YAŞAR UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

MASTER THESIS

A FRAMEWORK FOR IMPROVING ENERGY EFFICIENCY IN MUNICIPALITY BUILDINGS

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We certify that 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.

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ABSTRACT

A FRAMEWORK FOR IMPROVING ENERGY EFFICIENCY IN MUNICIPALITY BUILDINGS

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According to National Energy Efficiency Action Plan for Turkey, energy distribution demand illustrates that the buildings account for 35% of total energy consumption and cause roughly 25% of global CO2 emissions. In the highlight of this knowledge, since 2007 the Covenant of Mayor's projects have begun to be implemented all over the world by municipalities to reduce CO2 emissions at least by 20% by 2020 and at least 40% by 2030. Regional and local authorities in the European Union (EU) are concerned with adapting to climate change by sharing their project's vision, results and experiences; namely in the context of the Global Covenant of Mayors. Turkey, as a partner, has recently aimed to reach and exceed the objective of a 20% reduction in CO_2 within the boundaries of their districts in 10 municipalities; two of them metropolitans and eight of them districts. Besides that, the municipality buildings dissociates from other governmental buildings as having more interactive relations with the community than others. The significance of municipality buildings are obvious; these are the best-case example for citizens who live in that district. Therefore, the focus of this study is on the municipality administrative buildings working as office type building.

The aim of this study is to ascertain a framework for programmatic requirements and energy consumption standards of municipality buildings in Turkey. In this sense, a guide for improvement of energy efficiency performance for the municipality buildings, that have not been built yet, have been studied with the help of simulation tool. Regarding to the track, the question of the thesis has been directed as what amount of the energy efficiency is gained after specific improvements. Considering

all, three goals of the thesis are (1) to find the optimum program necessities of municipality buildings, (2) to set an energy consumption standard and (3) to evaluate energy efficiency level by alterning architectural design parameters by simulations of case building in İzmir, Turkey.

Consequently, the thesis provides a framework for performance based design of any municipality building regarding to the design phases:

Early Design Stage: **to create a design program** for each type of municipality total areas as a guide for the early design stage of municipality buildings. A bibliographic survey analysis has been used to obtain a building program for each type of municipality. This analysis has been obtained by assessing 22 municipality building architectural competitions in the 1985-2015 period. The building programs have been created by competitions' specifications and standards comparison.

Design Stage: For İzmir, municipality buildings' survey is a sample of the investigation and **limitation of energy consumptions**. The help of personal contact has used questionnaire survey method with eight municipalities, and an average electricity consumption has been set for municipality buildings.

Advanced Design Stage: to evaluate energy efficiency by the **simulation of energy performance parameters'** impact as an ideal model. The case building has been decided as Konak Municipality Building designed by the architectural competition project for İzmir. The tool has been chosen as OpenStudio to evaluate the energy performance parameters (glazing type, window to wall ratio, wall type, orientation, shading device).

The thesis consists of six chapters that include all of these subjects.

Keywords: energy efficiency, municipality building, computational tools, OpenStudio, simulation, performance-based design, sustainability

ÖZ

BELEDİYE BİNALARINDA ENERJİ VERİMLİLİĞİNİN GELİŞTİRİLMESİ İÇİN BİR ÇERÇEVE

Aydın, Elif Esra
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Mayıs 2017

Türkiye Ulusal Enerji Verimliliği Eylem Planı'na göre, enerji dağıtım talebi, binaların toplam enerji tüketiminin % 35'ini oluşturduğunu ve küresel CO2 emisyonlarının kabaca %25'ine neden olduğunu göstermektedir. Bu bilgiye dayanarak, 2007 yılından beri, belediyeler tarafından, karbondioksit emisyonunun 2020 yılına kadar en az % 20, 2030 yılına kadar da en az % 40 oranında azaltılması çalışmaları dünyanın her yerinde uygulanmaya başlanmıştır. Belediye Başkanları Küresel Sözleşmesi bağlamında, bölgesel ve yerel yönetimler Avrupa Birliği (AB), projelerinin vizyonunu, sonuçlarını ve deneyimlerini paylaşarak iklim değişikliğine uyum sağlama konusunda endişe duymaktadır. Türkiye bir ortak olarak, 10 belediyede sınırları içinde CO2'de % 20'lik bir azalma hedefine ulaşmayı ve bu hedefi aşmayı hedefliyor; bunlardan ikisi büyükşehir ve sekizi ilçe belediyeleridir. Bunun yanı sıra, belediye binaları toplumla daha etkileşimli ilişkilere sahip oldukları için diğer kamu binalarından ayrılıyor. Belediye binalarının önemi açıktır ki; bu bölgelerde yaşayan vatandaşlar için en iyi örnek yapılardır. Bu nedenle, bu çalışmanın odak noktası, ofis tipi bina olarak çalışan belediye idari binalarıdır.

Bu çalışmanın amacı, Türkiye'de belediye binalarının program gereksinimleri ve enerji tüketim standartları için bir çerçeve oluşturmaktır. Bu anlamda, henüz inşa edilmemiş olan belediye binaları için enerji verimliliği performansının iyileştirilmesi için bir kılavuz, simülasyon aracı yardımıyla incelenmiştir. Bu incelemeyle ilgili, tez sorusu, belirli iyileştirmelerden sonra ne kadar enerji verimliliği kazanıldığına yönlendirilmiştir. Tezin üç amacı vardır, (1) belediye binalarının optimum program ihtiyaçlarını bulmak, (2) bir enerji tüketimi standardı belirlemek ve (3) İzmir,

Türkiye'de ki örnek bina simulasyonları aracılığıyla mimari tasarım parametrelerini değiştirip enerji verimliliği seviyesini değerlendirmek.

Sonuç olarak, tez, tasarım aşamaları ile ilgili olarak herhangi bir belediye binasının performansa dayalı tasarımı için bir çerçeve sunmaktadır:

Erken Tasarım Aşaması: Belediye binalarının erken tasarım aşamaları için rehber olarak her belediye türü alanı için **bir tasarım programı oluşturmak.** Her belediye türü için bir bina programı elde etmek için bir kaynak anket analizi yapılmıştır. Bu analiz 1985-2015 dönemi için 22 belediye binası mimari yarışmasının değerlendirilmesi ile elde edildi. Bina programları, yarışmaların şartname ve standartların karşılaştırmasıyla oluşturulmuştur.

Tasarım Aşaması: İzmir için belediye binaları anketi, **enerji tüketiminin araştırılması ve sınırlandırılmasına** ilişkin bir örnektir. Sekiz belediyeyle bireysel temas yardımı ile anket yöntemi kullanılmış ve belediye binaları için ortalama bir elektrik tüketimi belirlenmiştir.

Gelişmiş Tasarım Aşaması: Enerji performans parametrelerinin simülasyonu ile **ideal bir model olarak enerji verimliliğini değerlendirmek.** Örnek bina, İzmir'de mimari yarışma projesi aracılığıyla tasarlanan Konak Belediye Binası olarak kararlaştırılmıştır. Simulasyon aracı, enerji performans parametrelerini (cam çeşitleri, pencere / duvar oranı, duvar tipi, yönlendirme, gölgelendirme cihazı) değerlendirmek için OpenStudio olarak seçilmiştir.

Tez, bu konuların tümünü içeren altı bölümden oluşmaktadır.

Anahtar sözcükler: enerji verimliliği, belediye binası, bilişimsel araçlar, simülasyon, OpenStudio, performansa dayalı tasarım, sürdürülebilirlik

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Elif Esra AYDIN

İzmir, 2017

TEXT OF OATH

I declare and honestly confirm that my study, titled "A FRAMEWORK FOR IMPROVING ENERGY EFFICIENCY IN MUNICIPALITY BUILDINGS" and presented as a Master's Thesis, has been written without applying to any assistance inconsistent with 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.

Elif Esra AYDIN

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May 16, 2017

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ABBREVIATIONS

EU	European Union
TUIK	Turkey Statistic Corporation
HVAC	Heating, Ventilation, Air Conditioning
NREL	National Renewable Energy Laboratory
CAD	Computer Aided Design
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
3D	Three-Dimensional
2D	Two-Dimensional
CDD	Cooling Design Day
HDD	Heating Design Day
VRF	Variable Refrigerant Flow
SHGC	Solar Heat Gain Coefficient
WWR	Window to Wall Ratio
EEM	Energy Efficiency Measures
VAV	Ventilating Air Valve
CAV	Constant Air Volume
LED	Light Emitting Diode
ALT	Alternative
CO_2	Carbon Dioxide
kWh	Kilowatt Hour - Unit of Energy
W/m^2	Watt per squaremeter - Unit of Irradiance
kWh/m^2	Kilowatt per squaremeter – Unit of Energy per Squaremeter
$kWh/m^2.a$	Annual Kilowatt per squaremeter – Unit of Annual Energy per Squaremeter

CHAPTER ONE
INTRODUCTION

Increasing energy efficiency in buildings is one of the main purposes of Climate Change Action Plan 2011-2023 for Turkey, (National Climate Change Action Plan, 2012). Aforementioned, 10 municipalities have already signed Covenant of Mayors from Turkey as a partner of the project. Moreover, the number of Energy Cities projects are increasing in Turkey as a part of more than 1000 local authorities from 30 countries. Principally municipalities are supporting this project, but also inter-municipal structures, local energy management agencies, municipal companies and groups of municipalities are participants. Ten municipalities are supporter and practitioner from Turkey (Covenant of Mayors, 2016).

The governmental or public office buildings are studied regarding energy efficiency by researchers. China is one such country, which is associated with energy consumption of office buildings including governmental offices. Xiao (2011) has collected data for office buildings in China. This study has obtained significant results for China, due to the involvement of 4600 primarily governmental or business office buildings in 13 cities or provinces. According to Xiao, the data of public building energy consumption *"always remains at a micro-perspective, lacking the understanding of overall characteristics on a regional or national level"* (Xiao, 2011). Yu (2015) is another Chinese researcher who has also collected data in this field. His determination of standards study includes six major cities in China with 12 types of building, more than half of these being government or private office building. Yu studied on high-rise offices and government office buildings. According to Yu's study, the government explained legislative control for an office building, the national standards were named *"design standard for energy efficiency for public buildings"* and *"design code for office building"* (Yu, 2015). Also for Inner Mongolia Region, there is a guide as *"Energy Audit Guidelines of Government Office Building and Large Scale Public Building"* in Lu's study (Lu, 2016).

In this context, setting standards is significant in the public buildings, especially for both central offices and government agencies. Due to public relations, municipality buildings dissociates from other governmental buildings. Municipality buildings have more interactive relations with the community than others. Considering all, the municipalities have an impact on building sector as playing a vital role in order to supervise energy performance of buildings within the boundaries of their districts. In addition, a municipality should be an example for building sector as a role model for a better-built environment. Therefore, the focus of this study is the municipality administrative buildings as working office type building.

1.1. Subject and Context

Office buildings have two types: public and private, in this sense, the municipality buildings are public office buildings (Varlı, 2004). According to the BRITA in PuBs project, eight public buildings have been investigated that aimed to increase innovative and cost-effective retrofitting solutions to improve energy efficiency and implementation of renewable energy in public buildings all over Europe (BRITA, 2016). With the help of knowledge of vital impacts of public buildings, the thesis has examined the energy efficient municipality building design and creates a guide for that by using computational tools. Therefore, the question is can we make a guide for programmatic requirements for municipality buildings? Can energy efficiency performance be improved for municipality buildings? Regarding to the improvements made for municipality buildings, what is the energy efficiency acquisition obtained after specific improvements?

According to some researches, the building program is involved in the design stage and the main precautions regarding energy efficiency can be taken at this stage, rather than after implementation of the building. For instance, the China building energy standards examine buildings with two main topics as design stage and post occupancy. “Design Stage” includes design standards for commercial buildings (office buildings, hospitals etc.), standards for daylighting design of the building, standard for lighting design of building and evaluation standard for green buildings. “Post-Occupancy” includes a standard for building energy performance certification, the standard for consumption of buildings (Hong, 2015). Therefore, the importance of program design for energy efficiency investigates in the first chapter of this study

is about municipality buildings in Turkey to find optimum program necessities of municipality building. This chapter investigates three types of municipality buildings: metropolitan, provincial and district. Subsequenlty the investigation of municipality program, the thesis will answer how we can interpret the relationship between optimum program necessities and energy efficiency in the building. As will be explained broadly, the relationship of program design and energy efficiency depends on preventing the design of the unnecessary space for preventing more energy consumption in the municipality building.

Architectural competition is a widespread method to design public or governmental buildings in Turkey. On this basis, 22 architectural competitions for the design of municipality buildings have been used for the 1985-2015 period to obtain municipality building program and average program necessities. The building program has been analyzed with the help of municipality classification and norms of municipalities. In addition, mandatory and optional departments have been checked with the average necessities (sqm) by the comparison of standards and competition specifications. Additionally, İzmir has held a municipality building competition in 2015 for Konak Municipality. Therefore, Konak municipality building has been used as an evaluation sample model for the thesis. On the other hand, municipality buildings dissociates from other governmental buildings because of public relations. Municipality buildings have more interactive relations with the community than others. Considering all, the main choice for building type is a municipality building that was designed for an architectural competitions. Thus, the thesis will answer the how we can obtain the optimum design program for municipality buildings.

The optimum program necessities mean the square meter values of the each type space as a department for each type of municipality. Depending on the norms and standards of municipalities, the the number of employees has defined required departments. In the thesis, optimum program necessities have been calculated by comparing competition specifications program and standards' departments. After the thesis defined how many areas are optimal for municipality buildings are, İzmir's existing situation has been investigated based on district municipality buildings regarding program design and energy consumption. Because, the buildings should have same parameters and be in the same climate zone in order to find limits of energy consumption in İzmir. The defined parameters of energy consumption are

annual electricity, water, and natural gas demands in the thesis. Energy efficiency has been examined by comparing the energy consumption values (kWh/m2.a). Thus, the energy performance situation of the building can be compared globally. With the help of the data collection, the thesis have provided a standard for energy comsuption limits which will guide the simulations. In addition, existing energy consumption can define İzmir's case in terms of energy efficiency awareness in municipality buildings.

The following two chapters have been related with the simulating municipality buildings. In the first phase has been tested simulation tool (OpenStudio as a plug-in of Sketch Up software supported by EnergyPlus database) to find deviations between accurate value and simulation results by using a current municipality building (Gaziemir) which is located in İzmir. After that, in the final chapter has been studied a case phase that contains a municipality building (Konak) which was designed for an architectural competition in 2015 in İzmir. In this context, the program of project has been compared with optimum limits and has been created alternatives to reach the optimum limit of energy consumptions by using simulation tool OpenStudio. Energy efficiency parameters have been determined by surveying the available literature researches. When the determination is finalized, the window type, window to wall ratio, wall type, shading device and orientation have been selected to show the architectural parameter impact on energy efficiency. The mechanical system parameters and the renewable energy sources have not been studied in the thesis. OpenStudio has been selected to diversify these parameters easily improving the energy efficiency of municipality building in the application project design. While working on this case study there was a collaboration with the architectural team. Consequenlty, the writer of the thesis, as a supervisor, evaluates the energy consumption per square meter for this case study.

1.2. Aims and Problem Definition

The main problem of the thesis is the lack of a framework study about performance-based design in terms of energy efficiency for the municipality building.

Therefore, the problems of the thesis are depends on these below questions:

- What are the criteria that effects the energy efficiency of a building?

- What should be the ideal model model to obtain an energy efficient municipality building?
- What are the threshold values and the energy efficiency limit for municipality buildings?

Can energy efficiency performance influence the design phase of a building?

Considering all the questions, these questions will be responsed by means of searching the absences of a guide for necessity programs and energy consumption limits in terms of electricity, natural gas (heating and cooling), and water consumption in municipality buildings. Therefore, the thesis has two main aspects, obtaining average areas of program design in municipality building and achieving energy efficiency standards for reduction of energy consumption for municipality buildings. As a result, of these two focuses, a sample model will be simulated to illustrate the evaluation sample of the optimum program necessities and energy efficiency performance.

The programs have been set by regulations in Turkey that show some changes depending on population. However, some program defects have caused to design unnecessary space in municipality buildings. Hence, the necessaries have been searched for in municipality buildings designed by architectural competition. The first main goal of the thesis is to obtain a guide for new Municipality Buildings in order to prevent designing unnecessary spaces.

The second focus of thesis is the energy consumption in municipality buildings. According to many studies, there are not standards for energy consumption of municipality buildings in Turkey, although China has some limitations of energy consumption per square meter as “65.0 kWh with the specific criteria indicating 70kWh/ for office buildings” (Xiao, 2011; Jiang, 2014). Moreover, some of the literature studies demonstrate that having some limitation to be low energy building such as 80 kWh/m2.yr for Energy Class A Finnish Building (Mohamed, 2015) or 70 kWh/m2.yr low energy Class II in Danish Buildings (Jorgensen, 2011; Danish Building Regulations, 2006). Therefore, the other goal of the thesis is to achieve an energy efficient municipality building evaluation by setting standard energy consumption limits per square meter and to give advice by energy efficiency approach with simulation’s support.

As explained in Table 1; each chapter has different aims, goals and methods to support the main aims and results.

1.3. Methodology

The thesis includes three main studies that have been discussed in three chapthers. Chapter 2 Design Principles Of Municipality Buildings' Program, Chapter 3 Existing Program And Energy Consumption Situation Of Izmir's Municipality Buildings and Chapter 5 Case Study; Konak Municipality Building. **Therefore, the thesis has three main methods to investigate the topic, those being analysis, survey (Chapter 2-3) and evaluation by simulation application (Chapter 5) (Table2).** Chapter 4 is the validation of simulation tool OpenStudio. This supports the Chapter 5 as given the reliability of OpenStudio in comparing energy consumption of simulation results and the actual Gaziemir Municipality Building bills.

Chapter 2 analyzes the norms and standards for municipalities in Turkey and competition specification to obtain building program. The aim of this chapter is to obtain classification of municipalities and standardization of municipality building program. The analysis includes the research questions: what the municipality building is, can we make a guide for programmatic requirements for municipality buildings, what is the classification of municipality types. After what the municipality and municipality building is defined, the literature on the standards and regulations has been searched. As a result, it has provided three main classifications: metropolitan, provincial, district municipalities. Depending of municipality types, total 22 competition projects have been classified in three branches as five metropolitans, five provincials, and twelve district municipalities. With the knowledge of norms and standards, departments have been compared for the classification of departments as mandatory and optional. The space requirement have been depicted in national competitions as squremeters by dividing the sum of competition departments' areas to the number of buildings. This chapter concludes the **design program for each type of municipalities with squaremeters as a guide for the early design stage of municipality buildings.**

Chapter 3 is the survey for the investigation of existing municipality buildings in terms of building program and energy consumption values for İzmir case. The aim of

this chapter is to obtain building program approach and energy performance situation of the examined İzmir’s districts municipality buildings.

The questions of this chapter are; what the threshold values and the energy efficiency limit are for district municipality buildings; can we set a limit for the energy consumption in terms of electricity, water, solid fuel, and natural gas for municipality buildings? Therefore, this survey method includes the questionnaire to obtain İzmir's municipality building program and energy performance situation. The questionnaire provides the data of building construction, mechanical and electrical system details and energy consumption bills. The energy consumption limitations determined by dividing energy consumption to total sqm area for each building example. This chapter provides a sample for design stage of the municipality building in the context of existing energy performance and building program examination. **By the help of personal contact with eight municipalities, an average electricity consumption has been achieve to set for municipality buildings.**

Chapher 5 is the last step used the evaluation method supported by simulation tool. The aims of this chapter are to illustrate an evaluation sample’s investigation of program design and energy performance in the application project design. The early design stage evaluation is related to the program design and the post design stage is related to the energy performance. The goals are to compare the program of case building (Konak Municipality Building) by using average area needs obtained from Chapter 2 and to check the impact of energy efficiency parameters on the case building by using limitations obtained from Chapter 3. This chapter answers broadly how the energy performance is evaluated for municipality buildings, what the parameters are required for energy performance evaluation and how many percentage improvement of energy performance the simulations can achieve. Due to the responses of these questions, this chapter defined the energy effieciency measures to simulate the performance. Respectively, this chapter includes comparison of the average program necessities with the designed program areas, definition of architectural parameters for application project design, analysis of the parameters' impact for energy performance by OpenStudio and evaluation of the case study by comparing the results with the Chapter 2 and Chapter 3 outputs. Consequently, this evaluation provides:

A sample as a guide for comparison of average program necessities and designed program regarding to Chapter 2 outputs.

An ideal model for energy efficient municipality building design: Energy performance parameters has been searhed to achieve energy consumption limits. OpenStudio has been simulated for the application project design of a municipality building to improve energy performance regarding to Chapter 3 outputs.

Considering all, the thesis provides a framework for performance based design of municipality building. The outputs of the thesis for different design stages are like below:

Early Design Stage: Program design for creating a guide,

Design Stage: For İzmir, municipality buildings' survey as a sample for investigation and limitation of energy consumptions,

Advanced Design Stage: Simulation of energy performance parameters' impact as an ideal model.

Table 1. Chapters' Summary of the Thesis

Chapter's Summary	AIM(s)	GOAL(s)	METHOD	RESULTS/OUTPUTS
CHAPTER 2 DESIGN PRINCIPLES of MUNICIPALITY BUILDINGS' PROGRAM	to obtain: 1. definition of the municipality and it's building 2. Classification of municipalities. 3. standardization of municipality buildings	1. to find out the average area needs with square meters 2. to classify the departments of municipalities	Analysis of: 1.norms and standards for municipalities in Turkey (total 3 main classifications: metropolitan, provincial, district municipalities) 2.competition specification to find out building program (total 22 municipality building projects)	**Design program for each type of municipalities with squaremeters** **Metropolitan Municipality Building: 34,404 m^2** **Provincial Municipality Building: 10,500 m^2** **District Municipality Buidling: 11,587 m^2**
CHAPTER 3 EXISTING PROGRAM AND ENERGY CONSUMPTION SITUATION OF IZMIR'S MUNICIPALITY BUILDINGS	to obtain: 1.building program approach 2.energy performance situation	1.to set the limit for energy consumption as electricity, water, solid fuel, natural gas	Survey: 1.Investigation of İzmir's municipality building program and energy performance by the help of personal contact. 2.Questionnaire includes building construction, mechanical and electrical system details and energy consumption bills data	**Average Electricity consumption value as kWh/m^2 of district municipality for İzmir case.** **Average Electricity Consumption: 102,92 kWh/m^2**
CHAPTER 4 VERIFICATION: SIMULATION OF AN ACTUAL MUNICIPALITY BUILDING	to validate: OpenStudio as simulation tool for energy modelling	1.to find out the deviation of OpenStudio and accurate value 2.to prove the realiability of OpenStudio to use it for Chapter 5	Comparison of the numerical energy consumption values Gaziemir Municipality Building actual energy consumption bills and simulated results	**OpenStudio:** **Reliable tool to check energy performance for illustrating the energy efficiency by the case study.** **OpenStudio deviation: 1,6%**
CHAPTER 5 CASE STUDY; KONAK MUNICIPALITY BUILDING	to illustrate: an evaluation sample investigation of early design stage as program design and post design stage as energy performance in application project design.	1. to compare the case building by using average area needs obtained from Chapter 2 2. to check the impact of energy efficiency parameters on the case building by using limitations obtained from Chapter 3	Comparison of the program design Defining of energy effieciency measure to simulate the performance. Simulating a competition project to improve energy performance of building in the design stage of application project.	**A case model-Konak Municipality Building: can be a guide for new municipality building designs.** **Sample Evaluation of:** **1.Program necessities for early design stage** **2.Energy performance criterion for application project design stage (improving 9.39 %)**

Table 2. Methodology of the Thesis

CHAPTERS	IMPACT OF DESIGN	METHOD	EXPLANATION	OUTPUTS	THESIS RESULTS
CHAPTER 2 DESIGN PRINCIPLES of MUNICIPALITY BUILDINGS' PROGRAM	EARLY DESIGN STAGE	BIBLIOGRAPHIC SURVEY ANALYSIS	**Legislation Survey,** **Survey of Standards,** **Analysis of Program Design:** Program Space Requirements are defined by 22 municipality buildings spesifications of national competitions between 1985-2015	Average Program Necessities for each type of municipality buildings.	A framework of designing municipality building for different design stages. **Early Design Stage:** Program design for creating a guide, **Design Stage:** İzmir's municipality buildings' survey as a sample for investigation and limitation of energy consumptions, **Advanced Design Stage:** Simulation of energy performance parameters' impact as a sample model.
CHAPTER 3 EXISTING PROGRAM AND ENERGY CONSUMPTION SITUATION OF IZMIR'S MUNICIPALITY BUILDINGS	DESIGN STAGE	QUESSTIONNAIRE SURVEY	**Sample Survey:** Investigation of actual municipality buildings in terms of building program and annual energy consumption values for İzmir case.	Limitation of electricity consumption. *Water, Solid Fuel and Natural Gas consumption limits do not able to given in the thesis because of the missing data.	
CHAPTER 5 CASE STUDY; KONAK MUNICIPALITY BUILDING	ADVANCED DESIGN STAGE	EVALUATION	**Evaluation by Case Study:** Comparison of the average program necessities with the designed program areas. Defining architectural parameters for application project design. Analyze the parameters' impact for energy performance by OpenStudio. Evaluate the case study by comparing the results with the Chapter 2 and Chapter 3 results.	**Regarding to Chapter 2 Outputs:** A sample for comparison of average program necessities and designed program. **Regarding to Chapter 3 Outputs:** A sample model for energy efficient municipality building design by searching energy performance parameter alternatives to achieve energy consumption limits	

1.4. Literature Survey

1.4.1. General View to Office Building Studies

Nowadays, the climate change is becoming one of the main problems globally. Therefore, the European Directive and Covenant of Mayors suggest decreasing energy consumption at the rate of at least 20%. Similarly, Inter-Governmental Panel on Climate Change (IPCC) reports achieving public awareness on energy use and its environmental implications (IEA, 2015), this study has been examined to raise awareness by municipality buildings for public.

According to reviewed literature, the offices have a wide range of the building types regarding energy consumption. In order to reduce energy consumption, preliminary studies about office buildings are concerned with the existing situation in the region. In this respect, the initial problem of improving energy efficiency is the reliability of data, missing data and faults of classification sectoral energy consumption belonging to collected office building energy consumption data (Xiao, 2011).

According to studies, **there are no limits of energy consumption for municipality buildings in Turkey,** although China has some limitations of energy consumption per square meter as *"65.0 kWh with the specific criteria indicating 70kWh/ for office buildings"* (Xiao, 2011; Jiang, 2014). Moreover, some of the literature studies demonstrate that having some limitation to be low energy building such as 80 kWh/m2.yr for Energy Class A Finnish Building (Mohamed, 2015) or 70 kWh/m2.yr low energy Class II in Danish Buildings (Jorgensen, 2011; Danish Building Regulations, 2006).

1.4.2. General View to Governmental Office Building Studies

As Kyritsis (2016) study has demonstrated that offices comprise approximately 23% of total surface of non-domestic buildings in the EU-28. That means the offices have the significant place in the building sector.

The reviewed studies have one general main aim to achieve; low energy use in office buildings. Besides that, there are some other aims such as good thermal comfort

(Poirazis, 2008), high quality indoor (Jorgensen, 2011; Zhao, 2011), using BIPV (Building Integrated Photovoltaic Panel) (Yau, 2016).

When elaborated on, we have found out studies of the governmental or public office buildings and their impact on the awareness of the public. According to this review, it could be said that the influences of the municipality (governmental/public office) buildings are playing a vital role in building sector. Because the governmental legislative control mechanism is straightforwardly related with energy consumption in the buildings. Because of that, it could be found many studies about regulations, standards of energy consumption in buildings. As Yu (2015)' study mentioned, China has national standards for energy efficiency *"design standard for energy efficiency for public buildings"* and *"design code for office building"* which is more related to envelope design for offices. Another example for the regulations of energy efficiency is Lu's (2016) study for Inner Mongolia Region which is a guide as *"Energy Audit Guidelines of Government Office Building and Large Scale Public Building"*. Another study belongs to Sanseverino et al (2014) which is *"Municipal Building Regulations for Energy Efficiency in Southern Italy"*. This study is well guides the municipal regulation to buildings by *"the Technical Implementation Norms of the Municipal General Urban Planning and the Municipal Building Regulation are connected to the ruling system at Municipal level."*

Summarizing this information, it could be interpret that significance of the office building and the municipal regulative influence demonstrate that this study can be a good guide for the municipality (office) buildings for Turkey where there are not specific regulations for energy efficiency limits.

1.4.3. Total Average Energy Consumption of Offices

According to the literature on the energy consumption of office buildings, some average of total energy consumption could be got belongs to governmental or public offices.

As seen below, there is some limitation of energy consumption as average value in kWh/m2 unit (Knissel, 2004; Spyropoulos and Balaras, 2011; Tupper, 2012; Rose and Thomsen, 2015). **Except for these countries, Turkey has not a limitation or standards to compare energy performance or government office buildings.**

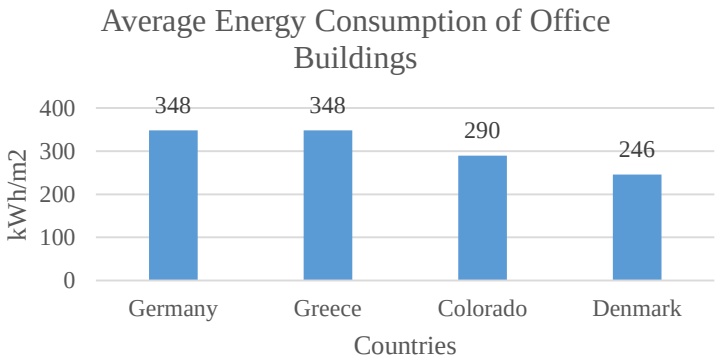


Figure 1 Average Total Energy Consumptions

According to Güçyeter & Günaydın (2012) study, defining a systematic approach for energy efficient retrofit of existing buildings is the main necessity for Turkey, because of that the current Turkish regulations are not sufficient to provide a dynamic approach to obtain energy responses of a building. As known *"the worst modern building use more energy than the worst old building"* by Xu's (2013) study, this study will be associated with being a guide for new municipality/office buildings.

Considering all these studies, a collection of data about municipality buildings is significant particularly regarding program design and energy consumptions. Because of that, Turkey could have some energy consumption averages but not have a standard for being energy efficient office building. **Therefore, the thesis has provided an average energy consumption of municipality buildings for contribution as a knowledge to literature being a part of thesis outputs.**

CHAPTER TWO
DESIGN PRINCIPLES of MUNICIPALITY BUILDINGS' PROGRAM

The energy efficiency has been studied in the highlight of creating a framework for program guide in the thesis. In order to avoid comsuming more energy in the building, the building has to be optimally designed. Regarding to the performance-based design principle, a program design guide is a significant instrument for the early design stage. To have the knowledge of the design principles of municipality buildings, this chapter have been examined the types of municipality, legislation survey, departmental classification and the design program of municipality buildings.

Moreover, municipality buildings are complex buildings such as hybrid configuration to serve the public. Because of that, municipality buildings have been investigated regarding being administrative office building of the municipality. As explained further, the differentiation of office and cultural zones of municipality buildings are explicit for program design. The reason for this is that social-cultural departments have been formed depending on the necessity of urban type and life style.

In this context, some program deficiency has been caused designing unnecessary spaces in the municipality building. ***In other words, unnecessary spaces mean unnecessary energy consumption and low energy performed design.*** Because of that, the program requirements for improving energy efficiency on municipality buildings has been analyzed initially. The aims of this chapter is to obtain (1) a definition of the municipality and its building, (2) a classification of municipalities, (3) standardization program necessities for each type of municipalities. In this chapter, two goals are (1) to classify the departments of municipalities and (2) to find out the average area needs with squaremeters.

When the literature has been reviewed, it is realized that many studies support taking prediction to consume more energy in the early stage of design process. Lobato (2011) has said the most effective intervention to building at the beginning of the design stage. Jorgensen (2011) has studied a case to figure out the implementation of technical knowledge in the early design process for an architectural competition of a

building. Besides supporting energy efficiency prediction in the early design process, it is an example of the architectural competition case for the thesis. Korjenic & Bednar (2012) have studied and promoted using simulation tool in the early design stage explicitly. They have used the simulation tool to analyze energy usage, validating building performance and predicting building energy consumption. Asadi (2014) has made a new model for prediction and quantifying energy consumptions to use in the early stages of building design. Yu (2015) has studied to develop energy performance index in China as a matter of urgency by means of evaluating the thermal performance in an office-building envelope. And also he has supported prediction of energy use at the early stage of architectural design. Yau (2016) has promoted that creating the environmentally friendly, energy and material efficient building, from site selection to deconstruction. Finally, Zuazua-Ros (2016) has demonstrated the extreme impact of the decisions made during the early stage of designing process in his study.

Considering examples in the available literature, as a sort of design stage parameter, creating an efficient building program as a main precaution for energy efficiency can be taken at the early design stage, rather than during construction stage.

Consequently, the essential description of the municipality, municipality buildings, and the necessities of departments have been analyzed to obtain program necessities initially. The analysis has been made by norms and standards for municipalities in Turkey as three main classifications: metropolitan, provincial, district municipalities. The following step has been analyzing of the competition specification to obtain a building program. The total 22 competitions, held between 1985-2015, have been searched for the thesis to collect department area data. The competition specifications have been analyzed by comparison of the squaremeter values for each department. Besides that, the optimization of department areas has been assessed according to regulations (standards) and architectural competitions' specifications comparison of municipality buildings. At the end of the chapter, the optimum program necessities has been given by arithmetic mean.

2.1. Description of the Municipality Building

In the literature, the office is a general term that has the same meaning with bureau term. Nowadays the office term is using in contemporary bureau approach (Varlı, 2004). For the thesis, the main description of the bureau is working places where there are editorial and administrative departments; the builts of the bureau satisfy the expectations of bureau necessities, office builts (Hasol, 1979). The thesis has matched the "*office"* term to explain municipality administrative buildings.

According to the economic or managerial classification of office buildings, two main branches have been existed namely administrative office buildings and commercial office buildings. Administrative office buildings have serviced commerce, industry, cultural or political jobs. Additionally, administrative office buildings have been divided into public and private buildings (Eldem, 1950). Commercial office buildings have not had specific programs for any business segment but had the necessary indoor air quality to work and can be rentable zone by zone (Varlı, 2004).

The aim of office buildings is giving a sustainable work life with comfortable, humanist, and healthy circumstances. As seen in Table 3, municipality buildings have been classified under the public office buildings branch as a local government building. Therefore, the thesis has been trying to achieve office's aim investigated by energy efficiency issue upon municipality buildings.

Table 3. Office Building Types (Varlı, 2004)

OFFICE BUILDINGS

PUBLIC BUILDINGS	PRIVATE BUILDINGS
1.Goverment Administrative Office Building	1. Bank Buildings
-Ministry Buildings	- Head Office Buildings
-Assistant Instution Buildings	2. Industrial Administrative Building
*National Security Council	- Press Buildings
*Council Of State	- Factory Buildings
*Court Of Accounts	-etc.
*State Planning Organization	3.Commercial Administrative Buildings
-Central Government Offices	
-Embassy Buildings	
2. Local Government Buildings	
-**Municipality Buildings**	
- Village Administration Buildings	
3. Public Utility Buildings	
- University Buildings	
- TRT Buildings	
-Public Vocational Institute Buildings	
*Trade and Industry Chambers	
*Commodity Exchanges	
-Public Economic Organizations	

2.1.1. Departments of Municipality Buildings

Regarding municipality program necessities, there are not enough sources to find optimal area needs of buildings for municipalities. On the other hand, considering previous researches in the literature about municipality buildings; departments have been generally divided into 5 or 6 main titles as dependent on the organization chart of administration. For instance, Akbulut (2005) has searched and classified municipality service departments based on the previous studies about the municipality. He has examined the using municipality buildings as real cases and after devised the below classifications that are divided into main 6 unites:

1-Administrative Departments:

-Mayor of Municipality

-Vice-Presidents of Municipality

-Private Secretariat

2-Developmental Departments:

- Local Planning Authority

- Directorate of Cartography

-Building Control and Housing Department

-Directorate of Real Estate

-Searching, Planning, Coordination Department

3-Productive and Applied Departments:

-Public Works and Engineering

-Cleaning Service

-Park and Park and Gardens Department

-Woodworking department

-Machine Repair and Maintenance Department

4-Managemental Departments:

-Editorial Department

-Human Resources Department

-Department of Legal Affairs

- Information Processing Department

-Council Department

-Financial Service (accounting) Department

5-Socia-Cultural, Educational Departments:

-Civil Defense Department

-Kindergarten Department

-Handicapped Department

-Department of Marriage

-Department of Health and Social Affair

-Veterinary Department

6-Consultancy and Controller Departments:

-Traffic and Municipal Police Department

-City Council (Akbulut, 2005)

However, this classification has been merely given an idea about the variety of departments, but not included space area information. Because of this, the space analysis is one of the priorities for energy efficient design that has been emphasized in the thesis.

The optimizated programs types have been investigated with the help of comparison regulations (standards) and architectural competitions' specifications of municipality buildings. As the focus of this chapter is to show the space requirements for

municipality buildings, one of the final outputs of the thesis promoting the table in the designing process for different kinds of municipality buildings by giving average space needs. The thesis will suggest optimal area needs for municipality administrative buildings based on this classification with regulations.

2.2. Regulations in Turkey: Municipalities and Their Authorities

According to 1580 code of legislation about municipalities, the municipality is a legal entity, which is responsible for arranging, and providinge necessities for the population located within its boundary. Municipalities have numerous duties and responsibilities;

- *To present service for development of place*
- *To present service aimed at house building*
- *To present service public transportation*
- *To build or get bazaar place, pier, bridge built*
- *To give approval and permission for all buildings, maintenance, restoration etc.*
- *In addition, to give punishment after determined the forbidden conditions against the law and local rules.*
- *To establish the educational and cultural buildings such as theater, library, concert hall, etc.*
- *To build shops for wholesale and retail sale*
- *To build municipality guest house, hotels, wedding hall, car parking, cold storage house, bakery, gas station etc. in qualifying conditions*
- ***To build municipality service buildings and similar buildings***
- *To check and give permission to shops and office depends on healthy conditions*
- *To determine water, natural gas, and electric bills producing by municipalities (Çamaş, 2000).*

As explained by the above regulations, municipalities have a responsibility to build their administrative buildings as well as other kind of buildings within their boundaries (Municipality Law, 1930). Obviously, the influence of municipalities is extremely important for public awareness to be an example highlighting energy efficiency.

Regulations have classified municipalities into six main groups depending on the population and how many they have. This study only has consisted of fours;

metropolitan municipalities (Group A), provincial municipalities (Group B), metropolitan district municipalities (Group C), and district municipalities (Group D) (Union of Municipalities of Turkey, 2014). Based on regulations, municipalities have been classified as metropolitan, provincial, district municipalities in the thesis. In the regulations of municipalities as a standard source, the municipality employee needs have been related to municipality program. While assessing, these data have been used to compare with specifications of architectural competitions.

Therefore, the thesis have been based on these standard and regulations. These standards have contained mandatory and optional staff details such as numbers and positions up to municipality class. This employee information shows essential departments in municipality administrative building due to the population and their needs (Apendixes 1-5).

2.2.1. Metropolitan Municipality

According to norms and number of staff in the municipality, the class of metropolitan municipalities has been named Group A (A1 to A6). The main differences are numbers of staff and some department needs of municipalities changing due to population ratio (Union of Municipalities of Turkey, 2014). Appendix 1 illustrates the mandatory staff for metropolitan municipalities. The optional staff can be chosen from (I) numbered list (Appendix 2), (Union of Municipalities of Turkey, 2014). According to Appendixes of the regulation, the details about department standards are clear. (Appendix 5)

2.2.2. Provincial Municipality

The provincial municipalities are in Group B in norms and staff regulations (B1 to B8). These municipalities have differed than metropolitans in terms of mandatory departments such as editorial, environmental protection, etc. (Union of Municipalities of Turkey, 2014). Appendix 3 illustrates the mandatory staff for provincial municipalities. The optional staff can be chosen from (III) numbered list (Appendix 4), (Union of Municipalities of Turkey, 2014).

2.2.3. District Municipality

The district municipalities are in C and D group; the Group C is metropolitan district municipalities, Group D is district municipalities. Appendix 5 illustrates the mandatory staff for district municipalities. Also, the optional staff can be chosen from (III) numbered list (Appendix 4) likewise provincial municipalities (Union of Municipalities of Turkey, 2014).

Summarizing regulations, the number of employee norms have guided to classify departments for compariring specifications. From metropolitan to district municipality regulation details have shown that the mandatory department number is decreasing despite an increasing number of optional departments. Inaccordance with this, the needs of inhabitants affect program design regarding standards and regulations.

2.3. Programs of Municipality Buildings in Architectural Competitions

Architectural competitions are used in a widespread manner to find the best approach. If we look through the municipality programs, architectural competitions help to find out proposed area needs. Besides that, architectural competitions are a standard method in Turkey of designing and constructing municipality buildings. Therefore, the thesis has analyzed 22-municipality building's programs chosen by architectural competitions during 1985-2015. Based on the previous chapters, the program investigations have classified as three main titles; metropolitan, provincial, district municipality buildings. The total distribution of the 22 buildings is as follows; 5 metropolitan, 5 provincial and 12 district municipality buildings (Regulations, n/a; Aykutlar, 2016). The space needs and comparison have been shown on Table 5, 7, 9.

2.3.1. Metropolitan Municipality Buildings

According to the analysis, metropolitan municipality buildings belong to Tekirdağ (2015), İstanbul (2001), Ankara (2000), Gaziantep (1986), Ankara (1985). Ankara is the capital of Turkey and one of the three biggest cities in Turkey, likewise İstanbul.

Ankara and İstanbul have become metropolitan cities in 1984 by 3030 code of legislation. Then Gaziantep has become a metropolitan city in 1987 depends on 3398 code of legislation. The last city, Tekirdağ has become a metropolitan city by 6360 code of legislation in 2011. Therefore, all these cities have been investigated in the metropolitan classification (Regulations 1, n/a).

Table 4. Summary of Metropolitan Municipality Building Features

Year	Group of Municipality	Name of the Project	Number of Population	Total Project Area (m2)	Building Area (m2)
2011	A-1 (0-999 999)	Tekirdağ	1157	874.475	520.000
2005	A-6 (greater than 7 500 000)	İstanbul	4535	10.033.480	240.512
2005	**A-5** (5 000 000-7 499 999)	Ankara	3721	4.007.860	131.062
1996	**A-2** (1 000 000-1 999 999)	Gaziantep	1319	1.844.438	23.273
1992	**A-5** (5 000 000-7 499 999)	Ankara	2.485	3.306.327	85.563

Table 5. Program Comparison of Metropolitan Municipality Building (Competition Specification, n.d.)

METROPOLITAN MUNICIPALITY BUILDINGS		2015	2001	2000	1986	1985	Sum of total Areas	building number	AVERAGE AREA of Program	Existence Ratio
		TEKİRDAĞ	İSTANBUL	ANKARA	GAZİANTEP	ANKARA				
Departments on STANDARDS	**Departments on PROGRAM**	48808,00	54998	31706	12952	23558	172022	5	**34404,40**	5/5
	Entrance	480,00					480	1	**480,00**	1/5
Directorate	Directorate	240,00	270	248	436	305	1499	5	**299,80**	5/5
Private Secretariat	Private Secretariat	265,00	270	104	184	39	862	5	**172,40**	5/5
Office Of Secretary General	Office Of Secretary General	320,00	228	512	184	864	2108	5	**421,60**	5/5
	Consultancy	190,00		408			598	2	**299,00**	2/5
Supervisory Board	Supervisory Board	335,00	1008	704	96	396	2539	5	**507,80**	5/5
	Municipal Council Hall	1040,00	2508	1912	624	364	6448	5	**1289,60**	5/5
	Committee Hall	100,00	456	384	288	192	1420	5	**284,00**	5/5
Human Resources Department	Human Resources Department/Personnel Directorate	600,00	912	832	168	1060	3572	5	**714,40**	5/5
Public İnformation Agency	Public Information Agency	380,00	300	720	272	520	2192	5	**438,40**	5/5
Municipal Police	Municipal Police	990,00	3300	1032	392	96	5810	5	**1162,00**	5/5
Environmental Protection And Control	Environmental Protection / Cleaning Service	1130,00	1584	2328	200		5242	5	**1048,40**	5/5
Public Works And Engineering	Department Of Public Works And Engineering	60,00	2472	7270	744	2372	12918	5	**2583,60**	5/5
Editorial Department	Editorial Department	680,00	306	552	396	676	2610	5	**522,00**	5/5
Department Of Legal Affairs	Department Of Legal Affairs	465,00	1536	472	152	432	3057	5	**611,40**	5/5
Information Processing Directorate	Information Processing Directorate	1025,00	1578	712	112	80	3507	5	**701,40**	5/5
Local Planning Authority	Local Planning Authority	1735,00	5440	3148	632	2848	13803	5	**2760,60**	5/5
Financial Services	Financial Services (Account Affairs +Economics)	1300,00	3384	3000	1300	1872	10856	5	**2171,20**	5/5
Support Services	Support Services	740,00	2388	856	88	1612	5684	5	**1136,80**	5/5
License And Supervision	License And Supervision									
	Purchase And Tender Administrative Affairs									
Cultural And Social Affairs	Cultural, Educational And Social Affairs & Social Services	1400,00	492	2856	96	780	5624	5	**1124,80**	5/5
Plan And Project	Mapping And Planning, Plan And Project		1738	392	336	384	2850	5	**570,00**	5/5
Strategy Development	Searching-Planning-Coordination, Strategy Development	500,00	508	1112	136	1008	3264	5	**652,80**	5/5
Directorate Of Real Estate	Directorate Of Real Estate	490,00	3396	1608	168	1222	6884	5	**1376,80**	5/5
Urban Design	Urban Renewal-New &Squatter Settlement	860,00	1794		120	144	2918	5	**583,60**	5/5
Traffic And Accessibility	Road Maintenance And Repair	1715,00	492	192		120	2519	4	**629,75**	4/5
Municipal Health Services	Municipal Health Services						9502	5	**1900,40**	5/5
Veterinary	Veterinary	1800,00	1296	3000	400	3006				
Cemeteries	Cemeteries									
Fire Department	Fire Department	355,00	1362	224		4118	6059	5	**1211,80**	5/5
	General Facilities	3495,00	126	22154	4684		30459	4	**7614,75**	4/5
	General Archive	3000,00		3500	360	2500	9360	4	**2340,00**	4/5
	Dining Hall	1000,00	3070	3272	980	1844	10166	5	**2033,20**	5/5
	Prayer Room	100,00	150	300		300	850	4	**212,50**	4/5
	Blueprint And Copy Room	50,00	400	584		168	1202	4	**300,50**	4/5
	Technical Room	3495,00	10000	6000	602		20097	4	**5024,25**	4/5
	Circulation Areas	13945,00	90192	53968	9066	34647	201818	5	**40363,60**	5/5
	Social And Cultural Spaces	1720,00	4056	2850	1672	7906	18204	5	**3640,80**	5/5
	Kindergarten	200,00	1816			3734	5750	3	**1916,67**	3/5
	Multi-Purpose Hall	1520,00	2240	2850	1200	2636	10446	5	**2089,20**	5/5
	Technical Services									
	Close Car Parking	4000,00	54000	400	1000	2500	61900	5	**12380,00**	5/5
	Open Car Parking	1000,00				400	1400	2	**700,00**	2/5
	Shelter	2213,00	21000				23213	2	**11606,50**	2/5
	Phone Santral	120,00	200	220	64	220	824	5	**164,80**	5/5
		LEGEND	**MANDATORY DEPARTMENT**		**OPTIONAL DEPARTMENT**					

2.3.2. Provincial Municipality Buildings

The population data of cities has been determined by TUIK (Turkey Statistic Corporation) in 2011 and the new legislations has been accepted regarding approval of new metropolitan cities in 2012. According to this, Manisa, Trabzon, and Aydın have become metropolitan municipalities in 2012. However, the competitions of these municipalities have been done before 2012. Therefore, these municipalities have been assumed as provincial in the municipality classification table. The chronological range is as follows; Manisa (2011), Manisa (2005), Karabük (2005), Trabzon (1996), Aydın (1992) (Regulations 2, n/a).

Table 6. Summary of Provincial Municipality Building Features

Year	Group Of Municipality	Name Of The Project	Number Of Population	Total Project Area (m2)	Building Area (m2)
2011	A-2(1.000.000-1.999.999)*	Manisa	1.340.074	82517	9560
2005	A-2(1.000.000-1.999.999)*	Manisa	1.319.920	17226	17226
2005	B-4(150.000-199.999)	Karabük	105.159	15384	7189
1996	A-1(0-999.999)*	Trabzon	975.137 (2000)	9445	6295
1992	A-2(1.000.000-1.999.999)*	Aydın	824.816 (1990)	17233	6295

*Manisa, Trabzon and Aydın Municipalities became Metropolitan Municipalities after 2011. So these municipalities were considered as provincial municipalities.

Table 7. Program Comparison of Provincial Municipality Building (Competition Specification, n.d.)

PROVINCIAL MUNICIPALITY BUILDINGS		2011	2005		1996	1992	Sum of total Areas	building number	AVERAGE AREA NEEDS	Existence Ratio
		Manisa	Manisa	Karabük	Trabzon	Aydın				
Departments on STANDARDS	**Departments on PROGRAM**	9560	17226	7189	6295	12233	52503	5	**10500,60**	5/5
	Entrance	230	316	200			746	3	**248,67**	3/5
Directorate	Directorate	300	292	152	285	176	1205	5	**241,00**	5/5
Private Secretariat	Private Secretariat	500	176	288	120		1084	4	**271,00**	4/5
Office Of Secretary General	Office Of Secretary General	210	96	126	170	48	650	5	**130,00**	5/5
Consultancy	Consultancy	100	80	72	85		337	4	**84,25**	4/5
Supervisory Board	Supervisory Board	60	72	32	60	72	296	5	**59,20**	5/5
	Municipal Council Hall	750	646	418	240	438	2492	5	**498,40**	5/5
	Committee Hall	60	120	96	140	160	576	5	**115,20**	5/5
Human Resources Department	Human Resources Department/Personnel Directorate	105	120	64	100	168	557	5	**111,40**	5/5
Public İnformation Agency	Public Information Agency	165	120	96	135	44	560	5	**112,00**	5/5
Municipal Police	Municipal Police	230	136	360	290	172	1188	5	**237,60**	5/5
Environmental Protection	Environmental Protection / Cleaning Service	160	136	48		76	420	4	**105,00**	4/5
Public Works And Engineering	Department Of Public Works And Engineering	530	712	104	220	662	2228	5	**445,60**	5/5
Editorial Department	Editorial Department	125	120	96	175	148	664	5	**132,80**	5/5
Department Of Legal Affairs	Department Of Legal Affairs	165	104	64	90	84	507	5	**101,40**	5/5
Information Processing Directorate	Information Processing Directorate	300	208	120	100	100	828	5	**165,60**	5/5
Local Planning Authority	Local Planning Authority	430	776	628	340	662	2836	5	**567,20**	5/5
Financial Services (Accounting)	**Financial Services (Accounting)**	185	688	600	770	1144	3387	5	**677,40**	5/5
	Account Affairs		296	160	190	904	1550	4	**387,50**	4/5
	Economics		56	80	110	132	378	4	**94,50**	4/5
Support Services	**Support Services**	275	568	64	285	76	1268	5	**253,60**	5/5
License And Supervision	License And Supervision				155		155	1	**155,00**	1/5
	Purchase And Tender	110	384	64			558	3	**186,00**	3/5
	Administrative Affairs		184		130	76	390	3	**130,00**	3/5
Cultural Social Affairs	Cultural, Educational And Social Affairs & Social Services	270	72	72	265	48	727	5	**145,40**	5/5
Plan And Project	Mapping And Planning, Plan And Project	625	432		185	464	1706	4	**426,50**	4/5
Strategy Development	Searching-Planning-Coordination, Strategy Development		104		170	44	318	4	**79,50**	4/5
Directorate Of Real Estate	Directorate Of Real Estate	385	336		375		1096	3	**365,33**	3/5
Urban Design	Urban Renewal-New &Squatter Settlement			136			136	1	**136,00**	1/5
Traffic And Accessibility	Road Maintenance And Repair	175	168	80		44	467	4	**116,75**	4/5
Municipal Health Services	**Municipal Health Services**	165	416	280	125	224	1210	5	**242,00**	5/5
Veterinary	Veterinary	25	72			68	165	3	**55,00**	3/5
Cemeteries	Cemeteries		32	64			96	2	**48,00**	2/5
Water And Sewerage Services	Water And Sewerage Services	280	720	288	385	462	2135	5	**427,00**	5/5
Park and Gardens	Park and Gardens	95	120	32		92	339	4	**84,75**	4/5
General Facilities	General Facilities	2040				1392	3432	2	**1716,00**	2/5
Library	Library	490	580	136			1206	3	**402,00**	3/5
	General Achieve	400	416	566	400		1782	4	**445,50**	4/5
	Dining Hall	950	504			320	1774	3	**591,33**	3/5
	Canteen & Cafe	120	96	353		72	641	4	**160,25**	4/5
	Blueprint And Copy Room	200	96	32	50		378	4	**94,50**	4/5
	Technical Room	480	524	358	280	5037	6679	5	**1335,80**	5/5
	Circulation Areas	5736	3913	3595	3150		16394	4	**4098,50**	4/5
	Commercial Service Spaces	1000	22000	500	2000		25500	4	**6375,00**	4/5
Kindergarten	Kindergarten	410	400	288		28	1126	4	**281,50**	4/5
Sport Management	Sport Management	500	400				900	2	**450,00**	2/5
	Close Car Parking	45700	1500	3500	2000	4000	56700	5	**11340,00**	5/5
	Open Car Parking	375				1000	1375	2	**687,50**	2/5
	Shelter	1277	685	600			2562	3	**854,00**	3/5

2.3.3. District Municipality Buildings

District municipalities have two classifications, namely metropolitan district municipalities and district municipality buildings. According to standards, these two have been C and D group of municipalities, respectively. In the thesis, 12 district municipality buildings have been investigated which are İzmir-Konak (2015), İzmir-Bornova (2015), Antalya-Gazipaşa (2013), Adana-Çukurova (2011), Osmaniye-Kadirli (2009), Diyarbakır-Yenişehir (2005), İstanbul-Pendik (2005), Eskişehir-Tepebaşı (2004), Kocaeli-Derince (1997), Ankara-Çankaya (1995), Kayseri-Kocasinan (1991), Ankara-Altındağ (1986).

Table 8. Summary of District Municipality Building Features

Year	Group Of Municipality	Name of The Project	Number of Population	Total Project Area (m2)	Building Area (m2)
2015	C-15 (600 000-699 999)	İzmir-Konak	380.295	22.115	14.226
2015	C-16 (700 000-799 999)	İzmir-Bornova	431.149	60.055	27.555
2013	C-15 (600 000-699 999)	Antalya-Gazipaşa	48.561	9.885	3.535
2011	C-15 (600 000-699 999)	Adana-Çukurova	271.344 (2008)	16.160	11.830
2009	D-14 (150.000-174.999)	Osmaniye-Kadirli	114.476	6.766	2.732
2005	C-13 (400 000-499 999)	Diyarbakır-Yenişehir	186.901 (2008)	8.988	4.532
2005	C-18 (900 000-999 999)	İstanbul-Pendik	520.486 (2007)	14.155	10.485
2004	C-15 (600 000-699 999)	Eskişehir-Tepebaşı	271.732 (2008)	14.499	6.892
1997	C-11 (250 000–299 999)	Kocaeli-Derince	97.283 (2000)	17.233	1.2233
1995	C-19(1.000.000 and more)	Ankara-Çankaya	769.331 (2000)	44.200	12.900
1991	C-15 (600 000-699 999)	Kayseri-Kocasinan	282.883 (1990)	9.912	9.912
1985	C-15 (600 000-699 999)	Ankara-Altındağ	650.000	23.466	22.216

Table 9. Program Comparison of District Municipality Building (Competition Specification, n.d.)

DISTRICT MUNICIPALITY BUILDINGS		2015 İzmir Konak	2015 İzmir-Bornova	2013 Antalya Gazipaşa	2011 Adana Çukurova	2009 Osmaniye Kadirli	2005 Diyarbakır Yenişehir	2005 İstanbul Pendik	2004 Eskişehir Tepebaşı	1997 Kocaeli Derince	1995 Ankara Çankaya	1991 Kayseri Kocasinan	1986 Ankara Altındağ	Sum of total Areas	building number	AVERAGE AREA NEEDS	Existence Ratio
Departments of STANDARDS	**Departments of PROGRAM**	14226	27555	3535	11.830	2732	4532	10485	6892	12233	12900	9912	22216	139048	12	**11587,33**	12/12
	Entrance	192	670	270		112	200	276	200			150	150	2220	9	**246,67**	9/12
Directorate	Directorate	262	250	130	184	128	152	170	184	176	300	200	200	2336	12	**194,67**	12/12
Private Secretariat	Private Secretariat	560	520	100	384	96	136	400	176		250	456	256	3334	11	**303,09**	11/12
Office Of Secretary General	Office Of Secretary General	172	190	15	188	68	112	144	120	48	150	56	88	1351	12	**112,58**	12/12
	Consultancy				216	48	64	168	120		250		168	1034	7	**147,71**	7/12
Supervisory Board	Supervisory Board	214	110	20	244	32	32		32	72			160	916	9	**101,78**	9/12
	Municipal Council Hall	492	700	350	506	256	420	484	664	438	1400	926	984	7620	12	**635,00**	12/12
	Committe Hall	72	60		96	48	64	60	112	160	250	208	256	1386	11	**126,00**	11/12
Human Resources Department	Human Resources Department/Personnel Directorate	168	165		144	56	64	70	64	168	700	320	632	2551	11	**231,91**	11/12
Public İnformation Agency	Public İnformation Agency	521	310	50	160	88	112	206	112	44	250	182	248	2283	12	**190,25**	12/12
Municipal Police	Municipal Police	238	195	80	232	112	216	322	328	172	500	256	472	3123	12	**260,25**	12/12
Cleaning Service Environmental Protection And Control	**Environmental Protection / Cleaning Service**	96	270	60	172	16	48	100	84	76	150	144	208	1424	12	**118,67**	12/12
Public Works And Engineering	Department Of Public Works And Engineering	410	265	165	296	112	64	266	96	662	500	432	600	3868	12	**322,33**	12/12
Editorial Department	Editorial Department	152	155	85	144	80	96	90	112	148	250	288	344	1944	12	**162,00**	12/12
Department Of Legal Affairs	Department Of Legal Affairs	278	245	65	176	32	40	120	56	84	300	208	208	1812	12	**151,00**	12/12
İnformation Processing Directorate	İnformation Processing Directorate	228	335	20	152	80	96	220	96	100	300	192	208	2027	12	**168,92**	12/12
Local Planning Authority	Local Planning Authority	666	545	185		288	368	208	608	662	2500	1096		7126	10	**712,60**	10/12
Building Control	Building Control	304	265		148			80					1304	2101	5	**420,20**	5/12
Financial Services (Accounting)	**Financial Services (Accounting)**	1098	305	105	484	196	368	525	632	1144	2700	768	1424	9749	12	**812,42**	12/12
	Account Affairs						96	120	164	904	2500	768	1072	5624	7	**803,43**	7/12
	Revenue						208	425	372	60				1065	4	**266,25**	4/12
	Economics					66				132	200		352	750	3	**250,00**	3/12
Support Services	**Support Services**	416	390		264	66		360	96	76	3400	184	664	5916	10	**591,60**	10/12
License And Supervision	License And Supervision	206	215		120						200		208	949	4	**237,25**	4/12
	Purchase And Tender					56		150			200		208	614	3	**204,67**	3/12
	Administrative Affairs							210	96	76	150	184	248	964	6	**160,67**	6/12
Cultural Social Affairs	Cultural, Educational And Social Affairs & Social Services		455		224	32		270		240	200	368	536	2325	8	**290,63**	8/12
Plan And Project	Mapping And Planning, Plan And Project	414	265					312		464				1455	4	**363,75**	4/12
Strategy Development	Searching-Planning-Coordination, Strategy Development	96	105		100	32		220		44	200	256	272	1325	9	**147,22**	9/12
Directorate Of Real Estate	Directorate Of Real Estate	176	225		280			90			400	240	328	1739	7	**248,43**	7/12
Urban Design	Urban Renewal-New &Squatter Settlement	192	175								150			517	3	**172,33**	3/12
Traffic And Accessibility	Road Maintenance And Repair		115		84		48		64	44				355	5	**71,00**	5/12
Municipal Health Services	**Municipal Health Services**		235			160	96	320	192	224	450	344	416	2437	9	**270,78**	9/12
Veterinary	Veterinary		50					70		68	150	128	184	650	6	**108,33**	6/12
Cemeteries	Cemeteries					16								16	1	**16,00**	1/12
Water And Sewerage Services	Water And Sewerage Services	196	190	90	24	64	64	46	112	554	300	232	328	2200	12	**183,33**	12/12
General Facilities	General Facilities		165							1392	350		3180	5087	4	**1271,75**	4/12
Agricultural Services	Agricultural Services		75											75	1	**75,00**	1/12
Library	Library	74	50	50		64	120	90	120			232		800	9	**88,89**	9/12
Social Studies And Projects	Social Studies And Projects	248	365											613	2	**306,50**	2/12
Municipal Foreign Affairs Office	Municipal Foreign Affairs Office	80	75											155	2	**77,50**	2/12
Theater	Theater		50											50	1	**50,00**	1/12
	Civil Defense	24	20				32		32		75			183	5	**36,60**	5/12
	Reserve Department	290	300			64	160	500	240					1554	6	**259,00**	6/12
	General Achieve	2078	3000	400	1000	112	216	1200	316		2000	370	720	11412	11	**1037,45**	11/12
	Dining Hall	750				184		700	498	320	1500	500	1142	5594	9	**621,56**	9/12
	Canteen & Cafe		120				264			40	150	100	110	784	6	**130,67**	6/12
	Blueprint And Copy Room		290	265	210	64	32	100	32		100	48	400	1541	10	**154,10**	10/12
	Technical Room	750	1500	250	616	350	240	168	272	632	1200	412	250	6640	12	**553,33**	12/12
	Circulation Areas	4415	8525	1000	4436	2000	2266	3670	2757	5037			9148	43254	10	**4325,40**	10/12
Kindergarten	Kindergarten			200		128	288		288	28				932	5	**186,40**	5/12
Sport Management	Sport Management	200	125											325	2	**162,50**	2/12
	Multi-Purpose Hall		250	600		1048	320		700	500	450	500	600	4968	8	**621,00**	8/12
	Close Car Parking	3750	15000	1800	750	250	1600	2900	3500	4000	8000	625	1250	43425	12	**3618,75**	12/12
	Shelter	711	900	350	750	322	340	707	350					4430	8	**553,75**	8/12
	General Storages	600	500	200	100							250	200	1850	6	**308,33**	6/12
		LEGEND	MANDATORY		OPTIONAL												

2.4. Evaluation of Program Comparisons

Assessment results have shown that the regulations match with specifications regarding the mandatory and optional department, although the name of departments vary between regulations and specifications. However, the mandatory departments have existed almost half of the specified program. The main reason of this is to differ departments depending on the social and cultural needs of the local population on the contrary common obligatory needs.

The number of department increase when looking from metropolitan to districts by examined mandatory and optional units. The reason for this is that requirements increase and change depending on the responsibility of municipality and social life of the population. Metropolitan municipalities have more general responsibility than districts by keeping some boundaries against to requirements that are more detailed. The options should be more on small scales than large ones to solve problems and to serve better. Even if the department variety is less, the required space areas are larger in metropolitan because of the needs of the employee to serve a crowded population.

Except for the mandatory,

- Metropolitan municipality buildings have general archives, dining halls, prayer rooms, blueprint & copy rooms, multi-purpose halls and close parking areas at a rate of 80%-100%;
- Provincial municipality buildings have general archives, dining halls, canteen & cafés, blueprint & copy rooms, kindergartens, commercial service areas and close parking areas at a rate of 80%-100%;
- District municipality buildings have general archives, reserve departments, blueprint & copy rooms, multi-purpose halls and close parking areas at a rate of 60%-100%.

Considering this, we can ascertain that each type of municipality building needs on average 34,404 m^2 area for a metropolitan municipality building, 10,500 m^2 area for a provincial municipality building, 11,587 m^2 area for a district municipality buildings as seen below in Table 10,11,12.

Additionally, this study has provided the average square meters per person who lives within the region of each municipality types by means of using population number.

Main administrative municipality buildings have 0,33 m^2 area per person for metropolitan; 0,02 m^2 area per person for provincial; 0,07 m^2 area per person for the district. As a result, district municipalities have more space per person in their buildings despite having less population. When explaining this, according to the areas of responsibility in metropolitan regions (which are broader than others) and also contain other's area of responsibility, these results make sense as districts are in the lowest level regarding municipal work.

In Summary, Turkey has minimum 1443 municipality buildings, of which 30 metropolitans, 51 provincials, 534 metropolitan districts, 795 district, and 33 subsidiary municipalities according to source *"Union of Municipalities of Turkey"* (Union of Municipalities of Turkey, 2014). . Considering all of this, municipalities can be an example by having a wide impact on all over Turkey regarding creating sustainable & energy efficient buildings.

As mentioned before, the program design is the most significant instrument for taking precautions against consuming excess energy in the early design stage. Therefore, **optimal space requirements have been given for each type of municipality based on the classification of regulations. (Table 10, 11, 12). According to these tables, Chapter 5 has been evaluated on the case building study to obtain an example ideal model for further studies.**

Table 10. Metropolitan Municipality Building Program (*based on the regulations of standard employee needs)

Metropolitan Municipality Buildings		**Total Area**	**Evaluated Building**	**Mean Area**
***Standard Departments**	**Specification Program Departments**	170202	5	**34404,44**
Directorate	Directorate	1499	5	**299,80**
Private Secretariat	Private Secretariat	862	5	**172,40**
Office of Secretary	Office of General Secretary	2108	5	**421,60**
Supervisory Board	Supervisory Board	2539	5	**507,80**
Human Resources	Human Resources	3572	5	**714,40**
Public Information Agency	Public Information Agency	2192	5	**438,40**
Municipal Police	Municipal Police	5810	5	**1162,00**
Environmental Protection	Environmental Protection	5242	5	**1048,40**
Works & Engineering	Public Works & Engineering	12918	5	**2583,60**
Editorial Department	Editorial Department	2610	5	**522,00**
Legal Affairs	Legal Affairs	3057	5	**611,40**
ICT	Information and Communication Technology	3507	5	**701,40**
Local Planning	Local Planning Authority	13803	5	**2760,60**
Financial Services	Financial Services	10856	5	**2171,20**
Support Services	Support Services	5684	5	**1136,80**
Cultural & Social Affairs	Cultural &Social Affairs	5624	5	**1124,80**
Plan And Project	Plan And Project	2850	5	**570,00**
Strategy Development	Searching-Planning-Coordination	3264	5	**652,80**
Real Estate	Directorate Of Real Estate	6884	5	**1376,80**
Urban Design	Urban Renewal	2918	5	**583,60**
Traffic And Accessibility	Road Maintenance And Repair	2519	4	**629,75**
Municipal Health Services	Municipal Health Services	9502	5	**1900,40**
Fire Department	Fire Department	6059	5	**1211,80**
	General Facilities	30459	4	**7614,75**
	General Archive	9360	4	**2340,00**
	Dining Hall	10166	5	**2033,20**
	Prayer Room	850	4	**212,50**
	Blueprint And Copy Room	1202	4	**300,50**
	Technical Room	20097	4	**5024,25**
	Social And Cultural Spaces	18204	5	**3640,80**
	Multi-Purpose Hall	10446	5	**2089,20**
	Close Car Parking	61900	5	**12380,00**
	Shelter	23213	2	**11606,50**
	Municipal Council Hall	6448	5	**1289,60**
	Committee Hall	1420	5	**284,0**

Table 11. Provincial Municipality Building Program (*based on the regulations of standard employee needs)

Provincial Municipality Buildings		**Total Area**	**Evaluated Building**	**Mean Area**
***Standard Departments**	**Specification Program Departments**	52503	5	**10500,60**
Directorate	Directorate	1205	5	**241,00**
Private Secretariat	Private Secretariat	1084	4	**271,00**
Office of Secretary	Office of General Secretary	650	5	**130,00**
Consultancy	Consultancy	337	4	**84,25**
Supervisory Board	Supervisory Board	296	5	**59,20**
Human Resources	Human Resources Department	557	5	**111,40**
Public Information Agency	Public Information Agency	560	5	**112,00**
Municipal Police	Municipal Police	1188	5	**237,60**
Environmental Protection	Environmental Protection	420	4	**105,00**
Works & Engineering	Public Works And Engineering	2228	5	**445,60**
Editorial Department	Editorial Department	664	5	**132,80**
Legal Affairs	Legal Affairs	507	5	**101,40**
ICT	Information and Communication Technology	828	5	**165,60**
Local Planning Authority	Local Planning Authority	2836	5	**567,20**
Financial Services	Financial Services (Accounting)	3387	5	**677,40**
Support Services	Support Services	1268	5	**253,60**
License And Supervision	License And Supervision	155	1	**155,00**
Cultural Social Affairs	Cultural, Educational &Social Affairs	727	5	**145,40**
Plan And Project	Plan And Project	1706	4	**426,50**
Strategy Development	Searching-Planning-Coordination	318	4	**79,50**
Directorate of Real Estate	Directorate of Real Estate	1096	3	**365,33**
Urban Design	Urban Renewal	136	1	**136,00**
Traffic and Accessibility	Road Maintenance and Repair	467	4	**116,75**
Municipal Health Services	Municipal Health Services	1210	5	**242,00**
Veterinary	Veterinary	165	3	**55,00**
Cemeteries	Cemeteries	96	2	**48,00**
Water And Sewerage	Water And Sewerage	2135	5	**427,00**
Park and Gardens	Park and Gardens	339	4	**84,75**
General Facilities	General Facilities	3432	2	**1716,00**
Library	Library	1206	3	**402,00**
Kindergarten	Kindergarten	1126	4	**281,50**
Sport Management	Sport Management	900	2	**450,00**
	General Archive	1782	4	**445,50**
	Canteen & Cafe	641	4	**160,25**
	Blueprint And Copy Room	378	4	**94,50**
	Technical Room	6679	5	**1335,80**
	Circulation Areas	16394	4	**4098,50**
	Commercial Service Spaces	25500	4	**6375,00**
	Close Car Parking	56700	5	**11340,00**
	Municipal Council Hall	2492	5	**498,40**
	Committee Hall	576	5	**115,20**

Table 12. District Municipality Building Program (*based on the regulations of standard employee needs)

District Municipality Buildings		**Total Area**	**Evaluated Building**	**Mean Area**
***Standard Departments**	**Specification Program Departments**	139048	12	**11587,33**
Directorate	Directorate	2336	12	**194,67**
Private Secretariat	Private Secretariat	3334	11	**303,09**
Office Of Secretary General	Office Of Secretary General	1351	12	**112,58**
Supervisory Board	Supervisory Board	916	9	**101,78**
Human Resources Department	Human Resources Department	2551	11	**231,91**
Public Information Agency	Public Information Agency	2283	12	**190,25**
Municipal Police	Municipal Police	3123	12	**260,25**
Cleaning Service	Environmental Protection	1424	12	**118,67**
Public Works & Engineering	Public Works And Engineering	3868	12	**322,33**
Editorial Department	Editorial Department	1944	12	**162,00**
Legal Affairs	Legal Affairs	1812	12	**151,00**
ICT	Information Communication Technology	2027	12	**168,92**
Local Planning Authority	Local Planning Authority	7126	10	**712,60**
Building Control	Building Control	2101	5	**420,20**
Financial Services	Financial Services (Accounting)	9749	12	**812,42**
Support Services	Support Services	5916	10	**591,60**
License And Supervision	License And Supervision	949	4	**237,25**
Cultural Social Affairs	Cultural, Educational & Social Affairs	2325	8	**290,63**
Plan And Project	Plan And Project	1455	4	**363,75**
Strategy Development	Searching-Planning-Coordination	1325	9	**147,22**
Real Estate	Directorate of Real Estate	1739	7	**248,43**
Urban Design	Urban Renewal	517	3	**172,33**
Traffic and Accessibility	Road Maintenance and Repair	355	5	**71,00**
Municipal Health Services	Municipal Health Services	2437	9	**270,78**
Veterinary	Veterinary	650	6	**108,33**
Water And Sewerage Services	Water And Sewerage Services	2200	12	**183,33**
General Facilities	General Facilities	5087	4	**1271,75**
Library	Library	800	9	**88,89**
Social Studies and Projects	Social Studies and Projects	613	2	**306,50**
Kindergarten	Kindergarten	932	5	**186,40**
	Consultancy	1034	7	**147,71**
	General Archive	11412	11	**1037,45**
	Dining Hall	5594	9	**621,56**
	Blueprint And Copy Room	1541	10	**154,10**
	Technical Room	6640	12	**553,33**
	Multi-Purpose Hall	4968	8	**621,00**
	Close Car Parking	43425	12	**3618,75**
	Municipal Council Hall	7620	12	**635,00**
	Committee Hall	1386	11	**126,00**

CHAPTER THREE
CURRENT PROGRAM DESIGN AND ENERGY PERFORMANCE of MUNCICIPALTY BUILDINGS in IZMIR

In this chapter, the existing situation of İzmir's District Municipality Buildings has been assessed regarding energy consumption. To achieve the energy efficiency level as consumption in the building initially a standard should have been to limit it. Therefore, aims of this chapter are to obtain (1) a building program approach and (2) energy performance of existing situation in İzmir. Related to that, the goal is to set the limit for energy consumption as electricity, water, solid fuel, natural gas. By means of this chapter, lack of the energy consumption limit and threshold values could be acquirable for İzmir case in literature.

A questionnaire survey has been used for the analysis of İzmir's municipality building program and energy performance with the help of personal contact. The questionnaire has included building construction, mechanical, electrical system details, and energy consumption bills data for this chapter. The summary of Chapter 3 method:

- The municipalities have been visited to collect detailed building program and energy consumption bills. The mayors, vice mayors and technical personals have shared these data.
- After data collection, existing municipality buildings has been compared with standards related to the getting program as obtained from Chapter 2 outputs.
- Annual electricity consumption has been consolidated for obtaining threshold values and the average limit, especially for district municipality buildings in İzmir. Due to the missing energy consumption bills for natural gas, solid fuel and water consumption, the total energy consumption value could not be given.

The literature has been reviewed regarding office buildings that are concerned about energy efficiency studies. Main outputs of the review have been general approaches of government office building, total annual energy consumption of office buildings, energy consumption limits for offices and using simulation tools.

The existing situation of energy consumption in İzmir's municipality building has been searched by using questionnaire with the municipality employees who are in charge of energy consumptions. Both Zheng (2016) and Zhao (2009)'s studies have been examples for data collection such as Liu et al (2012)'s study. Liu's methodology for data collection regarding existing condition has been as follows: "*•Building data collection (location, floor area, built year, structure), •Energy consumption measurements (by the help of visiting site and measuring buildings' energy consumption statistics), •Energy audit (in order to determine the weakness of energy consumption management aspects)"*. Therefore, in this study questionnaire has involved the building name, building construction date, construction materials with features, square meter values of building program, HVAC systems, and energy consumptions of the building (Questionnaire). Total eight municipalities have shared the data of total nine buildings and consumptions. Güzelbahçe, Seferihisar, Urla, Gaziemir, Menderes, Buca, Konak and Kemalpaşa municipalities have been chosen depending on having reliable data for this academic study. In this context, this chapter has allowed to have a knowledge about district municipality cases for İzmir.

3.1. Existing District Municipality Buildings in İzmir

This chapter has investigated the existing situation in two main parts, namely the "*program design"* and "*energy consumption"* of İzmir metropolitan district municipality buildings. The program analysis of Chapter 2 have provided the necessities of metropolitan district buildings in particular. The energy consumption analysis have been able to give threshold values as minimum and maximum limits of energy consumption as İzmir in a climate zone as hot and humid summer and warm winter (TS825, 2010).

Aforementioned, the main departments of 9 municipality buildings have been compared with the obtained program guide. These were Güzelbahçe, Seferihisar, Urla, Gaziemir, Menderes, Buca, Konak (2) and Kemalpaşa Municipality Buildings. These buildings have been chosen according to ability to acquire information

properly and easily among 31 metropolitan district municipalities in İzmir. Mayors, vice-mayors and their technical personals of municipalities have been contacted to collect data. Some departments have been charged to keep building drawings and energy consumption data; however, a few municipalities have had reliable data regarding reporting. Especially, many of the municipalities have not not tracked their consumption because of deals with distributers of electricity or water. Therefore, even if we were able to obtain building drawings for some municipalities, we could not successfully obtain consumption data or the vice-versa.

Finally, the energy consumption level has been determined on the similar buildings with the help of energy consumption reports that details electricity, solid fuel, natural gas, water consumptions annually. As aforementioned, energy consumption bills have been used to validation of the threshold values. Moreover, the survey has involved the building information such as building envelope material, HVAC systems due to affecting building energy consumptions directly.

3.1.1. Current Program Design of Municipality Buildings

This chapter has illustrated the inspected buildings programs obtained by comparison with standards depending on the classification of municipalities. The classifications are numbered from one to eighteen, according to the population of the district. According to this analysis, investigated İzmir's municipalities in between C7 and C17 were investigated, as seen details in Table 13. (Union of Municipalities of Turkey, 2014).

Table 13. Classification of Surveyed District Municipalities in İzmir

Parameters		**Building Area**	**Number of Floors**	**Population**	**Municipality Degree**
Name of Municipality	**Unit**	**sqm**		**Number***	**Classification***
Güzelbahçe Municipality		1502	2	27.389	C7
Seferihisar Municipality		2157.5	2	33.588	C8
Urla Municipality		1861	3	56.571	C9
Gaziemir Municipality		14000	6	129.534	C11
Menderes Municipality		1642	4	77.706	C10
Buca Municipality		11862	12	454.112	C16
Konak 1st building		3305	8	385.843	C15
Konak 2nd building		4476,5	8	385.843	C15
Kemalpaşa Municipality		3375,5	2	97.499	C10

With the help of personal contacts and the web page of municipalities, data of departments have been collected for each municipality. However, we were unable to source departments' square meter data due to the missing project drawings of municipality buildings. Therefore, the existing situation is thus; program design chapter has had only the comparison that includes the existence or absence of departments in Table 14. As seen table, the existence ratio has been given to illustrate that which municipality buildings have mandatory and optional departments by comparing regulations (Personal Contacts, 2015).

Table 14. Building Programs of District Municipalities in İzmir

MUNICIPALITY BUILDINGS' PROGRAM in İZMİR CASE	**Classes of municipality degree**	C7	C8	C9	C11	C10	C16	C15		C10	**No of Municipality with departments / Total number of municipality**
	Number of human population	27.389	33.588	56.571	129.534	77.706	454.112	385.843		97.499	
	Name of Municipality	Güzelbahçe	Seferihisar	Urla	Gaziemir	Menderes	Buca	Konak 1st	Konak 2nd	Kemalpaşa	
	Building Area (sqm)	1502	2157.5	1861	14000	1642	15182	3305	4476,5	3375,5	
Standard Departments	**Existing Building Program / Legend**	MANDATORY			OPTIONAL						
Directorate	Directorate	X	X	X	X	X	X	X	X	X	9/9
Supervisory Board/Administration	Supervisory Board/Administration	X	X	X	X	X	X	X	X	X	9/9
Human Resources Department	Human Resources Department	X		X	X	X	X		X	X	7/9
Public Information Agency	Public Information Agency	X	X		X	X	X		X	X	7/9
Municipal Police	Municipal Police	X	X	X	X	X	X		X	X	8/9
Environmental Protection and Control	Environmental Protection and Control		X			X	X		X	X	5/9
Cleaning Service	Cleaning Service	X	X		X	X	X		X	X	7/9
Public Works and Engineering	Public Works and Engineering	X	X	X	X	X	X			X	7/9
Editorial Department	Editorial Department	X	X	X	X	X	X	X	X	X	9/9
Legal Affairs	Legal Affairs	X	X	X	X	X	X		X	X	8/9
Information Communication Technology	Information Communication Technology	X	X	X	X		X			X	6/9
Local Planning Authority	Local Planning Authority	X	X	X	X	X	X			X	7/9
Building Control	Building Control	X	X				X			X	4/9
Financial Services (Accounting)	Financial Services (Accounting)	X	X	X	X	X	X	X		X	8/9
Administrative Affairs	Administrative Affairs	X	X				X				3/9
Support Services	Support Services		X	X	X	X	X			X	6/9
Licence and Supervision	Licence and Supervision	X	X	X		X	X		X	X	7/9
Culture and Social Affairs	Culture and Social Affairs	X	X		X	X	X		X	X	7/9
Social Studies and Projects Department	Social Studies and Projects Department				X		X		X		3/9
Plan and Project	Plan and Project	X	X	X	X		X			X	6/9
Directorate of Real Estate	Directorate of Real Estate	X	X				X			X	4/9
Urban Renewal	Urban Renewal	X	X				X				3/9
Veterinary	Veterinary	X	X				X		X		4/9
Municipal Foreign Affairs Office	Municipal Foreign Affairs Office	X	X				X		X		4/9
Design and Project Department	Design and Project Department	X	X		X	X	X				5/9
Strategy Development	Strategy Development	X	X	X	X		X	X		X	7/9
	Park and Gardens	X	X	X	X	X	X			X	7/9
	Agricultural Services	X	X				X				3/9
	Archieve	X	X	X	X	X	X	X		X	8/9
	Sport Affairs	X	X				X		X		4/9
	Traffic and Accessibility	X	X				X			X	4/9
	Family Services	X	X				X		X		4/9
	Meeting Room	X	X	X	X		X	X	X		7/9
	Car Parking				X		X			X	3/9
	Security	X			X	X	X	X	X	X	7/9
	Healt Center				X		X		X		3/9

3.1.2. Architectural Data of Municipality Buildings

Information from these municipality buildings consists of materials, equipment, HVAC and renewable systems of building in the thesis. Accordingly, scientific studies in the literature have shown that the HVAC undoubtedly has the most significant impact on the energy consumption. Thus, the HVAC and materials of the buildings have been used data to figure out differences between consumptions in the same climate zone as İzmir.

As seen by Table 15, there has been a lack of information on building envelope components and lack of usage renewable energy systems on the building. In order to figure out the differentiation of energy consumption between buildings, data of buildings have been tried to collect completely.

When checking the materials, it could be interpreted that the buildings obviously have the same structure type, namely moment frame & shear wall filled with a brick wall. Some of municipality buildings have had glazing façades such as in Buca, Konak, and Gaziemir. However, for insulation layer could not be obtained a lot of information that is important for reducing heat loss. Regarding the interior lighting equipment, all buildings have been using the fluorescent lighting. Finally, HVAC systems have varied in these buildings, being split air conditioning, VRF, central heating & cooling systems.

As shown in Table 15, Gaziemir municipality building has had almost all details because of attained project drawing by the help of municipality personal. Moreover, the PV panels have been used as renewable energy systems in only that building. Therefore, Gaziemir municipality building has been used to calculate deviation of simulation tool in the fourth chapter.

Table 15. Data Table of Building Material, Equipment, HVAC and Renewable Systems

Parameters		Materials			Equipment	HVAC systems		Renewable Energy Systems
Name of Municipality	type	Brick	Glass	Insulation	Lighting	Heating	Cooling	
Güzelbahçe Municipality		19/13,5/19 cm TS EN 771 – 1	ISICAM 4+12+4 mm	Capatect Dalmaçyalı	Fluorescent	Air-Conditioning		-
Seferihisar Municipality		-unknown-	glass 2+6+2 mm double glass	-unknown-	Fluorescent	Air-Conditioning		-
Urla Municipality		brick-concrete	aluminium frame glass	-unknown-	Fluorescent	Air-Conditioning		-
Gaziemir Municipality		autoclaved aerated concrete wall+ glazing façade	ISICAM 4+12+4 mm with argon gas low-E Glazing Façade	-unknown-	Fluorescent	VRF system-198 items (using natural gas)	Cooling Tower (including drain back system)	Solar energy (PV panels) (a)320 sqm for electricity (b) 100 sqm for mechanical systems
Menderes Municipality		-unknown-	Glass 4mm	-unknown-	Fluorescent	Air-Conditioning		-
Buca Municipality		Brick wall+ glazing façade	-unknown- Glazing Façade	-unknown-	Fluorescent	Central Heating (using natural gas) heating: chiller 140 Fans 16 ceiling fan	Central Cooling Cooling Tower	-
Konak 1st building Konak 2nd building		glazing facade brick wall	-unknown- Glazing Façade	-unknown-	Fluorescent	Central Heating	Central Cooling Chiller Systems	-
Kemalpaşa Municipality		brick wall	12mm single ISICAM	Insulation+ YapıBlok	4x18 fluorescent(1=72watt)	Central Heating split air condition	Central Cooling split air condition	-

3.1.2.1. Municipality Building Locations & Orientations

İzmir is located in the western part of Turkey (Figure 2). As seen Figure 3, eight municipalities have been investigated as nine buildings. Orientation and the type of construction of buildings are obviously different for each municipality building in existing situation. ***As an architectural parameter, the orientation affects energy consumption as an early design parameter.*** Therefore, the site location and orientation have become the first parameter to focus on. Afterward, the construction and materials have an impact on energy consumption. Figure 2, 3, 4, 5 illustrate the location of İzmir in Turkey, municipality location in İzmir, municipality building orientations and building construction and types.

Figure 2. Location of İzmir in Turkey

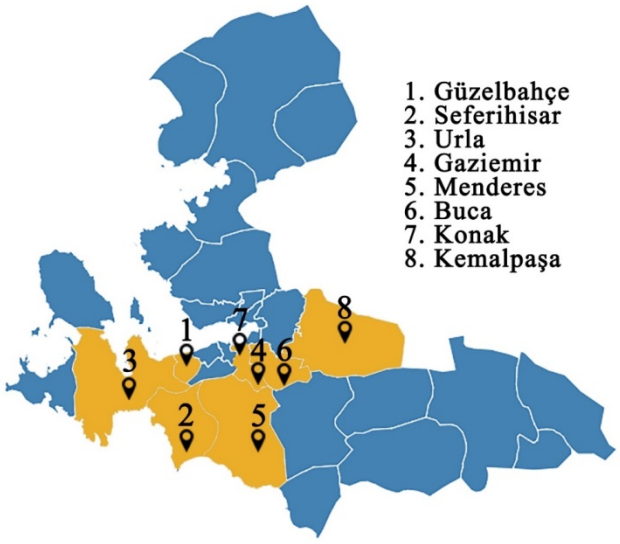


Figure 3. Investigated İzmir's District Municipalities

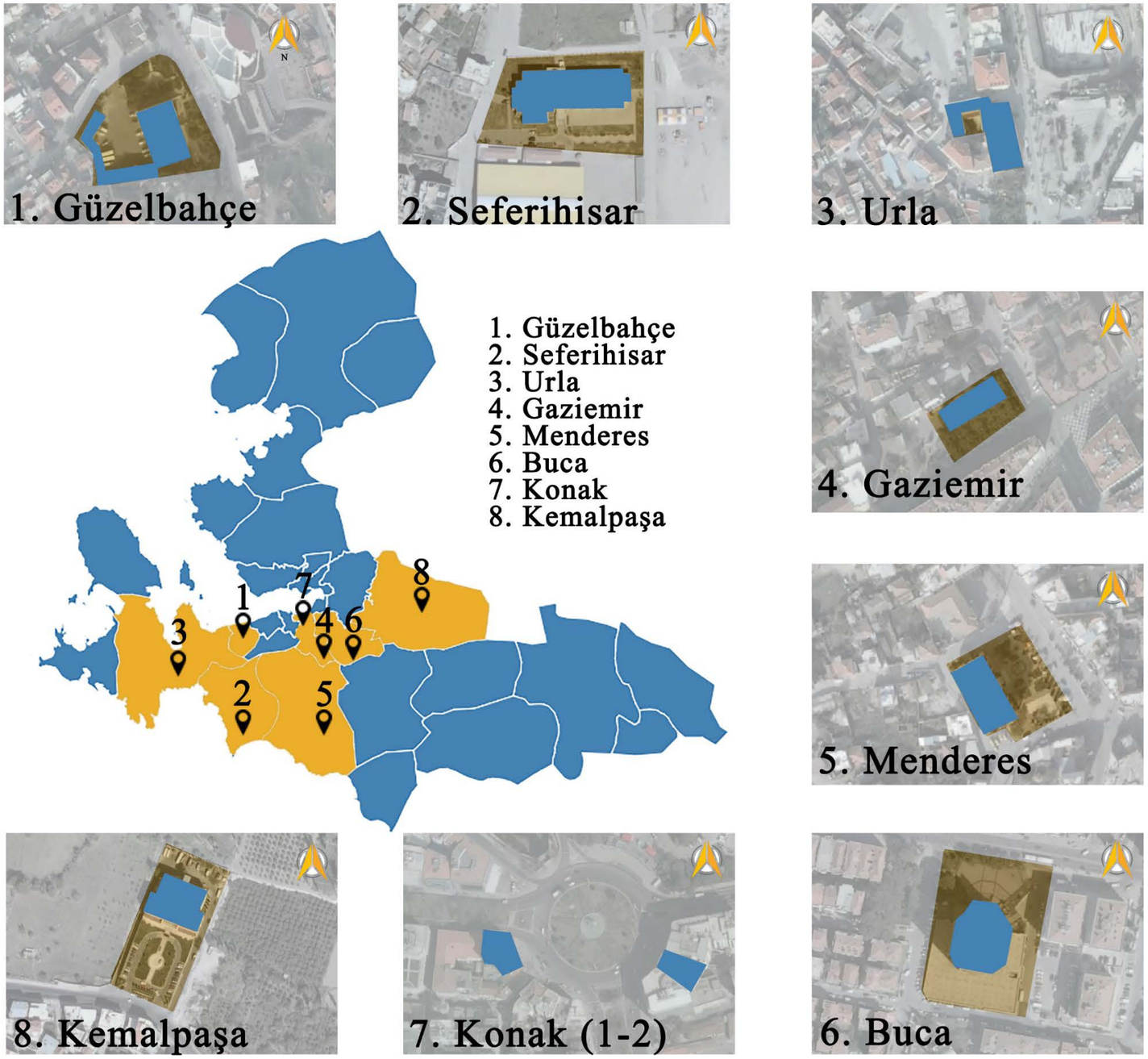


Figure 4. Orientations of Investigated Municipality buildings (İzmir 3D City Surfing)

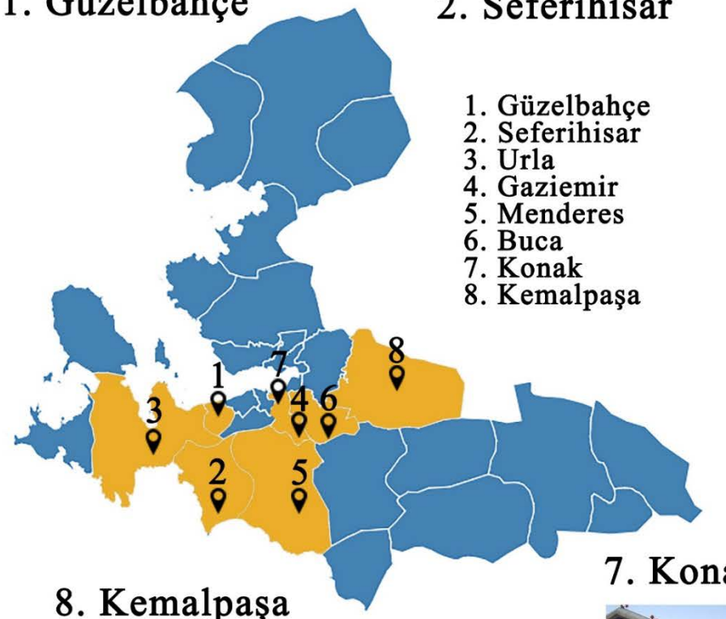
1. Güzelbahçe

2. Seferihisar

3. Urla

4. Gaziemir

5. Menderes



1. Güzelbahçe
2. Seferihisar
3. Urla
4. Gaziemir
5. Menderes
6. Buca
7. Konak
8. Kemalpaşa

8. Kemalpaşa

7. Konak (1-2)

6. Buca

Figure 5. Photographs of Investigated Municipality Buildings (İzmir 3D City Surfing)

3.1.3. Energy Consumptions of Municipality Buildings

To determine energy consumption standards is an unprecedented study for İzmir case. Because of this, data collection has been made by getting contact with selected municipalities one by one. As explained before, the energy consumptions have been investigated on actual electricity, water, fuel bills annually. This chapter is necessary to understand the limits of İzmir municipalities as minimum and maximum kWh of electricity, m^3 water, tons fuel values per square meter. During the collecting consumption data stage, we have distinguished the various departments which are responsible of consumptions. **Besides that, some municipalities have not kept the consumption data with the awareness of energy efficiency**. Because of this challenge, misreporting problem has been faced for data collection of existing situation. Therefore, the absence of solid fuel, natural gas and water usage data have been prevented tha standardization of consumption. As given in Table 16, 17, 18, 19; only electricity data has been suitable to validate in the thesis. As Liu (2012) mentioned, the main reason for this is the absence of professional staff in charge of energy efficiency management. Considering the developed buildings, the existence of the regulations about energy conservation and controlling energy consumption has provided the energy management in the buildings.

Table 16, 17, 18, 19 Municipality Buildings Energy Data illustrate building area information along with the annual total energy consumption. Annual and unit cost of electricity consumption have been used for the 2015 year in municipality buildings to reach kWh value per square meter. As explained in the below table, some of the buildings have had the unit cost, some have had a total cost, and some have had all the information that we need. For example, Buca and Konak Municipalities have had total kWh consumption with the total and unit cost. Gaziemir Municipality has had total cost and unit value for kWh per square meter.

Table 16. District Municipality Buildings Electricity Data for İzmir

Parameters		**Building Area**	**Electricity Consumption**	**Annual Cost**	**Energy Unit**
Name of Municipality	**Unit**	**sqm**	**kWh**	**TRY**	**kWh/m2**
Güzelbahçe Municipality*		1502	145.900	51.065	97,13
Seferihisar Municipality*		2157.5	230.744	80.760	106,94
Urla Municipality*		1861	219.776	76.922	118,09
Gaziemir Municipality*		8800	511.500	180.000	36,5
Menderes Belediyesi*		1642	308.571	108.000	187,92
Buca Municipality**		11862	902.418	311.908,40	76,07
Konak 1st building***		3305	246.450	77.471,87	74,6
Konak 2nd building***		4476,5	307.545	96.695,53	68,7
Kemalpaşa Municipality*		3375,5	468.250	163.877,50	138,72

* (1kwh=0,351876 tl)

**total kWh data is used

***(1kwh=0.26642tl+value-added-tax)

Table 17. District Municipality Buildings Solid Fuel Data for İzmir

Parameters		**Building Area**	**Solid Fuel**	**Annual Cost**	**Energy Unit**
Name of Municipality	**Unit**	**sqm**	**tons**	**TRY**	**tons/m2**
Güzelbahçe Municipality		1502	40.000	21.500	26,6
Seferihisar Municipality		2157.5	-	-	-
Urla Municipality		1861	-	-	-
Gaziemir Municipality		8800	-	-	-
Menderes Belediyesi		1642	-	-	-
Buca Municipality		11862	-	-	-
Konak 1st building		3305	-	-	-
Konak 2nd building		4476,5	-	-	-
Kemalpaşa Municipality		3375,5	-	-	-

Table 18. District Municipality Buildings Natural Gas Data for İzmir

Parameters		**Building Area**	**Natural Gas Bill**	**Annual Cost**	**Unit**
Name of Municipality	**Unit**	**sqm**	**TRY**	**TRY**	**TRY/m2**
Güzelbahçe Municipality		1502	-	-	-
Seferihisar Municipality		2157.5	-	-	-
Urla Municipality		1861	-	-	-
Gaziemir Municipality*		8800	19.500	78.000	8,9
Menderes Belediyesi		1642	-	-	-
Buca Municipality**		11862	29.500	23.724	2,0
Konak 1st building		3305	-	-	-
Konak 2nd building		4476,5	-	-	-
Kemalpaşa Municipality		3375,5	20.000	20.000	5,9

* for 3 months

** for 6 months

Table 19. District Municipality Buildings Water Usage Data for İzmir

Parameters		**Building Area**	**Water**	**Annual Cost**	**Unit**
Name of Municipality	**Unit**	**sqm**	**tons**	**TRY**	**TRY/m2**
Güzelbahçe Municipality		1502	-	-	-
Seferihisar Municipality		2157.5	-	-	-
Urla Municipality		1861	-	2.306,54	1,2
Gaziemir Municipality		8800	-	60.000	6,8
Menderes Belediyesi		1642	-	-	-
Buca Municipality		11862	9.638	-	-
Konak 1st building		3305	-	-	-
Konak 2nd building		4476,5	-	-	-
Kemalpaşa Municipality		3375,5	-	-	-

3.2. Assessment of Energy Consumptions in İzmir's District Municipality Building

As mentioned in this chapter, the program design is the first stage to understand the administration requirements for the municipality buildings. Due to this, we were able to obtain the data from nine metropolitan's district municipality buildings which classified Group C on regulations (Union of Municipalities of Turkey, 2014). These classes have been ranged as C7-C16, which means that data consist a minimum of 27.289 inhabitants (C7-Güzelbahçe Municipality) and a maximum of 454.112 inhabitants (C16-Buca Municipality).

According to the program assessment, the mandatory departments of standards have occupied the range of 77.7%-100%; optional departments existed in the range of 33.3% - 77.7%; and others were in the range of 33.3% - 77.7%. The meaning this, user profile and usage style have varied this occupancy differences. Therefore, the main reason for differences is municipality building function and department hierarchical usage. For this reason, mandatory departments have existed in almost all of the buildings, and optional departments have had a wide range of usage. Additionally, department hierarchical usage have provided the differences in such a way that one department includes the other department within itself. Also, some departments have been mostly using in investigated buildings; even though not as mandatory or optional departments; such as archive with 88.8% usage percentage and meeting room, security, park and gardens departments with 77.7% usage percentage.

The secondary assessment in this chapter is illustrating the energy consumption limitation in İzmir case.

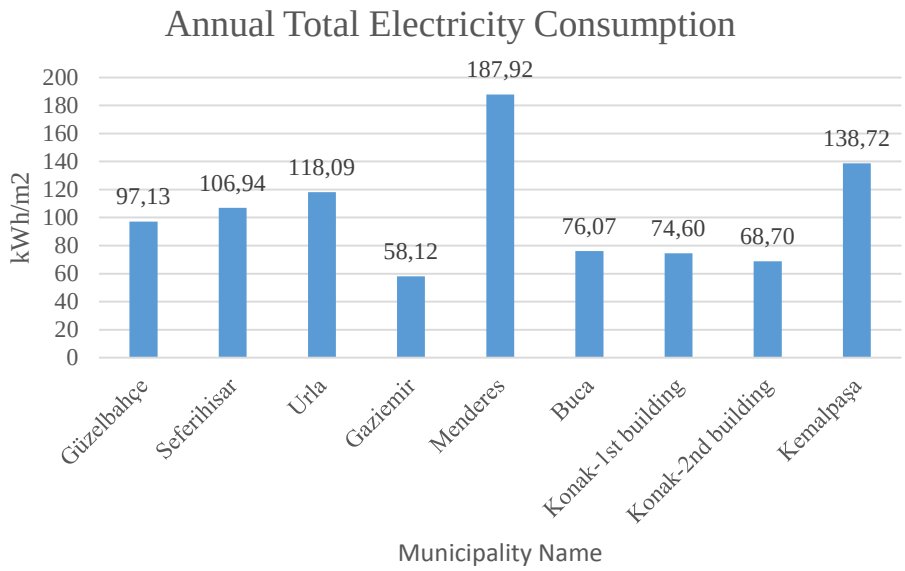


Figure 6. Annual Total Electricity Consumption in İzmir

As seen in Figure 6, the minimum limit belongs to Gaziemir Municipality Building, having 58.12 kWh/m^2 total electricity consumption. In addition, the maximum limit of 187.92 kWh/m^2 belongs to Menderes Municipality. **Therefore, the threshold values are 58,12 kWh/m^2 and 187,92 kWh/m^2 for İzmir case.** The reason for this maximum limit is that Menderes municipality building that was built in 1996. This building is non-isolated and the HVAC systems are inadequate. As a result of this, Menderes municipality building have needed extra energy for heating. The reason for the minimum limit is that Gaziemir municipality building is a new building. It was built in 2014 and features 380 m^2 PV panels on the rooftop. These PV panels have feeded the electricity and heating-cooling systems. The VRV water systems have been used, and there has been drain back system in the building. Actually, Gaziemir municipality building is a good example for a low energy building in İzmir's climate. **As averagely, İzmir has 102.92 kWh/m^2 total electricity consumption for municipality buildings.**

Although the thesis is a new source for electricity consumption threshold and average value, it is not capable of validation for the total annual energy consumption of district municipality buildings. According to Hoos (2016), energy consumption in buildins has been categorized as being low, normal and high consumption in buildings. His study has illustrated that buildings with a low consumption are between 90 and 130 kWh/m^2.a, and high consumption is between

150 and 190 kWh/m^2.a. Buildings between 130-150 kWh/m^2.a are designated “normal”. However, as mentioned previously, other studies concerning offices have refered to low consumption as being 60-70 kWh/m^2a. **Regarding to the electricity consumption, the existing consumption situations in İzmir could be interpret as high up to the Hoos classification of consumptions.**

On the other hand, this study have some recommendations for avoiding the lack of information as a regulation. Because, absence of program and energy consumption data has had a primary discussion and a problem in the literature for measuring building performance. *As is widely known, something cannot be assessed or compared without being measured.* Furthermore, the absence of the professional energy management staff has influenced unneccessary wasting of energy in the buildings. Another absence is the awareness of user profile who is employees of municipalities. Therefore, we can classify the problems in thecases of municipalities as the absence of staff awareness, the absence of professional staff for energy performance reporting and absence of energy data archieve. These are all causes of missing data and increase the energy consumption of the municipality buildings.

Considering all, the threshold values of electricity consumption are 58,12 kWh/m^2 and 187,92 kWh/m^2 for İzmir case. As average, İzmir has 102.92 kWh/m^2 total electricity consumption for district municipality buildings.

In addition, this chapter has provided a building for validation of OpenStudio tool by the help of data collection. Gaziemir Municipality building has been used to find the deviation of the simulation tool by comparing it with actual energy consumption values in the following chapter.

CHAPTER FOUR
VERIFICATION: SIMULATION OF AN ACTUAL MUNICIPALITY BUILDING

Simulations of energy performance have become an integral part of the planning process for designers and engineers due to the growing complexity of buildings. Therefore, the software usage of computer simulation has increased to predict building performance in regards to energy and comfort in the designing process (OpenStudio, n.d). Because of that, this study had included the simulation section for the case study. The aim of this chapter is to validation of OpenStudio as simulation tool for energy modelling. The goals are (1) to find out the deviation of OpenStudio between accurate value and simulation results and (2) to prove the reliability of OpenStudio to use it for Chapter 5. The comparison of energy consumption values has been analyzed between actual energy consumption bills and simulated results of Gaziemir Municipality Building. Rely on this chapter result; OpenStudio is a reliable tool if all details of building are entered the system.

4.1. Decision of Simulation Tool Usage

While assessing the simulation tool usage in energy consumption prediction or retrofitting, we were able to discover the significance of its usage in the design stage. For instance, Korjenic (2012) used a simulation tool in the design phase to establish energy performance criteria. Therefore, he has been able to validate building performance, analyze energy use and predict building energy consumption prior to construction. In other example, Oree (2016) has used a simulation tool to influence realistic retrofit strategies regarding electricity consumption.

Moreover, the research on simulation usage for offices consist of 53 studies about energy consumption limitations for office building cases that were done between 2004-2016. Figure 6 illustrates that 72 % of the total were using simulation tools in that literature review. The primary reason for the increased usage of computational

tools has been pertained to its allowing the taking precautions in the design stage with the help of technological improvement to reduce energy consumption.

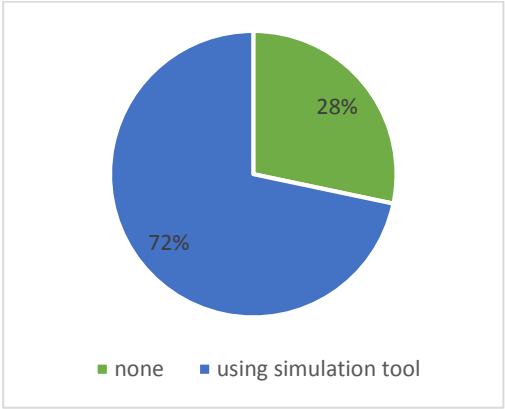


Figure 7. Using Simulation Tool Ratio Regarding Office Studies

Another output of the literature review is in the below figure that illustrates the usage of simulation tool types. As seen Figure 8, the most popular tool is Energy Plus owing to its two optional usages: firstly as an energy simulation tool and secondly as a simulation interface. For instance, OpenStudio energy simulation tool uses Energy Plus as the interface to calculate energy consumption measurements. Additionally, OpenStudio is an open source to use and to establish energy consumption that is a plug-in for Sketch-Up.

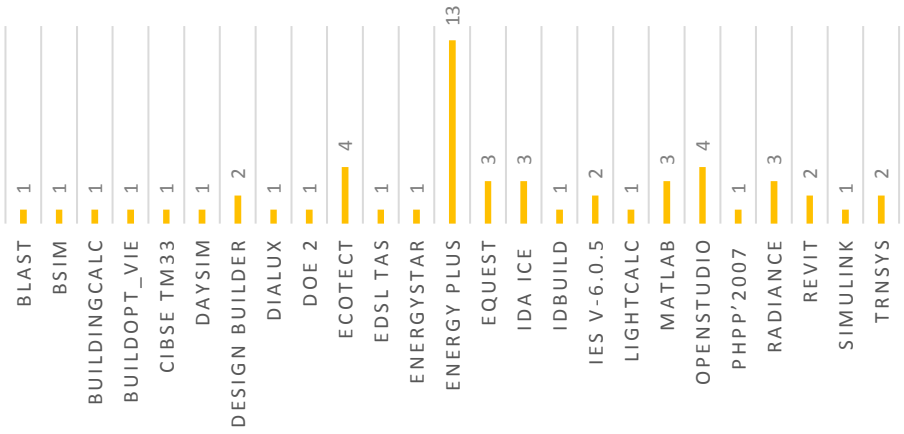


Figure 8. Simulation Tools for Energy Performance Analysis

Moreover, several searches have validated and verified the tool by measuring the deviation distinction between accurate value and simulation results. Lin's study (2016) has consisted of simulated results, which were benchmarked against actual

results to analyze discrepancies. According to Mao (2016), the deviations are acceptable within 10% of measured values. Considering all, OpenStudio has been chosen to calculate energy consumption distinctions of Gaziemir Municipality Building.

4.2. OpenStudio: Energy Simulation Tool

The software was produced by National Renewable Energy Laboratory (NREL); combining the EnergyPlus software for producing an energy model for whole building and Radiance software for making a detailed analysis for daylight in the same platform. As a free open source licensed platform; it produces a graphical interface by the help of Software Development Kit (Crawley, n.d) working as a plug-in; it transfers the energy data from EnergyPlus to SketchUp 3D modeling environment (OpenStudio, n.d.)

After creating the building geometry and the mass in the concept phase, it provides changes according to the simulation feedback which can be changed depending on the user feedback. After the initial design process, the SketchUp model can be transferred to CAD environment after for improving the design details (OpenStudio, n.d.)

The simulation process starts with the identification step wherein the building type is chosen as an office which affects the ‘Schedule’ of the building; depending on the workload and human load in a matter of electric consumption and HVAC usage. The climate zone is also picked from ASHRAE and the site-specific weather data is gathered for analysis as 3C for İzmir. The second step is to design the building on a 2D plan scheme and to develop it on a 3D model. We have mostly used the default settings of OpenStudio; as a significant effect on the electric consumption, the lighting loads are arranged depending on the lighting level need in watts per space floor area (W/m2). After giving the details of the boundary conditions, construction settings, space types, thermal zones and thermostats, building stories; the expected analysis results are determined and the energy consumption data output is gathered as kWh.

4.3. Simulation of Gaziemir Municipality Building

4.3.1. Gaziemir Municipality Building

Within our study, *"Comparison between Building Energy Simulation and Measurement Results for a Municipality Building"*, Gaziemir Municipality Building has been investigated to find a deviation in OpenStudio which is located in İzmir, Turkey. The building can be drawn almost same as current building, so the zones have been investigated space by space. The total area of the building is 8.800 m² set on a 1.700 m² ground floor. Two basement floors are used as car parking area, the ground floor has a lobby for the entrance and open offices for the citizens and upper three floors are mainly the management offices. The conference hall starts on the second floor, also uses the third floor. The café is set on the fourth floor. The building is planned with an atrium in the middle obtaining the vertical circulation, visual connection, and daylight benefit (Aydın, 2016).

Table 20. Building Zones and Lighting Loads

Floor	Function	OpenStudio	Lighting Load
-2, -1	parking area	Storage	5,5
0	Lobby	Lobby	12,59
0	Open Offices	Open Offices	10,65
1, 2, 3	Offices	Open Offices	10
2	Conference Hall	Conference Hall	12,59
4	Café	Break Room	10
4	Mechanical	Mechanical	5,5
0, 1, 2, 3, 4	Stairs	Stairs	5,81

4.3.2. OpenStudio Simulation Process

Regarding the recognition of a municipality building's function as an office, schedule, and construction set values have been chosen from the software. The climatic zone for İzmir has been set depending on ASHRAE as 3C: Warm – Marine with SI Units CDD10ºC ≤ 2500 and HDD18ºC ≤ 2000 (ASHREA Climate Zone, 2009). After the boundaries and the base levels of the mass have been defined, the space types and stories have been entered as listed in Table 20.

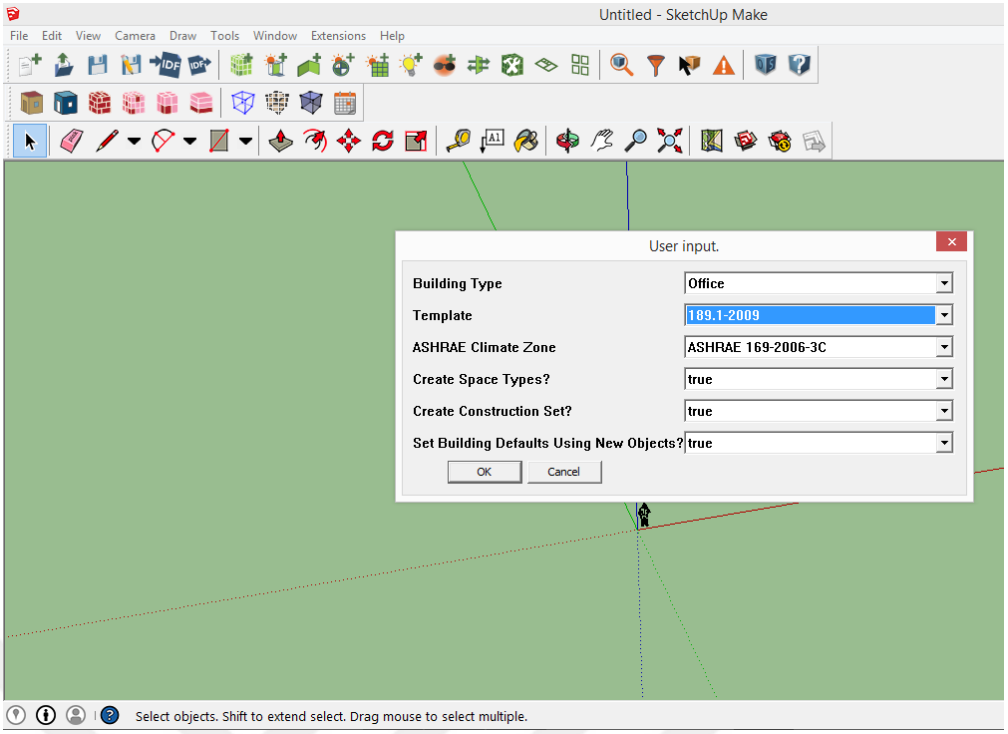


Figure 9. OpenStudio Building Type and Climate Zone Setting

The simulation process starts with the identification of building type has been chosen from 14 various functions (office, hospital, retail, supermarket etc.). The building type has a high importance on defining the 'Schedule' of the building on OpenStudio model; depending on the workload and occupancy load in a matter of electric consumption and HVAC usage. The climate zone has been also chosen from the values of 1A to 8B as defined in ASHRAE and the site specific weather data is gathered for analysis. The second step is to design the building on a 2D plan scheme and to develop it on a 3D model with all the openings. The following step requires deciding the necessarry details of the building to run the analysis with the OpenStudio interface. In these circumstances, all the office occupancies have been settled according to the working conditions in Turkey; from 8.30 to 17.00 between Monday and Friday (Figure 10). So the electric consuming equipment are scheduled with this important information. Even we have mostly used the default settings of OpenStudio; as a significant effect on the electric consumption, the lighting loads are arranged depending on the lighting level need in watts per space floor area (W/m^2). Therefore using of hourly calculation methods of lighting settings are mentioned in Table 20. After giving the details of the boundary conditions, construction settings, space types (Table 21), thermal zones (Figure 12) and thermostats, building stories; the expected analysis results should be determined. The energy consumption data

output has been given in kWh unit (Table 22); district heating and cooling energy consumption in million Btu and Daylight autonomy need as annual rates.

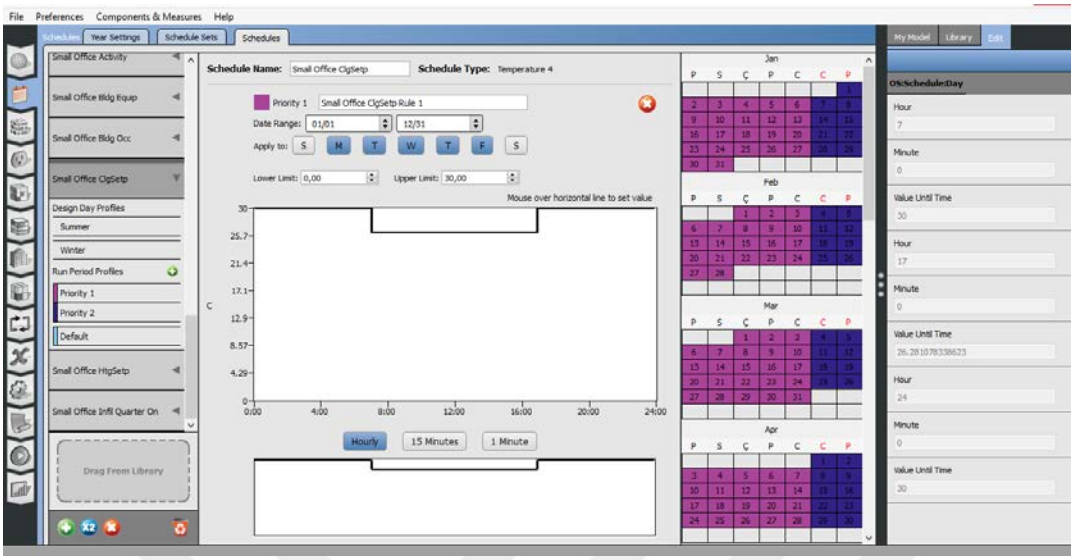


Figure 10. OpenStudio Schedule Settings

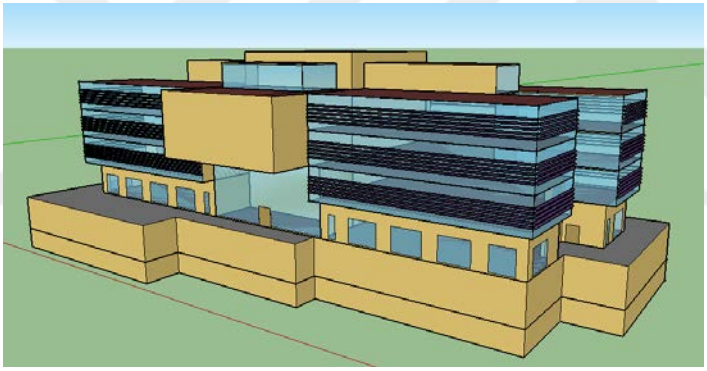


Figure 11. OpenStudio Building Model

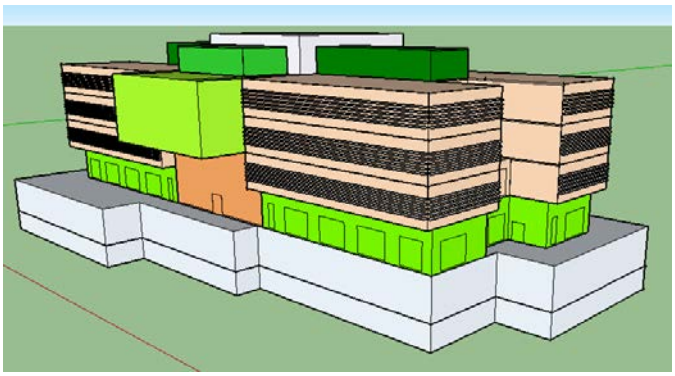


Figure 12. OpenStudio Thermal Zone Model

According to the current Gaziemir Municipality building construction project, the building component features have been used as given on the Table 21. OpenStudio has allowed us to provide input details for each material. Consequently we have been

able to use a detailed model for deviation control. The energy assessment of material can be done by determining the U values. However, this tool does not only allow the changing of U value directly, but also thermal conductivity value of a component with component thickness. Finally, we were able to influence the material features and the outputs of OpenStudio report may summarize the U values of building envelope.

Table 21. Building Components of Gaziemir Municipality Building

Building Element	**Components**	**Component Thickness d (m)**	**Thermal Conductivity W/mK**
Exterior Wall	Gypsum plaster	0,02	0,7
	Aerated concrete	0,2	0,11
	Thermal Insulation (XPS)	0,03	0,03
	Gypsum plaster	0,03	1,6
Interior	Painting	0,012	0,16
	Gypsum plaster	0,02	0,7
	Aerated concrete	0,2	0,11
	Gypsum plaster	0,02	0,7
	Painting	0,012	0,16
Floor	Flooring material	0,07	0,06
	Concrete	0,2	2,5
	Air-gap	1,1	
	Gypsum board	0,015	0,16
	Painting	0,012	0,16
Basement Wall	Concrete	0,3	1,65
	Water Insulation	0,01	0,19
	Thermal Insulation (XPS)	0,03	0,035
	Insulation (PVC)	0,003	0,19
Roof	Gravel	0,05	0,7
	Insulation (PVC)	0,003	0,19
	Heat insulation &waterproofing (double)	0,01	0,19
	Screed concrete	0,03	1,4
	Reinforced concrete	0,15	2,5
	Gypsum plaster	0,01	0,7
	Painting	0,012	0,16
Door	Aluminium	0,04	204
Fenestration	low-e double glazing (argon)	0,004+0,012+0,004	0,0096

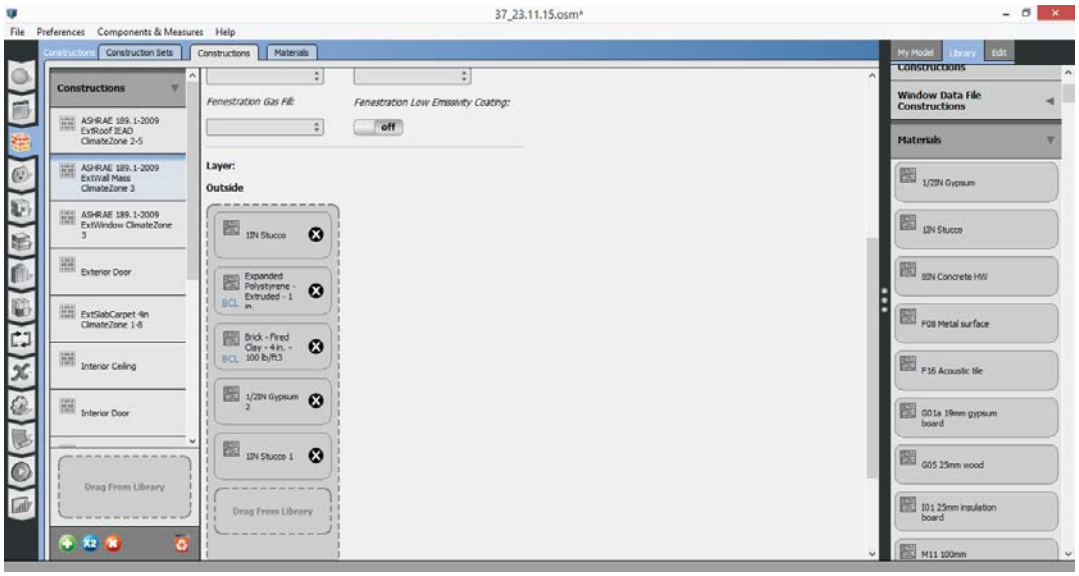


Figure 13. OpenStudio Building Component Settings

After the given material details, the HVAC system details have been adjusted on OpenStudio Launch. As given tables before, The HVAC systems have been defined as "*VRF*" and the mechanical systems details are defined in energy model (Figure 14).

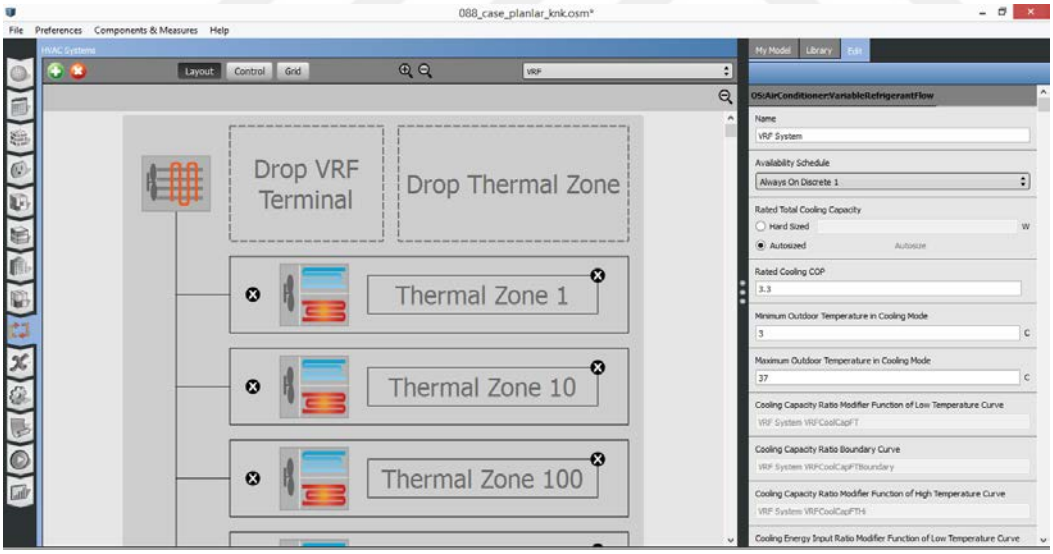


Figure 14. OpenStudio HVAC system's settings

4.3.3. Validation of OpenStudio Tool Deviation

At the very beginning of the study; the electric consumption of the case building has been decided to be the parameter to make a comparison between the actual value and the two simulations. So the annual and monthly results have been chosen from all the sources. (Table 22).

Table 22. Validation of Electric Consumption Results

Electric consumption (kWh)	Annual	Monthly
Actual	511.543,0	38.462,55
OpenStudio Sim.1	589.020,74	38.967,88
OpenStudio Sim.2	519.705,36	38.285,09

The OpenStudio output data has had a slight difference with the actual data which is acceptable for simulation software which relies on assumptions. The component, time schedule, heating and cooling data could be used in simulations as same as with current building. Accordingly, the result of the first simulation is almost the same as the actual value, as the difference in electricity consumption is 1.28 % (505.33 kWh) monthly, 15.1 % (77.477,74 kWh) annually. Thisis because of the detailed information consumption has been obtained as monthly (updated-Aydın, 2016)

As a result, a 15.1 % deviation is not acceptable for simulation tool's validity in reaching actual values. Therefore, the simulation has been rechecked, and has been realized that the space definition was general in first simulation. Figures 15 and 16 illustrates that the differences between space and thermal zone definition in simulations. In the first simulation, closed offices have been defined as seen number 1 and 2 zones because of the assumption as including print room, restroom, offices and stair zones (Figure 15). In the second simulation, offices and other zones have been splitted up as offices (1,2), stair (3), restroom (4), breakroom (5), and print room (6) zones. Consequently, 1.6% deviation annually has been achieved between actual value and OpenStudio simulation.

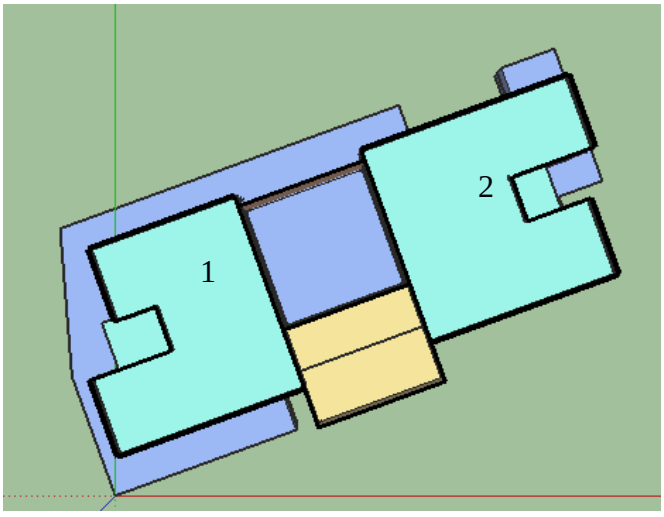


Figure 15. Space-Thermal Zone Definition in the First Validated Simulation

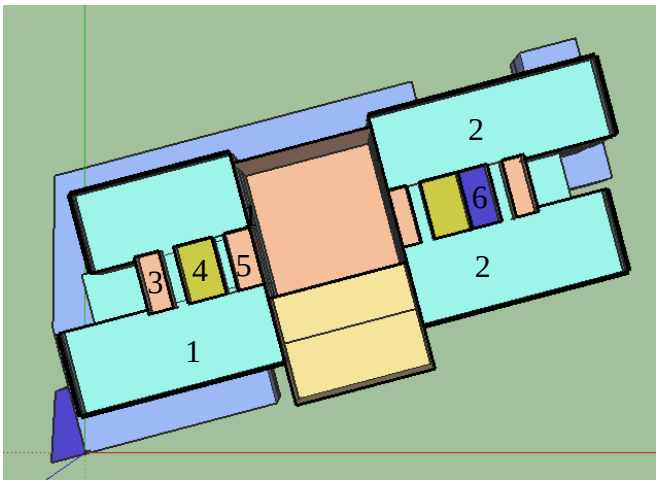


Figure 16. Space-Thermal Zone Definition in the Second Validated Simulation

One reason for the discrepancy between monthly and annually relates to an actual detailed bill of monthly consumption which was available from the municipality, and with the help of that making an assumption for annual data. **According to this, the results of annual and monthly data deviations are 1.6 %, 0.4% respectively which are acceptable for simulation software that relies on assumptions.**

As the idea of this chapter was to have an idea about the proximity between the chosen simulation tool and the actual values, the study has presented challenging differences which should be studied deeply with analyzed in a more extensive study for further. **The significance of simulation usage is being supportive tool for advanced design stage to decide all the details for the application project in the thesis. Therefore, OpenStudio has affected this study as a decision-maker tool for creating alternative and measuring the energy performance of building fast.**

For the next chapter, the energy simulation tool OpenStudio has been used to reduce the energy consumption of a case study building. This building has been designed and has been selected by an architectural competition in 2015 which has not been built yet. In this context, this study has been a guide for the architectural team to change some parameters or materials still during the design process to achieve energy efficient building.

CHAPTER FIVE
CASE STUDY; KONAK MUNICIPALITY BUILDING

Konak Municipality Building has been designed by an architectural competition in 2015, named Independent National Single-Stage Architectural Project Competition (Serbest Ulusal Tek Kademeli Mimari Proje Yarışması). According to the municipality's main requirement for the competition, this building has to be a municipality building which can response to inhabitant's needs through technological, accessible, energy efficiently design approaches. The aim of designing this building is as a symbol of Konak Municipality's aim and approach to nature and humanity (Competition Specifications-Konak). Besides that; İlker Kahraman, the advisor of the thesis, was a sustainability consultant jury member of this competition owing to his expertise in energy efficiency. Therefore, we were able to track all process of building design as well as after the design process. Because of Konak Municipality's vision/approach and his being a consultant, this building has been chosen a case study building for the thesis.

The aim of this chapter is to illustrate the evaluation example via the case building. The evaluation has been made initially for investigation into the **early design stage as program design.** Afterwards, the simulations have been run for the **advanced design stage as energy performance** of application project design. The goal is to discover the situation of Konak Municipality Building by comparing average area necessities obtained from Chapter 2. In addition, the other goal is to validate the impact of energy efficiency parameters on Konak Municipality Building by using limitations obtained from Chapter 3.

The evaluation has been made by comparison of the program design. Regarding to the literature, the definition of energy effieciency measures has been obtained to simulate the energy performance. The parameters have been decided as glazing type, window to wall ratio, wall type, orientation and shading device. The other architectural, mechanical and renewable source parameters have not been examined in this study. As a final study, alternatives of application project has been simulated

to improve energy performance of building by comparing the base model for the advanced project design stage.

5.1. Information of Case Building

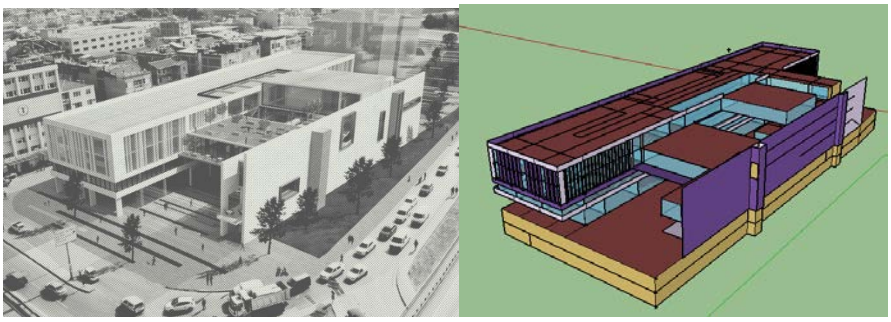


Figure 17. Simulated building (Realistic Render-OpenStudio Simulation Render)

Konak Municipality building has a concrete structure which use shear walls for cores. The general office spaces have been covered by glazing façade with sunshades. A huge concrete wall has been designed to prevent noise pollution from the freeway and also protected against the north wind and negative effects. There has been totally six floors, of which two are car parking and mechanical system spaces. The other floors have had closed and open plan types offices. The net conditioned area is 8959.25 m^2 (Table 23).

Table 23. Simulated Konak Municipality Building Area Values

Building Area	Area (m2)
Total Building Area	19707.12
Net Conditioned Building Area	8959.25
Unconditioned Building Area	10747.87

Regarding climate, İzmir is in the 1st climatic zone in Turkey which is a marine and mild climate. The case building will be located in Yenidoğan neighborhood in the Konak District, İzmir.

- The geometric form is rectangle designed by equal axis.
- The total of 6 floors include 2 basement floors, a ground floor and 3 floors.
- The general dimension of ground floor is 44.3 m x 113.90 m.

- Total building height from ground level is 15,0 m and for basement floors is 6,40 m.
- The floor heights: basement floors: 3,20 m, ground floor: 4,20 m, 1st,2nd, 3rd floors: 3,60 m.
- Roof type is a terrace roof which is accessible for employees.
- The whole construction is concrete moment frame construction except for roofs of the interior street and council chamber space. The aluminium frame structure is used for the glazing façade.

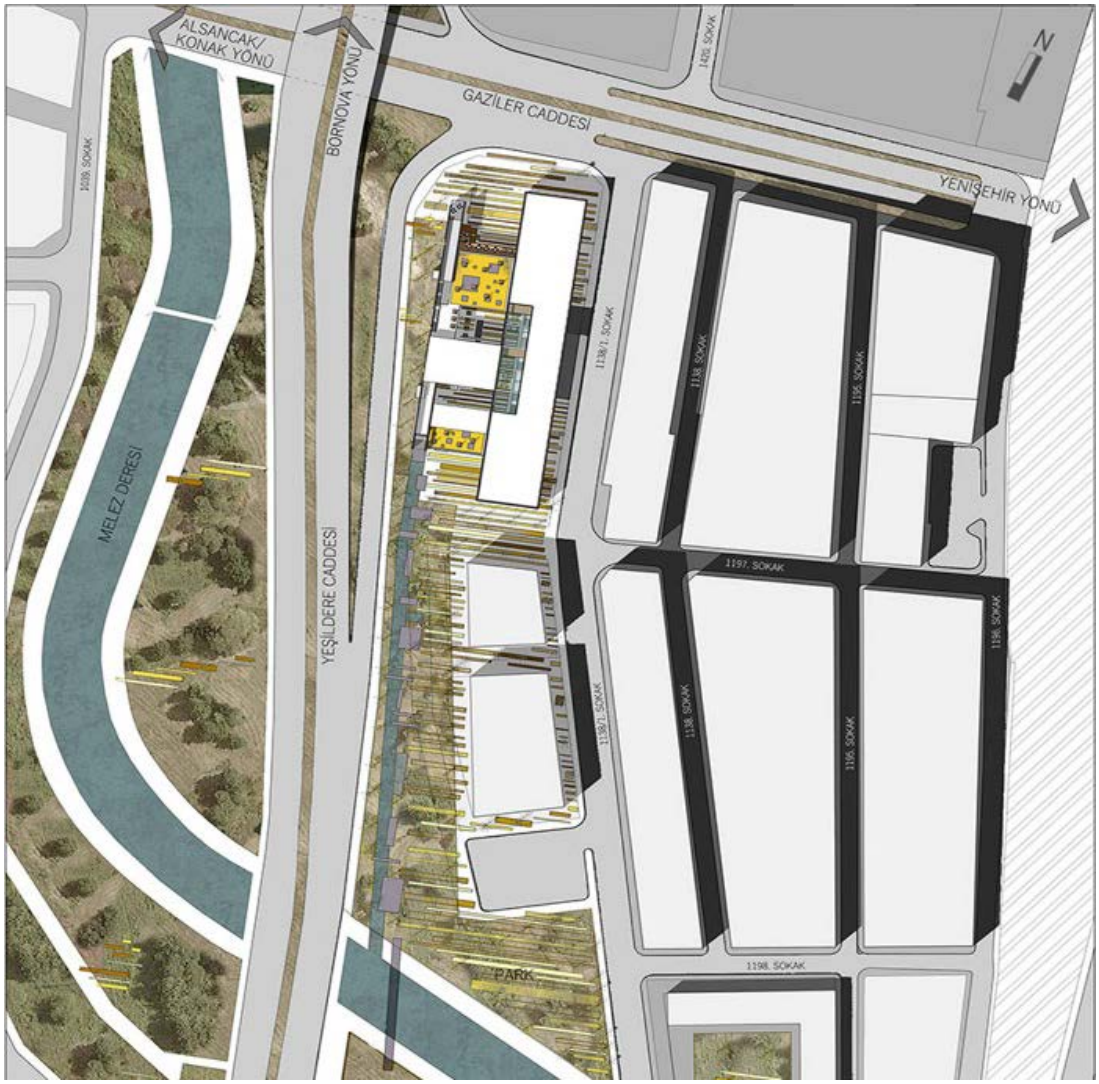


Figure 18. Site Location of Konak Municipality Building (İmren, 2015)

Architectural Plans of Konak Municipality Building:

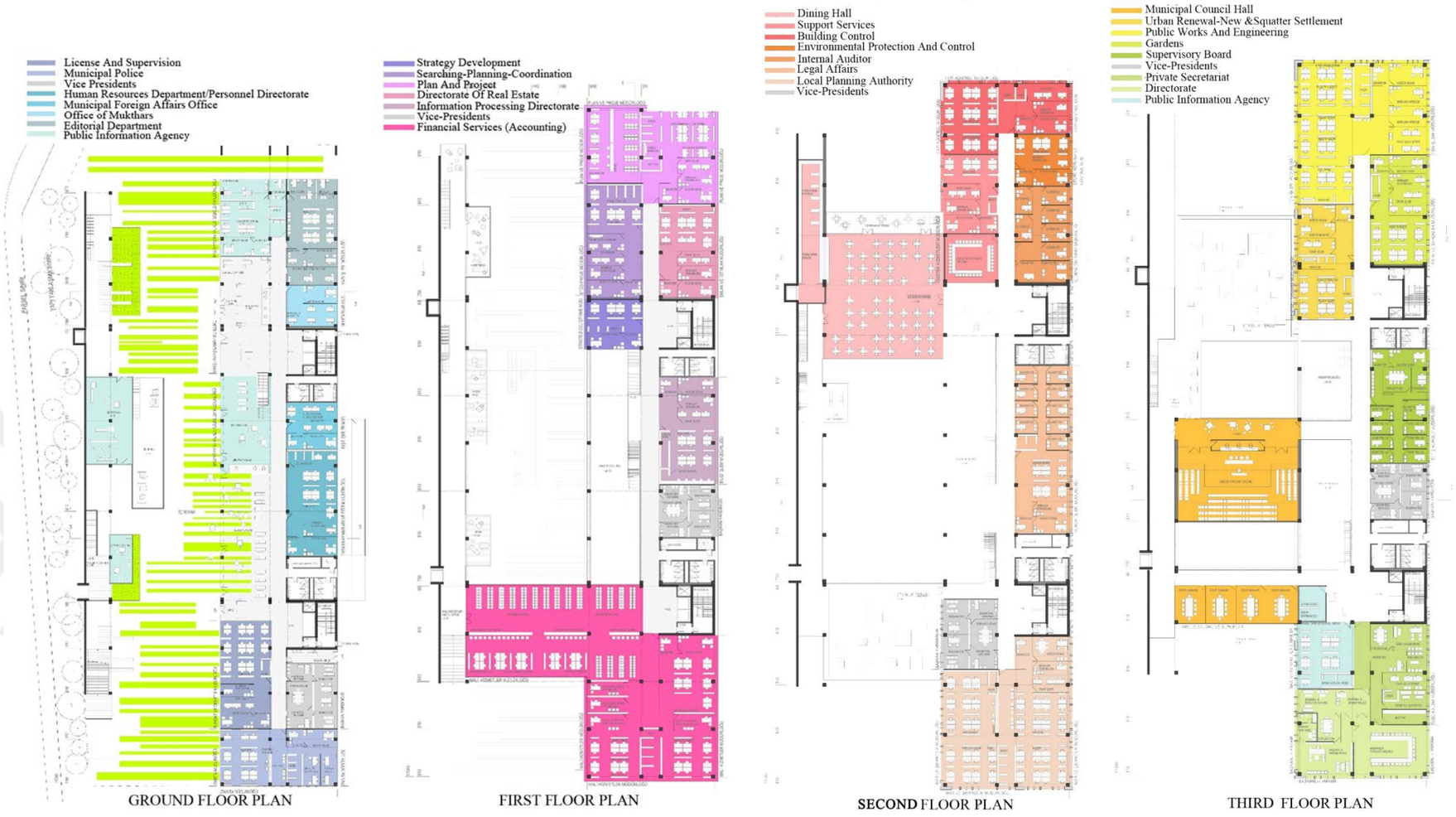


Figure 19. Floor Plans of Konak Municipality Building (İmren, 2015)

5.2. Program Evaluation of Case Building

As mentioned before, the building program is the first step in designing a building. Therefore, the first performance based design criterion is assessing the building program.

Building program assessment depends on specifications of Konak Municipality Building and the standards with average are needs (Table 12). Moreover, this assessment involves the existing situation (Konak Municipality), competition requests (Konak Municipality), proposed areas (architect team) and projected areas (architect team).

Table 24 illustrates the distinctions of program necessities by comparing various areas. The distinction of existing situation and proposed area is almost the same. Existing building is 139 m^2 larger than the proposal one. This means, architect team designed their building according to the Konak Municipality situation.

As refered the competition and average area needs, there is a 6891,5 m^2 distinction. It could be said the main reason of that is circulation area calculation. Moreover, some of the departments are not in the average area of department list such as “study and planning, internal auditor etc”.

Obviuosly, the huge discrepancy belongs to proposed and average area needs. Some of departments were not detailed for first proposal by the architectural team. Because of that, the proposal is 11.298,98 m^2 less than the average area needs.

While assessing the distinction of projected and average area needs, we may interpret as almost being the same. The projected area is 176 m^2 less than average area needs of district municipality buildings. **It means the architects of Konak Municipality project has achieved the accurate program necessities finally.**

Considering all, if the projected areas were insufficient for average needs, Konak municipality building could have encountered an obstacle to being a energy efficient building. **However, the final design is at a successful enough level to be an example for disrict’s municipality building.**

Table 24. Konak Municipality Building Program Design Assessment Table

KONAK MUNICIPALITY BUILDING-2015		EXISTING AREA SITUATION	COMPETITION REQUESTED AREA	PROPOSED AREA NEEDS	PROJECTED AREA	AVERAGE AREA NEEDS	DISTINCTION between PROJECTED & AVERAGE	DISTINCTION between EXISTING & PROPOSED	DISTINCTION between COMPETITION & AVERAGE	DISTINCTION between PROPOSED & AVERAGE
Departments of STANDARDS	**Departments of PROGRAM**									
	Entrance	243	**192**	524	597,1	246,67	350,43	-281,00	-54,67	277,33
Directorate	Directorate	285	**262**	255	485,4	194,67	290,73	30,00	67,33	60,33
Private Secretariat	Private Secretariat	168	**172**	180	105,5	303,09	-197,59	-12,00	-131,09	-123,09
Office Of Secretary General	Office Of Secretary General	393	**560**	240	0	112,58	-112,58	153,00	447,42	127,42
Supervisory Board	Supervisory Board	115	**214**	173	145,4	101,78	43,62	-58,00	112,22	71,22
Human Resources Department	Human Resources Department/Personnel Directorate	295	**168**	189	158,7	231,91	-73,21	106,00	-63,91	-42,91
Public İnformation Agency	Public İnformation Agency	288	**401**	496	260,6	190,25	70,35	-208,00	210,75	305,75
Municipal Foreign Affairs Office	Municipal Foreign Affairs Office	70	**80**	78	71,2	77,50	-6,30	-8,00	2,50	0,50
Municipal Police	Municipal Police	335	**238**	210	198,8	260,25	-61,45	125,00	-22,25	-50,25
Environmental Protection And Control	**Environmental Protection / Cleaning Service**	103	**96**	104	99,7	118,67	-18,97	-1,00	-22,67	-14,67
Public Works And Engineering	Public Works And Engineering	421	**410**	418	360,8	322,33	38,47	3,00	87,67	95,67
Editorial Department	Editorial Department	272	**152**	169	152,9	162,00	-9,10	103,00	-10,00	7,00
Legal Affairs	Legal Affairs	268	**278**	240	230,7	151,00	79,70	28,00	127,00	89,00
ICT	Information Communication Technology	286	**228**	230	185,7	168,92	16,78	56,00	59,08	61,08
Local Planning Authority	Local Planning Authority	537	**666**	525	490,5	712,60	-222,10	12,00	-46,60	-187,60
Building Control	Building Control	262	**304**	246	236	420,20	-184,20	16,00	-116,20	-174,20
Financial Services (Accounting)	**Financial Services (Accounting)**	1044	**1098**	914	863,2	812,42	50,78	130,00	285,58	101,58
Support Services	**Support Services**	215	**210**	238	167,1	591,60	-424,50	-23,00	-381,60	-353,60
License And Supervision	License And Supervision	237	**206**	172	238,4	237,25	1,15	65,00	-31,25	-65,25
Plan And Project	Mapping And Planning, Plan And Project	421	**414**	328	272	363,75	-91,75	93,00	50,25	-35,75
Study And Planning	Study And Planning	256	**248**	204	184,1	0	184,10	52,00	248,00	204,00
Strategy Development	Searching-Planning-Coordination, Strategy Development	110	**96**	91	74,2	147,22	-73,02	19,00	-51,22	-56,22
Directorate Of Real Estate	Directorate Of Real Estate	162	**176**	152	136,3	248,43	-112,13	10,00	-72,43	-96,43
Urban Design	Urban Renewal-New &Squatter Settlement	140	**192**	170	157,1	172,33	-15,23	-30,00	19,67	-2,33
Library	Library	83	**74**	104	0	88,89	-88,89	-21,00	-14,89	15,11
Sport Management	Sport Management	0	**198**	0	178,8	162,50	16,30	0,00	35,50	35,50
	Internal Auditor	275	**228**	0	80,2	0,00	80,20	275,00	228,00	0,00
	Municipal Council Hall	0	**492**	498	310,9	635,00	-324,10	-498,00	-143,00	-137,00
	The Work Of A Mukhtar	0	**0**	60	63	0,00	63,00	-60,00	0,00	60,00
	Park and Gardens	230	**196**	167	150,8	0,00	150,80	63,00	196,00	167,00
	Committee Hall	0	**72**	0	60,5	126,00	-65,50	0,00	-54,00	-54,00
	City Council	0	**27**	0	31,3	0,00	31,30	0,00	27,00	27,00
	Civil Defense	0	**15**	0	22,2	36,60	-14,40	0,00	-21,60	-21,60
	Reserve Department	0	**142**	0	128,7	259,00	-130,30	0,00	-117,00	-117,00
	General Achieve	0	**1768**	0	1662,8	1037,45	625,35	0,00	730,55	730,55
	Dining Hall	0	**798**	0	393,3	621,56	-228,26	0,00	176,44	176,44
	Others	0	**259**	0	895,1	0,00	895,10	0,00	259,00	259,00
	Technical Room	0	**757**	0	387,8	553,33	-165,53	0,00	203,67	203,67
	Circulation Areas	0	**8209**	0	2179	4325,40	-2146,40	0,00	3883,60	3883,60
	Close Car Parking (142 Cars)	0	**4038**	0	4535,2	3618,75	916,45	0,00	419,25	419,25
	Shelter	0	**615**	0	470	553,75	-83,75	0,00	61,25	61,25
	General Storages	0	**616**	0	1076,5	308,33	768,17	0,00	307,67	307,67
TOTAL AREAS / TOTAL AREAS' DISTINCTIONS		**7514**	**25565**	**7375**	**18497,50**	**18673,98**	**-176,48**	**139**	**6891,02**	**-11298,98**

5.3. Energy Performance Simulation

As aforementioned, the simulation tool is OpenStudio & EnergyPlus energy analysis tool. The help of this computational tool has guided the thesis for the architectural goals.

5.3.1. Methodology of Simulations

As a methodology of the simulation stage by these parameters, two main objectives have been chosen and have been tried to achieve. The objectives are **(1) energy consumption minimization and (2) illuminance maximization.** To deal with the energy consumption minimization, total energy has been concerned as kWh value per square meter (electricity, heating and cooling demands). OpenStudio is limited for measuring overall illuminance value results therefore; a point has been selected as the worst at receiving daylight in the chosen space. This space has three façades facing from South-East to South-West.

5.3.2. Inputs of Simulation

- Building Envelope Material is the same as in the real application projects. TS825 values have been refered for the whole values of the envelope materials (Table 26).
- Heating and Cooling Setpoints have been given on optimum values of office usage according to Çakmanus (Figure 20) (Interview-2016)
- Lighting Loads have been given as LED usage, which are same in the application project (Table 25).
- Schedule Ruleset: Office Activity, Office Work Occupancy schedules have been given according to the work times of municipalities generally (Figure 21,22).
- Thermal zone details are given space by space which means each space matches one thermal zone for obtaining the most accurate simulation results (Figure 25).
- **Simulation Cooling Setpoints:** Summer weekdays: 20-30 ^{o}C, **t**he rest of the year: 22-24 ^{o}C

- **Simulation Heating Setpoints:** Winter weekdays: 18-22 ºC**, t**he rest of the year: 18 ºC

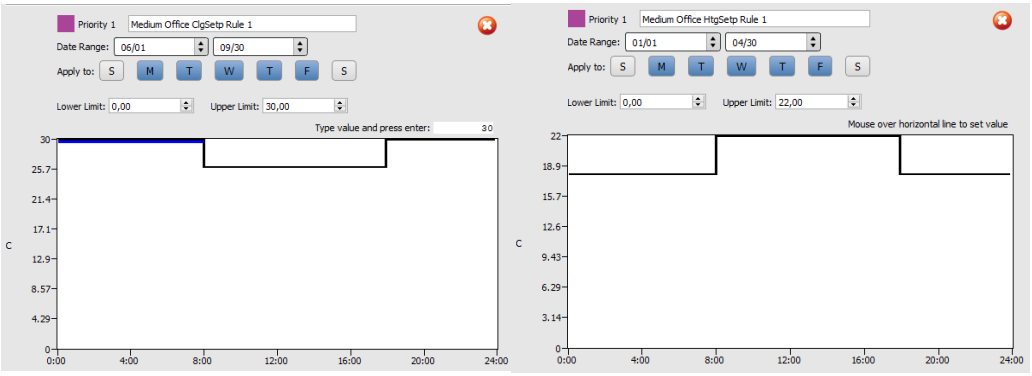


Figure 20. Cooling and Heating Setpoints

- **Office Activity Schedule:** Weekdays: 08.00-18.00 (unusual circumstances - 20.00)

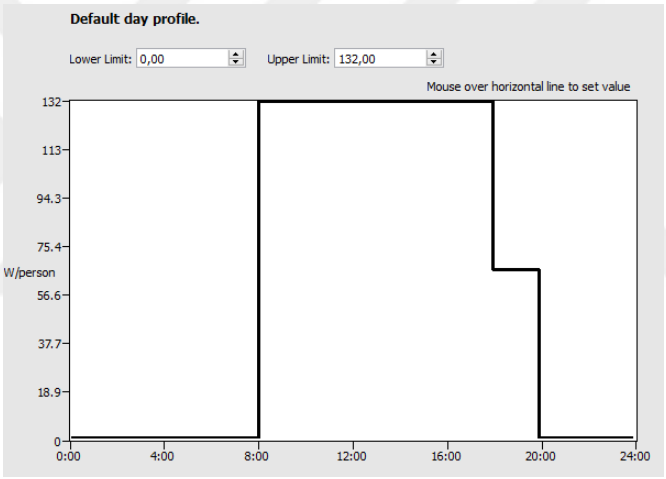


Figure 21. Office Activity

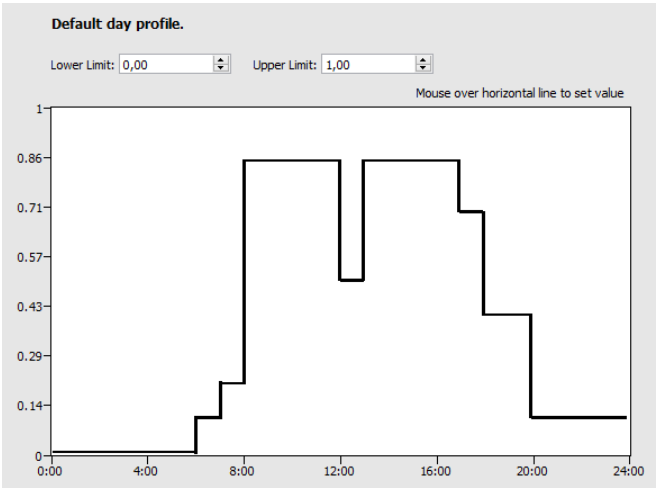


Figure 22. Office Work Occupancy

Table 25. Lighting Loads of Simulated Konak Municipality Building

Used lighting loads	**OpenStudio**	**Actual**
Space type	W/m2 values	
Breakroom (WC)	11,62	7,96
Storage (Car parking)	7,75	2,42
Closed Office	10,65	4,78
Open Office	10,65	3
Stair	5,81	6,4
Corridor	4,84	2,77
Conference Hall	12,59	3,1

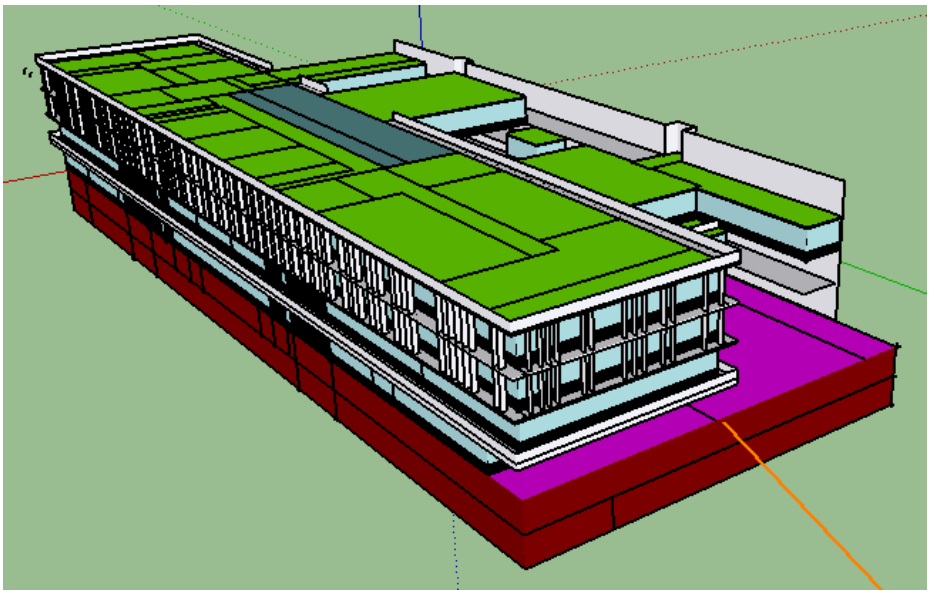


Figure 23. Building Construction Type

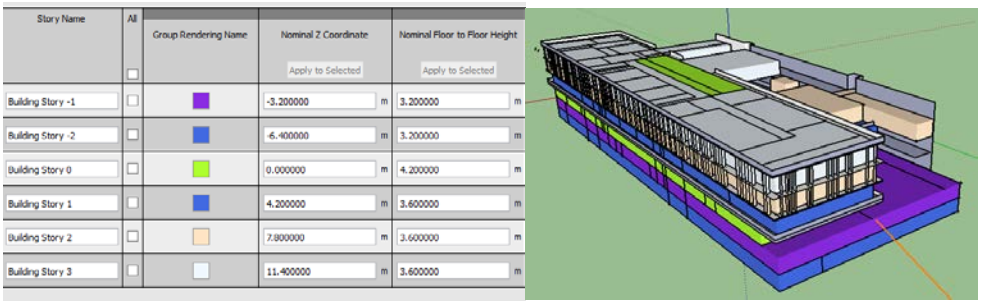


Figure 24. Building Storey Heights

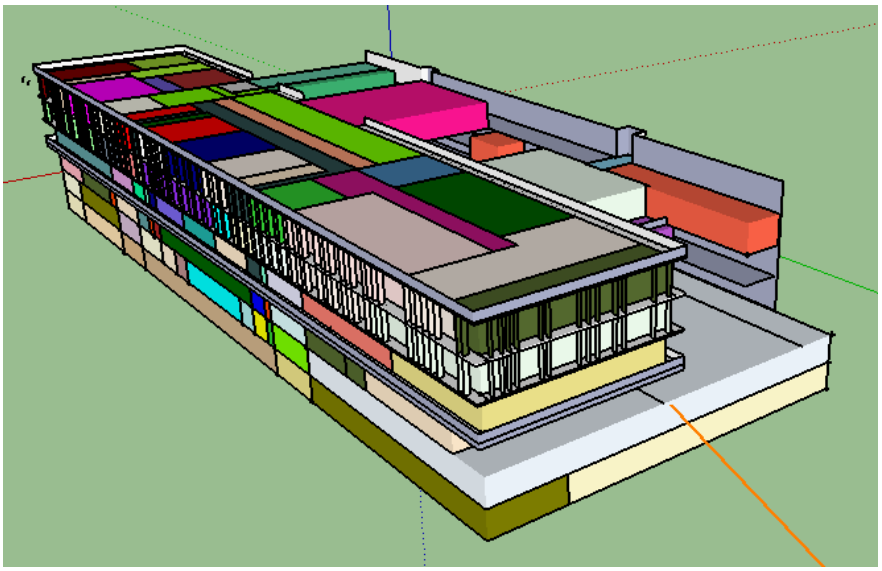


Figure 25. Thermal Zones (Space by Space)

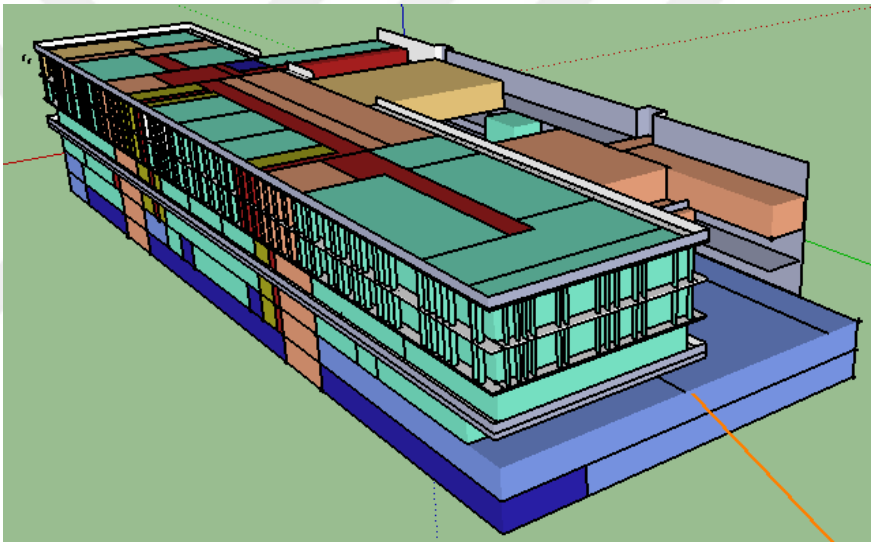


Figure 26. Space Types

Table 26. Designed Building Envelope Material based on TS825 standards

Placement of Construction	Using Space	Material Names (OpenStudio-from outside to inside)	Thickness d(m)	Thermal Conductivity W/m.K	Density kg/m3
Outdoor	**Exterior Wall**	Reinforced Concrete Shear Wall or	0,3	2,5	2400
		Exposed concrete	0,2	1,65	2200
		Clay brick	0,04	0,45	600
Outdoor	**Exterior Floor (Bridge Construction)**	Steel	0,1	58	7850
		Thermal Insulation	0,04	0,035	8-500 (43)
		Steel Construction	0,1	58	7850
		Steel-raised flooe	0,5	58	7850
		Carpet	0,02	0,06	200
Outdoor	**Roof**	Granit	0,02	2,80	2500-2800
		Adhesive Mortar	0,02	-	-
		Water Insulation	0,01	0,19	1200
		Levelling Concrete	0,04	1,65	2200
		Thermal Insulation	0,04	0,035	8-500(43)
		Reinforced Concrete Floor Plate	0,2	2,5	2400
		Exposed Concrete and HVAC systems	0,2	1,65	2200
Ground	**Basement Ceiling Exterior Slab**	Soil	0,4	-	-
		Plastic Viol	0,1	-	-
		Gravel	0,1	0,7	1800
		Cement Finish	0,03	1,40	2000
		Polyurethane water insulation	0,01	0,19	1200
		Levelling Concrete	0,04	1,65	2200
		Reinforced Concrete Floor Plate	0,2	2,5	2400
		Exposed Concrete and HVAC systems	0,2	-	-
Ground	**Basement Floor**	Concrete	0,1	1,65	2200
		Raft Foundation	0,7	1,60	2000
		Water Insulation	0,01	0,19	1200
		Levelling Concrete	0,1	1,40	2000
Ground	**Basement Floor (ceiling)**	Epoxy Cladding	0,002	0,35	
		Cement Finish	0,1	1,40	2000
		Reinforced Concrete Floor Plate	0,2	2,5	2400
		Exposed Concrete and HVAC systems	0,2	1,65	2200
Ground	**Basement Wall**	PVC water insulation	0,01	0,19	1200
		BIMSBlock	0,2	0,18	600
		Reinforced Concrete Shear Wall	0,3	2,5	2400
		Cement Plaster	0,02	1,60	2000
		Exposed concrete	0,2	1,65	2200
Indoor	**Interior Wall**	Clay brick	0,04	0,45	600
		Cement Plaster	0,02	1,60	2000
		Exposed concrete	0,2	1,65	2200
		Cement Plaster	0,2	1,60	2000
		Clay brick	0,04	0,45	600
Interior	**Interior ceiling/floor**	Exposed Concrete and HVAC systems	0,2	1,65	2200
		Reinforced Concrete Floor Plate	0,2	2,5	2400
		Cement Finish	0,1	1,40	2000
		Epoxy Cladding	0,002	0,35	0,735 (288)
Interior	**Door**	Glazed Door	0,04	-	-
Interior	**Window**	ISICAM	0,04	-	-
Outdoor	**Fenestration**	ISICAM 4/4 aluminyum cerceve	0,04	-	-
Outdoor	**Skylight**	ISICAM 4/4	0,04	-	-
Outdoor	**Shading Device**	Precast Concrete	0,15	0,69	1858

5.3.3. Energy Efficiency Measures (EEM)

According to the Ören's thesis which pertains to the reducing of energy consumption in office buildings through passive methods, the components of building envelope are main parameters for reducing energy demands. The parameters can be summarized: *the insulation parameters (type, thickness, location); the glazing façade parameters (number of glass, the thickness of glass and layer, gas type, SHGC and U values, WWR); infiltration and schedule parameters, the daylight effect and finally green roof systems* (Ören, 2010).

Another thesis relating to existing office refurbishment regarding energy efficiency has investigated parameters in four main titles, namely *space heating, ventilation, space cooling (avoiding excessive heating) and lighting.* Within this context, 5 scenarios were presented by assessing alternatives about U values and insulation materials, glazing façade, shading control, WWR, HVAC systems (Karaca, 2011).

According to the Li's study (2013), energy efficiency measures were categorized as: building envelopes *(thermal insulation, thermal mass, window/glazing (including daylight) and reflective/green roofs);* internal conditions *(indoor design conditions and internal heat loads (due to electric, lighting and equipment/appliances))*; building service systems *(HVAC (heating, ventilation and air conditioning), electrical services (including lighting) and vertical transportation (lifts and escalators))*

Considering Sanseverino's study (2014), *"Municipal Building Regulations for Energy Efficiency in Southern Italy",* we were able to ascertain an exampleenergy annex created for Italy case. According to the southern Italy situation, the general parameters were classified as Area 1: Environmental sustainability and enhancement of the context, Area 2: Energy performance of building envelope, Area 3: Energy performance of technical systems and Area 4: Renewable energy sources. Area 1 consists of building orientation, natural lighting, external microclimate control, usage of arboreal types, water saving and usage eco-friendly and recycled materials. Area 2 consists of acoustic pollution control, the ratio between dispersion surface and controlled temperature volume, thermal insulation of buildings (winter&summer), shutters performances and shading controls, roof performances, and usage of passive cooling measures. Area 3 consists of high-performance heat generation systems,

thermal centralized plants and metering system, thermal regulation systems, low-temperature systems, and mechanical ventilation systems. Area 4 consists of solar thermal systems, renewable energy sources for electrical generation, and electrical infrastructures for electric vehicles recharging.

Considering all the parameters in many studies, EEMs have been categorized as architectural parameters, service system parameters and renewable intervention parameters.

1. Architectural Parameters

- Envelope
  - Construction Material-U value
    - **Wall**
    - Roof
    - **Glazing**
  - Façade Design
    - **Glazing WWR**
    - **Shading Device**
    - Overhang Factors
    - Façade Type
- Geometry
  - Plan of space
  - Height of space
  - Depth of space
- **Orientation**
  - Weather conditions
- Daylight Strategies
  - Daylight systems
  - Solar/Daylight control systems
  - Natural Lighting

2. Service System Parameters

- HVAC systems
  - Heating
  - Cooling
  - Air Conditioning
  - Ventilation
  - VAV, CAV, VRF systems
- Electricity
  - Lighting
  - Loads
  - Equipment
- Schedule
- Comfort

3. Renewable Intervention Parameters

- Photovoltaic Panel
- Grey Water Usage

5.3.4. Simulation Parameters

According to the negotiations with municipality and architectural team, this case study might based on the architectural project regarding changing material and façade design. The constant is the architectural functional program for this study. Because of that, Konak municipality building has been compared and has been discovered for the program design as mentioned before. Afterwards, the initial idea of the chosen design parameter has been the material of envelope as architectural parameter. As seen below, simulations have been altered depending on glazing type, window to wall ratio, wall type, orientation and shading device.

5.3.4.1. Evaluated Architectural Parameters

1. Glazing Type (depends on Transmittance, U value)

2. Window to Wall Ratio (WWR: depends on the range of 40-90%)

3. Wall Type (depends on the U value)

4. Orientation*

5. Shading Device (with-without situation)*

**Alternatives have been tried just for demonstrating the general impact of orientation and shading device on a building.*

When Konak municipality building design has been analyzed, it has been realized that architects used glass on the whole façades and on separator walls. This means that the effective material is glass for energy and daylight measurements in this case. Consequently, the glazing type and window to wall ratio (WWR) have been altered respectively. The minimum energy demand has been tried to achieve for all building and maximum illuminance level for an open office in the second floor. As being refered later in the result chapter, the best WWR value provided a third parameter, that being a wall type. The initial design has a fully glazed façade; after running simulations new alternatives demonstrated that 60% of WWR provides best optimization result energy and illuminance level for this case study.

5.3.4.1.1. Glazing Type

Glazing material has been choosen as ISICAM brand due to its being the most used glass material in Turkey trade. Additionally, influences on energy consumption has

been estimated by measuring the differantiations between basic types, namely double pane, triple pane, acoustic and thermal (Low-E) features of glazings. As seen in the Table 28, transmittance value is in the range of 61% and 71%. The base glazing has solar and active thermal control and the best glazing type has noise control, security and safety control besides others. Results demonstrated the transmittance value is the most effective features on the energy consumption. OpenStudio requires the transmittance, reflections and thermal conductivity value in order to estimate detailed. Therefore, U value of glazing has been defined as thermal conductivity for the calculations.

5.3.4.1.2. Window to Wall Ratio (WWR)

In the Shen (2012) study, the WWR has been in the range of 15-70% at 10% increments and Sherif et al (2014) has used the range of 10-90% at 5% increments. In the thesis, the range of WWR is between 40-90% at 10% increments. The base design of municipality building has 100% percentage of glazing; however, OpenStudio requires the frame and divider as mullion and frame of glazing façade, separately. Owing to this, WWR has been defined as 90% for all the facades in the base simulation. The reason of minimum limit of WWR as 40% depends on many studies about the optimization of WWR, such as **Goia's** study: the optimal WWR has been in the range of 30-45%.

5.3.4.1.3. Wall type (insulation, wall material)

İzmir is located in the first region as prevalent climate zones in Turkey. Therefore, the constant U value of wall detail is 0.7 W/m^2K in TS825 regulations (Table 27). Rather than this U-value is being too low, new studies demonstrates that 0.7 W/m^2K is not enough for new buildings effiency level. Yetkin Yazıcı (2016) has studied a thesis about suitable envelope details for achieving thermal environmental and budget goals by researching the optimum wall detail for a hospital patient room. Her research includes 24 wall details that matched six varient U-values with different wall materials. The main approach of her thesis is achieving a goal of the intersection for the best wall detail in terms of U value, cost and total environmental impact. In the thesis, her six details have been used for achieving the minimum energy demand by taking one of six different wall details. Table 29 illustrates the used details from Yetkin thesis.

Table 27. U values of Building Envelope for İzmir Case (TS 825)

U values for İzmir (1st Climate Zone)	
$W/m^2.K$	**Current values**
U wall	0,7
U floor	0,7
U roof	0,45
U Window	2,4

5.3.4.1.4. Orientation

Konak Municipality Building has been oriented 18 degrees from South to North. To understand the impact of orientation, simulation has been altered based on the ALT18. According to the orientation alternatives, the building turns 90^o for each simulation. Table 29 shows that the orientation affects the total energy consumption. Although the orientation is the first parameter on the building design in architecture, this case study has not allowed changing orientation for application project. Because of that, orientation has been simulated in order to show the impact value for the early design stage parameter.

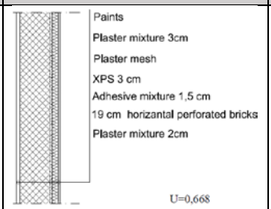
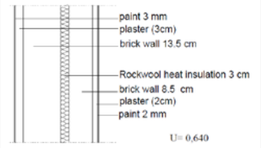
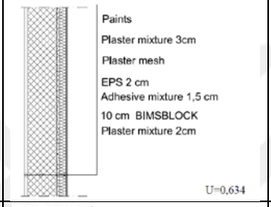
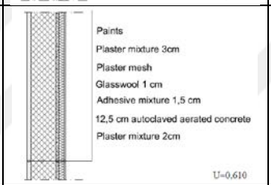
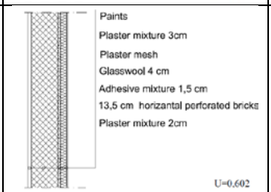
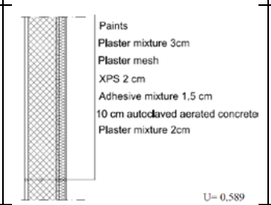
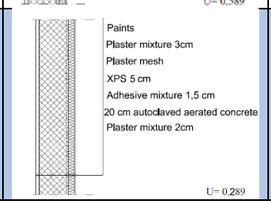
5.3.4.1.5. Shading Device

Architectural team has designed randomly vertical shading devices for each façade of Konak Municipality Building. As future works, the shading device type can be studied as a thesis by the help of other computational tools. In the thesis, only the impact of having shading device has been illustrated. Therefore, the simulation has been run based on the ALT18 as a best result of the thesis without shading devices.

Table 28. Glazing Type Simulation Inputs

				Daylight Values			Solar Energy Values				U-Value	
				Transmittance	Outer-Reflection	Inner-Reflection	Direct Transmittance	Outer-Reflection	Total Transmittance	Shading Coefficient	Air	
NAME	**Product**	**Layers**	**Type**	**%**	**%**	**%**	**%**	**%**	**%**		W/m²K	**Remarks**
BASE	**Isıcam K**	4+16+4	Low-E	71	10	11	40	29	44	0,51	1,3	Active Thermal Control+Solar Control
ALT1	**Isıcam K T**	6+16+6	Low-E+Düzcam	71	14	14	38	33	43	0,5	1,3	Active Thermal Control+Solar Control+Safety
ALT2	**Isıcam K AL T**	6+16+4,42	Low-E+Acoustic+ Laminated	70	14	14	35	33	42	0,49	1,3	Active Thermal Control+Solar Control+Noise Control+Security+Safety
ALT3	**Isıcam K AL**	4+16+4,42	Low-E+Acoustic+ Laminated	69	10	11	36	29	43	0,49	1,3	Active Thermal Control+Solar Control+Noise Control+Security+Safety
ALT4	**Isıcam K AL T 3+**	6+16+4+16+4,42	Low-E+Düzcam+ Low-E	61	16	16	29	34	38	0,44	0,7	Active Thermal Control+Solar Control+Noise Control+Security+Safety
ALT5	**Isıcam K 3+**	4+16+4+16+4	Low-E	63	12	14	32	30	39	0,44	0,7	Max. Thermal Control+Solar Control
ALT6	**Isıcam K T 3+**	6+16+4+16+6	Low-E+Düzcam+ Low-E	64	16	16	32	34	39	0,44	0,7	Max. Thermal Control+Solar Control+Safety

Table 29. Details of Wall Type Alternatives (Yetkin Yazıcı, 2016)

Detail Number	Detail	Total U value	Wall Components in Simulation Tool (from interior to outdoor)				
1		0,668	Plaster (2cm)	Brick (19 cm)	XPS (2cm)	Plaster mixture (3 cm)	
23		0,64	Plaster (2cm)	Brick (13,5 cm)	Rockwool (3 cm)	brick (8,5 cm)	Plaster mixture (3 cm)
10		0,634	Plaster (2cm)	Bimsblock (10cm)	EPS (2cm)	Plaster mixture (3 cm)	
20		0,61	Plaster (2cm)	Aerated concrete block (12,5cm)	Glasswool(1 cm)	Plaster mixture (3 cm)	
8		0,602	Plaster (2cm)	Brick (13,5 cm)	Glasswool(3cm)	Plaster mixture (3 cm)	
13		0,589	Plaster (2cm)	Aerated concrete block (10cm)	XPS (2cm)	Plaster mixture (3 cm)	
Alt18		0,289	Plaster (2cm)	Aerated concrete block (20cm)	XPS (5cm)	Plaster mixture (3 cm)	

5.4. Energy Performance Simulation Results

Base simulation has been run depending on materials given by architecture team. As mentioned previously, the main objectives of simulation are glazing type, window to wall ratio (WWR) and wall type. Considering the flow of simulations, the base simulation has ISICAM K (4+16+4; 1,3 W/m2K; 71% transmittance); 90% WWR (the rest of 10% is frame). The wall U value is given as 2,951 W/m^{2}K however, the whole façade designed as glazing. As a result, base simulation has 149 kWh/m2 and 245 lux for a selected point. Figure 27 illustrates the flow of simulation.

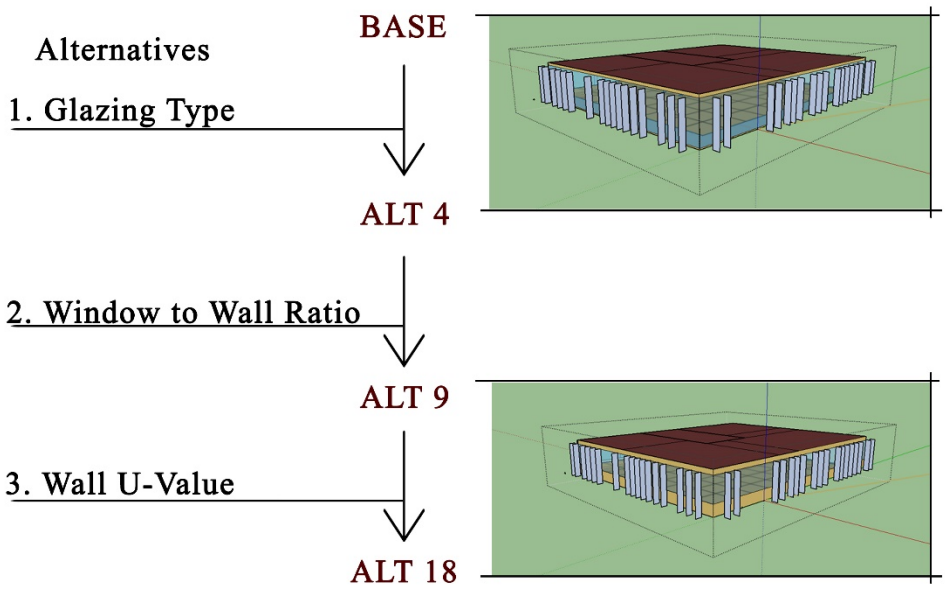


Figure 27. The Flow of Simulation Scenarios

5.4.1. Glazing Type

Glazing type alternatives demonstrates that (ALT4) ISICAM K AL T 3+ (6+16+4+4,42; 0,7 W/m2K; 61% transmittance) has given the best results when compared to all ISICAM K type of glazing that are on the market in Turkey. The ALT4 has 152 kWh/m2 and 266 lux for a selected point (Table 30). Rather than increasing the energy demand in the new alternative, illuminance level is rising more than energy demand. As a reason of that, the Alternative 4 has been chosen as the first best result as glazing type (Figure 28).

5.4.2. Window to Wall Ratio (WWR)

ALT 4 glazing type features has been used to measure the impact of the window to wall ratio (WWR) in all façade. The base WWR is 90% due to OpenStudio model not allowing drawings frame and divider of the glazing. Therefore, glazing on the façade illustrates only the glass material without frames. Because of that, the rest of 10% has been considered and assumed as a frame and divider of glazing façade. The best option among WWR alternatives is the 60% glazing on the whole façades (10% is frame and the rest 30% is wall) designated as Alternative 9 (ALT 9). As a result, ALT 9 comsumes 141 kWh/m2 energy and has 236 lux for a selected point. The primary objective to select the best WWR has been balancing energy demand differences with illuminance level. WWR alternatives have changed the building façade instead of glazing type, by forming wall 30% on the façade. Therefore, the wall components became a new parameter for retrofitting this building simulation (Figure 29).

5.4.3. Wall Type

The wall components and U value have been altered depending on the result of another master thesis results. Yetkin Yazıcı (2017) have created 24 alternatives as wall detail to achieve the best U value besides the total environmental impact and cost efficiency. Six different wall U-values have been chosen to create alternatives apart from considering the cost and environmental impact. In the market, we might find the more thick material based on the best result. Because of that, the new alternative (Alternative 18-ALT18) has been created by using the best result of Yetkin's details on this case study. The Alternative 17 (ALT17) has 0,589 w/m2K wall and 135,34 kWh/m2 and 246 lux for a selected point. It has 10 cm Aeregated Concrete Block and 2cm XPS insulation as a detail. The new detail has 20 cm Aeregated Concrete Block and 5cm XPS insulation and U value of wall decreased 0,289. Therefore, quite low U-value has been achieved for a wall that can be adaptable for İzmir case resulted as 135,13 kWh/m2 and 293 lux for a selected point (Figure 30).

The selected parameters are the context of the thesis to affect different design phases. The impact of the simulation is mostly effective for the advanced design stage in order to decide the building component materials. The glazing type, window to wall

ratio and wall U value and shading device alternatives have been analyzed for the advanced design stage. Moreover, this study has provided some alternatives such as the orientation for the early design stage. In light of this knowledge, the thesis could be a guide sample to evaluate a municipality building design from the early design to the advanced design phase (Figure 31).

5.4.4. Orientation and Shading Device

The orientation and shading device simulations have been run for illustrating the impact on the building. Depends on the early design parameters, orientation could be change by simulation tool to define the location of building in the site. Considering the orientation, the heating and cooling consumptions have proved the effect on the building by maximum 5 kWh/m^2 differences totally.

On the other hand, the shading device influences have been tried only with and without situation. As a result, the building without shading device has had more than the base simulation result as 153,52 kWh/m^2. As considering the effect of shading device existence, the buildings can simulated for further studies as optimization of shading devices for each façade specifically.

Table 30. Simulation Alternative Results

RESULT TABLE		21st December	Electricity	Cooling	Heating	TOTAL			Orientation	The Best Results
		illuminance lux	kWh/m2	kWh/m2	kWh/m2	kWh/m2	WWR %	Wall U-Value	North -18	
BASE	Glazing type	245	37,76	89,01	22,34	**149,11**	90	2,951	-18	
ALT 1		254	37,76	99,71	20,67	**158,11**	90		-18	
ALT 2		215	37,75	98,50	20,83	**157,08**	90		-18	
ALT 3		184	37,76	97,22	22,79	**157,76**	90		-18	
ALT 4		266	37,74	90,86	23,41	**152,02**	90		-18	1st Best Result of Glazing Type
ALT 5		207	37,71	90,79	24,40	**152,90**	90		-18	
ALT 6		213	37,73	93,29	22,33	**153,36**	90		-18	
ALT 7	WWR	98	37,79	68,35	30,33	**136,47**	40		-18	
ALT 8		126	37,77	72,53	28,85	**139,15**	50		-18	
ALT 9		236	37,74	75,84	27,84	**141,42**	60	2,951	-18	2nd Best Result of WWR
ALT 10		172	37,75	80,07	26,64	**144,46**	70		-18	
ALT 11		342	37,76	85,41	25,26	**148,43**	80		-18	
ALT 12	Wall Type	208	37,73	78,59	19,73	**136,05**	60	0,668	-18	
ALT 13		191	37,72	78,02	19,63	**135,37**	60	0,64	-18	
ALT 14		219	37,72	78,09	19,68	**135,48**	60	0,634	-18	
ALT 15		224	37,76	78,42	18,94	**135,13**	60	0,61	-18	
ALT 16		252	37,74	78,48	20	**136,22**	60	0,602	-18	
ALT 17		246	37,74	78,42	19,18	**135,34**	60	0,589	-18	
ALT 18		293	37,74	79,24	18,15	**135,13**	60	0,289	-18	3rd Best Result of Wall U-Value
ALT 19	Orientation	168	37,77	73,54	18,86	130,18	60	0,289	-108	
ALT 20		147	37,76	79,57	19,43	136,76	60	0,289	-198	
ALT 21		503	37,71	76,55	17,78	132,04	60	0,289	-288	
ALT 22	Shading Device	318	37,71	100,22	15,58	**153,52**	60	0,289	-18	*Without shading device

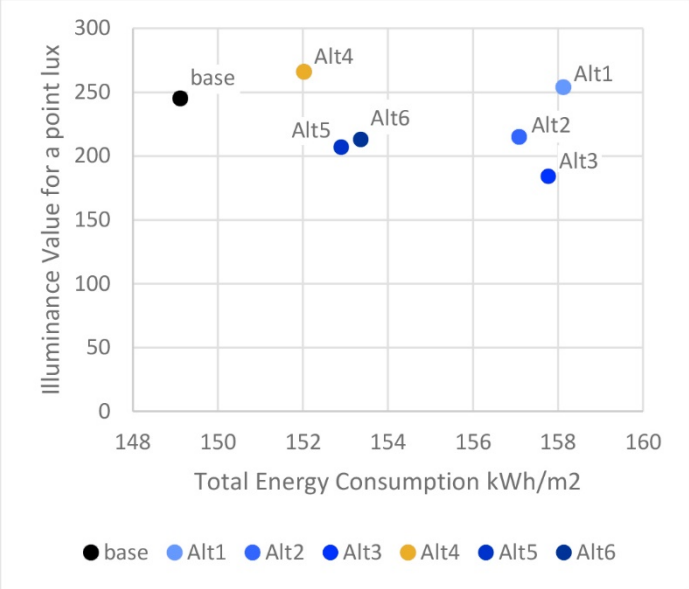


Figure 28. Results of Glazing Type Alternatives

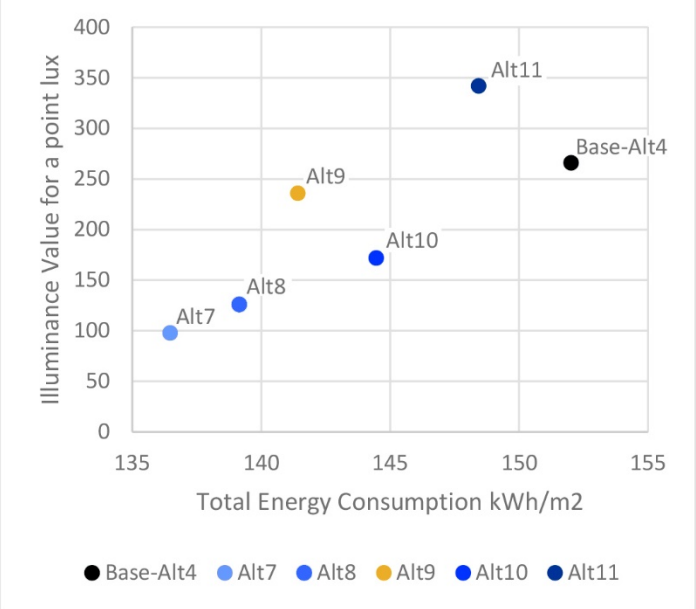


Figure 29. Results of Window to Wall Ratio Alternative

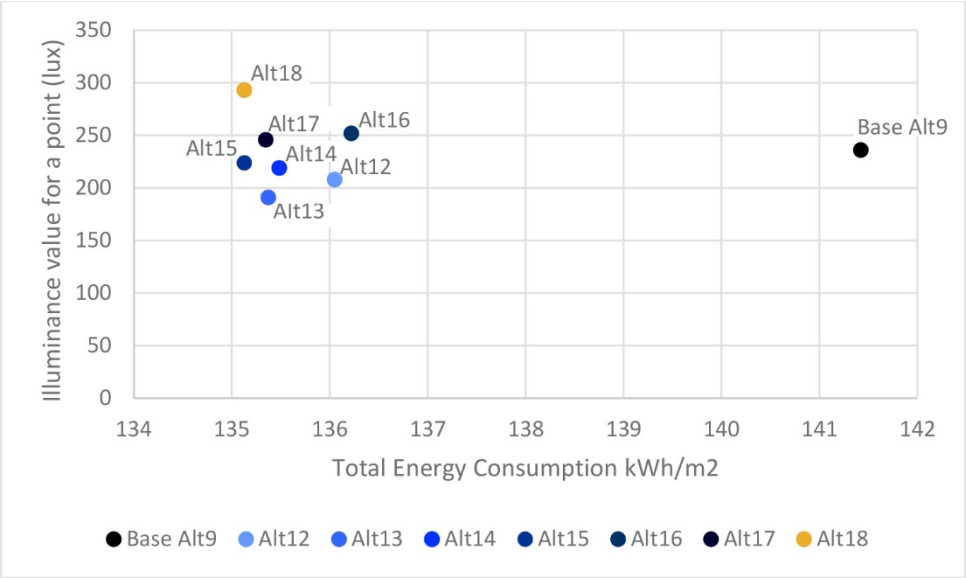
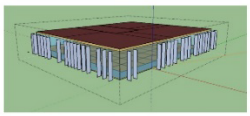


Figure 30. Results of Wall Type Alternatives

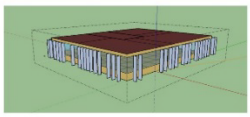


BASE Isıcam K 4+16+4
90% WWR (10% frame)
149 kwh/m2
245 lux

1. Glazing Type Alternatives

ALT 4 Isıcam K AL T 6+16+4+4,42
90% WWR (10% frame)
152 kwh/m2 +
266 lux +

2. Window to Wall Ratio



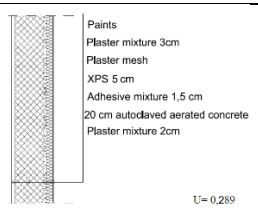
ALT 9 Isıcam K AL T 6+16+4+4,42
60% WWR (10% frame 30% wall)
2,951 Wall U-Value
141 kwh/m2 -
236 lux -

3. Wall U-Value

ALT 18 Isıcam K AL T 6+16+4+4,42
60% WWR (10% frame 30% wall)
0,289 Wall U-Value
135 kwh/m2 -
293 lux +

Figure 31. Result Visualization

Table 31. Summary of the Best Results

Name	EEM	Simulation Parameter	Features		U-Value
ALT 4	**Glazing type**	Isıcam K AL T 3+ 90%WWR	6+16+4+16+4,42	Low-E+Düzcam+ Low-E 61% (Transmittance)	0,7 (window)
ALT 9	**Window to Wall Ratio**	Isıcam K AL T 3+ 60% WWR			0,7 (window)
ALT 18	**Wall U-value**	Isıcam K AL T 3+ 60% WWR	*Plaster 2cm *Aerated Concrete Block 20cm *XPS 5cm Plaster mixture 3cm		0,289 (wall)

CHAPTER SIX
CONCLUSION

Regarding the performance based design principle; the thesis provides a framework for the guide to design energy efficient municipality building. As explained in the thesis, the framework has been formed around the design stages of municipality building as early design, design and advanced design. Because of that, **improving energy efficiency of municipality building has been studied via three varied investigations: (1) creating a program, (2) setting the standard for energy consumption, and (3) evaluation of energy performance by simulations.**

Literature survey demonstrates that much researches have been studied concerning offices, but not especially municipality office/administrative buildings as a local government building especially in Turkey. The significance of municipality building is that the municipalities could be policy makers for setting regulations and standards for energy efficiency in the building sector. In addition, municipalities have more public relationships than other type of government buildings. Because of that reason, municipalities could be an ideal model for all office buildings by demonstration of using the standard in their administrative buildings. **Influence of the governmental/public office building could provide public awareness by the help of municipal administrations.**

Aforementioned, municipality building have broadly complex structure as a program. Although the office/administrative spaces are more than other facilities, municipality buildings contain the social-cultural spaces in its own program. The social-cultural spaces could be varied depending on the urban texture of the culture, city, etc. Despite of municipality requirements have been differentiated as depending on individual preferences, any standard has been set by regulations or studies for required space area of municipality building program. The only source is Regulations (2014) by given numbers and limitations for employees of municipal departments. (Appendixes 1-5) **By the mean of the thesis, the program design requirements have been obtained for the early design stage of municipality building.**

Moreover, architects and engineers have realized the importance of energy simulations and have used those tools from early stage of design. Due to this this, the usage of energy performance simulations are becoming mandatory in reducing energy consumption. In the thesis, the simulation has been used from early to advanced design stages for improving energy efficiency. By means of simulation, this study has provided the framework of energy performance parameters usage in OpenStudio as a simulation tool for the district municipality building design. **This energy performance analysis aimed to integrate the simulation tool usage to architectural design in order to take precautions against causing more energy consumption.**

As explained above, this study has a novelty by creating a framework for architectural design of municipality buildings.

Evaluation of the municipality building, as a framework, guides:

1. Program necessities for early design stage

2. Energy consumption standards for design stage

3. Energy performance criterion for advanced design stage (improving energy efficiency 9.39 %)

6.1. Program Design Necessities

In the thesis, program necessities have been investigated on 22 municipality buildings with the help of architectural competitions. The classification of the municipalities has been done depending on the regulations as metropolitan municipalities (5), provincial municipalities (5) and district municipalities (12). Architectural competitions have been searched as “specifications” (şartnameler) one by one in the period of 1985-2015 (Competition Specifications).

Regulations have been examined by code of regulations and Union of Municipalities of Turkey source (Union of Municipalities of Turkey, 2014). The departments’ number of employees data has formed standard areas in the thesis. **Considering all, the optimum building programs have become a guide table in the thesis (Table 10, 11, 12). These tables have provided the necessary areas for each department for each type of municipality building.**

For further studies as an architectural design approach, the municipality building program could be separated as administrative departments (offices) and social-cultural departments (conference hall, dining hall, etc.). As a result of Chapter 2, classification of departments, as mandatory and optional, could be matched administrative (offices) and social-cultural (conference hall, dining hall, etc.) departments. This provides the separation of the occupancy frequency of varied departments in the building. Therefore, the architectural form could be designed in a regularity by pertaining to the mechanical system directly. **The meaning of that, the program layout design affects the mechanical system design related to the energy consumption explicitly. Considering all, the optimum program design provides the energy efficiency even if in the early design stage.**

According to the UNDP, sustainability integrated design starts by building program and continues with developing the design by simulations (UNDP, 2016). Because of that, **municipality program tables can be used as a first guide to define architectural competition specifications and municipality building program design.**

6.2. Energy Consumption Standardizations

Although İzmir has 31 district municipalities, eight municipalities have been studied via on nine buildings. The reason for this is due to contacting these municipalities and collecting data easily than from others. Buca, Gaziemir, Güzelbahçe, Kemalpaşa, Konak, Menderes, Seferihisar, Urla municipalities have supported this study by means of sharing their building information. The electricity, natural gas, solid fuel and water consumption data have been tried to collect by municipalities. However, only the electricity consumption has been validated for each municipality. Because of the misreporting and the lack of awareness about energy efficiency have caused this missing data in municipalities. As an option to solve this problem, a department could be defined for each type of municipality certainly to collect all consumption data regularly. Also, some seminars could be given to municipality personnels for increasing the awareness of energy efficiency.

As a consequence of the existing municipality building investigation, the second main output is energy consumption limitation for İzmir case. As obtained by existing

situation, **the threshold values have obtained 58,12 kWh/m^2 and 187,92 kWh/m^2; average electricity consumption has obtained 102.92 kWh/m^2 for İzmir case.**

6.3. Energy Performance Simulations

Gaziemir municipality building is the most assertive municipality as having all details to investigate it in all studied municipalities. All energy consumption bills and detailed project drawing could be obtained. Because of that, simulation on this building has been run to find deviation of OpenStudio simulation tool initially. **As result of this simulation, the deviation of OpenStudio has been proved, 1.6% is as different as the actual building results.**

Konak Municipality would like to move their administrative municipality building to another site in İzmir. Consequently, they have opened a call for architectural competition. Ziya İmren and partners, as winners of the competition, have designed a building for that architectural competition. As mentioned before, the thesis has been related to investigation of municipality building designed by architectural competitions. Therefore, Konak Municipality Building have been studied as a case building to find out an ideal model. During the thesis process, the municipality and architect have been got in contact to collect data and to share results.

For Konak Municipality case, as an architectural parameters glazing type, window to wall ratio, wall type, orientation and shading device have been searched. Despite of the orientation has been simulated pertaining to the early design stage; glazing type, WWR, all type and shading device parameters has been simulated pertaining to the advanced design stage for a building. The rest of the determined the architectural, service system and renewable intervention parameters could be studied by the help of other computational tools for further studies.

Glazing type: As a base building, Konak Municipality Building has a glazed façade for each orientation. The glazing type has been assumed ISICAM K (4+16+4; 1,3 W/m2K; 71% transmittance); 90% WWR (the rest of 10% is frame). Glazing type alternatives demonstrate that (ALT4) ISICAM K AL T 3+ (6+16+4+4,42; 0,7 W/m2K; 61% transmittance) has given the best results when compared to all Isıcam K types of glazing that are on the market in Turkey. **The ALT4 has 1.94% raise for total energy demand depends on base; in contrast, it has 8.57% raise for illuminance level for a specific point** (Table 30). Considering all the glazing type

parameters, it might be interpret that the Uvalue and the transmittance values are the most effective parameters of glazing type. The ALT 4 as the first best result is lower 10% in transmittance and 0,6 w/m^2K U value than the base simulation.

Window to Wall Ratio: For the "window to wall ratio" alternatives, the best result has 60% WWR except for frame as ALT 9. **In ALT 9, the decreasing of energy consumption is by 6.96% and illuminance level is by 11.27% decreasing of illuminance level.** The main objective to select the best WWR is to balance energy demand differences with illuminance level.

Wall type: A new alternative (Alternative 18-ALT18) has been created by using the best result of Yetkin's details on the thesis case study. Yetkin's best wall detail has 10 cm Aeregated Concrete Block and 2cm XPS insulation as a detail. The new detail has 20 cm aeregated concrete block and 5cm XPS insulation and U value of wall decreased 0,289. Therefore, Quite low U-value has been achieved for a wall which can be adaptable for İzmir case. **This means decreasing 4,44% of energy demands and 24,1% increasing of illuminance level.**

Comparing with the base of simulation, municipality design had a fully glazing façade. **Total achievement is a decreasing 9.39 % rate of energy demand and an increasing 19% rate of illuminance level.** As considering all these results, it could be interpret the glazing type has the minimum impact on the energy demand. The decreasing of WWR influenced the building positively regarding energy demand in the contrast to receiving benefit of daylighting. **Consequenlty, the wall U-value is the most effective parameter for minimizing energy demand and maximizing daylight illuminance level indoor.**

Furthermore, the electricity consumption of Konak M.B. is lower value than the average electricity consumption of İzmir. However, because of that the rest of the energy consumption levels could not be obtained by survey, the total energy consumption of Konak MB comparison could not be compared with the total average.

Orientation and Shading Device: On the other hand, the orientation and shading device effects can be seen in Table 30. While orientation changes, total energy consumption have decreased by 3% based on ALT18, ALT22 as an alternative without shading device increases energy consumption by 13% based on ALT18. In

addition, the impact of the shading device can explained with the help of cooling and heating energy consumption details. According to the results, although heating energy consumption decreases 3 kWh/m^2.yr, cooling energy consumption raises almost 21 kWh/m^2.yr total energy.

6.4. A Framework of Performance Based Design Guide for Municipality Building

A proposal perspective can be applied for a further guide application:

1. Early Design Stage: Draft Project

Program Design (Chapter 2.4)

Orientation (Chapter 5.4)

2. Design Stage: Project

Existing Municipality Building Investigation (Chapter 3.1)

Program Design

Building typology

3. Advanced Design Stage: Application Project

Simulation tool usage: OpenStudio (Chapter 4.3)

Evaluation of Energy Performance Parameters (Chapter 5)

Glazing Type (depends on Transmittance, U value)

Window to Wall Ratio (WWR: depends on the range of 40-90%)

Wall Type (depends on the U value)

Shading Device (with-without situation)*

4. Post Design Stage

Construction-Application (this is not the topic of the thesis)

5. Management of the facility

Municipality Administration awareness (Chapter 3)

To set a department to be responsible for data collection of energy consumptions

To set the standard for energy consumptions

Considering all of the above, this study may be a usable guide starting from municipality buildings to governmental office buildings. The needs of optimum program design and energy consumption level might be standardised by authorities. For energy performance measurements, the simulation usage could be supportive tool for the design phases. Moreover, the municipalities in Turkey can realize that their administrative buildings have a substantial impact by the mean of eight municipalities signed Covenant of Mayors. The mere awareness of the importance of energy consumption reduction by the public might be improved the energy efficiency level in Turkey.

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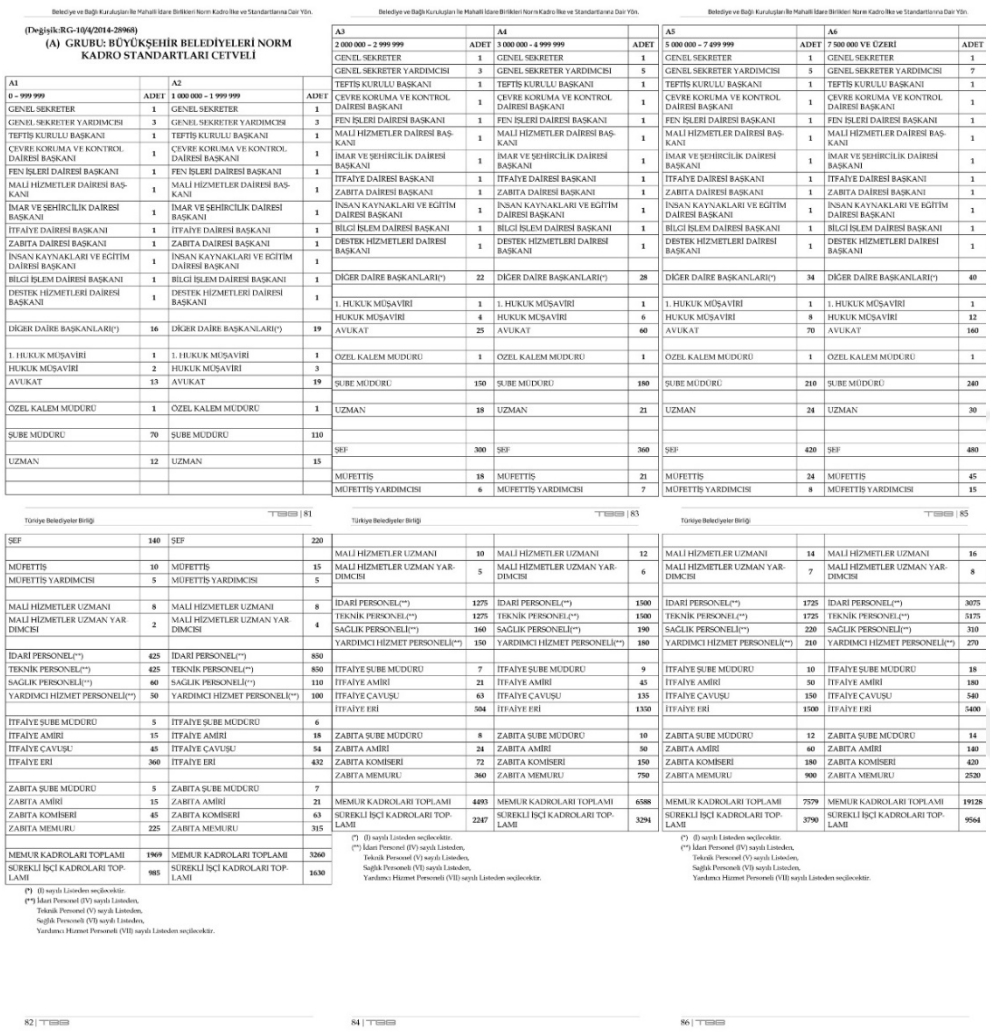
APPENDIX 1

A Groups Municipality: Norm and Standards regarding number of employee



Belediye ve Bağlı Kuruluşları İle Mahalli İdare Birlikleri Norm Kadro İlke ve Standartlarına Dair Yön.

(Değişik:RG-10/4/2014-28968)

(A) GRUBU: BÜYÜKŞEHİR BELEDİYELERİ NORM KADRO STANDARTLARI CETVELİ

A1		A2	
0 – 999 999	ADET	1 000 000 – 1 999 999	ADET
GENEL SEKRETER	1	GENEL SEKRETER	1
GENEL SEKRETER YARDIMCISI	3	GENEL SEKRETER YARDIMCISI	3
TEFTİŞ KURULU BAŞKANI	1	TEFTİŞ KURULU BAŞKANI	1
ÇEVRE KORUMA VE KONTROL DAİRESİ BAŞKANI	1	ÇEVRE KORUMA VE KONTROL DAİRESİ BAŞKANI	1
FEN İŞLERİ DAİRESİ BAŞKANI	1	FEN İŞLERİ DAİRESİ BAŞKANI	1
MALİ HİZMETLER DAİRESİ BAŞKANI	1	MALİ HİZMETLER DAİRESİ BAŞKANI	1
İMAR VE ŞEHİRCİLİK DAİRESİ BAŞKANI	1	İMAR VE ŞEHİRCİLİK DAİRESİ BAŞKANI	1
İTFAİYE DAİRESİ BAŞKANI	1	İTFAİYE DAİRESİ BAŞKANI	1
ZABITA DAİRESİ BAŞKANI	1	ZABITA DAİRESİ BAŞKANI	1
İNSAN KAYNAKLARI VE EĞİTİM DAİRESİ BAŞKANI	1	İNSAN KAYNAKLARI VE EĞİTİM DAİRESİ BAŞKANI	1
BİLGİ İŞLEM DAİRESİ BAŞKANI	1	BİLGİ İŞLEM DAİRESİ BAŞKANI	1
DESTEK HİZMETLERİ DAİRESİ BAŞKANI	1	DESTEK HİZMETLERİ DAİRESİ BAŞKANI	1
DİĞER DAİRE BAŞKANLARI(*)	16	DİĞER DAİRE BAŞKANLARI(*)	19
1. HUKUK MÜŞAVİRİ	1	1. HUKUK MÜŞAVİRİ	1
HUKUK MÜŞAVİRİ	2	HUKUK MÜŞAVİRİ	3
AVUKAT	13	AVUKAT	19
ÖZEL KALEM MÜDÜRÜ	1	ÖZEL KALEM MÜDÜRÜ	1
ŞUBE MÜDÜRÜ	70	ŞUBE MÜDÜRÜ	110
UZMAN	12	UZMAN	15

A3		A4	
2 000 000 – 2 999 999	ADET	3 000 000 - 4 999 999	ADET
GENEL SEKRETER	1	GENEL SEKRETER	1
GENEL SEKRETER YARDIMCISI	3	GENEL SEKRETER YARDIMCISI	5
TEFTİŞ KURULU BAŞKANI	1	TEFTİŞ KURULU BAŞKANI	1
ÇEVRE KORUMA VE KONTROL DAİRESİ BAŞKANI	1	ÇEVRE KORUMA VE KONTROL DAİRESİ BAŞKANI	1
FEN İŞLERİ DAİRESİ BAŞKANI	1	FEN İŞLERİ DAİRESİ BAŞKANI	1
MALİ HİZMETLER DAİRESİ BAŞKANI	1	MALİ HİZMETLER DAİRESİ BAŞKANI	1
İMAR VE ŞEHİRCİLİK DAİRESİ BAŞKANI	1	İMAR VE ŞEHİRCİLİK DAİRESİ BAŞKANI	1
İTFAİYE DAİRESİ BAŞKANI	1	İTFAİYE DAİRESİ BAŞKANI	1
ZABITA DAİRESİ BAŞKANI	1	ZABITA DAİRESİ BAŞKANI	1
İNSAN KAYNAKLARI VE EĞİTİM DAİRESİ BAŞKANI	1	İNSAN KAYNAKLARI VE EĞİTİM DAİRESİ BAŞKANI	1
BİLGİ İŞLEM DAİRESİ BAŞKANI	1	BİLGİ İŞLEM DAİRESİ BAŞKANI	1
DESTEK HİZMETLERİ DAİRESİ BAŞKANI	1	DESTEK HİZMETLERİ DAİRESİ BAŞKANI	1
DİĞER DAİRE BAŞKANLARI(*)	22	DİĞER DAİRE BAŞKANLARI(*)	28
1. HUKUK MÜŞAVİRİ	1	1. HUKUK MÜŞAVİRİ	1
HUKUK MÜŞAVİRİ	4	HUKUK MÜŞAVİRİ	6
AVUKAT	25	AVUKAT	60
ÖZEL KALEM MÜDÜRÜ	1	ÖZEL KALEM MÜDÜRÜ	1
ŞUBE MÜDÜRÜ	150	ŞUBE MÜDÜRÜ	180
UZMAN	18	UZMAN	21
ŞEF	300	ŞEF	360
MÜFETTİŞ	18	MÜFETTİŞ	21
MÜFETTİŞ YARDIMCISI	6	MÜFETTİŞ YARDIMCISI	7

A5		A6	
5 000 000 – 7 499 999	ADET	7 500 000 VE ÜZERİ	ADET
GENEL SEKRETER	1	GENEL SEKRETER	1
GENEL SEKRETER YARDIMCISI	5	GENEL SEKRETER YARDIMCISI	7
TEFTİŞ KURULU BAŞKANI	1	TEFTİŞ KURULU BAŞKANI	1
ÇEVRE KORUMA VE KONTROL DAİRESİ BAŞKANI	1	ÇEVRE KORUMA VE KONTROL DAİRESİ BAŞKANI	1
FEN İŞLERİ DAİRESİ BAŞKANI	1	FEN İŞLERİ DAİRESİ BAŞKANI	1
MALİ HİZMETLER DAİRESİ BAŞKANI	1	MALİ HİZMETLER DAİRESİ BAŞKANI	1
İMAR VE ŞEHİRCİLİK DAİRESİ BAŞKANI	1	İMAR VE ŞEHİRCİLİK DAİRESİ BAŞKANI	1
İTFAİYE DAİRESİ BAŞKANI	1	İTFAİYE DAİRESİ BAŞKANI	1
ZABITA DAİRESİ BAŞKANI	1	ZABITA DAİRESİ BAŞKANI	1
İNSAN KAYNAKLARI VE EĞİTİM DAİRESİ BAŞKANI	1	İNSAN KAYNAKLARI VE EĞİTİM DAİRESİ BAŞKANI	1
BİLGİ İŞLEM DAİRESİ BAŞKANI	1	BİLGİ İŞLEM DAİRESİ BAŞKANI	1
DESTEK HİZMETLERİ DAİRESİ BAŞKANI	1	DESTEK HİZMETLERİ DAİRESİ BAŞKANI	1
DİĞER DAİRE BAŞKANLARI(*)	34	DİĞER DAİRE BAŞKANLARI(*)	40
1. HUKUK MÜŞAVİRİ	1	1. HUKUK MÜŞAVİRİ	1
HUKUK MÜŞAVİRİ	8	HUKUK MÜŞAVİRİ	12
AVUKAT	70	AVUKAT	160
ÖZEL KALEM MÜDÜRÜ	1	ÖZEL KALEM MÜDÜRÜ	1
ŞUBE MÜDÜRÜ	210	ŞUBE MÜDÜRÜ	240
UZMAN	24	UZMAN	30
ŞEF	420	ŞEF	480
MÜFETTİŞ	24	MÜFETTİŞ	45
MÜFETTİŞ YARDIMCISI	8	MÜFETTİŞ YARDIMCISI	15

Türkiye Belediyeler Birliği T.B.B. | 81

ŞEF	140	ŞEF	220
MÜFETTİŞ	10	MÜFETTİŞ	15
MÜFETTİŞ YARDIMCISI	5	MÜFETTİŞ YARDIMCISI	5
MALİ HİZMETLER UZMANI	8	MALİ HİZMETLER UZMANI	8
MALİ HİZMETLER UZMAN YARDIMCISI	2	MALİ HİZMETLER UZMAN YARDIMCISI	4
İDARİ PERSONEL(**)	425	İDARİ PERSONEL(**)	850
TEKNİK PERSONEL(**)	425	TEKNİK PERSONEL(**)	850
SAĞLIK PERSONELİ(**)	60	SAĞLIK PERSONELİ(**)	110
YARDIMCI HİZMET PERSONELİ(**)	50	YARDIMCI HİZMET PERSONELİ(**)	100
İTFAİYE ŞUBE MÜDÜRÜ	5	İTFAİYE ŞUBE MÜDÜRÜ	6
İTFAİYE AMİRİ	15	İTFAİYE AMİRİ	18
İTFAİYE ÇAVUŞU	45	İTFAİYE ÇAVUŞU	54
İTFAİYE ERİ	360	İTFAİYE ERİ	432
ZABITA ŞUBE MÜDÜRÜ	5	ZABITA ŞUBE MÜDÜRÜ	7
ZABITA AMİRİ	15	ZABITA AMİRİ	21
ZABITA KOMİSERİ	45	ZABITA KOMİSERİ	63
ZABITA MEMURU	225	ZABITA MEMURU	315
MEMUR KADROLARI TOPLAMI	1969	MEMUR KADROLARI TOPLAMI	3260
SÜREKLİ İŞÇİ KADROLARI TOPLAMI	985	SÜREKLİ İŞÇİ KADROLARI TOPLAMI	1630

(*) (I) sayılı Listeden seçilecektir.
(**) İdari Personel (IV) sayılı Listeden,
Teknik Personel (V) sayılı Listeden,
Sağlık Personeli (VI) sayılı Listeden,
Yardımcı Hizmet Personeli (VII) sayılı Listeden seçilecektir.

82 | T.B.B.

Türkiye Belediyeler Birliği T.B.B. | 83

MALİ HİZMETLER UZMANI	10	MALİ HİZMETLER UZMANI	12
MALİ HİZMETLER UZMAN YARDIMCISI	5	MALİ HİZMETLER UZMAN YARDIMCISI	6
İDARİ PERSONEL(**)	1275	İDARİ PERSONEL(**)	1500
TEKNİK PERSONEL(**)	1275	TEKNİK PERSONEL(**)	1500
SAĞLIK PERSONELİ(**)	160	SAĞLIK PERSONELİ(**)	190
YARDIMCI HİZMET PERSONELİ(**)	150	YARDIMCI HİZMET PERSONELİ(**)	180
İTFAİYE ŞUBE MÜDÜRÜ	7	İTFAİYE ŞUBE MÜDÜRÜ	9
İTFAİYE AMİRİ	21	İTFAİYE AMİRİ	45
İTFAİYE ÇAVUŞU	63	İTFAİYE ÇAVUŞU	135
İTFAİYE ERİ	504	İTFAİYE ERİ	1350
ZABITA ŞUBE MÜDÜRÜ	8	ZABITA ŞUBE MÜDÜRÜ	10
ZABITA AMİRİ	24	ZABITA AMİRİ	50
ZABITA KOMİSERİ	72	ZABITA KOMİSERİ	150
ZABITA MEMURU	360	ZABITA MEMURU	750
MEMUR KADROLARI TOPLAMI	4493	MEMUR KADROLARI TOPLAMI	6588
SÜREKLİ İŞÇİ KADROLARI TOPLAMI	2247	SÜREKLİ İŞÇİ KADROLARI TOPLAMI	3294

(*) (I) sayılı Listeden seçilecektir.
(**) İdari Personel (IV) sayılı Listeden,
Teknik Personel (V) sayılı Listeden,
Sağlık Personeli (VI) sayılı Listeden,
Yardımcı Hizmet Personeli (VII) sayılı Listeden seçilecektir.

84 | T.B.B.

Türkiye Belediyeler Birliği T.B.B. | 85

MALİ HİZMETLER UZMANI	14	MALİ HİZMETLER UZMANI	16
MALİ HİZMETLER UZMAN YARDIMCISI	7	MALİ HİZMETLER UZMAN YARDIMCISI	8
İDARİ PERSONEL(**)	1725	İDARİ PERSONEL(**)	3075
TEKNİK PERSONEL(**)	1725	TEKNİK PERSONEL(**)	5175
SAĞLIK PERSONELİ(**)	220	SAĞLIK PERSONELİ(**)	310
YARDIMCI HİZMET PERSONELİ(**)	210	YARDIMCI HİZMET PERSONELİ(**)	270
İTFAİYE ŞUBE MÜDÜRÜ	10	İTFAİYE ŞUBE MÜDÜRÜ	18
İTFAİYE AMİRİ	50	İTFAİYE AMİRİ	180
İTFAİYE ÇAVUŞU	150	İTFAİYE ÇAVUŞU	540
İTFAİYE ERİ	1500	İTFAİYE ERİ	5400
ZABITA ŞUBE MÜDÜRÜ	12	ZABITA ŞUBE MÜDÜRÜ	14
ZABITA AMİRİ	60	ZABITA AMİRİ	140
ZABITA KOMİSERİ	180	ZABITA KOMİSERİ	420
ZABITA MEMURU	900	ZABITA MEMURU	2520
MEMUR KADROLARI TOPLAMI	7579	MEMUR KADROLARI TOPLAMI	19128
SÜREKLİ İŞÇİ KADROLARI TOPLAMI	3790	SÜREKLİ İŞÇİ KADROLARI TOPLAMI	9564

(*) (I) sayılı Listeden seçilecektir.
(**) İdari Personel (IV) sayılı Listeden,
Teknik Personel (V) sayılı Listeden,
Sağlık Personeli (VI) sayılı Listeden,
Yardımcı Hizmet Personeli (VII) sayılı Listeden seçilecektir.

86 | T.B.B.

APPENDIX 2

Number I-List of Optional Stuff for Group A Municipalities

(Değişik:RG-10/4/2014-28968)

(I) SAYILI LİSTE: DİĞER DAİRE BAŞKANLARI (BÜYÜKŞEHİR BELEDİYELERİ) KADRO UNVANLARI

DİĞER DAİRE BAŞKANLARI (BÜYÜKŞEHİR BELEDİYELERİ) KADRO UNVANLARI
STRATEJİ GELİŞTİRME DAİRESİ BAŞKANI
BASIN YAYIN VE HALKLA İLİŞKİLER DAİRESİ BAŞKANI
KENT ESTETİĞİ DAİRESİ BAŞKANI
BİLGİ TEKNOLOJİLERİ DAİRESİ BAŞKANI
DEPREM RİSK YÖNETİMİ VE KENTSEL İYİLEŞTİRME DAİRESİ BAŞKANI
DIŞ İLİŞKİLER DAİRESİ BAŞKANI
EMLAK VE İSTİMLAK DAİRESİ BAŞKANI
ETÜD VE PROJELER DAİRESİ BAŞKANI
EMLAK YÖNETİMİ DAİRESİ BAŞKANI
İŞLETME VE İŞTİRAKLER DAİRESİ BAŞKANI
SATINALMA DAİRESİ BAŞKANI
SOSYAL HİZMETLER DAİRESİ BAŞKANI
SAĞLIK VE SOSYAL HİZMETLER DAİRESİ BAŞKANI
SAĞLIK İŞLERİ DAİRESİ BAŞKANI
KAYNAK GELİŞTİRME VE İŞTİRAKLER DAİRESİ BAŞKANI
KÜLTÜR VE SOSYAL İŞLER DAİRESİ BAŞKANI
MAKİNA İKMAL BAKIM VE ONARIM DAİRESİ BAŞKANI
TRAFİK İŞLERİ DAİRESİ BAŞKANI
ULAŞIM DAİRESİ BAŞKANI
YAZI İŞLERİ VE KARARLAR DAİRESİ BAŞKANI
YAPI KONTROL DAİRESİ BAŞKANI
ULAŞIM PLANLAMA VE RAYLI SİSTEM DAİRESİ BAŞKANI
TARIMSAL HİZMETLER DAİRESİ BAŞKANI
KIRSAL HİZMETLER DAİRESİ BAŞKANI
DAİRE BAŞKANI

APPENDIX 3

B Group Municipality: Norm and Standards regarding number of employee

B4			
150 000-199 999	**ADET**	ŞEF	**36**
BELEDİYE BAŞKAN YARDIMCISI	**3**		
YAZI İŞLERİ MÜDÜRÜ	**1**	MÜFETTİŞ	**6**
MALİ HİZMETLER MÜDÜRÜ	**1**	MÜFETTİŞ YARDIMCISI	**2**
FEN İŞLERİ MÜDÜRÜ	**1**		
İMAR VE ŞEHİRCİLİK MÜDÜRÜ	**1**	AVUKAT	**4**
TEMİZLİK İŞLERİ MÜDÜRÜ	**1**		
İTFAİYE MÜDÜRÜ	**1**	MALİ HİZMETLER UZMANI	**2**
ZABITA MÜDÜRÜ	**1**	MALİ HİZMETLER UZMAN YARDIMCISI	**1**
HUKUK İŞLERİ MÜDÜRÜ	**1**		
VETERİNER İŞLERİ MÜDÜRÜ	**1**	İDARİ PERSONEL(**)	**87**
TEFTİŞ KURULU MÜDÜRÜ	**1**	TEKNİK PERSONEL(**)	**80**
		SAĞLIK PERSONELİ(**)	**21**
DİĞER MÜDÜRLER(*)	**12**	YARDIMCI HİZMET PERSONELİ(**)	**15**
ÖZEL KALEM MÜDÜRÜ	**1**		
		İTFAİYE AMİRİ	**3**
UZMAN	**6**	İTFAİYE ÇAVUŞU	**9**
		İTFAİYE ERİ	**81**
		ZABITA AMİRİ	**4**
		ZABITA KOMİSERİ	**12**
		ZABITA MEMURU	**76**
		MEMUR KADROLARI TOPLAMI	**471**
		SÜREKLİ İŞÇİ KADROLARI TOPLAMI	**227**

(*) (III) sayılı Listeden seçilecektir.

(**) İdari Personel (IV) sayılı Listeden,
Teknik Personel (V) sayılı Listeden,
Sağlık Personeli (VI) sayılı Listeden,
Yardımcı Hizmet Personeli (VII) sayılı Listeden seçilecektir.

APPENDIX 4

Number III-List of Optional Stuff for Group B, C, D and F1 Municipalities

(III) SAYILI LISTE: DIGER MUDURLER (B, C, D ve F1 GRUPLARI) KADRO UNVANLARI

DİĞER MÜDÜRLER (B, C, D ve F1 GRUPLARI) KADRO UNVANLARI
DESTEK HİZMETLERİ MÜDÜRÜ
MALİ HİZMETLER MÜDÜRÜ
STRATEJİ GELİŞTİRME MÜDÜRÜ
BASIN YAYIN VE HALKLA İLİŞKİLER MÜDÜRÜ
BELEDİYE TİYATRO MÜDÜRÜ
BELEDİYE ORKESTRA MÜDÜRÜ
BİLGİ İŞLEM MÜDÜRÜ
ÇEVRE KORUMA VE KONTROL MÜDÜRÜ
DIŞ İLİŞKİLER MÜDÜRÜ
EMLAK VE İSTİMLAK MÜDÜRÜ
ETÜD PROJE MÜDÜRÜ
FEN İŞLERİ MÜDÜRÜ
GECEKONDU VE SOSYAL KONUTLAR MÜDÜRÜ
HAL MÜDÜRÜ
HASTANE MÜDÜRÜ
HUZUREVİ MÜDÜRÜ
İMAR VE ŞEHİRCİLİK MÜDÜRÜ
İNSAN KAYNAKLARI VE EĞİTİM MÜDÜRÜ
RUHSAT VE DENETİM MÜDÜRÜ
İŞLETME MÜDÜRÜ
İŞLETME VE İŞTİRAKLER MÜDÜRÜ
KREŞ MÜDÜRÜ
KENTSEL TASARIM MÜDÜRÜ
KÜTÜPHANE MÜDÜRÜ
KÜLTÜR VE SOSYAL İŞLER MÜDÜRÜ
MEZARLIKLAR MÜDÜRÜ
MEZBAHA MÜDÜRÜ
PARK VE BAHÇELER MÜDÜRÜ
PLAN VE PROJE MÜDÜRÜ
SAĞLIK İŞLERİ MÜDÜRÜ
SOSYAL YARDIM İŞLERİ MÜDÜRÜ
SU İŞLERİ MÜDÜRÜ
SU VE KANALİZASYON MÜDÜRÜ
TEMİZLİK İŞLERİ MÜDÜRÜ
ULAŞIM HİZMETLERİ MÜDÜRÜ
TARIMSAL HİZMETLER MÜDÜRÜ
KIRSAL HİZMETLER MÜDÜRÜ
KADIN VE AİLE HİZMETLERİMÜDÜRÜ
VETERİNER İŞLERİ MÜDÜRÜ
YAPI KONTROL MÜDÜRÜ
TESİSLER MÜDÜRÜ
SPOR İŞLERİ MÜDÜRÜ

APPENDIX 5

C Group Municipality: Norm and Standards regarding number of employee

C11		
250 000–299 999	ADET	MÜFETTİŞ
BELEDİYE BAŞKAN YARDIMCISI	4	MÜFETTİŞ YARDIMCISI
YAZI İŞLERİ MÜDÜRÜ	1	
MALİ HİZMETLER MÜDÜRÜ	1	MALİ HİZMETLER UZMANI
FEN İŞLERİ MÜDÜRÜ	1	MALİ HİZMETLER UZMAN YARDIMCISI
İMAR VE ŞEHİRCİLİK MÜDÜRÜ	1	
TEFTİŞ KURULU MÜDÜRÜ	1	İDARİ PERSONEL(**)
TEMİZLİK İŞLERİ MÜDÜRÜ	1	TEKNİK PERSONEL(**)
ZABITA MÜDÜRÜ	1	SAĞLIK PERSONELİ(**)
HUKUK İŞLERİ MÜDÜRÜ	1	YARDIMCI HİZMET PERSONELİ(**)
DİĞER MÜDÜRLER(*)	13	
		ZABITA AMİRİ
ÖZEL KALEM MÜDÜRÜ	1	ZABITA KOMİSERİ
		ZABITA MEMURU
UZMAN	5	
		MEMUR KADROLARI TOPLAMI
ŞEF	20	SÜREKLİ İŞÇİ KADROLARI TOPLAMI
AVUKAT	4	

(*) (III) sayılı Listeden seçilecektir.
(**) İdari Personel (IV) sayılı Listeden,
Teknik Personel (V) sayılı Listeden,
Sağlık Personeli (VI) sayılı Listeden,
Yardımcı Hizmet Personeli (VII) sayılı Listeden seçilecektir.

C13		C14	
400 000-499 999	ADET	500 000-599 999	ADET
BELEDİYE BAŞKAN YARDIMCISI	4	BELEDİYE BAŞKAN YARDIMCISI	5
YAZI İŞLERİ MÜDÜRÜ	1	YAZI İŞLERİ MÜDÜRÜ	1
MALİ HİZMETLER MÜDÜRÜ	1	MALİ HİZMETLER MÜDÜRÜ	1
FEN İŞLERİ MÜDÜRÜ	1	FEN İŞLERİ MÜDÜRÜ	1
İMAR VE ŞEHİRCİLİK MÜDÜRÜ	1	İMAR VE ŞEHİRCİLİK MÜDÜRÜ	1
TEFTİŞ KURULU MÜDÜRÜ	1	TEFTİŞ KURULU MÜDÜRÜ	1
TEMİZLİK İŞLERİ MÜDÜRÜ	1	TEMİZLİK İŞLERİ MÜDÜRÜ	1
ZABITA MÜDÜRÜ	1	ZABITA MÜDÜRÜ	1
HUKUK İŞLERİ MÜDÜRÜ	1	HUKUK İŞLERİ MÜDÜRÜ	1
DİĞER MÜDÜRLER(*)	16	DİĞER MÜDÜRLER(*)	27
ÖZEL KALEM MÜDÜRÜ	1	ÖZEL KALEM MÜDÜRÜ	1
UZMAN	6	UZMAN	9
ŞEF	24	ŞEF	30
AVUKAT	5	AVUKAT	8
MÜFETTİŞ	6	MÜFETTİŞ	9
MÜFETTİŞ YARDIMCISI	2	MÜFETTİŞ YARDIMCISI	3
MALİ HİZMETLER UZMANI	6	MALİ HİZMETLER UZMANI	8
MALİ HİZMETLER UZMAN YARDIMCISI	3	MALİ HİZMETLER UZMAN YARDIMCISI	4
İDARİ PERSONEL(**)	140	İDARİ PERSONEL(**)	180
TEKNİK PERSONEL(**)	79	TEKNİK PERSONEL(**)	100
SAĞLIK PERSONELİ(**)	22	SAĞLIK PERSONELİ(**)	30
YARDIMCI HİZMET PERSONELİ(**)	23	YARDIMCI HİZMET PERSONELİ(**)	25
ZABITA AMİRİ	8	ZABITA AMİRİ	10
ZABITA KOMİSERİ	16	ZABITA KOMİSERİ	20
ZABITA MEMURU	96	ZABITA MEMURU	120
MEMUR KADROLARI TOPLAMI	465	MEMUR KADROLARI TOPLAMI	597
SÜREKLİ İŞÇİ KADROLARI TOPLAMI	233	SÜREKLİ İŞÇİ KADROLARI TOPLAMI	299

(*) (III) sayılı Listeden seçilecektir.
(**) İdari Personel (IV) sayılı Listeden,
Teknik Personel (V) sayılı Listeden,
Sağlık Personeli (VI) sayılı Listeden,
Yardımcı Hizmet Personeli (VII) sayılı Listeden seçilecektir.

C15		C16	
600 000-699 999	ADET	700 000-799 999	ADET
BELEDİYE BAŞKAN YARDIMCISI	5	BELEDİYE BAŞKAN YARDIMCISI	5
YAZI İŞLERİ MÜDÜRÜ	1	YAZI İŞLERİ MÜDÜRÜ	1
MALİ HİZMETLER MÜDÜRÜ	1	MALİ HİZMETLER MÜDÜRÜ	1
FEN İŞLERİ MÜDÜRÜ	1	FEN İŞLERİ MÜDÜRÜ	1
İMAR VE ŞEHİRCİLİK MÜDÜRÜ	1	İMAR VE ŞEHİRCİLİK MÜDÜRÜ	1
TEFTİŞ KURULU MÜDÜRÜ	1	TEFTİŞ KURULU MÜDÜRÜ	1
TEMİZLİK İŞLERİ MÜDÜRÜ	1	TEMİZLİK İŞLERİ MÜDÜRÜ	1
ZABITA MÜDÜRÜ	1	ZABITA MÜDÜRÜ	1
HUKUK İŞLERİ MÜDÜRÜ	1	HUKUK İŞLERİ MÜDÜRÜ	1
DİĞER MÜDÜRLER(*)	31	DİĞER MÜDÜRLER(*)	33
ÖZEL KALEM MÜDÜRÜ	1	ÖZEL KALEM MÜDÜRÜ	1
UZMAN	10	UZMAN	10
ŞEF	32	ŞEF	36
AVUKAT	9	AVUKAT	10
MÜFETTİŞ	9	MÜFETTİŞ	9
MÜFETTİŞ YARDIMCISI	3	MÜFETTİŞ YARDIMCISI	3
MALİ HİZMETLER UZMANI	10	MALİ HİZMETLER UZMANI	10
MALİ HİZMETLER UZMAN YARDIMCISI	5	MALİ HİZMETLER UZMAN YARDIMCISI	5
İDARİ PERSONEL(**)	195	İDARİ PERSONEL(**)	210
TEKNİK PERSONEL(**)	121	TEKNİK PERSONEL(**)	142
SAĞLIK PERSONELİ(**)	32	SAĞLIK PERSONELİ(**)	34
YARDIMCI HİZMET PERSONELİ(**)	30	YARDIMCI HİZMET PERSONELİ(**)	35
ZABITA AMİRİ	11	ZABITA AMİRİ	12
ZABITA KOMİSERİ	22	ZABITA KOMİSERİ	24
ZABITA MEMURU	132	ZABITA MEMURU	144
MEMUR KADROLARI TOPLAMI	666	MEMUR KADROLARI TOPLAMI	729
SÜREKLİ İŞÇİ KADROLARI TOPLAMI	333	SÜREKLİ İŞÇİ KADROLARI TOPLAMI	365

(*) (III) sayılı Listeden seçilecektir.
(**) İdari Personel (IV) sayılı Listeden,
Teknik Personel (V) sayılı Listeden,
Sağlık Personeli (VI) sayılı Listeden,
Yardımcı Hizmet Personeli (VII) sayılı Listeden seçilecektir.

C18		MÜFETTİŞ YARDIMCISI	4
900 000-999 999	ADET		
BELEDİYE BAŞKAN YARDIMCISI	5	MALİ HİZMETLER UZMANI	12
YAZI İŞLERİ MÜDÜRÜ	1	MALİ HİZMETLER UZMAN YARDIMCISI	6
MALİ HİZMETLER MÜDÜRÜ	1		
FEN İŞLERİ MÜDÜRÜ	1	İDARİ PERSONEL(**)	240
İMAR VE ŞEHİRCİLİK MÜDÜRÜ	1	TEKNİK PERSONEL(**)	184
TEFTİŞ KURULU MÜDÜRÜ	1	SAĞLIK PERSONELİ(**)	38
TEMİZLİK İŞLERİ MÜDÜRÜ	1	YARDIMCI HİZMET PERSONELİ(**)	50
ZABITA MÜDÜRÜ	1		
HUKUK İŞLERİ MÜDÜRÜ	1	ZABITA AMİRİ	16
		ZABITA KOMİSERİ	32
DİĞER MÜDÜRLER(*)	40	ZABITA MEMURU	192
ÖZEL KALEM MÜDÜRÜ	1	MEMUR KADROLARI TOPLAMI	906
		SÜREKLİ İŞÇİ KADROLARI TOPLAMI	453
UZMAN	12		
ŞEF	40		
AVUKAT	14		
MÜFETTİŞ	12		

(*) (III) sayılı Listeden seçilecektir.
(**) İdari Personel (IV) sayılı Listeden,
Teknik Personel (V) sayılı Listeden,
Sağlık Personeli (VI) sayılı Listeden,
Yardımcı Hizmet Personeli (VII) sayılı Listeden seçilecektir.

C19	
1.000 000 VE ÜZERİ	ADET
BELEDİYE BAŞKAN YARDIMCISI	5
YAZI İŞLERİ MÜDÜRÜ	1
MALİ HİZMETLER MÜDÜRÜ	1
FEN İŞLERİ MÜDÜRÜ	1
İMAR VE ŞEHİRCİLİK MÜDURU	1
TEFTİŞ KURULU MÜDÜRÜ	1
TEMİZLİK İŞLERİ MÜDÜRÜ	1
ZABITA MÜDURU	1
HUKUK İŞLERİ MÜDÜRÜ	1
DİĞER MÜDÜRLER(*)	45
ÖZEL KALEM MÜDÜRÜ	1
UZMAN	13
ŞEF	46
AVUKAT	18
MÜFETTİŞ	15
MÜFETTİŞ YARDIMCISI	5
MALİ HİZMETLER UZMANI	14
MALİ HİZMETLER UZMAN YARDIMCISI	7
İDARİ PERSONEL(**)	270
TEKNİK PERSONEL(**)	205
SAĞLIK PERSONELİ(**)	42
YARDIMCI HİZMET PERSONELİ(**)	60
ZABITA AMİRİ	18
ZABITA KOMİSERİ	36
ZABITA MEMURU	216
MEMUR KADROLARI TOPLAMI	1024
SÜREKLİ İŞÇİ KADROLARI TOPLAMI	512

(*) (III) sayılı Listeden seçilecektir.
(**) İdari Personel (IV) sayılı Listeden,
Teknik Personel (V) sayılı Listeden,
Sağlık Personeli (VI) sayılı Listeden,
Yardımcı Hizmet Personeli (VII) sayılı Listeden seçilecektir.

QUESTIONNAIRE

Building Information Paper

Building name:
Project year:
Building Program:

1- How is the planning scheme of municipality buildings?

2- What are the components of external walls?

3-What are the properties of windows' and doors' materials?

4- Is there any shading device on the building façades?

5- Please inform about the lighting equipment of municipality buildings.

6-Is there any hot water usage? How is can be sourced that?

7- Is there any artificial ventilation in the building? How?

8- How many m^3 water consumption for annual?

9- How many kWh energy consumption for annual?
