are offices of different sizes according to different needs. The exterior of the building can be defined as the amorphous form of the rectangular form. The exterior design of the building provides both acoustic and daylight benefits. Sunscreens are designed on the exterior of the building to prevent the negative effects of the sun's rays. sunshades are of great importance since the façade is designed as a complete glass. In the project, 100% redundant generator and VRF share meter heating & cooling system were used.

3.3.2. Folkart Towers

Folkart Towers

Location: İzmir

Function of Building: Office, Residence and AVM

Land Area:27.000 m2

Evaluation method used: certificate method is not used

Table.3.2 Folkart Tower (http://folkart.com.tr/proje_detay/folkart-towers)

General information about the building: Folkart Towers is a 45-storey building consisting of two towers. Folkart towers include a shopping center, sports complex, residences and offices. It is a multi-functional high rise building. Rectangular hard hats were used as piles. There are 86 hard hat piles and 72 piles under the soil at a depth of 62 meters. Every 1.5 meters there are 80 cm diameter cement columns. We took the soil, and concrete and iron were injected instead. 3-meter foundation was poured for the first time in Turkey controlled at one time. Special cement and special concrete were produced for this project.

3.3.3. Ege Perla

Ege Perla

Location: İzmir

Function of Building: Office, Residence and AVM

Land Area:18.392 m2

Evaluation method used: certificate method is not used

Table.3.3 Ege Perla (http://emrearolat.com/gallery/ege-perla/)

General information about the building: Ege perla is a multifunctional high rise building. Ege perla consists of two towers. One tower consists of 46 floors and the other 29 floors. Ege perla has indoor swimming pool, social facilities, fitness, shopping areas, office. Ege Perla project, which was realized with an investment of approximately 170 million dollars in the district called "New City Center" in Konak district of İzmir, it was designed by the world famous architect Emre Arolat, who was awarded the Project Aga Khan. Ege perla is a reinforced concrete high rise building.

3.4. Conclusion

İzmir, which ranks third in terms of both population size and socioeconomic development, increases its development potential with the planned investments and strategies. Izmir is Turkey's second largest trading center. While İzmir stands out by offering multifaceted economic activities, rich natural resources and quality of life together, it has the potential of rapid development in parallel with the investments made.

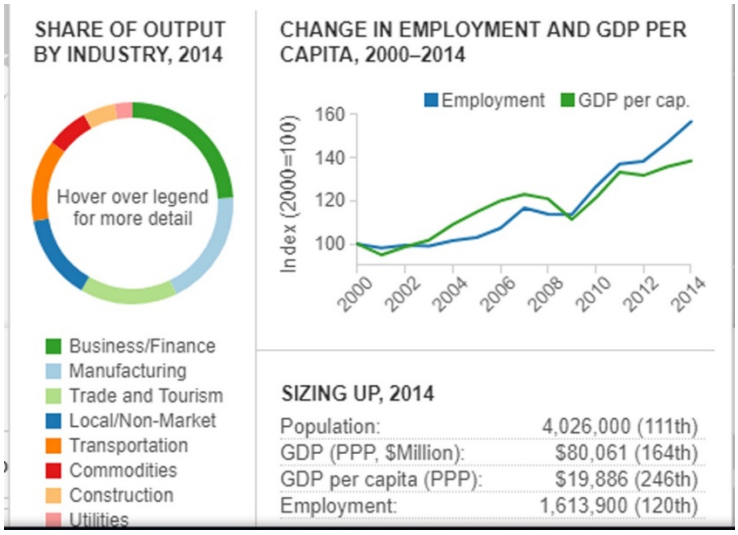


Table.3.4 In The Metro Global Metro Monitor 2014 'REPORT prepared by Brooking Institute and JP Morgan Chase, Izmir Ranking Between 300 Rising Cities. (https://www.brookings.edu/research/global-metro-monitor/)

According to the research done by Brookings Institution, the following data were obtained and listed;

- Business / finance is %24.1,
- Manufacturing is %18.7,
- Trade and Tourism is %15.7,
- Local/Non-Market is %13.7,
- Transportation is %13.1,
- Commodities is %6.7,
- Construction is %5.2,
- Utilities is %2.9.

In Izmir, one of the cities where the construction sector is most active, recent projects have attracted the attention of investors to İzmir. The number of public housing and

social housing projects as well as residential and office construction by Izmir, Turkey's leading real estate firms in the new town center was declared as the day is increasing.

The developments that shape the development of İzmir are listed as follows;

- **Istanbul Izmir Motorway** (improve access to Istanbul, the center of Turkey's economy is a significant advantage for Izmir)
- **Ankara-Izmir High Speed Train** (Approximately 6 million passengers are expected to be transported annually with this project.)
- **Çandarlı Port** (Turkey's Aegean port and meet the need, It is intended to serve transit freight and 3rd generation ships.)
- **Urban Rail System** (New lines to strengthen the connections of the city, Energy-friendly tram projects are realized in the city.)
- **Coastal Design** (This is a project to strengthen the relationship between the inhabitants of Izmir and the sea and includes the 40km coastline between Mavisehir - Inciralti Urban Forest)

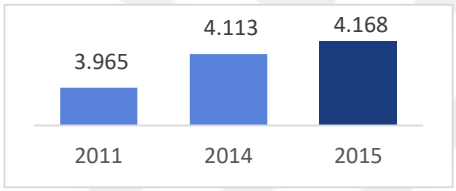
All these reasons make people prefer this region. Therefore, targets should be set for urban sustainability and sustainability in high-rise buildings. Strong economy, quality life and strong society should be targeted. People should be promised quality life in Izmir which is developing every day in economic terms. Therefore, buildings are of great importance as people spend most of their lives indoors. In order to provide high quality of life; sustainable environment, quality urban life and accessible İzmir are important.

These needs can be provided by the newly designated Urban Center. The ease of transportation and the land for new buildings provide all the needs. Therefore, high rise buildings have been built in this region and will continue to be built. The high rise buildings constructed in Bayraklı serve as an example for the new ones. The functions assigned to the high rise buildings should serve the people of Izmir and be able to respond to their needs. The correct functions given to the building increase the contribution of the building to the environment. Considering that İzmir has a constantly increasing population, new buildings are important.

High rise buildings can serve more people with vertical construction in a few square meters and therefore high rise buildings have begun to be built in the new urban center.

CHAPTER 4
SUSTAINABILITY ANALYSIS OF MISTRAL TOWERS IN İZMIR

Izmir stands out with its multi-faceted economic activities, rich natural resources and quality of life, and has the potential for rapid development in parallel with the investments made. Izmir's outstanding features; economy, industry, tourism, logistics, tourism, logistics infrastructure, population employment, education and foreign direct investment. İzmir has become an important center of attraction in the Aegean region and the country with its logistics infrastructure, qualified human resources, multi-sector structure and high standard of living.



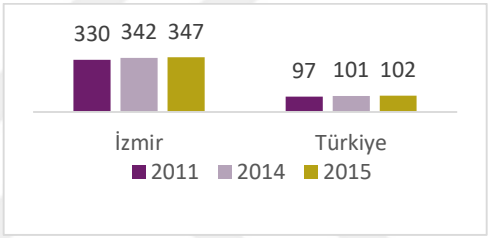


Table.4.1 Population, thousand people **Table.4.2** (Population Density, person / km2)

(https://www.brookings.edu/research/global-metro-monitor/)

Izmir, Turkey Demographic ranking of 3. Next, literacy rate (age 6+) at the rate of 98%, and the labor force participation rate with 10 universities is a province within 54%.

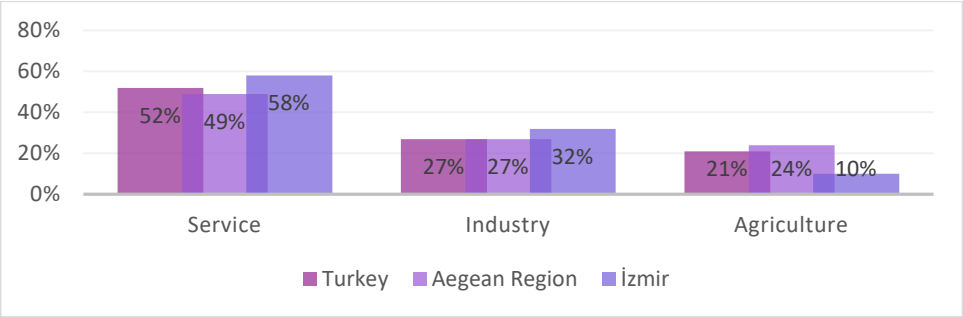


Table.4.3 Economic Power and Trade, Potential Employment by Economic Activities; 2015 (%) (https://www.brookings.edu/research/global-metro-monitor/)

In the Metro Global Metro Monitor 2014 report prepared by Brooking Institute and Jp Morgan Chase, İzmir ranks 3rd among the rising 300 cities. Turkey's total industrial output that performs 9.3%, is an important industrial center. İzmir, which ranks third in terms of both population size and socioeconomic development, increases its development potential with the planned investments and strategies. Istanbul-Izmir highway, Ankara-Izmir High Speed Train, Candarli Port, urban rail system, coastal design studies are among the important developments that will guide Izmir. Easier access to Istanbul is an important advantage for Izmir. The project is expected to carry approximately 6 million passengers per year. The port of Çandarlı meet the needs of Turkey and the Aegean, it is intended to serve transit cargo transportation and 3rd generation ships. Urban rail system; new lines to strengthen the connections of the city and energy-friendly tram projects are carried out within the city. Coastal design studies; It is a project to strengthen the relationship of the people of Izmir with the sea and covers the 40km coastline between Mavişehir - İnciraltı Urban Forest.

As a result of the migration of İzmir center, the roads and parking lots were insufficient for the city center and the need for a new center was created to create a tourism and trade city of the future. With the great transformation decision taken in 2003, the new city center of 471 hectares between Alsancak-Bayraklı-Turan was declared. In the last 7 years, qualified mixed projects have gained momentum in order to meet the need of the luxury residents in the city center, close to commercial and social areas. Those targeted with the New City center; Creating a city center with 500,000 inhabitants,

increasing existing projects worth $ 18 Mia and creating new jobs while the Izmir economy is developing.

İzmir's new center; Bayraklı has become a remarkable region in terms of the real estate sector and stands out as one of the regions where new generation projects are realized most. Mistral İzmir, which consists of office and residence towers, was built by Miray Construction in Bayraklı. Mistral Tower is located in a busy location in Bayrakli, close to the city center and the business districts in the region. The Mistral Tower is located; Bornova district center is 4.7 km, Alsancak Port is 1.8 km and the city center is 5 km away. Location close to metro and public transportation stops, high accessibility, preferred area in terms of housing, trade and tourism use in the New City Center, location close to social equipment areas and limited number of empty parcels that can be preceded in the region provide location advantage.

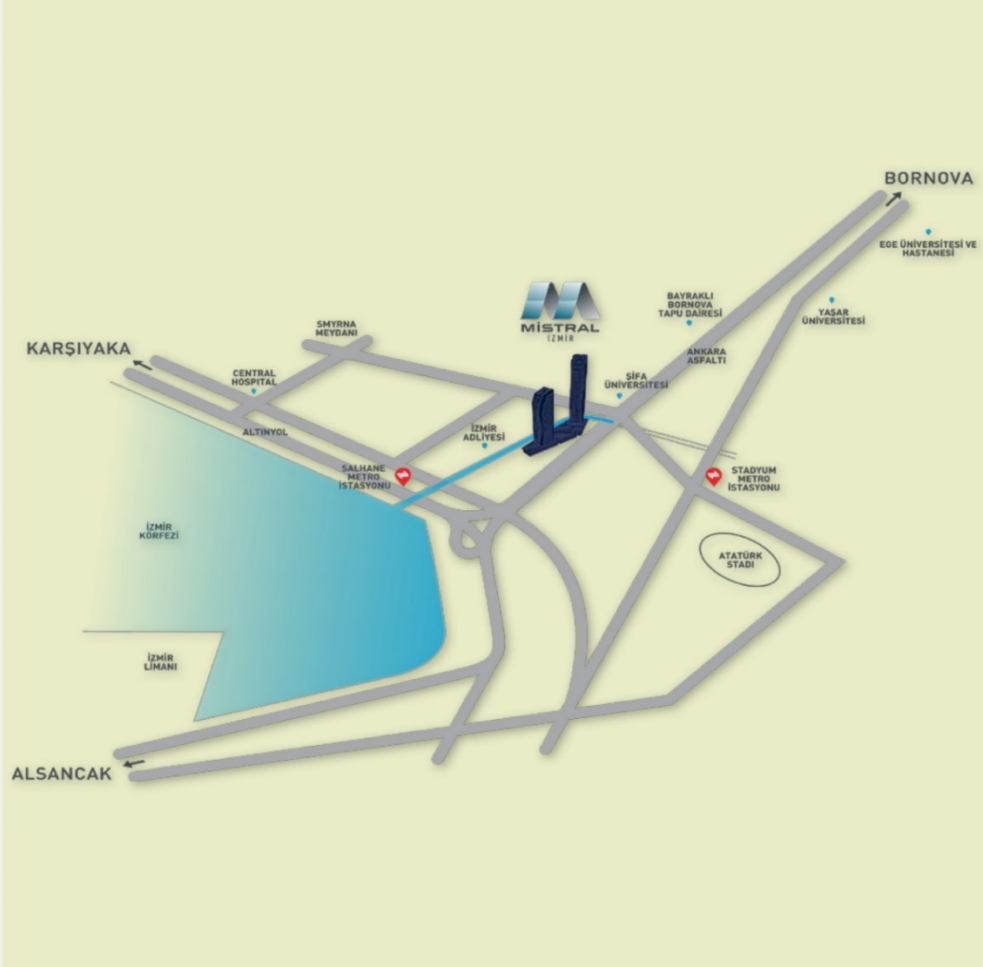


Figure.4.1. Location of Mistral Towers

(http://www.mistralizmir.com.tr/)

The land size is 13,923 m2 and the construction area is 117,404 m2. Project type Residence, office, hotel and shopping center. Mistral İzmir stands out among the projects in the region with its superior steel construction structure and solid foundation. The project in Turkey is very rare in the building and the LEED certification awarded to environmentally friendly building and in 2014 «European Property Awards» given by the Highly Commended Mixed Use Architecture has been awarded the prize. The project received LEED Gold certificate in 2018. It is observed that the projects where the residences are serviced together with the shopping mall and the office have gained momentum in İzmir as in the recent years.

The Mistral Izmir Project, with its mixed structure consisting of shopping malls, residences and offices, supported by strong brands and collaborations, addresses the demand in the region and provides its customers with a modern living space and high added value investment opportunities. Mistral Izmir project started in 2013 and delivered in September 2016. Table 7 shows the Mistral Izmir Project time plan.

Figure.4.2. Mistral Izmir Project Timetable

(Mistral İzmir) (designed by, G. Devran, 2019)

Mistral Izmir, built with steel composite construction technology. It is a structure consisting of 2 towers in a 48-storey office and 38-storey residential block. It has a base that connects these two towers and is designed as two floors. The residence block has 38 floors and includes spa-hotels and residences. 1-2 floors of the residence block serve as a spa and sports facility. It is located on 1270 m2 area as a spa and sports facility. 2-10 floors of the residence block serve as a hotel. The hotel has a total floor area of 8.115 m2. This hotel has 110 rooms and is open for business and leisure.

4.1.Strategy of LEED Certification System of Mistral Towers

Buildings have effects on natural environment during production, construction, operation and demolition phases. 40% of the raw material extracted from the world is used in constructions, 40% of man-made wastes are produced by the construction sector and 40% of all the energy produced is consumed by buildings. The energy consumed by the buildings cannot be denied considering these rates. (Özdil, 2007)

The concept of sustainability has emerged in the building sector where energy consumption is so high. Thanks to sustainable structures, energy consumption has been tried to be kept to a minimum.

Approaches to assess the sustainability of structures have emerged. Certification systems are needed to determine the sustainability of a structure. These certification systems evaluate buildings by scoring. Scoring and evaluating certificate systems; LEED and BREEAM. In order to evaluate environmental impacts and sustainability in a structure, these certification systems are needed. Performance standards have been introduced to evaluate buildings in many countries. These standards through building practices are demonstrated effects on the environment and degradation stages of their life cycle. The most widely used certification system is LEED. (Odaman Kaya, 2012)

LEED examines the environmental performance of buildings in eight categories, and these performance categories are listed below,

- sustainable sites,
- water efficiency,
- energy and atmosphere,
- materials and resources,
- indoor environmental quality,
- placement and connection,
- innovation and design process,
- regional priority credits.

The environmental performance evaluations listed above were evaluated on the Mistral Towers.

Sustainable Sites: Mistral Towers's location is central. It is located in the newly created city center in Izmir. There are hospitals, schools and commercial areas in the vicinity. There are public transport to provide access to Mistral. These can be listed as follows,

- buses,
- rail systems,
    - Izban
    - Metro
- private minibus.

Public transport is within walking distance of the stops from Mistral Towers. The ease of transportation encourages people to public transport. Mistral Towers's parking garages are kept at minimum legal numbers. Parking spaces are reserved for those using bicycles in the car parks. These factors cause people not to use special tools. In this way, people prefer public transport and traffic will be relieved. The Mistral high rise buildings scored 21 out of 26 points from the sustainable sites. The characteristics of the buildings with the highest scores are as follows; development density and community connectivity, alternative transportation, public transportation access, alternative transportation-low-emitting and fuel-efficient vehicle and alternative transportation, parking capacity .

Water Efficiency: Efficient water was given importance at Mistral Towers. Both buildings use gray water. In addition, sanitary ware and fittings are used in bathrooms and kitchens to reduce water consumption. In this way, unnecessary water consumption is prevented. Mistral high rise buildings have received 8 points from the water management assessment. These 8 points were taken under the following sub-evaluation headings; water use reduction, innovative wastewater technologies and water efficient landscaping.

Energy and Atmosphere: Mistral Towers has not done much energy-related applications. Control of all mechanical and electrical systems is provided only by automation system. There are no studies on renewable energy. Mistral Towers scored 15 points in LEED's energy and atmosphere assessment. The scores can be listed under

the following headings; optimize energy performance, enhanced commissioning, enhanced refrigerant management and measurement and verification.

Materials and Resources: Waste control was carried out from the construction phase of the building to the beginning of the life cycle. Waste control is also carried out when the building is transferred to operation. Some of the materials used were imported according to the architect's preference. Some materials were obtained from the surrounding area. All materials used are TSE guaranteed. Mistral towers gets 5 points from material and resources. These 5 points came from the following evaluations; construction waste management, recycled content and regional materials.

Indoor Environmental Quality: According to ASHRAE standards, air quality in the building is created and continuously controlled this system. Natural lighting was utilized. Daylight provides maximum light for both buildings. Both towers have sea views. Due to the design of the building, the landscape was moved in. People's health and comfort was given importance. Mistral towers received 6 points from the Indoor environmental quality assessment, which is based on the following topics; construction IAQ management plan- during construction, low-emitting materials-adhesives and sealant, low-emitting materials-paints and coatings, indoor chemical and pollutant source control, thermal comfort-design and thermal comfort- verification.

Innovation and Design Process: During the design and implementation, LEED consultant was employed. All stages of design and application have been tried to be carried out with innovative technology. Mistral towers received 6 points from the innovation and design process, which is based on the following topics; LEED accredited professional and innovation in design: specific titles.

Regional Priority Credits: Considering the environment of the building, solutions that contribute to the environment have been created. Some of these can be listed as follows; formation of green areas, construction of bicycle paths, encouraging the use of public transportation, proliferation of commercial areas. Mistral towers received 4 points from the regional priority credits, which is based on the following topics; regional priority: specific credits.

Mistral Towers has prerequisite LEED certificates. (figure.4. figure.5) The above evaluations were made according to this grading system.

LEED 2009 for New Construction and Major Renovations

Project Checklist

Project Name

Date

Y	?	N		Sustainable Sites	Possible Points: 26
21	0	0			
Y			Prereq 1	Construction Activity Pollution Prevention	
1			Credit 1	Site Selection	1
5			Credit 2	Development Density and Community Connectivity	5
			Credit 3	Brownfield Redevelopment	1
6			Credit 4.1	Alternative Transportation—Public Transportation Access	6
1			Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
3			Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
2			Credit 4.4	Alternative Transportation—Parking Capacity	2
			Credit 5.1	Site Development—Protect or Restore Habitat	1
1			Credit 5.2	Site Development—Maximize Open Space	1
1			Credit 6.1	Stormwater Design—Quantity Control	1
			Credit 6.2	Stormwater Design—Quality Control	1
1			Credit 7.1	Heat Island Effect—Non-roof	1
			Credit 7.2	Heat Island Effect—Roof	1
			Credit 8	Light Pollution Reduction	1
8	0	0		**Water Efficiency**	Possible Points: 10
Y			Prereq 1	Water Use Reduction—20% Reduction	
2			Credit 1	Water Efficient Landscaping	2 to 4
2			Credit 2	Innovative Wastewater Technologies	2
4			Credit 3	Water Use Reduction	2 to 4
15	0	0		**Energy and Atmosphere**	Possible Points: 35
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	0
Y			Prereq 3	Fundamental Refrigerant Management	
8			Credit 1	Optimize Energy Performance	1 to 19
			Credit 2	On-Site Renewable Energy	1 to 7
2			Credit 3	Enhanced Commissioning	2
2			Credit 4	Enhanced Refrigerant Management	2
3			Credit 5	Measurement and Verification	3
			Credit 6	Green Power	2
5	0	0		**Materials and Resources**	Possible Points: 14
Y			Prereq 1	Storage and Collection of Recyclables	0
			Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
			Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
2			Credit 2	Construction Waste Management	1 to 2
			Credit 3	Materials Reuse	1 to 2

Y	?	N		Materials and Resources, Continued	
1			Credit 4	Recycled Content	1 to 2
2			Credit 5	Regional Materials	1 to 2
			Credit 6	Rapidly Renewable Materials	1
			Credit 7	Certified Wood	1
6	0	0		**Indoor Environmental Quality**	Possible Points: 15
Y			Prereq 1	Minimum Indoor Air Quality Performance	0
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	0
			Credit 1	Outdoor Air Delivery Monitoring	1
			Credit 2	Increased Ventilation	1
1			Credit 3.1	Construction IAQ Management Plan—During Construction	1
			Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
1			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
1			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
			Credit 4.3	Low-Emitting Materials—Flooring Systems	1
			Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
1			Credit 5	Indoor Chemical and Pollutant Source Control	1
			Credit 6.1	Controllability of Systems—Lighting	1
			Credit 6.2	Controllability of Systems—Thermal Comfort	1
1			Credit 7.1	Thermal Comfort—Design	1
1			Credit 7.2	Thermal Comfort—Verification	1
			Credit 8.1	Daylight and Views—Daylight	1
			Credit 8.2	Daylight and Views—Views	1
6	0	0		**Innovation and Design Process**	Possible Points: 6
1			Credit 1.1	Innovation in Design: Specific Title	1
1			Credit 1.2	Innovation in Design: Specific Title	1
1			Credit 1.3	Innovation in Design: Specific Title	1
1			Credit 1.4	Innovation in Design: Specific Title	1
1			Credit 1.5	Innovation in Design: Specific Title	1
1			Credit 2	LEED Accredited Professional	1
4	0	0		**Regional Priority Credits**	Possible Points: 4
1			Credit 1.1	Regional Priority: Specific Credit	1
1			Credit 1.2	Regional Priority: Specific Credit	1
1			Credit 1.3	Regional Priority: Specific Credit	1
1			Credit 1.4	Regional Priority: Specific Credit	1
65	0	0		**Total**	Possible Points: 110

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

Table.4.4. Mistral Office Building LEED Prerequisite Assessment (Miray İnşaat, 2009)

LEED Certification Review Report

This report contains the results of the technical review of an application for LEED® certification submitted for the specified project. LEED certification is an official recognition that a project complies with the requirements prescribed within the LEED rating systems as created and maintained by the U.S. Green Building Council® (USGBC®). The LEED certification program is administered by Green Business Certification Inc. (GBCI®).

Mistral Towers Residences

Project ID	1000024612
Rating system & version	LEED-NC
Project registration date	05/14/2012

CERTIFIED SILVER GOLD PLATINUM

Design and Construction Final Application

CERTIFIED: 40-49, SILVER: 50-59, GOLD: 60-79, PLATINUM: 80+

LEED 2009 NEW CONSTRUCTION

ATTEMPTED: 81, DENIED: 0, PENDING: 29, AWARDED: 50 OF 110 POINTS

SUSTAINABLE SITES	23 OF 26
SSp1 Construction Activity Pollution Prevention	Y
SSc1 Site Selection	1 / 1
SSc2 Development Density and Community Connectivity	5 / 5
SSc3 Brownfield Redevelopment	0 / 1
SSc4.1 Alternative Transportation-Public Transportation Access	6 / 6
SSc4.2 Alternative Transportation-Bicycle Storage and Changing Rooms	1 / 1
SSc4.3 Alternative Transportation-Low-Emitting and Fuel-Efficient Vehicles	3 / 3
SSc4.4 Alternative Transportation-Parking Capacity	2 / 2
SSc5.1 Site Development-Protect or Restore Habitat	0 / 1
SSc5.2 Site Development-Maximize Open Space	1 / 1
SSc6.1 Stormwater Design-Quantity Control	1 / 1
SSc6.2 Stormwater Design-Quality Control	1 / 1
SSc7.1 Heat Island Effect, Non-Roof	1 / 1
SSc7.2 Heat Island Effect-Roof	1 / 1
SSc8 Light Pollution Reduction	0 / 1

WATER EFFICIENCY	4 OF 10
WEp1 Water Use Reduction-20% Reduction	N
WEc1 Water Efficient Landscaping	4 / 4
WEc2 Innovative Wastewater Technologies	0 / 2
WEc3 Water Use Reduction	0 / 4

ENERGY AND ATMOSPHERE	5 OF 35
EAp1 Fundamental Commissioning of the Building Energy Systems	N
EAp2 Minimum Energy Performance	N
EAp3 Fundamental Refrigerant Mgmt	Y
EAc1 Optimize Energy Performance	0 / 19
EAc2 On-Site Renewable Energy	0 / 7
EAc3 Enhanced Commissioning	0 / 2
EAc4 Enhanced Refrigerant Mgmt	2 / 2
EAc5 Measurement and Verification	3 / 3
EAc6 Green Power	0 / 2

MATERIALS AND RESOURCES	6 OF 14
MRp1 Storage and Collection of Recyclables	Y
MRc1.1 Building Reuse-Maintain Existing Walls, Floors and Roof	0 / 3
MRc1.2 Building Reuse, Maintain 50% of Interior	0 / 1
MRc2 Construction Waste Mgmt	2 / 2
MRc3 Materials Reuse	0 / 2
MRc4 Recycled Content	2 / 2
MRc5 Regional Materials	2 / 2
MRc6 Rapidly Renewable Materials	0 / 1
MRc7 Certified Wood	0 / 1

INDOOR ENVIRONMENTAL QUALITY	6 OF 15
IEQp1 Minimum IAQ Performance	N
IEQp2 Environmental Tobacco Smoke (ETS) Control	N
IEQc1 Outdoor Air Delivery Monitoring	0 / 1
IEQc2 Increased Ventilation	0 / 1
IEQc3.1 Construction IAQ Mgmt Plan-During Construction	1 / 1
IEQc3.2 Construction IAQ Mgmt Plan-Before Occupancy	0 / 1
IEQc4.1 Low-Emitting Materials-Adhesives and Sealants	1 / 1
IEQc4.2 Low-Emitting Materials-Paints and Coatings	1 / 1
IEQc4.3 Low-Emitting Materials-Flooring Systems	0 / 1
IEQc4.4 Low-Emitting Materials-Composite Wood and Agrifiber Products	0 / 1
IEQc5 Indoor Chemical and Pollutant Source Control	1 / 1
IEQc6.1 Controllability of Systems-Lighting	0 / 1
IEQc6.2 Controllability of Systems-Thermal Comfort	0 / 1
IEQc7.1 Thermal Comfort-Design	1 / 1
IEQc7.2 Thermal Comfort-Verification	1 / 1
IEQc8.1 Daylight and Views-Daylight	0 / 1
IEQc8.2 Daylight and Views-Views	0 / 1

INNOVATION IN DESIGN	4 OF 6
IDc1.1 SSc7.1: Heat Island Effect, Non-Roof	1 / 1
IDc1.1 Innovation in Design	0 / 1
IDc1.2 SSc5.2: Site Development - Maximize Open Space	1 / 1
IDc1.2 Innovation in Design	0 / 1
IDc1.3 WEc2: Innovative Wastewater Technologies	0 / 1
IDc1.3 Innovation in Design	0 / 1
IDc1.4 EBOM v3 MRp2: Solid Waste Mgmt Policy	1 / 1
IDc1.4 Innovation in Design	0 / 1
IDc1.5 Innovation in Design	0 / 1
IDc1.5 Innovation in Design	0 / 1
IDc2 LEED® Accredited Professional	1 / 1

REGIONAL PRIORITY CREDITS	2 OF 4
WEc1 Water Efficient Landscaping	1 / 1
EAc5 Measurement and Verification	1 / 1

TOTAL	50 OF 110

Table.4.5. Mistral Residence Building LEED Prerequisite Assessment (Miray İnşaat, 2009)

4.1.1 İzmir Climatic Conditions and its Influence on Building Envelope

The main factor affecting the birth and development of cities the advantages offered by appropriate environmental conditions, and this advantage over time, by supporting technology and social organization and the differentiation of urban identity. (Karadağ, 2000)

The characteristics that distinguish a city from the others can be explained as the geographical landscape that emerges within the framework of the interrelations of the natural and social (human) environmental components of the city and its reflections on the city culture. (Karadağ, 2006)

As is known, the city; It is an organized settlement consisting of natural environment, human and its works. Anywhere, the existence and development of the city depends more on the opportunities and resources provided by the natural environment. More clearly, natural environmental factors (location, geological structure and location shapes, climate characteristics, water and soil resources, the city settlement becomes difficult and continuous. Efforts to increase and diversify production, industrialization, development and dissemination of transportation and trade, meeting the social and economic needs, and cultural formation is all about the structural organization of natural environmental factors, depends on the balanced functioning of the factors. (Pacione, 2001)

Location of the building; It is important to know the values of climate elements such as solar radiation, air temperature, air movement and humidity, which affect energy expenditures, as well as the determinants of micro-air conditioning conditions which play a very important role in building energy efficiency. As seen in Figure.4.3 and Figure.4,4., the elements around the building are important factors affecting the

microclimate around the building. (Moore,1993)

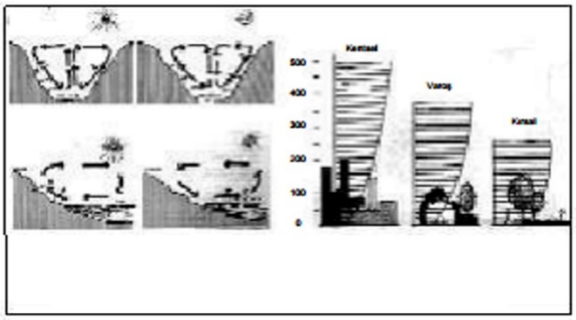
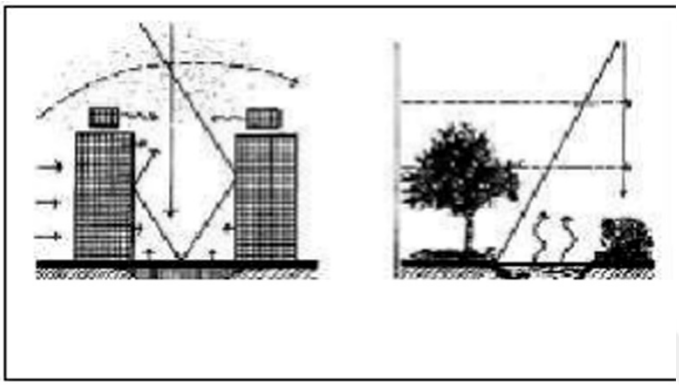


Figure.4.3 Micro-Air Conditioning Conditions (Yılmaz, 2006)



Figures.**4.4**. Affecting The Microclimate Around The Building (Yılmaz, 2006)

The most important goal of smart buildings is to be energy efficient. In order to increase energy efficiency in smart buildings, all mechanical and electrical components in the building are controlled by automation system. Smart buildings pay attention to human health and comfort at a minimum level of energy consumption. In high rise buildings, this energy consumption is higher. 7/24 energy consumption is also very high because of the high quality of these buildings. A large percentage of the total energy consumption in Turkey is spent on the construction and life cycle of buildings. The energy consumed in these buildings is for the comfort of the user. Too much energy is spent on the heating, cooling, ventilation and lighting needs of a

building.

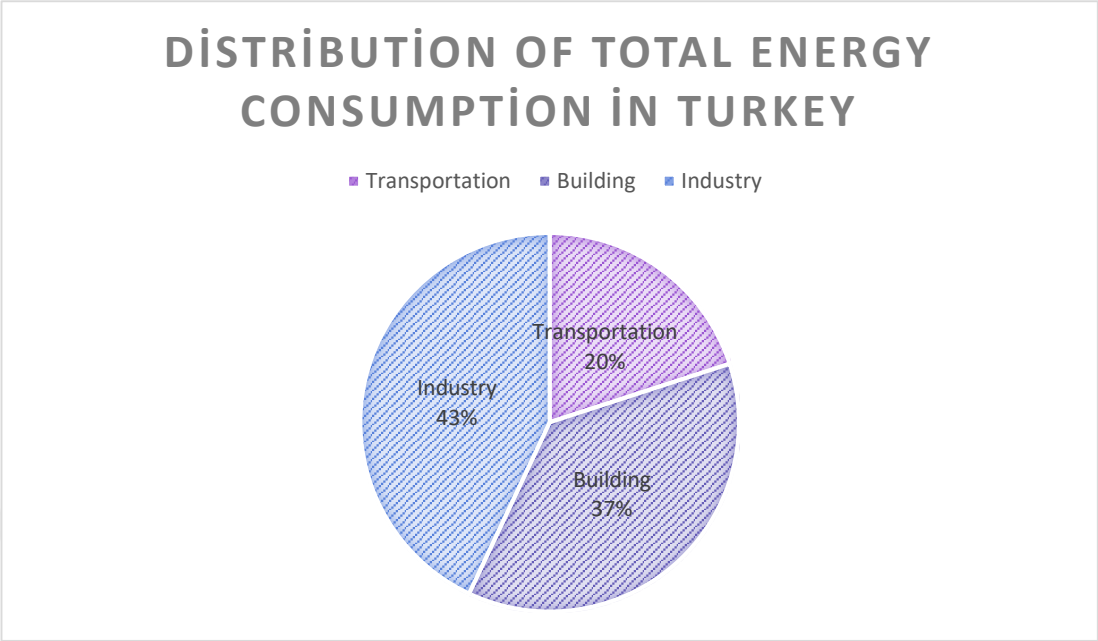


Table.4.6. Distribution of Total Energy Consumption in Turkey (Yılmaz, 2006)

The energy spent in buildings is undeniably high. Therefore, energy efficient buildings should be designed. technological and mechanical systems have no benefit. For energy efficient building construction, design, application, location of the building and climatic conditions of its location are important. Climatic conditions are beginning to affect the design phase of the building. The effects of climate conditions on the building can be listed as follows;

- it affects the construction period: (According to the weather conditions, the duration of the construction may be prolonged and shortened),
- affects material selection (material selection should be made according to climatic conditions - selection of durable material according to wind strength),
- the location of the building form and direction should be decided according to the climatic conditions,
- building functions are added for water efficiency according to climate

conditions (rainwater collection etc.),

- conversion of natural resources into energy according to climatic conditions. (integrating solar panels into the building, use maximizing daylight).

The location of the building affects the design of the building. Energy consumption in high rise buildings is much higher, more attention should be paid to selecting the location. Factors affecting the energy performance of the building emerge during the design phase. The factors can be listed as follows;

- location,
- distance and positioning of the building to other buildings,
- direction of the building,
- form of building (Enables building to benefit from environmental impacts),
- physical properties of shell elements affecting the heat transfer,
- solar control and natural ventilation systems.

All the conditions listed above depend on the climatic conditions in which the building is located. For energy efficient design, the above requirements must be present in the building. If the building does not save energy, it is no different from a classical building. The building form is important for building energy efficient buildings in different climatic types. In cold climatic zones, compact forms are used to minimize the area of energy-losing surfaces. In hot, dry climate zones, compact and courtyard forms are designed to minimize heat gains and to provide shady and cool living spaces. In the hot humid climate zone, elongated forms should be designed with long façade directed to the prevailing wind direction, which allows maximum ventilation to the

maximum level. (Yılmaz, 2006)

Factors affecting energy consumption;

- solar radiation,
- temperature,
- air movement,
- moisture. (Yılmaz, 2006)

İzmir province is in the middle latitude zone and is open to marine influences. It has a climatic character according to the tectonic characteristics of the coastal Aegean coastline with its inland sea structure. It has the character of Mediterranean climate. Summers are dry and hot, winters are mild and rainy. The spring months in İzmir show transition characteristics. Sunbathing potential is high. Since the wind condition is open to the sea, it creates potential. İzmir's renewable energy resources are extremely high. Solar and wind energy is utilized in Izmir. It is seen that the temperature varies between maximum 45 C and minimum 13 C in İzmir. Relative humidity in İzmir is low in summer when temperature is high and cloudiness is low. The relative humidity in July is 50% in İzmir city center. In winter, the average monthly humidity is around 70%. The largest variability among the climate elements in İzmir is the amount of precipitation. Although the average annual precipitation is 700 mm, the total rainfall in some years is approaching 1000 mm due to changes in the general atmosphere circulation. In some years, the total

rainfall drops to around 300 mm.

Province (C)

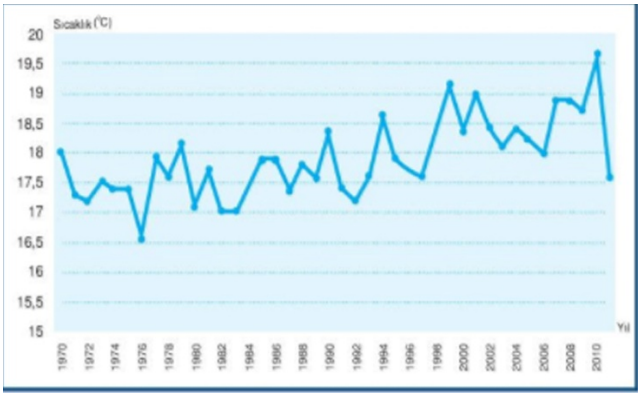


Table.4.7. Annual Average Temperature Time Series Trend in İzmir

(Izmır Büyük Şehir Belediyesi) (https://www.izmir.bel.tr/)

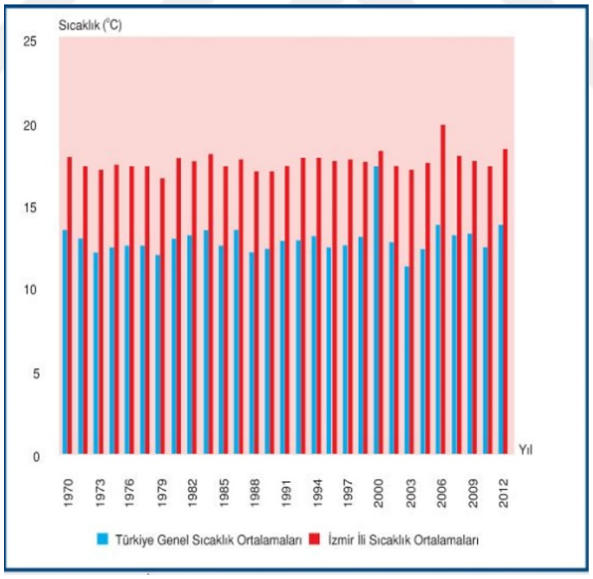


Table.4.8. İzmir and Turkey General Average Annual Temperature (C)

(Izmır Büyük Şehir Belediyesi) (https://www.izmir.bel.tr/

The Average Annual Rainfall in İzmir (kg / m2)

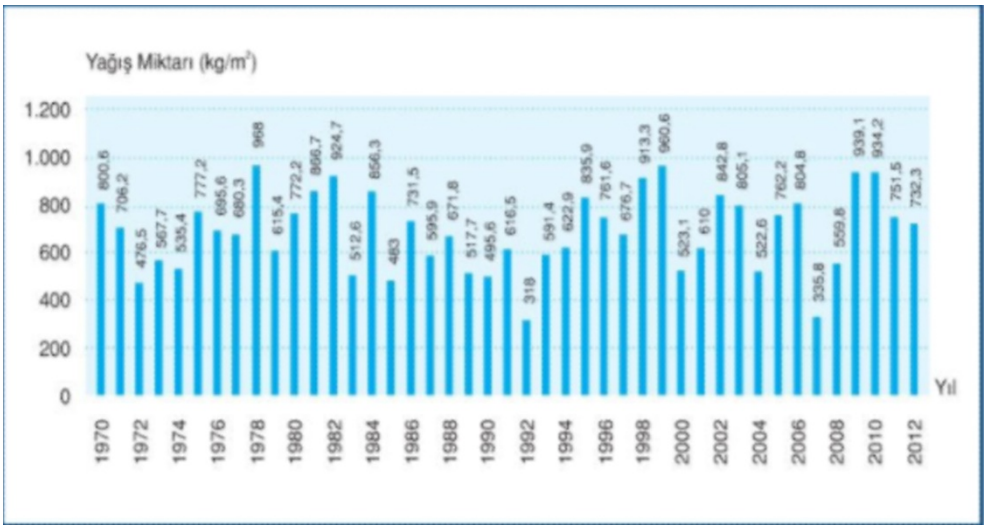


Table.4.9. The Average Annual Rainfall in İzmir (kg / m2)

(Izmır Büyük Şehir Belediyesi) (https://www.izmir.bel.tr)

The advantages of the buildings built in İzmir in terms of climate are listed below,

- construction time (Construction time decreases due to climatic conditions.),
- easy construction progress (Weather is not very cold and hot labor force is accelerated),
- energy efficiency (Benefit from daylight, wind energy and rain water),
- healthy and comfortable buildings.

It is easier to build energy efficient buildings in İzmir due to climatic conditions. Climatic conditions allow for easier construction in İzmir. Since it is possible to work inside the building in rainy times, the construction site never stops. During the design phase, considering the climatic conditions of İzmir, care must be taken to use renewable energy at maximum level. The outer shell of the building takes shape according to the environmental conditions. Factors that affect it are wind direction, sunlight. All these factors are examined and the building location and the outer shell are designed. The climatic conditions affect the design stage of the building. If a sustainable building is to be designed, it is necessary to design it according to the

climatic conditions during the design phase. Considering the climatic conditions, energy saving solutions should be found in the design.

All these climatic advantages of the region were not used in any design apporach for natural ventilation, heating, cooling and lighting needs of Mistral Towers. On the contrary, it has a negative impact on global warming due to the heating and cooling systems. Moreover, the case study building is situated in the prevailing wind direction so this location and orientation interrupt and prevent needed natural ventilation. (Özmehmet, Yüksel, 2019)

The crystallized transparency that has been created by wide terraces, which significantly contribute to the interior life in the buildings, as well as the differentiation of wind and sun breakers on the terraces, contribute to the specificity of the project, and the difference of height between two high building create a positive perception on the urban scale. As the floor number of the high-rise buildings increase, the structured elevation surface enlarges, consequently increasing their yearly energy consumption. Especially when glass is used for a building envelop, energy efficiency has become an even more important issue. To achieve better results, tempered glass is used for the façade of the high-rise. Şişecam Temperable Low-E Neutral (50/33) is used mostly in office and shopping mall projects for its optimum light transmittance (49%) and maximum solar control. (33%). Due to its temperable Solar Low-E coating effective thermal insulation in winter is provided and heating expenses are reduced and it keeps cooler in summer and cooling expenses are reduced. It provides clear view from outside to inside and neutral view from inside to outside due to its low reflectance coating. Also, the advantages of the tempered coating meet the safety need of the building complex. (Özmehmet, Yüksel, 2019)

4.2. Energy Efficiency Analysis

There are two different problems related to energy consumption in the world. The decrease in energy sources and the effects of fossil-based energies on the environment constitute a major problem. Fossil fuels account for fifty percent of the energy used in the world and are expected to run out in the next century. When the sectoral distribution of energy consumption in industrialized countries is considered, the construction sector ranks third after industry and transportation. From these two points, it is

foreseen that all actors involved in the planning, building design, construction, use and transformation process will fulfill their responsibilities in order to endure the least harm to the environment. In this context, energy efficient design strategy and purpose can be explained as developing a general perception about energy efficient design approach. The impact of the planning, design, use and conversion parameters on the energy performance of the building where the construction decision is made should be calculated from the planning stage. In the architectural design process, for example, an approach that takes climate data into consideration will increase the energy efficiency of the building. It is not possible to recover the energy consumed during the production process of materials to be used in building construction, earthmoving and building construction and in the use of heating, ventilation, lighting and equipment. However, the selection of materials, the speed and quality of the construction process and the design and selection of systems are directly under the responsibility of the design team.

Energy efficient building;

•requires less energy with the measures taken during the design phase,

• providing the energy it needs from renewable sources,

• it can be defined as a minimum oscillating building by using the energy provided in the most efficient way.

4.2.1. HVAC System Analysis

In order to improve the energy efficiency of smart buildings, the energy expenditure of the building is automatically being controlled by additional equipment. Therefore, the most important task of the smart building, without sacrificing user comfort of the building to ensure minimum energy expenditure. (Yılmaz, 2006)

Mechanical systems have been designed to improve the energy performance and indoor air quality of the building, meeting the following four measures:

- compliance of projects with laws and standards,
- selection of high energy performance vehicles for building,
- strict follow-up of designs,

- designing automation scenarios and ensuring that system operations are compatible with projects and scenarios. (Öncül, 2012)

The heating and cooling system of the Mistral Izmir Project (residential apartments, hotel rooms, office spaces, store ones, etc.) is made with a four-pipe fan coil system. There are four pipes in this system: cold water return and hot water return. The special feature of this system is that we achieve comfort temperatures designed in regions where different temperatures are felt during the same time period. For example, one room can be heated in one apartment while the other room can be cooled. This is often an important design for comfort during seasons.

Figure.4.5. Example of Four Pipe Fan Coil System (http://usacoil.com/)

Fluid operating temperatures in the system: 7/12 °C

In the heating circuit: 80/60 °C

Indoor environment according to these values (Summer temperature): 24 °C

Indoor (winter temperature): 22 ° C.

All fan coils have three cycles and the heat loads are calculated according to the medium circuit. All fan coils are equipped with threaded ball valves at the inlets and outlets of the fan coils for disassembly, assembly and maintenance of the fan coils independently of the system. These are decisions taken at the design stage. It is intended for ease of operation. This design approach is human comfort and convenience for building operation.

Figure.4.6. Example of Threaded Ball Valve
(https://www.indiamart.com/proddetail/threaded-ball-valve-13045609273.html)

The operating pressure of all valves is PN 16 (16 bar). The operating pressure was calculated according to the number of floors of Mistral and manufactured accordingly. The building operation must also check the pressures regularly.

Combined balancing valves (figure.10) are used in fan coil outlets in order to cut the water flow (cooling 7 C - heating 80 C) into the fan coil when the room temperature reaches the desired level in fan coil outlets.

Figure.4.7. Example of Combined Balancing Valve (https://www.danfoss.com/tr-tr/)

These valves have two purposes on the system. When the ambient temperature of the fan coil reaches the desired comfort conditions (with sensing room thermostats), the valve motor prevents water from entering the fan coil and stops the flow.

The other task will be to provide hydraulic balancing in the system as a dynamic balancing valve. The purpose of this project is to prevent excess energy from passing through the fan coil. Thus, the desired cooling and heating loads can be obtained on the line closest to the pump and on the farthest line.

The controls of the fan coils in the spaces are made of smart panel. The measurement of the heating-cooling system is carried out by means of an M-bus ultrasonic calorimeter connected to a central module fitted to each flat, office and store entrance. The amount of energy consumed in the calorimeter is determined by determining the temperature differences on the flow and return pipelines and the amount of water per unit hour passing over the return pipe. The consumer invoicing is determined according to the amount of 30% of the invoice coming to the building and the remaining 70% of the area of use.

All residential and office floor entrances, plumbing, clean cold water and hot water lines in order to work with low pressure connections (3 - 4 bar range) pressure reducer was installed on the line. In this way, the inlet pressures of the installation are fixed to all batteries. For the purpose of detecting cold water and hot water measurements in the clean water in the building (M-bus) ultrosonic water meters have been assembled. All this is to provide convenience in the maintenance and repair phase when life starts in buildings.

Dynamic balancing valves were installed in all floor entrances for flow control in heating and cooling systems as well as for hydraulic balancing. Accordingly, any flow difference in the floor transitions will be prevented in the pressure fluctuations that will occur in the heating and cooling system. In this way, the comfort of the user will be provided and maintenance repair will be easier to intervene. This will also save labor.

Figure.4.8. Example of Dynamic Balancing Valves
(https://www.vironline.com/en/products/dynamic-balancing-valves)

Intermediate mechanical rooms have been established in the 19th floor and 34th floor in the housing section. The existing mechanical room has fan coil feed pumps, boiler feed pumps, air handling unit feed pumps and primary circuit heat exchanger pumps for the entire building. All of the pumps belonging to the existing zones are frequency controlled pumps.

All pumps are inline air cooled pumps with dry rotor and all are freqank controlled. The operating principle of the system will close the valve on the fan coil line as soon as the desired temperature (cooling or heating) is obtained in the residential floors (via thermostat), which will create an additional pressure on the system. The resulting pressure will increase the difference between the pressure values at the inlet and outlet of the pump in the mechanical chamber and reduce the flow and speed of the pump with the differential pressures read from the transmitters on the lines, thus saving energy.

Heat recovery air handling units are used in mechanical rooms to give fresh air to the rooms. All air handling units are 100 percent fresh air. There are heating coils for heating purposes and cooling coils for cooling purposes. There are two types of filters at the entrances of air handling units for the purpose of holding dust and particles. One of these filters has bag capacity (EU 4) of 3 - 10 micron particles. The second filter is a precision filter with a capacity of 0.3 - 1 micron particles. Between all air handling

units and their own aspirators. Heat recovery units are available. The selection of heat recovery units is designed according to the existing residential areas in mechanical rooms. Therefore, the heat recovery units of the air handling units in the building have been identified as three types.

Rotor heat recovery devices (60% - 55% efficiency)

Air to water heat recovery devices (50% - 45% efficiency)

Air to water heat recovery devices (40% efficiency)

The purpose of the heat recovery device will be to bring the temperature of the inlet air closer to the 7-8 °C room air by using the temperature in the return air. In this case, a significant saving in the amount of energy required to condition the site will be achieved.

For example, in summer conditions the outdoor temperature will be 37 °C and the return air will be 24 °C. By means of two air transfers over the heat recovery exchanger, the outdoor temperature will be reduced to 29 - 30 °C before the cooling coil comes on the coil. In this way, human comfort will be provided indoors. The indoor air temperatures are adjusted to ASHRAE standards and are constantly under control. ASHRAE standards are internationally recognized and give importance to human health and comfort.

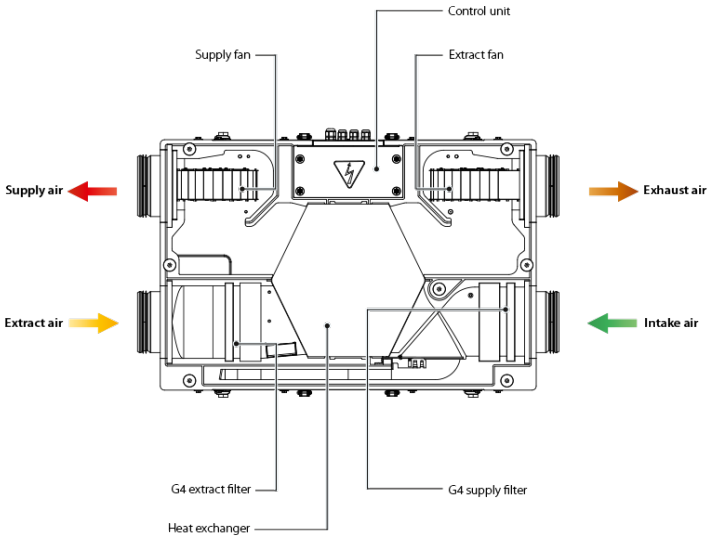


Figure.4.9. Rotor Type Heat Recovery Device Air Conditioning Plant (https://blaubergventilatoren.de/en/series/komfort-d5-180-s3-s4)

Figure.4.10. Recovery Air Conditioning Plant
(https://www.refrigerantrecoverymachine.com/)

Figure.4.11. Precision Filter (https://airplus.com.tr/en)

Figure.4.12. Rough Filter (https://airplus.com.tr/en)

At the entrance of all air handling units, silencer was installed at the outputs of the device in order not to give the fan motor sound to the ducts and therefore to the spaces. It is an application made for comfort purposes. It is designed to prevent the passage of sound to the interior and not to create noise pollution. As the offices are delivered in rough construction, the use of these silencers is provided to the owner.

Figure.4.13. Channel Type Silencer (https://www.researchgate.net/figure/The-structure-of-a-parallel-splitters-silencer-air-channel-width-H-5-2a-splitter_fig2_269808965)

In order to save energy in air handling units, there are two-way combined balancing valves on serpentine turns. These valves will detect the comfort temperature in the room return air and switch to the closed position, stopping the flow of hot water or cold water. There is no compromise on human comfort while saving energy. With the automation control, the labor force of the employee is also saved. It provides fast movement for repair.

Differential pressure sensors are also installed in order to determine the pollution pressure of the filters of the power plants and to measure the differential pressure of the inlet and outlet of the filters. The purpose of doing this is to protect human health and comfort and to lead life in a healthy environment.

The hot water supply of the Residential, Hotel and Shopping Mall sections of the building is done with Single Wall Upright type boilers. The primary circuits of the painters are supplied by boilers and boiler pumps and 80-60 C water inlet and outlet are provided according to the need. All boiler heating pumps are frequency controlled. The water temperature on the secondary side of the boiler is designed as clean water inlet temperature 10 C domestic hot water outlet 60 C. At the same time, there is a recirculation line and pump in the system in order to obtain hot water instantly. All of these productions are aimed at human comfort.

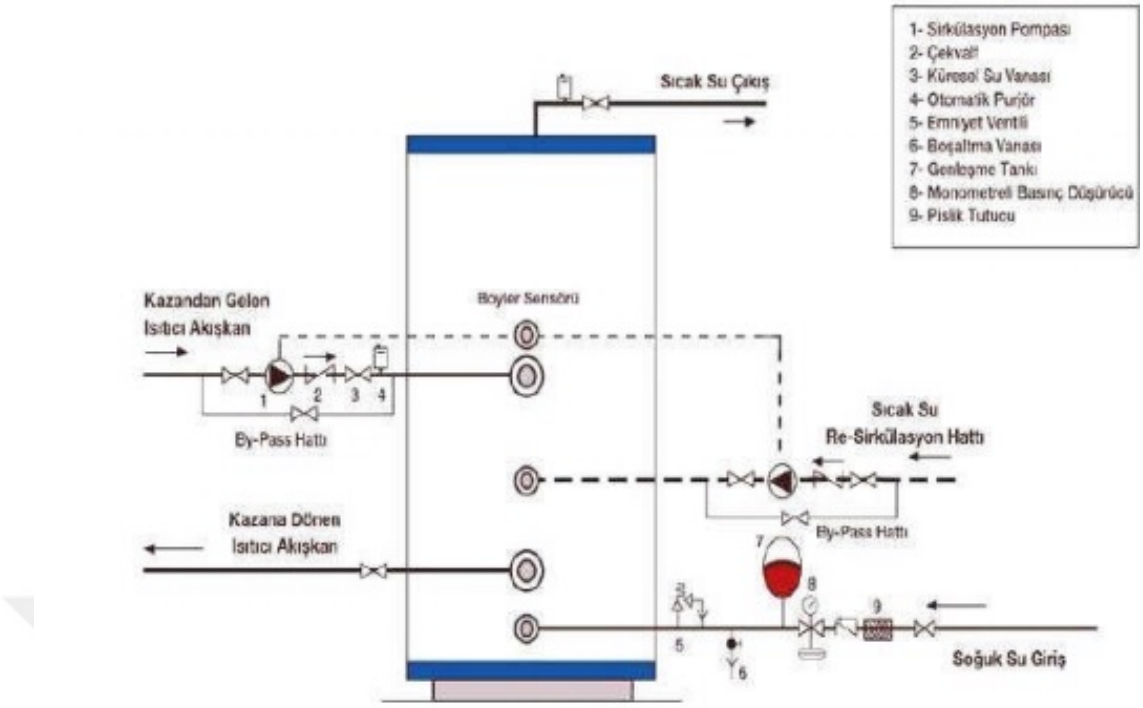


Figure.4.14 Representative Drawing (https://www.vizyonmekanik.net/boyler-montaji-ve-kazan-baglantilari/)

As a precaution against Legionnaires disease in the boiler system, the domestic water temperature is increased to 70 C one day a week. This prevents bacterial growth and then reduces the temperature to normal temperatures. n this way, the formation of bacteria harmful to human health will be prevented. A healthier interior will be provided.

In terms of energy saving, boiler automation is installed in the recirculation return line and the return water temperature is controlled, and when the water temperature reaches 60 C, the primary heating pumps are automatically stopped. All boilers in the system are insulated with self-insulating material. This prevents energy loss.

In the high-rise building, a mechanical chamber was created on about 20 floors, mainly due to the high static pressure depending on the height. Taking into account the existing static pressure, a heat exchanger system resistant to PN 16 pressure was used in each mechanical room. A temperature of (±) 5 ° C occurs between the primary circuit of the heat exchanger and the secondary circuit transition.

The purpose of pressure zoning;

- decreasing the static pressure of the system,
- reduce the upper / lower pressure difference,
- to control the fluid flow.

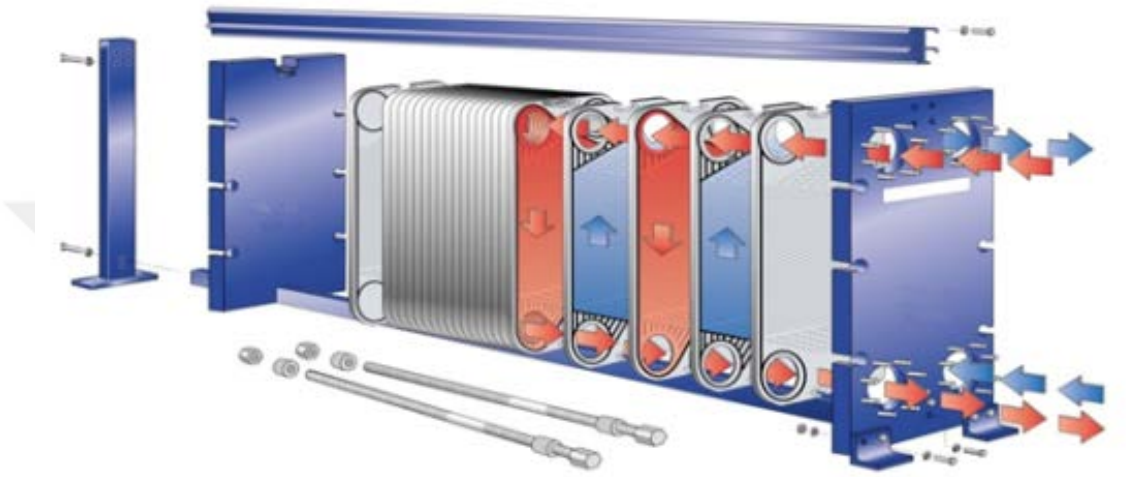


Figure.4.15. Heat Exchanger Working Principle (https://www.alfalaval.co.uk/microsites/gasketed-plate-heat-exchangers/tools/how-gphes-work/)

There is a three-way valence valve on the primary side of the heat exchanger for energy saving. When the return water temperature on the secondary side is sensed and reaches the desired temperature, the three-way valve closes the heat exchanger inlet on the primary side,

Thus, 80 C heating water returns to the return line without entering the heat exchanger so that no energy loss occurs in the heat exchanger line.

In Mistral Towers complex, central HVAC system is used for chilling and water cooling at the mall and common areas and at office and residential areas, VRV system is used for cooling. The central heating system works with gas and each residence has radiator available for central gas heating. Outdoor units have built-in noise-reducing features, that also lowers the sound level. Residential applications have the 'night set' mode, that functions over a programmed period of time. (Özmehmet & Yüksel,

Evaluation of High Rise Building Sustainability Performance, 2019)

People comfort, health and energy efficiency are considered in Mistral. All necessary mechanical and electrical designs have been made for this purpose. Automation system controls all mechanical electrical system and provides energy efficiency.

4.2.2 Lighting Analysis

Lighting is one of the important elements of architecture in providing comfort conditions in living and working areas and perception of space. In order to provide user comfort in the construction environment, energy consumption for air conditioning and lighting purposes constitutes approximately 50% of the total energy consumption in our country as in the whole world. For this purpose, besides the automation of the mechanical and electrical systems of the building, all the systems belonging to the building should be evaluated as a whole from the beginning of the design process. Successful energy management can only be achieved through an energy efficient design approach where design, construction, use and post-use processes are handled together. Otherwise, users will be provided with buildings with advanced automation systems, but with low energy efficiency and high energy consumption. (Kutlu, 2010)

Tier Design Aproach of Lighting	
Tier 1	Lighting
Basic Building Design	Window Glazing Type Interior Finishes
Tier 2	Daylighting
Natural Energies and Passive Techniques	Skylights Clerestories Light Shelves
Tier 3	Electric Light
Mechanical and Electrical Equipment	Lamps Fixtures Location of Fixtures

Table.4.10. Tier Design Aproach of Lighting (Lechner, 2015)

Lighting was provided by window, glazing type and interior finishes in traditional buildings. When sustainable buildings started to be built, natural energies were used

for lighting. Daylight is used as natural energy. When the sustainable building and the smart building are combined in a design, electricity lighting is provided. Lamps and luminaires are used in electrical lighting. (Lechner, 2015)

Lighting is used throughout the day especially in offices. The number of users in tall buildings is very high. Therefore, energy consumption is higher than other traditional structures.

The design of the building shell is an important factor in lighting. The outer shell design should be designed to allow maximum daylight penetration. The building has negative effects on the sun, and tools are needed to prevent these negative effects. he building can be protected from the negative effects of the sun by using light shelves, light tubes, solar shading panels, smart glass etc. systems.

Figure.4.16. Example of Light Selves (Yener, 2007)

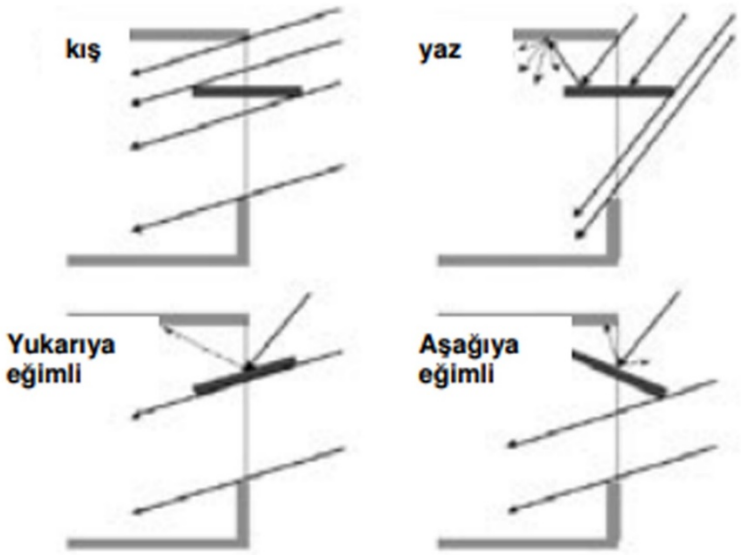


Figure.4.17. Effects Of Light Shelves On Summer And Winter Periods (Yener, 2007)

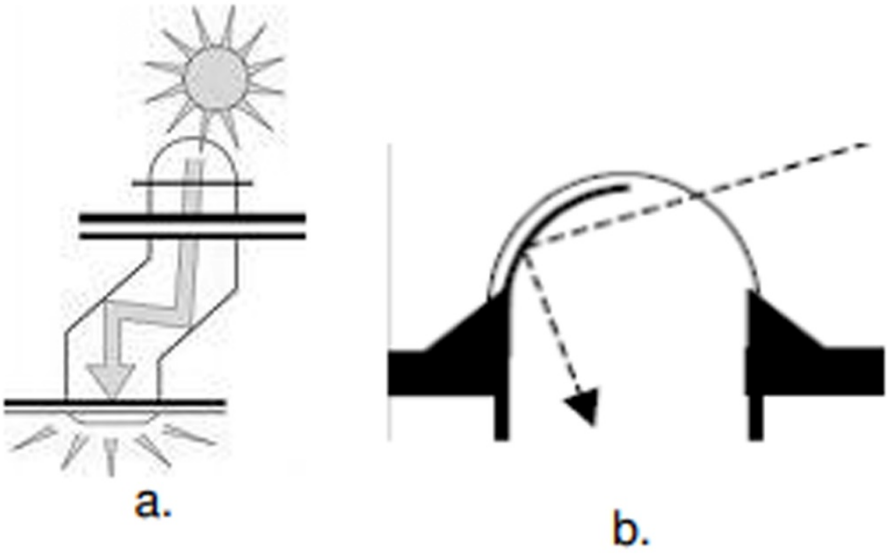


Figure.4.18. Working principle of light tube / Reflective dome in light tube (Yener, 2007)

Passive methods of transmission of light into the building are listed below; (Yener, 2007)

- light Shelves,
- prismatic systems,
- light direction glasses,
- the heliostats,
- sunbathing tubes.

Active methods of transmission of light into the building are listed below; (Yener, 2007)

- smart glass technology,
- electrochromic glasses, (EC)
  liquid crystal glass, (LC)
- gas chromic glass, (GC)
- photochromic or thermochroic glasses,
- photovoltaic panels.

The development of technology has evolved together making is important in buildings such as offices and schools throughout the day, and the control systems that can be used in such buildings are as follows: (Yener, 2007)

- human detectors,
- timed systems,
- fotocell-sensitive systems.

The use of photoelectric controls inside the building is important for comfort. Factors affecting the comfort of the building; on-off and dimmer control, provide daylight-dependent lighting control.

Research on the performance of various lighting control systems in the offices has shown that energy savings of 23% with on-off system, 45% with user sensors, 40% with user sensor and manually dimmable systems, 44% with user sensor and auto dimmable systems. (Jennings, v.d., 1999).

Automation systems to be created according to the function of the space provide energy saving in lighting. Offices are the most intense working places. Therefore, if

the lighting automation to be selected in the offices is selected correctly, approximately 30% energy saving can be achieved. Offices are the most commonly used places, daylight and artificial lighting should be used together in there. (Kutlu,R.G., 2008).

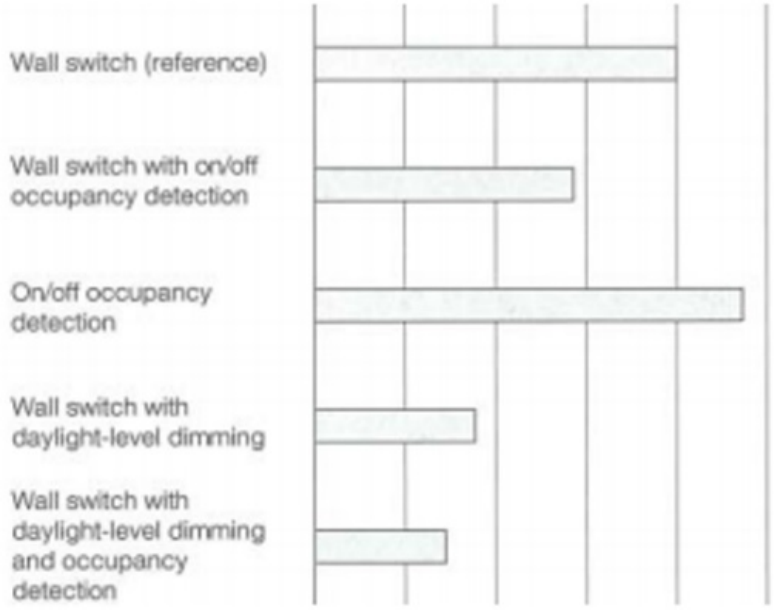


Figure.4.19. Annual Energy Saving Rates of Control Systems (%) (Hegger, Fuchs, Stark, Zeumer, 2008)

Research shows that approximately 20% of the electrical energy is consumed for illumination purposes. This ratio is minimized without compromising the comfort conditions of the user is important in solving problems both economically and environmentally. (Yener, 2007)

Mistral Towers are examined in accordance with the above topics. When the outer shells of the two towers were examined, it was observed that there were large window openings in the housing block. In the office block, the complete outer shell is covered with glass. The residential block can benefit from daylight in the office block. Energy consumption is high due to the dense population in the office block. Therefore, daylight and artificial lighting were designed with one in mind. There are sunshades on the exterior of the housing block. Sunscreens have been used to protect sunlight

from harmful climatic rays. In addition, the large balconies in the residential block are comfortable for residential users.

The energy efficient design is even more important in the building whose outer shell is covered with glass. It is important for safety to use tempered glass in glass coated outer shells. Thanks to the Solar Low-e coating material, it provides thermal insulation in winter and keeps the interior cool in summer.

"All aluminum profiles incorporate polyamide thermal barriers to meet the building U values and window energy rating requirements. The optimum system is the perfect aluminum window for high rise buildings with extremely low air infiltration (0.18m3/hm2), (EU standards: 1.89 m3/hm2). The thermal break technology is used in this product. 40% of the product is manufactured with recycled materials in the UK. The product has low weight, high strength and endless design possibilities. As for coating, GRC (glass reinforced concrete) is used. Hollow rib profiles with a depth of 50-100mm provide the structural integrity of the components. Being 80% lighter than pre-cast steel reinforced concrete, the applied GRC system plays a positive role on emission reduction. Aluminum joint stick plates were used for coating. In terms of external blinds and shutter, power operated external blind with aluminum construction with antibacterial lead-free finishing and polyester (15%) PVC (85%). FP Line Zip Curtain for sun and wind (Ferrari Sortis 86) curtain was used and tested according to DIN EN 1932 which is a test of the resistance to wind load. It has been reported that the features of the materials are the visibility toward the outside, low emissivity, tear resistance, no sagging, efficient maintenance, flame retardant and recyclable textile which has a protocol concerning the reduction of CO2 emissions from the building." (Özmehmet, Yüksel, 2019)

In both towers, sensor illumination is used in public spaces for lighting. Mistral uses sensor lighting in parking lots. All lighting is designed and applied as LED. LED lighting used in common spaces and parking lot provides comfort to people and helps to make energy efficient structure. Apart from sensor lighting in the house and office, led lighting was used to make the corridors bright. The LED is installed in the light band and the light is indirectly reflected in the corridor.

Environmental lighting and exterior lighting of the towers are provided by automation control with the time clock. Controlled lighting with an astronomical time clock is provided. Control with automation is important for energy efficient design. The automation system is important for human comfort. All electrical and mechanical

components in the house can be intervened by telephone from work and outside. One-point multiple and one-point control of all electrical receivers of the house is provided. All electrical cables used separated from the halogen cable in the Mistral Towers. This cable was used for human health. It was used to prevent the release of toxic gas in the event of a fire in the Mistral Towers.

Figure.4.20. Mistral İzmir (http://www.mirayinsaat.com/portfolio/mistral-izmir/)

Figure.4.21. Mistral İzmir Panoramic View (http://mistralizmir.com.tr/ofis/)

Figure.4.22. Mistral Oficce İzmir (http://mistralizmir.com.tr/ofis/)

4.2.3 Water Management Analysis

The wastewater caused by the needs and uses of people in daily life activities, which originate from houses and small businesses such as schools and hospitals, is considered as domestic wastewater. Domestic wastewater is divided into two parts: gray water

and black water. Domestic wastewater is divided into two parts: gray water and black water. The water from the shower, bathroom, sink, washing machine and dishwasher is defined as gray water. Toilet water is defined as black water. Water from the bathroom, shower and washbasin is the most commonly used gray water in recycling technologies since they are less dirty than water from kitchen and dishwasher. The recycled gray water should meet the standards of the place where it will be used. Purified gray water toilet reservoirs are used in laundry, garden watering, ornamental pools. (Üstün & Tırpancı, 2015)

Mistral İzmir was determined to be a gray water line during the project phase. Gray water use The Mistral project is only intended for use in reservoirs. In normal systems without gray water line, wastewater (kitchen, toilet, washbasin, shower) goes over a single line. In the gray water line, all expenses must be separated. In the gray water line, all expenses must be separated. In the mistral structure, the gray water system is collected from the sinks, floor drains and showers in the treatment center, and the treatment is completed by coarse filter, bristle filter, sand filter, activated carbon filter and ultrafiltration process. Necdet Tunalı, a mechanical engineer, has a Gray water treatment flow calculation for Mistral. The gray water treatment flow rate calculation is calculated according to the water requirements of the TS 1258 standard structures. (see Table 4.11)

Number of apartments on the 37th floor-35th floor	Number of people in an apartment	Number of people in the building	Number of flats on the 33rd floor - 20th floor	Number of people in an apartment	Number of people in the building	Number of apartments on the 18th-11th floor	Number of people in apartment	Number of people in the building	Number of rooms in hotel	Number of people found in a room	Number of people in the building	Number of people in housing / hotel
piece	piece	piece	piece	piece	piece	piece	piece	piece	piece	piece	piece	piece
6	5	30	56	4	224	48	2	96	105	2	210	560

Table 4.11. Water calculation of buildings in TS 1258 standard (Mistral İzmir, 2019) (designed by, G. Devran 2019)

1	2	3	4	5	6	7	8
Number of people in residential / hotel floors	Water requirement per person	Daily water needs of the Mistral Building	According to the total water flow rate water needs	Shower and Sink co-use factor according to total water flow	Total water flow for shower and sinks Daily water needs	Shower and sink co-use factor	Daily water needs of shower and sink according to total water flow
Pcs	Lt/day	Lt/day	Lt/day	%	Lt/day	%	Lt/day
560	100	56000	7280	0.74	41440	0.8	33152

Table 4.12. Total daily used shower and sink water flow at the Residence and Hotel (Mistral İzmir, 2019) (designed by, G. Devran 2019)

In the Residential and Hotel section, daily and total used shower and basin water flow rate is calculated. The water consumption used for shower and wash basin was considered to be 74%, as the co-use factor taken in column 5 was used as 13% of total water used per person and 13% as household. The co-use factor in column 6 is the percentage of using the sink and shower in the day. In the column 4, the water requirement for use in the reservoir for the housing and the hotel is indicated. For a total of 7280 liters of water, 10000 lt wastewater tank and 10000 lt. There is depose of domestic water (gray water). Gray water flow rate of 30000 lt / day was selected for residential and hotel block. 56000 lt. 7280 lt of water is recycled and used in reservoirs. Only 8% of the water consumed is recycled and other increased gray water is ejected. (see Table 4.12)

1	2	3	4	5	6	7	8	9	10
Total office space used as office building	Number of people per m2 in the office	Number of people in office structure	Water requirement per person	Total office space in the office tower	Sink co-use factor according to total water flow	Daily water needs of the sink according to total water flow	Single sink co-use factor	Daily water needs of the sink according to total water flow	Daily water requirement of reservoir according to total water flow rate
M2	People/m2	people	Lt/day-people	Lt/day	%	Lt/day	%	Lt/day	Lt/day
28333	10	2833	45	127499	0.74	94349	0.8	75479	16574

Table 4.13. Total daily flow of basin used in the Office (Mistral İzmir, 2019) (designed by, G. Devran 2019)

In the office tower, the number of people in offices is taken from the additional 5 / A user load coefficient of the fire protection regulation. The water consumption used for the basin was considered to be 74% as the co-use factor taken in column 6 of Table.4.13 was used to 13% reservoir of total water per capita and the other 13% was used in the sink. The co-use factor in column 8 is the percentage of using sink within days. In the column 10, the daily water requirement of the reservoir, which is planned to be spent in one day in the office block, is calculated. The office block has 15000 liters of wastewater and 15000 liters of domestic water (gray water) tank. The amount of water intended for the reservoir in the office block for 1 day is 16574 liters. The office block will provide this water treatment depose 15000 liters and the usage water depose is 15000 liters. Since the daily need is 16574 liters, the treatment depose is 15000 liters. The use of the gray water line in the mistral structure was spent on the normal installation as a pulse for 20.000 Euro treatment systems and 5.000 Euro for the additional piping. When no one is left in the building, and gray water cannot be produced when consumption is higher than production, these systems are filled from clean water. Clean water is used to prevent the toilet. If there is not enough wastewater, a water float is provided with pilot float level control valve and the reservoirs are prevented from dehydration. The use of gray water in the mistral structure is designed to be used only in residential and office blocks. The use of gray water in common

toilets and commercial areas is not foreseen in the market section. This decision was decided during the project phase. When we examine the housing block in May 2019, the hotel has a 100% occupancy in the residential section and a 50% occupancy in the housing block. Housing block is provided with 210 tons of gray water per month. 10 tons of clean water is added. The reason for adding 10 tons of clean water is that there is not enough water in the system. Less water consumption than envisaged. The occupancy rate in the office block is 50%. 300 tons of gray water is used and no clean water is added. As there are more people in the offices, gray water gain from the sinks is higher. The Mistral structure from the gray water system provides savings of 6,000.00 TL per month. 7200.00TL per year is only deducted from the cost of water.

Cost List	Operating costs (electric-coagulation and personnel)	Maintenance Expenses
Monthly cost	1,300.00 TL	1,000.00 TL

Table 4.14. Monthly Cost Documentation of Mistral Gray Waterline (Mistral İzmir, 2019) (designed by, G. Devran 2019)

As seen in Table.4.13, total annual maintenance and operation cost is 27.600,00 TL. The net income is TL 4,400.00 from the gray water recovery. In order to ensure the gray water recovery of the Mistral structure, TL 169,750.00 was spent (according to the CBRT 15 May 2019). In 4 years, gray water pays for use. The depreciation of spending in 4 years is an encouraging result of gray water use. No reclamation of rainwater is considered when designing this building. The lack of rain water is related to both the investor decision and the location of the building. It is decided on how much the recovery will be and how much of the need can be achieved by taking into account the approximate rainfall throughout the year. Rainwater collection is less costly than gray water collection. In places where climate conditions are favorable, rain water collection is more economical for investor and building management. In the building business, there is no need for maintenance and personnel as well as gray water. It is assumed that about 40 tons of water is used for landscaping irrigation

around the Mistral structure. This water is covered by the municipality. If a work could be done and stored at first about storing rainwater, a certain amount of water spent for irrigation could be met from rainwater. In these two systems, the investor needs to decide on the project stage.

Water saving is provided to new technologies other than regaining and storing water. Sensors that reduce the flow of water in half by the minute and double flow toilets again save up to 60% water. Water consumption with dehydrated urinals is reduced to zero. (Yalçınalp, Öztürk, & Bayrak, 2018) With the use of water-saving products, people should be made aware of water use. While brushing teeth in daily life, leaving the tap open while shaving, repairing dripping taps and so on. When the habits are dropped and water is used carefully, water savings will be ensured. (Deniz,2012)

It is important in the selection of vehicles that use water for saving water after the building is designed and constructed. In men's toilets, photocell-controlled urinal or dehydrated urinal may be preferred instead of normal urinal. To reduce water consumption by using siphon systems with low water consumption for toilets, shower heads with low flow rate and other waterproof equipment can be used. In the landscape consuming less water and local plants should be selected. Reservoir systems that consume less water should be used. Instead of siphon that consumes 16 liters of water, siphons that use 6 liters of water should be used.

4.2.4. Transportation Analysis

İzmir is a city that stands out by offering multifaceted economic activities, rich natural resources and quality of life together. İzmir has a rapid development potential in parallel with the investments made. İzmir is an important center of attraction in the Aegean Region and the country with its logistics infrastructure, qualified human resources, multi-sector structure and high standard of living.

The prominent features of Izmir are listed below;

- economy,
- industry,
- logistics infrastructure,

- qualified human resources,
- tourism,
- population,
- employment,
- education,
- foreign direct investment.

The features listed above allow Izmir to receive continuous migration. There is a need for new structuring due to continuous migration. Construction area decreased in the city center. Land prices also increased in direct proportion. As the lands decreased, the population density continued to increase. The congestion of İzmir center as a result of the migrations, the roads and parking lots were insufficient for the city center. A new center was needed to create the future tourism and trade city. The decision taken in 2003 was declared as the new city center of 471 hectares of land between Alsancak-Bayraklı-Turan.

In the last 5 years, qualified mixed projects have gained momentum in order to meet the need of the luxury residents in the city center, close to commercial and social areas.

The projects developed and planned for this new city center are listed below;

- qualified residences,
- comfortable hotels,
- office and commercial buildings in global standards,
- marina & entertainment & cultural centers,
- creating a city center with 500,000 inhabitants,
- creation of new employment while Izmir economy develops.

Transportation is a major problem for the projects planned above. The new city center was chosen as it is a settlement with infrastructure in transportation.

Urban transportation in İzmir is done by road, rail systems and sea. The distribution of daily trips in the transportation master plan is shown in Table.3.

Public Transportation Systems	pedestrian transportation	Private transport	Total vehicle transportation	Total Transportation
%50	%38	%12	% 62	%100
0.72 trip / person	0.55 trip / person	0.18 trip / person	0.55 trip / person	1.45 trip / person

Table 4.15. Daily Passenger Rates in Izmir City (Mistral İzmir, 2019) (designed by, G. Devran 2019)

"Transformation in Transportation Project" was initiated by Izmir Metropolitan Municipality in 2000. In this scope, it is aimed to implement bridges, underpasses, overpasses, metro and tram transportation vehicles. The project is expected to be completed by 2030. (İzmir Büyükşehir Belediyesi, 2009)

Types of public transport in Izmir (İzmir Büyükşehir Belediyesi, 2016)

- Public transport System with rubber wheels
- *Rail systems
    - Light rail system
    - Suburban system
- Sea Way System
- Cable Carrying System

The number of passengers transported by public transportation lines in İzmir according to their types is shown in Table.4.15 and Figure 4.16.

DAILY NUMBERS	ESHOT / İZULAŞ	İZMİR METRO	İZBAN	İZDENİZ	TOTAL
WEEKDAYS	5.373.191	1.616.198	1.330.341	205.978	8.525.708
WEEKEND	1.418.757	432.513	412.684	74.541	2.338.495
TOTAL	6.791.948	2.048.711	1.743.025	280.519	10.864.203
DAILY AVERAGE	970.278	292.673	249.004	40.074	1.552.029

Table 4.16 Daily Public Transport Usage Counts (Izmir Metropolitan Municipality, 2019)

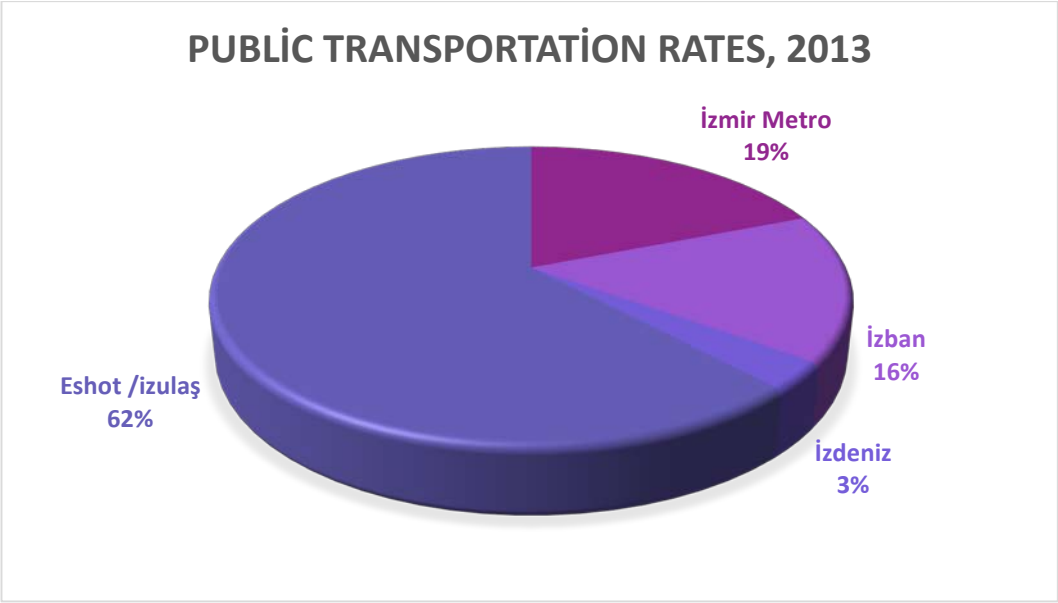


Figure.4.23. Public Transportation Rates, 2013

(Izmir Metropolitan Municipality, 2019)

When Figure 4.21 and Table.4.15 are examined, it is seen that the road is mostly used. People should be encouraged to use rail systems in transportation, to use the sea route. Ensuring and encouraging close constructions to the public transport network will eliminate traffic congestion.

Figure.4.24. Transportation Infrastructure of İzmir Province, 2013

(İzmir Büyükşehir Belediyesi, 2019)

(https://www.izmir.bel.tr/tr/Yayin/213/4#dergi/sayfa56-sayfa57)

Transportation infrastructure of İzmir in 2013 is shown in Figure.4.23. Transportation infrastructure of İzmir in 2023 is shown in Figure3.24. İzmir Çanakkale Motorway will be completed in 2023 and the İzban line will be extended to Bergama Selçuk.. The existing cycling routes in İzmir province are concentrated around the gulf. the bicycle path extends from Sasalı to Üçkuyular.

LINE	LENGTH (KM)
North Line	26.3
East Line	29.7
South Line	54.7
Southeast Line	16.1
Total	126.5

Table 4.17 Bicycle Paths Lengths
(İzmir Büyükşehir Belediyesi, 2019)
(https://www.izmir.bel.tr/tr/Yayin/213/4#dergi/sayfa54-sayfa55)

Bicycle paths lead people to a healthy life. Offers rental for people without bicycles. Projects that encourage the use of bicycles should also be carried out on urban roads. The most common rail system is used after transportation. It is necessary to direct people to the rail system and transportation from the sea. This will make transportation even more comfortable.

There are many high-rise buildings in Bayraklı district of İzmir. There are many buildings planned but waiting for construction. Bayraklı has become a remarkable region in terms of the real estate sector and stands out as one of the regions where new generation projects are realized most. Mistral Towers is one of these high buildings. Mistral towers consist of two towers. It has a base that connects these two towers and is designed as two floors. The residence block has 38 floors and includes spa-hotels and residences. 1-2 floors of the residence block serve as a spa and sports facility. It is located on 1270 m2 area as a spa and sports facility. 2-10 floors of the residence block

serve as a hotel. The hotel has a total floor area of 8.115 m2. This hotel has 110 rooms and is open for business and leisure. (Figure.4.25)

Figure.4.25. Position of Mistral (created by G. Devran, 2019)

Mistral Izmir is 4.7 km from Bornova district center, 1.8 km from Alsancak port and 5 km from the city center. The location is centrally located. Mistral is a multifunctional high rise building. There is life in these buildings 24/7. Transportation is also important because there are a lot of people in this building. People should have easy access to this building. Mistral office building has 48 floors and 50% occupancy rate. Mistral Rail system, highways, bicycle transportation can be provided. It is located in the middle of the transportation vehicles. Mistral Tower is LEED certified. Regarding transportation, it is evaluated according to LEED credit form.

Figure.4.26. Mistral (Mistral İzmir, 2019) (designed by, G. Devran, 2019)

Mistral Towers have been evaluated from the transport criteria listed below;

- alternative transportation-public transportation access,
- alternative transportation bicycle storage and changing rooms,
- alternative transportation-low emitting and fuel-efficient vehicles,
- alternative transportation parking capacity.

Mistral Towers are 800 meters from the Stadium Metro, and Salhane Metro is 1.1 km from the Mistral Towers. Two-rail transport is also within walking distance. It is an important transportation facility for residents and office workers. The rail system provides transportation to many places in Izmir. The Mistral Towers is 30 meters from the municipal bus stop. It is an important factor for companies to choose Mistral Towers. It is in a place where its employees will provide easy transportation and is considered as the middle of Izmir. There are too many human populations in high rise buildings, the ease of transportation is a relief to traffic. Because people will try to come to a place where transportation is not easy. This will cause traffic congestion

during the working hours. Mistral Towers has kept parking space for private vehicles to a minimum. It tries to direct people to public transportation with this design approach. The minimum number of car parks requested by Izmir Metropolitan Municipality was taken into consideration.

The Mistral Towers has parking spaces for bicycles in the parking lot and outside landscaping area. There are bicycle paths in the municipality. The municipality is working for transportation by bicycle. Table.4 contains the bike paths and length information. It also offers rental facilities for non-bikes. By providing transportation by bicycle, it is possible to reach the desired place without suffering from a healthy life and traffic problems. The Mistral Tower also offers a space for bicycles in the parking area and a bike path in front of the building encourages people to use it. Many office workers come to work by bicycle in the Mistral Office Tower. There is a gym in the Mistral's bazaar, and most people have access to bicycles by bike. It is observed that the activities aimed at using the bicycle planned in the project phase have been realized.

The LEED certification system provides certain requirements for transport. These conditions not only affect the building, but also the environment in which the building is located.

Mistral Towers did not have a negative impact on the environment related to transportation. He tried to direct people to public transportation and bicycle transportation. It contributes to its environment. It is close to everywhere and easy access makes the building preferred.

Location in high buildings is an important factor for building. It is important that the building is accessible for use. Human populations are high in high buildings. In order for these buildings to be filled and to have life, it is important that they are easy to access, comfortable and environmentally sensitive structures that do not harm human health. Functions to be given to tall buildings should also be functionalized according to the environment and transportation.

CHAPTER 5
CONCLUSIONS AND FUTURE RESEARCH

5.1 Conclusions

High rise buildings have developed and changed functions from the past to the present. In the history, first the religious structures began to be built high. These structures were built with the desire of being inaccessible and at the top due to religious beliefs. Most of these buildings were designed and built for office use with realization of the industrial revolution. High rise buildings have been designed as housing after the Second World War. Today, it is designed and constructed as multi-functional buildings. High rise buildings have come to the present day by changing the functions of people according to their needs.

The socioeconomic development, economic power and trade center, quality of life promises and the high number of places of education leaded to continuous migration of cities. Urban planning was not responding to the needs of the increasing population density. As population density increased and keeps increasing the need for settlements, workplaces and trade areas increases in direct proportion. City centers are the most preferred places due to the ease of transportation and facilities. The density of people in the city centers makes it necessary to build new settlements. Areas for new construction in city centers are decreasing. Therefore, land prices in the city centers are higher. The increase in land costs leads to an increase in construction costs. In addition, the decrease in the places to be constructed has led to the formation of multifunctional structures. Many functions in a building have been solved at once. Multi-functional high-rise construction started with the decrease of land plots in the city centers.

There are too many occupants in high buildings. Especially in high-rise buildings that function as offices, the human population is very high during daytime. In places where

people are dense, some environmental problems arise to a critical level. The most important of this is transportation. These people should have commercial spaces with the capacity to respond to their needs. The great number of human population in high rise buildings also affects the quality of life in interiors. People spend most of their lives indoors. Indoor spaces need to provide good and healty quality of life, healthy comfortable.

Buildings consume a larger part of the total energy consumed. More energy is consumed in tall buildings than in traditional and conventional buildings. This surplus of energy is too large in volume and is too much in the human population.

Environmental impacts of high rise buildings are very important an sustainability. Negative effects should be minimized in this buildings. Energy-efficient structures contribute to both the environment and ecology.

In this context, Mistral Towers were examined within the scope of sustainability and it effects on İzmir city. Mistral towers were examined in terms of environmental factors and sustainability. Throughout this research, the elements that make the environment and sustainable structure were listed and examined as; HVAC system, lighting strategies, water management strategies and transportation. As one of the conclusions, all of these were applied in the building without compromising human comfort and health. As for the case study, all mechanical and electrical informations were obtained by communications with Mistral's construction team in 7 meetings. The Information during the operational phase was obtained from Mistral management during one-to-one meetings. As one of the outputs of these investigates, both buildings did not use any kind of renewable energy. Renewable energy must be used in a sustainable building. Due to the location and climatic conditions of the building, it could benefit from solar and wind energy. The main reason for the employer may not have done so because of the costs to be spent during construction. However, it is thought that it can remove the cost spent during the operation in a short period of time.

When the building is considered as a location, subheadings may occur as follows; Transportation, site selection and neighborhood. Mistral Towers is successful in site selection, development intensity and community engagement topics. There is ease of

transportation for both office and residential buildings. This is important for people's comfort and city traffic. It is important that there is public transport as IZBAN and İzmir Metro lines; where high-rise buildings are located and that people use these means of transport under contributes to the environment. It is an advantage for the building to keep parking spaces to a minimum and to provide incentives for bicycle use. It makes people more environmentally responsible. A station could be set up to encourage the use of electric vehicles in the parking lot. During the project phase, electric charging stations were included in the parking lots. However, it was later removed from the project at the request of the employer. In fact, the electric vehicle stations should have been in the project as well. It was a good idea for both environmental and user comfort. When people do their work in the building, they charge their cars and save time. In this way, the damage to the environment by personal means would be minimized. This should be done first to encourage users. It is necessary to promote the use of electric vehicles and to convey the ease of use to building users and to encourage them to use them.

When both buildings are examined in terms of energy, the subheadings can be considered as follows; HVAC and lighting. Both are important factors that affect human comfort. They have successfully solved the building HVAC system. Human comfort and health were given importance. This system is controlled by automation system. This saves manpower. It also allows faster intervention for maintenance and repair. In this way, excessive energy consumption is prevented. Both manpower and unnecessary energy use are prevented. The indoor environment temperature, ventilation system, continuity of fresh air circulation are the factors that affect human life comfort. Ensuring the desired air conditioning indoors and keeping it at the same level increases the comfort level of the users. Both buildings do not have designs that greatly affect energy consumption. Both buildings have automation systems. With the smart panels in the residential apartments, the lighting and sockets of the whole house can be intervened from a single place. It is important for human comfort and energy efficient design. Lighting is provided by motion sensor in common halls of residential and office. In all applications LED bulbs were used for artificial lighting. A sustainable method is not considered for outdoor lighting. Solar-powered lighting systems could be used in outdoor common areas. A sustainable method is not considered for environmental lighting. Solar-powered environmental lighting could be used. Outer

shell lighting is illuminated by LED. An energy efficient design is not considered. If the use of solar and wind energy was considered, the outer shell lighting and the lighting of the common spaces could be provided with renewable energy. Natural lighting is used at maximum level especially in the office building. However, no design has been designed to protect against negative effects. The windows used in the office building do not completely cut off the sun's rays. Therefore, indoor air conditioning works more and consumes energy. Natural lighting is maximized while saving lighting. However, the saving from lighting does not cover the energy used for air conditioning. Automation systems should be built in office interior spaces and automation scenarios should be created according to user profile. In addition, more efficient energy usage is achieved by using motion sensor. Solar shades must be on the outside so that energy can be saved for air conditioning. Large window openings allow the user to benefit from daylight in the residence. Due to the large balconies in the residential block and the complete covering of the building, it does not allow the sun directly. Therefore, it is protected from the negative effects of the sun. There are also sunshades on the corners of the building. It also minimizes the negative effects of the sun.

Another important criterion for the Mistral Towers is water management. Water-efficient productions were also made in the residential block and the office block. It is important to prevent depletion of natural resources. The use of gray water has infrastructure in both buildings. In addition, sanitary ware and fittings are used to reduce water consumption. The office block is delivered in rough construction stage to the users. But, the toilets as wet spaces were built completely and delivered to the employers. Therefore, offices are integrated into the gray water system. However, the office will be completed by the user and there is no specification for extra toilets. Therefore, sanitary ware and fittings to be used to minimize gray water use and water consumption are left to the user's discretion. There is no such problem in the residence. Because the apartment is completed and it is given to the owner. In this way, the use of gray water and sanitary ware and fittings are not left to the user's discretion. That's why; The post-building life scenario should be considered and certain specifications should be established after life starts in the building. In this way, the sustainability of the building will be maintained. When the building is being renovated, it will be done in accordance with the rules without the user's discretion.

. As seen in all researches; Mistral is a successful structure in land selection, water consumption and indoor quality. There has not been an adequate design for energy efficiency and renewable energy use. The building in question cannot be called a fully sustainable structure. However, it is a structure that is more environmentally sensitive than traditional structures, has positive effects on environmental conditions, contributes to the environment in which it is located, and accommodates an intelligent system. All of these are factors that have a positive impact on human comfort and cannot be ignored.

There are many high-rise projects that are expected to be implemented in Bayraklı district of İzmir. High rise building will continue to be built in line with the increasing needs together with the ever increasing population. High rise buildings should not be constructed solely to satisfy the need for living. There are applications in high buildings that need to be decided during the project phase. Their identification and benefits to the building and the environment should be shared with the employer. Information about the cost spent during the construction period should be given to the start-up recovery. It should be encouraged to create more convenient and comfortable environments and to be the most important energy efficient design. LEED certified buildings should not be used for prestige purposes only. The aim of sustainability should be adopted and environmentally sensitive, human quality of life oriented structures. It is possible for such LEED-certified buildings to proliferate as the user profile of the buildings becomes aware and cares about their own living comfort.

5.2. Future Research

In the scope of this research, detailed investigations on sustainable intelligent high-rise buildings were made within the scope of the research. LEED criteria were evaluated by using resources on the analyzed building.

As future research proposals, new research can be conducted for the development of LEED certification system. In a different climate, location on a city, the same building type can be examined and different readings can be made. Based on the methodology proposed, other densely populated building types can be analyzed.

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