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Implementing the Principles and Standards of Sustainability in the Example of Government Building

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Abstract
Natural resources have decreased with each passing day due to problems such as developing population, increasing needs, and consumption growth and the sustainability has become further important. Public buildings, which have an important area of usage in our daily life, may also have higher energy consumption and this situation damages the sustainability. These buildings, which have both high number of users and a lot of spaces and mostly cover a huge area, need a serious energy requirement while meeting their basic needs such as lighting, heating, and cooling. For public buildings that are not designed as sustainable, this situation both brings an important financial loss and damages the sustainability of our nature. For this reason, it is very important to consider public buildings in accordance with the standards of the sustainability during their design processes. In this study, it will be examined how basic principles and standards of sustainability are implemented in an example Government Building designed for Yalova and how these principles and standards direct the building design. Thus, it will be investigated what the sustainability standards to be used during design process of public buildings may be and a design example in accordance with these principles will be presented.

Keywords
public building, government building, Yalova, sustainability standards, standardization

1. Introduction

Today, the ever-growing population and the need for consumption which arises based on this increase pose a serious threat to our natural resources. This situation necessitates to take steps, which may make the use of natural resources possible in the long-term, and to use renewable energy resources. The concept "sustainability" becomes important so as to smoothly hand down these resources to the next generations.

Sustainability refers to maintaining the continuity of activities of a society, an ecosystem or any sustained system without any interruption, consuming the same as a result of overuse, or without overloading on primary vital resources of the system (Cebeci and Cakilcioglu, 2002). According to official description made by the United Nations (UN) in Brundtland Report 1987; sustainable development is development that meets the needs of the today's generations without jeopardizing the ability of future generations to meet their own needs (WCED, 1987).

Sustainability fundamentally has a concern for the future even though it sometimes takes on different meanings in different industries, and can be generally divided into sub-titles such as economic, environmental, social and cultural sustainability (Durak, 2014). In architectural industry, one of the areas in which sustainability must be considered, the sustainability becomes more crucial for enabling to eliminate several problems just in the project stage and makes it necessary to make sustainable designs.

The main purpose of sustainable design is to ensure the coexistence of inorganic elements constituting global ecosystem, living organisms and humans, and in order to achieve this, 5 main situation must be taken into consideration: resource efficiency, energy efficiency, prevention of pollution, being in harmony with the environment, and integrated and systematic approaches (Yedekci, 2015).

The public buildings, necessitating the intensive use of energy, must be also evaluated within this framework and have an energy saving structure generating its energy from natural resources, conserving its energy, intertwined with the nature by taking its inspiration from the nature and bringing people and nature together. Therefore, this study aims to realize an example of implementation of the sustainability principles and standards. In addition, main purpose of this study is to examine the sustainability standards via an example of public building.

Within this context, it was decided within the scope of the course taken in doctoral program in Architecture Department at the Kocaeli University to design a building of Government Office in the province of Yalova that serves for this purpose. While designing the project, it has been considered how the sustainable building can be obtained via passive systems in particular and the design has been developed accordingly.

Both active and passive systems have been employed with the project of the Government Building designed. However, passive principles and standards shaping the design have been mostly emphasized. As a result of study; a breathing building which can generate its own energy, conserve its energy, provide a social living space and is intertwined with the nature has been designed. Therefore, it is an important step to determine the sustainability principles and standards just in the stage of design and shape the designs accordingly in order to rendering the nature sustainable.

2. Implementation of the Sustainability Principles and Standards in Government Building Example Designed for Yalova

In this study, the Province of Yalova which is located in Marmara Region in Turkey and between the East Longitudes of 28°45' and 29°35' and North Latitudes of 40°28' and 40°45' was selected as the place for which the project is designed. While the northern and western parts of the city are surrounded by the Sea of Marmara, the province of Kocaeli is on the eastern part of the city and the province of Bursa is on the southern part of the city. The city which has an important position in terms of transportation due to being close to the provinces of Istanbul, Kocaeli and Bursa, can be reached by intensive ferry services. Yalova has 6 districts including the central district and is the city with the smallest surface area in Turkey. When the population of this city in recent years is examined, it is observed that the population of the city was 211799 in 2012; 220112 in 2013 and 226514 in 2014 (TSI, 2016). Before beginning the study, we met with office of the Governor of Yalova and the expectations and requests of the Governor, as a user, were heard and then, the need program was prepared. Following this stage, the area was selected and the necessary studies were initiated.

2.1. Area selection

Heykel Region, regarded as the city center of Yalova where current Government Building is located, is dense in terms of the number of buildings and there is a problem of parking lot due to heavy traffic. The region which Sehit Omer Faydali Street is located at and is considered to be one of the newly developing regions of the city and is not far from the city center is evaluated since the landscape will be densely employed in the project planned to be designed and larger area will be needed due to the building's need program (Figure 1). Accordingly, the area that the Governorship of Yalova was wanted to be moved once upon a time but was not due to various reasons was selected. The current area is not used nowadays and is seen as Basement + 3 Floors and Tourism + Housing Zone in the Zoning Plan.

Fig. 1. Google earth view of the area selected and current government building

2.2. Analysis and its results

2.2.1. Climate analysis

The climate of Yalova, as a type of macroclimate, has the characteristics of transition between Mediterranean climate and Black Sea climate, and reflect the characteristics of continental climate here. In this province, summers are generally hot and dry and winters are generally warm and rainy. The vegetation cover of the province consists of maquis and forests.

According to 30-year observation data; an annual average temperature in Yalova is 14.6°C; an average temperature of the coldest month is 6.6°C; an average temperature of the hottest month is 23.7°C; temperature of sea water is 22.9°C and the highest in August and 7.4°C and the lowest in February; on the other hand, average number of snow days is 10.6 and average number of snow covered days is 5.2 (Cil, 2013).

When the dominant wind direction of the city is examined, it is seen that the northeast takes the first place and the northwest takes the second place (Yalova General Directorate of Meteorology). Once the solar angles are calculated, it is determined to be 73°, 27°, and 50° in 21st of June, 21st of December, and 21st of March and 23rd of September, respectively.

2.2.2. Transportation and orientation analysis

Our land which is shaded in green in Figure 2 is located at the area where Sehit Omer Faydali Street (Red Road) and Fatih Street (Orange Road) intersect. Sehit Omer Faydali Street, which is separated from Bursa- Yalova road, is a road which is intensively used for going to the city's districts Termal, Cinarcik, Esenkoy, and Armutlu. On the other hand, Fatih Street is a road coming from to the city center and less- heavier road which addresses to the location close to the seaside. Gazipasa Street (Yellow Road) joining to these roads is a pedestrianized coastal road which is semi-open in terms of traffic. Our land is located at the intersection of these three important roads. The section where the Sea of Marmara is located is at the northern part of our land and therefore, these roads stretch parallel to the sea and to the direction of west and east. Narrow streets (blue roads), which are densely available around the land, are open to traffic and stretches to the Sea of Marmara.

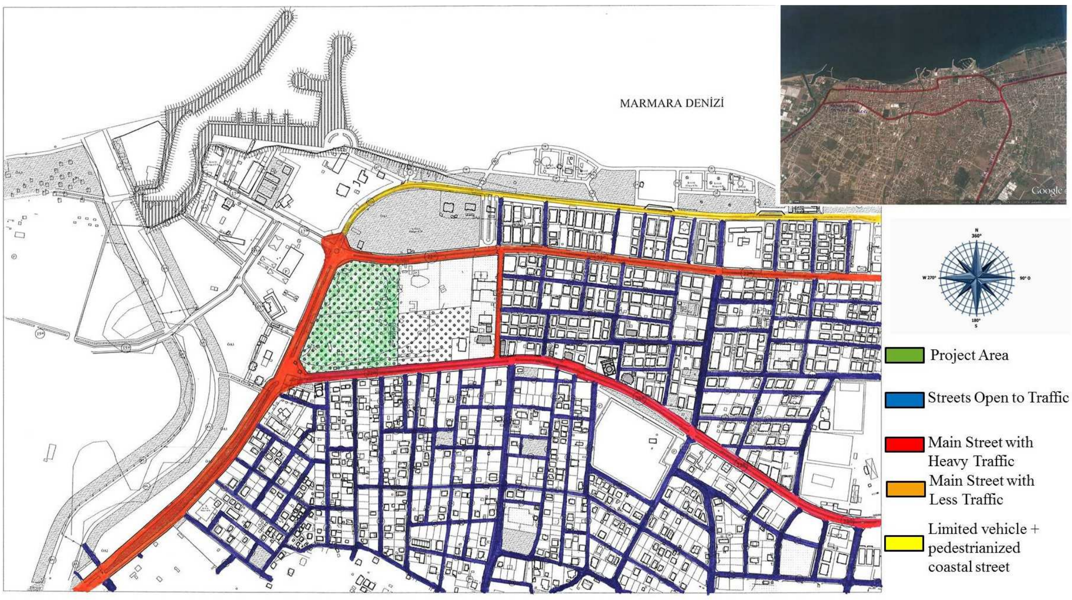

Fig. 2. Transportation and orientation analysis

2.2.3. Analysis of immediate vicinity

Figure 3 shows the analysis of immediate vicinity of the area selected. Accordingly, our area is mostly surrounded by low-rise buildings. However, there are also official buildings even if they are rare. It is considered as an advantage that there are mosques, which are religious facilities, KIPA shopping mall, which is large enough for the city, and sea which may give an opportunity for scenery.

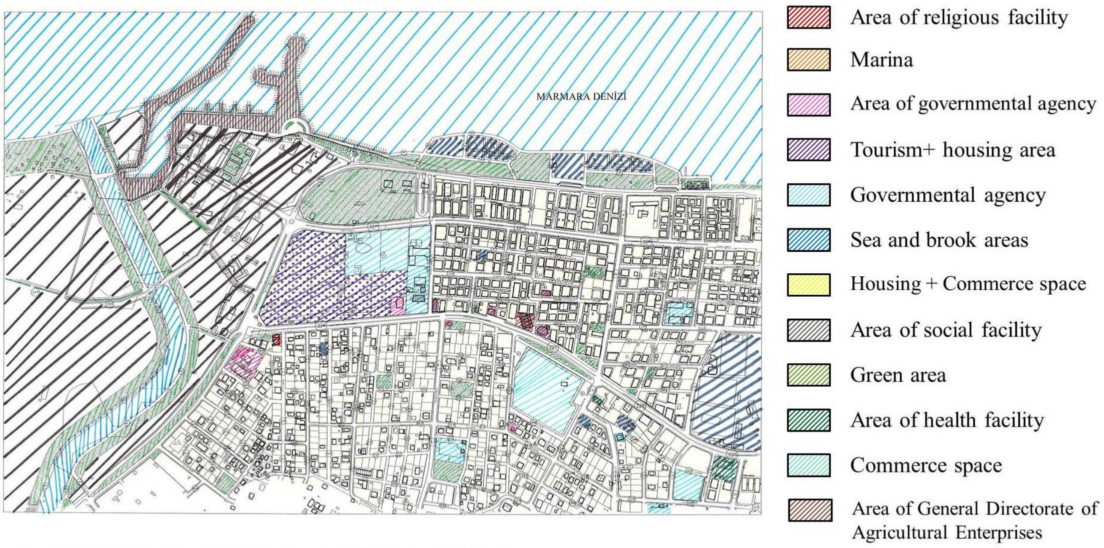

Fig. 3. Analysis of immediate vicinity

2.2.4. Green-field and slope analysis

When green-field analysis is investigated, a big green field is allocated on the northern part of the land (Figure 4). In addition, it is seen that a serious green field is allocated especially from the lower section of coastal side. Therefore, it is required to extend this green field on the north until the internal zone and turn it into something which may address to the surrounding building fabric. When the slope of our area is examined, it is seen that there is not serious difference in the elevation throughout the area, but there is only a slope of approximately 1-2 meter on the southern part.

Fig. 4. Green field analysis

2.3. Formation of project design according to sustainable principles and standards

The housing permission is granted for the eastern part of the land and it is possible for this area to have housing in the future. Therefore, after the necessary height has been calculated, our mass has been located in a manner that it is closer to the middle and western part of the land so that any probable housing on the eastern part is not affected by the length of shadow and the sunbeams. General pedestrian entrance of the building is on the southern part since it can easily address to the city, the transportation is easier from Sehit Omer Faydali Street, which is 22 meter in length, there are lots of houses in the south and the northern part is mostly covered with the green fields and thus, a mass to be located on the southern part is more suitable for the environmental texture. Therefore, the building was located in a manner closer to the southern part of the land (Figure 5).


Figure 5. General layout of the building

A vehicle entrance was designed on the western side, where the traffic is light, for the citizens. Since the traffic here is light, the entrances for officials and official state cars are designed on the northern side and these entrances are separated from general use. The problem regarding social areas on the eastern part of the building was solved and its western part was allocated for the utilization of underground energy and the other infrastructure systems required for sustainability.

The building having a closed construction site of approximately 12,000 m^2 was not solved by means of a single mass and consisted of a total of masses which were interconnected with each other and distributed to a certain part of the land. The building masses were composed of basement + ground floor or basement + ground floor+1st floor in terms of accessibility and the preservation of green-nature appearance and were connected to each other by means of two big courtyards in the middle and green terrace roofs. Moreover, glass skylights were installed in certain sections to increase the illumination level in the entrance parts of the masses composed of basement and ground floor (Figure 6). Parking lots were located on the basement floor joining all masses so as to preserve the natural green environment and prevent the traffic noise.


Fig. 6. Courtyards interconnecting the building masses, green terrace roofs and glass skylights on the green terrace roofs

Street-like structural gaps were formed throughout the building so as to create an imitation of natural life (Figure 7) Thus, as was already determined in the analysis of immediate vicinity, the street culture, which is present in the building texture surrounding the area, was maintained here and environmental integrity was provided. These areas which provide the people with an opportunity to socialize will also enable the building breath by means of wind. It was aimed that the winds mainly blowing from the northern part be distributed through the gaps formed in this direction and reach to different parts of the building. However, when the cold weather and the effect of winter were considered, these gaps were not on the same alignment with each other and were opened as obfuscatory. The building's elevation of subbasement was kept low and thus, it was enabled for the disabled people to easily reach all environments. Moreover, all of the accessibility standards such as tactile pathways, door features, and stair-ramp solutions, railings were met.

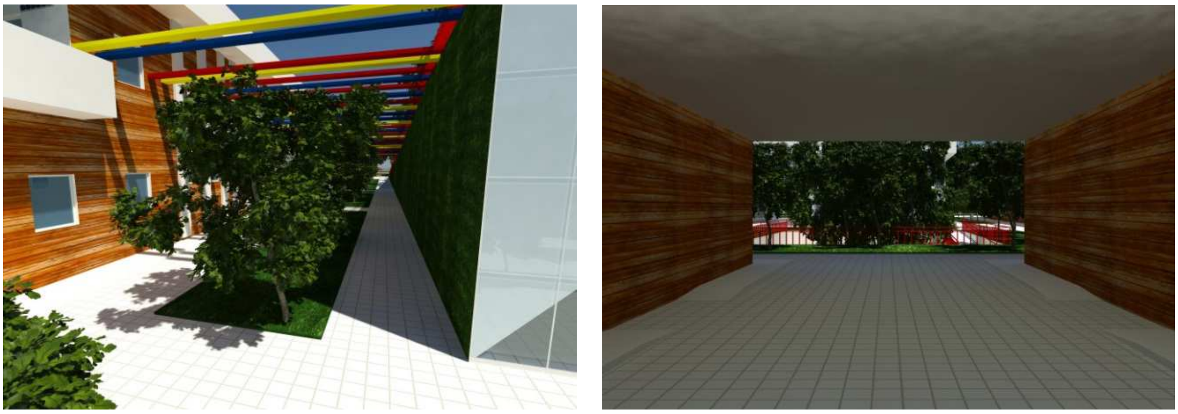

Fig. 7. Structural gaps creating an impact of street

It was deemed suitable to utilize the slope varying between 1 and 2 meter(s) and being intense on the southern part of the land in order to preserve the nature of topography. The slope descending from north to south also creates an opportunity for enjoying the general view. Therefore, the pedestrian entrance was formed to be located at the level of building's entrance on the southern direction. The problem regarding this entrance was solved by designing it as a natural ramp and it was intended to be a part of the natural slope. Also, the seats are in the systematics of amphi in terms of its design, will provide an opportunity for view and ensure the creation of a natural life has been designed in a manner to preserve the topographical structure throughout the southern part of the land and in parallel to the slope lines at sides (Figure 8).

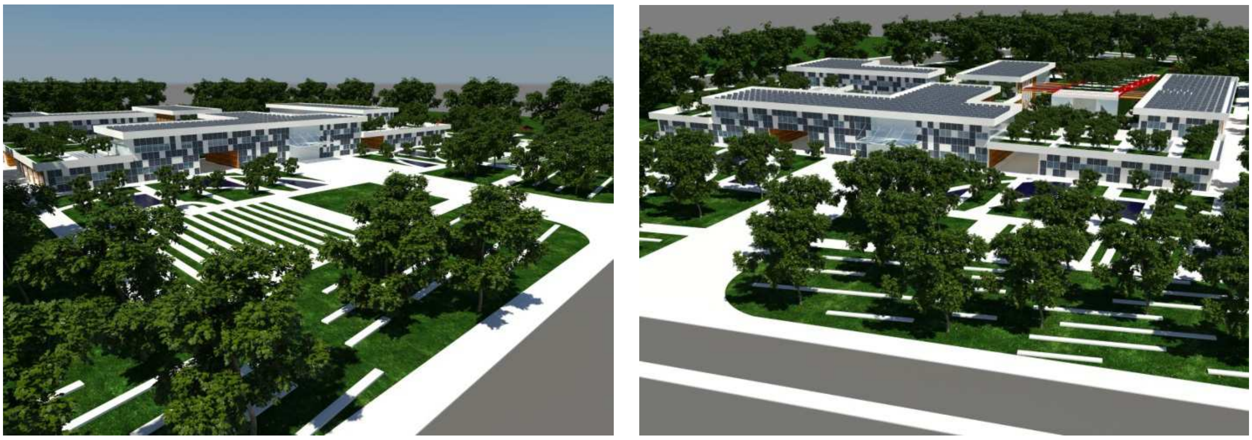

Fig. 8. Southern view of the building and seats designed in natural slope for viewing

The eastern-western axle of building was kept long to utilize the southern facade of the building which is the most efficient in terms of sun as much as possible and the units mostly used were tried to be directed to this direction. The photovoltaic panels to generate the energy need from solar energy were used in a great majority of southern facades of the building masses and they were placed randomly to create an aesthetic impact (Figure 9). Solar energy systems, following these photovoltaic panels, to enable obtaining hot water were installed on the terrace roofs on the highest elevation of the building masses. While installing them, they were directed towards the south according to the solar angles (accepted to be 50° in average) which were calculated during the analyses. Therefore, the greening activities were rarely performed so that sunbeams are not prevented on the front side of the southern facade which is the longest facade of the building. Deciduous trees were selected for the forestation of this area so as to function as a natural sunshade and also prevent interruption of the sunbeams in summer.

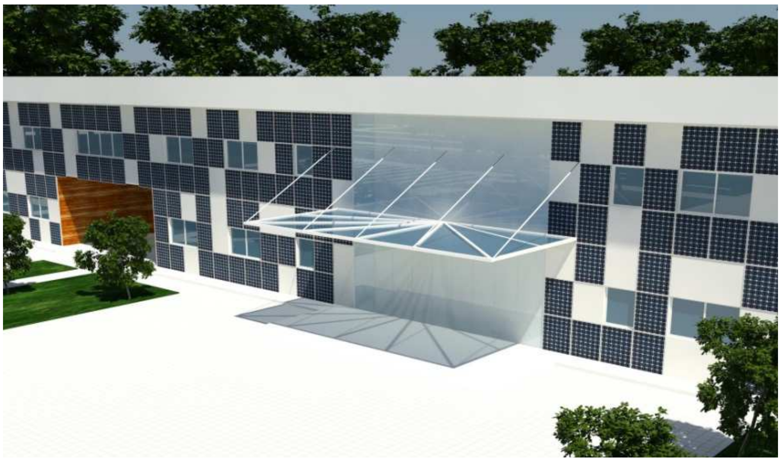

Fig. 9. Photovoltaic panels generating electric power located on the southern facades of the building

It is figured out that the north section of the building will be exposed to an intensive wind flow due to the northeast (1st place) and northwest (2nd place), which are dominant wind direction. It is required that the wind is usually disrupted, however, also blows inside the building through the structural gaps so that the building can breathe. Also, it was specified in the green field analysis that there was a big green field on the northern part of our land and it will be important to extend this area to the internal zone from the southern part for the housing. Another issue is that the north is a weak direction to allow the sunbeams for the region. Thus, a greater effort must be made to allow the sunbeams in from this directions. Due to these reasons; only green band was utilized in a certain distance to the buildings and then it was sparsely forested (Figure 10).

Fig. 10. Northern view of the building

It will be ensured that the sunbeams will be allowed in the building with the low vegetation here. This situation has been strengthened further with the big glass surfaces in this direction. It is deemed suitable to forest densely and frequently the entire part of northern part until the end of the land after a distance in proportion to the height of the building. This green line which seems like a forest will join with the green band on its north; ensure the natural continuity; mostly disrupt the strong winds; lower the speed of wind and ensure that the wind reaches to the building mass in a more balanced manner. Therefore, the evergreen trees were mostly selected for the forestation here.

The conference hall on the northern part of the land was extended by earth-fill in the axle of north-south and brought together with the natural ground by means of a suitable slope for the disabled people. In this way, some portion of the soil to be produced during the excavation in the construction of the building was evaluated. The lateral facades of the conference hall, partially under this mass which is followed by this forest-like green line, have been vegetated and thus, the green effect from the north is aimed to reach to the courtyards (Figure 11).

People looking to the south from the observation deck to be reached at the end of this naturally inclined path can see courtyards, green terrace roofs and building masses, on the other hand, they will see Marmara Sea from north direction. Also, the sparsely scattered wood elements extending from the conference hall to the side masses is intended to have a street effect and create social areas (Figure 12).

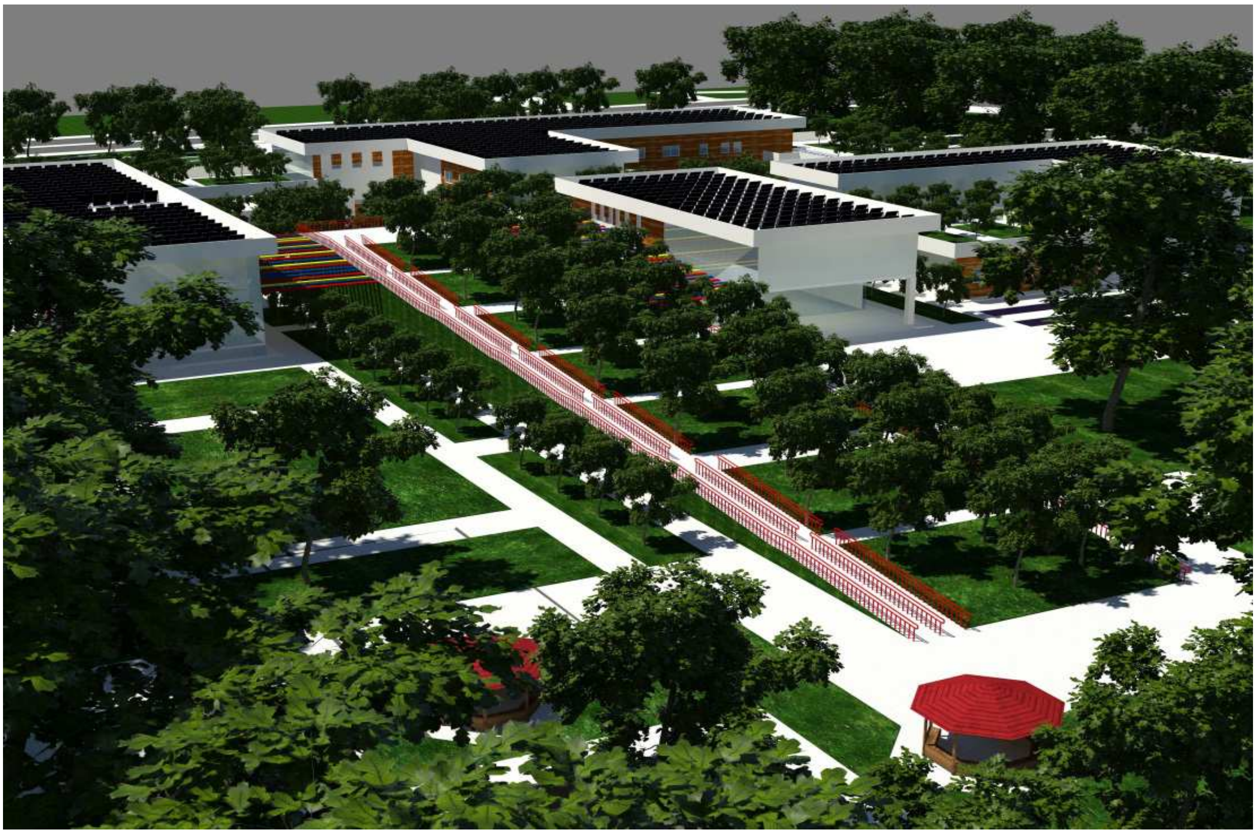

Fig. 11. Conference hall joining with soil surface through natural slope on the northern part of the building

For pedestrians coming from parking lots, an exit was formed with a ramp at two courtyards in the middle of building. The area in the middle of the ramps was greened at level of basement and thus, it was ensured to be the continuity of the courtyard. White paint to seem plain, the light sea-green cladding glasses of a reflecting type with the aim of reflecting the natural green fields and allowing the sunbeams inside the building, wood composite coating with the aim of adjusting to the natural environment, and photovoltaic panels to generate the electricity have been used on the facades of the building. It was tried to provide basic meeting areas needed for strong social life by means of reflection pools, amphitheatres, pergolas, cafes, terrace roofs, and meeting areas (Figure 13).

Fig. 12. Observation deck to courtyards (left) and socialization areas on the sides of conference hall (right)

Fig. 13. Exit ramps from basement to courtyard (top) and reflecting pools (bottom)

The constant temperature of the earth is averagely 15 degree (+ or - 5 degree) 2 meters down and it is possible to achieve natural chillness of summer by lying the pipes in which water flows 2-3 meters below the ground with the system to be established in the garden and reaching the temperature of soil to the building with the help of water by means of special pipes extending through the covering and roofs (Erengezgin, 2008). In the project, the underground temperature was conveyed inside the building by means of the system established on the western part of the area.

Another system employed in the project is treatment system. It is deemed necessary to evaluate the rain water in the rainy region. The rain water obtained from the terrace and terrace roofs of the building was conveyed to the water tank by means of pipes and preserved under the ground. Thus, it was possible to use the water to irrigate the courtyards and use it as cleaning water in the reservoirs.

3. Conclusion

In this study aiming to determine the sustainability standards for the public buildings and examine them on an example; it was decided to design a Government Building for Yalova. The study started by selecting a suitable and correct area inside the city and continued with various analyses. The subjects such as climate data, status of immediate vicinity, transportation, wind direction, direction, soil structure and slope were investigated by these analyses and a building in harmony with the environment was designed.

The data obtained as a result of the analyses were evaluated in terms of sustainability and turned into the structural decisions in compliance with the standards in this regard. Passive principles and standards of design handling the issues such as climate, environment, direction, ventilation, use of daylight, configuration of mass were primarily implemented in the project. Besides, the active systems such as photovoltaic panels and use of underground energy were used.

A green building which pretends to not existing in the nature, is in harmony with its surrounding, never gives harm, supports the social life, uses the renewable energy sources and utilizes them economically, provides both physical and mental comfort area for the users was provided to be created with the standards implemented in the project. The standards adopted in this example are guiding so that the public buildings to be constructed are sustainable. Thus, sustainable life will be offered and it will be possible to construct new public buildings without damaging the nature.

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