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Ph.D. IN MECHANICAL ENGINEERING

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**UNIVERSITY OF GAZİANTEP
GRADUATE SCHOOL OF
NATURAL & APPLIED SCIENCES**

**THEORETICAL AND EXPERIMENTAL
INVESTIGATION OF COOLING LOAD
TEMPERATURE DIFFERENCE (CLTD) VALUES
FOR BUILDING WALLS AND FLAT ROOFS**

**A Ph.D. THESIS
IN
MECHANICAL ENGINEERING**

**BY
OMER ADIL ZAINAL
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**Theoretical and Experimental Investigation of Cooling
Load Temperature Difference (CLTD) Values for Building
Walls and Flat Roofs**

**Ph.D. Thesis
in
Mechanical Engineering
University of Gaziantep**

**Supervisor
Prof. Dr. Recep YUMRUTAŞ**

**By
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September 2015**

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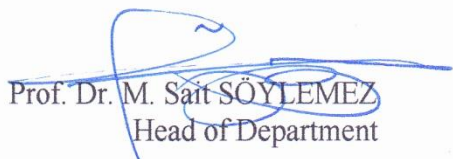
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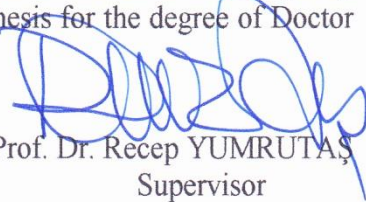
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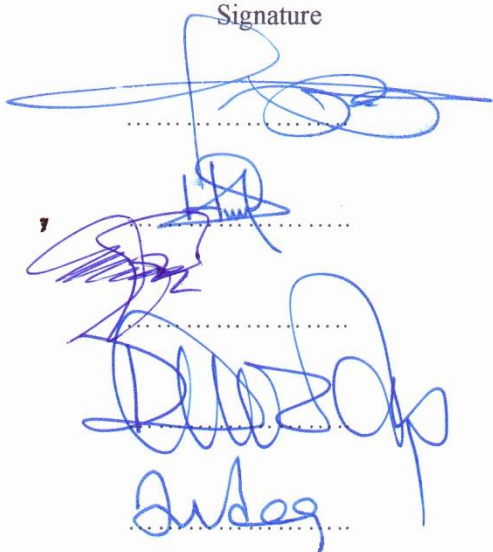
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ABSTRACT

THEORETICAL AND EXPERIMENTAL INVESTIGATION OF COOLING LOAD TEMPERATURE DIFFERENCE (CLTD) VALUES FOR BUILDING WALLS AND FLAT ROOFS

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Ph.D. in Mechanical Engineering

Supervisor: Prof. Dr. Recep YUMRUTAŞ

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In this thesis, Cooling Load Temperature Difference (CLTD) values for the commonly used multilayer building walls and flat roofs are obtained by using theoretical and experimental methods. A new periodic solution technique is applied for solving transient heat transfer problem for the building walls and flat roofs. The technique known as Complex Finite Fourier Transform (CFFT) technique is the first time used to obtain CLTD values for the building walls and flat roofs. Therefore, experimental system consisting of two testing rooms with eight types walls and two different roofs are used in the University of Gaziantep Campus to compare CLTD values for these elements. In the experimental study, inside and outside air temperatures, surface temperature of each layer of the walls and roofs and solar radiation flux on horizontal surface are measured instantaneously. Heat gains and CLTD values for the walls and roofs which are calculated using measurement values, and compared with theoretical results. Also, economic analysis has been done for some walls and roofs for finding the best wall type and optimum insulation thickness. A computational procedure based on the periodic solution is developed, and a program in Matlab is prepared for the numerical calculations. Validation for that model has been done by comparing CLTD values for some selected walls and roofs given in ASHRAE handbooks. It is observed that there is a considerable agreement between computed CLTD values and provided in ASHRAE handbooks for the selected structures. The results of economic analysis for ten years show the Roof 1 and AAC wall are the best for Turkey, as well as Roof B and Wall E the best for Iraq. Optimum thickness for Roof1, AAC wall, Roof B and Wall E are 36.7, 10.1, 24.5 and 10.8 cm, respectively.

Keywords: Cooling Load Temperature Difference, solar radiation, heat gain, cooling load, economical analysis.

ÖZET

DUVAR VE DÜZ TAVANLAR İÇİN SOĞUTMA YÜKÜ SICAKLIK FARKI (SYSF) DEĞERLERİNİN TEORİK VE DENEYSEL İNCELENMESİ

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Bu çalışmamada çok katmanlı bina duvarları ve düz tavanlarının Soğutma Yüğü Sıcaklık Farkı (SYSF) değeri teorik ve deneysel yöntemlerle elde edilmiştir. Bu duvar ve tavanlar için geçici rejim ısı transferi probleminin çözümünde yeni bir çözüm tekniğı kullanılmıştır. Bu teknik kompleks sonlu Fourier dönüşüm tekniğı olarak bilinmekte olup, literatürde ilk kez duvar ve düz tavanların SYSF değeri elde edilmesinde kullanılmıştır. Bunun için, SYSF değeri karşılaştırmak amacıyla Gaziantep Üniversitesi Kampüsü'nde inşa edilen, 8 duvar ve 2 tavadan oluşan 2 adet test odası kullanılmıştır. Bu deneysel çalışmada, iç ve dış hava sıcaklıkları, duvar ve tavanların her katmanının yüzey sıcaklığı ve yatay yüzeye gelen güneş ışıını anlık olarak ölçülmüştür. Deneysel olarak ölçülen bu veriler kullanarak ısı kazanç ve SYSF değeri hesaplanmış ve teorik sonuçlarla karşılaştırılmıştır. Ayrıca, bu duvarlar içerisinde en iyi duvar tipi ve yalıtım kalınlığını belirlemek için ekonomik analiz yapılmıştır. Sayısal sonuçlar elde etmek için, periyodik çözümü kullanan bir hesaplama yöntemi geliştirilerek bir Matlab programı hazırlanmıştır. Modelin doğruluğunu kanıtlamak için ASHRAE'dan seçilen bazı duvar ve tavanların SYSF değeri karşılaştırılmıştır. Hesaplanan SYSF değeri ile ASHRAE'de verilen değeri arasında dikkate değeri bir yakınlık olduğu gözlenmiştir. On yıl için yapılan ekonomik analiz sonuçları, 1 numaralı tavanın ve Gazbetonun Türkiye için en iyi, B kodlu tavan ile E kodlu duvarın ise Irak için en iyi olduğunu göstermiştir. 1 numaralı tavan, AAC, B kodlu tavan ve E kodlu duvar için en uygun kalınlıklar ise sırasıyla 36.7, 10.1, 24.5 ve 10.8 cm olarak hesaplanmıştır.

Anahtar Kelimeler: Soğutma Yüğü Sıcaklık Farkı, güneş ışıını, ısı kazanımı, soğutma yüğü, ekonomik analiz.

To **My**

Mother, who was hoping to I get a Ph.D. and Father who taught me the challenge of difficulties in the life and to my beloved wife which gave the time and support for me to reach this level from the knowledge

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LIST OF SYMBOLS

SYMBOLS

h_i	combined heat transfer coefficient at the inner surface (W/m ² K)
h_o	combined heat transfer coefficient at the outer surface (W/m ² K)
I	radiation heat flux on horizontal surface, (W/m ²)
I_b	Beam radiation, (W/m ²)
I_d	Diffuse radiation, (W/m ²)
I_o	Extraterrestrial radiation on a surface, (W/m ²)
I_T	radiation heat flux on tilted surface (W/m ²)
k	thermal conductivity (W/mK)
L	thickness (m)
q_c	heat gain (W/m ²)
t	time (s)
T	temperature (°C)
T_i	design inside air temperature (°C)
T_o	outside air temperature (°C)
A	Surface area of wall
N	Lifetime
c	Specific heat
C	Cost
C_E	Cost of electricity
C_{ins}	Insulation cost
C_w	Wall cost
COP	Coefficient of performance of cooling system
d	Inflation rate
r	Interest rate
E	Equation of time
G_{on}	Extraterrestrial radiation measured on the plane normal to the radiation on the n th day of the year

G_{sc} Solar constant

Greek symbols

α thermal diffusivity (m^2/s)

α_s absorptance of surface

Subscripts

i inside

j number of terms

n number of layer

N number of last layer

o outside

CHAPTER 1

INTRODUCTION

Energy saving is the main goal to people in the all developed countries in the world. Energy consuming is one of the most vital indicators pointing out the growth of community. Power needed each capita unceasingly increases alongside progress of indoor comfort conditions in living medium. It raises utilization of power origins. That leads to weighty implications on contamination. Meteorological conditions change. Rising price of power and depletion of the power resources [1].

Air conditioning is one of vital requisites for human beings. Who demand to live in spaces alongside comfort conditions all year round, the comfort conditions could be given as dry and soaked bulb temperatures. Humidity, air velocity and cleaning. It is vital to cool the living spaces in summertime period and to warmth it in winter season. Heating, ventilating and air conditioning (HVAC) arrangement is retained for cooling the living spaces in summertime period and warming in winter season.

HVAC arrangements have been the most momentous resolution for a extra cozy existence as long ago. Therefore, forecast of space cooling burden is the central portion of arranging of constructing power necessity or capacity of the HVAC systems. Transference of heat across constructing structural constituents is of paramount significance as approximating the space heating and cooling loads alongside the power necessity of each building [2]. In order to forecast number of power consumption by HVAC arrangement needed precisely, it is imperative to apply transient thermodynamic method of analysis for heat flow estimations in constructing constructions. This is because the usually utilized constructing blocks of constructions such as block, concrete, sand, tiles are scarcely in stable state. Due to adopting transient thermodynamic phenomenon separately from the computational price a momentous intricacy is imposed to the power analysis of constructing and

the vibrant simulation method of HVAC arrangements [3,4]. Especially, constructing envelopes or exterior walls and roofs have an vital act in cutting or rising heat defeat and heat gain from these structures. The average at that power is transferred into or inside generated inside each space at each instant is termed as heat gain. The heat gain of a constructing could encompass of each one or all from pursuing components: a) conduction of heat across exterior walls, ceilings and floors b) solar radiation across windows, ventilation or transparent surfaces, c) heat generation inside spaces occurs by lights, occupants and appliances etc. d) meteorological air ventilation and infiltration and miscellaneous heat gains [5]. Estimating the heat gain of a constructing precisely is prerequisite for the calculation of finished cooling burden and merely on that basis the manipulation locale of disparate constituents of air conditioning arrangements is decided. The heat gain through external opaque building elements comprises of a major part of cooling load and energy requirements in most of the buildings [6-9]. Hence, it is necessity to precisely guesstimate cooling burden needed as compensation for heat obtained across exterior walls and roof.

However the thermal storage effects of building structural components coupled with constantly changing external conditions make the heat gain phenomenon highly transient, subsequently making the process of having an accurate idea of the heat gain through external walls and roof complex and time consuming [8]. There are assorted disparate methods industrialized for calculation of heat gain by employing resolution of unsteady heat flow setback for the constructing envelope i.e. exterior walls and roof. The exact solution is the realistic solution, but it is very difficult to find temperature distribution in the building elements. Different exact and numerical solution methods are presented in literature. Recently, Bansal et. al. [8] developed a unsteady heat flow in one-dimensional based model to evaluate the CLTD values for buildings' exterior walls and flat roofs. Celestino et. al. [14] also developed a model using unsteady heat flow phenomenon and its corresponding numerical tool to predict the thermal behavior of multilayered walls and flat roofs. Barrios et al. [15] studied heat gain outline of an intermittent air-conditioned room fluctuating the form of its beyond walls and roofs and approximated its heat gain. There are a little frank calculation methods alongside precise and numerical resolutions that have been extensively consented alongside method of period for the estimation cooling loads on the buildings. These are Transfer Function Method (TFM), Cooling Load

Temperature Difference (CLTD), Total Equivalent Temperature Difference (TED) and the radiant Time Series (RTS) methods. Calculation procedures for the TFM.

CLTD and TETD methods are present in detail in refs. [8-11]. The TFM adopted by ASHRAE [12] is believed to be one of the most precise methods for computing heating and cooling loads. It is an extensively utilized computer helped cooling burden calculation method in air conditioning industry and it uses a set of assembly kinds alongside recalculated conduction transfer purposes coefficients. These coefficients are tabulated for certain types of walls, partitions roofs, floors and ceilings in ASHRAE [12]. Accuracy of cooling load calculations by using TFM depends on accuracy of transfer function coefficients [8]. Therefore, the coefficients should be computed accurately to obtain accurate cooling load for any structure. The CLTD is the one of the methods using to calculate cooling load which is the CLTD values generated by utilizing the TFM or heat balance method for particular walls and roofs [8]. Thus the CLTD method is much simpler than the TFM method and is also very widely used for manual calculation and estimation of building cooling loads [8].

The accuracy of the CLTD method after once more depends on the transfer purpose coefficients. It is additionally probable to produce the CLTD benefits for representative walls and roof employing the heat balance method and by resolving transient heat transfer setback alongside appropriate early and frontier conditions employing a suitable numerical method. The TETD method is one of the first methods developed to account for transient effect of solar energy and thermal storage [15]. The solar power affects inside nature and power necessities of buildings.

A fraction of the event solar flux is amassed and stored in the structural thermal mass of the constructing envelope and influences vitally vibrant thermal characteristics of the constructing and the indoor nature exceptionally across the cooling season. The RTS method is a simple method for estimating the cooling load calculation and it is based on balancing of heat and substitutes other various simplified non-heat-balance methods [11, 4].

In air conditioning design, it is important to differentiate between four related but distinct heat flow rates each of which varies with time: space heat gain, space cooling load, space heat extraction rate and cooling coil load ASHRAE [11].

1.1. Space heat gain

A constructing or room gains heated from countless sources. Inside occupants, computers, copiers, machinery and lighting all produce heat. Honest air from beyond enters across open doors and windows or as 'leakage' nevertheless the structure. However the biggest basis of heat is solar radiation from the sun beating down on the roof and walls and dispensing across the windows warming inner surfaces.

Space heat gain (instantaneous rate of heat gain) is the rate at which heat enters into and / or is generated within a space at a given instant of time. Heat gain is classified by: (1) the mode in which it enters the space; (2) whether it is a sensible or latent gain. The first classification is necessary because different fundamental principles and equations are used to calculate different modes of energy transfer. The heat gain occurs in the form of: (1) solar radiation through transparent surfaces; (2) heat conduction through exterior walls and roofs; (3) heat conduction through interior partitions, ceiling and floor; (4) heat generated within the space by occupants, lights, and appliances; (5) energy transfer as a result of ventilation and infiltration of outdoor air; or (6) miscellaneous heat gains. The second classification, sensible or latent is important for proper selection of cooling equipment.

1.2. Space cooling load

This is the rate at which heat must be removed from the space to maintain a constant space air temperature. The sum of all space instantaneous heat gains at any given time does not necessarily (or even frequently) equal the cooling load for the space at that same time.

Radiant heat gain, space heat gain by radiation is not immediately converted into cooling load. Radiant energy must first be absorbed by the surfaces that enclose the space (walls, floor and ceiling) and the objects in the space (furniture. etc).

1.3. Space heat extraction rate

The rate at which heat removed from the conditioned space equals the space cooling load only to the degree that room air temperature is held constant. In conjunction with intermittent operation of the cooling equipment the control system characteristics usually permit a minor cyclic variation or swing in room temperature.

1.4. Cooling coil load

The rate at which energy is removed at the cooling coil that serves one or more conditioned spaces equals the sum of the instantaneous space cooling loads (or space heat extraction rate if it is assumed that the space temperature does not vary) for all the spaces served by the coil plus any external loads. Such external loads include heat gain by the distribution system between the individual spaces and the cooling equipment and outdoor air heat and moisture introduced into the distribution system through the cooling equipment [11].

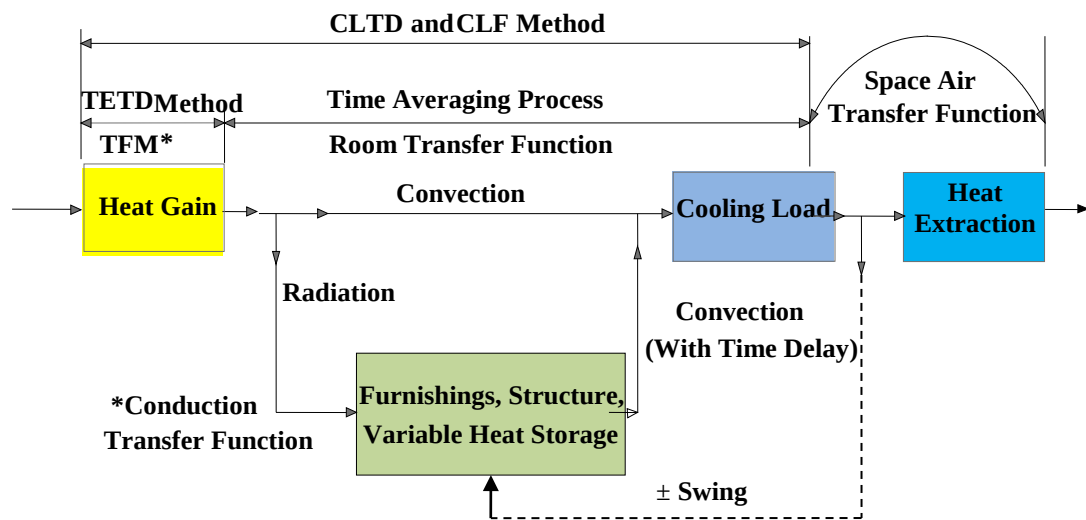


Figure 1.1. Relationships of space heat gain, cooling load and heat extraction

Conduction through exterior walls and roof given in the first component is very important for buildings or any spaces. Since the heat gain is directly proportional to the surface area of these structures. For that reason, they are very important building structural elements in determining capacity of the air conditioning systems. In many buildings the heat gain through the external opaque walls and roofs constitutes a major portion of the total cooling load of a space [8] since they have large surface area. The external surface or roof area of a building or a space cannot be changed.

Then heat gain sourced from these structures to be selected cannot be changed because of the surface area. But it is possible to decrease or increase the heat gain through these elements for a constant surface area by utilizing wall or roof materials having good or bad thermal characteristics, respectively. If walls or roofs having

good thermal characteristics to be used in building construction are selected and accurate estimation of the cooling load is performed then cooling load due to heat gain may decrease and suitable HVAC system may be selected. Finding exact solution for the given thermo-physical properties of wall and roof materials is analytical in nature.

The heat gain is the rate at which energy is transferred to or generated within space at any time. The heat gain is made up of components from many sources as shown in the Figure 1.2; the components that contribute to space cooling load consist of the followings [18]:

- a) Conduction through exterior walls, roof, and glass
- b) Conduction through interior partitions, ceilings and floors
- c) Solar radiation through glass
- d) Lightening
- e) People
- f) Equipments
- g) Heat from infiltration of outside air through openings

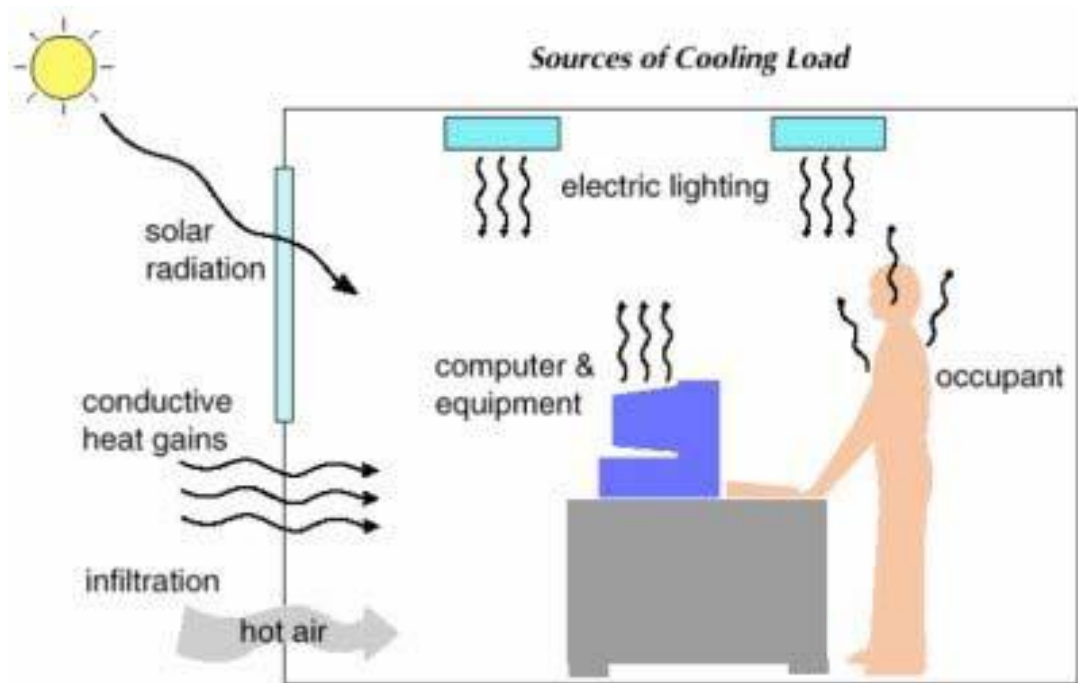


Figure 1.2. Schematic representation of the space cooling load sources

1.5. Goal of the thesis

This study is distinctive in the sense that for the first time Complex Finite Fourier Transform (CFFT) technique is applied for the calculation of CLTD values for building envelope i.e. exterior structures.

A computation procedure for the CLTD values for building exterior walls and roofs was developed. The procedure was based on periodic solution of unsteady heat flow problem for building exterior structures. The solution was obtained by applying CFFT technique for the problem formulation. The solution of periodic nature is a novel approach in applying CFFT technique for calculating CLTD values for these elements. A computational procedure based on the periodic solution is developed and a program in Matlab is prepared for the numerical calculations. The CLTD values are compared with those values given in ASHRAE handbooks. There is a considerable agreement between computed results and CLTD values provided in ASHRAE handbooks for the selected walls and roofs. It is obtained those differences in CLTD values for Roof 8, Roof 13 and Wall 3 selected for main directions change between 0 and 2.42 °C, 0 and 0.94 °C, and 1.8 and 4.3 °C, respectively. It is found that differences between estimated heat gain values and those given in ASHRAE by Radiant Time Series (RTS) method change between 0 and 5 W/m². The numerical calculations are validated with ASHRAE standard data [16].

In this solution, hourly values of surrounding air temperature and solar insolation were utilized as climatic conditions were measured real data experimentally.

A computer program in Matlab supported on the periodic solution of unsteady heat transfer problem was developed for numerical calculations. It was used to calculate data for solar insolation hourly on the exterior walls, distribution of temperature in the wall and roof and CLTD values for the building elements.

Experimental work measured the nodal temperature for the walls and roofs and measured hourly ambient air temperature and solar radiation flux on horizontal surface and calculated the solar radiation flux on the vertical surface for main direction. The eight type of walls and two type of flat roofs generally used in Gaziantep, Turkey and CLTD values of those structures were calculated experimentally and theoretically. As a result, CLTD values obtained from the present study were compared with those obtained experimentally and differences between

them were discussed. Calculate the effects of some factors to the CLTD value. The factors are thickness of walls and roofs, color of exterior surfaces, thermo-physical properties, insulations effects and direction of solar on the tilted surfaces.

Heat gains and CLTD values was obtained for six types of walls and two types of flat roofs are commonly used in Iraq by using the model which represented in this study. That it is proved the model can use for all types of walls and roofs. For a prove the model can use for any place, CLTD values were calculated for some selected cities in Iraq.

The economical analysis has been done for some walls, which it includes first cost of construction of walls, the effect of thickness of walls to energy saving, the effects of surface color to heat gain by the way to the CLTD and cost of energy.

1.6. Thesis outlines

The pending contents of this thesis are coordinated as follows:

Chapter 1 introduced heat gains and sources, cooling loads, space heat gains, cooling coils and CLTD values with the effects of many factors to the results. After introduced accurately with details. The contents of the chapters of this thesis were observed in this chapter 1.

Chapter 2 gives the factual findings and past references. The early portion of the thesis presents pictorial references that are encompassed to enable a larger discernible understanding of the subject matter. The past reference studies are selected firstly for their heat transfer relevance; secondly for their heat gains and cooling load temperature difference; thirdly; the effects of some factors to the CLTD values and fourthly; economical formulation study.

Chapter 3 presents the study and formulation of theoretical analysis and the descriptions and thermo-physical properties of materials of walls and flat roofs which used to validation of program and for walls and roofs are commonly used in Iraq.

Chapter 4 presents experimental study of this thesis and elements used in experimental setups with their characters. and equipments and tools which used in measurements, then presents the eight types of walls and two types of flat roofs with their descriptions and thermo-physical properties of materials which are commonly used in Turkey.

Chapter 5 presents the economical analysis and formulations and the effects of elements and some factors to the cost of walls and roofs. Estimate optimum thickness of walls and roofs then estimate optimum insulations thickness for that walls or roofs.

Chapter 6 presents the input ambient air temperatures and solar radiations on horizontal and tilted surfaces for different main directions for walls and flat roofs. Results of heat gains and CLTD values with the affected factors are drawn and discussed for walls and flat roofs are commonly used in Iraq and Turkey. The results of economical analysis obtained for walls and roofs which used in Turkey.

Chapter 7 concludes the results which obtained for some walls and roof are commonly used in Turkey and Iraq. Concludes the discover and gives a little discussions of upcoming discover on the heat gains and CLTD values for some types of walls and flat roofs, give the recommendations for different future study.

CHAPTER 2

LITERATURE REVIEW

This serving of the thesis gives past background concerning cooling load calculation studies and cooling load calculation methods gave previously. The finished believed of the thesis is to find CLTD coefficient consequently, studies contacting on needed parameters in calculation of CLTD values such as, thermal property of the walls and flat roofs hourly outdoor temperature and solar radiation are additionally surveyed.

Cooling load can be described as amount of heat energy to be removed from each space to uphold temperature of the space at design climatic condition after worst case outdoor design temperature is being experienced. Cooling load not merely compensate heat gain of space from outdoor but additionally includes heat inhabited by inhabitants, lights, occupants etc. Lots of parameter exists that affects cooling load. Certain and precise analysis about these parameters are not possible due to relationship among them. It is important to differentiate between heat gain, cooling load and heat extraction rate. Heat gain is the rate at which energy is transferred to or generated within a space. It has two components, sensible heat and latent heat, which must be computed and tabulated separately. Heat gains usually occur in the following forms:

- a) Solar radiation through openings
- b) Heat conduction through boundaries with convection and radiation from the inner surfaces into the space.
- c) Sensible heat convection and radiation from internal objects.
- d) Ventilation (outside air) and infiltration air.
- e) Latent heat gains generated within the space.

The cooling load is the rate at which energy must be removed from a space to maintain the temperature and humidity at the design values [17]. Cooling load

Usually approximated by summing inner and external instantaneous heat gain constituents described individually. Inner heat gain is completely autonomous from all outdoor effects. It is heat gain in the space due to internal occupants, machines, people and adjacent space. External heat gain is the heat gain of the space through outdoor walls, windows and roofs.

As previously defined; cooling load is the heat energy to be removed from any space to maintain indoor air temperature at design value. Heat energy to be removed is slightly different from heat gain in fact. Space heat gain is the rate at which heat enters a space or heat generated within a space during a period interval. That is the difference between the space heat gain and the space cooling load is due to the storage of a portion of radiant heat in the structure. The convective component is converted to space cooling load instantaneously. Methods used in this survey based on hourly calculation of cooling load. Methods recommended by ASHRAE [12]. VDI [19] are the most preferably used methods in the cooling load calculation.

In the heating load calculation noted that the heat loss from a room at any instant was equal to the heating load at that time. But with the cooling the situation is more complex. The amount of heat that must be removed (the cooling load) is not always equal to the amount of heat received at a given time. This difference is result of the heat storage and time lag effects of the total amount of heat entering the building at any instant, only a portion of it heats the room air immediately; the other part (the radiation) heats the building mass- the roof, walls, floors and furnishings. This is the heat storage effects. The room cooling load is the rate at which heat must be removed from the room air to maintain it at the design temperature and humidity. The cooling load calculation procedure that will be explained here is called the CLF/CLTD method. This procedure is relatively easy to understand and use. One of its valuable features is that in learning it. One may understand better the effects we have been discussing. The CLF/CLTD method can be carried out manually or by using a computer [18].

Yumrutaş et al. [6, 7], made a study about periodic heat flow through homogenous walls and roofs. Approximate and exact solutions for periodic heat flow through opaque building components are given. Basic concept of the study is variation of decrement factor and time lag with respect to thermal conductance and volumetric specific heat. The results have been given in paper graphically.

Mackey and Wright [20] then extended their approach to multilayer composite wall and roof. This study was also estimation of periodic heat flow through walls and roofs. Boundary conditions and assumptions in their solution are same as the previous study. The multilayer constructions are reduced to simple homogenous structure in the study.

Decrement factor and time lag of the composite wall is given in the study as well Stewart [21] later used the study to calculate 'Equivalent Temperature Differentials' for different building materials and hours of day. It can be said that the concept of the method introduced by the Stewart was fundamentals of the Total Equivalent Temperature Difference/Time Averaging (TETD/TA) method and Cooling Load Temperature Difference/Solar Cooling Load/Cooling Load Factor (CLTD/SCL/CLF) method.

Mitalas and Stephenson [17] describe a procedure for estimating both wall and roof response factor and room thermal response factor in 1967. Stephenson [23] later oriented the TETD/TA method which was the basic of the manual procedure given in ASHRAE Handbooks of Fundamentals in 1967 and 1972. TETD/TA method is the most well done and applied method in Turkey. This method gives effective results in wide interval for experienced users. Equivalent Temperature Difference has taken the place of absolute temperature difference in the method due to ability of massive building materials heat storage capacity [24]. Building materials stored energy they are exposure, during day and they released this energy to the space after particular time lag. In the TETD/TA method the response factor technique introduced by Mitalas and Stephenson [17] was used to calculate TETD values as functions of sol-air temperature and maintained room temperature. Various components of space heat gain associated TETD value and results are added to internal heat gain elements to get instantaneous total rate of space heat gain. This total heat gain then converted to an instantaneous cooling load by time averaging technique. Time averaging technique recognizes thermal storage by building mass and contents of the radiant portions of heat gain entering a space at any time, with subsequent release of stored heat to the space at any time. It further recognizes that the cooling load for a space at given hour is the sum of the all convective heat gain and no radiant portion of conductive heat gain to that space, plus the amount of previously stored radiant heat gain released back to the space during that same hour ASHRAE [11].

Mitalas [20] introduced new method of Transfer Function Method (TFM) in concludes the discover and gives a little discussions of upcoming discover on the heat gains and CLTD values for some types of walls and flat roofs, cooling load calculation similar in principle to TETD/TA method however, the new method uses series of weighting factor (WF) or conduction transfer function (CTF) coefficients to the various exterior opaque surfaces and to differences between sol-air temperature and inside temperature to determine heat gain with appropriate reflection of thermal inertia of such surfaces. CTF are used to describe the heat flux at the inside wall, Roof, partition, ceiling or floor as a function of previous values of the heat flux and previous values of inside and outside temperatures. The WF is used to translate the zone heat gain into cooling loads. Due to TFM complexity, the method force designers to spend valuable time consulting tables and performing repetitive calculations. ASHRAE developed a new method in 1975 derived from TFM to overcome complexity and make the TFM more manual friendly cooling load calculation procedure. This new method is called as CLTD/ CLF method and depends on tabulated data to simplify its operation for manual use. This method was subjected to several revisions to accommodate the problems that rose from approximations and limitations to cover more accurate tabulated data. Two important points exist in the method. At first, heat gain from any heat source is not the same of cooling load met by air conditioning system since heat storage capacity of the materials. SCL and CLF coefficients are developed to incorporate heat storage effects in to cooling load. This method uses tabulated CLTD (cooling load temperature difference). SCL (solar cooling load factor). CLF (cooling load factor) all includes effect of time lag in conductive heat gain through opaque exterior wall and roofs and time delay by thermal storage in converting radiant heat gain to cooling load.

All of the recently cooling load calculation methods given by [21] based on calculating a surface by surface conductive, convective and radiative heat balance for each room surface together with convective heat balance for the room air. The model is called as Heat balance (HB) model (sometimes called the exact solution). To calculate space cooling load directly by heat balance procedures requires laborious solution of energy balance equations involving space air, surrounding walls and windows, infiltration and ventilation air and internal energy sources. Some of the

computations required by this rigorous approach to calculating space cooling load make the use of modern digital computers essential. All calculation procedures involve some kind of model requiring simplifying assumptions therefore are approximate. The fundamental assumption is that the air in the thermal zone can be modeled as well mixed, meaning it has a uniform temperature throughout zone. The next major assumption in the heat balance method is that the surfaces of the room can be treating as having:

- Uniform surface temperatures.
- Uniform long-wave and short-wave radiation.
- Diffuse radiating surfaces.
- One-dimensional heat conduction.

Within framework of the assumptions, the heat balance model can be presented as four distinct processes

- a) Outside heat balance
- b) Wall conduction process
- c) Inside face heat balance
- d) Air heat balance

Likewise, conduction time factors reflect the percentage of an earlier heat gain at the exterior of a wall or roof that becomes heat gain at the inside during current hour. Methodology for RTS is as follow:

- Component heat gain is calculated for 24 h period. Periodic response functions for the heat conduction through walls, roofs and floors which involves 24 h coefficient. Conduction time series are applied to account conduction time delay
- Infiltration heat gain is directly converted to cooling load
- Heat gain from internal sources is calculated
- Heat gains are splited into radiant and convective parts. Convective heat gain directly becomes part of cooling load however. Time delay exists for radiant heat gain because of heat storage capacity of massive components.
- Appropriate radiant time series are applied to radiant part of heat gain to account for time delay in conversion to cooling load

- The hourly cooling load is determined by summing up the loads from the convective portions and cooling loads due to radioactive heat gains.

After calculating cooling loads for each component for each hour, they are summed to determine the total cooling loads for each hour and then the hour with peak load for design of air conditioner is selected.

Mackey and Wright [14] studied periodic heat flow through homogenous wall and roofs. The one dimensional periodic heat transfer through wall and roofs was solved by both an exact solution and approximate one. The exact solution is used to find 24 h inside surface temperature variation. An approximate solution presented in the study starts with knowledge of the periodic sol-air temperature as a function of time. Sol-air temperature, periodically changes, during 24 h. The sol air temperature at any times influences the inside surface temperature of the walls or roofs. Variation of periodic sol-air temperature by time is same as periodic variation of inside surface temperature but reduced in amplitude and delay in time. Change of two parameter decrement factor corresponding reduced in amplitude and time lag corresponding delay in time with respect to thermal conductance and volumetric specific heat is given graphically in the study.

Mackey and Wright [15] extended the solution given in previous study to composite walls and roofs. Periodic heat transfer was solved mathematically for composite two and three layer constructions. Additionally, subject of equivalent homogenous construction is given in the study. Equivalent homogenous construction is defined as a simple homogenous wall or roof which will have the same inside surface temperature variation with time compared to actual composite constructions under identical thermal ambient conditions. A simple methodology function of two thermal resistance and heat capacity is given clearly. The equivalent construction defined in the study is valid only in the particular case of periodic heat flow approaches.

It cannot be extended to all other possible case of unsteady or transient heat flow. Conclusion from the study can be summarized as follow.

- Any composite wall or roof construction can be converted to one layer simple homogenous construction having same effects on internal surface temperature variation resulting same cooling load.

- Order of materials forming multilayer constructions influences thermal behavior of the construction. Using material having lower density on the outdoor layer decrease the decrement factor that is, maximum rate of heat transfer to the inside and increase time lag. Interchanging any of the middle layers with the inside layer have no distinguishable effect upon thermal behavior of the wall. Interchanging outside layer with others layer in the middle and on the inside effects maximum rate of heat transfer to inside. For this reason, using low density material (low thermal conductivity and low volumetric specific heat) on the outer surface instead of high density material reduces the maximum rate of heat transfer and increase time lag. This result is also shown in present study.
- Solar absorptivity of outer layer is important parameters that affects maximum heat transfer rate into space directly.

After take some idea about different methods to calculate heat gain in space and heat flow through walls and roofs especially CLTD method. This study will discover new method of calculate cooling load temperature (CLTD) values by using complex finite Fourier transform (CFFT). This method new and first used in this study, give accurate and more reliable results of CLTD and can use this method for all place and types of walls and roofs used in world.

CHAPTER 3

THEORETICAL ANALYSIS

3.1. Introduction

The objective of this chapter is to give methodologies for calculating heat gain and Cooling Load Temperature Difference (CLTD) values for building walls and flat roofs for different types of structures and different cities and countries.

The methodology given for calculation of CLTD values consists of calculation of sol-air temperature for each direction, hourly solar radiation on tilted (vertical wall) surfaces and then calculation of CLTD values. In these calculations, the values of temperatures and solar radiation on horizontal surface are used. Theoretical model developed by Yumrutaş et al. [6, 7] is presented for comparison of results obtained from the experimental study. In this chapter, solution procedure of transient heat transfer problem for multilayer building wall and flat roof and validation of periodic solution for computing CLTD values for structures would be done and expressions for CLTD are summarized in this chapter.

3.2. Estimation of Cooling Load Temperature Difference (CLTD)

Cooling load temperature difference CLTD related with heat gain through a walls or flat roofs. The amount of inner surface temperatures of the structure, inside convection heat transfer coefficient and inside room air temperature. The inner surface temperature of the structures changes with time which depends on solar radiation flux on the surface of structures, ambient air temperature, the indoor conditions, and thermo physical properties of the walls and roofs materials [1].

A methodology of calculating CLTD values was discovered to consider effects of all these parameters mainlined above. The heat gain is obtained by multiplying UA-value of the building elements with the CLTD value [11, 18]:

$$Q_c = UA(CLTD) \quad (3.1)$$

Where, U is the coefficient of overall heat transfer of the building walls or roofs and A is the surface area.

Analytical method in this study, based on Complex Finite Fourier Transform (CFFT) is adopted for the solution of the transient heat transfer through multilayer walls submitted to periodic ambient temperature and solar radiation specific to the city of Turkey. Yumrutaş et al. [6] were the first who used this technique for evaluating heat transfer through multilayer walls and roofs. Inner surface temperatures and heat gains into 24 h calculated. These study representative summer design day for different wall structures with and without insulation. The same analytical methodology was also used by Yumrutaş et al. [7].

Then we get heat gain by equations:

$$Q_c = h_i A [T(0, t) - T_i] \quad (3.2)$$

After get it heat gain (Q) by (CFFT) technique present in Equations (3.2). consequently the cooling load temperature difference (CLTD) can be calculated using Equations (3.1) and (3.2) as:

$$CLTD = \frac{h_i}{U} [T(0, t) - T_i] \quad (3.3)$$

Where the overall heat transfer coefficient is given by:

$$U = \left(\frac{1}{h_i} + \sum_{n=1}^m \frac{L_n}{k_n} + \frac{1}{h_o} \right)^{-1} \quad (3.4)$$

The above calculations, i.e. solving the 1-D. transient heat transfer equation applying complex finite Fourier transform technique, generating the temperature profile for a wall or roof; and estimating the CLTD as well as plotting the same for a particular structure (wall/roof) is done using MATLAB program.

A mathematical model for finding CLTD values of building walls and its flat roofs is a novel approach in the present study. The model is consisted of three components; namely, finding result for unsteady heat flow phenomenon, estimation of solar intensity on building wall surfaces and expressions for the CLTD. Methodology for finding the CLTD has been based on energy balance for the exterior walls and roofs. In this balance, it is required to find distribution of temperature hourly in any given wall or roof during design day. In ASHRAE [11] and literature, the surface temperatures of building components have been calculated by using different numerical and closed solution methods such as finite difference, finite element and closed solution. In this study, CFFT is used to solve the unsteady heat flow problem for multilayered buildings' structural components, which is a new technique applied for calculating the CLTD values. In this section, procedures of the mathematical model are given briefly, which are solution of the problem, computation of solar energy flux on the structures and the CLTD [16].

3.3. Formulation of Periodic solution of unsteady heat flow problem

Theoretical ideal is encompassed of resolution of unsteady heat transfer setback for multilayered walls and flat roofs, estimation of solar radiation flux on horizontal and tilted surfaces into 8 types of the wall surfaces and heat flow across these structures. Procedures for every single constituent of the hypothetical ideal are gave quickly in this section. The geometrical configuration of a multilayered constructing wall or flat roof is shown in Figure 3.1 and Figure 3.2, respectively. The wall serving consists of a finite number of layers alongside disparate thicknesses and thermal and physical properties. The thickness of the n 'th layer is denoted by L_n . and the transient temperature field within the n 'th layer is denoted by $T_n(x,t)$. The left side of the wall is exposed to room air, that is retained at a fixed inside design air temperature (T_i). That is; there is convection heat transfer amid wall and inside air, that relates undeviatingly to the air conditioning load required to maintain the inside design temperature. The right hand side of the wall is exposed to recognized period fluctuating periodic ambient air temperature $T_o(t)$, and solar radiation flux $q_s(t)$. There is convection and radiation heat transfer amid wall and beyond air at the temperatures of $T_N(L_N,t)$ and $T_o(t)$, respectively.

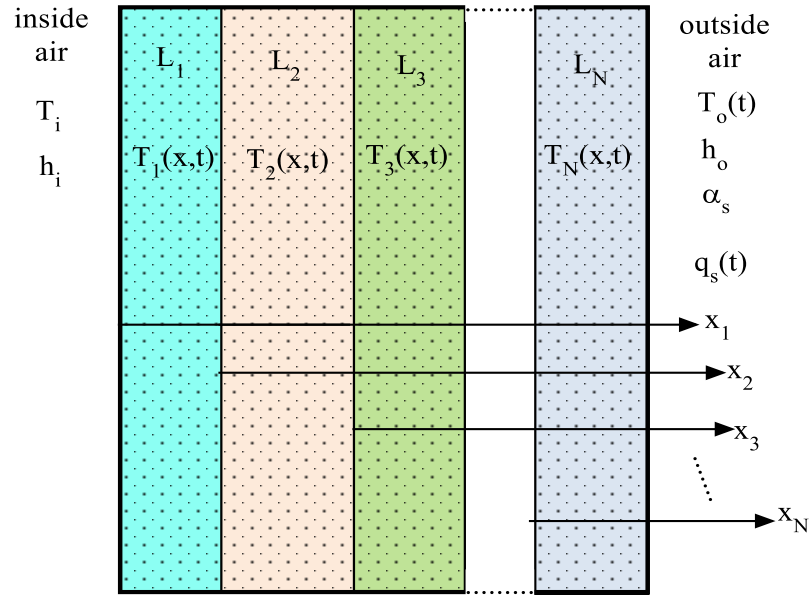


Figure 3.1. Schematic representation of the multilayer walls

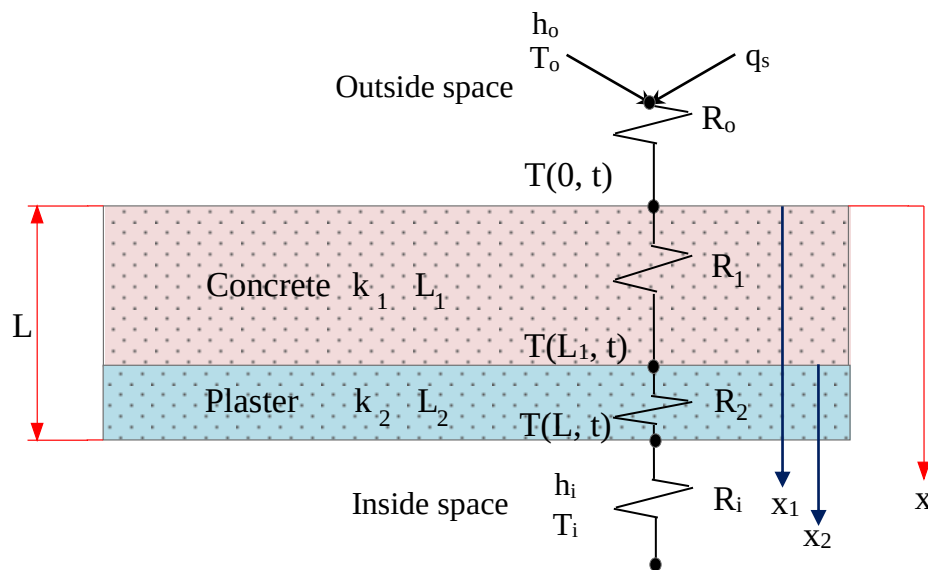


Figure 3.2. Schematic representation of the multilayer roofs

The analytical model is formulated employing the pursuing assumptions:

- Among the layers of walls and roofs the heat not generated.
- The matching between the layers is good; hence the interface resistance is negligible.
- The variation of thermal and physical properties is negligible.
- The convection coefficients are constant and are based on the direction of heat flow.

The administrating equation for the heat flow across the multilayer building elements can be expressed as functions of inner wall surface and room air temperatures, thermal and physical properties of the elements. The heat flow in an association perpendicular to the wall surface can be given as one dimensional period reliant partial differential equation, boundary and matching conditions to find the temperature variation at the inside and at each locale in the wall or roof constructions, that are gave in Yumrutaş et al. [6, 7].

$$\frac{\partial^2 T_n}{\partial x_n^2} = \frac{1}{\alpha_n} \frac{\partial T_n}{\partial t} \quad \text{For} \quad 1 \leq n \leq N \quad (3.5)$$

Where α_n is the thermal diffusivity ($k_n/\rho_n c_n$) and the subscript n refers to the layer. i.e.. $n=1, 2, \dots, N$. Two boundary conditions at the inside and outside surfaces are given as:

$$h_i(T_i - T_1) = -k_1 \frac{\partial T_1}{\partial x_1} \quad \text{At} \quad x_1 = 0 \quad (3.6)$$

$$-k_N \frac{\partial T_N}{\partial x_N} = h_o[T_N - T_o(t)] - \alpha_s q_s(t) \quad \text{At} \quad x_N = L_N \quad (3.7)$$

Where, h_i and h_o are the combined heat transfer coefficients at the inner and outer surfaces. k is the thermal conductivity and α_s is the solar absorptivity of the surface.

It is necessary to give additional conditions which can be used for solving the differential equation since the periodic solution is independent of the initial temperature distribution. These conditions are known as matching conditions:

$$-k_{n-1} \frac{\partial T_{n-1}}{\partial x_{n-1}}(x_{n-1} = L_{n-1}) = -k \frac{\partial T_n}{\partial x_n}(x_n = 0) \quad \text{At} \quad 2 \leq n \leq N \quad (3.8)$$

$$T(x_{n-1} = L_{n-1}) = T(x_n = 0) \quad \text{At} \quad 2 \leq n \leq N \quad (3.9)$$

The problem given by Equations (3.5) - (3.9) is converted into dimensionless form presented in Yumrutaş et al. [6]. The dimensionless form of the problem is transformed by an application of the following Complex Finite Fourier Transform (CFFT) that is also applied to the energy storage problems presented in Yumrutaş et al. [6, 7].

$$T_n(z_n, \tau) = \sum_{j=-M}^M T_{nj}(z_n) e^{i w_j \tau} \quad w_j = 2\pi j \quad (3.10)$$

$$\bar{T}_{nj}(z_n) = \int_{-\frac{1}{2}}^{\frac{1}{2}} T_n(z_n, \tau) e^{-i w_j \tau} d\tau, \quad \bar{T}_{no} = \int_{-\frac{1}{2}}^{\frac{1}{2}} T_n d\tau, \quad (3.11)$$

The transformed problem is then solved, and the solution is given in Yumrutaş et al. [6] in detail. The general solution is given as:

$$T_{no} = A_n Z_n + B_n \quad \text{For} \quad j=0 \quad (3.12)$$

$$T_{nj} = C_{nj} \sinh(\gamma_{nj} Z_n) + D_{nj} \cosh(\gamma_{nj} Z_n) \quad \text{For} \quad j \neq 0 \quad (3.13)$$

When the solution Equations (3.12) - (3.13) are inserted in the inverse transform of the CFFT expressed by Equation (3.10), general closed solution of the problem is then obtained where. M is the large number. The temperature, $T_n(z_n, \tau)$ at any point in the structure does not change when the number takes above the M .

Heat flow rate from the wall to the space can be calculated by using the temperature variations at the inside surface of the wall, inside room air temperature and convection heat transfer coefficient.

$$q_c = h_i [T_1(0, t) - T_i] \quad (3.14)$$

Where $T_1(0, t)$ is the inside surface temperature of the wall or flat roof, which is obtained by using the general solution given in Equation (3.14) for a distance of $Z_n=0$.

$$T_1(0, t) = \sum_{j=-M}^M T_{1j}(0) e^{i w_j \tau} \quad w_j = 2\pi j \quad (3.15)$$

3.3.1. Interior surface temperatures

In this section, a procedure for finding temperature variation at the interior wall or roof surface will be presented. The solution given by Equation (3.10) can be used to find the highest and lowest temperatures at the interior surfaces.

Variation of temperature with respect to time at the interior surface may be obtained by inserting layer number. $n=1$ and dimensionless distance. $Z_1=0$, into Equation (3.10) give Equation (3.15):

$$T_1(0, t) = \sum_{j=-M}^M T_{1j}(0) e^{i w_j \tau} \quad w_j = 2\pi j$$

Where, $T_{10}(0)$ and $T_{1j}(0)$ are transformed temperatures, which are B_1 for $j=0$ and D_{1j} for $j \neq 0$, respectively. These constants of B_1 and D_{1j} are obtained from equations given in (3.12) - (3.13) in detail. When derivative of Equation (3.15) is set equal to zero, and constants of B_1 and D_{1j} are inserted in the derivative of the Equation (3.15).

The highest and lowest temperatures and the period can be determined from:

$$B_1 + \sum_{j=-M}^M D_{1j} [-\sin(2\pi j \tau) + i \cos(2\pi j \tau)] = 0 \quad (3.16)$$

Where, τ 's are periods of dimensionless time. Roots of the Equation (3.16) give the periods of time at which the highest and lowest temperatures take place.

It is significant to obtain the roots of this equation for determining of the highest and lowest temperatures. A computer program known as Mathematica is used to find the periods of time for 50 terms ($j=50$). The 50 terms are sufficient to obtain exact results since more than 50 terms do not affect the results. The highest and lowest temperatures may be determined by inserting the roots of the Equation (3.16) into Equation (3.15).

3.3.2. Exterior surface temperatures

The procedure given above for the interior surfaces will be applied for the exterior surfaces and for finding the highest and lowest temperatures and the time period in reaching these temperatures. Temperature distribution for the exterior wall or roof surface is given as:

$$T_N(1, \tau) = \sum_{j=-M}^M T_{Nj}(1) e^{i w_j \tau} \quad w_j = 2\pi j \quad (3.17)$$

Where N is the layer number of the external surfaces, which is inserted into Eq. (3.9) for dimensionless distances of $Z_N = 1$.

Setting the derivative of the temperature distribution equation (3.17) to zero and inserting the constants given in Yumrutaş et. al. [7] into that equation, we obtain:

$$A_N + B_N + \sum [C_{Nj} \sinh(\gamma_{Nj}) + D_{Nj} \cosh(\gamma_{Nj})] \cdot [-\sin(2\pi j \tau) + i \cos(2\pi j \tau)] \cdot \omega_j = 0 \quad (3.18)$$

Where, A_N and B_N are variables for $j=0$. There is no need to use zero j indices in numerical calculations. The time periods for reaching the highest and lowest temperatures at the surfaces are obtained using 50 terms. The obtained time is inserted into Equation (3.17) to determine the highest and lowest temperatures.

3.4. Solar radiation flux on the building elements

It is known that solar heat flux on the exterior walls or roofs of buildings constitutes a major part of total heat gain of the building during summer season. Since, they are exposed to a wide range of solar radiation each day throughout the season. They absorb great amount of the solar energy impinged on them and store the absorbed energy and release it back to surrounding later [13]. The absorbed heat energy increases temperature within the exterior walls and roof, which raises space heat gain. Hence, the periodic solution equation for the temperature distribution in any wall or roof, given by Equation (3.10), $T_n(z_n, \tau)$ is obtained as a function of the solar energy flux, $q_s(t)$ and outdoor air temperature $T_o(t)$. It is necessary to calculate solar

energy impinged on the walls to obtain temperature variation in the walls. In this study, solar energy flux on the walls is obtained in two ways. The first one is to compare results for the CLTD values given in ASHRAE [11] and obtained from the present study. In ASHRAE [11], hourly sol-air temperatures are given in a table for main directions. The sol-air temperature, t_e is expressed as a function of time and as follows [11, 22]. Combined effect of incident solar radiation and outdoor air temperature on the building envelope is indicated by imaginary temperature called sol-air temperature. It is the fictitious outdoor dry bulb temperature such that in the absence of solar radiation, the surface will exchange the same net amount of energy to air at sol-air temperature as is exchanged in the actual environment and is expressed as:

$$t_e = T_o(t) + \frac{\alpha_s I_T(t)}{h_o} - \frac{\epsilon \Delta R}{h_o} \quad (3.19)$$

Parameters used in Equation (3.19) for horizontal and vertical surfaces are taken from ASHRAE [11]. For horizontal surfaces that receive long-wave radiation from the sky only, the appropriate value of ΔR is about 63 W/m^2 , so that if $\epsilon=1$ and $h_o \approx 17 \text{ W/(m}^2 \cdot \text{K)}$, the long-wave correction term is about -3.9°C . Therefore, it is common practice to assume $\Delta R=0$ for vertical surfaces. Sol-air temperature values are calculated for three values of parameter α_s/h_o ; the value of 0.026 is appropriate for a light colored surface, while 0.039 and 0.052 represent the usual gray and maximum value for this parameters, respectively. I_T presented in Equation (3.19) is solar radiation on tilted surface [11].

3.4.1. Hourly solar radiation on the tilted surface

Hourly solar heat flux on the walls is obtained by employing the Equation (3.19) and it is given in the following expression.

$$I_T(t) = \frac{h_o[t_e(t) - T_o(t)] + \epsilon \Delta R}{\alpha_s} \quad (3.20)$$

Where $t_e(t)$ and $T_o(t)$ are hourly sol-air and ambient air temperature, respectively and α_s is absorption constant for the building external elements. Parametric value used in Equation (3.20) for the horizontal and vertical surfaces are borrowed from ASHARE [11]. The second way for the solar heat flux on building exterior walls is commonly used in literature and is also given in the present study. The hourly solar heat flux on a wall or tilted surface $I_T(t)$ is equal to intensity of solar radiation falling on unit area flux $q_s(t)$ given in Equation (3.7). It can also be expressed as sum total of various types of solar radiation viz. beam, diffuse and reflected radiation, given in Duffie and Beckman [23].

$$I_T(t) = I_b(t)R_b + I_d(t)\left(\frac{1 + \cos\beta}{2}\right) + I(t)\rho_g\left(\frac{1 - \cos\beta}{2}\right) \quad (3.21)$$

Where $I_b(t)$, $I_d(t)$ and $I(t)$ are beam, diffuse and total radiation on horizontal or tilted surface. Ground reflectance ρ_g is taken as 0.2 in the present study. R_b is geometric factor which is defined as the ratio of beam radiation on a tilted surface to that on a horizontal surface. It can be expressed for vertical surfaces ($\beta=90^\circ$) as;

$$R_b = \frac{\cos\delta\sin\phi\cos\gamma\cos\omega + \cos\delta\sin\gamma\sin\omega - \sin\delta\cos\phi\cos\gamma}{\cos\phi\cos\delta\cos\omega + \sin\phi\sin\delta} \quad (3.22)$$

Where, δ , ϕ , ω and γ are the declination, latitude, hour and surface azimuth angles, respectively. Methodology for finding $I_T(t)$ and R_b is given in detail in Duffie and Beckman [23]. Beam radiation is:

$$I_b = I - I_d \quad (3.23)$$

The ratio of hourly diffuse radiation on a horizontal plane to that of total hourly radiation on horizontal plane is given as:

$$\frac{I_d}{I} = \begin{cases} 1 - 0.09k_T \Rightarrow k_T \leq 0.22 \\ 0.9511 - 0.16k_T + 4.388k_T^2 - 16.638k_T^3 + 12.336k_T^4 \Rightarrow 0.22 \leq 0.8 \\ 0.165 \Rightarrow k_T > 0.8 \end{cases} \quad (3.24)$$

The hourly clearness index k_T is the ratio of hourly radiation on a horizontal surface to hourly extraterrestrial radiation, which is given as:

$$k_T = \frac{I}{I_o} \quad (3.25)$$

Extraterrestrial radiation on a surface for an hour period is:

$$I_o = 12 \cdot \frac{3600}{\pi} G_{sc} \left[1 + 0.033 \cos \left(360 \frac{n}{365} \right) \right] \left\{ \cos \phi \cdot \cos \delta \left[\sin \omega_2 - \sin \omega_1 \right] + 2\pi \left(\frac{\omega_2 - \omega_1}{360} \right) \sin \phi \sin \delta \right\} \quad (3.26)$$

Theoretical upper limit of solar radiation available at the earth surfaces is called as the extraterrestrial radiation. The radiation emitted by the sun and its spatial relationship to the earth causes a nearly fixed intensity of solar radiation external side of the earth's atmosphere. This intensity is represented by the solar constant, G_{sc} which is the energy from the sun per unit time received on a unit area of surface perpendicular to the direction of spreading of radiation at mean earth sun distance, outside of the atmosphere. The value of G_{sc} of 1367 W/m^2 is used in this study. The extraterrestrial radiation depending on time of year is given by the following equation.

$$G_{on} = G_{sc} \left(1 + 0.033 \cos \frac{360n}{365} \right) \quad (3.27)$$

Where G_{on} is the extraterrestrial radiation measured on the plane normal to the radiation on the n th day of the year. Beam radiation is the solar radiation received

from the sun without having been scattered by the atmosphere. Diffuse radiation is the solar radiation received from the sun after its direction has been changed by scattering by atmosphere. It is necessary to calculate the hourly radiation on a tilted surface from the measurements of solar radiation on a horizontal surface. The available data are total radiation for hours on the horizontal surface, whereas the beam and diffuse radiation is needed for this purpose.

Solar time is the time on the basis of the apparent angular motion of the sun across the sky, with solar noon the time the sun crosses the meridian of the observer. It shouldn't be confused by local clock time. The difference between solar time and standard time is:

$$\text{Solar Time} - \text{Standard Time} = 4 (L_{st} - L_{loc}) + E \quad (3.28)$$

Where L_{st} is the standard meridian for the local time zone, L_{loc} is the longitude of the location considered. The equation of time E (in minutes) is determined from:

$$E = 229.2 \left(\begin{array}{l} 0.000075 + 0.001868 \cos B - 0.032077 \sin B - \\ 0.014615 \cos 2B - 0.04089 \sin 2B \end{array} \right) \quad (3.29)$$

Where B is:

$$B = (n-1) \frac{360}{365} \quad (3.30)$$

Declination angle δ is the angular position of the sun at solar noon with respect to the equator plane north positive. The declination δ is function of the day of the year and can be found from equation:

$$\delta = 23.45 \sin \left(360 \frac{284 + n}{365} \right) \quad (3.31)$$

Hour angle ω determines angular displacement of the sun east or west of the local meridian due to rotation of the earth on its axis at 15° per hour angle takes negative value at morning and positive value at afternoon.

Angle of incidence θ is the angle between the beam radiation on a surface and the normal of that surface. It can be estimated by the relation.

$$\begin{aligned} \cos \theta = & \sin \delta \sin \phi \cos \beta - \sin \delta \cos \phi \sin \beta \cos \gamma + \cos \delta \cos \phi \cos \beta \cos \omega \\ & + \cos \delta \sin \phi \sin \beta \cos \gamma \cos \omega + \cos \delta \sin \beta \sin \gamma \sin \omega \end{aligned} \quad (3.32)$$

Zenith angle is the angle between the beam radiation and normal of earth surface.

Thus for horizontal surface, the angle of incidence becomes the zenith angle of the sun θ_z , for this situation $\beta=0$ and the equation above becomes as:

$$\cos \theta_z = \cos \phi \cos \delta \cos \omega + \sin \phi \sin \delta \quad (3.33)$$

The ratio of beam radiation on the tilted surface to that horizontal surface at any time can be calculated as below:

$$R_b = \frac{\cos \theta}{\cos \theta_z} \quad (3.34)$$

3.5. Validate the analytical model using to estimate CLTD value

For the purpose of adopting theoretical model to obtain heat gain and CLTD values for any structures should be validate that model. Validation of model have been done by made the comparison between the results of heat gain and CLTD values obtained by analytical model presented in this study and the results presented in other recommended methods for same type of structure. Comparisons of heat gain and CLTD values obtained by this model have been done with the heat gains and CLTD values obtained by CLTD calculation method and RTS method which presented in ASHRAE [11] and ASHRAE [24], respectively. Specifications of walls and roofs which used to make comparisons are present in Table 3.1.

Table 3.1. Specifications of the wall and roofs selected from ASHRAE [11, 24]

Roof and wall No.	Description of construction	Code of roof and wall inner to outer	U-value. W/m ² °C
Roof 2 [11]	Steel Deck w/125mm insulation	E ₀ A ₃ B ₁₄ E ₃ E ₂ A ₀	0.315
Roof 13 [11]	150mm h.w. concrete w/50mm insulation	E ₀ C ₁₃ B ₆ E ₃ E ₂ A ₀	0.6661
Wall 3 [11]	100mm h.w. concrete block with 25mm ins	E ₀ C ₃ B ₅ A ₆ A ₀	1.085
Spandrel wall [25]	Spandrel bronze - tinted glass, opaque. Backed with air space, rigid mineral fiber insulation. mineral fiber batt insulation	F ₀₁ F ₀₉ F ₀₄ I ₀₂ F ₀₄ G ₀₁ F ₀₂	0.51

3.5.1. Thermo-physical properties of structure

Table 3.2. Thermo physical properties and code numbers of wall and roof layers given in ASHRAE [11, 24]:

Code	Description	L mm	K W/mK	ρ kg/m ³	C _p kJ/kgK	R m ² K/w	Mass/area kg/m ²
A ₀	Outside surface resistance	0	0	0	0	0.059	0
A ₃	Steel siding	2	44.998	7689	0.42	0	11.71
A ₆	Finish	13	0.415	1249	1.09	0.031	16.10
B ₅	25mm insulation	13	0.043	91	0.84	0.587	2.44
B ₆	50mm insulation	51	0.043	91	0.84	1.173	4.88
B ₁₄	125mm insulation	125	0.043	91	0.84	2.933	11.71
C ₃	100mm h.w. concrete block	100	0.813	977	0.84	0.125	99.06
C ₁₃	150mm h.w. concrete	150	1.731	2243	0.84	0.088	341.60
E ₀	Inside surface resistance	0	0	0	0	0.121	0
E ₂	12mm slag or stone	12	1.436	881	1.67	0.009	11.22
E ₃	10mm felt and membrane	10	0.190	1121	1.67	0.050	10.74
F ₀₁	Outside surface resistance	0	0	0	0	0.04	0
F ₀₉	Opaque spandrel glass	6.4	0.99	2528	0.88	0.01	16.1
F ₀₄	wall air space resistance	0	0	0	0	0.15	0
I ₀₂	50mm insulation board	50.8	0.03	43	1.21	1.76	2.2
G ₀₁	16mm gypsum board	15.9	0.16	800	1.09	0.10	12.7
F ₀₂	Inside Vertical Surface Resistance	0	0	0	0	0.12	0

Thermo-physical properties have significant effects on temperature distribution of the building elements. Therefore it is necessary to know these properties of the elements that provide CLTD values. Thermo physical properties of materials which are used in constructing walls and roofs including density, thermal conductivity, thickness of layers, specific of heat and thermal diffusivity. As well as the thermal resistance was calculated for the layers of walls or roofs by using thickness and thermal conductivity. then overall heat transfer coefficient U calculated as input data for the written program. The program after validated and compared with the obtained results with previous approved methods used to calculate CLTD values or heat gain. Thermo-physical properties of materials used for validation presented in Table 3.2.

3.5.2. Climatic data used in this study and in the validation

The interior design air temperature the combined heat transfer coefficients at the interior and exterior surfaces are taken to be 25°C , 9 and $17 \text{ W/m}^2\cdot^{\circ}\text{C}$, respectively.

Solar radiation flux on hourly basis for the walls and roofs presented in ASHRAE handbook are calculated using sol-air temperatures taken from ASHRAE [11] in Equation (3.20) and hourly outside air temperatures are taken from ASHRAE [11] and given in figures. For the present study the hourly solar radiation on horizontal surface and ambient air temperature recorded by the meteorological station situated in Gaziantep city during 2013 summer are used in calculations. For comparison of CLTD values given in ASHRAE [11] and also calculated in the present study firstly, solar radiation on the wall and roof surfaces are calculated in Equation (3.20) by using outside air temperature and the other variables of absorption, inside and outside combined heat transfer coefficients. Secondly, inside surface temperature for the walls or roofs are calculated. Lastly, CLTD values for the building elements are computed [16].

The present novel approach was extended for the calculation of CLTD values for various other configurations of walls and roofs commonly used in Turkey. Long period data for the solar insolation and ambient air temperature values were used to obtain more exact and pragmatic CLTD values. Numerical calculations were done using the average values of the ambient air temperatures measured on hourly basis and solar insolation recorded for a decade (2004-2014). A long range and averaged

data minimized the uncertainty arising due to sudden swing of climate and delivered reliability and precision to the cooling load calculation. Solar radiation intensity falling at the wall surface is computed adopting isotropic sky model discussed in Refs. [11]. utilizing the available solar radiation data on hourly basis for a horizontal surface.

3.6. Calculation of CLTD values different cities and country

This thesis give the program written by MATLAB software for model used to obtain CLTD values by using CFFT method for any type of structures of walls or roofs.

That program has approved after comparison with approved methods. Therefore the Matlab program after validated and compared the obtained results with previous approved methods used to calculate CLTD values or heat gain. Therefore, the model program has become ready to use for any structures in the any country on the world.

As well as, the model which represented in this study was used to calculate heat gains and CLTD values of some selected walls and flat roofs are commonly used for different selected cities in Turkey and Iraq.

3.6.1. Climatic and solar radiation data used in this study

The interior design air temperature, the combined heat transfer coefficients at the interior and exterior surfaces are taken to be 25°C, 8.3 and 17 W/m.²°C, respectively.

Hourly Solar radiation flux on horizontal surface and ambient air temperatures for 72 selected cities in Turkey and some selected cities in Iraq presented in index from this study for Turkey and Iraq and shown in figures in chapter 6.

3.6.2. Calculate CLTD values for different cities in Turkey

In order to calculate heat gain and CLTD values of different types of walls and roofs are commonly used in Turkey. The eight types of walls and two types of flat roofs which used in experimental setup are shown in Figure 4.2, were used to calculate CLTD values for different selected cities in Turkey. Descriptions and thermo-physical properties of the structures are presented in Tables 4.1 and 4.2, respectively. Hourly values of solar radiation flux on horizontal surface and ambient air temperatures, which have been measured for some cities of Turkey, are taken from

the Turkish State Meteorological Service, given in Appendix C. and used to obtain more reliable and realistic CLTD values. The solar radiations flux on horizontal surface and ambient air temperatures for different cities of Turkey are represented in index of this thesis which that used as input data for obtain heat gain and CLTD values. Then the results which obtained for walls and roofs and the effects of surface color, thickness and thermo-physical properties for some walls and roofs for Gaziantep and different cities are drowned and discussed in chapter 6.

3.6.3. Calculate CLTD values for different cities in Iraq

Figure 3.3 shows six types of walls and two types of flat roofs are commonly used in Iraq. That different types of walls and roofs used for calculations of heat gains and CLTD values. Descriptions and thermo-physical properties of those structures are presented in Tables 3.3 and 3.4, respectively. Hourly values of solar radiation flux on horizontal surface and ambient air temperatures, which have been measured for some cities of Iraq, are taken from the Iraqi Meteorological Organization and Seismology. The results of heat gains and CLTD calculation have been done for the walls and roofs which represented in Figure 3.3, for some selected cities in Iraq and data recorded in Appendix C. Then that results which obtained for walls and roofs have been drowned and discussed in the chapter 6, from this thesis.

Table 3.3. Specifications of the walls and roofs are commonly use in Iraq

wall & roof	Descriptions from inside to outside	U W/m ² K
Roof A	20mm plaster+150mm concrete+20mm felt+100mm clay+40mm sand +40mm Slabs of concrete Mtstih	0.885
Roof B	20mm plaster+150mm concrete + 20mm felt+25mm insu.+100mm clay+40mm sand+40mm Slabs of concrete Mtstih	0.509
Wall A	20mm plaster +240mm Brick+20mm plaster	1.493
Wall B	20mm plaster +240mm Thermiston +20mm plaster	0.731
Wall C	20mm plaster +200mm Block +20mm plaster	1.986
Wall D	20mm plaster +240mm Brick+50mm hilan Stone	1.441
Wall E	20mm plaster+240mm Brick+50mm insu.+120mm Brick Veneer	0.394
Wall F	20mm plaster+200mm Block +50mm ins.+80mm Block +20mm plaster	0.481

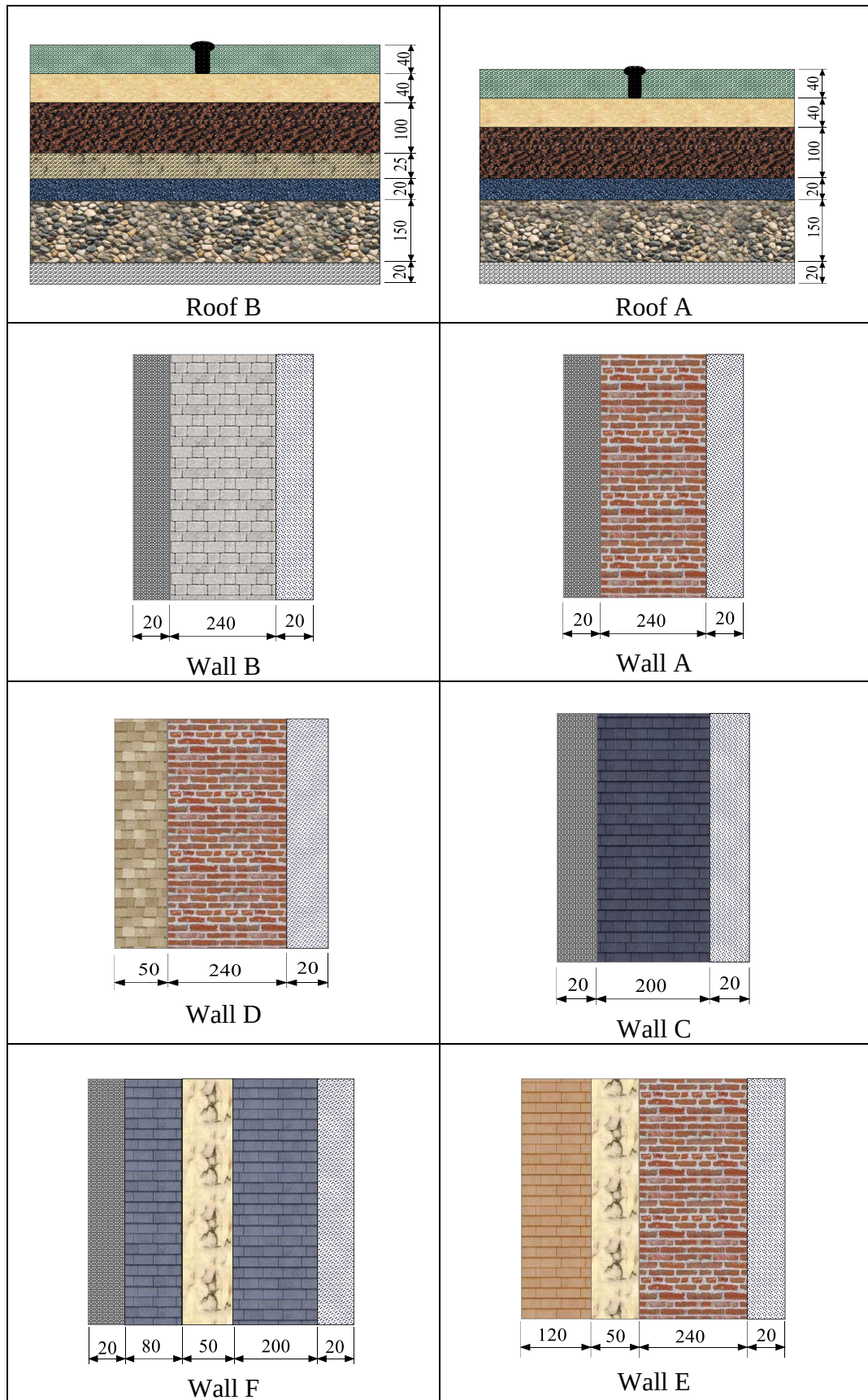


Figure 3.3 Schematic representations of the walls and roofs commonly used in Iraq

Table 3.4. Thermo physical properties of walls and roofs materials used in Iraq

Building Materials**	Thermal conductivity k (W/m K)	Thermal transition h_t (W/m ² . K)	Density ρ (kg/m ³)	Specific heat c (kJ/kg K)	Thermal diffusivity α (m ² /s)
Inner Plaster	0.57	0	1200	0.840	2.99×10^{-7}
Outer Plaster	0.99	0	2121	0.840	3.09×10^{-7}
Concrete	1.49	0	2300	0.880	7.50×10^{-7}
Felt	0.35	0	1400	1.280	3.47×10^{-7}
Clay	0.25	0	1450	0.840	3.57×10^{-7}
Sand	0.24	0	1690	0.840	3.58×10^{-7}
Concrete Slab	0.85	0	2240	0.880	5.20×10^{-7}
Polisterin Insu.	0.03	0	15	1.500	14.0×10^{-7}
Brick	0.54	0	1460	0.840	4.58×10^{-7}
Thermiston	0.21	0	760	1.090	3.75×10^{-7}
Hilan Stone	1.13	0	1680	1.047	4.15×10^{-7}
Block	0.72	1.4*	1440	0.840	3.78×10^{-7}
Brick Veneer	0.54	2.78*	1200	0.840	2.33×10^{-7}

* Inhomogeneous material they units W/m².K. Then, $R=1/h_t$.

** Inside surface and outside surface resistance is 0.13 and 0.04 m²k/w, respectively.

CHAPTER 4

EXPERIMENTAL SYSTEM AND PROCEDURE

4.1. Introduction

In this study, an experimental study for determining of Temperature among the multilayer walls and flat roofs commonly used. Heat gain and cooling Load Temperature Difference (CLTD) is investigated. An experimental system was installed at the south side of Laboratories of Mechanical Engineering Department in University of Gaziantep to perform this investigation. The experimental system is composed of two testing rooms. Each room is consisted of mainly seven components which are four different walls and a roof, measurement elements, data logger, computer and Heat Pump, one of testing room have Air Source Heat Pump (ASHP) another testing room have Ground Source Heat Pump (GSHP). In this chapter, each component of the experimental setup and its characteristics are explained in detail.

4.2. Testing Rooms

Two testing rooms were constructed having dimensions of 4 m x 4m x 2.7m. The each room has four different walls and a flat roof. Each one of the rooms constructed above a suitable mechanism is placed in the concrete. The mechanism has a capacity that carries weight of the room completed and it allows it to be rotated. The rotator has vehicle axles with hubs of wheel. Picture of two rooms constructed on the platform that can be rotated are seen in Figure 4.1. The rooms have eight different types of walls and two different types of roofs, which are commonly used in Turkey. The rooms are named as Room 1 and Room 2. Brick, blokbims, Autoclaved Aerated Concrete (it will be called as AAC in this study) and XPS (wall with extrude

polystyrene insulation) walls were selected for the Room 1. Briquette, covering, EPS (wall with expanded polystyrene insulation) and siding walls were used in the Room 2. There are two types of roofs. The roofs of two rooms are numbered as Roof 1 and Roof 2. Roof 1 constructed from four layers, having from inside to outside; plaster, concrete, insulation material (XPS) and concrete. The Roof 2 consisted two layers only which is having plaster and concrete has no insulation material. Schematic representation of the walls and roofs with their dimensions which have been used in experimental system are Shown in Figure 4.2. Description of walls and flat roofs which are used in experimental study are shown in Table 4.1. While thermo physical properties for construction materials which are used in build of walls and roofs are shown in Table 4.2.



Figure 4.1. Picture of the testing rooms

Table 4.1. Description of commonly used walls and flat roofs

wall & roof	Descriptions	U W/m ² K
Roof 1 (R1)	4cm concrete+5cm XPS+12cm concrete+2cm plaster	0.557
Roof 2 (R2)	12cm concrete +2cm inner plaster	3.367
Brick (W1)	2cm plaster +19cm Brick+2cm plaster	1.950
AAC (W2)	2cm plaster +20cm AAC+2cm plaster	0.640
Blockbims (W3)	2cm plaster +20cm Blockbims +2cm plaster	0.903
XPS (W4)	2cm plaster +8.5cm Brick+3cm XPS+8.5cm Brick +2cm plaster	0.732
Briquette (W5)	2cm plaster +20cm Briquette+2cm plaster	2.180
Covering (W6)	2cm plaster +19cm Brick +2cm plaster +3cmXPS	0.720
EPS (W7)	2cm plaster +13.5cm Brick +2.5cm EPS + 8.5cm Brick+2cm plaster	0.824
Siding (W8)	2cm plaster +19cm Brick + 2cm plaster +30mm XPS + Siding	0.588

Table 4.2. Thermo physical properties of wall and roof materials

Building materials	Thermal conductivity k (W/m K)	Density ρ (kg/m ³)	Specific heat c (kJ/kg K)	Heat capacity ρc (kJ/m ³ K)	Thermal diffusivity α (m ² /s)
Plaster	0.700	2778	0.840	2333.52	2.99×10^{-7}
Concrete	1.370	2076	0.880	1826.88	7.50×10^{-7}
XPS	0.034	22	1.280	28.16	12.1×10^{-7}
EPS	0.038	18	1.500	27.00	14.0×10^{-7}
Briquette	0.920	1600	0.840	1344.00	6.84×10^{-7}
Brick	0.690	1580	0.840	1327.20	5.20×10^{-7}
Blokbims	0.230	770	0.835	642.95	3.57×10^{-7}
AAC	0.150	400	1.047	418.80	3.58×10^{-7}

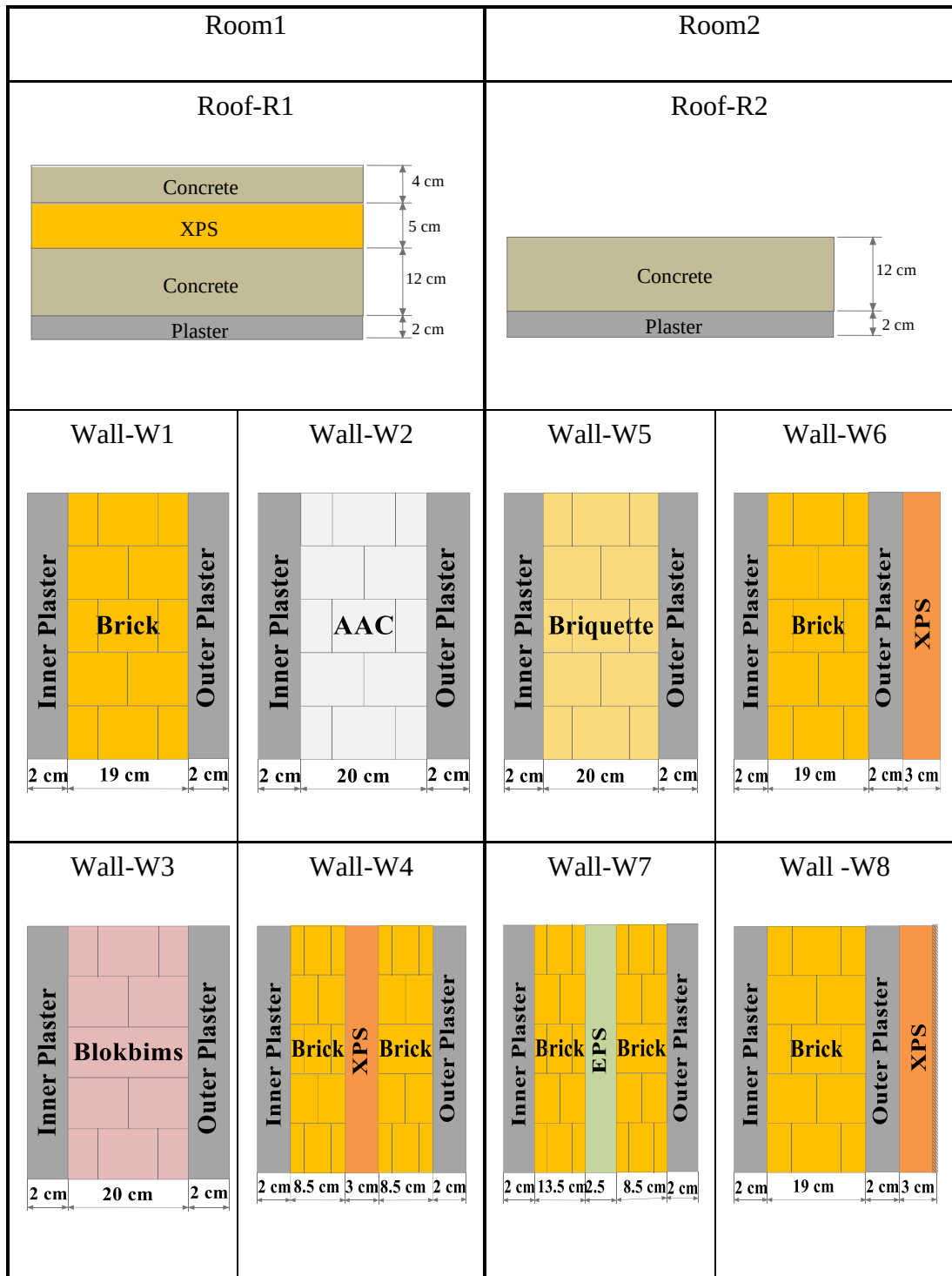


Figure 4.2. Schematic representation of the walls and roofs used in Turkey

4.3. Preparations of testing room

Due to start the collect of experimental data should be prepare the two testing rooms which given above constructed at 2008 by Önder Kaşka [25]. Some walls of the

rooms are affected by weather and humidity of rainy season and are in bad conditions as shown in Figure 4.3.



Figure 4.3. Case of walls of two testing room before maintenances

It will affect the accuracy of the data to be collected. Therefore, all necessary maintenance work completed for walls and both testing room as shown in Figure 4.1. In order to be ready for test the establish of electrical tools have been made for both testing room and set the thermocouples in the walls and roofs then connected to the data loggers and computers as shown in Figures 4.4.



Figure 4.4. Prepare electrical establishments for testing room

4.4. Measurement System

The J-type thermocouples were used to measure nodal temperatures in the each layer surface of the walls and roofs, inside and outside air temperatures. The thermocouples used to measure surface temperatures of wall and roof layers were placed through plastic tubes. The thermocouples were put through the tubes to replace them easily when any problem occurs in thermocouples. So, effects of the thermocouples from the environmental conditions and tubes properties on temperature profile were minimized. Replacement of the thermocouples through the plastic tubes is shown in Figure 4.5. The plastic tubes having 4mm inner and 6mm outer diameters were placed at each surface of the layers. Tips of the tubes were bent parallel to these surfaces to measure the nodal temperatures correctly. The thermocouples were pushed into the plastic tubes until they reached measurement point.



Figure 4.5. Replacement of thermocouple housing plastic tubes



Figure 4.6. Data loggers and connector modules with PC for data measurement

All thermocouples in the both testing rooms were connected to Delta 3005 labeled data logger through connector module as shown in Figure 4.6. The data logger records collected data from thermocouples and saved to the memory tool in the same time that was connected to the PC to transfer data and save as excel files. The data logger with expansion connector module was used to collect data for the required nodal temperatures as well as temperature and pressure of refrigerant liquid which cycling in cooling systems. After connecting the measuring equipments, they were calibrated. Before starting the data transfer, measuring system was checked for each of the nodal points. The measurement was not started until the system run faultless. Since there were many measurement points. Inside and outside air temperatures and temperatures of the required nodal temperatures at the surfaces of the walls and roofs were measured in each 5minutes and saved on the memory tool and PC, as shown in Figure 4.7.

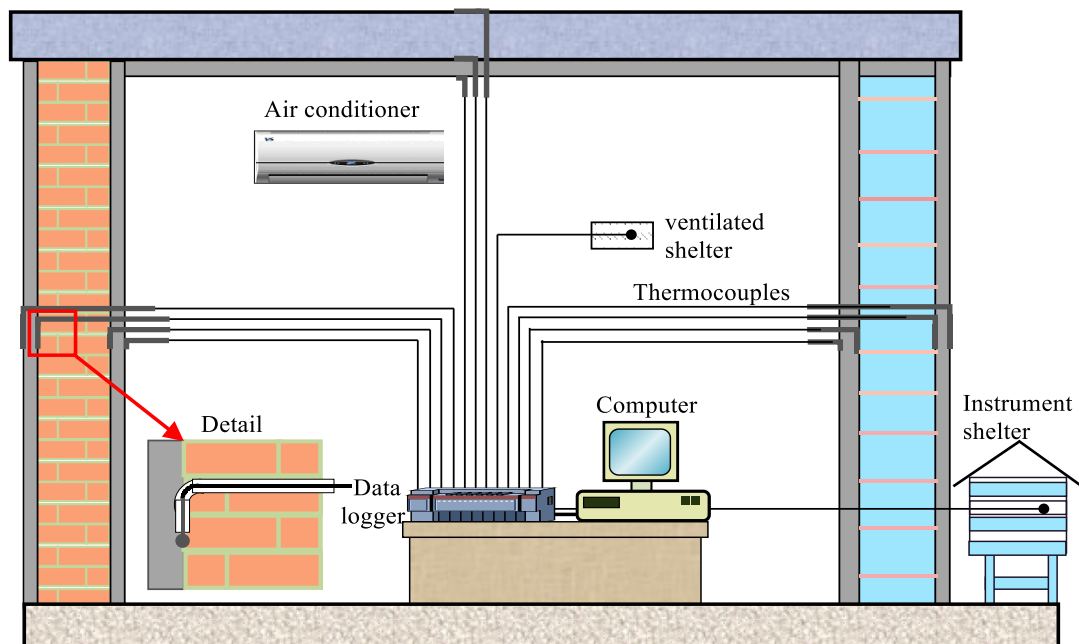


Figure 4.7. Schematic representation of the room with detail of the measurement

4.4.1 Thermocouple calibration

Constant temperature water bath alongside a working scope of 10°C to 90°C was utilized to calibrate the thermocouples. Water was heated till the set temperature of the thermostat by a heater. A mixer was utilized to blend the water to attain uniform

temperature. Mercury in glass thermometer possessing sensitivity of 0.1°C and scope of 0-100°C was utilized in calibration. For calibration goal the temperature scope utilized was 15-75°C alongside temperature increments of 10°C. Each of thermocouples connected to Delta data logger (3005) confidential immersed in to the water in the bath. Delta data logger permits the user to select thermocouple kinds such as T, J and K kind and to apply a linear correction to every single channel mV readings. Firstly, J kind thermocouple readings were checked for each channel simultaneously. After water temperature becomes stable, temperature is noted and then allowed the data logger to receive data for 30 seconds with one second increment. The procedure was repeated for five disparate set temperature values. Data for 30 temperatures were collected for each set and averaged and compared to readings of mercury in glass thermometer. Although the averaged temperature readings by data logger shows for each channel $\pm 0.4^\circ\text{C}$ deviation from the readings of mercury in glass thermometer, linear curve fit was done for reading by least square method.

$$T = m \cdot T_c + b \quad (4.1)$$

Where T is temperature reading of mercury in glass thermometer T_c is readings stored for J type thermocouples by each channel of Delta (3005) personal, m and b are slope and offset coefficients, respectively. Data from the analysis shows that the linear correction provided an excellent fit to the reference temperature points. Coefficients of linear curve fitting for thermocouples are given Appendix B.

CHAPTER 5

ECONOMIC ANALYSIS

5.1. Introduction

The objective of this chapter is to calculate the best wall type in the fourteen walls used in this study, and optimum insulation thickness for that walls of the building.

The optimum insulation thicknesses of external walls or roofs and insulation layer of buildings during cooling season based on cooling loads. The cooling loads, calculated by using measured long-term meteorological data for Gaziantep, are used as inputs to a life-cycle cost analysis in order to determine the optimum thickness of the external wall and insulation layer. The life-cycle cost analysis is applied by using the CLTD method. The life cycle cost analysis which consists of life-cycle total costs and life-cycle savings is often applied to energy technologies and building projects. The calculation of life-cycle cost analysis includes the change in interest and inflation that directly affect the cost of wall and insulation materials and electric.

5.2. Economic requirement

This chapter deals with describes the economic solution of a range of energy needs for roofs and walls in air-conditioned buildings in summer season. The objective of this study is to find the optimum type of external walls and roofs layers of buildings, which are commonly used in Turkey. The heat gains through the external walls and roofs calculated by using CFFT technique, are used as inputs to a life-cycle cost analysis in order to determine the optimum type of the external wall and roofs layer. The life-cycle cost analysis is applied by using the CLTD method. The hourly variation of inside surface heat flux is integrated over 24 h period to obtain a daily total loads.

5.3. Heat gain from external walls and flat roofs

Energy consumption for cooling of any building is high in buildings, especially in the hot climate zone. components of heat gains in the buildings are known as external walls, roofs, windows, ceiling, and floor and air infiltration. The external walls and roofs have the highest heat gain. Therefore, it is very important to find the heat gains from these structures.

Yearly cooling load due to heat source from external structure are calculated by using CLTD method, which is described in chapter 3.

The heat gain in a unit area of external wall or roof is given by:

$$q = U (\text{CLTD}) \quad (5.1)$$

Where, U is the overall heat transfer coefficient, CLTD is Cooling Load Temperature Difference which is described in chapter 3.

The overall heat transfer coefficient, U_{un} for a typical wall or roof with no insulation is expressed as:

$$U_{un} = \frac{1}{R_i + R_s + R_o} \quad (5.2)$$

The overall heat transfer coefficient, U_{ins} for a typical wall or roof that includes a layers of insulation is given by:

$$U_{ins} = \frac{1}{R_i + R_s + R_{ins} + R_o} \quad (5.3)$$

Where R_i and R_o are the inside and outside air-film thermal resistances, respectively. R_s are total thermal resistance of the composite structure wall or roof materials excluding the insulation layer resistance. R_{ins} is the thermal resistance of the insulation layer, which is:

$$R_{ins} = \frac{x_{ins.}}{k_{ins.}} \quad (5.4)$$

Where x_{ins} and k_{in} are the thickness and conductivity of the insulation material, respectively. The difference between U_{un} and U_{ins} can be written as:

$$\Delta U = U_{un} - U_{ins} = \frac{1}{R_i + R_s + R_o} - \frac{1}{R_i + R_s + R_{ins} + R_o} \quad (5.5)$$

5.4. Energy consumptions for external walls or roofs

The objective of this chapter is reach to the optimum solution which give lower energy consumption for cooling operations it is one of the most important problems of a modern life, In some countries like Turkey and Iraq, they imports most of their energy since their energies are not sufficient, energy saving and the effective usage of energy has become much more important every passing day. In utilities of energy, large amounts of energy are consumed by buildings. Energy consumption for cooling opraties increases because air-conditioning is the major energy consumer in the buildings. Therefore, recently electric energy consumption, used for air-conditioning loads, has been reached its maximum level during summer days. Any reduction in this energy requirement can be achieved by using optimum external walls or roofs and insulation thickness.

The heat gains from external structures during cooling seasons, calculated by using measured long-term meteorological data for Gaziantep, are used as inputs in order to determine energy consumptions due to external walls or roofs.

The annual energy requirement per unit area can be calculated by dividing the annual heat gain to COP:

$$E_A = \frac{q_A}{COP} = \frac{U (CLTD)}{COP} \quad (5.6)$$

Where, q_A is annual heat gain of walls and roofs. COP is the coefficient of performance of cooling system. The annual amounts of the energy expended for cooling without insulation and with insulation are expressed in Equations (5.7) and (5.8) respectively, as:

$$E_{A_{un}} = \frac{q_{un}}{COP} = \frac{U_{un} (CLTD)}{COP} \quad (5.7)$$

$$E_{A_{ins}} = \frac{q_{ins}}{COP} = \frac{U_{ins} (CLTD)}{COP} \quad (5.8)$$

5.5. Formulation of economic analysis in summer season

There are two options to reduce the air-conditioning load as well as the cooling energy cost in summer they are optimum external wall and insulation thickness. However, increasing external wall or roof thickness and insulation thickness causes increasing the initial cost of the construction material. Therefore an economic analysis should be performed in order to estimate the optimum external structure and insulation thickness which minimizes the total cost including the external wall, roof, insulation and the energy consumption costs. The optimum thickness of external structures of building and insulation depends on the electricity tariff as well as the cost of external structure and insulation material, lifetime of the building, inflation and discount rate and coefficient of performance of the air-conditioner.

The economical analysis presented in this study one of many types of economic calculation method, which is calculated based on the estimated cooling loads can be carried out by using life-cycle-cost analysis. The life-cycle-cost analysis which computes a present value of the energy consumption cost over the lifetime of the building by accounting for the effects of the inflation rate (rise in costs) and the discount rate (value of money) over this period. Present worth factor. PWF is used to obtain a present value of the cost of energy consumption over a lifetime of n years. The present worth factor, PWF is a function between of the inflation rate (d) and the interest rate (r). The present worth factor, PWF is the defined as below:

$$PWF = \sum_{j=1}^N \frac{(1+r)^{j-1}}{(1+d)^j} = \begin{cases} \frac{1}{(d-r)} \left[1 - \left(\frac{1+r}{1+d} \right)^N \right] & \text{if } r \neq d \\ \frac{N}{1+r} & \text{if } r = d \end{cases} \quad (5.9)$$

5.5.1. The Cost of structure without insulation

The actual value of annual total cost is summation of annual energy consumption cost and wall constriction cost:

$$\text{Total Cost} = \text{Energy cost} + \text{Structure cost} \quad (5.10)$$

The annual energy consumption cost per unit area over a lifetime of N years without insulation is obtained by multiplying the annual consumption of energy, calculated per unit area in section 5.6, by electricity cost C_E and present worth factor (PWF):

$$\text{Energy Cost} = \left(\frac{q_A}{COP} \right) C_E \text{ PWF} \quad (5.11)$$

$$\text{Energy Cost} = \left(\frac{U_{un} 3600 \text{ CLTD}}{COP} \right) C_E \text{ PWF} \quad (5.12)$$

The construction of structure cost per unit area can be calculated by the following equation:

$$\text{Structure Cost} = C_s x_s \quad (5.13)$$

Where C_s is the price of structure material (\$/m³) and x_s is the thickness of wall or roof (m).

As a result, the life-cycle total cost (LCT) of the building without insulation is given by the following equation:

$$\text{Total Cost} = \left(\frac{U_{un} 3600 \text{ CLTD}}{\text{COP}} \right) C_E \text{ PWF} + C_S x_S \quad (5.14)$$

The optimum thickness of external wall or roof can be determined by minimizing the life-cycle total cost of building. In other words, the optimum thickness of external wall and roof is obtained mathematically by taking the derivative of the life-cycle total cost of building function with respect to x_S and setting it equal to zero:

$$\frac{\partial(\text{Totalcost})}{\partial(x_S)} = \frac{\partial U_{un}}{\partial x_S} \frac{3600 \text{ CLTD}}{\text{COP}} C_E \text{ PWF} + C_S \frac{\partial x_S}{\partial x_S} \quad (5.15)$$

So that optimum thickness of external wall or roof is obtained by:

$$x_{\text{structure-opt}} = \left(\frac{\text{PWF } C_E 3600 \text{ CLTD } k_S}{C_S \text{ COP}} \right)^{1/2} - \left(\frac{1}{R_i + R_o} \right) k_S \quad (5.16)$$

5.5.2. The Cost of structure with insulation

The insulation cost per unit area can be calculated by the following equation:

$$C_{ins} = C_{ins.} x_{ins} \quad (5.17)$$

Where $C_{ins.}$: is the price of wall material (\$/m³) and $x_{ins.}$ is the thickness of wall (m).

The life-cycle total cost (LCT) of the building with insulation is given by the following:

$$\text{Total Cost} = \text{Energy cost} + \text{Structure cost} + \text{Insulation cost} \quad (5.18)$$

$$\text{Total Cost} = \left(\frac{U_{\text{ins}} 3600 \text{ CLTD}}{\text{COP}} \right) C_E \text{ PWF} + C_S x_S + C_{\text{ins.}} x_{\text{ins}} \quad (5.19)$$

$$\text{Total Cost} = \left(\frac{U_{\text{ins}} 3600 \text{ CLTD}}{\text{COP}} \right) C_E \text{ PWF} + (C_S + C_{\text{ins.}}) x_{\text{S-ins.}} \quad (5.20)$$

The optimum thickness of structure with insulation is obtained mathematically by taking the derivative of the life-cycle total cost of building function with respect to x_{ins} and setting it equal to zero:

$$\frac{\partial(\text{Totalcost})}{\partial x_{\text{S-ins.}}} = \frac{\partial U_{\text{ins}}}{\partial x_{\text{S-ins.}}} \frac{3600 \text{ CLTD}}{\text{COP}} C_E \text{ PWF} + C_{\text{S-ins.}} \frac{\partial x_{\text{S-ins.}}}{\partial x_{\text{S-ins.}}} \quad (5.21)$$

The optimum insulation thickness is obtained by:

$$x_{\text{ins-opt}} = \left(\frac{\text{PWF } C_E 3600 \text{ CLTD } k_s}{C_{\text{S-ins.}} \text{ COP}} \right)^{1/2} - \left(\frac{1}{R_i + R_s + R_o} \right) k_{\text{ins}} \quad (5.22)$$

Life-cycle saving (LCS) which is the difference between the saved energy cost over the lifetime and the insulation payout is given by:

$$\text{Saving} = \left(\frac{\Delta U 3600 \text{ CLTD}}{\text{COP}} \right) C_E \text{ PWF} - C_{\text{ins.}} x_{\text{ins}} \quad (5.23)$$

CHAPTER 6

RESULTS AND DISCUSSION

6.1. Introduction

This chapter describes and discuss experimental and theoretical results of Cooling Load Temperature Difference (CLTD) and validate the model written by MATLAB to obtain CLTD values by using Complex Fourier Finite Technique CFFT.

In this study, Cooling Load Temperature Difference (CLTD) values for eight different walls and two types of flat roofs includes briquette, brick, blokbims, Autoclaved Aerated Concrete (AAC), XPS, EPS, covering and siding walls and for two types of roofs with and without insulation material for some cities in Turkey are computed using measured values. The computations are performed by preparing two programs of computer in EES (Engineering Equation Solver) and EXCEL.

The program in EXCEL is used for calculating hourly mean values of outside air, inside and outside wall and roof surface temperatures measured for each minute and used for determining hourly mean values of solar radiation and outside air temperatures measured at all cities in Turkey and for last ten years (2004-2014). The solar radiation and hourly outside air temperature values are taken from the Turkish State Meteorological Service to obtain more reliable CLTD values. The EES is used to compute hourly solar radiation on the wall surfaces, sol-air temperatures which are function of outside air temperature (T_o), solar radiation on horizontal (I) or tilted surface (I_T). Then describes the results of CLTD values of the walls and roofs are commonly used in Iraq are computed for some cities in Iraq using measured values taken from Iraqi Meteorological Organization and Seismology.

Then in this chapter describes calculations of the economic study. The heat gain and CLTD values for building walls and roofs was calculated hour by hour during summer season and then the annual cooling load was obtained. The results of cooling

load calculations, were used as input parameters in order to obtain the calculations of economical analysis. The economical analysis was based on the life-cycle cost analysis. Finally, the life-cycle total cost (LCT) of the building with insulation or no insulation and the optimum thickness of external wall were obtained.

6.2. Computational procedure for the CLTD

The purpose of this section is to represent the computation procedure of all of numerical calculations explained in chapters 3, 4 and 5. A computer program was prepared in Matlab in order to carry out all of the numerical calculations which are the calculations of solar radiation flux, instantaneous nodal surface temperature, CLTD and heat gain values for different types of walls and flat roofs into different cities and countries. As well as economic analysis procedure. The program is based on the using periodic transient heat transfer problem for composite building walls and flat roofs to obtain heat gain and CLTD values. The solution of the periodic heat transfer problem was given in Yumrutaş et. al. [6]. The solution of the economical analysis was carried out by using life-cycle cost analysis. Matlab programs written to some walls and roofs in ASHRAE for validate the model, then written for eight types of walls and two types roofs are commonly used in Turkey. Finally written to six types of walls and two types of roofs are commonly used in Iraq. In order to make model in the optimal case and useful in many applications, have been made study of the effects of colors, thermal absorption coefficient, inside room temperatures and other factors which are affected CLTD values. A simplified flowchart of structure of this study is shown in Figure 6.1.

6.2.1. Computational procedure for theoretical analysis

A computational program is prepared in MATLAB to perform the numerical computations based on developed analytical model. The analytical model contains many expressions for solar heat flux absorbed by the building elements, temperature distribution on the wall or roof surfaces by using periodic solution of unsteady heat flow problem for the elements, overall heat transfer coefficient, heat gain through the structures and their CLTD values for the elements. Algorithm of the program is shown in Figure in Appendix A. The MATLAB program uses several parameters, which are number of wall or roof layers, thermo physical properties of the structure.

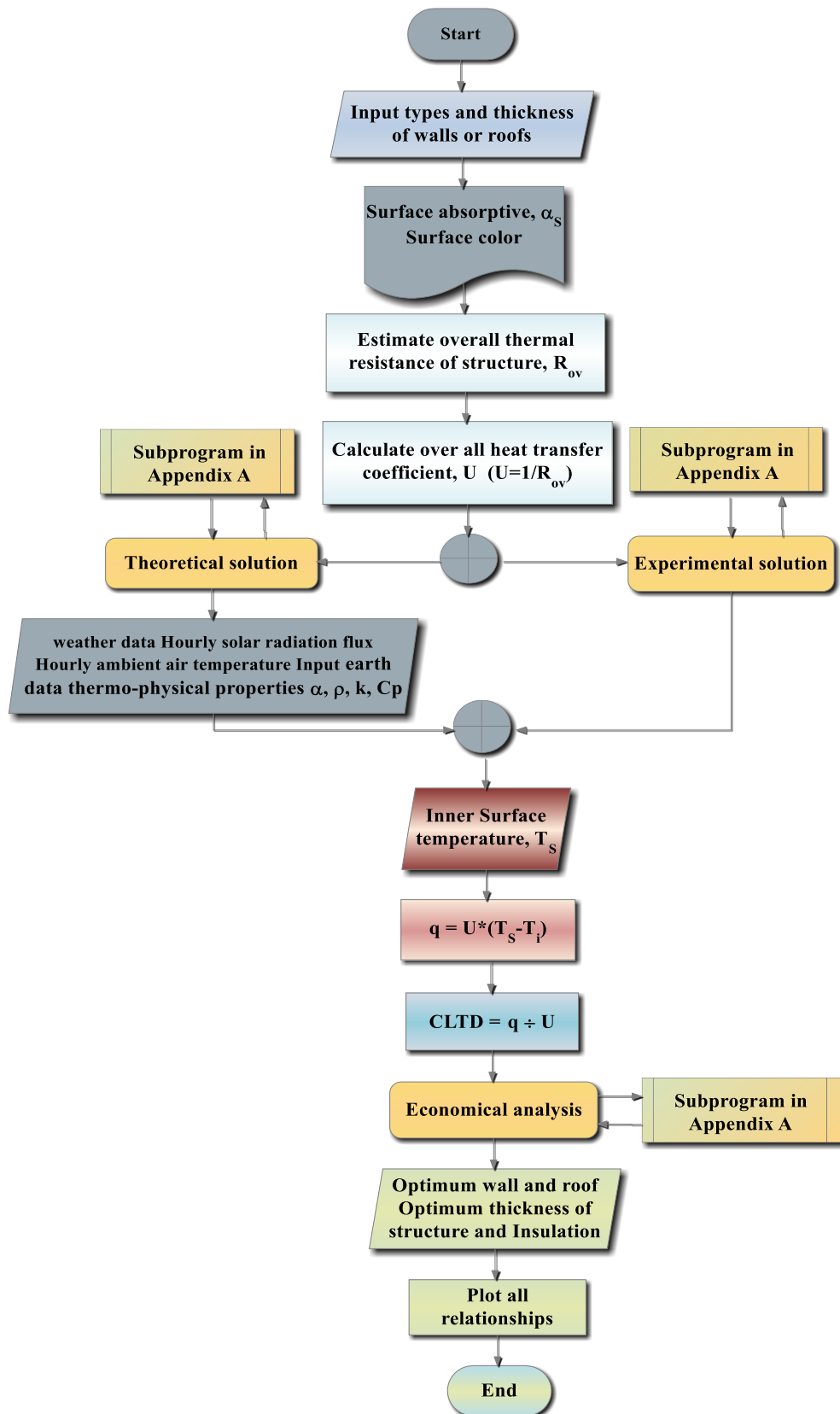


Figure 6.1. A simplified flowchart of structure for this study

and climatic and solar radiation data used as input data for the program. The data used by the program are explained in the following subsections in detail.

The execution of the program is summarized as the following explanations, when the program was executed; number of wall or roof layers was entered firstly. Secondly, thermo physical properties of the structures, which were thickness of the each layer, density, specific heat and thermal conductivities of the each layer, were given as inputs. Thirdly, climatic and solar radiation data which were interior design air temperature, the combined heat transfer coefficients at the interior and exterior surfaces, hourly values of outside air temperature, solar radiation on horizontal surface were given as input data. After entering of the input parameters, hourly solar radiation flux on the wall surface was calculated using Equation (3.21), given in Section 3.4.1, and then, overall heat transfer coefficient (U), hourly temperature distribution on the inside surface of the structures were obtained using Equations (3.4) and (3.15), respectively. As a result of the all numerical calculations, CLTD values for the desired building structure were calculated by Equation (3.3).

Validation of models done by prepare the programs for some types of walls and roofs with the description and thermo-physical properties are presented in Tables 3.1 and 3.2, respectively. The programs was prepare to eight types of walls and two types of roofs which are shown in Figures 4.2, for walls and roofs used in Turkey. Then the programs have been written for walls and flat roofs which are commonly used in Iraq. Heat gain and CLTD values obtained for some roofs and walls and for some selected cities in Iraq and shown in Figure 3.3. Descriptions and thermo-physical properties for walls and roofs which used in Iraq are presented in Tables 3.3 and 3.4, respectively.

6.2.2. Computational procedure for experimental systems

The heat gain and CLTD values are obtained experimentally by using experimental systems as mainlined with details in chapter 4, which consist two testing rooms constructed from eight types of walls and two types of roofs are commonly used in Turkey. Descriptions and thermo-physical properties for walls and roofs which used in experimental setups are presented in Tables 4.1 and 4.2, respectively.

Nodal surface temperatures for each layer of walls and flat roofs, solar radiations flux on horizontal surfaces and ambient air temperatures have been measured

instantaneously by using measurement tools. The temperatures are measured by using J-type of thermocouples and digital data logger recorded the measured data to the computers of each room with keeping inside room temperatures fixed with design conditions. The measured temperatures used to calculate heat gains throw the walls and flat roofs. As well as CLTD values for each types of walls and roofs. Comparisons have been made between theoretical and experimental results. The experimental procedure presented in flow chart of Appendix A.

6.2.3. Computational procedure for economical analysis

The purpose of this part is to represent the computation procedure of economic calculation which presented in chapter 5. The solution of the economical analysis was carried out by using life-cycle cost analysis. The program includes eight types of wall and two types of roofs commonly used in Turkey, four main directions. Some parameters are used as input parameters in this program and which affected the results of heat gain then affected the cost of energy need to cooling the space. Those parameters are thermal and physical properties such as number and thickness of layers, density, specific heat thermal conductivity and diffusivity, combined convection heat transfer coefficient for both sides of inside and outside air, hourly outside air temperature and inside design air temperature. Finally, the calculation of life-cycle cost analysis was carried out by using the heat gain. All of these calculations for a given wall and a given wall orientation and surface is calculated over a 24 hour period. The procedure is repeated for each day of cooling season in order to get annul cooling load per square meter of the wall surface and to obtain optimum external walls or roofs and insulation thickness. The procedure presented in flow chart of Appendix A.

6.2.4. Climatic data

CLTD values and heat gains from exterior walls and roofs are also functions of design and outdoor conditions, climatic data of hourly outside air temperatures and solar radiation flux on horizontal surface. The data affect the temperature and heat gain variations of the structures. The temperature variations and heat gain are functions of climatic conditions. The climatic data are the two of the most important factors. Therefore, it is necessary to know the design conditions and climatic data.

The inside air temperature is taken to be 25°C. Combined heat transfer coefficients at the inner and outer surfaces are taken to be 8.3 and 17 W/m², respectively. In order to calculate the hourly solar radiation flux on any wall surface and hourly outside air temperatures, 10 years long term hourly measured outside air temperatures and solar radiation flux data on horizontal surface are used. The measured outside air temperatures are used in the calculation of the sol-air temperature. These 10 years long term measured data were taken from the local meteorological stations located in Gaziantep, and presented in Appendix C.

6.2.5. Solar absorptivity

Absorptivity of a building wall is another important parameter. Because absorbed solar energy depends on the absorptivity constant. The different colors absorb different amounts of solar energy. Therefore each color has a different absorptivity constant. In this study, dark, black, green, brown, white, light and gray colored walls are used. Their absorptivity constants, α_s are taken as 0.884, 0.85, 0.80, 0.75, 0.48, 0.442 and 0.663, respectively.

6.3. Validation of the theoretical model

There is an important question: how reliable is this theoretical study? In order to give a correct answer to this question, it is necessary to check validation of the solution method given in this study to find CLTD values for walls and horizontal roofs correctly. Therefore, validation of the method will be checked in this section. Two types of flat roofs and one type of wall with different thickness are selected from ASHRAE [11] to find CLTD values. CLTD values given in ASHRAE [11] for these structures are compared with the CLTD results obtained by using the method given in this study. The calculation method for CLTD values in ASHRAE [11] is based on transfer function method (TFM). In ASHRAE handbooks, CLTD values are given for several building walls and flat roofs with light, medium and heavy thermal properties. All thermo-physical properties of the selected structures, hourly ambient air and sol-air temperatures are taken from the ASHRAE handbook. Specifications of the selected roofs and wall, thermo-physical properties and code of each structure are given in Table 3.1 and 3.2, respectively, as shown in chapter 3. Solar insolation on hourly basis incident on the walls and roof are calculated using Equation (3.19) by

inserting data for hourly ambient air and sol-air temperatures given in ASHRAE [11]. The data are given in Figure 6.2. Data presented in ASHRAE [11] handbook for the certain walls and roofs are used as input to the MATLAB program. Results taken from the ASHARE [11] and calculated from the study are given in two subsections of flat roofs and walls. and they are compared.

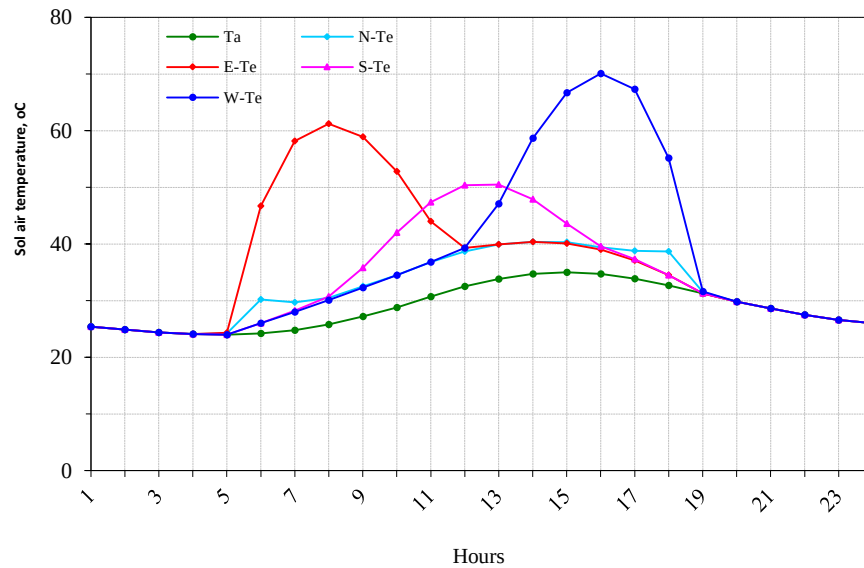


Figure 6.2. Variation ambient and sol-air temperatures for main direction [11]

6.3.1. Comparison of CLTD values for flat roofs

In the ASHRAE Handbook. CLTD values for many types of roof are presented. From these roofs, two types are selected in order to compare the CLTD values with results obtained in the present study. Specifications and thermo physical properties of the roofs are given in Table 3.1 and 3.2, respectively. The selected roofs are named as Roof 2 and 13 in ASHRAE handbook [11]. Figure 6.3 shows variation of CLTD values given in ASHRAE and obtained in the present study for the roofs. The figure shows that the CLTD values taken from ASHRAE [11] and calculated CLTD values for both roofs are closer to each other. There are differences in CLTD values between about 0 and 2.42 °C, 0 and 0.94 °C for the Roof 2 and Roof 13, respectively. The difference ranges are reasonably low. Match of the figures shows validity of the solution method presented in this study. There are some reasons behind the differences between the values. Solution methods of unsteady heat flow problem for the wall and roof are different in ASHRAE [11] and present study. While CFFT

technique is utilized to find temperature profile at any distance in the wall or roof material, transfer function method (TFM) is applied to solve the problem in ASHRAE [11]. However, the accuracy of TFM method depends on the transfer function coefficients if TFM is used for finding the CLTD values [26]. Number of terms and transfer function coefficients used in calculating temperature values can be due to these reasons. As a result, it is observed that this figure indicates validity of the present model given in this study.

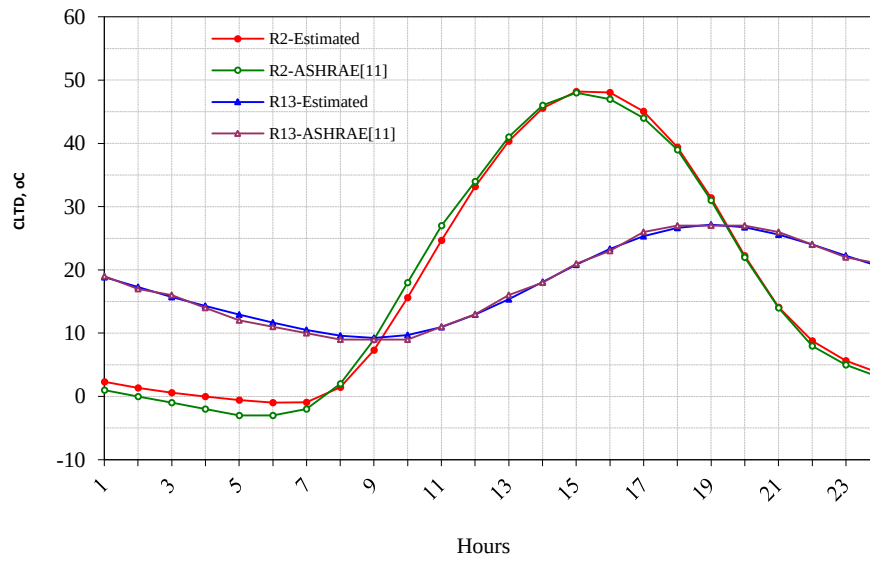


Figure 6.3. Variation of CLTD values for two selected roofs of ASHRAE [11]

6.3.2. Comparison of CLTD values for the walls

There are several types of walls for which CLTD values are tabulated in ASHRAE [11]. One type of the wall, which is named as Wall 3, is selected to compare CLTD values presented in ASHRAE and calculated in this study. The selected wall is directed to four main directions. Specifications and thermo physical properties are given in Table 3.1 and 3.2, respectively. Daily variations of CLTD values during design day (July 21) for the selected wall directed to main directions of East, West, South and North are shown in Figure 6.4. Curves for calculated CLTD values follow the curves depicted by using CLTD values in ASHRAE [11]. The figure shows that most of the calculated CLTD values are reasonably closer to the CLTD values given in ASHRAE [11]. However, there are few differences between calculated and given CLTD values. Differences in the CLTD values computed by this study and given in

ASHRAE [11] are obtained as 3.4, 4.3, 3.9 and 1.8 °C for East, West, South and North facing walls, respectively. There are many reasons for these differences.

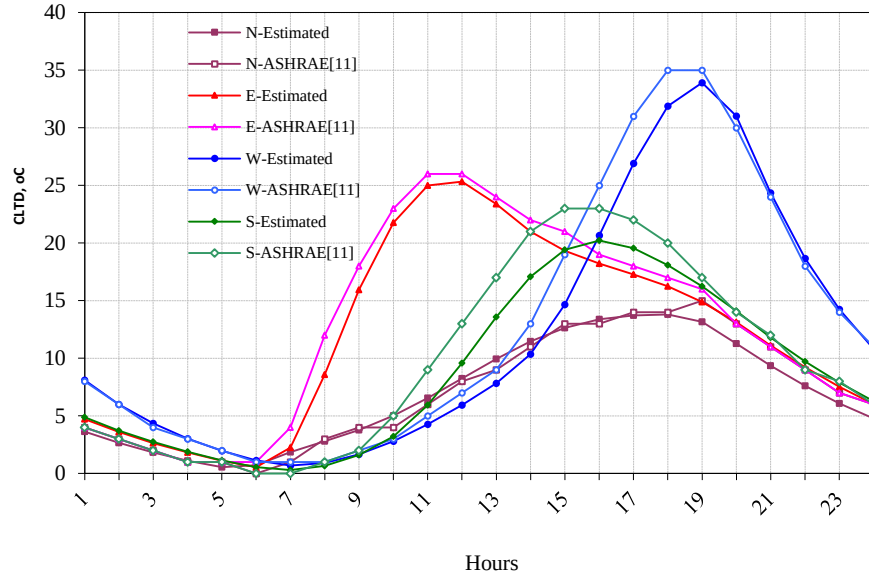


Figure 6.4. Variation of CLTD values for the wall 3 given in ASHRAE [11]

Solution methods of unsteady heat flow problem are different in ASHRAE [11] and the present study. Transfer function method (TFM) is used in ASHRAE [11] while CFFT technique is used to solve the heat transfer problem in the present study. Both of the solutions are used to find temperature at any distance in the wall and roof elements. Small differences of constants and number of terms in both solutions can cause these differences. Calculation procedure of solar radiation flux is another reason, since solar radiation flux for any surface is used in calculation of temperature distribution in the wall and roofs in this study. Daily sol-air temperatures are given in ASHRAE [11]. In the present study, solar radiation flux on any surface is computed by using the given sol-air temperature values and then temperatures of the wall and roof surfaces are calculated. As a result, CLTD values computed in this study are well in agreement with the results given by ASHRAE [11].

6.3.3. Comparison of heat gain values for the wall

In order to validate the present model, heat gain values are calculated for a west-facing wall given in ASHRAE [24]. Results for the heat gain values obtained by using radiant time series (RTS) method in ASHRAE [24] and from the present study are shown in Figure 6.5. Heat gain values for a Spandrel Wall with overall heat

transfer coefficient of $0.51 \text{ W/m}^2\text{K}$ is calculated and given in ASHRAE [24] (Table 26 B) with unit of Watt for 11.15 m^2 west wall surface area. It is seen from the figure that characteristic of the figures are similar. Heat gain values change between -0.05 and 20.1 W/m^2 , 0.62 and 24 W/m^2 for the present and RTS [24] methods, respectively. Differences in heat gain values change between 0 and 5 W/m^2 . For both studies, some heat gain values are closer to each other but there has been difference between heat gain values. Solar energy increases up to an hour of 16 and then decreases again. However, maximum heat gain values are obtained by the present study and given in ASHRAE [24] as 20.1 W/m^2 and 24 W/m^2 at hour of 17, respectively. This is normal condition because of the highest solar energy happens at hour of 16 with a value of 716 W/m^2 . It is understood that there is one hour time lag. Differences between estimated heat gain values and those of RTS method [24] change between 0 and 5 W/m^2 .

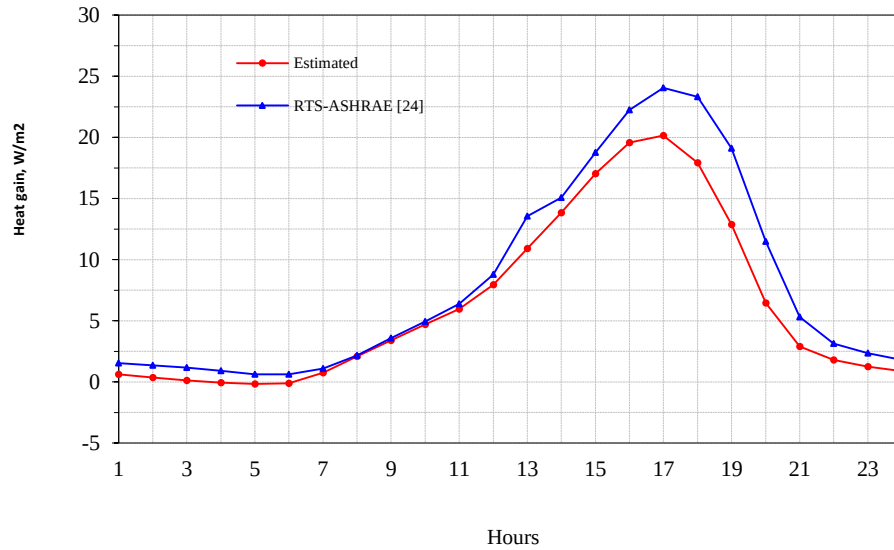


Figure 6.5. Variation of heat gain values for the wall given in ASHRAE [24]

6.4. Theoretical and experimental procedure for building walls and flat roofs

Instantaneous solar radiation flux on horizontal surface, inside room temperatures, outside air temperatures and each layer surface temperatures of the walls and flat roofs used in the experimental study are measured in the experimental system.

Hourly solar radiation is also measured by Meteorological Station located for 72 cities of Turkey. In this section, theoretical and experimental values of hourly

temperature and heat gain for some selected walls and roofs are presented. In order to compare theoretical and experimental results for the transient temperature distribution in the multilayer building walls and roofs and heat flow through the structures, it is necessary to give computational procedure for finding daily variation of temperature in the structures and heat gain. A computer program in MATLAB based on the theoretical solution of the conduction heat transfer problem presented in the chapter 3 is prepared for the numerical calculations. The solution is used to find heat gain and CLTD values through the walls or flat roofs and also temperature variations in these structures for daily periodic operation. The program uses as input parameters are:

1. Thermo physical properties of the walls and flat roofs used in the present study for experimental system are given in chapter 4 as a table form. They are not given in this section again.
2. The interior design air temperature, the combined heat transfer coefficients at the interior and exterior surfaces are taken to be 24°C, 8.3 and 17 W/m².°C, respectively.
3. Hourly solar radiation flux on a horizontal surface and outside air temperature are used in the numerical calculations for the data measured during July 21. 2013 in Gaziantep, which is shown in Figure 6.6. The data measured during a clear sky day are selected and given in the figure.

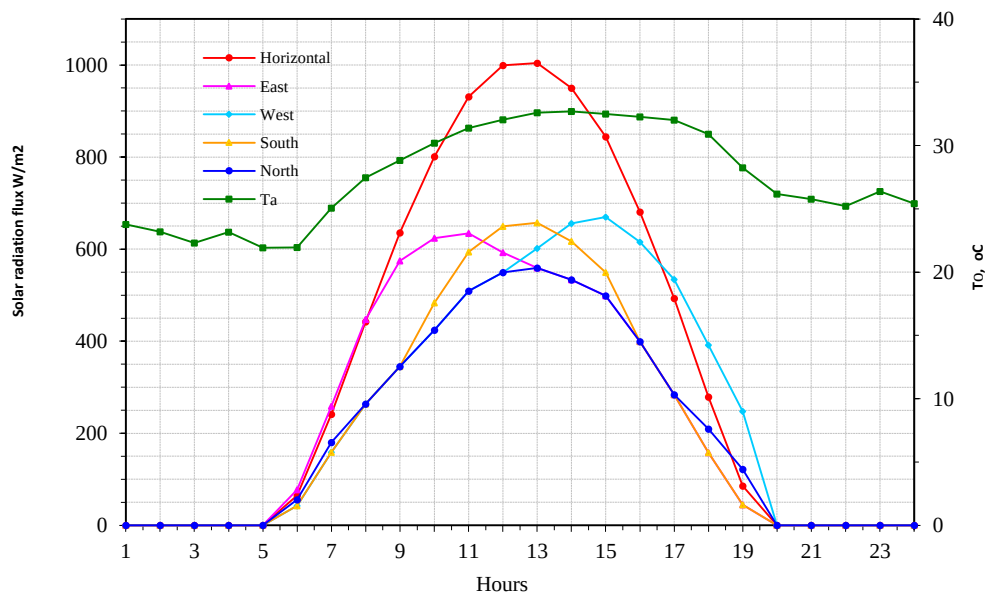


Figure 6.6. Measured solar radiation and ambient air temperature on July 21. 2013

Figure.6.6. shows the ambient air temperature and solar radiation on horizontal surface and vertical surface in four main directions on July 21. 2013. Ambient air temperature values are variation between 21.93°C and 32.7 °C and hourly solar radiation flux on horizontal surface variation between 0 W/m² and 1004 W/m², but solar radiation on the walls or vertical surface to the main direction are minimum value zero and maximum value of solar radiation for East, West, South and North direction are 634.3, 669.5, 657.3 and 559.3 W/m², respectively.

In this section, theoretical and experimental studies are shown the estimating time related with variation of temperature in multilayer building walls and flat roofs and heat flow through structures and also for comparing the evaluated temperatures and heat flow with these values obtained by measurement. The measured values for hourly solar radiation flux, outside air temperatures and nodal temperatures for each layer of flat roofs and walls are used to calculate heat gain and CLTD values for each structure then compare theoretical results with experimental for same structures.

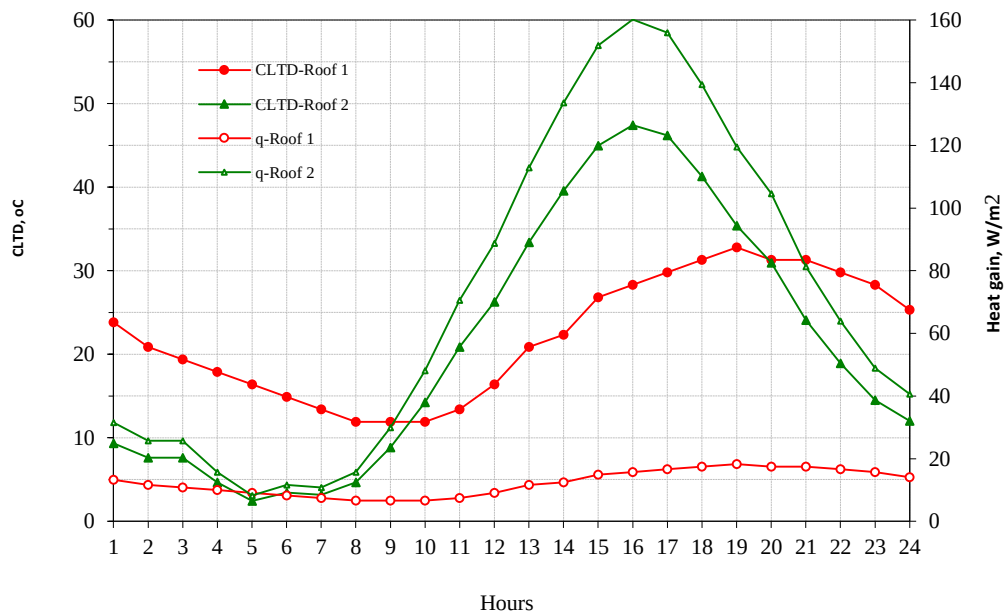


Figure 6.7. Experimental CLTD and heat gain values for roofs on July 21. 2013

Figure.6.7. Shows the experimental values of heat gain and CLTD for two types of roofs with and without insulation, seen in the figure heat gain values for roof number one variation between 6.6 and 18.3 W/m² but for second roof heat gain variation between 8.3 and 160.2 W/m², CLTD values for roof 1 variation between 11.9 and

32.8°C but for roof 2 variation between 2.5 and 47.4°C. The result of heat gain and CLTD values presented in the Figure 6.6. Shown the difference between minimum and maximum values in the roof 1 less than roof 2. The maximum value of heat gain and CLTD for roof 2 higher than roof 1. In order that roof 1 constructed from four layer but roof 2 constructed from two layer materials as shown in Figure 4.2. Therefore the heat resistance of roof 1 higher than roof 2 are $R_1=1.795$ and $R_2=0.296$, respectively. The overall heat transfer coefficient (U) for roof 2 higher than roof 1, which $U_1=0.557$ and $U_2=3.377$ W/m².°C but heat gain too high in the roof 2 lead to increase the CLTD values. The CLTD values inversely proportional with U-value and directly proportional with heat gain. Experimental and theoretical heat gain and CLTD values of the roof 1 and 2 presented in Figure 6.8. As shown the theoretical values are reasonably closer with experimental values and small difference occurs that effected from leakage when the door opened or stopped the cooling system. The heat gain from roof 2 higher than roof 1 that occurs because of material and thickness of roof 1 bigger than roof 2.

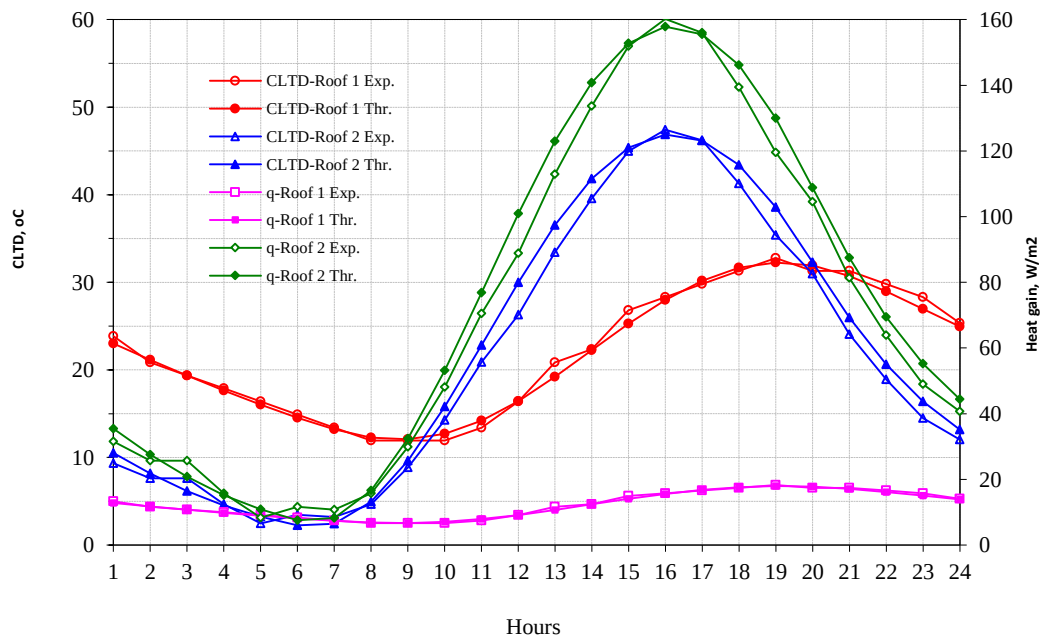


Figure 6.8. Experimental and theoretical CLTD values for roofs on July 21. 2013

Daily CLTD values obtained experimentally with south direction for eight different light color walls painted by white color commonly used in Turkey are represented in Figure 6.9. The maximum CLTD values for walls Brick, AAC, Blockbims, XPS,

Briquette, Covering, EPS and Siding are 15.277, 16.378, 15.696, 13.691, 15.342, 11.416, 12.311 and 13.978°C respectively. The minimum CLTD values for walls Brick, AAC, Blockbims, XPS, Briquette, Covering, EPS and Siding are 3.196, 2.126, 2.778, 4.361, 3.047, 6.536, 5.68 and 8.003°C. The result in the Figure 6.9. Observed the AAC wall has bigger maximum value and minimum value of CLTD, that meaning the AAC wall has bigger difference between maximum and minimum CLTD values therefore seen the AAC wall has high amplitude. The Brick, Blockbims and Briquette walls has amplitude less than AAC although has same thickness but different material effected U-factor higher than AAC as seen in Table 4.1, Covering, EPS and Siding walls they have less amplitude because of different materials and thickness of wall. The CLTD values inversely proportional with U-value and directly proportional with heat gain.

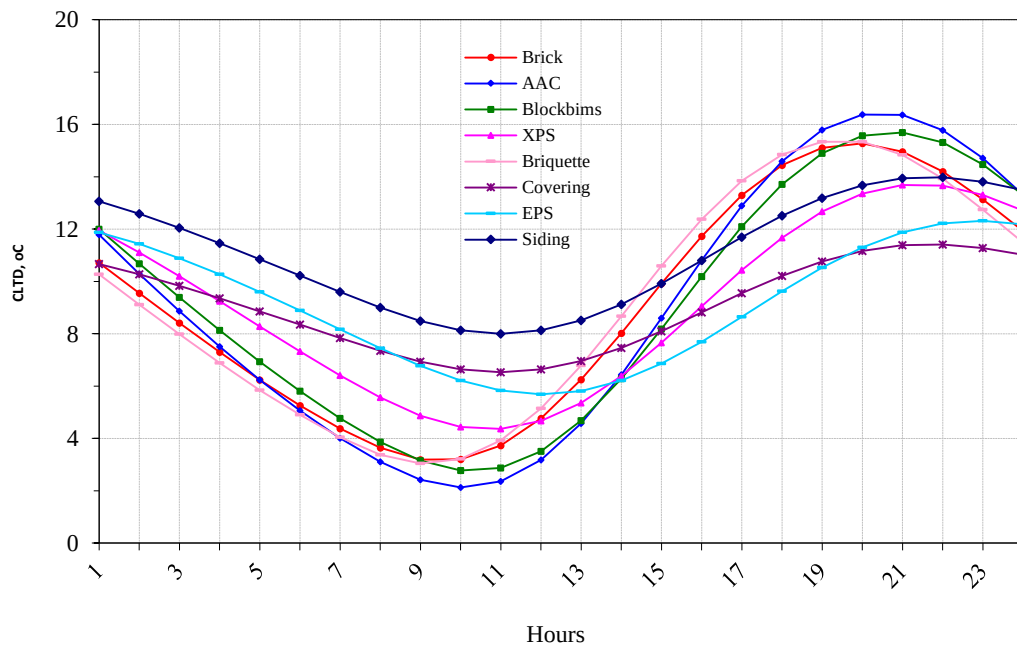


Figure 6.9. Experimental daily CLTD values of south walls on July 21, 2013

Experimental and theoretical daily CLTD values for different walls due to south direction on July 21, 2013 as shown in Figure 6.10. As shown in the figure the experimental and theoretical values are reasonably closer each other. The small difference occurs in order to stopped time of cooling system air conditioner and indoor air humidity affected because the thermocouple connected to the data logger inside the room would be affected by humidity.

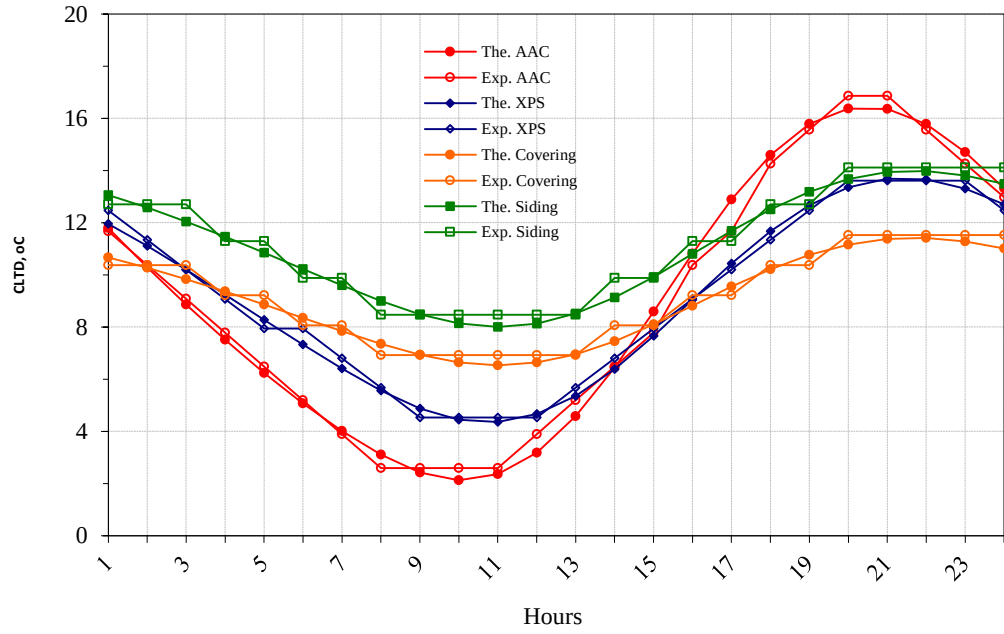


Figure 6.10. Daily experimental and theoretical CLTD values for different south walls on July 21, 2013

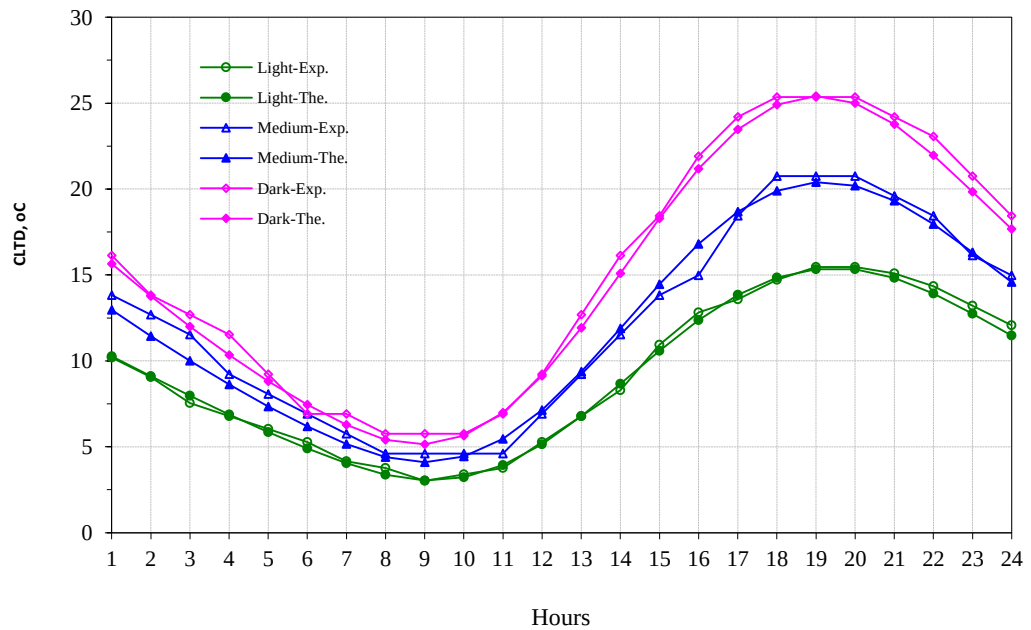


Figure 6.11. Effects of surface color on CLTD for south briquette July 21, 2013

Figure 6.11. Shown the effect of surface colored to CLTD values for Briquette wall due to south direction on July 21, 2013. As seen in the figure the CLTD value increase when surface painted by dark color as black color because solar absorption increase ($\alpha_s=0.884$) and heat gain increase as in the Equation (3.7). Medium color

when briquette wall surface painted by gray color that meaning decrease the solar absorption ($\alpha_s=0.664$). But when painted the wall surface by white color that meaning light color affected decrease the solar absorption ($\alpha_s=0.442$) therefore CLTD values decrease.

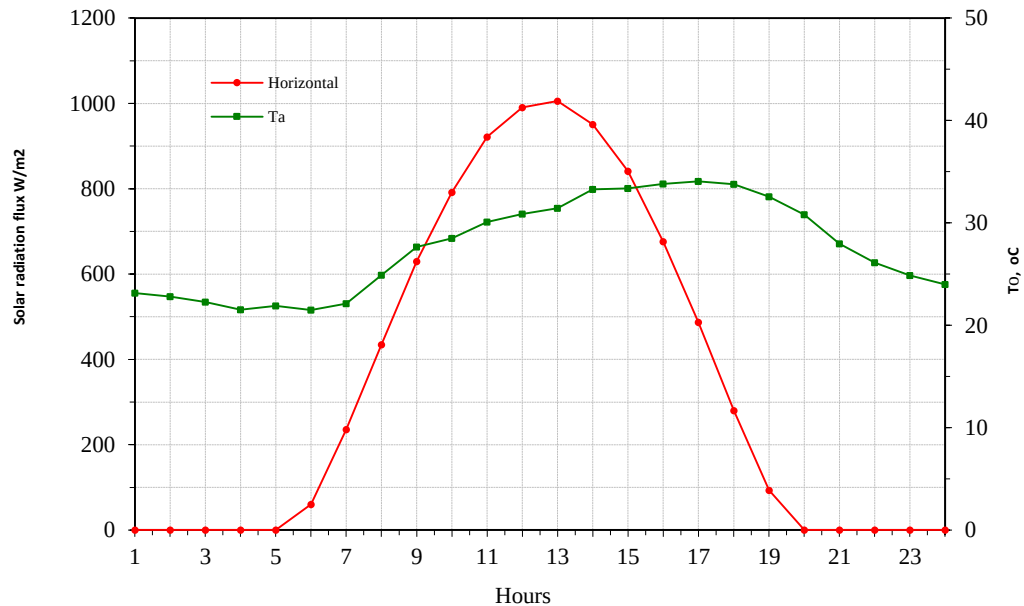


Figure 6.12. Measured values of solar radiation on horizontal surface and outside air temperature for design day of July 24. 2013 at $T_{in}=26^{\circ}\text{C}$

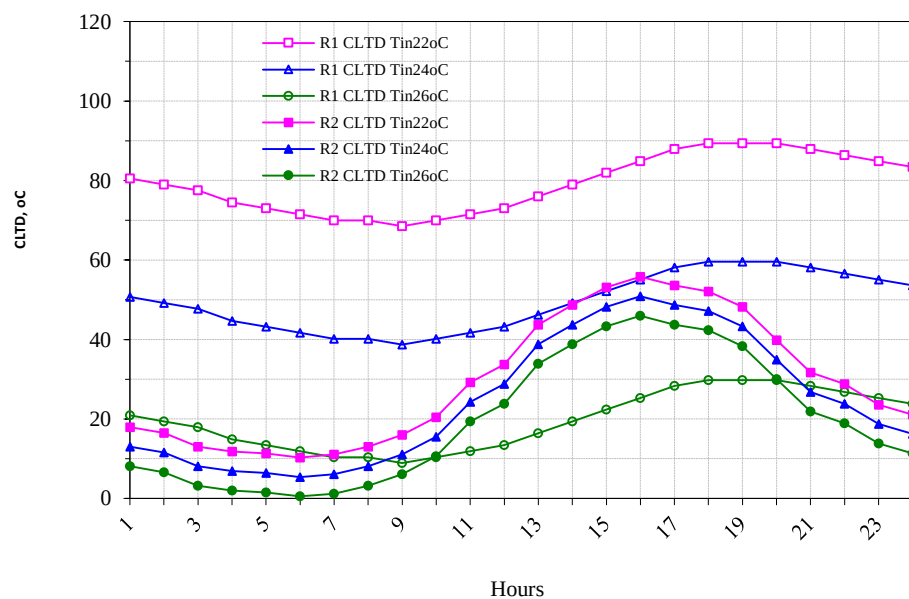


Figure 6.13. Experimental CLTD values of the roofs for July 24. 2013 with change inside room temperature

Ambient air temperature and solar radiation on the horizontal surface on July 24, 2013. As shown in the Figure 6.12. This data used to calculate CLTD values for 24 hours, which CLTD estimated from heat gain value divided by U factor as in Equation (3.3). The experimental data collected when inner room temperature fixed is $T_{in}=26^{\circ}\text{C}$. and subtracted from inside surface temperature and the result product to convection heat transfer coefficient $h_{in}=8.3$ as in Equation (3.2). Therefore by change inner room temperature to 22 and 24°C . can seen the effect of inside room temperature to the CLTD values in the Figure 6.13.

6.5. CLTD values for commonly used walls and roofs in Turkey

CLTD values and heat gains for commonly used walls and flat roofs in Gaziantep, Turkey are given and discussed in this section. In order to calculate the CLTD values, two main data are necessary, which are known as thermo-physical properties of the walls and roofs and the climatic data. Specifications and thermo-physical properties of the roofs and walls are given in Table 4.1 and 4.2, respectively.

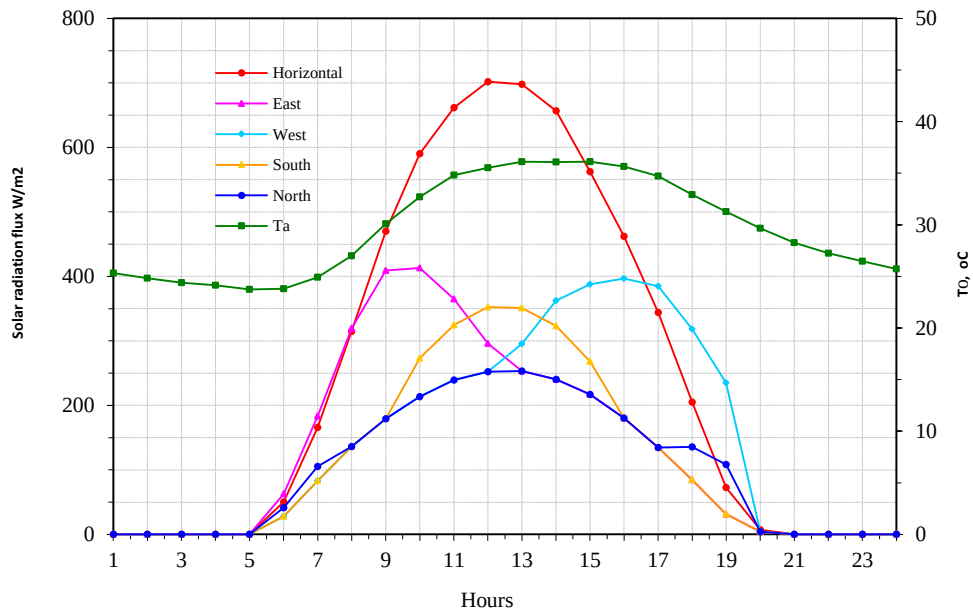


Figure 6.14. Solar radiation and ambient air temperature of Gaziantep design day

In order to calculate the CLTD values, average values of solar insolation recorded for horizontal surface on hourly basis, computed solar insolation falling on the walls directed to four main directions and hourly ambient air temperatures should be

known. Therefore, the values of hourly solar flux on the walls are computed by employing clear-sky model presented in Duffie and Beckman [23]. Hourly solar flux on flat roofs and wall surfaces and ambient air temperatures are given in Figure 6.14.

CLTD and heat gain values for the roofs and walls commonly used in Gaziantep are calculated and given in the figures in this section.

6.5.1. CLTD values for flat roofs

In Gaziantep, two different roofs are very common. One is with insulation while other is without insulation. Roof 1 is composed of 4 cm concrete, 5 cm insulation, 12 cm concrete and 2 cm inner plaster and Roof 2 is consisted of 12 cm concrete and 2 cm plaster. Description with thermo-physical properties for the materials of which roofs are made up of are provided in Table 4.1.

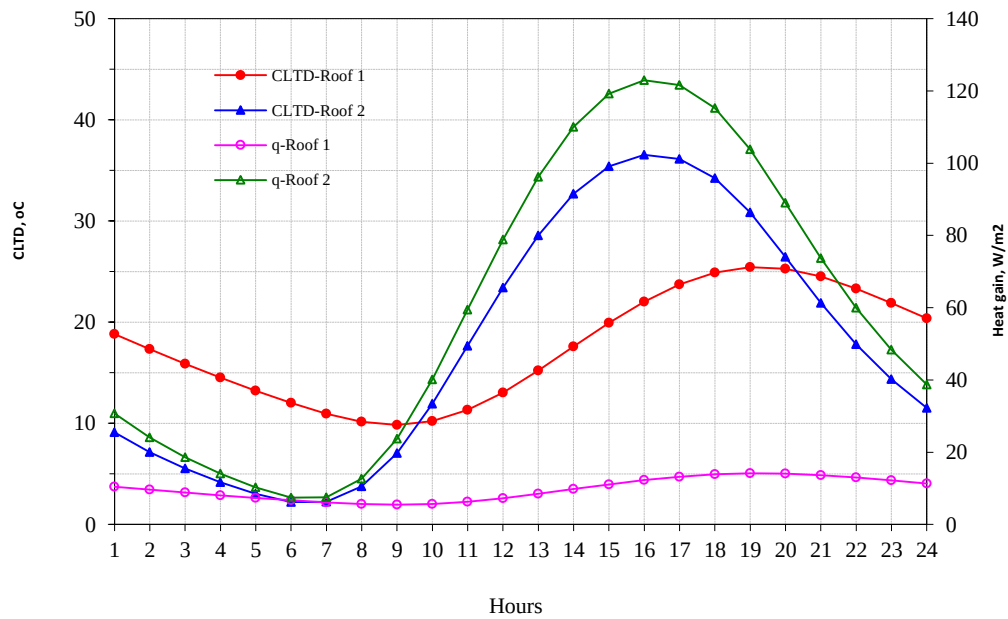


Figure 6.15. CLTD and heat gain values for two commonly used Roofs 1 and 2

Daily variations of CLTD and heat gain values through the roofs are depicted in Figure 6.15. Amplitude of the CLTD for Roof 2 is higher than that of Roof 1. While the amplitude for Roof 2 is equal to 37 °C, it is 25.8 °C for Roof 1. Insulation decreases reasonably amplitude of the daily CLTD and heat gain values. While the maximum heat gain through Roof 2 is obtained as 124.7 W/m², the lowest heat gain is obtained as 14.4 W/m² for Roof 1. As these values show, the highest heat gain for

Roof 2 is approximately 8.7 times higher than that of Roof 1. Insulation with a thickness of 5 cm decreases the heat gain in great amount. It is observed that insulation has a very important effect on the heat flow. Roof of a building or space should be constructed with the insulation for energy saving during summer and winter seasons and for comfort conditions of people living in that space. It is recommended that roof of any building should not be constructed without insulation.

6.5.2. CLTD values for commonly used walls

Blokbims, autoclaved aerated concrete (AAC), briquette and brick are the four generally used wall material in Gaziantep, which are, Specifications and thermo-physical properties of the walls are given in Table 4.1 and 4.2, respectively. Daily variations of CLTD and heat gain values for the walls are depicted in Figures 6.16 and 6.17, respectively.

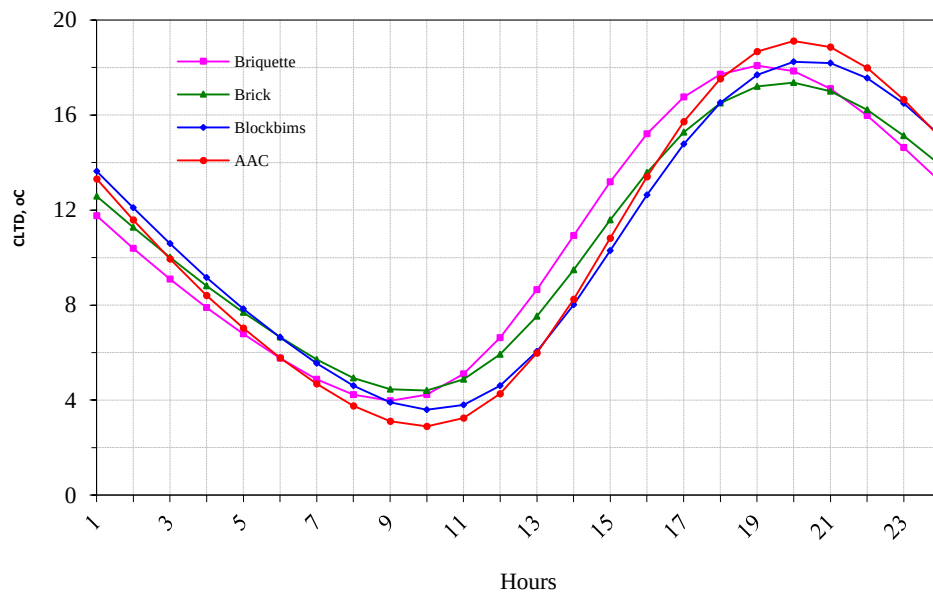


Figure 6.16. Daily CLTD values of commonly used walls due to south direction

Figure 6.16. shows that the maximum daily variation in the CLTD values occurs for the AAC wall and then by blokbims, briquette and brick in descending order. That is, amplitude of CLTD graph for the AAC wall is higher than that of the other walls. As the figure shows, daily variations of the CLTD values are closer to each other. In fact, in order to find daily variation of heat gain for each wall. CLTD values should be multiplied by overall heat transfer coefficient (U). When the CLTD values are

multiplied by U value of each wall, heat gains are obtained and given in Figure 6.17. It is observed that the heat gain is the highest through the briquette whereas it is the lowest through the AAC wall [16]. Among these walls, the briquette is the worst wall type of the commonly used walls in terms of heat loss and gain. It is clear in Figure 6.17 that cooling load of a building will be very high when exterior walls of the building are made with briquette and followed brick. But, most of the building walls are constructed with the briquette and brick in Turkey. This indicates that more energy will be consumed for room conditioning of the buildings constructed with the briquette and brick. Also, the higher heat gain or loss requires the higher capacity of boiler and air conditioning unit, which causes higher initial and operational costs. The lowest heat gain or loss is desirable to use the minimum boiler or air conditioning capacity which provides more comfortable conditions.

The figure shows that exterior walls of the buildings should not be constructed with the briquette and brick. However, it is recommended that blokbims and AAC are suitable for exterior walls in terms of heat gain and loss. When the blokbims or AAC is used, capacities of the heating and cooling units or energy requirement will decrease and then operation cost will decrease.

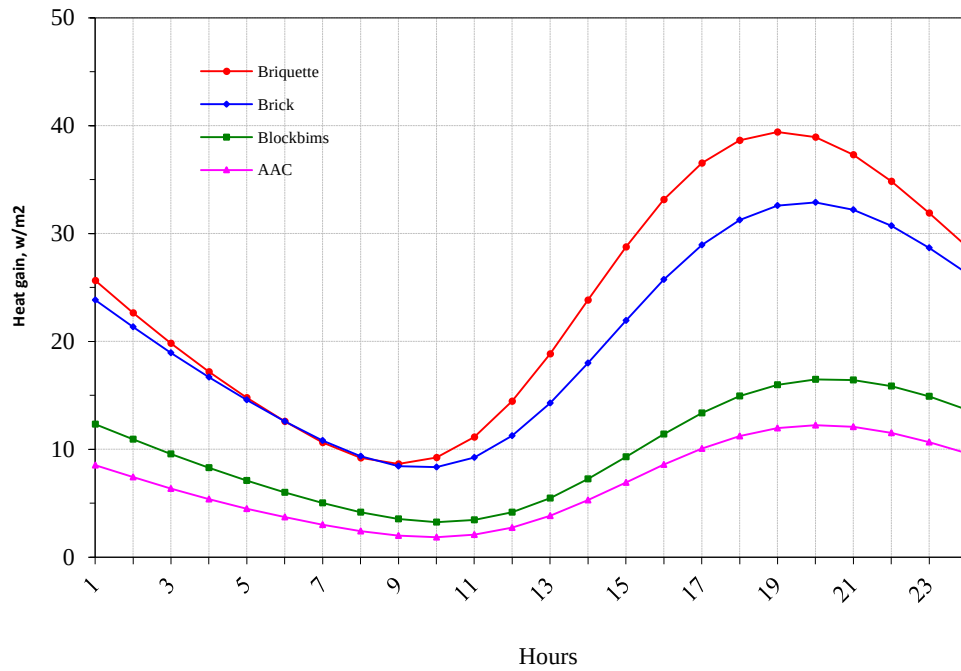


Figure 6.17. Daily heat gain values of south walls are commonly used

According to heat gain values shown in Figure 6.17, AAC is the most suitable wall of the commonly used walls. However, it is manufactured in industry. Therefore, its cost will be higher than that of the blokbims. Since, raw material of the blokbims is from natural bims. That is the blockbims is manufactured from raw bims or pomza material which is natural local volcanic sand in Kayseri, Nevşehir and Bitlis, cities situated in middle and east part of Turkey. Bims (pomza) have emerged with volcanic activities and has been taken away from open mining fields. It is fabricated with substantive pores and is long lasting with little or no physical and chemical effects. There are approximately 9 million m³ reserves at these regions of Turkey. Pomza reserves in these regions are over the World Standards in relation to its quality.

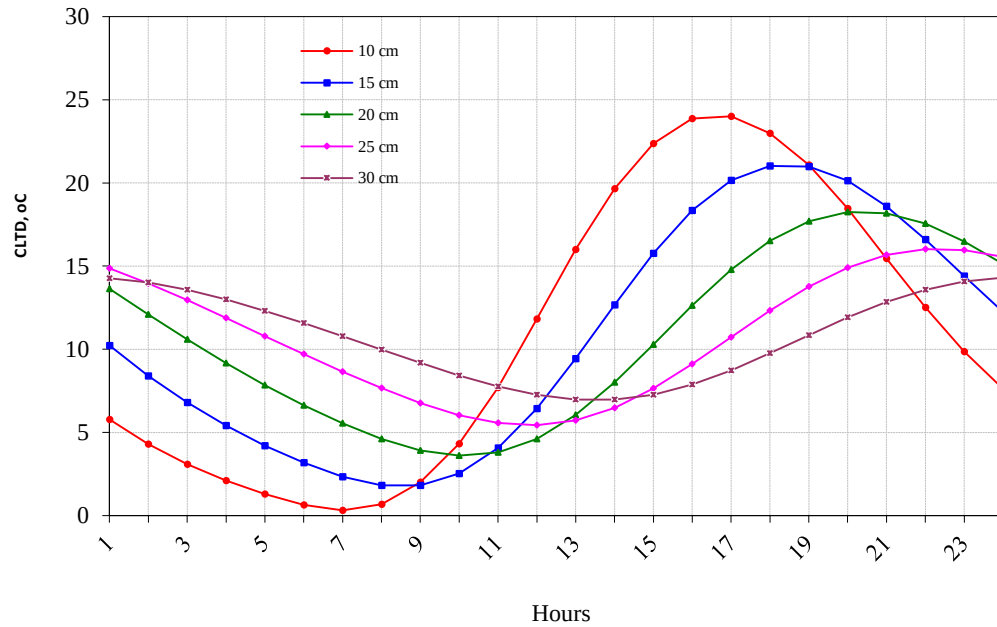


Figure 6.18. Daily CLTD values for the blokbims wall with changed thickness

Daily variation of CLTD values for the blokbims walls with different thickness values is shown in Figure 6.18, during design day in Gaziantep, Turkey. The figure demonstrates that thickness of a wall has significant effects on the CLTD values or heat gain. Since, amplitude of the CLTD is indirectly proportional with the wall thickness. When thickness of the wall increases and then amplitude of the CLTD decreases, it means that heat flow through the wall decreases. Time at which maximum CLTD value takes place proceeds with the thickness of the wall.

For example, the highest CLTD value for 10 cm wall thickness occurs 24 °C at 17:00. and the lowest CLTD for 30 cm takes place 14.3 °C after midnight. At the same time, while amplitude of the CLTD is equal to 23.7 °C for the wall thickness of 10 cm, it is equal to 7.4 °C for the wall thickness of 30 cm. It is clear that increasing wall thickness decreases CLTD values or heat gain and heat loss. However, it increases weight and initial cost of building exterior walls. In order to preclude this condition, it is possible to construct any building exterior walls with insulation, since the insulation decreases weight and initial cost of the building exterior walls.

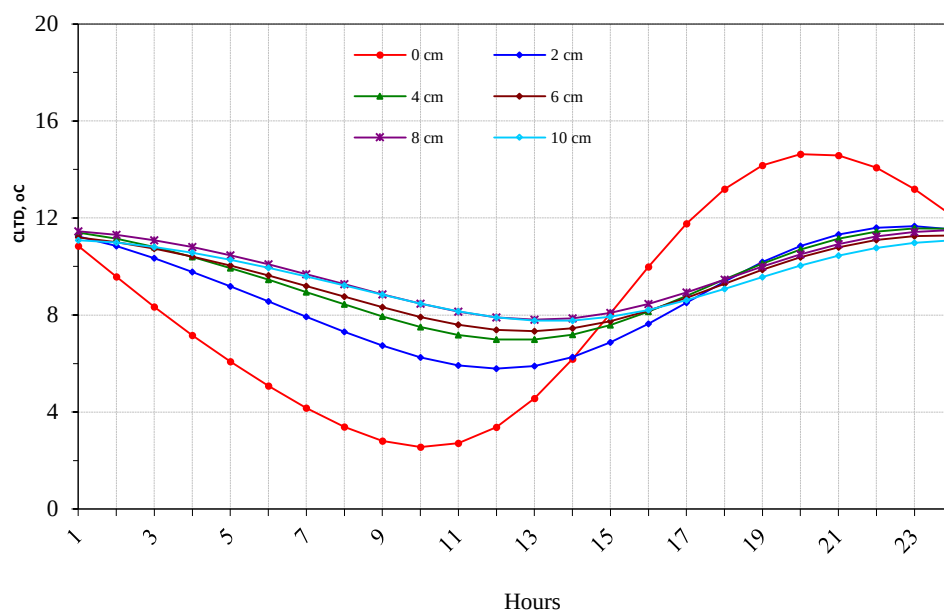


Figure 6.19. Effect of insulation thickness on CLTD values for blockbims wall

Figure 6.19, shows effect of the insulation on CLTD values for blockbims wall due to south direction with thickness of 20 cm. The figure shows that insulation has a strong effect on the CLTD or heat gain values. The highest and lowest CLTD values or amplitude of the CLTD decreases with the insulation thickness. Also, it is observed that the insulation with small thickness has a strong effect on the CLTD. When thickness of the insulation increases, the CLTD or heat gain decreases. It means that capacity of the air conditioning unit reduces with the wall or insulation thickness. As a result of increasing in wall or insulation thickness, comfort condition will increase and initial and operation costs will decrease. However, increase in the wall thickness will continue up to optimum wall thickness because of the wall economy.

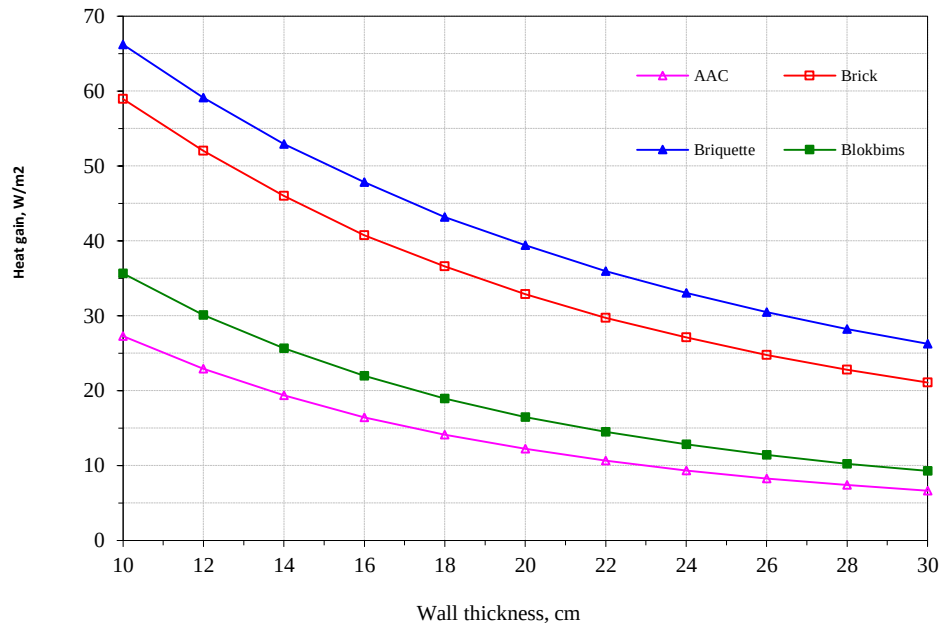


Figure 6.20. Variation of the maximum heat gain with thickness for four walls

Figure 6.20 is presented the comparing of maximum values of heat gains with respect to walls thickness for four types of walls of briquette, brick, blokbims and AAC. Time of the maximum values of heat gain occurs in different hours depending on heat storage capabilities and thermo- physical properties for the material of walls. Thermal conductivity and heat capacity are the dominant properties. The heat gain for each wall and differences in heat gains of the walls decrease as the wall thickness increases. As the highest amount of maximum heat gain occurs for the briquette, the lowest heat gain takes place for the AAC. This figure gives an idea about which one of thickness for the walls constructed with briquette or brick corresponds to the AAC or blokbims. At this time, it indicates that how much thickness of wall need for amount of wall's heat gain is necessary for a and each of the structures. It is observed from the figure that heat gain through the blokbims wall with 10 cm thickness corresponds 19 cm of brick and 22 cm of briquette walls. Also, amount of gain through the AAC wall with a thickness of 10 cm will be equal to the same heat gain through blokbims, brick and briquette with thickness of 14 cm, 24 cm and 29 cm, respectively. It is concluded from the figure that blokbims gives approximate results with those of the AAC. This is a very significant result for the blokbims since its material is territory and natural materials or it is not manufactured as the AAC.

When it is used in building wall construction in Turkey, it provides stable temperature in the rooms and comfortable condition for the people living in the buildings. Also, size of air conditioner, initial and operation costs of the conditioner and building construction will be decreased.

Another effect of any wall or roof surface on heat gain is surface color. The surface color of any exterior surface is very important for heat gain values of any wall or roof, since heat gain of any space from exterior walls depends on heat flux absorbed by the wall surface. In order to see the effect of surface color on CLTD or heat gain. Figure 6.21 is depicted for light, gray and dark blockbims wall with thickness of 20 cm and directed to south, CLTD values for the dark blockbims surface are 1.5 times greater than those of light surface. This indicates that colors of building exterior surfaces are very important. Especially, any building should be constructed with light colors for the places near to the equator or having high solar flux to decrease cooling load and load on the cooling system in order to reduce the operational cost.

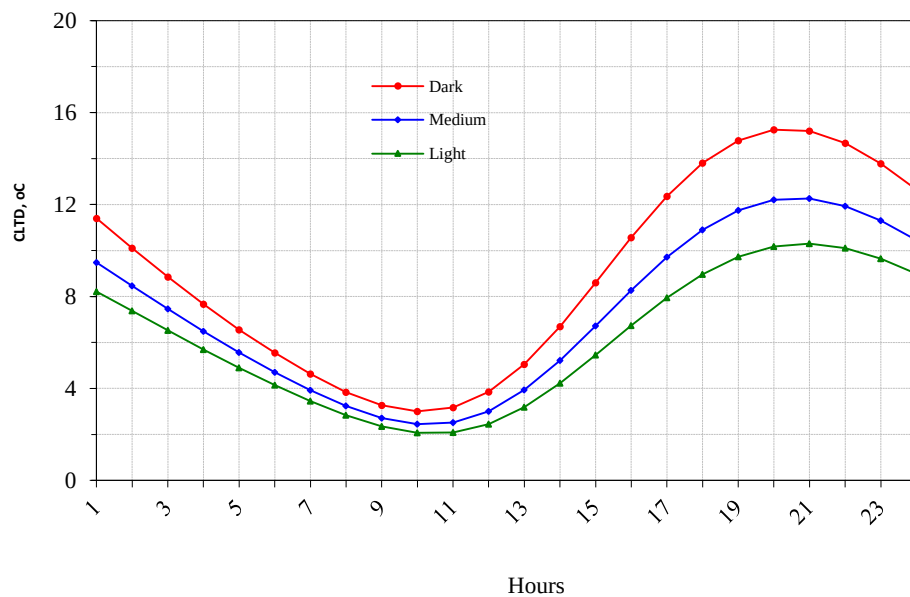


Figure 6.21. Effects of surface color on CLTD values for blockbims

Figure 6.22 is presented the effect of coefficient of surface absorptivity on the cooling load temperature difference (CLTD) values of briquette wall faced south direction. Wall surface absorptivity affected outer surface temperature for that wall as well affected amount of heat gain through the wall in result CLTD values was

changed. Surface absorbance coefficient is theoretically varied from 0 to 1. The CLTD values increases with the absorptivity.

It is observed from the figure that outside surface absorptivity has effect CLTD values because of effect on the surface temperature of walls and roofs. which increase or decrease heat gain through the structures. It indicates that plaster having lower or higher absorptivity should be used for cooling or heating season, respectively. Therefore, the point of view for structures which used for both seasons, it should be optimized in energy consumption during cooling and heating season.

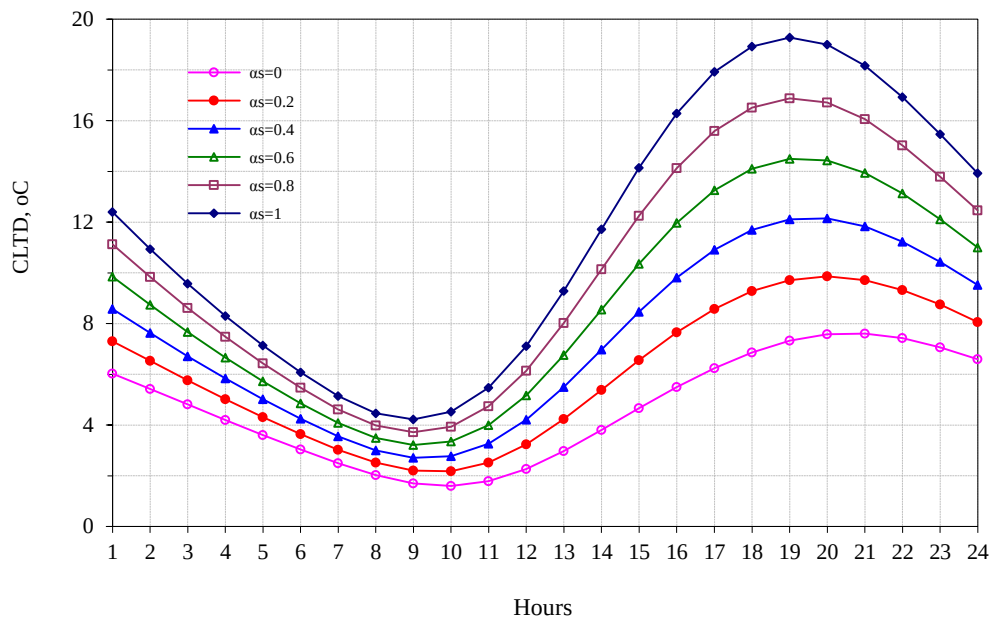


Figure 6.22. Daily variation of CLTD values for briquette wall due to south

Figure 6.23 shown effect of variation of surface solar absorbance to the highest heat gain through four types of walls facing south direction in Gaziantep. Indicate from figure the amount of heat gain through the walls increase with increasing walls surface absorbance for solar radiation because of increase walls surface temperatures. Surface absorbance coefficient value change depends on type and color of structure surface.

The inside design air temperature is another parameter in the calculation of heat gain or cooling loads. Figure 6.24 is shows that the daily highest heat gains of four different walls with 20cm thickness due to south direction with various T_i temperatures for Gaziantep in Turkey. The inside design air temperature is used in

the calculation of CLTD values linked to heat gain. When the inside design air temperature is decreased, the total heat gain is increased during summer or cooling season. Because more amount of energy is consumed to cool the inside of building. As a consequence, the lower inside design air temperature requires the higher cooling load.

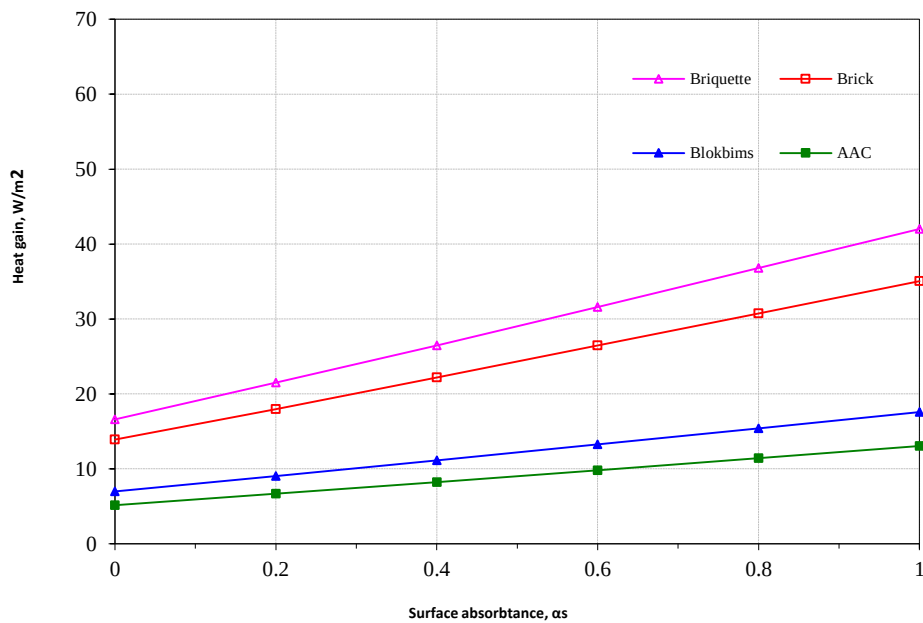


Figure 6.23. Daily maximum heat gain of walls with surface absorptivity

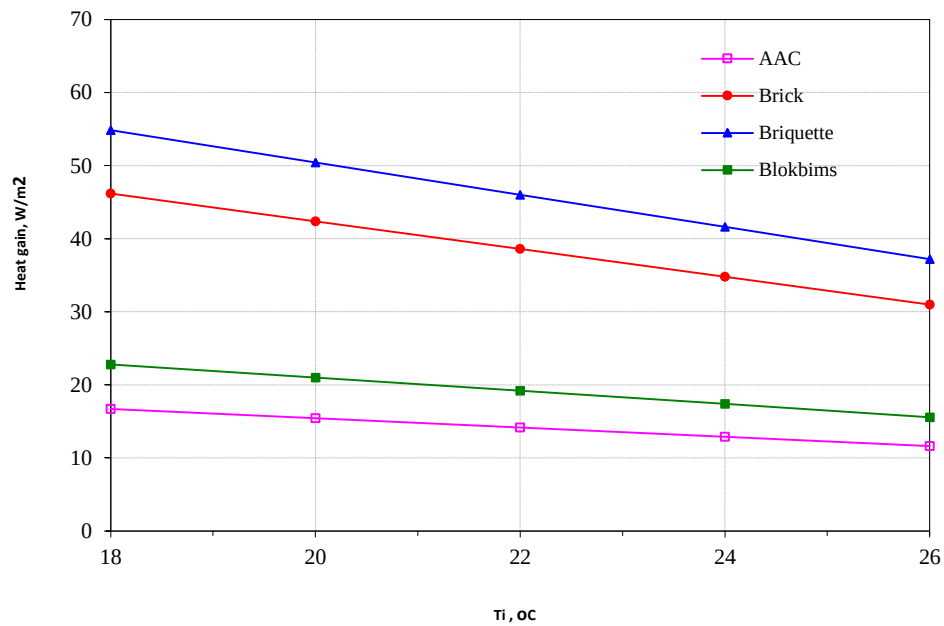


Figure 6.24. Variation of maximum heat gain with various T_i temperatures

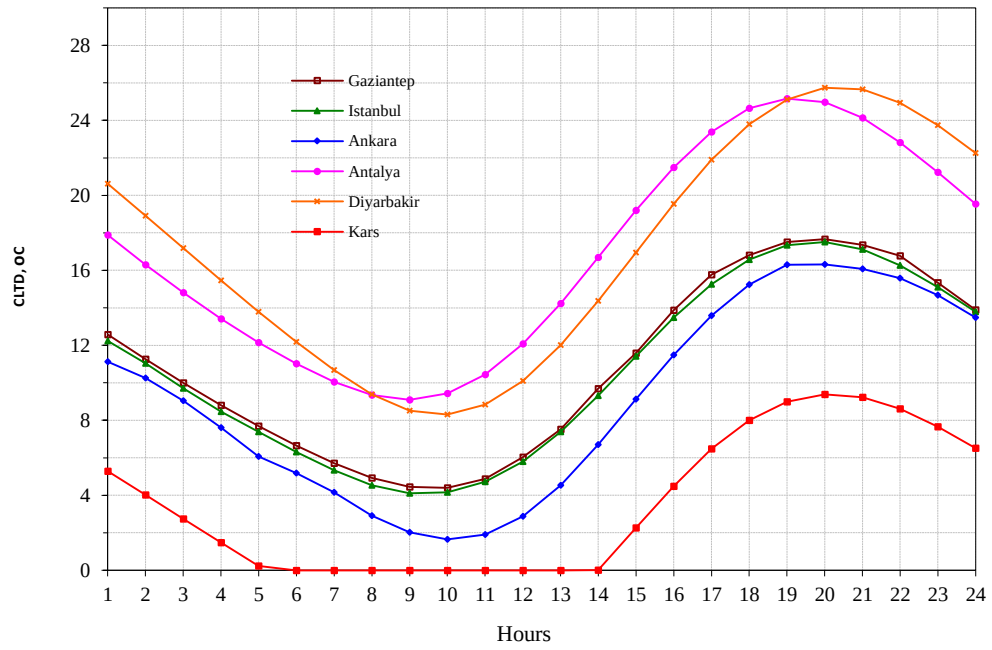


Figure 6.25. Daily variation of CLTD values for brick south walls

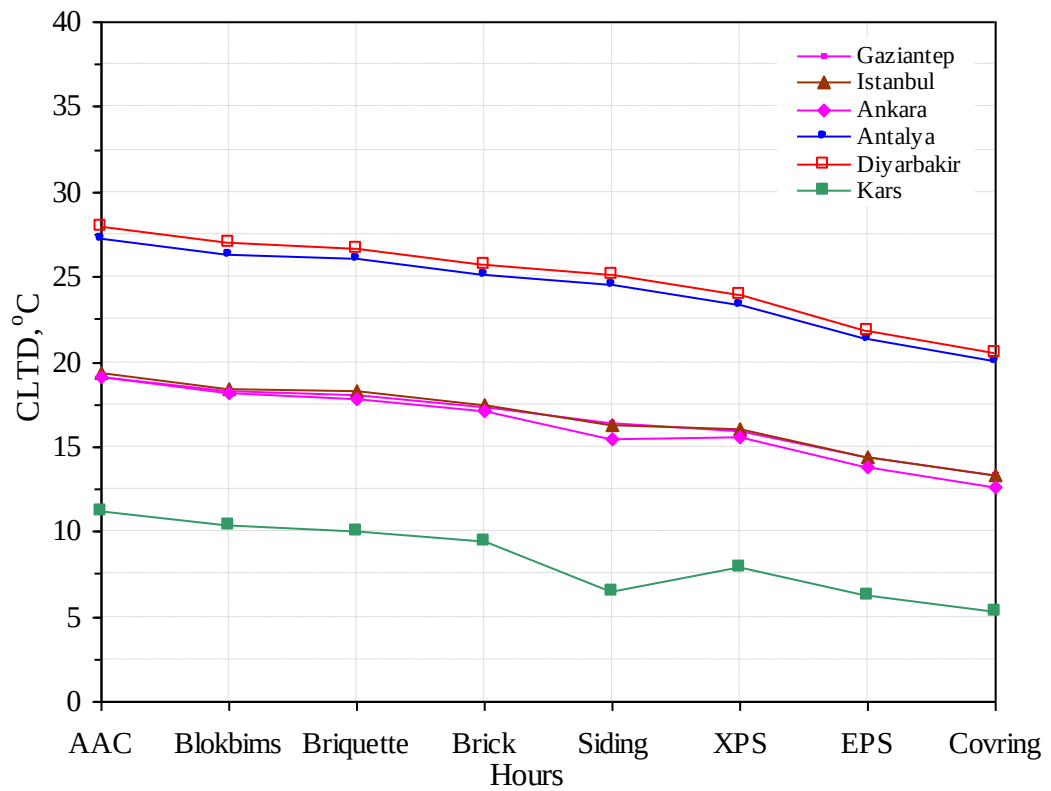


Figure 6.26. Maximum values of CLTD for the south walls in cities of Turkey

Solution of transient heat transfer problem and calculation procedure for CLTD values can be used for all multilayer building walls and flat roofs and for all climatic conditions. If climatic parameters such as latitude angle, hourly outside air temperatures and solar radiation flux are known, then hourly temperature distribution on the structures and CLTD values for the building elements can be calculated using program prepared in Matlab. That is mathematical and computational models given in the study can be used for all climatic conditions and building walls and flat roofs.

Figure 6.25 is depicted for hourly variation of CLTD values for south-facing brick walls with thickness of 20 cm and for some selected cities in Turkey. It is seen from the figure that the hottest and coldest cities are Diyarbakir and Kars, respectively. Mean values of CLTD values for the cities of Istanbul, Ankara, Antalya, Gaziantep, Diyarbakir and Kars are calculated as 10.6, 9.7, 16.8, 10.75, 17.1 and 3.6 °C, respectively. The CLTD values and its amplitude for Antalya are higher than those of the other cities. It indicates that the Antalya is closer to Equator than the other cities.

Figure 6.26 shows the variation of highest values of CLTD for eight types of walls with selected cities including Ankara, Antalya, Diyarbakir, Istanbul, Gaziantep and Kars. As shown in Figure 6.25 and 6.26 that CLTD values for Kars are lower than those for other cities. Diyarbakir is very hot region during summer season. Solar radiation values on horizontal surface in Diyarbakir are close to those in Antalya.

This shows that outside air temperature in Diyarbakir are higher than those in Antalya. This shows that the effect of outside air temperature on CLTD values more than the solar radiation flux.

6.6. Heat gain and CLTD values for commonly used walls and roofs in Iraq

As mentioned in this study the model was prepare to obtain heat gain and CLTD values for any type of walls and roofs which using in buildings and as well as can use the model for any place of any country on the world. Therefore, in this work would have been presented some types of walls and roofs which are commonly used in Iraq. Figure 6.27, shown solar radiation flux on horizontal and tilted surfaces with ambient air temperature for Baghdad city capital of Iraq are used as input data of calculation model to obtain requirements values of CLTD and heat gain.

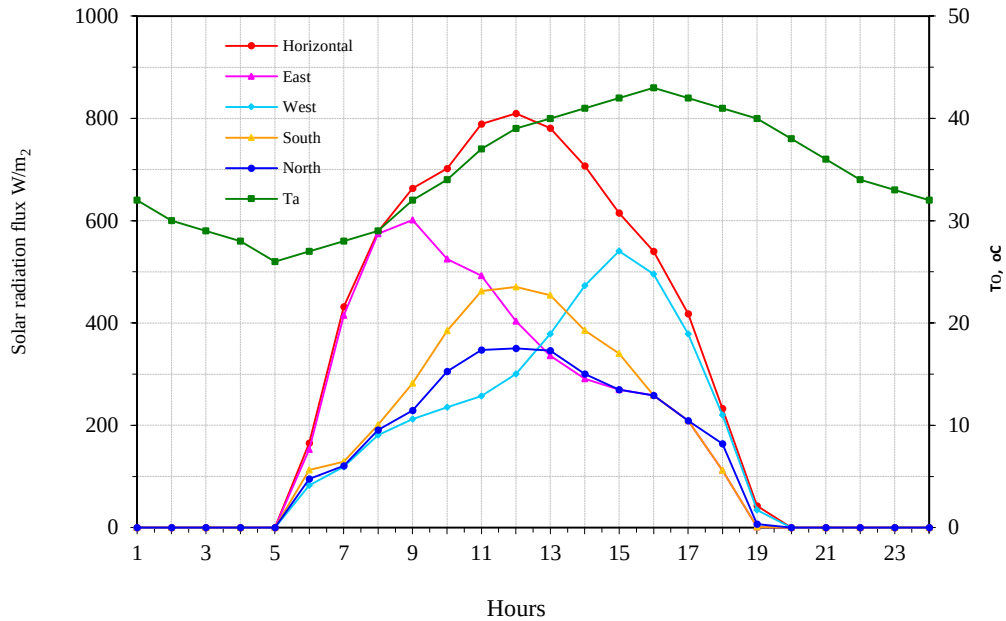


Figure 6.27. Solar radiation and ambient air temperature of design day in Baghdad

6.6.1. Roofs are commonly used in Iraq

The types of walls and flat roofs which are commonly used in Iraq country are shown in the chapter 3, exactly in Figure 3.3. In Baghdad, two different roofs are very common. One is with insulation while other is without insulation. Roof A is composed of 2cm gypsum plaster, 15 cm concrete, 2 cm felt, 10 cm clay, 4 cm sand and 4cm slabs of concrete mtstih and Roof B is consisted of 2cm gypsum plaster, 15 cm concrete, 2 cm felt, 2.5 cm poly starin as insulation, 10 cm clay, 4 cm sand and 4cm slabs of concrete mtstih. Description and thermo-physical properties for the materials of which roofs are made up of are provided in Tables 3.3 and 3.4, respectively. Daily variations of CLTD and heat gain values through the roofs are depicted in Figure 6.28. Amplitude of the CLTD for roof A is higher than that of roof B. While the amplitude for roof A is equal to 47.4 °C, it is 31.4 °C for roof B. Insulation decreases reasonably amplitude of the daily CLTD and heat gain values. While the maximum heat gain through roof A is obtained as 31.4 W/m², the lowest heat gain is obtained as 16 W/m² for roof B. As these values show, the highest heat gain for roof A is approximately 2 times higher than that of roof B. Insulation with a thickness of 2.5 cm decreases the heat gain in great amount. It is observed that insulation has a very important effect on the heat flow. Roof of a building or space should be constructed with the insulation for energy saving during summer and

winter seasons and for comfort conditions of people living in that space. It is recommended that roof of any building should not be constructed without insulation.

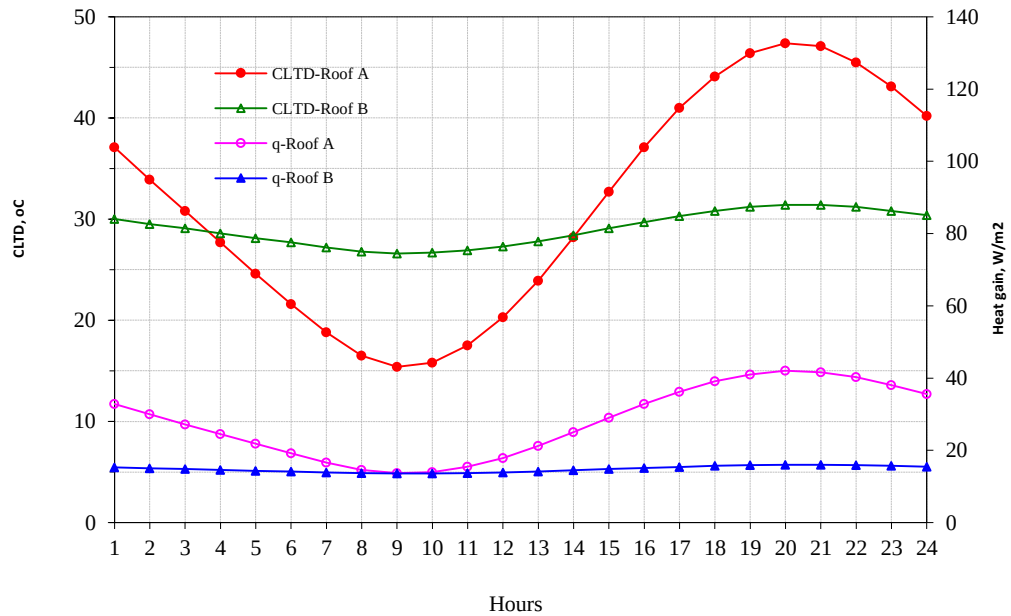


Figure 6.28. CLTD and heat gain values for two commonly used in Iraq

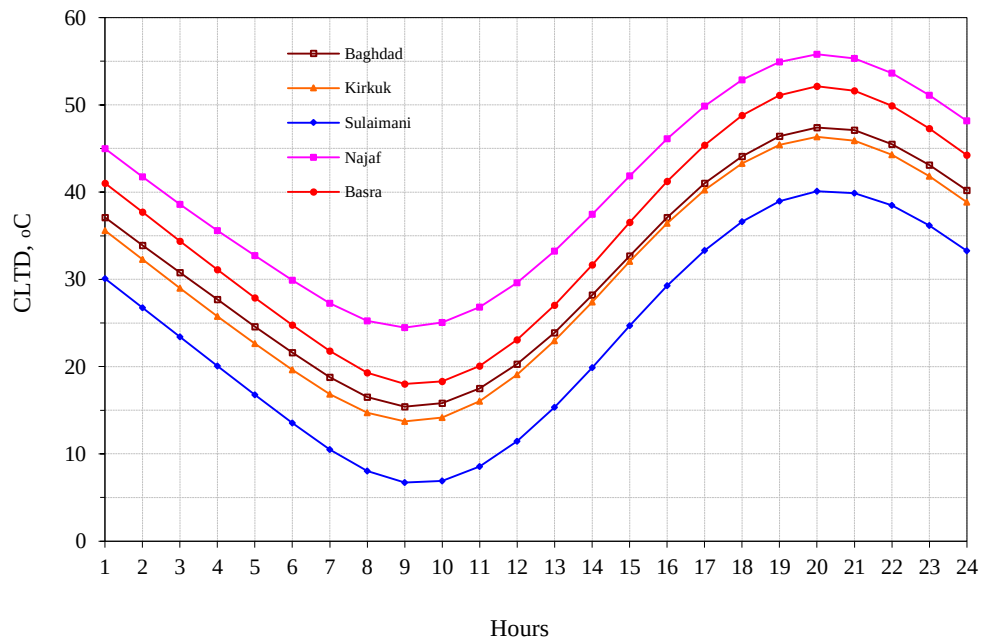


Figure 6.29. Daily variation of CLTD values for roofs A to different cities of Iraq

The main thing of this study a model of calculation procedure for CLTD values by using CFFT technique can be used for all multilayer building walls and flat roofs.

and for all climatic conditions. If climatic parameters such as latitude angle, hourly outside air temperatures and solar radiation flux are known, then hourly temperature distribution on the structures, heat gain and CLTD values for the building elements can be calculated using program prepared in Matlab. That is, mathematical and computational models can be used for any climatic conditions and building walls and flat roofs, as well as this model can be used for different structures and different cities. Figure 6.29 shows daily variation of CLTD values for roofs A into different cities of Iraq. It is shown from the figure that the cold and hot cities are Sulaimani and Najaf, respectively. Mean values of CLTD for the cities of Baghdad, Kirkuk, Sulaimani, Najaf and Basra are calculated as 31.5, 30.2, 23.7, 40.1 and 35.2°C, respectively. The CLTD values and its amplitude for Najaf are higher than those of the other cities. It indicates that the Najaf is closer to Equator than the other cities.

6.6.2. Walls are commonly used in Iraq

The six types of walls are commonly used in Iraq are shown in Figure 3.3, from chapter 3. Descriptions of walls and thermo-physical properties of used materials are presented in Tables 3.3 and 3.4, respectively.

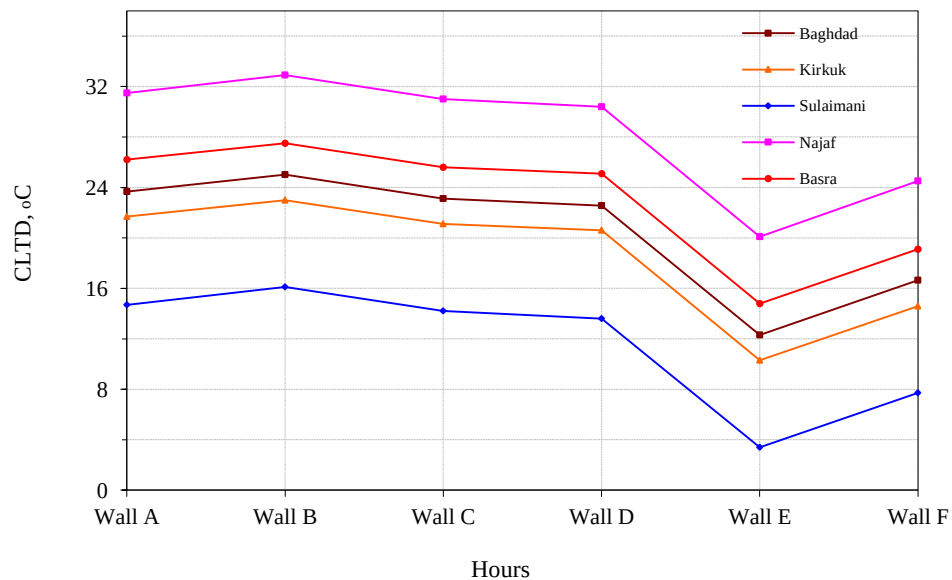


Figure 6.30. Maximum CLTD values of the south walls for cities in Iraq

Figure 6.30 shows the variation of maximum values of CLTD for six types of walls due to south direction with selected cities in Iraq. The mean values for the maximum

values of CLTD for different cities including Baghdad, Kirkuk, Sulaimani, Najaf and Basra, are calculated as 20.5, 18.5, 11.6, 28.4 and 23°C, respectively. Observed Figure 6.29 and 6.30 that CLTD values for Sulaimani are lower than those for other cities. Najaf is very hot region during summer season. Solar radiation values on horizontal surface in Najaf are close to those in Basra. While the outside air temperature in Najaf are higher than those in Basra. This shows that the effect of outside air temperature on CLTD values more than the solar radiation flux.

6.7. Results for economical analysis

In order to obtain optimum walls and roofs and insulation thickness, an economical analysis is required. All of the numerical calculations were realized to obtain economical analysis which is obtained by using the heat gain results. The CLTD method was used for determination of the building energy consumption for cooling load. The economical analysis is based on life cycle cost analysis. As a result of the economical analysis, energy cost, total cost and optimum walls, roofs and insulation thickness of different wall and roof types were obtained. The effects of directions, color of surfaces, types of walls and structures thickness on economical analysis were investigated.

The energy cost of light colored brick walls for four main directions with different walls thickness during cooling season is depicted in Figure 6.31. The highest heat gain leads the highest energy cost. It is seen from the figure that the highest energy cost is obtained for the wall directed due to East direction with 5cm wall thickness and the lowest energy cost is obtained for the wall directed due to North with 30cm wall thickness. If the wall thickness is increased, the cost of energy is decreased. But, there is a limit for the thickness of wall. Because increasing wall thickness causes the increasing wall and total cost. Therefore, the economical analysis is carried out to find optimum wall thickness. Figure 6.32 shows that the energy cost of light colored brick wall for four main directions during cooling season with 20cm. It is observed from the figure that the highest energy cost is obtained for the wall directed due to East during May, June, August and the lowest energy cost is obtained for the wall directed due to North. But, the highest energy cost for all directions are obtained during July, and also for the wall directed due to West during July. As a result of

these figures, the west directed wall with 20cm brick wall during July has the maximum energy cost.

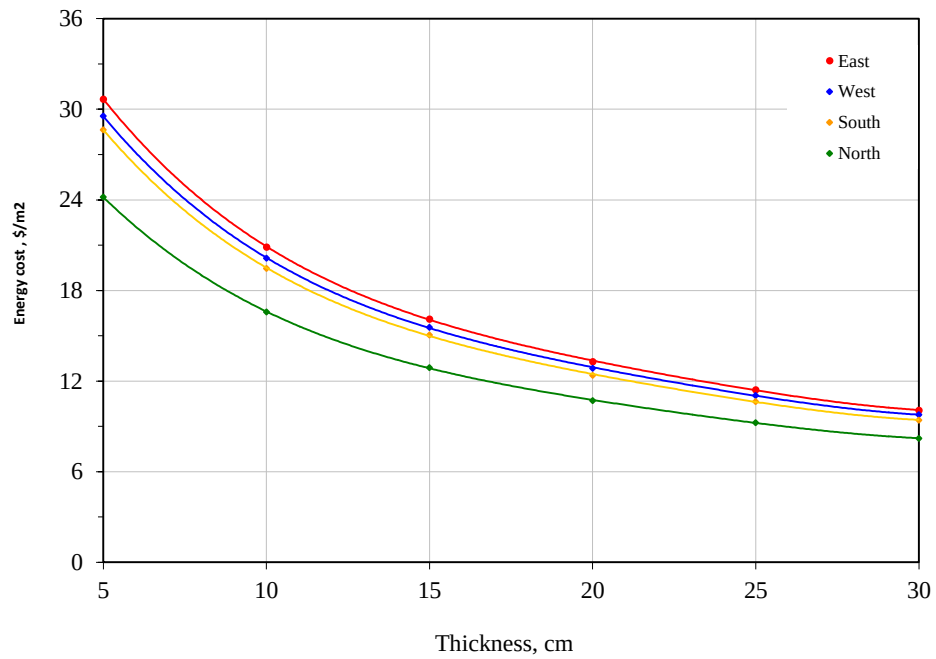


Figure 6.31. Annual cooling energy cost of brick wall for main directions

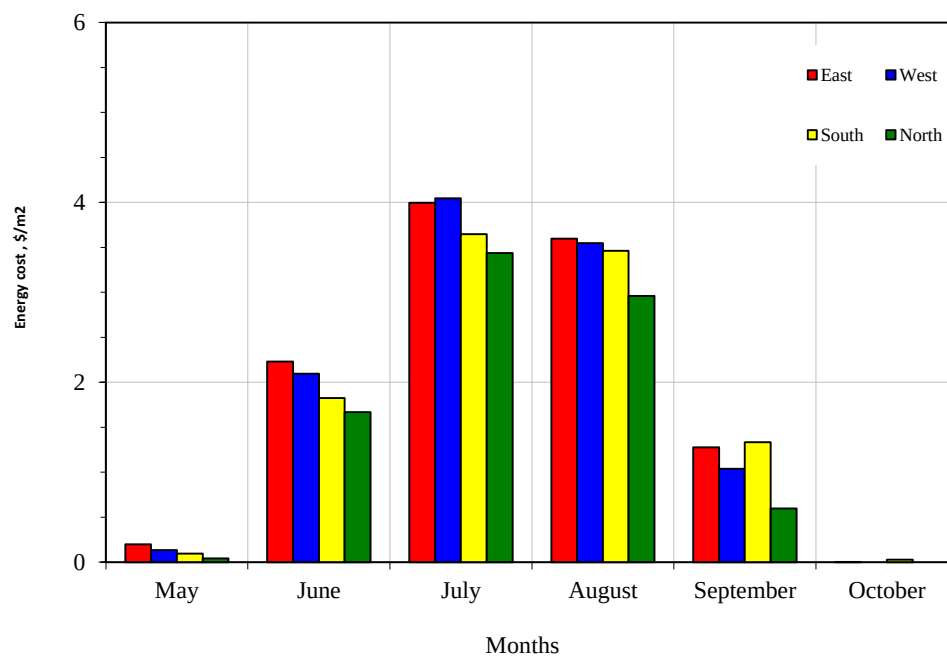


Figure 6.32. Energy cost of brick wall for main directions during cooling season

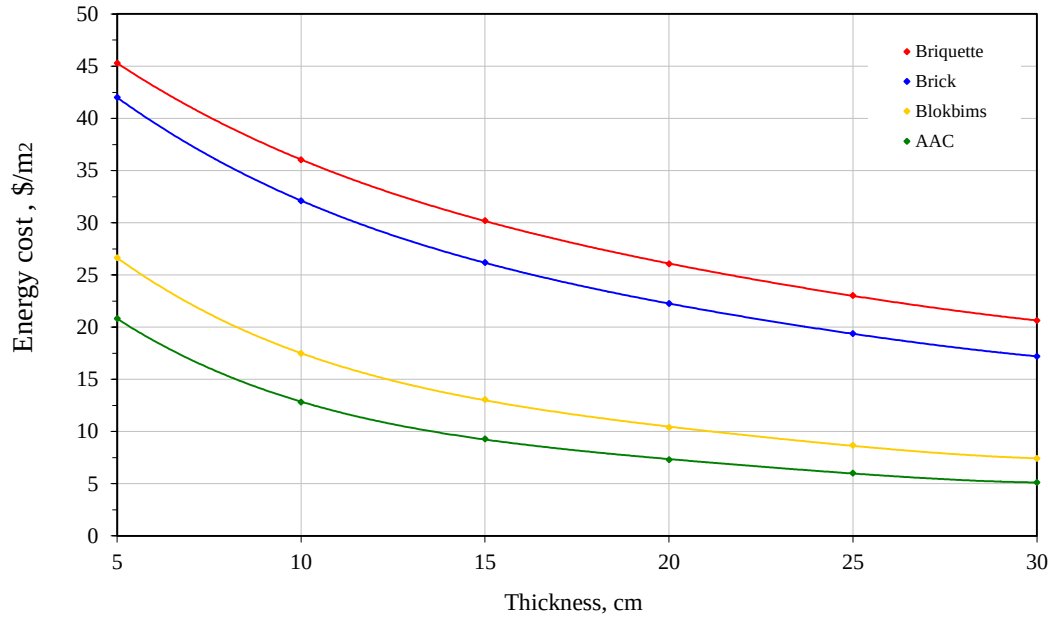


Figure 6.33. Annual energy cost with thickness of different south walls

Different types of walls have the different thermophysical properties which are thermal conductivity, density, specific heat, thermal diffusivity and heat capacity.

The variation of energy costs with respect to wall types are depicted in Figure 6.33 and Figure 6.34.

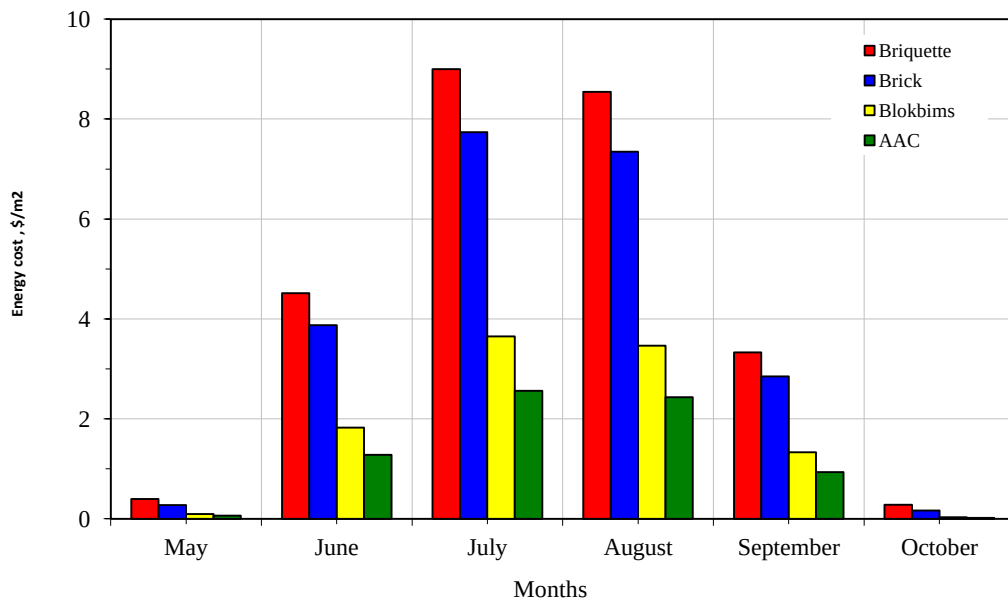


Figure 6.34. Monthly variation of energy cost of four different south walls

The total cooling energy cost during year with respect to wall thickness of four different walls which directed to south and colored light surface is shown in Figure 6.33. As the highest energy cost is obtained for briquette wall with minimum thickness, the lowest energy cost is taken for AAC wall with maximum thickness. The briquette wall has the maximum heat gain because of the highest heat capacity and thermal conductivity. Therefore, the briquette wall has the highest energy cost. The lower energy cost is obtained with increasing thickness of wall because of decreasing heat gain. Figure 6.34 depicts the monthly variation of energy cost with respect to different wall types. It is seen from the figure that all of wall types have the maximum energy cost during July, due to the highest solar radiation. As a consequence, the briquette wall with small thickness is undesirable construction wall material. The capacity and energy cost of air conditioning system increases owing to using of briquette wall with small thickness in construction.

Figure 6.35, 6.36 and Figure 6.37 shows the effects of surface absorptivity on energy cost. Variation of surface absorptivity effected daily energy cost of four types of wall because of it effected heat gain of that walls, which presented in Figure 6.35. Where the briquette wall give highest heat gain, therefore present highest energy cost and AAC wall lowest energy cost due to lowest heat gain.

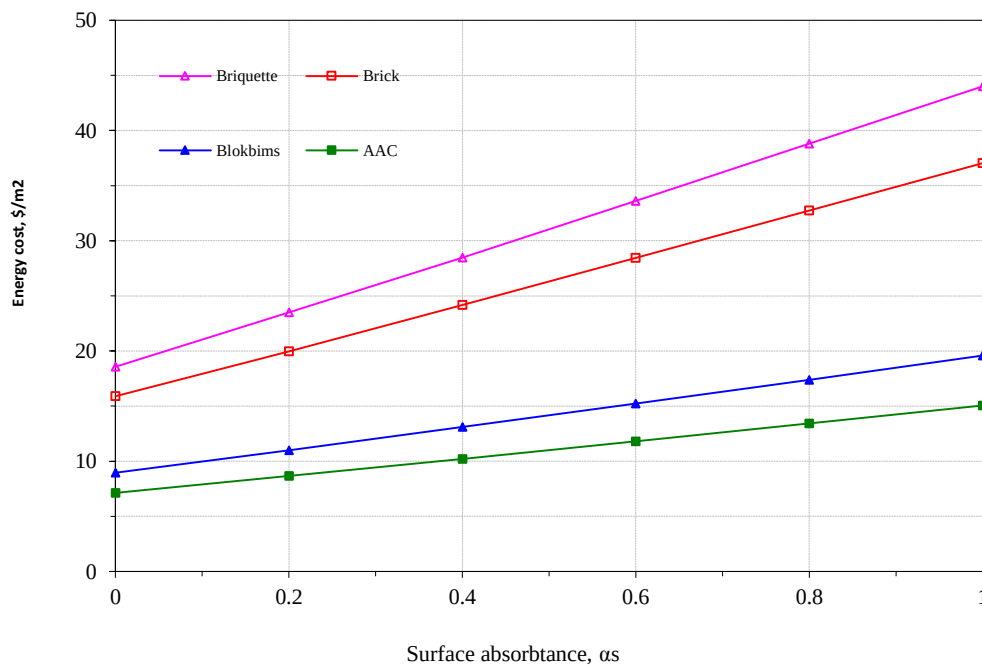


Figure 6.35. Effect of surface absorptivity on daily energy cost of four walls

The amount of energy cost increase with increasing surface absorptivity, where the Figure 6.35 shows the amount of daily energy cost of briquette is 38.81 $\$/\text{m}^2$ and for AAC wall is 13.4 $\$/\text{m}^2$ at the 0.8 surface absorptivity. The effect of surface colors with respect to wall thickness on the annual cooling energy cost for the blokbims wall which is directed South direction is shown in Figure 6.36. The energy cost increases with the increasing surface absorptivity due to heat gain.

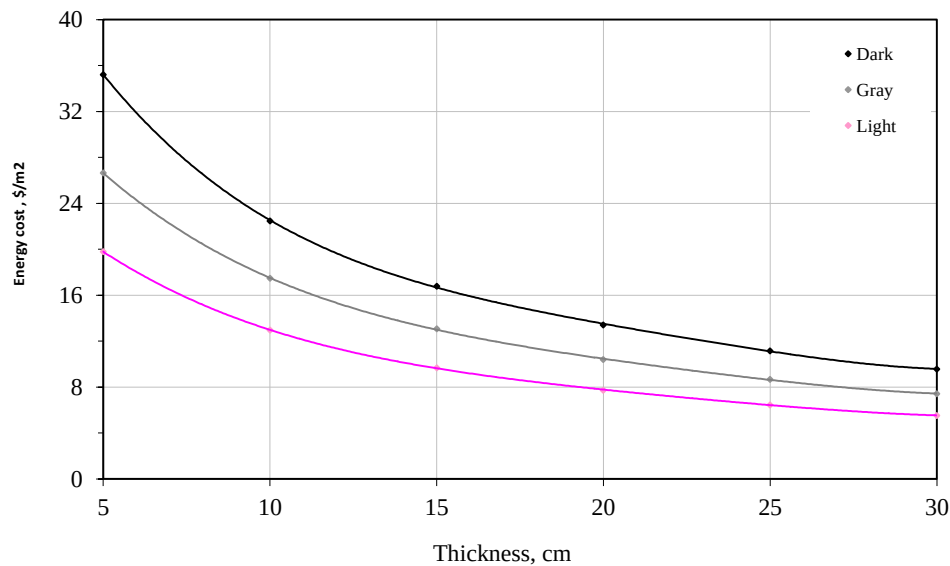


Figure 6.36. Effect of surface colors on the annual cooling energy cost for the blokbims wall facing South with different thickness

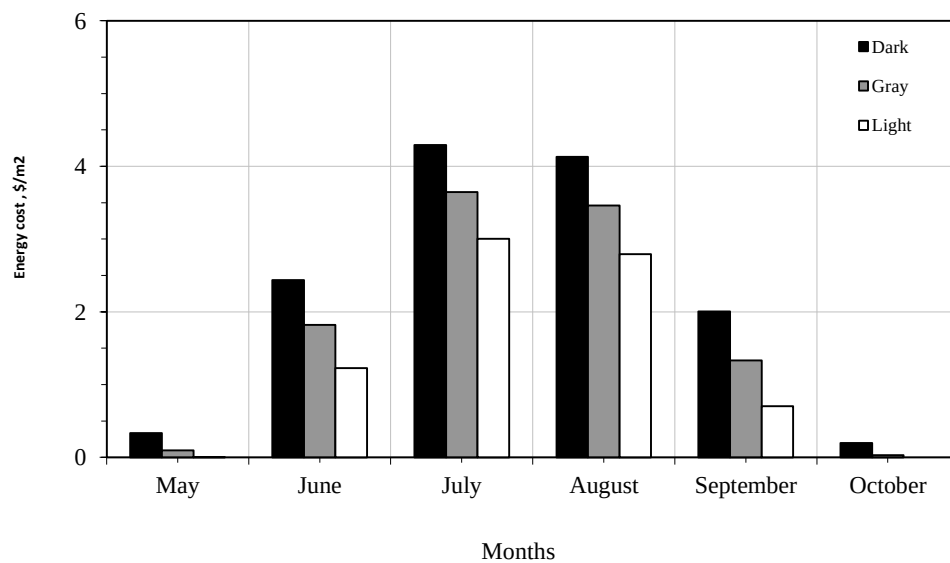


Figure 6.37. Effect of surface colors on energy cost for south blokbims wall

But the effect of absorptivity decreases with increasing wall thickness. Because dark surface walls with small thickness absorb more solar radiation. Therefore, the building walls constructed with higher absorptivity and small thickness are required more energy cost in order to cool the inside of building. Figure 6.37 shows that the effects of surface colors on energy cost for the blokbims wall directed to south direction during cooling season. Because of more solar radiation and absorption, the maximum energy cost is obtained for dark surface during July. The surface absorptivity which changes with surface color is profound effect on energy cost.

The main purpose of economical analysis is determination of the optimum thickness of wall and insulation material with respect to cooling loads. In this study, the optimum thickness of four different wall materials are calculated for cooling loads at Gaziantep of Turkey.

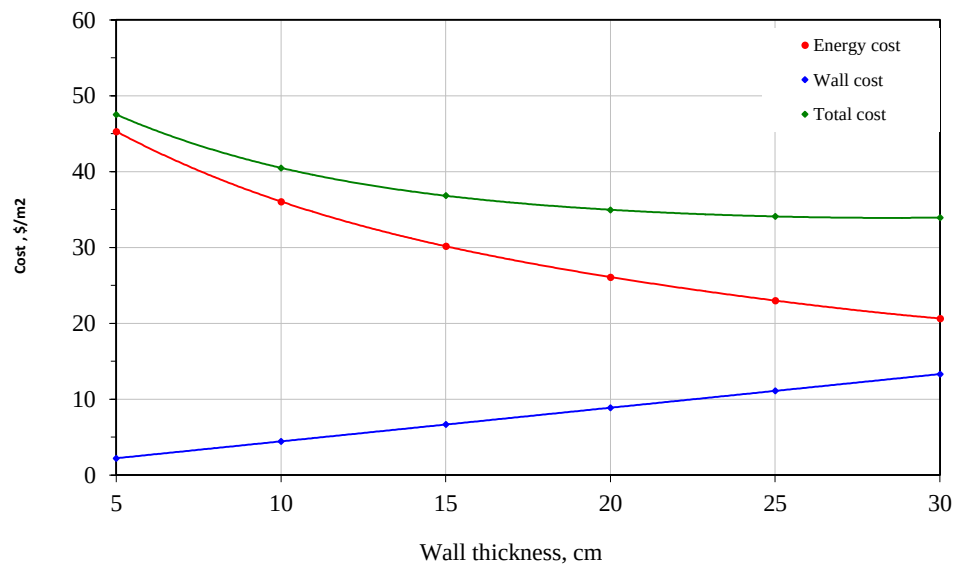


Figure 6.38. Variation of wall, energy and total cost with thickness of briquette

The energy cost, the wall cost and the total cost are plotted versus wall thickness in Figures 6.38-6.41. In buildings with an increased wall thickness heat gains decrease. If the wall thickness is increased the cooling load and energy cost decrease. However, increasing the thickness means increasing the cost of wall. On the other hand the wall cost increases linearly with wall thickness and is independent of energy cost. The total cost is obtained when the cost of energy is added to the wall material cost with respect to wall thickness for cooling loads. As expected, the total cost curve shows a

minimum that corresponds to the optimum wall thickness. It is noted that the optimum wall thickness results obtained from formulation is approximately same from the Figures 6.38-6.41. The optimum thickness of briquette, brick, blokbims and AAC is 29.21, 25.61, 15.74 and 9.84cm , respectively. When the optimum thickness of briquette and brick are close to each other the optimum thickness of blokbims and AAC are close to each other.

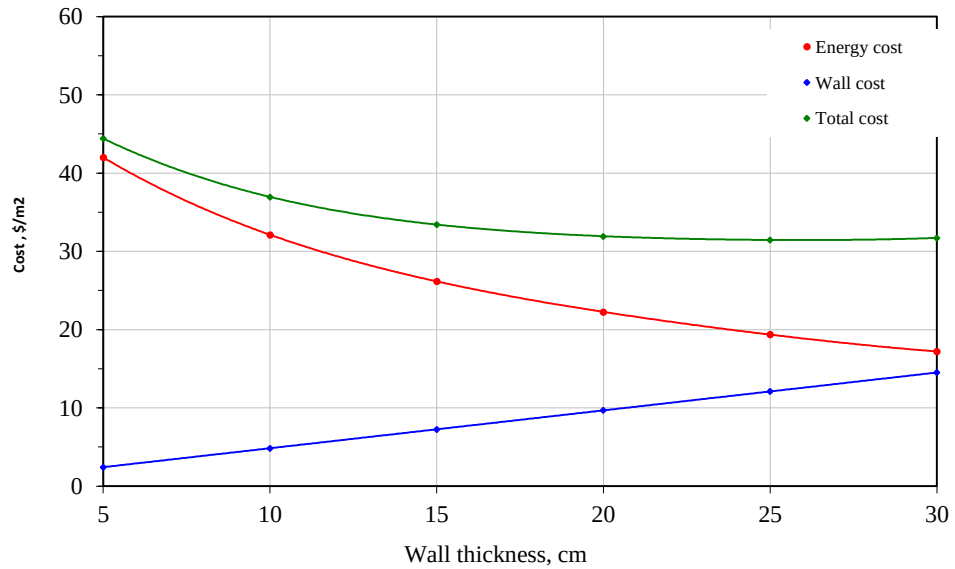


Figure 6.39. Variation of wall, energy and total cost with thickness of brick wall

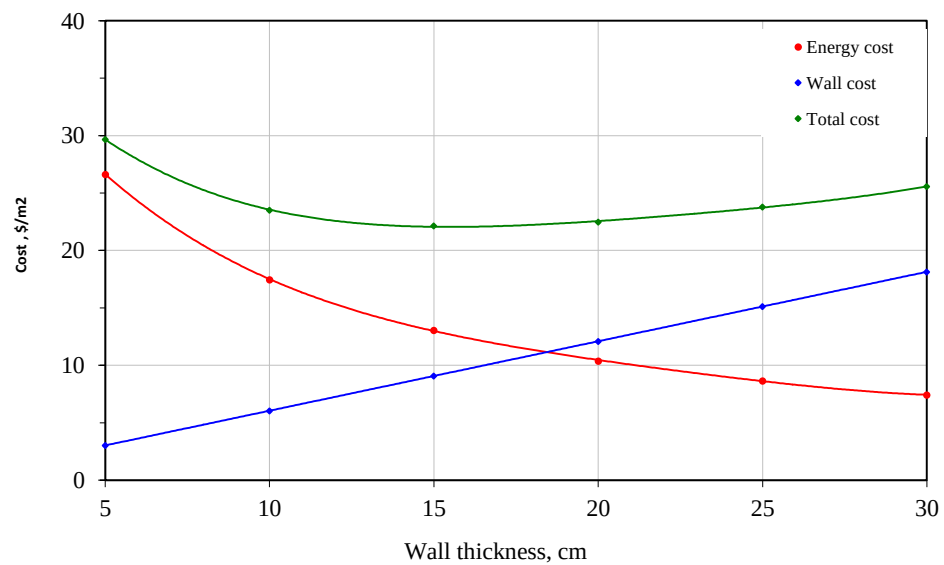


Figure 6.40. Variation of wall, energy and total cost with thickness of blokbims wall

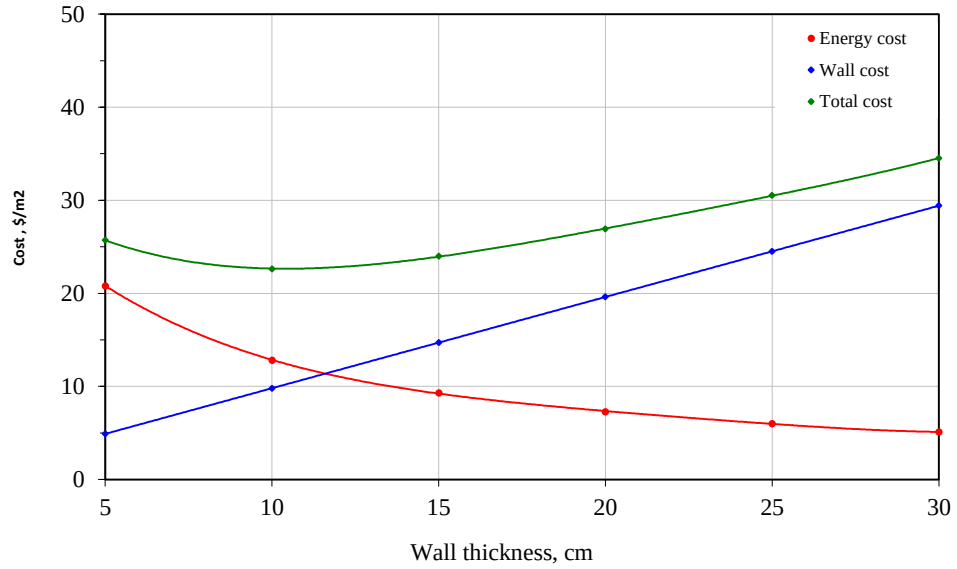


Figure 6.41. Variation of wall, energy and total cost with thickness of AAC wall

The total cost of four wall types are depicted in Figure 6.42. It is seen from the figure that the cost of briquette, brick, blokbims and AAC which have optimum thickness are 33.94, 31.46, 22.13 and 22.63\$/m², respectively. Consequently, the using of brick wall in construction is better than the briquette wall. Because, the total cost of brick is cheaper than the briquette. Also the using of blokbims wall in construction is better than the AAC wall. Since total cost of blokbims is cheaper than AAC.

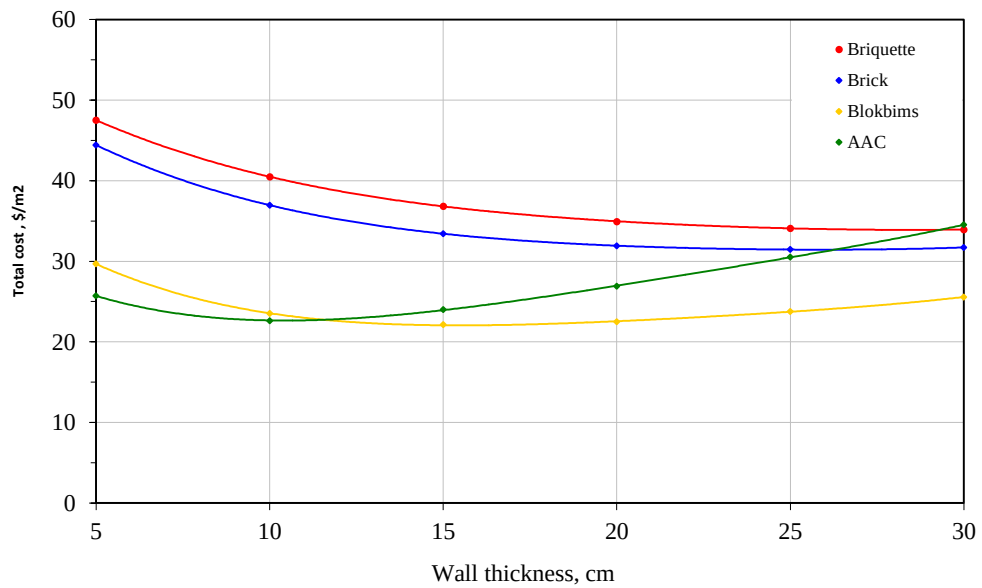


Figure 6.42. Variation of total cost with thickness of four wall types

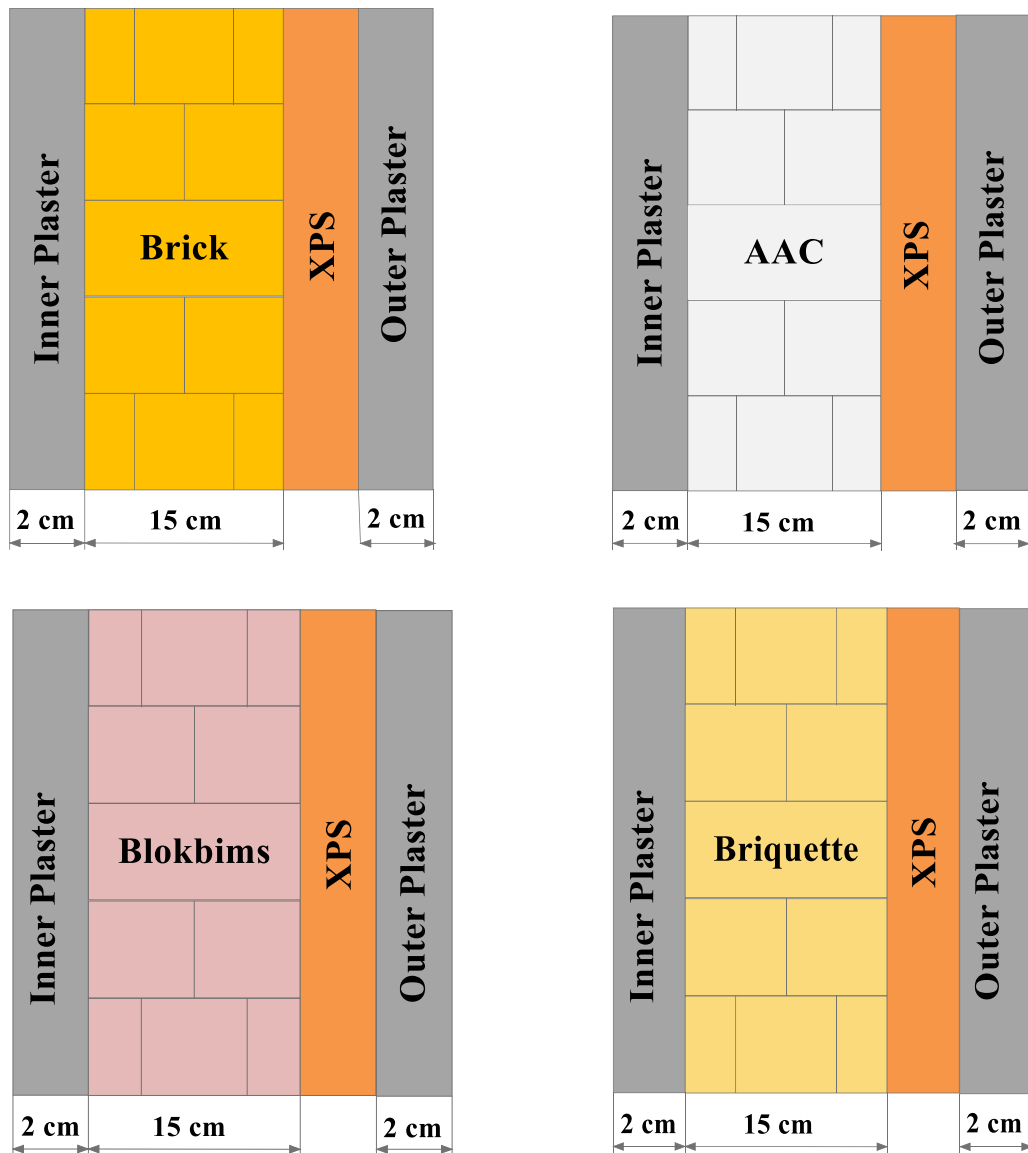


Figure 6.43. Schematic representation of different walls with change thickness

Figures 6.44-6.47 show that the variation of insulation cost, energy cost and total cost with respect to insulation thickness. The walls are insulated with XPS. The thickness of all wall types are considered 15cm. Schematic representation of these walls is shown in Figure 6.43. In order to find optimum insulation thickness of these structures, XPS insulation material is used. The optimum insulation thickness of briquette, brick, blokbims and AAC is 0.06, 0.06, 0.04 and 0.03m, respectively.

While the briquette and brick wall are required the highest insulation thickness, AAC is required the lowest insulation.

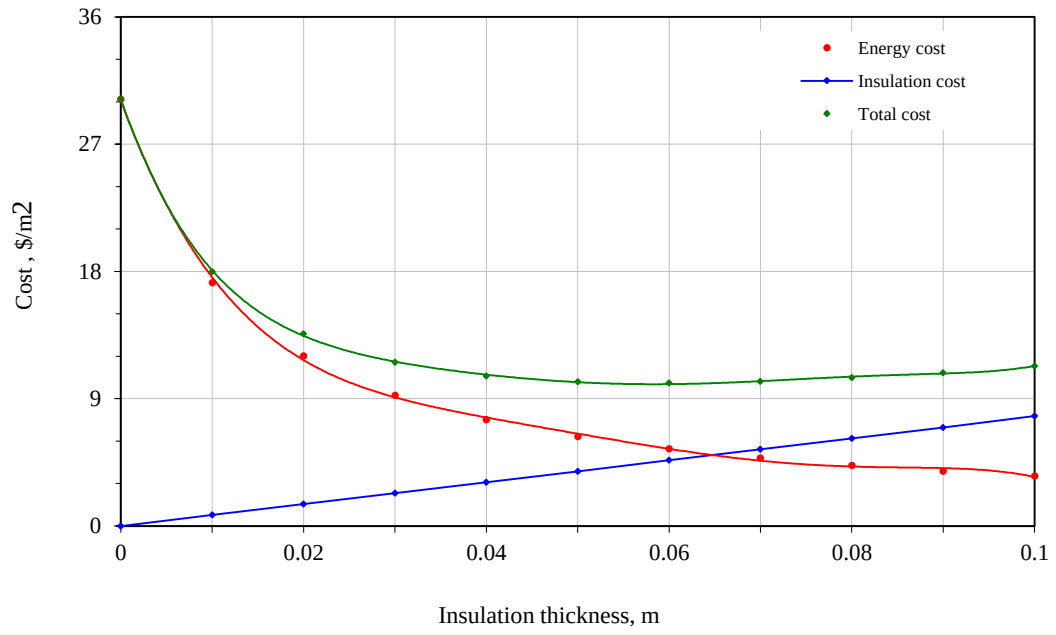


Figure 6.44. Insulation, energy and total cost with insulation thickness of briquette

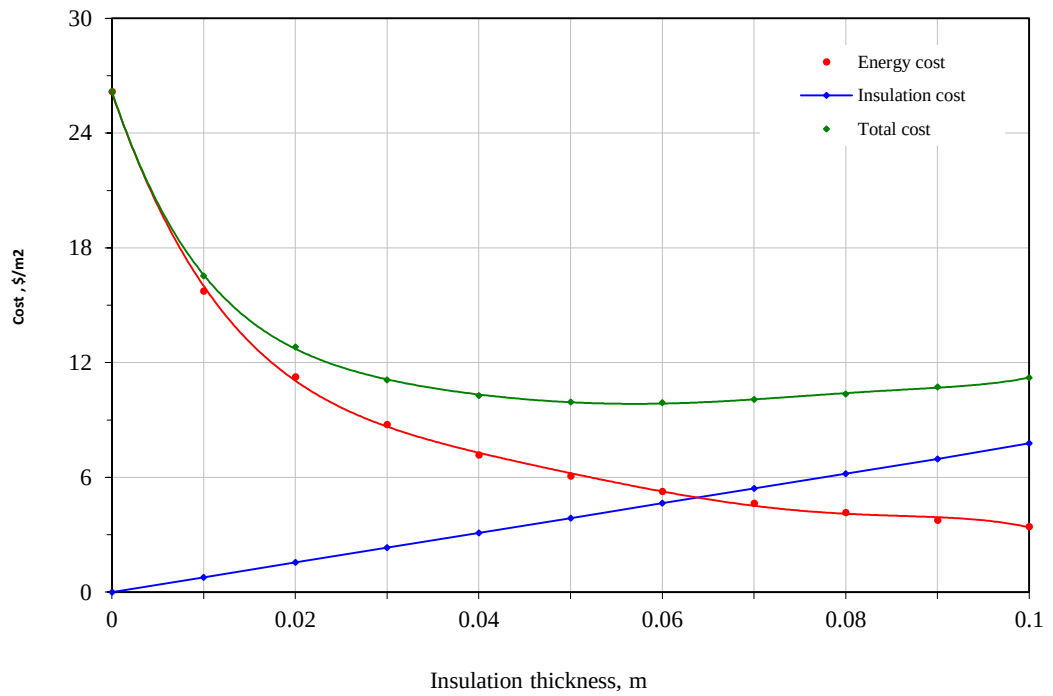


Figure 6.45. Insulation, energy and total cost with insulation thickness of brick wall

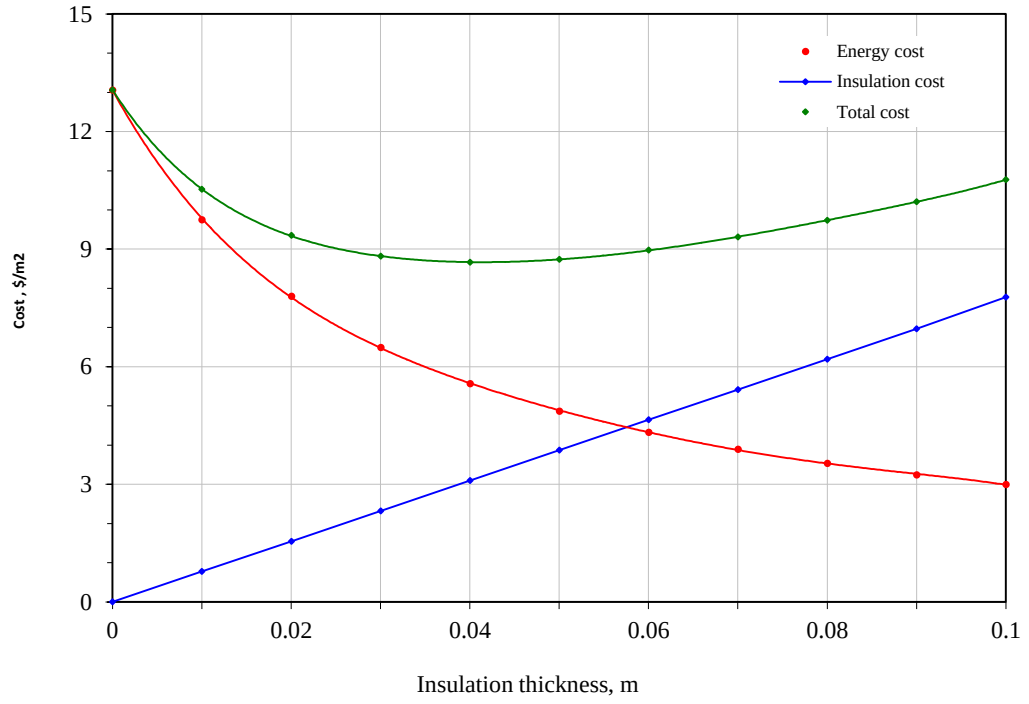


Figure 6.46. Insulation, energy and total cost with insulation thickness of blokbims

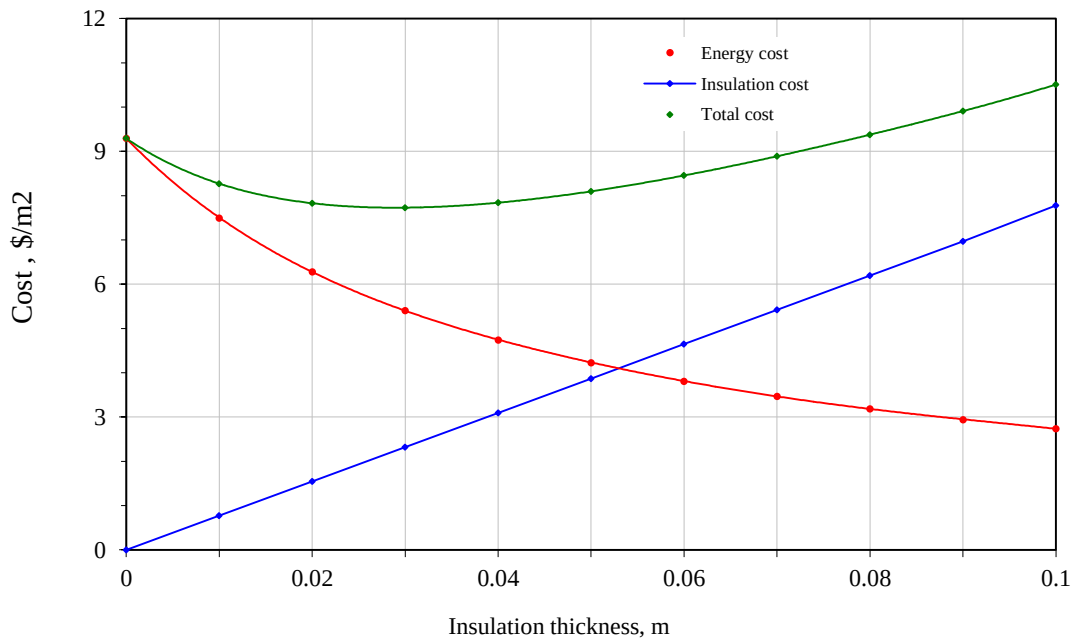


Figure 6.47. Insulation, energy and total cost with insulation thickness of AAC

Energy savings of walls are indicated in Figure 6.48. It is seen from the figure that maximum savings cannot be obtained with increasing insulation thickness. The energy saving is maximum at optimum insulation thickness. The highest energy saving is obtained for briquette wall and it follows brick, blokbims and AAC, respectively. The values of energy savings are 20.08, 16.26, 4.35 and 1.56 $\$/m^2$.

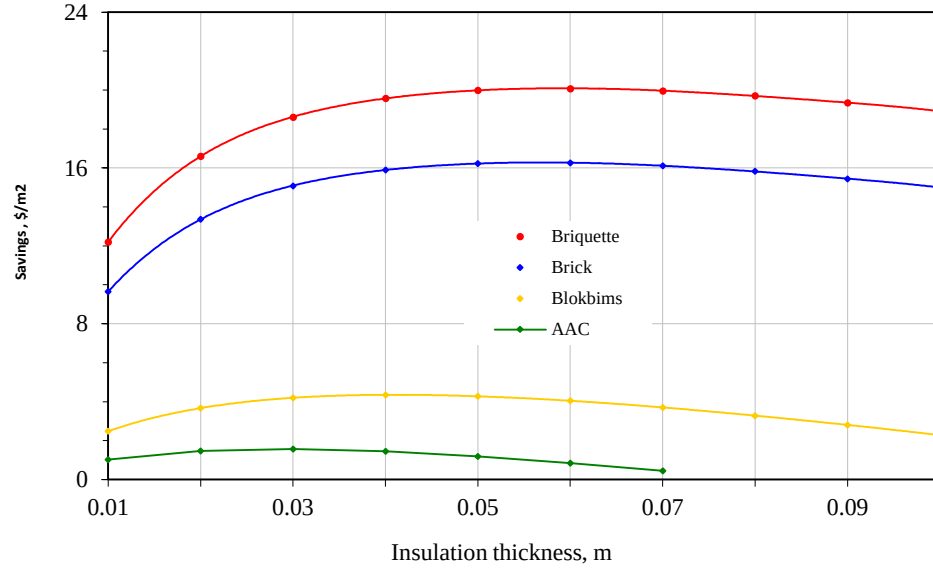


Figure 6.48. Variation of savings of four wall types with insulation thickness

6.7.1. Results for energy cost of commonly used different walls

In order to obtain a present value of the cost of energy consumption of walls over a lifetime of n years, the economical analysis is required. The economical analysis consists of a present worth factor. PWF, is function of the inflation rate (d) and the interest rate (i). The economical analysis was realized by using cooling loads of structures. The heat gains through the walls were obtained by using Cooling Load Temperature Difference CLTD method. The CLTD values consist of ambient air temperatures and solar radiation flux on horizontal and tilted surfaces. The solar radiations temperatures are functions of hourly outside air temperature and solar radiation flux on horizontal surface which were taken from meteorological station. As a result of the economical analysis, the present values of energy costs of eight walls were obtained. Many constructions in Turkey have standard walls and roofs types. Therefore, eight walls and two types of roofs were selected which are commonly used in Turkey. These walls and roofs are presented in chapter 4, from this thesis. Schematic representation of walls is shown in Figure 4.2.

The energy costs of light colored eight walls for south direction during cooling season is shown in Figure 6.49. It is seen from the figure that the highest energy cost for all wall types are obtained during July. Since more solar radiation is obtained in July during cooling season. Figure 6.50, shows that the total energy cost of eight walls during cooling season. It is observed from the figure that the higher energy costs are obtained from no insulated walls and the lower energy costs are obtained from insulated walls.

As the highest energy cost is obtained from Wall-5 and the lowest energy cost is obtained from Wall-8. Since the briquette wall has the highest heat gain and absorbs more solar radiation than the others and the siding wall the lowest heat gain than the others. The wall-6 and wall-8 have the same construction materials but have different thicknesses. The wall-4, wall-6 and wall-8 have the same insulation material thickness but have different wall thickness. When the wall thickness increases the energy cost decreases. The thickness of wall material and insulation material is important factor for energy cost. The wall-2, wall-4 and wall-7 have the nearest amount of cost are equal to 10.48, 10.02 and 10.14 respectively.

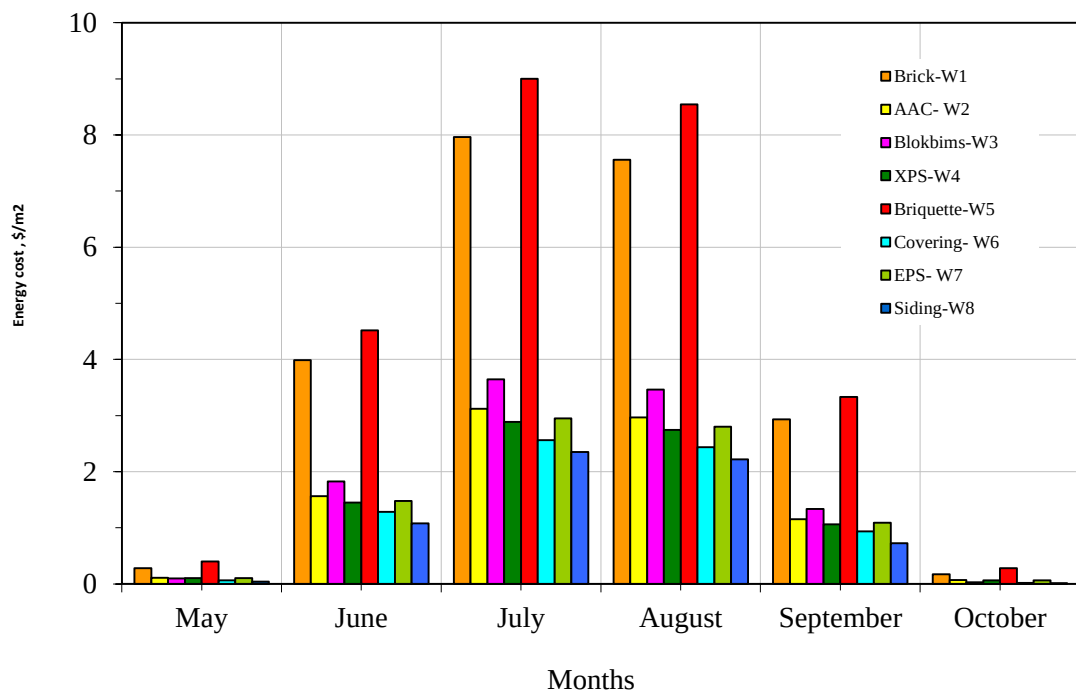


Figure 6.49. The energy costs of eight walls for south direction during cooling season

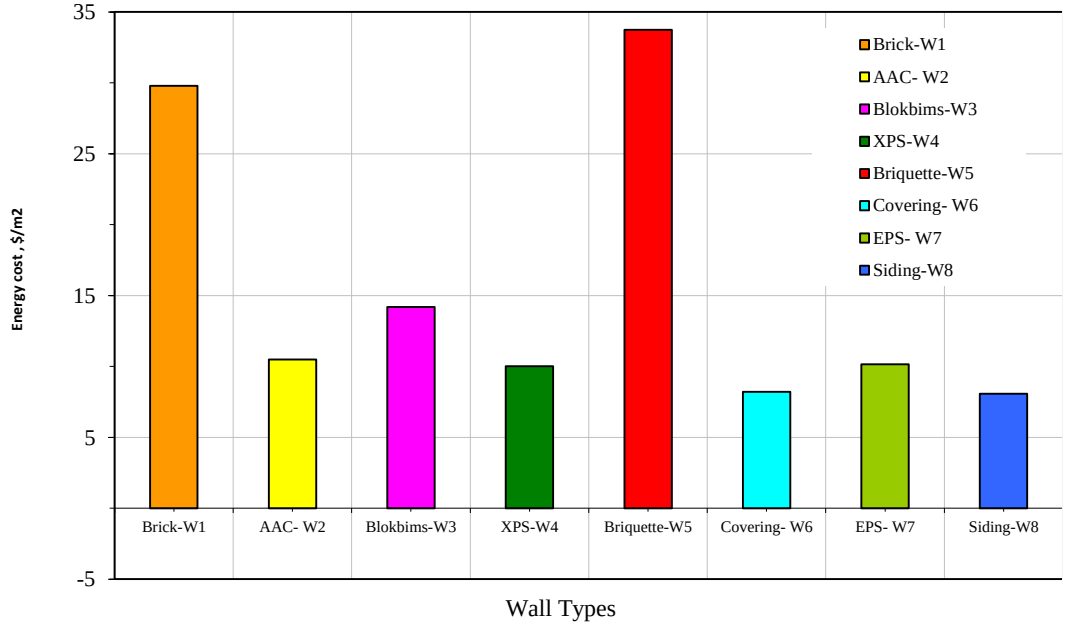


Figure 6.50. The total energy cost of eight walls for south direction

6.8. Uncertainty analysis

There are always chances of errors in all experimental measurements regardless of the care taken. It is therefore, necessary to analyze the system to determine the maximum possible error and hence the validity of experimental measurements. The error in measurement is usually defined as the difference between its true value and the measured value.

A precise method of estimating uncertainty analysis in experimental results has been suggested by Kline and McClintock. The method is based on a careful specification of the uncertainties in the various primary experimental measurements.

If a parameter is calculated using certain measured quantities as:

$$y = y[x_1, x_2, x_3 \dots] \quad (6.1)$$

Then uncertainty in measurement of 'y' is given by:

$$u(y) = \sqrt{\sum_{j=1}^n \left(\frac{\delta y}{\delta x_j} u(x_j) \right)^2} \quad (6.2)$$

Where $\mathbf{u}x_1 . \mathbf{u}x_2 . \mathbf{u}x_3 \cdots$ are uncertainties in measurement of $x_1 . x_2 . x_3 \cdots$

In the present investigation the important parameters are:

a) Heat gain, q

$$q = U(T_s - T_i) \quad (6.3)$$

$$u(q) = \sqrt{\left(\frac{\delta q}{\delta U} u(U)\right)^2 + \left(\frac{\delta q}{\delta T_s} u(T_s)\right)^2 + \left(\frac{\delta q}{\delta T_i} u(T_i)\right)^2} \quad (6.4)$$

b) Temperature difference, ΔT

$$u(\Delta T) = \sqrt{\left(\frac{\delta \Delta T}{\delta T_s} u(T_s)\right)^2 + \left(\frac{\delta \Delta T}{\delta T_i} u(T_i)\right)^2} \quad (6.5)$$

c) Overall thermal resistance, R_{ov}

$$R_{ov} = \frac{\Delta T}{q} \quad (6.6)$$

$$u(R_{ov}) = \sqrt{\left(\frac{\delta R_{ov}}{\delta \Delta T} u(\Delta T)\right)^2 + \left(\frac{\delta R_{ov}}{\delta q} u(q)\right)^2} \quad (6.7)$$

CHAPTER 7

CONCLUSION AND RECOMMENDATIONS

7.1. Conclusion

In this study, CLTD values for multilayered walls and roofs are estimated by utilizing solution of unsteady heat flow problem for the building elements. The periodic solution has been obtained by using Complex Finite Fourier Transform CFFT technique. The periodic solution is applied for the first time to find CLTD values for any building. The CLTD method is a normally manual approach based on tabulated values given in ASHRAE Handbooks, but our method is not manual method. Since, hourly solar radiation values on a desired wall, numerical values of several expressions and constants cannot be calculated by manual approach.

Therefore, a computer program in MATLAB based on the periodic solution of unsteady heat flow problem is developed for the numerical calculations. The computer program developed in this study does not require the use of extensive tables, figures and some corrections when performing heating and cooling load calculations. The program requires only data for thermo-physical properties of building walls or roofs, hourly solar radiation on a horizontal surface and outside air temperatures during design day CLTD values given in ASHRAE for Roof 8, Roof 13 and Wall 3 selected are compared with results obtained from the study and calculated for commonly used walls and roofs in Gaziantep, Turkey.

In the present work, daily and monthly CLTD and heat gain values for Gaziantep in Turkey are obtained by using hourly outside air temperature and solar radiation on horizontal surface for four types of walls commonly used. which are briquette, brick, blokbims and AAC in order to obtain annual cooling load. Then the results of cooling loads are used as input parameters to obtain economical analysis. The economical analysis is required to decide any type of walls is better in construction

and how much optimum wall and insulation thickness is used in construction. Also, it gives the energy cost, wall cost and total cost of each wall types.

The results show that higher solar radiation and ambient air temperatures give higher CLTD values, leading higher heat gains and higher energy consumption to keep a space at a given temperature. Meteorological values, absorptivity of surfaces, thermo physical- properties, directions of the walls and type of walls have important effects on the heat gain linked to optimum wall and insulation thickness. All of these effects and important results and recommendations can be summarized as follows:

1. The CLTD results given in the ASHRAE handbook for the selected roofs and walls are in excellent agreement with those results obtained in the present study. There are differences in CLTD values between about 0 and 2.42 °C, 0 and 0.94 °C for the Roof 2 and Roof 13, respectively. Differences in the CLTD values computed by this study and given in ASHRAE [11] are obtained as 3.4, 4.3, 3.9 and 1.8. °C for East, West, South and North facing walls, respectively. Differences between estimated heat gain values and those of RTS method ASHRAE [24]. change between 0 and 5 W/m². The difference ranges are reasonably low. Thus, it validates novel approach used for the development of theoretical model in the present study. It is proved that the periodic solution of the unsteady heat flow problem for building walls and flat roofs will be used to find CLTD values for these structures.
2. A computational program in MATLAB based on the periodic solution is developed for finding CLTD and heat gain values of any building wall and roof without the use of any standard tables for any possible constructional configuration and exterior thermal conditions. Only, thermo-physical properties of the walls and roofs, outdoor air temperatures and solar insolation are adequate for executing of the program. These are advantages over the other methods given in ASHRAE handbooks.
3. Solar radiation flux, ambient air temperature, surface's absorptivity, thermal and physical properties of the building walls and roofs have substantial effects on the CLTD and heat gain values.
4. Daily variations of the CLTD values for the AAC and blokbims walls and Roof 1 are significantly higher in comparison to the other wall and roof types.

But, amplitude of heat gain for the walls is lower than that of the brick and briquette walls. Heat gain values for the blokbims are closer to those of AAC. Therefore, it is recommended that building exterior walls should be constructed with blokbims made of natural raw materials.

5. The directions of walls have important affect on the CLTD values and heat gain leads to economical analysis. The lowest CLTD, heat gain and energy cost are obtained for north direction during October but the highest CLTD, heat gain and energy cost are obtained for west direction during July, Generally, east directed walls have higher CLTD, heat gain and energy cost than west directed walls during cooling season except of July. The north directed walls always have the lower CLTD, heat gain and energy cost during cooling season. The highest annual cooling CLTD, heat gain and energy cost are obtained for east directed walls and it follows that west, south and north directed walls, respectively.
6. Absorptivity of surfaces has profound effect on the CLTD, heat gain and energy cost. The values of absorptivity change with color of surfaces. The absorptivity of dark surface is higher than light surface. Therefore dark surfaces absorb more solar radiation than the light surfaces.
7. Thermo- physical properties of the wall materials have profound effects on CLTD, heat gain and energy cost. That is the highest thermal resistance or lowest thermal conductivity gives the highest time lag but it gives the lowest decrement factor. The lowest decrement factor causes the lowest CLTD, heat gain and energy cost.
8. The building construction is important factor for the calculation of CLTD, heat gain and economical analysis in order to determine the most suitable building walls or roofs material. Eight types of walls and two types of roofs are selected since they are commonly used in building construction in Gaziantep. Six types of walls and two types of roofs are selected in Iraq. All of the materials of walls and roofs types have different heat capacity and thermal conductivity from each other. The higher heat capacity and thermal conductivity give the higher CLTD, heat gain and energy cost. Because of the highest heat capacity and thermal conductivity.

9. The thickness of walls is significant factor in the construction of buildings. Therefore, the optimum thickness of each wall is calculated. Each wall has different optimum thickness. As the briquette wall has the highest optimum thickness the AAC wall has the lowest optimum thickness.
10. Another important factor in the construction of buildings is the optimum insulation thickness. Each type of wall has different optimum insulation thickness.
11. The maximum energy savings are obtained at optimum insulation thickness. Energy savings increase with increasing cooling load. The briquette wall has the highest saving because of the highest cooling load.

It can provide tables for some specific CLTD values for our regions or cities in future. At the same time CLTD values for any different building structures can be tabulated for the most important cities in the World if thermo-physical properties of the structures and climatic data for these cities are known.

7.2. Recommendations

The primary purpose of this study was determination of the optimum external wall and insulation thickness by economical analysis. The economical analysis was carried out using cooling loads as input parameters for commonly used wall types which are briquette, brick, blokbims and AAC. The heat gains were obtained by using Cooling Load Temperature Difference CLTD Method. The CLTD values are functions of ambient air temperatures and Solar radiation flux on horizontal surface for Gaziantep in Turkey. The following recommendations omitted in this study are given for further study:

1. The CLTD values, heat gains and economical analysis for all of the cities may be obtained for all building structures constructed in Turkey.
2. The heat gains and economical analysis may be carried out during heating season.
3. In the economical analysis, different insulation materials may be used. The optimum insulation thickness of walls may be obtained for different insulation materials.
4. Cost of building site area may be considered in the economical analysis.

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APPENDICES

APPENDIX A

**Flow charts representation of experimental, theoretical and
economical procedures**

Figure A.1. Flow chart of experimental procedure

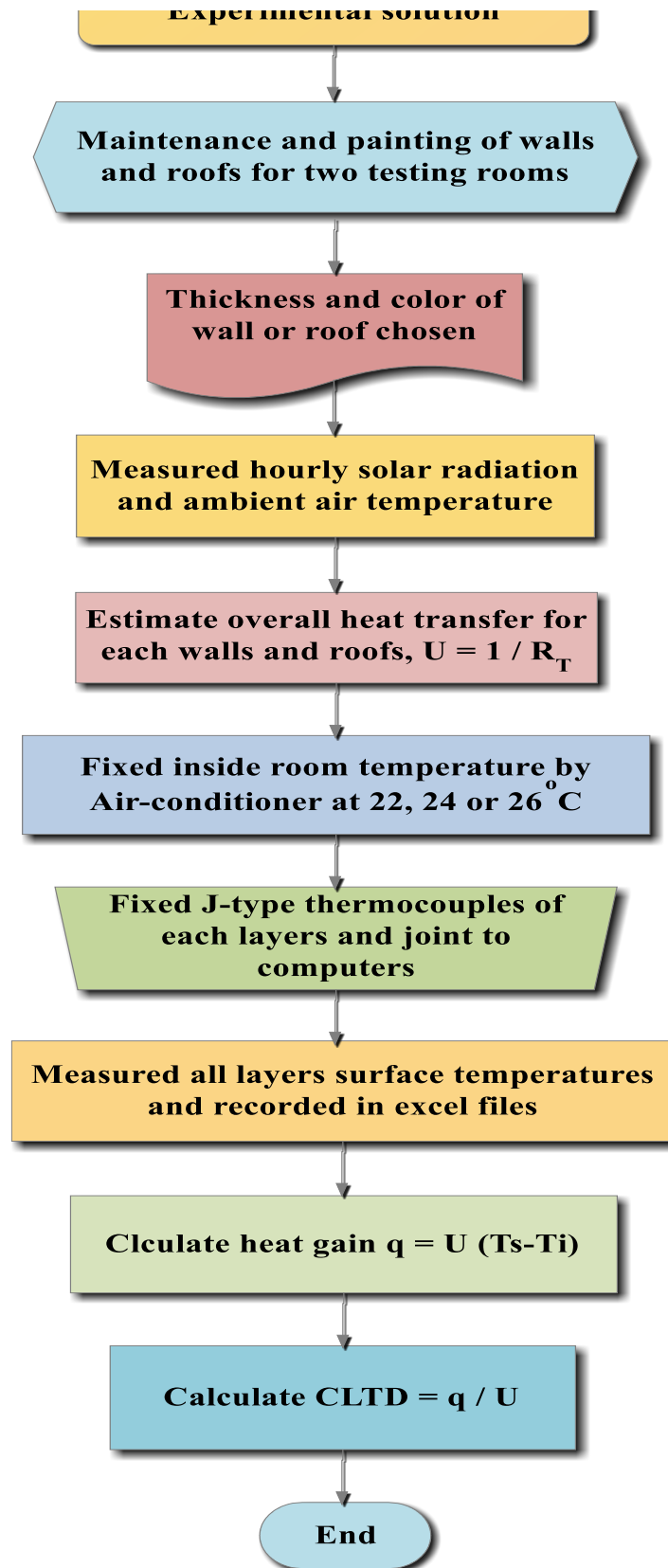


Figure A.2. Flow Chart of theoretical procedure Matlab program

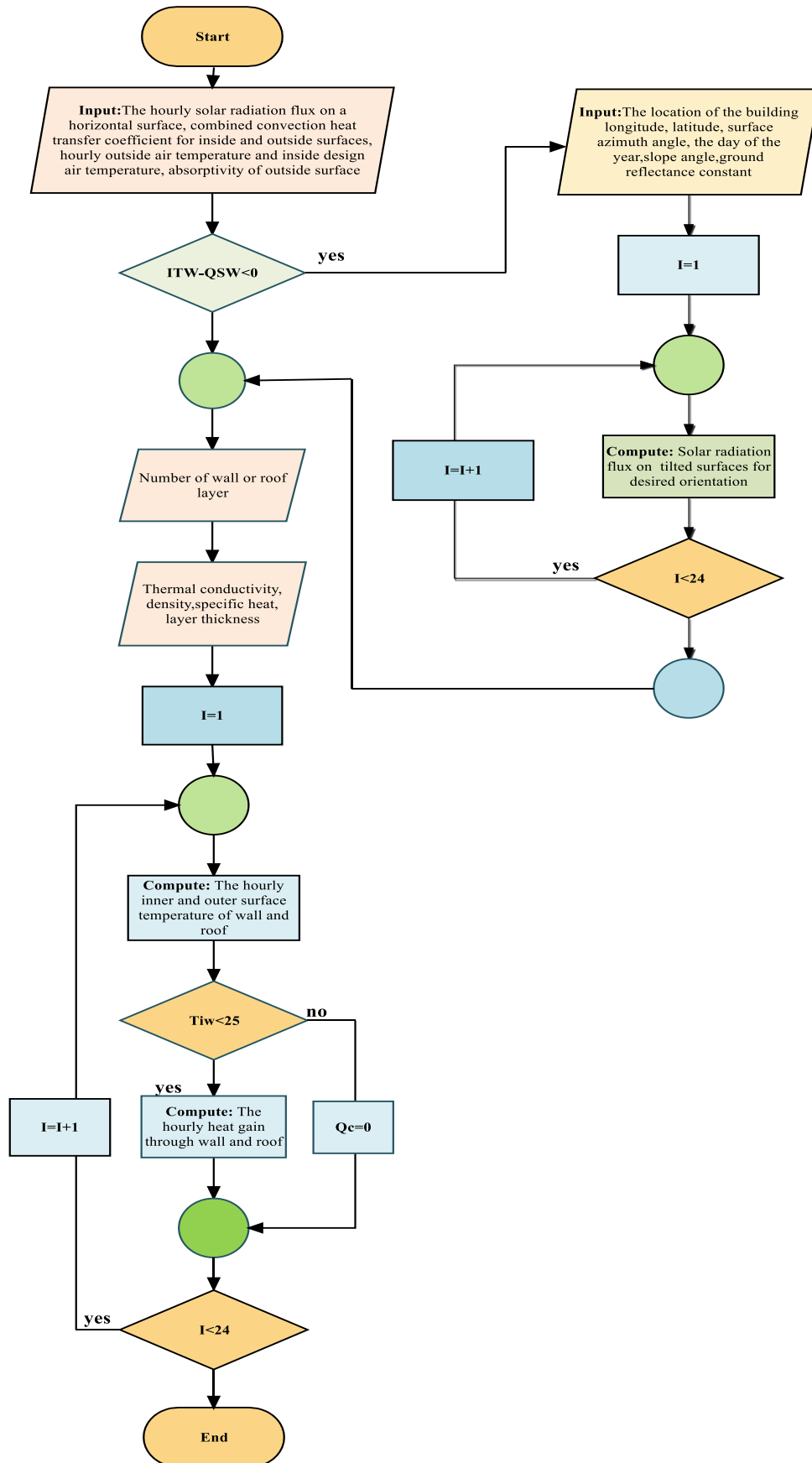
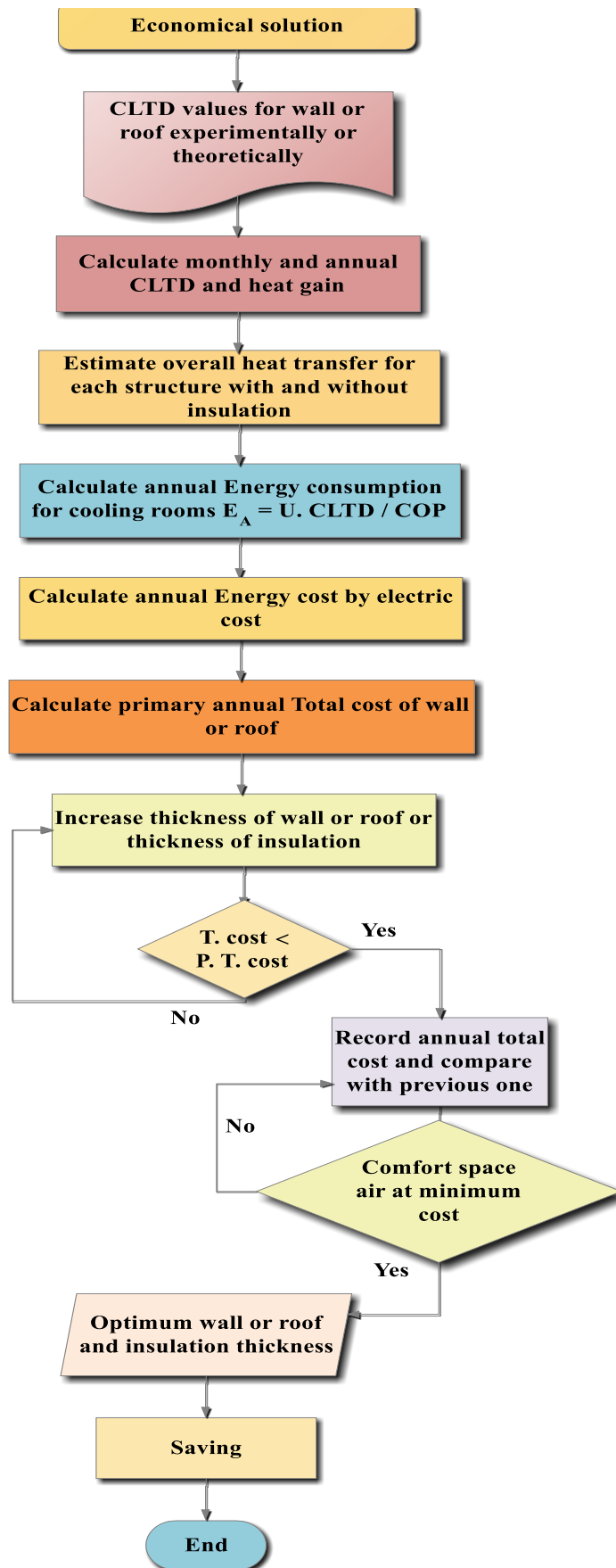


Figure A.3. Flow Chart of economical procedure



APPENDIX B

Measurement Calibration Tables

Table B1. Thermocouple readings and corresponding calibration equations of Delta (3005) personal data logger used in room 1

Temperature (°C)							T=m*Tc+b	
Channel	25.6	35.9	46.7	55.7	65	75.1	m	b
Readings								
CH1	25.1	35.5	46.4	55.5	64.8	75.3	0.9879	0.8432
CH2	25.2	35.7	46.7	55.7	65	75.4	0.9981	0.652
CH3	24.8	35.2	46.2	55.3	64.6	75	0.987	1.134
CH4	24.7	35.1	46.2	55.4	64.6	75.1	0.983	13.346
CH5	24.4	34.9	45.9	55.2	64.5	74.9	0.9806	16.703
CH6	25.3	35.8	46.8	55.8	65.2	75.5	0.9873	0.5782
CH7	25.3	35.7	46.7	55.8	65.1	75.5	0.987	0.6405
CH8	25.2	35.6	46.7	55.7	65.1	75.5	0.985	0.7914
CH9	25.1	35.5	46.6	55.7	65	75.3	0.9861	0.8335
CH10	24.8	35.2	46.2	55.3	64.7	75	0.9862	11.586
CH11	24.7	35.2	46.2	55.3	64.6	75	0.9856	12.229
CH12	24.7	35.2	46.1	55.2	64.5	74.9	0.9879	11.737
CH13	24.6	35	46	55.1	64.3	74.7	0.9893	12.528
CH14	24.9	35.3	46.3	55.4	64.7	75.1	0.987	10.353
CH15	24.5	35	46	55.2	64.5	74.9	0.9831	14.963
CH16	25	35.5	46.5	55.6	64.9	75.3	0.9856	0.9273
CH17	25.2	35.6	46.7	55.7	65.1	75.4	0.9864	0.7365
CH18	24.6	35	46.1	55.3	64.5	75	0.983	14.329
CH19	25.3	35.7	46.7	55.8	65.2	75.5	0.9862	0.6655
CH20	25.2	35.6	46.7	55.8	65.4	75.4	0.9837	0.8113
CH21	24.6	35	46.1	55.3	64.5	75.1	0.9816	14.869
CH22	24.7	35.1	46.1	55.2	64.5	74.9	0.987	12.328
CH23	24.7	35.2	46.3	55.2	64.8	75.1	0.9831	13.011
CH24	25.1	35.4	46.4	55.2	64.8	75.1	0.9907	0.7993
CH25	25.3	35.3	46.7	55.3	64.6	75	0.987	10.353
CH26	25.2	35.7	46.1	55.4	64.8	75.1	0.9831	14.963
CH27	25.4	35.4	46.4	55.7	64.8	74.9	0.9856	0.9273
CH28	25.1	35.7	46.5	55.6	64.6	74.9	0.9864	0.7365
CH29	25.6	35.6	46.2	55.2	64.5	74.8	0.983	14.329
CH30	25.5	35.4	46.5	55.1	64.9	74.8	0.9862	0.6655
CH31	25.3	35.3	46.7	55.7	64.8	75	0.9837	0.8113
CH32	25.5	35.8	46.3	55.6	64.7	75.1	0.9816	14.869
CH33	25.1	35.4	46.5	55.6	64.6	75.1	0.987	12.328
CH34	25.3	35.6	46.4	55.5	64.7	74.9	0.9831	13.011
CH35	25.4	35.7	46.7	55.7	64.8	75	0.9907	0.7993

Table B2. Thermocouple readings and corresponding calibration equations of Delta (3005) personal data logger used in room 2

Temperature (oC)							T=m*Tc+b	
Channel	25.6	35.9	46.7	55.7	65	75.1	m	b
Readings								
CH1	25.1	35.5	46.4	55.5	64.8	75.3	0.9879	0.8432
CH2	25.2	35.7	46.7	55.7	65	75.4	0.9981	0.652
CH3	24.8	35.2	46.2	55.3	64.6	75	0.987	1.134
CH4	24.7	35.1	46.2	55.4	64.6	75.1	0.983	13.346
CH5	24.4	34.9	45.9	55.2	64.5	74.9	0.9806	16.703
CH6	25.3	35.8	46.8	55.8	65.2	75.5	0.9873	0.5782
CH7	25.3	35.7	46.7	55.8	65.1	75.5	0.987	0.6405
CH8	25.1	34.6	45.4	55.5	63.8	74.3	10.032	-0.0505
CH9	25.4	34.9	45.7	55.4	64.5	75.3	0.9928	0.0665
CH10	24.9	34.9	46.0	55.8	64.4	75.1	10.028	-0.5838
CH11	25.4	34.4	45.2	55.2	63.6	74.7	10.021	0.0486
CH12	25.6	35.0	46.1	55.9	64.6	75.0	0.9993	-0.4360
CH13	24.9	34.9	46.0	55.4	64.4	75.1	10.030	-0.5391
CH14	25.5	35.5	45.7	55.8	64.1	74.9	10.056	-0.6267
CH15	24.9	35.5	45.7	55.7	64.1	74.9	10.120	-10.012
CH16	25.0	34.5	45.6	55.5	64.0	74.8	0.9941	0.3054
CH17	24.8	33.9	45.2	54.9	63.7	74.7	0.9912	0.8092
CH18	24.7	35.0	46.2	54.9	64.6	75.3	0.9847	0.5522
CH19	25.4	34.9	46.1	55.1	64.5	75.3	0.9936	-0.0113
CH20	24.6	35.1	46.2	55.2	64.6	74.7	10.064	-0.6493
CH21	24.9	34.1	45.3	54.8	63.7	75.2	0.9873	0.8657
CH22	24.0	34.5	46.5	55.8	65.0	74.6	10.034	-0.6669
CH23	25.1	34.5	45.5	55.0	63.9	74.7	0.9976	0.2338
CH24	25.2	34.7	45.7	55.1	64.1	74.9	0.9976	0.0782
CH25	24.6	34.6	46.5	55.7	65.0	74.6	0.9981	-0.3286
CH26	25.0	34.7	45.7	55.1	64.2	75.1	0.9911	0.3834
CH27	25.3	34.8	45.7	55.2	64.4	74.9	0.9964	0.0440
CH28	25.1	34.4	45.1	55.5	63.5	75.1	0.9924	0.4917
CH29	25.3	34.9	45.9	55.1	64.3	75.2	0.9939	0.0991
CH30	25.2	34.3	45.3	54.8	63.2	74.1	10.122	-0.1665
CH31	25.0	34.5	45.4	55.4	63.5	74.4	10.025	0.0749
CH32	25.5	35.4	46.6	55.4	65	74.9	0.9934	0.0812
CH33	25.3	35.6	46.6	55.3	64.8	75	0.9976	0.0782
CH34	25.4	35.5	46.7	55.5	65	75.1	0.9899	0.07763
CH35	25.5	35.8	46.6	55.1	64.9	75	0.9998	0.0836

APPENDIX C

Input Data

**Solar radiation on horizontal plane and ambient air temperature
data for the cities of Turkey**

Tables C1. Solar radiation on horizontal plane and ambient air temperature data for the cities of Turkey

ADANA		ADIYAMAN		AFYON		AGRI		AKSARAY		AMASYA		ANKARA		ANTALYA		ARTVIN	
36.59*		37.46*		38.45*		39.44*		37.40*		40.40*		39.50*		38.24*		41.11*	
Aug-09		Jul-28		Aug-02		Jul-20		Aug-02		Jul-26		Jul-30		Jul-28		Jul-30	
To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²
27.4	0.0	29.9	0.0	21.9	0.0	19.3	0.0	24.0	0.0	23.5	0.0	21.9	0.0	28.4	0.0	22.9	0.0
26.8	0.0	29.9	0.0	20.4	0.0	18.1	0.0	23.7	0.0	22.1	0.0	20.7	0.0	28.2	0.0	22.8	0.0
26.4	0.0	29.1	0.0	19.5	0.0	17.2	0.0	22.9	0.0	21.1	0.0	19.9	0.0	28.0	0.0	22.7	0.0
25.8	0.0	28.0	0.0	18.8	0.0	16.3	0.0	22.1	0.0	19.9	0.0	18.8	0.0	28.6	0.0	22.5	0.0
25.5	21.7	27.8	0.5	18.3	0.6	15.7	0.0	21.6	0.1	19.1	0.8	18.1	0.6	28.6	2.4	22.2	0.8
25.7	128.1	27.7	25.6	18.6	44.5	15.3	14.0	21.1	33.4	19.3	34.1	18.8	31.0	29.0	56.6	22.8	25.2
27.4	294.4	29.2	141.1	21.0	186.3	17.4	105.3	22.3	168.3	21.8	163.6	21.7	134.1	31.5	201.7	24.2	136.4
29.5	462.5	32.1	314.0	23.6	371.2	21.6	293.1	25.4	335.0	25.3	353.3	25.1	276.0	34.4	379.6	26.0	325.7
31.7	601.4	35.5	447.4	26.8	545.0	25.4	458.7	28.4	483.0	28.4	516.4	28.7	426.5	36.7	561.1	28.1	505.6
33.9	702.9	38.0	556.7	29.4	690.9	28.4	577.3	30.6	592.3	31.8	642.0	31.9	562.1	38.6	691.5	30.0	650.5
35.6	756.8	40.1	631.9	31.8	776.7	31.0	667.4	33.1	669.9	34.5	730.9	34.5	653.6	39.8	768.3	32.1	745.9
37.6	767.0	41.4	670.7	33.3	825.5	32.6	691.4	34.6	717.3	37.2	769.5	36.1	705.6	40.8	799.0	34.2	801.7
37.9	727.6	41.7	666.8	34.7	811.6	33.8	667.4	35.6	721.1	39.1	773.3	37.4	713.3	41.1	790.6	34.8	785.4
39.4	638.8	42.3	626.5	35.2	711.8	34.6	629.9	36.2	674.6	39.6	716.2	37.8	626.5	40.1	749.5	34.7	741.2
39.3	519.9	42.5	562.9	35.6	595.9	34.9	545.6	36.5	575.4	40.4	638.9	38.3	563.7	39.7	659.5	32.3	631.9
37.7	377.1	42.2	449.7	35.8	497.6	34.6	404.2	36.4	501.6	39.6	511.3	38.0	466.8	38.5	528.3	31.4	487.7
36.7	220.8	41.5	317.1	35.2	361.5	33.4	264.2	35.6	338.8	38.1	374.3	37.5	353.6	37.2	365.7	30.1	324.1
34.9	61.6	40.1	154.3	33.8	206.6	31.5	129.7	34.6	191.6	36.1	182.0	36.5	207.0	35.3	212.5	28.2	156.7
32.9	4.0	37.6	30.9	31.4	63.9	29.0	55.2	31.8	54.4	33.9	45.4	33.2	85.3	33.3	70.8	26.9	33.9
31.5	0.0	35.7	0.9	29.7	1.9	27.1	3.5	29.6	1.1	32.4	2.3	30.9	9.8	31.8	2.8	25.4	4.5
30.1	0.0	34.1	0.0	28.5	0.0	25.4	0.0	27.7	0.0	30.9	0.0	28.8	0.0	30.6	0.0	25.0	0.0
29.3	0.0	33.2	0.0	27.2	0.0	23.8	0.0	26.5	0.0	30.1	0.0	26.7	0.0	30.2	0.0	24.4	0.0
28.5	0.0	32.2	0.0	25.7	0.0	22.2	0.0	25.6	0.0	27.9	0.0	25.3	0.0	30.2	0.0	23.9	0.0
28.1	0.0	31.4	0.0	24.5	0.0	20.4	0.0	24.2	0.0	26.6	0.0	24.3	0.0	29.4	0.0	23.5	0.0

* Latitude

AYDIN		BALIKESIR		BARTIN		BATMAN		BILECIK		BINGOL		BITLIS		BURDUR		BURSA	
37.51*		39.39*		41.38*		37.52*		40.09*		38.53*		38.22*		37.43*		40.11*	
Jul-22		Jul-27		Jul-30		Jul-20		Jul-30		Aug-02		Aug-07		Jul-30		Jul-29	
To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²
25.6	0.0	22.7	0.0	19.2	0.0	27.6	0.0	21.6	0.0	24.8	0.0	19.3	0.0	23.1	0.0	23.5	0.0
25.1	0.0	21.6	0.0	18.7	0.0	26.9	0.0	21.2	0.0	24.1	0.0	19.2	0.0	22.4	0.0	22.9	0.0
24.5	0.0	20.5	0.0	18.2	0.0	25.8	0.0	20.4	0.0	23.3	0.0	18.2	0.0	21.6	0.0	22.3	0.0
23.9	0.0	19.8	0.0	18.0	0.0	24.9	0.0	20.0	0.0	22.7	0.0	18.2	0.0	20.9	0.0	21.3	0.0
23.6	1.0	19.2	0.9	17.6	2.3	24.5	0.0	19.7	1.9	22.3	0.2	18.4	0.0	20.2	0.5	21.2	1.4
23.7	28.3	19.7	44.3	18.1	34.9	24.6	15.5	20.1	47.6	22.4	28.4	18.3	12.8	20.1	22.3	22.0	35.5
26.1	152.8	22.0	171.7	20.0	133.4	26.9	111.0	22.7	170.6	23.9	132.6	20.5	81.8	21.9	136.1	23.7	158.9
28.1	347.5	25.3	342.6	23.1	289.9	30.1	235.9	24.6	329.3	27.0	351.7	23.8	265.8	25.1	349.6	26.8	326.4
31.0	532.4	28.8	503.8	27.1	451.3	32.7	348.9	27.2	477.7	31.2	542.2	28.3	503.0	27.6	524.1	29.6	479.9
33.2	676.9	31.7	640.6	30.3	569.9	36.0	448.7	29.6	590.6	33.5	645.5	30.9	619.2	29.8	662.9	32.0	571.5
35.5	779.5	35.0	729.2	33.0	652.1	38.8	522.0	32.5	681.3	34.6	767.6	33.3	715.6	32.0	758.5	34.1	694.7
37.5	825.5	37.3	761.3	34.7	692.4	41.0	565.9	34.6	719.3	36.9	831.8	34.2	761.9	33.9	813.0	36.3	745.1
39.6	833.2	38.6	744.6	35.2	699.3	42.4	573.6	36.5	703.5	37.1	855.5	34.7	751.1	35.6	836.7	37.7	718.8
40.7	796.2	39.5	686.7	35.9	643.5	42.9	559.0	37.4	639.4	38.8	817.2	35.3	732.1	36.8	796.9	38.4	668.4
41.0	696.4	39.7	603.6	34.1	549.0	43.2	504.5	38.1	563.4	38.8	713.9	35.1	649.6	37.1	712.5	38.4	572.2
39.6	553.4	39.3	488.5	33.1	447.4	43.1	427.8	36.7	466.3	37.5	489.2	34.6	498.6	35.5	547.8	37.2	459.8
37.9	376.8	37.4	318.9	32.0	328.0	42.5	330.1	35.2	317.9	35.5	263.1	32.8	259.5	34.6	344.0	35.5	324.1
35.9	205.9	35.3	176.6	30.5	182.3	40.6	211.4	33.0	195.4	33.7	113.0	30.9	77.4	33.3	180.7	33.8	176.0
33.6	55.7	33.2	54.2	27.9	64.5	37.6	81.6	30.5	64.8	31.5	41.5	27.6	34.3	31.0	59.2	31.5	48.1
32.0	3.1	31.0	3.0	26.3	9.2	35.2	11.0	29.0	6.6	30.0	4.3	25.4	3.4	29.5	2.7	29.2	1.4
30.3	0.0	28.9	0.0	25.2	0.0	34.3	0.0	27.9	0.0	28.6	0.0	23.3	0.0	27.7	0.0	28.4	0.0
29.5	0.0	27.2	0.0	23.6	0.0	32.4	0.0	26.9	0.0	27.5	0.0	21.4	0.0	26.5	0.0	26.9	0.0
28.3	0.0	25.8	0.0	23.0	0.0	31.1	0.0	26.3	0.0	26.5	0.0	20.4	0.0	25.8	0.0	26.2	0.0
27.1	0.0	24.9	0.0	22.4	0.0	30.6	0.0	25.7	0.0	25.7	0.0	19.9	0.0	25.1	0.0	25.3	0.0

* Latitude

CANAKKALE		CORUM		DENIZLI		DIYARBAKIR		DUZCE		EDIRNE		ELAZIG		ERZINCAN		ERZURUM	
40.09*		39.14*		37.46*		37.55*		39.05*		41.40*		38.41*		39.44*		39.55*	
Jul-11		Jul-30		Jul-28		Aug-05		Jul-17		Aug-07		Jul-20		Jul-29		Jul-21	
To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²
24.9	0.0	19.0	0.0	26.8	0.0	27.5	0.0	21.2	0.0	19.0	0.0	24.2	0.0	24.2	0.0	14.9	0.0
24.3	0.0	17.9	0.0	26.1	0.0	26.7	0.0	20.5	0.0	17.9	0.0	23.6	0.0	23.6	0.0	14.1	0.0
23.8	0.0	16.8	0.0	25.6	0.0	25.8	0.0	19.8	0.0	16.8	0.0	22.8	0.0	22.8	0.0	13.7	0.0
23.3	0.0	16.0	0.0	24.7	0.0	24.8	0.0	19.2	0.0	16.0	0.0	22.1	0.0	22.1	0.0	12.3	0.0
22.9	1.8	15.2	1.4	23.9	1.2	24.5	0.1	18.4	2.0	15.2	1.4	22.0	0.0	22.0	0.0	11.2	0.0
23.1	36.3	15.1	40.7	24.0	33.3	24.4	28.1	18.3	43.5	15.1	40.7	21.7	25.1	21.7	25.1	12.3	41.5
24.5	141.9	18.0	177.2	26.2	121.4	28.3	163.6	19.9	143.4	18.0	177.2	24.8	149.3	24.8	149.3	15.9	178.3
26.5	307.0	21.8	346.1	28.7	248.4	31.2	352.0	22.1	279.1	21.8	346.1	27.6	321.0	27.6	321.0	21.3	300.9
28.5	464.4	26.4	496.9	31.1	381.0	34.1	518.0	25.4	446.0	26.4	496.9	30.0	475.2	30.0	475.2	25.2	466.7
30.0	577.7	29.3	630.8	33.3	494.1	36.3	663.7	28.1	577.9	29.3	630.8	31.8	593.9	31.8	593.9	27.3	611.8
31.5	652.8	32.7	726.4	35.1	566.6	38.1	748.2	30.9	678.2	32.7	726.4	34.0	683.2	34.0	683.2	29.2	714.9
32.7	701.7	35.0	767.6	36.7	623.2	39.6	791.6	33.4	729.6	35.0	767.6	35.6	725.7	35.6	725.7	30.8	733.5
33.8	711.8	36.6	750.2	38.5	628.1	40.9	807.0	35.5	723.2	36.6	750.2	37.1	735.5	37.1	735.5	32.2	654.5
34.7	680.0	37.6	707.6	39.6	593.9	42.1	774.0	36.4	687.0	37.6	707.6	38.5	712.5	38.5	712.5	33.1	624.2
35.5	621.9	37.6	599.4	40.2	510.8	42.5	680.5	35.7	574.1	37.6	599.4	39.0	652.5	39.0	652.5	33.1	540.5
35.0	516.4	37.8	505.9	39.7	416.6	42.3	581.5	35.2	433.9	37.8	505.9	39.0	533.8	39.0	533.8	32.9	464.4
34.1	379.2	37.2	337.1	38.5	296.6	41.7	433.7	34.0	308.9	37.2	337.1	38.4	401.3	38.4	401.3	32.0	342.8
32.8	232.6	35.2	203.1	36.8	155.6	40.5	268.3	32.6	203.0	35.2	203.1	37.6	238.7	37.6	238.7	30.3	203.2
31.0	95.3	31.7	66.3	34.2	52.7	38.5	86.5	30.1	77.8	31.7	66.3	35.4	111.0	35.4	111.0	25.8	82.2
29.3	6.0	29.6	3.4	32.4	5.1	36.3	0.0	28.2	7.2	29.6	3.4	32.5	8.2	32.5	8.2	23.1	4.3
28.5	0.0	27.4	0.0	30.8	0.0	34.1	0.0	26.7	0.0	27.4	0.0	31.1	0.0	31.1	0.0	22.2	0.0
27.4	0.0	25.8	0.0	29.4	0.0	32.5	0.0	25.4	0.0	25.8	0.0	29.2	0.0	29.2	0.0	19.6	0.0
26.8	0.0	24.8	0.0	28.1	0.0	30.7	0.0	24.1	0.0	24.8	0.0	27.6	0.0	27.6	0.0	17.2	0.0
26.2	0.0	22.9	0.0	27.2	0.0	29.8	0.0	23.4	0.0	22.9	0.0	26.8	0.0	26.8	0.0	15.4	0.0

* Latitude

ESKİŞEHİR		GAZİANTEP		ÇANKIRI		GÜMÜŞHANE		HAKKARİ		HATAY		İĞDIR		ISPARTA		İÇEL	
39.46*		37.01*		40.36*		40.27*		37.34*		36.5		39.55*		37.46*		36.48*	
Jul-19		Jul-23		Jul-04		Jul-14		Jul-30		Aug-01		Jul-04		Jul-28		Jul-28	
T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²
17.8	0.0	25.1	0.0	21.5	0.0	18.6	0.0	25.5	0.0	28.2	0.0	19.3	0.0	21.1	0.0	28.0	0.0
16.9	0.0	24.7	0.0	20.3	0.0	17.7	0.0	24.9	0.0	27.9	0.0	18.1	0.0	20.5	0.0	27.7	0.0
15.6	0.0	24.1	0.0	19.1	0.0	16.9	0.0	24.0	0.0	27.6	0.0	17.3	0.0	19.7	0.0	27.2	0.0
14.6	0.0	24.0	0.0	18.2	0.0	16.4	0.0	23.4	0.0	27.4	0.0	16.5	0.0	19.0	0.0	26.7	0.0
13.8	0.1	23.8	0.0	17.3	1.7	15.7	1.0	22.8	0.0	27.0	0.0	15.8	0.0	18.3	1.7	26.5	0.6
14.4	34.7	24.1	34.3	17.2	18.8	16.1	23.4	22.6	16.7	27.0	15.7	15.4	9.2	19.0	55.2	27.0	26.3
18.8	141.0	25.3	121.8	18.8	93.3	17.3	132.6	23.4	127.7	27.6	119.2	17.3	92.1	22.1	192.8	27.7	149.0
22.7	255.4	27.5	260.7	24.2	280.9	20.4	359.7	24.9	296.9	28.4	273.4	21.7	248.4	25.4	344.5	29.2	328.0
27.1	395.0	31.1	425.0	29.0	481.5	24.6	586.2	26.7	459.1	29.4	421.3	25.7	450.8	28.1	475.8	30.1	495.5
29.9	503.1	33.0	536.4	32.4	660.4	29.5	727.0	28.8	587.7	30.2	539.9	28.3	567.3	30.4	580.5	30.9	642.7
32.3	553.4	34.7	608.5	34.5	743.2	33.2	831.0	30.5	677.7	31.0	619.2	31.0	660.8	32.4	651.5	31.7	755.8
34.1	559.7	35.6	652.8	35.8	808.7	35.6	877.4	32.3	734.2	31.9	667.4	32.4	692.3	33.4	683.9	32.1	823.4
35.6	579.2	35.6	654.2	37.1	820.9	36.6	851.9	33.3	746.7	33.2	690.3	33.7	668.5	34.6	668.6	32.9	838.8
36.2	549.2	36.5	612.2	38.1	750.2	36.8	805.6	34.1	697.8	34.0	661.7	34.4	647.6	35.6	638.9	33.2	797.6
36.7	473.1	36.4	540.2	38.8	718.0	36.4	649.6	34.1	604.8	34.7	592.6	34.7	552.0	35.5	553.8	32.9	695.0
36.5	379.6	35.9	439.3	38.6	538.3	34.7	537.3	34.2	448.9	33.8	492.9	34.4	425.0	35.1	421.3	32.5	543.6
35.2	284.0	35.3	314.6	38.1	388.2	32.4	402.9	33.7	305.5	32.5	362.3	33.1	293.4	34.2	289.9	31.9	381.7
33.5	174.5	33.3	177.0	36.1	266.1	29.6	249.9	32.8	143.2	31.5	208.1	31.3	155.6	32.6	154.8	31.3	203.8
30.6	67.7	32.1	47.0	33.3	120.4	27.4	110.5	31.4	16.7	30.7	69.1	28.7	70.5	30.2	34.9	30.7	56.2
28.3	0.0	30.3	0.0	30.8	13.2	25.9	8.8	30.4	0.0	30.3	5.8	26.7	4.2	28.3	2.1	30.3	3.3
26.5	0.0	28.8	0.0	28.0	0.0	25.0	0.0	29.6	0.0	30.0	0.0	24.9	0.0	27.5	0.0	30.0	0.0
24.8	0.0	27.9	0.0	27.1	0.0	23.3	0.0	28.7	0.0	29.4	0.0	22.8	0.0	25.9	0.0	29.7	0.0
23.5	0.0	27.0	0.0	25.8	0.0	22.2	0.0	28.2	0.0	28.9	0.0	21.2	0.0	24.7	0.0	29.2	0.0
22.2	0.0	26.4	0.0	24.8	0.0	21.2	0.0	27.5	0.0	28.5	0.0	19.8	0.0	23.0	0.0	24.9	0.0

* Latitude

İSTANBUL		İZMİR		KMARAŞ		KARAMAN		KARS		KASTAMONU		KAYSERİ		KIRIKKALE		KIRŞEHİR	
41.01*		38.24*		37.35*		37.11*		40.36*		41.22*		38.43*		39.50*		39.09*	
Jul-26		Jul-28		Jul-30		Jul-20		Jul-27		Jul-29		Jul-28		Aug-01		Aug-02	
T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²
24.2	0.0	28.2	0.0	27.6	0.0	22.2	0.0	17.2	0.0	18.5	0.0	19.8	0.0	24.3	0.0	24.4	0.0
23.9	0.0	27.7	0.0	26.7	0.0	21.1	0.0	16.5	0.0	17.4	0.0	18.6	0.0	23.4	0.0	22.4	0.0
23.9	0.0	27.6	0.0	25.8	0.0	20.1	0.0	15.3	0.0	16.6	0.0	17.7	0.0	22.3	0.0	21.5	0.0
23.5	0.0	27.4	0.0	25.0	0.0	18.9	0.0	13.9	0.0	15.9	0.0	16.4	0.0	21.4	0.0	20.8	0.0
23.2	1.3	27.2	0.4	24.3	0.6	18.0	1.1	13.2	0.0	15.4	1.2	15.7	0.6	20.6	0.6	20.2	1.6
23.9	38.4	27.4	29.5	24.5	15.3	18.3	48.3	12.8	29.5	15.3	35.7	16.7	40.8	20.8	37.0	19.9	55.5
26.3	156.7	28.8	148.4	25.5	126.9	21.9	183.3	14.5	143.4	17.6	154.8	20.1	169.3	23.3	172.9	22.2	208.5
28.0	332.4	30.8	338.8	28.2	355.9	25.1	357.8	18.0	265.8	21.7	313.4	23.4	343.2	26.1	335.8	25.2	388.2
29.6	477.7	32.6	513.9	32.2	523.4	28.7	524.0	22.3	420.6	25.2	447.2	27.4	523.4	29.2	488.5	28.9	523.4
31.0	600.1	34.3	659.1	34.5	649.0	31.1	660.4	24.9	548.1	27.9	569.1	30.0	662.9	31.6	618.7	31.7	627.2
32.5	690.9	36.1	762.5	36.3	725.2	33.4	753.1	27.0	639.4	30.1	654.1	32.4	748.0	34.3	708.0	33.7	723.2
33.7	732.7	37.5	820.9	39.0	796.1	34.7	804.4	29.0	694.7	33.0	682.6	34.6	806.3	36.1	765.3	35.0	765.9
34.4	739.4	38.5	815.8	40.3	791.7	36.0	812.0	30.3	671.8	35.1	675.0	36.0	817.0	37.5	758.3	36.0	753.7
34.6	706.4	39.2	782.2	41.0	737.1	36.8	768.2	31.3	622.9	36.3	591.9	36.7	776.5	38.5	735.9	36.4	726.7
34.3	610.9	39.6	692.1	41.5	656.0	37.0	666.1	31.9	537.9	36.8	494.2	36.8	643.3	38.4	623.4	36.7	603.6
33.8	506.3	39.0	556.4	39.7	524.7	37.0	548.7	31.4	432.7	36.0	398.3	36.8	491.6	38.6	522.6	36.4	462.3
33.2	385.7	37.8	379.4	37.8	319.1	36.0	411.1	30.7	295.0	34.6	256.9	36.6	369.9	38.0	372.2	35.8	335.9
31.8	217.0	36.4	212.5	34.9	126.2	34.6	248.7	28.9	166.9	32.7	151.7	35.5	207.5	37.2	225.6	35.0	186.7
29.8	83.1	34.7	59.0	32.8	38.1	32.2	70.4	25.1	62.0	30.5	36.6	33.0	58.4	35.2	66.2	33.2	53.2
28.6	11.5	33.3	4.0	31.9	2.1	29.8	3.1	23.1	3.9	27.6	1.1	29.7	3.0	33.0	2.1	30.4	0.9
27.4	0.0	32.3	0.0	31.4	0.0	28.2	0.0	21.7	0.0	25.5	0.0	27.8	0.0	31.2	0.0	27.7	0.0
26.8	0.0	31.6	0.0	30.2	0.0	27.1	0.0	20.4	0.0	23.2	0.0	25.6	0.0	29.8	0.0	26.8	0.0
26.4	0.0	30.6	0.0	29.3	0.0	25.5	0.0	19.5	0.0	21.4	0.0	24.1	0.0	28.6	0.0	26.1	0.0
25.8	0.0	29.8	0.0	28.4	0.0	24.4	0.0	18.5	0.0	20.4	0.0	22.6	0.0	27.4	0.0	24.9	0.0

* Latitude

KİLİS		KOCAELİ		KONYA		KÜTAHYA		MALATYA		MANİSA		MUĞLA		MUŞ		NEVŞEHİR	
36.44*		40.46*		37.52*		39.25*		38.21*		38.36*		37.12*		38.44*		38.38*	
Aug-02		Jul-28		Jul-24		Jul-31		Jul-20		Jul-20		Jul-27		Jul-20		Jul-24	
T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²	T _o , °C	I w/m ²
28.0	0.0	24.3	0.0	23.0	0.0	20.0	0.0	27.3	0.0	27.3	0.0	26.3	0.0	24.9	0.0	16.2	0.0
27.5	0.0	23.8	0.0	22.3	0.0	19.1	0.0	26.5	0.0	26.5	0.0	25.8	0.0	24.3	0.0	15.3	0.0
27.2	0.0	23.5	0.0	20.6	0.0	17.8	0.0	26.4	0.0	26.4	0.0	25.2	0.0	22.9	0.0	14.8	0.0
26.7	0.0	23.1	0.0	20.0	0.0	17.1	0.0	25.4	0.0	25.4	0.0	24.5	0.0	22.7	0.0	13.5	0.0
26.5	0.6	22.9	0.5	19.3	1.7	16.3	0.5	24.6	0.0	24.6	0.0	24.2	0.8	21.4	0.0	12.8	1.0
26.6	44.0	22.9	16.7	20.0	65.6	16.3	24.9	24.9	33.3	24.9	33.3	24.2	24.4	21.2	8.4	13.7	55.7
28.1	184.8	23.8	79.3	22.6	228.9	17.9	128.4	26.5	165.2	26.5	165.2	25.8	146.4	21.9	92.8	18.9	189.0
30.1	360.0	26.1	242.4	26.7	436.8	21.3	298.7	28.3	355.9	28.3	355.9	27.7	355.9	23.7	271.5	23.5	347.6
32.6	516.9	29.1	409.9	29.8	607.8	25.4	480.1	30.1	513.3	30.1	513.3	30.4	511.2	27.3	427.8	27.5	515.8
34.6	642.8	30.9	526.5	31.7	739.7	29.1	602.2	31.9	643.5	31.9	643.5	33.1	637.7	29.8	561.8	30.8	647.1
36.5	696.9	32.9	582.3	33.3	826.9	31.9	684.6	33.8	735.9	33.8	735.9	35.6	718.0	32.3	672.0	33.4	741.0
37.9	746.2	34.0	626.8	34.7	868.8	33.5	734.8	35.2	780.1	35.2	780.1	37.5	753.7	33.8	724.4	34.9	789.8
39.5	750.1	35.7	633.2	35.0	852.1	34.9	735.5	36.4	795.5	36.4	795.5	38.3	755.4	35.5	746.7	35.9	763.8
40.6	716.0	36.6	604.6	36.4	783.7	35.2	649.0	37.7	765.3	37.7	765.3	38.9	723.2	37.1	715.3	35.9	689.0
40.6	609.3	36.8	531.6	36.5	691.6	35.4	619.7	38.7	691.7	38.7	691.7	38.7	634.2	37.7	628.7	36.2	633.2
39.9	477.2	35.9	440.9	36.2	592.5	35.0	494.8	38.4	570.7	38.4	570.7	38.0	509.4	37.7	494.8	36.1	498.6
39.3	359.4	34.6	326.1	35.6	412.4	33.7	373.3	38.0	411.7	38.0	411.7	37.0	370.8	37.0	337.8	35.3	360.3
37.3	205.7	33.3	185.9	34.4	235.2	32.0	224.0	36.8	220.2	36.8	220.2	35.0	189.3	35.8	200.3	34.0	219.4
34.2	55.4	31.5	66.8	31.4	79.7	29.1	76.4	34.8	68.0	34.8	68.0	32.9	22.7	33.0	64.2	30.6	78.3
33.1	3.2	30.3	5.7	29.5	2.3	27.0	8.0	33.2	1.3	33.2	1.3	31.2	0.2	31.2	12.6	26.3	6.0
31.2	0.0	28.9	0.0	27.7	0.0	25.5	0.0	31.9	0.0	31.9	0.0	29.6	0.0	29.0	0.0	23.9	0.0
29.9	0.0	27.9	0.0	26.2	0.0	23.9	0.0	30.9	0.0	30.9	0.0	28.4	0.0	27.7	0.0	22.3	0.0
29.1	0.0	27.1	0.0	24.8	0.0	22.7	0.0	30.3	0.0	30.3	0.0	27.2	0.0	26.2	0.0	21.1	0.0
28.1	0.0	26.3	0.0	24.9	0.0	24.9	0.0	24.9	0.0	24.9	0.0	24.9	0.0	25.1	0.0	20.6	0.0

* Latitude

NİĞDE		ORDU		RİZE		SAKARYA		SAMSUN		SİİRT		SİNOP		SİVAS		TEKİRDAĞ	
37.59*		41.00*		41.02*		40.46*		41.17*		37.56*		42.01*		39.45*		40.59*	
Jul-16		Aug-09		Jul-30		Jul-17		Jul-21		Jul-29		Aug-06		Jul-17		Jul-23	
To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²
21.5	0.0	23.5	0.0	23.1	0.0	22.2	0.0	24.0	0.0	29.4	0.0	24.2	0.0	20.6	0.0	22.9	0.0
20.7	0.0	23.5	0.0	22.8	0.0	21.7	0.0	23.8	0.0	28.8	0.0	24.1	0.0	19.6	0.0	22.7	0.0
20.0	0.0	23.4	0.0	22.5	0.0	21.7	0.0	24.1	0.0	28.5	0.0	24.1	0.0	18.6	0.0	22.2	0.0
19.5	0.0	23.4	0.0	22.5	0.0	21.3	0.0	24.0	0.0	28.0	0.0	24.0	0.0	17.7	0.0	22.1	0.0
18.8	0.6	23.3	0.2	22.1	1.4	21.0	1.4	24.4	2.1	27.6	0.0	23.8	0.0	16.8	1.1	21.9	0.8
19.0	43.2	23.5	18.8	23.0	37.9	21.4	33.7	24.3	53.6	27.9	29.8	24.0	16.0	16.6	37.9	22.5	38.3
20.9	214.5	25.1	124.1	24.7	135.1	22.9	153.5	26.1	183.3	29.7	144.7	24.7	57.7	18.5	189.0	24.8	165.6
24.8	413.0	27.2	276.0	26.7	289.3	26.2	336.8	27.7	359.0	32.0	304.5	25.7	223.3	22.0	366.7	26.2	316.6
28.3	591.3	28.6	406.3	27.9	447.2	29.0	485.9	29.0	492.3	34.3	436.5	26.7	432.7	25.5	525.9	27.5	464.4
30.6	738.4	28.7	532.7	28.7	565.2	31.3	595.0	29.5	634.4	36.6	548.7	27.6	563.4	28.6	650.3	28.2	584.3
32.4	842.5	29.5	666.1	29.4	642.6	33.4	685.7	29.7	703.5	38.0	623.6	28.7	657.2	31.7	742.3	28.6	668.6
33.7	904.6	30.0	711.8	29.9	679.5	35.0	718.8	29.8	738.4	39.0	662.4	29.2	711.8	33.3	781.0	29.2	705.4
34.7	920.6	30.3	704.0	30.3	662.4	36.5	706.1	29.2	714.9	39.8	660.4	29.4	722.6	34.6	782.2	29.8	682.0
35.4	890.7	30.5	656.8	30.5	605.8	37.1	649.6	29.2	703.5	40.3	598.3	29.9	672.5	35.4	716.2	30.7	632.5
35.7	810.1	30.3	576.9	30.9	544.3	36.7	553.1	29.0	567.8	40.6	548.1	29.4	583.0	36.1	643.3	32.4	544.9
35.8	657.2	29.7	434.2	30.8	411.1	35.6	430.1	28.8	437.8	40.8	448.5	28.7	461.2	35.6	483.4	32.0	453.0
34.9	489.1	28.7	269.0	30.2	281.7	34.1	298.8	28.1	301.9	39.9	313.4	28.0	309.6	34.6	381.9	32.0	355.9
33.8	310.9	28.0	138.1	29.3	145.3	32.7	163.1	27.6	192.8	38.4	154.8	27.1	178.9	33.0	218.2	31.2	212.5
31.8	109.7	26.9	37.5	27.9	26.5	30.9	50.2	26.6	64.7	36.2	39.3	26.3	55.2	30.3	80.3	29.4	59.6
30.0	10.8	26.1	2.3	27.3	1.7	29.2	1.3	26.0	8.8	34.0	0.0	25.7	8.5	28.4	5.1	27.7	9.1
28.2	0.0	25.2	0.0	26.8	0.0	27.4	0.0	25.2	0.0	33.0	0.0	25.2	0.0	27.0	0.0	26.6	0.0
27.2	0.0	24.7	0.0	26.5	0.0	26.3	0.0	24.8	0.0	31.9	0.0	25.0	0.0	25.6	0.0	25.6	0.0
25.7	0.0	24.4	0.0	26.4	0.0	25.0	0.0	24.5	0.0	31.5	0.0	24.6	0.0	24.1	0.0	24.9	0.0
24.9	0.0	23.9	0.0	26.0	0.0	24.1	0.0	24.0	0.0	31.0	0.0	24.4	0.0	23.0	0.0	24.4	0.0

* Latitude

TOKAT		TRABZON		TUNCELİ		Ş.URFA		UŞAK		VAN		YALOVA		YOZGAT		ZONGULDAK	
40.19*		41.00*		39.07*		37.08*		38.41*		38.28*		40.39*		39.50*		41.27*	
Jul-28		Jul-27		Jul-31		Jul-19		Jul-25		Aug-11		Jul-17		Jul-28		Jul-23	
To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²	To. °C	I w/m ²
22.4	0.0	23.7	0.0	25.3	0.0	31.5	0.0	22.8	0.0	22.1	0.0	22.3	0.0	21.2	0.0	25.0	0.0
21.8	0.0	23.3	0.0	24.9	0.0	30.7	0.0	21.8	0.0	22.3	0.0	21.9	0.0	20.7	0.0	24.8	0.0
21.0	0.0	22.9	0.0	24.3	0.0	30.0	0.0	20.9	0.0	21.2	0.0	21.4	0.0	20.1	0.0	24.6	0.0
20.0	0.0	22.9	0.0	23.6	0.0	29.8	0.0	20.4	0.0	21.1	0.0	21.6	0.0	19.5	0.0	24.1	0.0
19.6	0.6	22.9	1.0	23.0	0.0	29.1	0.0	19.8	0.0	20.7	0.0	21.4	1.7	18.6	1.5	24.2	3.6
19.8	33.9	23.1	40.3	22.4	9.9	29.1	31.0	19.8	41.9	20.5	31.2	21.9	28.6	18.5	40.7	24.7	57.7
22.1	178.9	24.0	133.3	24.3	138.4	31.0	160.5	22.4	181.4	22.5	170.3	23.6	138.3	22.1	168.4	25.7	174.5
25.0	382.5	25.7	272.2	26.6	341.9	33.7	377.6	25.8	355.9	25.4	368.5	26.2	327.4	26.6	348.1	26.9	331.5
28.7	536.8	27.4	407.5	30.1	530.4	36.6	542.0	29.0	565.2	28.0	542.9	28.4	492.3	29.3	516.4	27.9	443.8
31.9	677.5	29.4	492.7	32.9	668.8	38.9	669.1	30.8	732.7	29.4	695.0	30.3	638.2	31.1	646.4	28.9	565.2
34.0	770.8	30.3	608.5	35.9	766.5	40.6	745.2	32.9	830.4	29.6	801.1	31.8	727.6	32.5	735.4	29.7	726.4
36.1	822.9	30.9	679.7	37.8	832.7	41.9	786.2	34.1	872.3	30.0	866.7	32.9	775.9	33.4	778.1	29.7	755.1
38.4	821.6	31.2	672.7	39.5	850.2	42.8	773.1	35.2	879.3	31.3	883.5	34.1	782.9	34.1	779.0	29.6	729.2
39.1	761.2	31.2	608.5	39.9	811.8	43.0	735.9	36.1	851.4	31.3	805.3	33.9	749.2	34.3	737.1	29.5	663.6
39.2	672.5	30.9	508.0	40.6	719.9	43.0	667.6	36.4	746.7	30.7	720.2	33.4	654.7	34.4	650.7	29.4	559.0
38.6	527.8	30.4	383.8	40.6	590.8	42.8	542.0	36.0	614.1	30.3	594.6	33.3	533.5	34.4	488.5	29.3	422.9
37.4	387.6	30.1	281.9	39.6	451.3	42.1	396.3	34.8	446.6	30.2	421.5	33.1	375.0	33.8	358.6	28.8	315.4
34.9	225.9	29.4	149.3	37.5	269.8	40.9	244.2	33.3	258.2	28.9	249.8	31.4	201.1	32.3	182.4	28.0	192.6
32.5	79.7	28.4	41.9	34.5	87.4	38.9	86.1	31.6	83.7	27.8	76.1	29.5	71.7	30.3	59.3	27.6	58.9
30.7	5.7	27.2	2.3	32.6	3.9	36.9	8.3	29.8	3.5	26.3	3.5	28.4	6.7	28.0	4.3	26.4	3.9
28.5	0.0	26.1	0.0	31.0	0.0	35.6	0.0	28.0	0.0	24.9	0.0	27.4	0.0	25.4	0.0	26.0	0.0
27.4	0.0	25.5	0.0	30.2	0.0	34.6	0.0	26.8	0.0	23.9	0.0	26.2	0.0	24.6	0.0	25.0	0.0
26.1	0.0	24.7	0.0	29.1	0.0	33.9	0.0	25.7	0.0	23.0	0.0	25.6	0.0	24.1	0.0	24.7	0.0
24.9	0.0	24.4	0.0	27.9	0.0	32.9	0.0	24.5	0.0	22.5	0.0	25.1	0.0	23.2	0.0	24.7	0.0

* Latitude

Tables C2. Solar radiation on horizontal plane and ambient air temperature data for the some cities of Iraq

Baghdad		Kirkuk		Erbil		Sulaimaniya		Basra		Mosul		Najaf	
33.23*		35.47*		36.18*		35.55*		30.57*		36.32*		36.32*	
Aug-09		Aug-09		Aug-09		Aug-09		Aug-09		Aug-09		Aug-09	
T _o . °C	I w/m ²	T _o . °C	I w/m ²	T _o . °C	I w/m ²	T _o . °C	I w/m ²	T _o . °C	I w/m ²	T _o . °C	I w/m ²	T _o . °C	I w/m ²
32	0	29	0	27	0	23	0	33	0	29	0	39	0
30	0	28	0	27	0	22	0	32	0	28	0	39	0
29	0	28	0	26	0	21	0	31	0	27	0	37	0
28	0	27	0	25	0	20	0	30	0	26	0	36	0
26	0	26	0	22	0	19	0	29	0	27	0	35	0
27	165	27	162	25	163	19	151	24	183	28	158	35	181
28	432	27	414	27	420	21	397	29	467	29	401	37	468
29	579	30	565	30	568	24	531	32	589	31	539	35	590
32	663	33	649	33	651	28	629	35	687	33	634	37	689
34	702	36	698	36	700	32	662	38	731	35	678	40	738
37	789	38	767	38	770	34	745	41	811	37	762	42	819
39	810	39	798	39	802	36	773	43	836	38	791	44	841
40	781	40	774	39	778	37	753	44	802	39	771	45	804
41	707	40	699	40	701	37	678	45	735	40	754	47	733
42	615	41	601	40	608	38	582	46	640	40	601	47	638
43	540	41	528	41	531	38	503	45	562	41	528	47	564
42	418	41	410	40	413	38	397	44	433	40	406	47	431
41	233	40	221	39	220	37	198	43	251	39	219	47	249
40	2	39	41	38	40	36	38	41	48.2	38	40	46	49.1
38	0	37	0	36	0	33	0	40	0	36	0	44	0
36	0	34	0	34	0	29	0	38	0	34	0	42	0
34	0	32	0	32	0	27	0	37	0	33	0	41	0
33	0	31	0	30	0	26	0	36	0	31	0	40	0
32	0	30	0	29	0	25	0	34	0	30	0	38	0

* Latitude

Tables C3. Solar radiation on horizontal plane and ambient air temperature data for Gaziantep city of Turkey

	JANUARY																															
	DAYS																															
	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
D	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I		
1	3.5	0	4	0	3.7	0	3.2	0	3.7	0	4.6	0	4.3	0	3.4	0	2.4	0	2.7	0	2.9	0	2.8	0	3.2	0	3.4	0	3.3	0	2.8	0
2	3.3	0	3.8	0	3.6	0	3.1	0	3.5	0	4.5	0	4	0	3.2	0	1.9	0	2.4	0	2.6	0	2.6	0	3	0	3.1	0	3.1	0	2.5	0
3	3.1	0	3.7	0	3.2	0	3	0	3.5	0	4.2	0	3.9	0	3.1	0	1.8	0	2.1	0	2.4	0	2.5	0	2.7	0	2.9	0	3.1	0	2.2	0
4	3	0	3.6	0	3	0	2.8	0	3.5	0	4.1	0	3.7	0	2.9	0	1.6	0	1.9	0	2.3	0	2.5	0	2.4	0	2.7	0	2.9	0	1.9	0
5	2.7	0	3.6	0	2.8	0	2.7	0	3.5	0	3.8	0	3.6	0	2.7	0	1.4	0	1.5	0	2	0	2.5	0	2.5	0	2.6	0	2.7	0	1.7	0
6	2.3	0	3.6	0	2.6	0	2.7	0	3.6	0	3.8	0	3.6	0	2.4	0	1.3	0	1.2	0	1.9	0	2.5	0	2.4	0	2.3	0	2.7	0	1.5	0
7	2	0	3.4	0	2.6	0	2.6	0	3.5	0	3.9	0	3.4	0	2	0	1.1	0	1.3	0	1.7	0	2.5	0	2.3	0	2.1	0	2.5	0	1.3	0
8	2.2	206	3.5	167	2.8	273	3	146	3.5	77	4.2	90	3.6	135	2.2	98	1.6	108	1.7	84	2.1	113	2.6	95	2.5	180	2.4	116	2.8	214	1.8	149
9	3.9	852	4.6	590	4.1	852	4.2	468	4	327	5.5	390	4.9	705	3.8	570	3.5	702	3.3	486	3.5	653	4	630	4.3	767	4.4	558	3.7	714	4	786
10	6.5	1644	5.9	1194	6	1422	5.4	1146	4.2	474	6.4	942	6.3	1333	5.2	1176	5.4	1560	5.3	1260	4.9	1458	6.1	1620	6.4	1608	6	1260	5	1518	5.8	1680
11	8	2118	7	1674	7.3	1896	6.6	1608	4.6	696	7	1434	7	1644	6.4	1680	6.8	2238	6.4	1704	5.9	1998	7.5	2352	7.8	2268	7.2	1848	6	2118	7.1	2226
12	8.6	2274	7.6	1878	7.8	1860	7	1662	4.9	996	7.7	1680	7.4	1674	7	1986	7.6	2634	7	2052	6.4	2214	8.6	2802	8.8	2592	8	1974	6.9	2298	7.9	2508
13	8.9	2112	8.1	1806	8.3	2172	7.3	1686	5.3	1206	8.2	1740	7.5	1776	7.5	2040	8.2	2622	7.3	1830	7.1	2184	9	2658	9.1	2460	8.4	1998	7.6	2538	8.7	2652
14	9.5	1938	8.2	1530	8.7	1884	7.4	1566	5.7	1056	8.2	1776	7.6	1554	8	1800	8.4	2358	7.3	1638	7.2	1818	9.3	2358	9.5	2328	8.6	1968	8.1	2166	9.3	2586
15	9.4	1500	8.1	1272	8.4	1350	7.3	1254	5.8	822	8.1	1368	7.6	1248	7.7	1272	8.2	1722	7.2	1200	7.1	1500	9	1650	9.4	1650	8.3	1446	8.1	1758	9.2	2136
16	9	840	7.8	714	7.7	672	6.7	576	5.6	516	7.9	813	7.3	660	7.3	666	7.8	948	6.8	760	6.6	783	8.5	1026	8.8	762	7.8	798	7.7	1188	8.6	1333
17	7.6	163	6.8	177	6.9	130	5.6	199	5.2	217	7.1	344	6.4	155	6.1	145	6.3	252	6	278	5.7	238	7.2	317	7.6	195	6.7	270	6.6	271	7.2	382
18	6.4	15	6	0	6	0	5.2	60	4.9	60	6.3	90	5.7	180	5.3	30	5.9	0	5.3	45	4.9	0	6.3	0	6.5	15	5.8	60	5.6	30	5.8	60
19	5.7	0	5.3	0	5.2	0	4.7	0	4.7	0	5.8	0	5.1	0	4.6	0	4.5	0	4.9	0	4.4	0	5.4	0	5.5	0	5.1	0	5.1	0	4.7	0
20	5.2	0	5.1	0	4.7	0	4.5	0	4.6	0	5.5	0	4.7	0	4.1	0	4	0	4.5	0	4.1	0	4.8	0	5.1	0	4.5	0	4.4	0	4.1	0
21	4.9	0	4.8	0	4.5	0	4.4	0	4.6	0	5.2	0	4.4	0	3.5	0	3.6	0	4.3	0	3.6	0	4.3	0	4.6	0	4.2	0	4	0	3.7	0
22	4.6	0	4.4	0	4.1	0	4.1	0	4.7	0	4.8	0	4.2	0	3.3	0	3.3	0	3.8	0	3.3	0	4.1	0	4.1	0	4	0	3.6	0	2.9	0
23	4.4	0	4.2	0	3.8	0	3.8	0	4.6	0	4.6	0	3.8	0	3.1	0	3	0	3.5	0	3.2	0	3.9	0	3.8	0	3.6	0	3.3	0	2.5	0
24	4.2	0	4	0	3.5	0	3.7	0	4.7	0	4.4	0	3.5	0	2.7	0	2.8	0	3.1	0	2.9	0	3.5	0	3.5	0	3.4	0	3.1	0	2.2	0

	JANUARY																													
	DAYS																													
	17		18		19		20		21		22		23		24		25		26		27		28		29		30		31	
D	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	1.9	0	2.1	0	1.9	0	2.4	0	1.3	0	2.2	0	2.8	0	2.2	0	1.4	0	2.4	0	1.1	0	0.8	0	1.3	0	1.6	0	2.3	0
2	1.7	0	1.7	0	1.7	0	2.2	0	1.1	0	2.4	0	2.8	0	2.0	0	1.3	0	2.1	0	1.0	0	0.7	0	1.2	0	1.4	0	2.1	0
3	1.3	0	1.4	0	1.4	0	2.1	0	1.0	0	2.5	0	2.8	0	1.6	0	1.3	0	1.8	0	0.9	0	0.7	0	1.0	0	1.3	0	1.9	0
4	1.4	0	1.1	0	1.1	0	2.1	0	0.7	0	2.4	0	2.5	0	1.5	0	1.1	0	1.5	0	0.7	0	0.4	0	0.8	0	1.1	0	1.7	0
5	1.4	0	1.0	0	0.8	0	1.9	0	0.7	0	2.2	0	2.2	0	1.4	0	1.0	0	1.2	0	0.6	0	0.3	0	0.7	0	0.9	0	1.7	0
6	1.1	0	0.8	0	0.7	0	1.8	0	0.6	0	2.0	0	2.1	0	1.3	0	0.9	0	1.1	0	0.4	0	0.3	0	0.5	0	0.6	0	1.6	0
7	1.1	0	0.8	0	0.5	0	1.8	0	0.4	0	1.9	0	2.1	0	1.2	0	0.9	0	0.8	0	0.3	0	0.4	0	0.6	0	0.6	0	1.5	0
8	1.5	159	1.2	144	1.0	197	1.9	150	0.8	228	1.9	105	2.2	176.3	1.5	140	1.4	150	1.0	223	0.4	201.7	0.7	105	1.8	200	1.3	166.7	1.5	200
9	3.6	744	2.6	636	3.2	804	3.3	660	2.3	833	2.6	420	2.7	420	3.0	620	3.3	768	3.3	930	2.5	946.7	2.0	624	3.4	822	3.5	738	3.3	858
10	5.8	1578	4.0	1254	5.1	1506	4.5	1387	4.1	1380	3.5	794	3.4	846	4.3	1392	4.9	1506	5.5	1824	3.8	1482	3.3	1374	5.2	1614	5.2	1596	4.7	1686
11	7.5	2340	5.3	1938	6.0	2112	5.2	1704	5.2	1854	4.1	1134	4.0	1242	5.1	2010	6.2	2040	6.9	2580	4.7	1950	4.5	1920	6.3	2292	6.2	1974	6.1	2226
12	8.3	2670	6.1	2340	6.9	2490	5.9	1788	5.7	2196	4.3	1296	4.5	1506	5.5	2274	6.7	2316	7.6	3024	5.1	2322	5.4	2556	7.1	2568	6.9	2322	7.0	2610
13	9.2	3132	6.3	2154	7.2	2460	6.0	1632	6.0	1938	4.5	1332	4.8	1626	6.1	2238	7.0	2292	8.0	2784	5.6	2430	5.9	2652	7.8	2838	7.3	2406	7.6	2808
14	9.6	2688	6.8	1926	7.5	2184	6.1	1614	6.3	1848	4.6	1253	5.0	1674	6.4	2052	7.2	1896	8.2	2466	6.0	2154	6.3	2370	8.1	2472	7.6	2094	8.1	2484
15	9.6	2130	6.8	1452	7.7	1950	6.0	1398	6.5	1518	4.6	1033	5.4	1350	6.3	1578	7.3	1536	7.8	1974	5.8	1596	6.4	2028	7.8	1980	7.3	1632	8.3	2082
16	8.8	1242	6.4	858	7.3	1182	6.0	888	6.2	804	4.3	600	5.2	810	6.0	1110	7.1	1017	7.6	1206	5.4	918	6.0	1170	7.6	1326	7.1	972	7.9	1212
17	7.1	288	5.2	287	6.0	344	5.3	364	5.3	330	4.0	213	4.5	250	5.2	354	5.9	233.3	6.5	427	4.7	390	5.1	427.5	6.5	444	6.3	349	6.8	426.7
18	5.9	30	4.3	60	4.9	30	4.3	70	4.5	30	3.7	60	3.9	30	4.4	30	5.0	20	5.1	101	3.5	75	4.2	82.5	5.4	70	5.5	70	5.8	30
19	4.9	0	3.7	0	3.9	0	3.7	0	3.7	0	3.6	0	3.5	0	3.8	0	4.4	0	4.2	0	2.6	0	3.3	0	4.1	0	4.6	0	4.9	0
20	4.1	0	3.4	0	3.4	0	3.0	0	3.3	0	3.3	0	3.2	0	3.2	0	3.9	0	3.4	0	2.2	0	2.7	0	3.4	0	4.1	0	4.5	0
21	3.6	0	3.2	0	3.2	0	2.5	0	3.0	0	3.2	0	3.0	0	2.8	0	3.6	0	2.7	0	1.8	0	2.2	0	3.1	0	3.7	0	3.7	0
22	2.9	0	2.9	0	2.6	0	2.0	0	2.7	0	3.0	0	2.7	0	2.3	0	3.1	0	2.1	0	1.5	0	1.9	0	2.3	0	3.2	0	3.0	0
23	2.6	0	2.5	0	2.5	0	1.7	0	2.4	0	3.0	0	2.5	0	1.9	0	2.7	0	1.6	0	1.3	0	1.6	0	2.2	0	3.1	0	2.6	0
24	2.4	0	2.2	0	2.4	0	1.6	0	2.3	0	2.9	0	2.3	0	1.7	0	2.4	0	1.4	0	1.1	0	1.5	0	2.0	0	2.7	0	2.5	0

	FEBRUARY																															
	DAYS																															
	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
D	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I		
1	2.1	0	2.4	0	2.6	0	2.1	0	2.4	0	2.5	0	3.3	0	3.0	0	2.3	0	1.8	0	2.6	0	2.0	0	3.5	0	4.1	0	1.9	0	1.8	0
2	1.6	0	2.3	0	2.3	0	1.8	0	1.9	0	2.4	0	3.1	0	2.8	0	1.9	0	1.6	0	2.1	0	1.6	0	3.4	0	3.9	0	1.5	0	1.6	0
3	1.4	0	2.1	0	2.1	0	1.5	0	1.8	0	2.2	0	2.8	0	2.5	0	1.6	0	1.1	0	1.9	0	1.4	0	3.4	0	3.6	0	1.3	0	1.5	0
4	1.3	0	1.9	0	2.1	0	1.1	0	2.0	0	2.2	0	2.6	0	2.4	0	1.4	0	1.0	0	1.8	0	1.2	0	3.3	0	3.4	0	1.4	0	1.3	0
5	1.0	0	1.7	0	1.6	0	0.9	0	1.7	0	2.1	0	2.3	0	2.3	0	1.3	0	0.9	0	1.6	0	1.0	0	3.2	0	3.3	0	1.0	0	1.2	0
6	1.0	0	1.7	0	1.7	0	0.7	0	1.6	0	1.9	0	2.1	0	2.0	0	1.0	0	0.6	0	1.4	0	1.0	0	3.0	0	3.2	0	1.1	0	1.2	0
7	0.9	15	1.6	0	1.7	0	0.5	0	1.5	0	2.1	20	2.0	0	1.6	15	0.8	15	0.6	50	1.4	50	0.9	45	3.1	22.5	3.0	30	0.7	37.5	1.2	40
8	1.3	216.7	2.1	141.1	2.0	176.3	0.8	262	2.0	226	3.0	262.2	2.4	210	2.3	376.7	1.3	348	1.3	390	1.9	460	1.5	467	3.6	96.7	3.2	221	1.7	367.8	1.6	373.3
9	2.8	913.3	4.1	786.7	3.7	597	2.9	918	3.5	834	4.2	993.3	4.5	834	4.0	1116	3.8	1254	4.7	1296	4.3	1400	4.2	1272	4.7	526.7	5.1	924	3.4	1200	3.1	1020
10	4.8	1728	5.1	1284	4.8	1146	4.9	1620	4.7	1554	5.7	1578	5.9	1572	5.6	1854	5.9	2028	6.5	2166	6.0	2413	6.0	1992	5.9	1194	6.4	1614	5.0	2088	4.6	1704
11	6.0	2394	6.0	1998	5.5	1770	6.0	2256	5.7	2082	6.8	2376	8.0	2100	7.1	2772	7.5	3006	7.9	2880	7.3	2874	7.0	2898	6.8	1842	7.0	2232	5.8	2754	5.6	2670
12	7.1	2772	6.9	2430	5.9	1896	6.6	2622	6.2	2412	7.4	2778	8.4	2658	8.0	3192	8.5	3432	8.6	3270	7.9	3174	7.9	2922	7.3	1806	7.2	2136	6.2	2802	6.1	2880
13	8.0	3000	7.1	2424	6.3	2106	7.1	2568	6.5	2190	7.7	2418	8.8	2784	9.1	3480	9.1	3486	9.1	3078	8.3	3162	8.5	2718	7.7	2094	7.2	1896	6.5	3006	6.8	2886
14	8.6	2778	7.5	2244	6.6	1992	7.6	2238	6.6	1668	8.2	2082	8.6	2430	9.6	3084	9.3	3318	9.4	2952	8.7	2970	8.7	2421	7.9	2046	7.2	1824	6.8	2598	7.2	2628
15	8.7	2256	8.4	1860	6.8	1758	7.6	1938	6.3	1332	8.1	1674	8.5	2022	9.7	2604	9.4	2544	9.3	2448	8.8	2508	8.5	2027	7.9	1614	6.7	1470	6.8	2448	7.0	1992
16	8.4	1524	7.9	1176	6.7	1296	7.1	1236	6.2	1014	7.9	1194	8.3	1338	9.4	1900	8.7	1818	9.0	1692	8.6	1698	8.1	1353	7.7	1122	6.2	960	6.3	1428	6.7	1440
17	7.2	510	7.2	383.3	5.7	523.3	6.2	438	5.4	469	7.2	526.7	7.2	618	8.1	633.3	7.5	588	7.9	648	7.5	680	7.2	558.8	7.1	528	5.5	474	5.2	637	5.9	646.7
18	6.0	99	6.5	75	4.8	115	5.2	73.3	4.6	97.5	6.3	52	6.3	231	6.3	66.7	6.2	74.4	6.6	91.4	6.3	77.5	6.4	86	6.3	76.7	4.8	85	4.2	126	5.1	95
19	4.9	0	5.7	0	4.1	0	4.3	0	4.1	0	5.7	0	5.4	0	5.1	0	5.0	0	5.7	0	4.9	0	5.6	0	5.9	0	3.9	0	3.5	0	4.4	0
20	4.3	0	5.3	0	3.6	0	3.7	0	3.6	0	5.1	0	5.0	0	4.4	0	4.3	0	5.0	0	4.3	0	5.0	0	5.3	0	3.5	0	3.1	0	3.7	0
21	4.1	0	4.0	0	3.2	0	3.3	0	3.4	0	4.5	0	4.9	0	3.9	0	3.5	0	4.3	0	3.7	0	4.7	0	4.9	0	3.2	0	2.8	0	3.2	0
22	3.5	0	3.4	0	2.9	0	2.8	0	3.3	0	4.0	0	4.2	0	3.1	0	2.9	0	3.6	0	3.2	0	4.3	0	4.4	0	2.7	0	2.4	0	2.6	0
23	2.7	0	3.0	0	2.6	0	2.6	0	3.1	0	3.7	0	3.8	0	2.9	0	2.5	0	3.2	0	2.8	0	4.0	0	4.1	0	2.4	0	2.2	0	2.4	0
24	2.6	0	2.8	0	2.4	0	2.4	0	2.9	0	3.4	0	3.3	0	2.5	0	2.3	0	2.9	0	2.4	0	3.6	0	4.0	0	2.2	0	2.0	0	2.2	0

	FEBRUARY																									
	DAYS																									
D	17		18		19		20		21		22		23		24		25		26		27		28		29	
H	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	2.0	0	3.0	0	3.1	0	2.4	0	2.4	0	2.1	0	2.0	0	2.1	0	3.3	0	4.0	0	3.4	0	3.6	0	2.9	0
2	1.4	0	2.8	0	3.0	0	2.2	0	2.1	0	1.9	0	1.8	0	1.9	0	3.1	0	3.7	0	3.1	0	3.1	0	2.9	0
3	0.8	0	2.6	0	2.8	0	2.0	0	2.0	0	1.6	0	1.5	0	1.8	0	2.9	0	3.4	0	2.9	0	2.7	0	2.6	0
4	0.5	0	2.3	0	2.8	0	1.9	0	1.7	0	1.5	0	1.2	0	1.7	0	2.8	0	3.0	0	2.8	0	2.5	0	2.5	0
5	0.4	0	2.2	0	2.7	0	1.4	0	1.9	0	0.9	0	1.0	0	1.7	0	2.7	0	3.0	0	2.6	0	2.4	0	2.5	0
6	0.3	0	2.3	0	2.5	0	1.0	0	1.8	0	0.8	0	0.9	0	1.5	0	2.8	0	2.6	0	2.4	0	2.4	0	2.2	0
7	0.2	0	2.4	0	2.4	0	0.9	0	1.6	0	0.6	0	0.7	0	1.5	0	2.7	0	2.5	0	2.1	0	2.6	0	2.1	0
8	1.3	158.6	3.2	144.38	3.3	196.67	2.3	150	2.5	228	2.0	105	1.7	176.3	2.5	140	3.6	150	3.6	222.5	3.2	201.7	4.0	105	3.8	200
9	3.6	744	4.6	636	5.1	804	4.8	660	4.4	833	4.2	420	3.9	420	4.4	620	5.0	768	5.3	930	5.9	946.7	6.7	624	6.5	822
10	5.2	1578	5.8	1254	6.4	1506	6.6	1387	6.0	1380	6.1	794	5.7	846	5.8	1392	7.0	1506	7.1	1824	8.0	1482	8.6	1374	8.0	1614
11	6.5	2340	6.9	1938	7.2	2112	7.7	1704	7.1	1854	7.1	1134	7.1	1242	6.6	2010	8.3	2040	8.2	2580	9.3	1950	10.0	1920	9.4	2292
12	7.5	2670	7.6	2340	8.0	2490	8.5	1788	7.6	2196	7.8	1296	8.3	1506	7.6	2274	8.7	2316	9.0	3024	10.2	2322	10.7	2556	10.4	2568
13	8.1	3132	7.9	2154	8.6	2460	9.1	1632	7.9	1938	8.2	1332	9.1	1626	7.9	2238	9.1	2292	9.9	2784	10.8	2430	11.1	2652	11.0	2838
14	8.6	2688	8.0	1926	8.8	2184	9.5	1614	8.3	1848	8.2	1253	9.7	1674	8.1	2052	9.3	1896	10.4	2466	11.7	2154	11.5	2370	12.0	2472
15	8.4	2130	8.1	1452	8.7	1950	9.2	1398	8.3	1518	7.9	1033	9.8	1350	8.2	1578	9.3	1536	10.5	1974	11.5	1596	11.6	2028	12.0	1980
16	8.0	1242	8.0	858	8.4	1182	8.6	888	8.4	804	7.5	600	9.2	810	8.1	1110	9.1	1017	10.1	1206	11.0	918	11.3	1170	12.0	1326
17	7.3	288	7.6	287.14	7.2	343.89	7.4	364	7.1	330	6.6	213.3	7.9	250	7.3	354	8.3	233.3	9.1	427	9.5	390	10.5	427.5	10.9	444
18	6.7	30	6.6	60	6.4	30	6.4	70	6.2	30	5.8	60	6.7	30	6.8	30	7.3	20	8.0	101.3	8.4	75	9.3	82.5	9.6	70
19	5.9	0	5.9	0	5.1	0	5.4	0	5.3	0	4.7	0	5.6	0	6.1	0	6.6	0	6.9	0	7.2	0	8.2	0	8.5	0
20	5.2	0	5.2	0	4.5	0	4.8	0	4.5	0	4.2	0	4.8	0	5.6	0	6.0	0	6.0	0	6.4	0	7.5	0	8.0	0
21	4.6	0	4.8	0	4.3	0	4.1	0	3.9	0	3.6	0	4.0	0	4.8	0	5.6	0	5.4	0	5.4	0	7.0	0	7.8	0
22	4.3	0	4.2	0	3.8	0	3.4	0	3.5	0	3.2	0	3.5	0	4.6	0	5.3	0	4.7	0	4.9	0	6.5	0	7.7	0
23	3.9	0	3.8	0	3.5	0	3.0	0	3.0	0	2.8	0	2.9	0	4.1	0	4.9	0	4.1	0	4.3	0	6.2	0	7.7	0
24	3.5	0	3.5	0	3.1	0	2.7	0	2.4	0	2.3	0	2.4	0	3.7	0	4.6	0	3.7	0	4.0	0	5.7	0	7.5	0

	MARCH																															
	DAYS																															
	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
D																																
H	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	6.2	0	5.6	0	6.8	0	7.2	0	6.2	0	7.4	0	5.8	0	5.9	0	5.8	0	5.0	0	5.9	0	6.3	0	6.2	0	6.1	0	6.7	0	5.9	0
2	6.0	0	5.4	0	6.7	0	6.9	0	5.9	0	6.9	0	5.5	0	5.6	0	5.4	0	4.6	0	5.6	0	5.9	0	5.8	0	5.7	0	5.9	0	5.6	0
3	5.7	0	5.1	0	6.9	0	6.3	0	5.6	0	6.5	0	5.1	0	5.4	0	5.2	0	4.0	0	5.4	0	5.9	0	5.3	0	5.2	0	5.5	0	5.4	0
4	5.3	0	4.8	0	6.6	0	6.0	0	5.1	0	6.2	0	4.8	0	5.2	0	5.0	0	3.6	0	5.1	0	5.6	0	4.9	0	5.1	0	5.2	0	5.1	0
5	5.0	0	4.6	0	6.3	0	5.8	0	4.8	0	6.2	0	4.5	0	4.9	0	4.7	0	3.1	0	4.8	0	5.5	0	4.7	0	4.8	0	4.9	0	4.8	0
6	4.6	0	4.3	0	6.3	0	5.4	0	4.6	0	6.0	0	4.2	0	4.8	0	4.6	0	2.9	0	4.6	0	5.3	0	4.3	0	4.8	0	4.6	0	4.6	0
7	4.3	112.5	4.6	99.3	6.1	50	5.4	127	4.8	78.8	5.9	99	4.2	161.4	4.8	92.9	4.7	114.3	3.0	174.4	4.5	245	5.3	103.8	4.3	301.9	5.0	138.8	4.9	158.3	4.7	195
8	5.4	586.7	6.2	672	7.1	498	6.5	642	6.4	612	7.0	639	5.8	852	6.7	696	5.8	942	4.3	1026	5.8	846	6.2	700	6.2	1110	6.5	798	5.9	672	6.0	886.7
9	8.0	1407	9.2	2022	9.0	1434	8.8	1650	10.6	1884	9.9	1614	8.7	1944	8.7	1896	9.1	2202	7.2	2208	8.3	1998	8.8	2172	9.4	2268	9.6	2142	7.8	1680	8.5	2082
10	10.0	2334	11.1	3054	10.7	2316	11.3	2778	12.9	2880	11.6	2646	10.5	2766	10.7	2898	10.7	3078	9.8	3150	10.5	2934	10.4	2976	11.3	3378	11.1	3144	9.8	3198	10.4	3324
11	11.4	3036	12.2	3600	11.7	2940	12.7	3672	14.4	3522	12.7	3360	11.5	3264	11.6	3330	11.7	3576	10.9	3768	11.6	3438	11.5	3702	12.5	3966	12.2	3804	10.5	3684	11.6	3912
12	12.3	3606	13.1	4110	12.5	3402	13.6	4092	15.2	3702	13.2	3390	12.3	3702	12.4	3696	12.3	4236	11.5	4200	12.5	3942	12.4	3876	13.4	4632	13.1	4224	11.0	3402	12.1	3996
13	13.0	3672	13.8	3822	13.1	3462	14.3	3978	15.7	3576	13.5	3462	12.8	3594	12.9	3750	13.0	4338	12.4	4032	13.1	3996	12.9	3984	14.0	4524	13.2	4032	11.2	3486	12.9	4248
14	13.5	3516	14.1	3114	13.4	3330	14.8	3912	16.0	3510	13.7	3300	13.0	2916	13.1	3294	13.3	3630	12.6	3330	13.8	3918	13.2	3618	14.5	3876	13.6	3618	11.3	3570	13.3	4218
15	13.6	3066	14.0	2760	13.3	2436	14.8	3342	16.1	2820	13.9	3108	13.1	2610	12.8	2592	13.1	3000	12.4	2904	14.0	2982	13.3	3060	14.2	2778	13.6	3096	12.1	3468	13.5	3354
16	13.2	1836	14.0	2202	12.9	1650	14.3	2400	15.6	1878	13.6	2286	12.7	1938	12.3	1767	12.3	2208	11.9	2082	13.5	2268	12.9	2178	13.7	1938	13.0	2250	12.2	2700	12.9	2412
17	12.1	768	12.8	1128	12.2	876	13.5	1110	14.4	851	12.4	1146	12.1	1008	11.6	1067	11.3	1278	11.2	1176	12.6	1212	12.3	1146	13.5	1104	12.3	1176	11.6	1590	12.3	1406
18	10.9	192	11.2	159	11.3	129	12.0	140	13.1	138	10.9	318.3	11.1	230.6	10.6	343.1	10.3	333.8	10.1	190	11.5	305	11.3	215	12.4	223.3	11.1	260.6	10.5	383.3	11.1	457.5
19	9.5	0	9.9	0	10.1	0	10.5	0	11.8	0	9.7	0	9.8	0	9.3	0	9.1	0	9.0	0	10.5	0	10.2	0	10.9	0	10.0	0	9.5	0	9.9	0
20	8.8	0	9.1	0	9.4	0	9.4	0	10.4	0	8.8	0	8.9	0	8.5	0	8.1	0	8.4	0	9.6	0	9.7	0	9.8	0	9.4	0	8.9	0	8.9	0
21	8.2	0	8.6	0	9.1	0	8.5	0	9.7	0	7.8	0	8.2	0	7.8	0	7.2	0	7.9	0	8.9	0	8.4	0	8.7	0	8.6	0	8.2	0	8.1	0
22	7.4	0	8.0	0	8.5	0	7.7	0	8.8	0	7.0	0	7.6	0	7.1	0	6.3	0	7.3	0	8.1	0	7.7	0	8.0	0	8.1	0	7.4	0	7.1	0
23	6.9	0	7.7	0	8.1	0	7.1	0	8.3	0	6.6	0	7.0	0	6.7	0	5.8	0	6.8	0	7.3	0	7.0	0	7.5	0	7.4	0	6.8	0	6.9	0
24	6.3	0	7.3	0	7.6	0	6.6	0	7.8	0	6.3	0	6.3	0	6.3	0	5.4	0	6.4	0	6.9	0	6.4	0	6.9	0	7.1	0	6.4	0	6.4	0

	MARCH																													
	DAYS																													
	17		18		19		20		21		22		23		24		25		26		27		28		29		30		31	
D																														
H	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	6.0	0	6.7	0	6.0	0	5.0	0	5.9	0	6.4	0	6.0	0	5.1	0	6.7	0	6.2	0	6.3	0	7.1	0	6.9	0	7.8	0	7.9	0
2	5.6	0	6.4	0	5.6	0	4.8	0	5.6	0	6.0	0	5.6	0	4.8	0	6.5	0	5.5	0	6.0	0	6.7	0	6.5	0	7.4	0	7.5	0
3	5.2	0	5.8	0	5.3	0	4.5	0	5.4	0	5.6	0	5.5	0	4.6	0	6.0	0	4.9	0	5.5	0	6.3	0	6.0	0	7.3	0	7.3	0
4	4.6	0	5.6	0	5.1	0	4.4	0	5.1	0	5.3	0	5.4	0	4.5	0	5.8	0	4.6	0	5.3	0	6.0	0	5.8	0	6.9	0	7.1	0
5	4.2	0	5.2	0	4.8	0	4.1	0	5.0	0	5.0	0	5.1	0	4.4	0	5.4	0	4.6	0	5.0	0	5.7	0	5.6	0	6.8	0	6.9	0
6	3.8	0	5.2	0	4.6	0	4.1	0	4.8	0	4.9	0	4.9	0	4.2	0	5.3	0	4.5	0	4.8	0	5.7	0	5.7	0	6.7	0	6.6	0
7	4.2	213.3	5.6	174.44	4.8	201.67	4.5	249	5.0	237	5.3	188.9	5.3	205	4.4	226.7	5.7	253.3	5.1	268	5.1	289	6.0	276	6.2	402	7.4	322.5	7.2	348
8	6.3	1008	6.8	786	6.2	780	6.0	882	6.8	804	6.6	804	6.8	906	5.9	954	7.0	885	6.5	1140	6.9	990	7.9	954	7.7	1338	8.9	1170	9.4	1332
9	9.3	2694	9.3	1836	7.9	1962	8.2	2154	8.7	1770	9.2	2220	8.8	2328	8.3	2208	9.1	2430	8.6	2232	9.7	2214	10.4	2154	10.1	2610	11.8	2532	11.9	2580
10	11.3	3870	11.1	3180	9.2	2994	9.6	3492	9.9	2580	10.7	3054	10.2	3348	9.9	3528	10.6	3804	10.1	3366	11.4	3378	12.5	3378	12.5	3504	13.4	3546	13.5	3456
11	12.5	4314	12.0	3660	10.2	3810	10.6	4074	10.7	3204	11.4	3756	10.8	3504	10.8	4002	11.6	4602	11.1	3960	13.0	4308	13.6	3738	13.2	3876	14.3	4050	14.7	3936
12	13.2	4806	11.7	3594	10.3	3636	11.5	4344	11.2	3552	12.4	4254	11.4	4116	11.3	3696	12.0	4548	11.8	4212	13.8	4260	14.2	4056	14.4	4398	14.9	4470	15.6	4272
13	13.7	4380	12.3	3870	10.3	3300	11.8	4332	11.3	3036	12.7	3792	11.6	3720	12.0	4218	12.5	4380	12.4	4308	14.2	4440	14.7	4140	14.7	4008	15.6	4476	16.2	4236
14	13.9	4050	12.0	3234	10.9	3282	12.1	3936	11.4	2568	12.6	3426	12.1	3450	12.1	3402	12.7	3864	12.8	3990	14.9	4116	14.8	3342	15.0	3558	15.9	3696	16.6	3804
15	14.1	3306	11.8	2748	10.9	2922	12.1	3546	11.1	2166	12.9	3174	12.2	3030	12.1	3000	12.7	3288	12.7	3330	14.6	3198	14.5	2922	15.2	3228	15.2	2832	16.6	3180
16	13.9	2346	11.5	1848	10.7	2064	12.2	2586	10.8	1740	12.5	2508	11.8	2160	11.9	2484	12.5	2238	12.7	2664	13.9	2196	14.3	2352	15.1	2598	15.1	2316	16.2	2010
17	12.7	1260	11.0	1230	9.9	1242	11.4	1566	10.5	1062	12.0	1482	11.2	1260	11.4	1380	11.9	1607	11.9	1878	13.5	1560	13.5	1392	14.4	1338	14.2	1254	15.5	1248
18	11.8	334.4	10.2	319	8.8	325.5	10.1	390	9.6	296	10.7	507	10.0	366	10.3	461.1	10.4	573.3	10.8	654	12.3	596.7	12.7	566.7	13.3	441	13.3	461	14.6	402
19	10.3	0	9.0	0	7.8	0	8.8	0	8.7	0	9.3	0	9.0	0	9.5	0	9.3	0	9.6	0	11.3	0	11.3	0	11.9	0	12.0	0	13.6	0
20	9.5	0	8.2	0	7.3	0	8.1	0	8.3	0	8.5	0	7.9	0	8.7	0	8.6	0	9.0	0	10.4	0	10.1	0	10.9	0	11.1	0	12.9	0
21	8.9	0	7.6	0	7.1	0	7.6	0	7.8	0	8.1	0	7.3	0	8.1	0	8.3	0	8.2	0	9.6	0	9.4	0	10.2	0	10.5	0	12.2	0
22	8.0	0	7.0	0	6.2	0	6.9	0	7.3	0	7.3	0	6.7	0	7.7	0	7.8	0	7.6	0	8.8	0	8.7	0	9.3	0	9.6	0	11.2	0
23	7.5	0	6.5	0	5.7	0	6.3	0	6.8	0	6.9	0	6.3	0	7.2	0	7.3	0	7.1	0	8.3	0	8.1	0	8.8	0	9.0	0	10.7	0
24	6.9	0	6.3	0	5.4	0	6.1	0	6.5	0	6.5	0	5.6	0	7.2	0	6.8	0	6.6	0	7.6	0	7.7	0	8.2	0	8.4	0	10.1	0

	APRIL																															
	DAYS																															
	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
D																																
H	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	9.5	0	10.7	0	9.7	0	8.1	0	8.1	0	8.7	0	8.2	0	8.7	0	9.9	0	9.3	0	10.0	0	10.6	0	11.2	0	12.7	0	12.0	0	11.3	0
2	9.4	0	10.3	0	9.4	0	7.8	0	7.8	0	8.1	0	8.0	0	8.4	0	9.5	0	9.0	0	9.6	0	10.4	0	10.8	0	12.1	0	11.6	0	10.9	0
3	9.1	0	9.8	0	9.2	0	7.5	0	7.7	0	7.8	0	7.8	0	7.9	0	9.2	0	8.6	0	9.1	0	10.0	0	10.5	0	11.6	0	11.3	0	10.3	0
4	9.1	0	9.3	0	8.9	0	7.3	0	7.3	0	7.6	0	7.4	0	7.7	0	8.9	0	8.2	0	8.9	0	9.9	0	10.3	0	11.3	0	11.1	0	10.1	0
5	8.8	0	9.0	0	8.6	0	7.1	0	7.0	0	7.5	90	7.2	0	7.5	0	8.7	0	7.8	0	8.6	0	9.9	0	10.1	0	11.0	0	10.8	0	9.7	0
6	8.6	15	8.8	20	8.5	90	7.1	70	6.9	116	7.3	150	7.0	48.75	7.6	56.25	8.5	73.33	8.1	95.83	8.5	76	9.9	52.5	10.1	70	10.9	126.7	10.6	80	9.7	86.43
7	9.0	290	9.0	288	8.8	180	7.7	404	7.9	366	7.9	450	8.0	522	8.2	390	9.3	435	9.0	678	9.7	732	10.5	609	11.3	492	11.7	502.5	11.9	576	10.9	696
8	10.9	1080	9.9	864	9.7	666	9.0	1434	9.6	1098	10.3	1362	9.7	1518	10.4	1350	11.0	1374	11.1	1872	12.3	1938	13.1	1626	13.9	1590	14.2	1692	13.9	1656	13.2	1878
9	12.8	2454	11.6	1842	10.9	1782	11.3	2826	12.0	2496	12.8	2874	11.9	2556	13.1	2700	13.3	2766	13.8	3522	15.1	3618	15.8	3138	16.1	2586	17.5	3102	15.7	2946	15.3	3204
10	14.3	3222	12.6	2586	11.7	2646	13.0	3846	13.1	3120	14.5	3792	13.4	3558	14.6	3516	14.4	3534	15.7	4644	17.0	4542	17.7	4200	18.3	3756	19.0	3828	16.9	3990	16.2	3840
11	15.3	4086	13.3	2790	12.9	3504	13.9	4350	13.9	3510	15.3	4332	14.3	4194	15.7	4284	15.4	4044	16.8	5232	18.6	5226	19.0	4926	19.5	4404	20.2	4788	17.5	4146	17.3	4584
12	15.9	4356	13.6	2892	13.8	3768	14.4	4566	14.7	4200	15.5	4200	14.3	3930	16.3	4398	16.1	4296	17.9	5544	19.1	5418	19.6	5070	20.3	4650	20.8	4926	18.0	4860	17.8	4668
13	16.2	4056	13.9	3012	14.7	4242	14.6	4092	15.6	4284	16.1	4152	15.7	3942	16.7	4224	17.1	4884	18.7	5568	19.6	5226	20.2	5124	20.6	4626	21.1	4680	18.8	4272	18.1	4194
14	16.5	3528	14.1	2712	15.2	3960	14.7	3378	16.2	4392	16.1	3828	16.3	3942	17.0	3990	17.7	4518	19.3	5106	19.7	4506	20.5	4608	21.3	4470	21.3	4092	18.7	3876	18.5	4128
15	16.0	2736	13.9	1998	15.3	3486	14.5	3000	15.8	3246	16.2	3372	16.3	3318	16.7	3444	17.6	3840	19.2	4296	19.5	3558	20.2	3858	21.6	3888	21.2	3564	18.4	3330	18.3	3702
16	15.8	2148	13.6	1350	15.1	2646	14.2	2250	15.8	2526	15.9	2628	15.9	2412	17.0	2808	17.7	3306	18.9	3228	19.3	3048	19.8	2880	21.3	2904	20.6	2718	18.4	2634	17.9	2556
17	15.4	1350	12.7	793.33	14.4	1746	13.5	1284	15.1	1818	15.7	2107	15.2	1867	16.3	1830	17.0	2190	18.1	1878	18.8	1770	19.2	1908	20.6	1872	19.9	1722	17.6	1650	17.2	1380
18	14.4	484.5	12.1	385.71	13.0	646.67	12.2	547	14.2	594	14.2	701.1	13.8	553.3	15.0	594	15.5	816	16.7	690	17.5	546	17.8	690	19.3	774	18.5	636	16.1	786	16.4	648
19	13.3	120	11.6	50	11.8	29	11.0	60	12.9	60	13.0	76.67	12.6	45	13.6	55	14.1	110	15.0	33.33	15.5	110	16.2	72.5	17.7	140	17.0	61.67	14.9	185	15.2	35.63
20	12.8	0	11.1	0	10.8	0	10.3	0	12.1	0	12.1	0	11.8	0	12.8	0	12.8	0	13.7	0	14.3	0	14.8	0	16.7	0	15.7	0	14.1	0	14.4	0
21	12.2	0	11.2	0	10.1	0	9.6	0	11.3	0	11.4	0	10.9	0	11.7	0	12.1	0	12.7	0	13.2	0	14.1	0	15.8	0	14.9	0	13.4	0	13.5	0
22	11.6	0	10.8	0	9.3	0	9.1	0	10.5	0	10.3	0	10.1	0	11.3	0	11.0	0	11.9	0	12.1	0	12.9	0	15.1	0	14.1	0	12.9	0	12.8	0
23	11.6	0	10.5	0	8.7	0	8.7	0	10.0	0	9.3	0	9.6	0	10.7	0	10.4	0	11.2	0	11.5	0	12.5	0	14.1	0	13.2	0	12.5	0	12.2	0
24	11.0	0	10.1	0	8.3	0	8.5	0	9.3	0	8.7	0	9.1	0	10.2	0	9.7	0	10.7	0	11.0	0	12.0	0	13.4	0	12.5	0	12.1	0	11.8	0

	APRIL																											
	DAYS																											
D	17		18		19		20		21		22		23		24		25		26		27		28		29		30	
H	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	11.3	0	12.0	0	12.3	0	11.2	0	10.5	0	10.9	0	11.1	0	11.8	0	11.4	0	11.1	0	11.1	0	10.7	0	11.5	0	11.2	0
2	10.7	0	11.6	0	12.0	0	10.8	0	9.8	0	10.5	0	10.8	0	11.3	0	10.9	0	10.7	0	10.8	0	10.6	0	11.2	0	10.7	0
3	10.3	0	11.3	0	11.5	0	10.4	0	9.4	0	10.5	0	10.4	0	11.1	0	10.4	0	10.2	0	10.5	0	10.2	0	10.8	0	10.2	0
4	10.0	0	10.7	0	11.1	0	10.0	0	9.2	0	10.4	0	10.2	0	10.7	0	10.3	0	9.9	0	10.1	0	9.8	0	10.5	0	9.8	0
5	10.0	0	10.6	0	10.9	0	9.7	0	9.0	0	10.2	0	10.0	0	10.6	0	10.0	0	9.5	0	9.8	0	9.6	0	10.2	0	9.9	0
6	10.1	78	10.6	73.33	10.8	90	9.8	96.3	9.1	78.6	10.3	91.25	10.0	154.3	10.5	106.9	10.1	147.8	9.5	127.8	10.1	254.5	9.7	165	10.4	205	10.2	
7	11.1	582	11.7	450	11.7	504	10.6	606	10.4	600	11.1	498	11.0	498	11.4	654	11.1	648	10.7	852	11.1	696	11.4	1224	11.8	744	12.0	1056
8	13.8	1842	13.6	1566	13.6	1668	12.3	1788	13.1	1830	13.0	1896	12.6	1644	12.6	1356	12.8	1842	12.9	2130	13.2	2268	14.0	2562	14.3	2310	14.5	2352
9	16.0	3312	16.1	2796	16.0	3072	14.2	2904	15.3	3252	14.9	3024	14.8	2838	14.5	2286	15.6	3120	15.4	3318	16.1	3888	16.7	3750	17.1	3654	17.2	3696
10	17.3	4464	17.3	3324	17.3	3846	15.3	3522	16.8	4008	16.2	3672	15.8	3276	15.6	3204	16.6	3636	17.4	4200	17.8	4746	17.9	4584	18.4	4332	18.9	4668
11	19.0	5094	18.0	4134	18.0	4752	16.3	4290	17.8	4464	16.5	3714	16.6	3816	16.7	3852	17.6	4080	18.4	5058	18.5	5160	19.0	5166	19.7	5412	19.8	5220
12	19.3	4824	18.7	4428	19.1	4776	16.6	4740	18.0	4176	17.1	3780	17.8	4572	17.2	4014	18.0	4146	18.9	5166	19.3	5502	19.3	5022	20.3	5352	20.3	5562
13	19.4	4410	19.0	3672	19.7	4932	17.4	4452	18.1	3714	18.1	3822	18.3	4512	17.6	3588	18.3	4050	19.3	4794	19.9	5184	20.0	4956	20.4	5130	21.0	5208
14	19.7	4644	19.1	3288	20.2	4320	17.6	4464	18.1	3408	18.3	3822	18.5	3966	17.8	3306	18.7	4068	19.2	4224	20.3	4824	20.2	4596	20.5	4560	21.6	4620
15	19.8	3792	19.0	2964	20.1	3594	18.0	3780	17.2	2556	18.3	3144	18.3	3114	17.6	2802	18.4	3270	19.6	3714	20.4	3714	20.2	4026	19.5	3696	21.6	3870
16	19.6	2838	18.8	2394	19.8	2784	18.3	3120	17.2	2496	18.2	2394	18.2	2310	17.5	2412	18.4	2598	19.2	2886	20.2	2880	19.9	2964	19.3	2622	21.4	3060
17	19.0	1956	18.3	1464	18.4	1956	17.3	1926	16.9	1602	17.4	1380	17.7	1614	16.9	1638	18.3	1932	18.5	1980	19.3	1902	19.0	2267	18.4	1806	20.8	2310
18	17.6	912	17.5	570	16.9	876	16.1	648	15.8	513	16.3	516	16.7	819	15.8	588	17.1	926.7	17.3	860	17.9	840	17.7	860	17.4	768	19.3	930
19	16.2	102.5	16.4	58	15.5	115.71	14.8	54.3	14.3	60	14.9	85.71	15.6	91.88	14.7	88.13	15.7	165	15.5	68.75	16.5	129.3	16.2	88	16.6	108.89	17.6	96.5
20	15.2	0	15.6	0	14.6	0	13.8	0	13.5	0	14.6	0	14.7	0	13.9	0	14.5	0	14.4	0	15.4	0	14.8	0	15.3	0	16.3	0
21	14.5	0	14.8	0	13.6	0	13.2	0	13.0	0	13.4	0	13.9	0	13.2	0	13.7	0	13.6	0	14.5	0	14.1	0	14.3	0	15.2	0
22	13.7	0	14.1	0	12.9	0	12.3	0	12.3	0	12.7	0	12.9	0	12.6	0	12.8	0	12.8	0	13.3	0	13.2	0	13.3	0	14.3	0
23	13.2	0	13.6	0	12.4	0	11.7	0	11.7	0	12.2	0	12.5	0	12.2	0	12.1	0	12.1	0	12.5	0	12.6	0	12.6	0	13.6	0
24	12.5	0	12.9	0	11.7	0	11.2	0	11.2	0	11.8	0	12.2	0	11.9	0	11.5	0	11.6	0	11.7	0	12.1	0	11.8	0	13.2	0

D	MAY																															
	DAYS																															
	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
H	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	13.0	0	13.1	0	12.0	0	12.3	0	13.0	0	14.3	0	14.4	0	14.2	0	13.0	0	14.3	0	14.4	0	14.2	0	15.3	0	15.8	0	15.4	0	14.5	0
2	12.6	0	12.8	0	12.0	0	11.7	0	12.5	0	13.9	0	13.9	0	13.7	0	12.6	0	13.8	0	13.9	0	13.8	0	14.9	0	15.5	0	14.9	0	14.0	0
3	12.2	0	12.4	0	11.7	0	11.2	0	12.4	0	13.3	0	13.4	0	13.1	0	12.3	0	13.5	0	13.6	0	13.3	0	14.4	0	15.1	0	14.5	0	13.7	0
4	11.9	0	12.1	0	11.7	0	11.0	0	12.2	0	12.8	0	12.9	0	13.0	0	11.9	0	13.1	0	13.3	0	13.3	0	14.1	0	15.0	0	14.2	0	13.4	0
5	11.7	0	11.6	0	11.3	0	11.0	0	12.0	0	12.3	0	12.6	0	12.7	0	11.6	0	12.8	0	13.0	90	12.9	0	13.8	0	14.7	15	13.9	20	13.2	15
6	11.9	192	11.7	132	11.6	185.6	11.1	213	12.2	223	12.8	282.2	12.9	224	13.1	224	12.0	304.4	13.3	313.3	13.3	309.5	13.2	214	14.4	242.5	15.0	235	14.1	255	13.5	306
7	13.3	1032	13.3	822	13.3	942	12.3	1026	13.8	1122	14.4	1040	14.4	1050	14.3	960	13.7	1287	15.1	1140	15.2	1014	14.9	894	16.0	978	16.2	798	15.8	930	15.3	1068
8	15.3	2508	15.0	1902	15.3	2400	13.8	2280	16.0	2472	16.3	2148	16.7	2388	16.1	2160	16.1	2706	17.1	2544	17.8	2526	17.6	2310	18.2	2082	18.0	1932	17.6	2370	17.8	2490
9	18.1	4068	17.4	3204	17.6	3738	16.2	3450	18.9	3912	19.0	3348	19.7	4008	18.3	3366	19.3	3930	20.4	4008	21.1	3936	21.4	3978	21.5	3480	20.4	3582	20.6	3846	20.6	4014
10	19.3	4800	18.7	3846	18.9	4308	17.5	4068	20.6	4974	20.6	4374	21.2	4932	19.7	4026	20.7	4680	22.1	4830	22.7	4866	23.1	4848	22.7	4302	21.8	4518	21.9	4704	21.9	4884
11	20.2	5286	19.6	4458	19.8	4920	18.7	5046	21.7	5508	21.5	5106	22.1	5328	20.8	4422	21.6	5190	23.1	5436	23.8	5388	24.2	5628	23.4	4926	22.7	4860	22.9	5256	22.8	5460
12	20.7	4878	20.0	4374	20.4	4926	19.6	5328	22.5	5718	22.5	5238	22.8	5862	21.5	4602	22.2	5478	23.5	5718	24.5	5772	24.7	5604	24.2	4950	23.1	5196	23.5	5640	23.6	5730
13	21.1	5178	20.3	3924	20.6	4620	19.8	5448	23.0	5226	23.2	5232	23.5	5592	21.6	4596	23.0	5628	24.1	5508	24.7	5472	25.2	5598	24.8	5172	23.9	5184	23.4	5160	24.1	5166
14	21.6	4236	20.0	3876	20.5	3864	20.0	4332	23.2	4776	23.7	4488	23.7	4782	22.0	4206	23.5	5046	24.5	4824	24.7	4584	25.0	4728	25.0	4668	24.4	4218	24.0	4416	25.0	4362
15	21.8	4290	19.5	3198	20.7	3270	20.4	3822	23.6	4338	23.6	3966	23.4	4074	22.1	3762	23.5	4068	24.7	4086	24.8	3810	23.7	3630	25.5	4134	24.6	3840	22.7	3252	24.7	3702
16	21.8	3234	19.9	2340	20.4	2520	20.2	2934	23.6	3570	23.6	3180	22.9	3372	21.8	3048	23.5	3612	24.8	3186	24.6	3114	24.1	2796	25.4	3330	24.1	3018	22.6	2622	24.1	2845
17	21.2	1938	19.1	1836	19.7	1752	19.7	1662	22.8	2442	23.0	2016	22.3	2190	20.9	1890	22.5	2442	24.2	2238	24.1	2376	23.7	2202	24.2	2322	23.4	2160	21.7	2104	22.9	2186.7
18	19.6	948	17.8	776	18.5	876	18.5	666	21.7	1164	21.8	954	20.8	954	19.5	936	20.8	1176	22.6	972	22.8	1098	22.7	1164	22.7	1002	22.1	948	20.6	1033	21.6	1000
19	18.2	150	16.6	165	17.0	133.9	17.3	124	19.5	196	20.3	174.4	19.2	178.3	18.0	145	19.4	502.5	20.9	220	20.9	193.3	21.0	189.4	21.1	195.63	20.2	198.8	19.2	153.8	20.4	183.8
20	17.0	0	15.2	0	15.8	0	16.0	0	17.9	0	18.6	0	18.1	0	16.7	0	18.0	150	18.9	0	19.2	0	19.5	0	19.6	0	18.9	0	18.1	0	19.1	0
21	16.0	0	14.2	0	14.9	0	15.0	0	16.7	0	17.6	0	17.0	0	15.8	0	16.8	0	17.7	0	17.7	0	18.1	0	18.4	0	17.6	0	17.4	0	17.9	0
22	14.9	0	13.6	0	14.1	0	14.3	0	15.8	0	16.5	0	16.0	0	14.6	0	15.9	0	16.5	0	16.6	0	17.1	0	17.5	0	16.8	0	16.6	0	17.0	0
23	14.4	0	13.0	0	13.7	0	13.9	0	15.1	0	15.7	0	15.4	0	13.8	0	15.1	0	15.6	0	15.7	0	16.4	0	16.8	0	16.2	0	15.6	0	16.4	0
24	13.8	0	12.5	0	13.0	0	13.6	0	14.7	0	15.0	0	14.7	0	13.3	0	14.6	0	14.9	0	15.0	0	15.8	0	16.5	0	15.7	0	14.9	0	15.8	0

	MAY																													
	DAYS																													
	17		18		19		20		21		22		23		24		25		26		27		28		29		30		31	
D	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	15.2	0	15.0	0	15.2	0	15.3	0	16.3	0	16.6	0	16.8	0	16.9	0	16.9	0	16.0	0	17.0	0	17.3	0	17.4	0	17.7	0	16.8	0
2	14.7	0	14.4	0	14.9	0	14.7	0	15.7	0	16.2	0	16.4	0	16.3	0	16.3	0	15.5	0	16.5	0	16.9	0	17.3	0	17.3	0	16.4	0
3	14.3	0	13.8	0	14.6	0	14.4	0	15.3	0	15.7	0	15.9	0	15.8	0	16.0	0	15.0	0	16.1	0	16.3	0	16.7	0	16.6	0	15.9	0
4	14.0	0	13.4	0	14.5	0	14.0	0	15.1	0	15.3	0	15.7	0	15.4	0	15.4	0	14.6	0	15.8	0	16.0	0	16.5	0	16.2	0	15.6	0
5	13.6	30	13.2	15	14.4	22.5	13.7	17.5	14.8	15	14.7	60	15.6	105	15.1	35	15.1	22.5	14.5	82.5	15.3	90	15.6	60	16.4	46.7	15.7	75	15.2	61.25
6	13.9	213	13.6	286.5	14.8	328.5	14.0	278	14.9	354	15.2	324	16.0	427.5	15.5	393.3	15.5	363	15.0	444	15.7	456	16.1	388.5	16.8	504	16.1	402	15.7	529.5
7	15.4	714	15.4	1152	16.6	1230	15.8	1158	16.7	1260	17.1	1050	17.8	1218	17.5	1080	17.6	1380	17.0	1344	18.0	1428	18.1	1332	18.4	1434	17.9	1194	17.5	1464
8	17.8	1974	17.7	2412	18.7	2790	17.9	2544	18.7	2400	19.8	2358	20.6	2418	20.6	2274	20.1	2856	20.0	2466	20.3	2532	20.4	2550	20.6	2820	20.1	2508	19.7	2892
9	20.6	3510	20.1	4092	20.9	4326	20.1	4038	20.7	3990	22.5	4020	23.3	3954	23.2	4110	22.9	4398	22.7	4068	23.3	3900	22.9	4170	23.1	4374	22.9	4194	22.2	4242
10	22.2	4146	21.4	4818	22.6	5364	22.1	5226	22.5	4842	24.3	4896	25.1	5136	24.6	5028	24.7	5400	24.3	5088	24.6	4776	24.4	5124	24.6	5424	24.4	5100	23.7	4866
11	22.8	4452	22.1	5202	23.8	5910	22.9	5196	23.7	5598	25.6	5694	26.2	5904	25.5	5694	25.5	5934	25.4	5298	25.8	5220	25.5	5730	25.7	5748	25.4	5670	24.7	5304
12	23.2	4368	22.8	5418	24.5	5946	23.5	5178	24.6	5850	25.9	5784	26.9	5820	26.4	6162	26.2	5910	26.0	5658	26.5	5520	26.1	5682	26.6	6018	25.9	5658	25.1	5328
13	23.8	4572	23.7	5676	25.3	5610	23.9	5040	25.2	5580	26.2	5166	27.4	5400	27.0	5916	26.8	5790	26.4	5310	27.0	5022	27.0	5430	27.5	5964	26.5	5388	25.4	5220
14	23.9	3936	24.3	4746	25.7	5232	24.0	4830	25.7	4980	26.6	4734	27.7	4962	27.3	5148	27.2	5160	27.1	4854	27.6	4854	26.8	4896	27.8	5322	26.8	4896	25.9	4842
15	23.8	3930	24.1	3804	25.8	4440	24.5	3996	25.9	4290	26.7	4224	27.6	4362	27.3	4578	27.5	4482	26.8	3906	27.8	4140	27.3	4386	27.9	4818	26.7	4296	26.2	4464
16	23.8	3180	24.0	3180	25.7	3432	24.4	3402	25.6	3366	26.7	3396	27.3	3606	27.1	3774	27.1	3558	26.9	3114	27.1	3102	27.1	3414	27.4	3894	26.5	3720	25.8	3594
17	23.0	1896	23.0	2232	25.1	2310	23.8	2286	24.9	2364	25.7	2439	26.3	2436	26.4	2652	26.4	2598	25.5	2082	26.3	2196	26.3	2448	26.7	2820	25.6	2556	24.9	2490
18	20.9	981	21.8	978	23.3	1332	22.6	1350	23.8	1020	24.2	1200	24.2	1146	24.9	1470	24.7	1362	24.3	1248	25.2	1212	24.8	1410	24.7	1458	24.5	1218	23.3	1362
19	19.2	300	20.0	195	21.6	285	21.2	351	22.4	203	22.5	213.8	22.6	268.3	23.0	363.3	22.9	325.5	22.1	297	23.6	323.3	23.1	291	23.3	333.33	22.8	283.1	21.8	420
20	18.1	0	18.7	0	19.7	0	19.9	0	20.8	0	21.1	0	21.2	0	21.6	0	21.2	0	21.0	60	22.0	52.5	21.2	0	21.9	0	21.2	0	20.6	120
21	17.4	0	17.9	0	18.3	0	18.6	0	19.6	0	20.3	0	20.1	0	20.0	0	19.7	0	19.9	0	20.8	0	20.2	0	20.7	0	20.2	0	19.5	0
22	16.6	0	16.5	0	17.6	0	17.8	0	18.6	0	18.6	0	19.1	0	19.1	0	18.6	0	18.7	0	19.7	0	19.4	0	19.7	0	19.2	0	18.5	0
23	16.1	0	15.9	0	16.8	0	17.5	0	17.8	0	17.9	0	18.4	0	18.3	0	17.6	0	18.0	0	18.9	0	18.9	0	18.8	0	18.3	0	17.8	0
24	15.6	0	15.8	0	15.9	0	17.0	0	17.0	0	17.4	0	17.6	0	17.4	0	16.7	0	17.5	0	18.1	0	18.4	0	18.2	0	17.6	0	17.4	0

	JUNE																															
	DAYS																															
	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
D																																
H	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I		
1	16.5	0	17.6	0	18.0	0	17.9	0	19.0	0	18.9	0	18.7	0	19.0	0	20.0	0	19.4	0	19.4	0	19.1	0	19.9	0	20.6	0	21.1	0	20.8	0
2	16.0	0	17.2	0	17.6	0	17.8	0	18.4	0	18.3	0	18.1	0	18.6	0	19.6	0	18.7	0	18.5	0	18.9	0	19.5	0	20.4	0	20.7	0	20.7	0
3	15.6	0	16.8	0	17.3	0	17.4	0	18.0	0	17.8	0	18.0	0	18.2	0	19.3	0	18.5	0	18.1	0	18.7	0	19.0	0	20.0	0	20.3	0	20.2	0
4	15.4	0	16.4	0	16.8	0	17.2	0	17.5	0	17.4	0	17.4	0	17.7	0	18.7	0	18.1	0	17.7	0	18.3	0	18.8	0	19.8	0	19.8	0	19.6	0
5	15.1	50	16.0	86.67	16.5	30	17.0	45	17.1	53.3	17.1	90	16.4	0	17.6	116.7	18.1	40	17.6	36.25	17.6	135	18.1	30	18.5	45	19.6	105	19.5	60	19.3	0
6	15.6	458	16.4	552	16.9	364.5	17.5	468	17.5	504	17.5	516	16.8	504	17.7	534	18.5	438	17.8	591	18.0	576	18.2	441	19.4	435	20.2	516	19.8	434	19.7	420
7	17.4	1332	18.0	1680	18.6	1296	18.7	1536	19.2	1512	19.1	1638	18.9	1542	19.9	1440	20.7	1446	19.8	1782	19.7	1650	20.1	1506	21.1	1356	22.1	1602	21.6	1626	21.8	1548
8	19.7	2802	20.3	3036	20.8	2322	21.5	2952	21.5	2736	22.1	3030	22.1	2880	22.0	2886	22.4	2838	22.3	3204	22.2	3012	22.4	2892	23.6	2670	24.4	3036	24.4	3018	24.1	2760
9	22.6	4278	23.7	4470	24.1	4002	24.6	4248	24.0	4164	24.6	4446	24.7	4446	24.7	4458	25.1	4158	25.2	4596	25.2	4356	24.9	4242	26.3	4128	27.8	4410	27.1	4308	27.2	4338
10	23.9	5106	25.2	5292	25.6	5184	26.0	5178	25.9	5358	26.2	5334	26.1	5328	26.6	5424	26.9	5088	27.0	5334	26.7	5340	26.6	5184	27.7	5250	29.1	5142	28.6	5262	28.7	5238
11	25.0	5460	26.2	5610	26.5	5574	27.2	5610	27.0	5868	27.3	5904	26.9	5736	27.9	5922	28.2	5718	28.2	5874	27.7	5814	27.7	5634	28.9	5850	29.9	5640	29.8	5838	30.1	5730
12	25.4	5430	26.9	5850	27.1	5538	27.8	5496	27.7	5958	27.9	6012	27.6	5844	29.1	5958	28.9	5952	29.0	6222	28.6	6000	28.4	5730	29.5	5898	30.5	5586	30.4	5772	30.6	6066
13	26.3	5298	27.6	5586	27.9	5652	28.5	5472	28.0	5700	28.1	5742	28.2	5706	29.5	5904	29.5	5892	29.7	5958	29.2	5910	29.2	5772	30.2	5502	31.1	5700	30.7	5388	31.5	6018
14	26.6	4908	28.1	5544	28.1	5328	28.9	5370	28.9	5316	28.6	5574	28.9	5340	29.8	5232	29.7	5160	30.1	5346	29.5	5448	29.5	5268	30.6	5088	31.3	5238	31.0	4788	32.1	5580
15	26.9	4446	28.0	4716	27.7	4002	28.8	4638	28.7	4752	28.9	5028	29.0	4614	29.7	4320	29.9	4566	30.3	4740	29.7	4638	29.6	4830	30.5	4464	31.5	4506	31.4	4458	32.1	4728
16	26.4	3348	27.8	3876	27.4	3162	28.6	3540	28.4	3834	28.9	3900	28.9	3624	29.5	3726	29.7	3756	30.1	3852	29.4	3648	28.6	3600	30.6	3738	30.9	3414	31.4	3594	31.9	3930
17	25.4	2466	26.7	2682	26.1	2052	27.6	2514	27.2	2586	28.0	2856	28.1	2610	28.7	2802	29.0	2844	28.9	2868	28.0	2802	27.7	2580	29.6	2796	29.4	2376	30.0	2628	30.7	2736
18	24.1	1188	25.1	1470	24.6	1460	26.4	1344	25.9	1452	26.6	1506	26.8	1338	27.5	1530	27.7	1560	27.3	1680	27.0	1548	26.3	1368	28.3	1494	28.6	1464	29.1	1548	29.3	1464
19	22.5	279	23.9	486	23.1	376.67	23.7	440	24.3	348	24.8	363	25.0	352.5	25.7	465	26.1	330	26.2	507	25.3	466.7	24.4	343.3	26.9	354	26.9	486	27.3	426	27.8	399
20	21.2	10	22.6	0	21.8	60	22.3	0	22.7	30	23.0	0	23.0	10	24.0	55	24.5	40	24.1	45	23.4	15	23.2	45	25.1	60	25.5	200	25.4	20	26.1	30
21	20.2	0	21.3	0	20.5	0	21.4	0	21.5	0	21.8	0	22.2	0	22.5	0	22.9	0	22.6	0	22.1	0	22.1	0	23.7	0	24.3	0	24.0	0	25.0	0
22	19.3	0	20.2	0	19.8	0	20.6	0	20.5	0	20.9	0	21.3	0	21.4	0	21.9	0	21.5	0	21.0	0	21.3	0	22.9	0	23.1	0	23.0	0	24.1	0
23	18.7	0	19.3	0	19.0	0	20.0	0	19.9	0	20.1	0	20.6	0	20.8	0	21.0	0	20.8	0	20.5	0	20.7	0	22.1	0	22.3	0	22.0	0	23.3	0
24	18.1	0	18.6	0	18.4	0	19.8	0	19.5	0	19.2	0	19.7	0	20.3	0	20.0	0	20.1	0	19.8	0	20.4	0	21.4	0	21.7	0	21.4	0	22.6	0

	JUNE																											
	DAYS																											
D	17		18		19		20		21		22		23		24		25		26		27		28		29		30	
H	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	21.9	0	21.8	0	22.6	0	21.4	0	21.6	0	21.2	0	21.9	0	21.8	0	22.2	0	22.5	0	22.6	0	23.5	0	22.7	0	22.6	0
2	21.4	0	21.5	0	22.2	0	21.2	0	21.1	0	20.9	0	21.5	0	21.2	0	22.0	0	22.3	0	22.3	0	23.0	0	22.2	0	22.0	0
3	20.9	0	21.3	0	21.6	0	20.7	0	20.7	0	20.4	0	21.2	0	20.8	0	21.5	0	22.0	0	22.2	0	22.9	0	21.9	0	21.3	0
4	20.8	0	20.8	0	21.1	0	20.3	0	20.3	0	20.1	0	20.7	0	20.6	0	21.0	0	21.6	0	21.9	0	23.1	0	21.7	0	21.0	0
5	20.5	90	20.6	60	20.7	0	19.5	22.5	19.7	120	19.8	30	20.4	120	20.2	172.5	20.5	0	21.3	30	21.6	22.5	22.3	30	21.2	20	20.5	120
6	20.9	486	21.2	516	20.8	414	20.1	584	20.1	546	20.2	414	20.8	468	20.6	606	20.9	477	21.8	522	21.9	384	22.7	543	21.5	429	21.0	585
7	22.4	1596	23.1	1602	22.3	1260	22.1	1734	22.0	1698	22.6	1404	22.3	1530	22.3	1884	22.7	1332	23.3	1632	23.5	1374	24.1	1608	22.9	1440	22.8	1782
8	24.7	2940	25.2	2928	24.5	2484	24.5	3138	24.1	3060	25.0	2736	24.6	2904	24.3	3246	25.1	2322	25.5	2928	25.7	2616	26.0	2736	25.3	2718	25.4	3216
9	27.6	4230	27.8	4362	27.2	4356	26.9	4296	26.8	4398	27.6	4290	26.8	4212	27.4	4518	27.7	3930	28.5	4254	28.4	4152	28.5	4122	27.9	4182	28.0	4512
10	29.7	5178	29.5	5196	29.6	5352	29.1	5202	28.5	5274	29.2	5340	28.7	5082	29.1	5322	29.9	5280	30.1	4950	30.0	5166	30.0	5184	29.6	5304	29.6	5370
11	30.7	5808	30.5	5808	30.8	5934	30.2	5802	29.9	5958	30.4	5958	30.0	5694	30.3	5976	31.3	5634	30.3	5484	31.2	5694	31.0	5772	30.7	5976	30.9	5886
12	31.3	6018	31.7	6126	31.7	6000	30.9	6048	30.8	6282	31.0	6144	30.7	5838	31.1	6252	31.9	6072	32.1	5862	31.9	5982	31.7	5940	31.5	6258	31.6	6270
13	31.9	6006	32.2	6102	32.4	6072	31.6	6042	31.4	6288	31.8	6144	31.6	5802	31.8	6066	32.5	5910	32.7	5796	32.8	5916	32.5	5982	32.3	6012	32.6	6144
14	32.3	5556	32.5	5580	32.5	5760	31.9	5436	31.9	5754	32.1	5700	31.9	5214	32.3	5598	33.1	5658	33.0	5538	33.0	5010	32.9	5130	32.7	5478	33.2	5274
15	32.4	4938	32.7	5010	32.6	5124	31.7	4686	32.1	5004	32.0	4926	32.1	5070	32.5	4800	33.3	4794	32.9	4380	33.1	4344	32.8	4542	32.6	4554	33.5	4644
16	32.3	4116	32.7	4026	32.3	4086	31.1	3906	31.8	3864	31.8	4092	32.1	4314	32.5	4074	32.8	3816	32.7	3702	32.7	3570	32.6	3756	32.5	3960	33.2	3828
17	31.1	3042	31.9	2880	31.1	2976	30.0	2802	30.6	2850	30.4	2778	30.9	3222	31.7	2946	31.9	2970	31.3	2790	31.9	2676	31.6	2718	31.8	3006	32.3	2748
18	29.8	1812	30.5	1614	29.8	1638	28.7	1644	29.3	1722	29.0	1548	29.6	1902	30.4	1644	30.6	1572	30.0	1848	30.3	1530	30.0	1704	30.2	1698	30.3	1710
19	27.9	582	28.5	427.5	28.0	580	26.9	525	27.6	653	27.2	513.3	27.6	654	28.7	504	28.9	432	28.2	693	28.6	468	28.4	513	28.3	558	28.8	555
20	26.9	0	26.8	90	26.4	150	25.4	0	26.0	150	25.6	60	26.0	135	26.8	90	27.1	15	26.7	95	27.1	105	26.7	0	26.7	105	27.2	90
21	25.1	0	25.7	0	25.1	0	24.1	0	24.7	0	24.4	0	24.9	0	25.3	0	25.5	0	25.2	0	25.9	0	26.1	0	25.7	0	25.7	0
22	24.2	0	24.8	0	23.9	0	23.5	0	23.5	0	23.5	0	23.9	0	24.4	0	24.5	0	24.5	0	24.8	0	24.8	0	24.5	0	25.0	0
23	23.3	0	24.1	0	22.7	0	22.9	0	22.7	0	22.8	0	23.0	0	23.5	0	23.8	0	23.7	0	24.1	0	23.9	0	23.8	0	24.4	0
24	22.6	0	23.3	0	22.1	0	22.1	0	21.9	0	22.2	0	22.3	0	22.8	0	23.1	0	23.1	0	23.7	0	23.4	0	23.3	0	23.7	0

	JULY																															
	DAYS																															
	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
D																																
H	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	23.2	0	23.9	0	24.0	0	24.3	0	24.5	0	24.6	0	24.0	0	24.7	0	24.7	0	23.8	0	24.1	0	24.6	0	24.6	0	24.7	0	24.6	0	23.4	0
2	23.3	0	23.6	0	23.5	0	23.9	0	24.1	0	24.2	0	23.8	0	24.3	0	24.0	0	23.7	0	23.6	0	24.3	0	24.4	0	24.3	0	24.3	0	23.2	0
3	22.6	0	23.2	0	23.0	0	23.6	0	23.8	0	23.8	0	23.4	0	23.9	0	23.6	0	23.4	0	23.5	0	24.0	0	24.0	0	24.0	0	23.9	0	22.9	0
4	22.4	0	22.9	0	22.7	0	23.4	0	23.5	0	23.5	0	23.0	0	23.3	0	23.2	0	23.1	0	23.3	0	23.9	0	23.6	0	23.6	0	23.8	0	22.5	0
5	22.1	25	22.6	67.5	22.4	0	23.0	67.5	22.9	30	23.0	67.5	22.5	30	23.1	90	22.7	30	22.5	105	23.1	15	23.7	120	23.3	0	23.3	30	23.4	90	21.9	0
6	22.6	453	22.6	570	23.0	420	23.2	492	23.0	444	23.2	486	22.7	528	23.3	465	22.7	528	22.7	543	23.5	558	23.7	522	23.4	408	23.6	438	23.6	431	22.2	381
7	24.2	1572	24.0	1698	24.5	1476	24.5	1716	24.1	1524	24.8	1554	24.5	1608	24.5	1530	24.2	1584	24.1	1698	24.8	1710	24.9	1662	24.8	1266	24.9	1530	25.1	1428	23.9	1458
8	26.6	3078	26.4	3048	26.9	2880	26.7	3072	26.1	2970	26.9	2832	26.7	2958	26.7	2874	26.3	2820	26.3	3066	27.0	3060	26.6	3042	27.5	2652	27.2	2868	27.0	2700	26.2	2826
9	29.4	4578	29.0	4326	29.5	4302	29.1	4476	28.9	4362	29.3	4374	29.3	4356	29.0	4266	29.0	4146	29.0	4476	29.9	4362	29.3	4338	30.6	4224	30.0	4296	29.7	4080	28.9	4236
10	31.1	5442	30.9	5328	31.5	5238	30.8	5370	30.6	5226	31.0	5184	31.3	5256	31.2	5196	30.7	5094	30.6	5364	31.5	5298	31.4	5310	31.6	5148	32.2	5154	31.5	5130	30.8	5118
11	32.1	5994	32.0	5904	32.8	5838	32.1	5934	32.0	5856	32.3	5784	32.6	5856	32.7	5790	32.1	5760	31.9	5928	32.6	5910	33.0	5892	34.0	5754	33.8	5760	32.4	5742	32.1	5538
12	33.2	6156	33.0	6168	33.7	5970	33.0	6246	32.9	6072	33.3	5802	33.4	6114	33.4	5874	32.8	6018	32.7	6144	33.6	6210	34.2	6120	34.8	6102	34.4	6090	33.3	6000	33.0	5862
13	33.8	5784	33.7	6204	34.3	5832	33.8	6198	33.6	6072	33.8	5766	34.0	6000	35.0	5820	33.6	5928	33.5	5838	34.2	6192	35.0	6048	35.5	6030	35.2	5838	34.0	5598	33.4	5676
14	33.9	5208	34.0	5652	34.8	5304	34.4	5796	34.1	5736	34.2	5322	34.5	5448	34.4	5478	34.0	5406	34.0	5406	35.0	5778	35.7	5736	35.9	5532	35.5	5352	34.4	5442	33.7	5058
15	33.1	4548	34.1	4884	34.8	4824	34.5	4968	34.3	4812	34.5	4788	35.0	4734	34.6	4998	34.0	4596	34.0	4860	35.2	5064	36.0	5028	35.9	4986	35.5	4560	34.4	4614	33.5	4404
16	32.9	3708	34.0	3882	34.8	3990	34.4	4056	33.8	3924	34.1	3894	34.7	3858	34.4	4188	33.8	3936	33.8	4170	35.0	4146	36.0	4146	35.5	3876	35.2	3810	33.4	3786	33.2	3504
17	31.4	2742	33.3	2922	33.6	3066	33.7	2964	32.9	3114	32.8	2976	33.4	2874	33.6	3000	32.7	2886	33.0	3126	33.9	2982	35.1	3024	33.4	2904	33.9	2784	32.4	2850	31.7	2568
18	30.0	1608	32.0	1770	31.8	1872	32.0	1770	31.4	1836	31.2	1632	31.9	1764	32.2	1812	31.2	1740	31.4	1890	32.5	1728	33.5	1764	32.6	1734	32.1	1596	30.9	1740	30.4	1536
19	28.6	534	30.1	648	30.2	530	30.2	600	29.7	597	29.4	630	30.7	567	30.5	678	29.3	567	29.6	588	30.7	537	31.2	606	30.5	582	30.3	582	29.1	552	28.8	552
20	27.0	20	28.4	135	28.5	60	28.4	150	28.3	80	28.4	100	28.6	135	28.8	150	28.0	55	28.0	90	29.1	67.5	29.7	112.5	28.8	120	28.6	120	27.8	60	27.5	56.67
21	26.2	0	27.0	0	27.1	0	27.2	0	27.0	0	26.6	0	27.1	0	27.5	0	26.6	0	26.9	0	27.9	0	28.0	0	27.5	0	27.1	0	26.7	0	26.3	0
22	25.4	0	26.0	0	26.0	0	26.4	0	26.0	0	25.7	0	26.0	0	26.3	0	25.7	0	26.1	0	27.0	0	26.9	0	26.4	0	26.2	0	25.5	0	25.5	0
23	24.7	0	25.3	0	25.5	0	25.6	0	25.4	0	25.0	0	25.3	0	25.8	0	25.0	0	25.5	0	26.2	0	26.0	0	25.8	0	25.6	0	24.8	0	25.5	0
24	24.2	0	24.7	0	24.8	0	25.1	0	25.1	0	24.4	0	24.8	0	25.2	0	24.2	0	25.0	0	25.6	0	25.3	0	25.3	0	25.0	0	24.1	0	24.8	0

	JULY																													
	DAYS																													
	17		18		19		20		21		22		23		24		25		26		27		28		29		30		31	
D	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	24.4	0	24.6	0	24.9	0	25.3	0	25.3	0	25.1	0	25.1	0	24.7	0	25.3	0	24.5	0	25.3	0	25.5	0	25.6	0	26.2	0	25.1	0
2	23.4	0	24.4	0	24.7	0	25.0	0	24.8	0	24.6	0	24.7	0	24.2	0	24.6	0	24.2	0	25.0	0	25.3	0	25.3	0	25.1	0	24.8	0
3	23.1	0	24.2	0	24.3	0	24.5	0	24.4	0	24.3	0	24.1	0	23.9	0	24.3	0	23.8	0	24.9	0	25.0	0	24.9	0	24.5	0	24.5	0
4	22.9	0	23.7	0	24.1	0	24.0	0	24.1	0	23.7	0	24.0	0	23.4	0	23.9	0	23.5	0	24.5	0	24.6	0	24.3	0	24.1	0	24.5	0
5	22.7	0	23.2	0	23.7	0	23.7	15	23.7	0	23.4	0	23.8	0	23.3	0	23.6	0	23.2	0	24.4	0	24.3	0	24.2	0	24.0	0	23.6	0
6	22.9	456	23.6	401	23.9	453	23.8	432	23.8	432	23.6	429	24.1	294.6	23.8	423	23.6	366	23.5	348	24.6	366	24.4	192	24.3	394	24.1	360	24.0	360
7	24.0	1494	24.9	1476	25.3	1494	25.3	1356	24.9	1428	24.8	1488	25.3	1048	24.5	1302	25.1	1254	24.6	1332	25.7	1332	25.7	954	25.6	1350	25.4	1350	25.3	1284
8	26.4	2712	27.2	2844	27.4	2688	27.6	2694	27.0	2706	26.6	2736	27.5	2242	26.6	2598	27.1	2502	26.8	2556	28.3	2526	27.8	2070	27.6	2478	27.7	2628	28.0	2400
9	29.3	4056	29.9	4224	29.5	4074	30.7	4080	30.1	4044	29.7	4050	31.1	3654	29.7	4176	30.4	3966	30.3	3966	31.4	3888	30.8	3552	30.7	3870	31.0	3864	30.7	3678
10	31.2	4890	32.0	5112	31.6	5070	32.8	5118	32.7	5076	32.0	4884	33.0	4612	31.6	4974	32.4	4980	32.2	4878	33.4	4854	33.2	4584	32.9	4848	33.3	4782	33.2	4602
11	32.4	5538	33.2	5736	33.1	5712	34.1	5712	34.8	5688	33.8	5484	34.7	5232	33.0	5568	33.7	5580	33.4	5628	34.8	5496	34.9	5316	34.3	5502	34.7	5460	34.5	5292
12	33.3	5940	34.1	6030	34.1	6024	34.9	6054	35.5	6036	34.6	5736	35.6	5613	33.9	5916	34.6	5922	34.4	5886	35.6	5826	35.5	5640	35.0	5742	35.6	5778	35.6	5718
13	34.0	5736	34.7	5898	34.9	6060	35.5	6054	36.1	6000	35.4	5568	35.6	5625	34.7	5802	35.2	5730	35.2	5832	36.2	5832	35.8	5742	35.9	5820	36.2	5712	36.2	5796
14	34.4	5334	35.2	5526	35.4	5748	35.9	5682	36.1	5646	35.8	5208	36.5	5264	35.3	5154	35.4	5316	35.7	5328	36.2	5256	36.4	5352	36.4	5202	36.7	5190	36.6	5478
15	34.7	4782	35.5	4998	35.7	5028	36.2	4818	36.1	4836	35.4	4410	36.4	4645	35.3	4476	35.5	4512	36.0	4686	36.4	4500	36.4	4632	36.2	4428	36.5	4350	36.6	4392
16	33.9	3948	35.4	4092	35.4	4176	36.0	4032	35.6	3972	35.5	3906	35.9	3777	35.0	3522	35.2	3732	35.6	3714	35.7	3450	35.8	3756	35.7	3624	35.9	3594	36.0	3582
17	33.3	2892	34.3	2970	34.5	3096	35.1	2934	34.7	2958	34.8	2796	35.3	2705	34.0	2694	34.1	2916	34.4	2598	34.8	2694	34.2	2706	34.6	2634	35.3	2550	35.1	2574
18	31.5	1824	32.8	1722	32.9	1788	33.4	1692	32.9	1764	33.0	1608	33.3	1522	32.1	1470	32.2	1686	32.5	1518	32.9	1548	32.2	1500	33.1	1554	33.5	1422	33.1	1530
19	30.2	672	30.9	594	31.3	537	31.6	578	31.3	624	31.3	528	32.1	403.7	30.3	484.5	30.2	537	30.5	492	31.0	468	31.0	477	31.2	472	31.4	393	31.1	477
20	28.4	60	29.5	135	29.6	65	29.8	135	29.7	60	29.6	75	30.3	0	28.9	90	28.5	60	29.5	90	29.5	0	29.2	90	29.8	0	29.9	0	29.3	0
21	27.2	0	28.2	0	28.3	0	28.2	0	28.3	0	28.2	0	28.8	0	27.9	0	27.5	0	28.0	0	28.3	0	28.1	0	28.6	0	28.6	0	28.0	0
22	26.1	0	27.1	0	27.2	0	27.0	0	27.2	0	27.2	0	27.9	0	26.7	0	26.4	0	27.0	0	27.2	0	27.1	0	27.4	0	27.4	0	26.9	0
23	25.6	0	26.3	0	26.6	0	26.2	0	26.5	0	25.9	0	27.0	0	26.2	0	25.6	0	26.3	0	26.7	0	26.4	0	26.9	0	26.7	0	26.3	0
24	25.0	0	25.6	0	25.8	0	25.5	0	25.7	0	25.2	0	26.4	0	25.7	0	25.1	0	25.6	0	26.1	0	26.0	0	26.1	0	25.9	0	25.5	0

	AUGUST																															
	DAYS																															
	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
D	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I		
1	24.9	0	24.3	0	24.0	0	24.9	0	24.6	0	25.0	0	25.7	0	25.1	0	24.6	0	24.9	0	24.9	0	24.8	0	24.8	0	24.4	0	24.3	0	24.8	0
2	24.4	0	23.8	0	23.7	0	24.8	0	24.3	0	24.6	0	25.2	0	24.7	0	24.3	0	24.7	0	24.6	0	24.2	0	24.4	0	23.9	0	23.8	0	24.5	0
3	24.0	0	23.5	0	23.4	0	24.4	0	23.9	0	24.3	0	24.9	0	24.4	0	24.0	0	24.5	0	24.2	0	23.9	0	24.0	0	23.4	0	23.1	0	24.2	0
4	23.8	0	23.0	0	23.1	0	24.2	0	23.6	0	23.8	0	24.4	0	24.0	0	23.8	0	24.0	0	23.8	0	23.6	0	23.6	0	23.0	0	22.9	0	23.8	0
5	23.5	150	22.6	0	22.7	0	23.8	0	23.6	0	23.6	0	23.9	0	23.6	0	23.6	0	23.9	0	23.7	0	23.0	0	23.2	0	22.4	0	22.8	0	23.7	0
6	23.4	504	22.5	396	22.6	313	23.7	387	23.8	323	23.5	309	23.9	369	23.6	345	23.6	271	23.7	319.5	23.8	325.5	23.0	240	23.0	401.67	22.4	346.5	22.6	227.5	23.4	240
7	24.8	1362	24.0	1338	24.2	1158	24.8	1320	24.9	1296	24.4	1176	25.0	1206	24.5	1176	24.7	1134	24.6	1182	24.7	1320	24.3	1050	24.2	1278	23.5	1356	23.8	978	24.3	1104
8	27.2	2718	26.5	2592	26.3	2538	26.2	2466	26.9	2610	26.8	2406	27.1	2418	26.7	2454	27.1	2586	27.1	2460	26.7	2664	26.4	2496	26.7	2628	25.9	2586	26.7	2280	26.8	2442
9	30.1	4086	29.5	3834	29.1	4056	28.9	3612	29.6	3888	29.8	3666	30.4	3654	29.8	3660	30.6	3876	30.3	3654	29.8	3780	29.7	3732	28.5	3882	29.3	3708	30.1	3798	30.0	3744
10	32.9	4932	32.1	4782	31.6	4932	31.0	4452	31.5	4908	32.1	4518	32.4	4566	32.2	4686	32.6	4710	32.5	4494	32.2	4782	32.3	4692	31.8	4806	31.6	4806	32.7	4704	32.3	4578
11	34.1	5484	33.3	5430	33.0	5550	32.8	5118	33.1	5586	33.6	5178	33.9	5292	33.9	5292	33.9	5424	33.8	5046	33.4	5436	33.8	5322	33.4	5358	33.0	5424	34.2	5316	33.9	5334
12	34.7	5556	34.2	5838	33.9	5838	33.7	5490	34.2	5814	34.5	5430	34.7	5568	34.8	5670	34.7	5658	34.9	5286	34.5	5592	34.4	5694	34.3	5766	34.0	5736	35.0	5658	35.1	5700
13	35.2	5400	34.9	5724	34.4	5748	34.4	5430	34.9	5376	35.2	5394	35.2	5472	35.2	5616	35.6	5562	35.5	4980	35.2	5466	35.2	5706	35.1	5790	34.7	5802	35.3	5604	35.4	5520
14	35.6	5196	35.4	4734	35.1	5322	35.0	4788	35.3	5004	35.6	4698	35.7	5346	35.5	4878	36.2	4884	35.5	4356	35.5	4824	35.8	5310	35.3	5358	35.3	5310	36.2	4902	35.9	5214
15	35.7	4662	35.3	4482	35.0	4686	33.8	3714	35.4	4158	35.7	4188	35.8	4656	35.6	4332	36.2	4386	35.5	3756	35.3	4224	35.7	4662	35.6	4506	35.4	4632	36.1	4332	35.7	4554
16	35.3	3672	34.6	3564	34.8	3750	33.2	3042	35.2	3510	35.4	3336	35.6	3822	35.2	3408	35.5	3606	35.2	3258	35.1	3594	35.5	3582	35.4	3636	35.0	3582	36.0	3474	35.3	3696
17	34.3	2580	32.9	2436	33.5	2376	32.1	2256	34.3	2526	34.5	2394	34.7	2658	34.0	2430	34.3	2406	34.3	2292	34.0	2550	34.4	2598	34.8	2634	34.0	2592	34.6	2562	34.1	2544
18	32.2	1338	31.1	1440	31.7	1146	30.2	1242	32.5	1374	32.7	1296	32.8	1518	32.2	1416	32.4	1296	32.3	1278	31.9	1386	32.4	1458	32.4	1398	32.0	1440	32.4	1290	31.8	1326
19	30.4	414	29.1	429	30.1	323	28.8	342	30.5	444	30.6	343.5	30.4	504	30.5	418.5	30.6	333	30.1	343	30.1	364.5	30.4	364.5	30.2	337.5	30.1	315	30.6	230.5	29.7	273
20	28.8	20	27.9	0	29.0	90	27.6	15	29.1	60	29.3	0	28.9	60	29.0	0	29.1	0	28.7	0	28.4	0	28.8	30	28.2	30	28.5	0	28.8	0	27.9	0
21	27.4	0	26.8	0	27.2	0	27.0	0	27.9	0	28.2	0	27.8	0	27.3	0	28.1	0	27.6	0	27.4	0	27.5	0	27.2	0	27.2	0	27.5	0	26.8	0
22	26.3	0	25.6	0	26.5	0	26.2	0	27.0	0	27.2	0	26.9	0	26.3	0	26.8	0	26.6	0	26.1	0	26.5	0	26.3	0	26.1	0	26.5	0	26.1	0
23	25.6	0	24.9	0	25.7	0	25.6	0	26.3	0	26.7	0	26.1	0	25.6	0	26.1	0	25.9	0	25.6	0	25.7	0	25.7	0	25.3	0	25.9	0	25.2	0
24	25.0	0	24.3	0	25.4	0	25.1	0	25.7	0	26.1	0	25.7	0	25.0	0	25.4	0	25.3	0	25.2	0	25.2	0	25.1	0	24.8	0	25.4	0	24.7	0

	AUGUST																													
	DAYS																													
	17		18		19		20		21		22		23		24		25		26		27		28		29		30		31	
D	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	24.2	0	23.5	0	24.3	0	24.4	0	24	0	23.5	0	24.1	0	24.42	0	23.47	0	23.3	0	23.2	0	22.8	0	22.5	0	22.7	0	22.3	0
2	23.8	0	23.2	0	24	0	24.1	0	24	0	23.1	0	23.9	0	24.13	0	22.93	0	22.9	0	22.7	0	22.4	0	22.2	0	22.4	0	21.8	0
3	23.5	0	22.7	0	23.5	0	23.8	0	23	0	22.9	0	23.6	0	23.68	0	22.75	0	22.5	0	22.4	0	21.9	0	21.9	0	22	0	21.2	0
4	23.2	0	22.4	0	22.9	0	23.3	0	23	0	22.6	0	23.1	0	23.53	0	22.38	0	22.1	0	22	0	21.8	0	21.5	0	21.7	0	20.8	0
5	22.6	0	22.1	0	22.5	0	23.1	0	23	0	21.9	0	22.7	0	23.18	0	21.9	0	22	0	21.8	0	21.6	0	21.2	0	21.4	0	20.4	0
6	22.4	330	21.8	275	22.5	243.33	22.9	268	23	217	21.8	309.4	22.6	298.3	22.93	212.5	21.8	246.7	21.9	193.1	21.7	176.3	21.4	266.7	21	217.5	21.3	140	20.4	121.7
7	23.3	1170	23	1134	23.5	1134	23.5	1050	24	1050	22.8	1164	23.8	1110	23.7	1032	22.68	1086	22.9	1008	22.7	1068	22.3	1140	21.8	990	22.1	960	21.5	960
8	25.6	2460	25.7	2520	25.3	2400	25.9	2370	26	2334	25.1	2502	25.5	2376	25.96	2340	24.89	2418	25.1	2274	25.4	2394	24.5	2358	23.9	2238	24.1	2286	23.7	2184
9	29.3	3696	29	3816	28.9	3666	29	3678	29	3708	28.8	3768	29.8	3618	29.51	3654	28.33	3744	28.1	3516	28.1	3714	27.5	3696	27.4	3636	27.7	3504	27.4	3486
10	31.8	4692	31.9	4770	31.0	4434	31.6	4608	31	4698	31.1	4668	32.4	4602	31.72	4674	30.57	4554	30.1	4536	30.5	4680	29.7	4596	29.9	4584	30.1	4500	29.8	4452
11	33.2	5358	33.4	5358	32.5	4974	33.1	5268	33	5238	32.5	5358	33.9	5250	33.32	5322	31.78	5172	31.5	5256	31.9	5352	30.9	5226	31.1	5274	31.7	5178	31.3	5160
12	34.0	5652	34.2	5676	33.3	5148	34	5568	33	5544	33.8	5688	34.7	5562	34.1	5580	32.61	5532	32.7	5562	32.9	5658	31.9	5664	31.7	5652	32.5	5478	32.1	5340
13	34.7	5622	34.9	5616	33.9	4740	34.8	5598	34	5508	34.5	5610	35.3	5382	34.82	5502	33.21	5514	33.6	5646	33.6	5706	32.9	5628	32.7	5640	33.3	5352	32.9	5544
14	34.9	5118	35.2	5028	34.3	4398	35.4	5190	34	5058	34.9	4698	35.5	4854	35.17	5082	33.38	4770	33.7	4860	34	5112	33.5	5220	32.9	5178	33.5	4890	33.3	5070
15	34.6	4212	35.2	4488	34.7	3996	35.2	4410	34	4206	34.7	3960	35.6	4266	35.3	4350	33.38	4116	33.7	4170	34.1	4356	33.6	4188	33.2	4572	33.3	4062	33.2	4326
16	34.2	3366	35.1	3528	34.7	3318	34.8	3570	34	3342	34.5	3186	35.3	3330	34.93	3420	32.75	3390	33.1	3378	33.7	3366	32.9	3318	32.9	3462	33	3180	32.9	3252
17	33.5	2598	33.8	2412	33.7	2370	33.2	2400	33	2298	33.6	2220	34.2	2388	33.63	2316	31.76	2298	32.1	2322	32.7	2238	32	2394	31.8	2274	32.2	2238	31.7	2226
18	31.2	1428	31.7	1230	31.5	1206	31.4	1284	31	1200	31.5	1104	31.9	1242	31.67	1080	29.99	1188	30.2	1122	30.4	1098	29.6	1260	29.7	1104	29.9	1026	29.7	1005
19	29.4	381	29.6	270	29.1	282	29.7	356	29	283	29.5	237	29.5	265.5	29.57	238.1	27.86	326.7	28.2	243.8	28.4	217.5	27.7	210	27.7	226.5	28	142.5	27.5	188.3
20	27.9	0	28	0	28.0	0	28.4	0	27	0	27.4	0	28.1	0	28.18	0	26.74	0	26.8	0	26.8	0	26.3	0	26.4	240	26.4	0	26.2	0
21	26.7	0	27	0	27	0	27.1	0	26	0	26.9	0	27	0	26.9	0	25.94	0	25.8	0	25.6	0	25.2	0	25.3	0	25.3	0	25	0
22	25.7	0	26.2	0	26.1	0	26.1	0	25	0	26	0	26.2	0	25.92	0	24.9	0	24.8	0	24.6	0	24.3	0	24.5	0	24.4	0	23.7	0
23	25.1	0	25.5	0	25.4	0	25.3	0	24	0	25.4	0	25.5	0	25.07	0	24.26	0	24.2	0	23.8	0	23.5	0	23.7	0	23.6	0	23	0
24	24.3	0	24.8	0	24.8	0	24.5	0	24	0	24.8	0	24.8	0	24.34	0	23.62	0	23.7	0	23.4	0	23	0	23.2	0	23.1	0	22.4	0

	SEPTEMBER																															
	DAYS																															
	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
D																																
H	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	21.9	0	21.3	0	21.4	0	21.5	0	20.7	0	20.0	0	19.4	0	19.4	0	19.0	0	20.0	0	20.3	0	20.3	0	19.3	0	19.5	0	18.8	0	19.0	0
2	21.4	0	20.8	0	21.2	0	21.1	0	20.5	0	19.6	0	18.7	0	18.9	0	18.6	0	19.7	0	20.0	0	19.8	0	18.9	0	19.1	0	18.4	0	18.6	0
3	20.8	0	20.3	0	20.7	0	20.5	0	20.0	0	19.1	0	18.2	0	18.5	0	17.8	0	19.4	0	19.3	0	19.5	0	18.5	0	18.5	0	18.0	0	18.3	0
4	20.4	0	20.0	0	20.3	0	20.2	0	19.5	0	18.7	0	17.8	0	17.9	0	17.5	0	18.8	0	19.0	0	19.1	0	18.1	0	18.2	0	17.7	0	18.1	0
5	19.9	0	19.7	0	19.8	0	19.9	0	19.5	0	18.1	0	17.4	150	17.6	0	17.0	0	18.7	0	18.8	0	18.6	0	17.6	0	17.9	0	17.5	0	17.9	0
6	19.7	130	19.7	105	19.7	139.29	19.7	107	19.6	90	18.0	95.63	17.1	272.5	17.3	97.22	17.0	50.83	18.4	87.5	18.6	207.5	18.5	75	17.2	67.5	17.7	30	17.3	100	17.7	90
7	20.5	906	20.8	924	20.4	930	20.6	840	19.8	870	18.7	906	18.0	1032	18.5	906	18.2	720	19.1	816	19.3	870	19.0	738	18.1	768	18.0	744	18.1	673	18.3	732
8	23.0	2328	23.1	2244	23.1	2244	23.1	2136	21.8	2202	21.0	2292	20.5	2328	20.7	2088	20.9	1986	21.7	2046	21.5	2220	21.3	2028	20.3	2136	20.4	1998	20.8	1848	20.9	2010
9	26.2	3690	26.6	3612	26.2	3612	26.3	3480	25.1	3540	24.7	3594	24.2	3600	24.1	3420	25.0	3120	25.6	3354	25.6	3426	25.3	3336	23.9	3444	24.1	3348	24.4	3108	24.8	3414
10	29.1	4668	28.7	4566	28.7	4518	28.7	4452	26.9	4542	26.6	4560	26.0	4494	26.3	4290	27.6	3984	27.9	4254	28.2	4236	26.4	4260	25.5	4230	26.7	4164	26.9	4068	27.1	4260
11	30.2	5166	30.2	5238	30.4	5166	30.4	5082	28.9	5184	27.9	5034	27.4	5076	27.7	5028	28.7	4872	29.4	4938	29.6	4758	27.6	4830	27.2	4746	28.4	4824	28.3	4860	28.6	4818
12	31.2	5376	31.2	5526	31.1	5526	31.1	5244	29.5	5388	28.8	5256	28.3	5334	28.4	5130	29.6	5352	30.4	5334	30.2	4968	28.5	5208	28.2	4884	29.2	5202	29.1	5112	29.7	5166
13	32.0	5256	32.1	5208	31.8	5460	31.5	5184	30.2	5328	29.4	5076	29.1	5286	29.1	5016	30.5	5064	31.1	5214	30.7	4566	29.3	4938	29.0	4794	30.0	5058	29.8	4872	30.6	5082
14	32.3	4884	32.5	4854	32.2	5016	31.8	4932	30.5	4884	29.8	4716	29.6	4662	29.9	4674	31.1	4710	31.3	4584	30.9	4230	29.5	4386	29.4	4362	30.4	4380	30.3	4398	31.1	4656
15	32.5	4218	32.5	4200	32.3	4206	31.8	4050	30.8	4182	30.0	4134	29.4	3876	30.2	4002	31.0	4110	31.4	3888	30.9	3642	29.4	3612	29.6	3834	30.5	3858	30.4	3822	31.0	3912
16	31.9	3252	32.1	3348	32.0	3270	31.2	3162	30.4	3240	29.5	3132	29.0	2784	30.0	3084	30.6	3108	31.1	3174	30.1	2628	28.6	2820	29.2	3012	30.1	2814	29.9	2934	30.5	2850
17	30.7	2040	31.2	2106	30.8	2208	30.5	2172	29.4	1956	28.6	2022	28.5	1842	29.1	1854	29.8	1950	29.8	2058	28.9	1638	27.5	1908	28.3	1806	29.1	1890	28.9	1788	29.5	1703
18	28.5	912	28.9	936	28.7	942	28.3	912	27.1	777	26.3	777	26.6	793.3	27.4	716	27.6	734	27.5	825	26.9	597	25.6	657	26.4	678	27.0	702	26.4	628	27.3	633.3
19	26.7	150	27.0	208.75	26.7	187.22	26.2	136	25.3	89.4	24.1	156.7	24.7	167.1	25.1	140	25.2	116	25.4	190	24.8	112.5	23.8	120	24.3	195	24.6	225	24.4	243.8	25.4	300
20	25.3	0	25.9	0	25.4	0	24.7	0	23.8	0	23.0	0	23.2	0	23.6	0	23.6	0	24.1	0	23.5	0	23.0	0	22.6	0	23.0	0	22.9	0	23.6	0
21	24.2	0	24.7	0	24.2	0	23.6	0	23.0	0	22.1	0	22.0	0	22.3	0	22.5	0	23.1	0	22.6	0	21.6	0	21.5	0	22.1	0	21.8	0	22.5	0
22	23.2	0	23.7	0	23.3	0	22.7	0	22.2	0	21.1	0	20.4	0	21.2	0	21.6	0	22.3	0	21.9	0	20.9	0	20.7	0	20.9	0	20.8	0	21.5	0
23	22.5	0	22.8	0	22.7	0	21.9	0	21.3	0	20.4	0	19.7	0	20.4	0	20.9	0	21.4	0	21.2	0	20.3	0	20.4	0	20.0	0	20.1	0	20.9	0
24	21.9	0	22.0	0	22.0	0	21.2	0	20.6	0	19.9	0	19.3	0	19.8	0	20.5	0	20.9	0	20.8	0	19.7	0	20.0	0	19.6	0	19.4	0	20.1	0

	SEPTEMBER																											
	DAYS																											
D	17		18		19		20		21		22		23		24		25		26		27		28		29		30	
H	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	19.7	0	19.1	0	18.9	0	19.7	0	19.1	0	18.8	0	17.4	0	17.9	0	18.6	0	18.6	0	18.3	0	17.7	0	17.5	0	16.9	0
2	19.3	0	18.5	0	18.7	0	19.3	0	18.7	0	18.2	0	17.1	0	17.4	0	18.1	0	18.2	0	18.2	0	17.2	0	17.1	0	16.5	0
3	18.8	0	18.1	0	18.4	0	18.8	0	18.4	0	17.9	0	16.6	0	17.0	0	17.5	0	17.8	0	17.6	0	16.9	0	16.6	0	16.3	0
4	18.4	0	17.7	0	18.3	0	18.4	0	18.1	0	17.5	0	15.9	0	16.7	0	17.1	0	17.5	0	17.1	0	16.6	0	16.3	0	15.9	0
5	17.8	0	17.3	0	17.8	0	17.8	0	17.9	0	17.0	0	15.5	0	16.6	0	16.9	0	17.0	0	16.6	0	16.2	0	16.3	0	15.3	0
6	17.5	66	17.0	82.5	17.6	67.5	17.5	70	17.5	52.5	16.6	37.5	15.4	45	16.3	0	16.6	90	16.9	30	16.1	35	16.1	0	16.3	0	15.2	22.5
7	18.0	678	17.4	639	18.2	684	18.3	648	18.1	678	17.1	594	16.0	556.5	16.4	528	17.3	646.5	17.4	427.5	17.2	447	16.7	495	16.7	385.5	15.6	398
8	20.1	1806	20.1	1854	20.8	1932	20.9	1824	20.2	1944	19.2	1740	18.3	1686	19.2	1656	19.7	1836	19.8	1482	19.7	1416	18.8	1614	18.6	1422	18.1	1470
9	24.1	3048	24.7	3180	24.9	3162	24.9	3216	24.3	3228	23.6	2940	23.4	2928	24.0	3072	23.9	3090	23.5	2694	23.6	2808	22.6	2736	22.1	2688	22.2	2784
10	26.6	4098	27.2	4236	27.5	4068	27.1	4068	26.7	4116	25.9	3698	25.7	3792	26.6	4068	26.6	3888	26.1	3846	25.8	3678	25.4	3834	24.6	3474	24.7	3624
11	28.1	4824	28.5	4914	29.2	4764	28.5	4656	28.0	4734	27.3	4494	27.1	4674	28.1	4752	28.0	4506	27.4	4326	27.3	4428	26.6	4506	25.4	3720	26.2	4488
12	29.1	5106	29.4	5154	29.9	5118	29.1	5064	29.0	5004	27.9	4428	28.0	4932	28.8	4914	28.5	4302	28.3	4512	28.0	4632	27.4	4440	26.4	4242	27.3	4830
13	29.8	4992	30.1	5082	30.8	5034	29.5	4728	29.6	4806	28.6	4794	28.7	4668	29.5	4842	28.1	3696	29.2	4632	28.7	4344	27.8	4392	27.0	4380	26.8	4470
14	30.2	4386	30.5	4656	31.0	4608	29.8	4278	29.8	4182	29.0	4230	29.3	4578	30.0	4278	28.1	3540	29.4	4050	28.8	3624	28.2	3738	27.2	3864	26.9	3594
15	29.9	3690	30.5	3798	31.2	3834	29.6	3264	29.7	3384	28.7	3336	29.2	3516	29.9	3534	27.9	2934	29.2	3348	28.7	3168	27.6	2802	27.0	3294	26.9	2976
16	29.7	2760	30.1	2808	30.5	2856	28.9	2436	28.9	2634	28.3	2688	28.9	2718	29.5	2694	27.6	2298	28.7	2412	28.3	2346	26.8	2100	26.3	2406	26.3	2154
17	28.6	1560	29.1	1704	29.5	1674	27.6	1377	27.6	1368	27.4	1488	27.5	1608	28.0	1548	26.4	1338	27.3	1440	27.0	1356	25.1	1302	24.9	1434	24.9	1236
18	26.8	537	26.6	472	27.0	526	25.3	496	25.7	417	25.2	424.5	25.2	579	25.8	424.5	24.4	480	25.1	451.5	25.0	367.5	23.1	396	23.0	319	23.0	320
19	24.7	420	24.5	180	24.8	240	23.5	300	23.8	240	23.9	360	22.8	210	23.7	210	22.7	120	23.1	120	23.0	300	21.3	300	21.2	0	21.3	90
20	23.0	0	22.9	0	23.3	0	21.9	0	22.5	0	21.6	0	21.4	0	22.3	0	21.5	0	21.9	0	21.8	0	20.3	0	20.1	0	20.0	0
21	21.4	0	22.1	0	21.9	0	21.4	0	21.3	0	20.8	0	20.3	0	21.1	0	20.7	0	20.9	0	20.9	0	19.4	0	19.3	0	19.4	0
22	20.5	0	20.9	0	21.1	0	20.6	0	20.4	0	19.7	0	19.5	0	20.2	0	20.0	0	20.0	0	19.9	0	18.8	0	18.3	0	18.4	0
23	19.9	0	20.0	0	20.7	0	20.1	0	19.7	0	19.0	0	18.8	0	19.6	0	19.3	0	19.4	0	19.3	0	18.3	0	17.8	0	17.8	0
24	19.3	0	19.5	0	20.2	0	19.7	0	19.3	0	18.2	0	18.2	0	19.2	0	19.0	0	18.8	0	18.6	0	17.9	0	17.3	0	17.5	0

	OCTOBER																															
	DAYS																															
	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
D	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I		
1	16.9	0	16.8	0	16.5	0	15.9	0	15.5	0	15.5	0	16.9	0	17.1	0	15.7	0	15.5	0	15.6	0	15.6	0	14.2	0	15.0	0	15.7	0	15.0	0
2	16.6	0	16.3	0	16.2	0	15.5	0	14.9	0	15.1	0	16.5	0	16.6	0	15.2	0	14.9	0	15.2	0	15.3	0	13.9	0	14.7	0	15.1	0	14.7	0
3	16.0	0	15.7	0	15.7	0	15.2	0	14.7	0	14.8	0	16.1	0	16.1	0	14.5	0	14.3	0	14.9	0	14.6	0	13.6	0	14.3	0	14.7	0	14.2	0
4	15.6	0	15.5	0	15.6	0	15.1	0	14.3	0	14.3	0	15.8	0	15.8	0	14.2	0	14.1	0	14.5	0	14.4	0	13.0	0	14.1	0	14.3	0	13.8	0
5	15.3	0	15.3	0	15.6	0	14.7	0	13.9	0	14.1	0	15.4	0	15.3	0	13.7	0	13.8	0	14.2	0	13.9	0	12.8	0	13.7	0	13.8	0	13.4	0
6	15.2	0	15.0	0	15.6	30	14.4	30	13.6	0	13.8	30	14.9	30	14.8	0	13.6	15	13.6	0	14.1	0	13.7	0	12.7	90	13.5	0	13.4	0	13.1	0
7	15.6	467	15.5	401	15.8	331	14.9	448	14.1	460	14.4	302	15.1	399	14.8	274.5	13.9	299	14.3	247	14.3	342.2	14.3	259	13.0	353.5	14.0	314.5	13.4	283	13.3	236.5
8	17.3	1596	17.5	1476	17.7	1416	17.2	1512	16.6	1500	16.7	1242	17.6	1398	17.5	1326	16.1	1338	15.9	1104	16.7	1092	16.7	1188	15.6	1326	16.2	1224	15.4	1320	15.5	1242
9	21.0	2766	21.1	2574	21.2	2586	21.0	2766	21.3	2748	20.4	2424	21.1	2490	21.7	2622	19.8	2544	19.7	2238	20.3	2292	20.3	2430	20.3	2538	20.1	2346	19.9	2388	19.2	2304
10	23.7	3648	23.5	3702	22.9	3372	23.9	3768	23.7	3804	24.0	3438	24.3	3438	24.2	3678	22.9	3588	22.8	3450	23.0	3210	23.4	3336	23.2	3378	23.1	3288	22.3	3096	21.2	3126
11	25.2	4452	25.1	4554	24.1	4104	25.3	4506	25.6	4482	25.4	4026	26.0	4122	26.2	4350	24.5	3900	24.7	4062	24.7	3864	24.6	3840	24.7	4122	24.8	3876	23.9	3762	22.7	3630
12	26.1	4704	25.6	4716	24.5	4026	26.2	4650	26.4	4866	26.5	4290	27.2	4452	26.9	4602	25.4	4290	25.8	4074	25.1	3930	25.5	4236	25.7	4476	26.2	4128	24.9	4068	23.4	3786
13	26.7	4494	26.3	4254	25.5	4158	26.7	4344	27.1	4602	27.1	4062	27.9	4350	27.5	4458	26.2	4110	26.6	3948	25.9	4056	26.1	4074	26.4	4404	26.8	3816	25.5	3816	24.1	3540
14	27.1	4032	26.4	3624	25.8	3726	26.8	3648	27.1	4074	27.5	3558	28.3	3798	27.6	3840	26.6	3594	27.2	3426	26.3	3588	26.4	3732	26.9	3792	27.0	3492	25.8	3240	24.9	3306
15	26.9	3060	26.4	3096	25.0	2976	26.2	2970	27.1	3318	27.5	3108	28.0	2934	27.3	3186	26.3	2748	26.9	2772	26.6	3054	26.2	2922	26.6	3066	26.8	2760	25.5	2460	24.3	2724
16	26.2	2142	25.8	2220	24.1	2136	25.5	2136	26.7	2370	26.9	2112	27.3	1962	26.7	2214	26.6	1800	26.2	1926	25.8	2106	25.0	2004	25.8	2076	26.2	1932	24.1	1584	23.6	1764
17	24.8	1236	24.0	960	23.0	987	23.9	1086	24.8	1194	25.4	1074	25.3	906	24.6	1074	24.0	936	23.7	936	23.5	780	23.1	900	23.7	882	24.1	848	22.8	498	22.1	786
18	22.9	370	22.3	190	20.7	286.25	22.1	316	22.5	314	23.0	219.5	23.2	195.6	22.5	186	22.3	178.1	22.1	146.7	21.6	161.7	21.1	141.9	21.8	194.29	22.1	240	20.8	67.14	20.4	134.2
19	21.1	240	20.7	0	19.0	30	20.4	90	20.5	0	21.6	0	21.5	0	20.9	0	20.5	0	20.2	0	19.9	0	19.4	0	19.6	0	20.4	0	19.4	0	18.9	0
20	20.2	0	19.7	0	18.3	0	19.1	0	19.3	0	20.4	0	20.5	0	19.6	0	19.2	0	18.9	0	18.7	0	18.2	0	18.4	0	19.1	0	18.3	0	18.0	0
21	19.3	0	18.9	0	17.7	0	18.1	0	18.3	0	19.0	0	19.6	0	18.4	0	18.1	0	18.2	0	17.8	0	17.3	0	17.6	0	18.3	0	17.4	0	17.6	0
22	18.4	0	18.2	0	17.1	0	17.1	0	17.4	0	18.2	0	18.9	0	17.4	0	17.1	0	17.1	0	17.0	0	16.2	0	16.7	0	17.1	0	16.7	0	16.9	0
23	17.6	0	17.6	0	16.5	0	16.6	0	16.9	0	17.6	0	18.2	0	16.6	0	16.3	0	16.6	0	16.3	0	15.5	0	16.2	0	16.7	0	16.0	0	16.5	0
24	17.2	0	17.1	0	16.2	0	16.2	0	16.2	0	17.2	0	17.6	0	16.2	0	15.8	0	16.2	0	15.9	0	14.9	0	15.6	0	16.2	0	15.6	0	15.9	0

	OCTOBER																													
	DAYS																													
	17		18		19		20		21		22		23		24		25		26		27		28		29		30		31	
H	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	15.2	0	14.8	0	14.3	0	13.2	0	12.4	0	12.6	0	12.0	0	10.9	0	11.6	0	12.1	0	12.7	0	11.9	0	11.3	0	10.0	0	10.2	0
2	14.9	0	14.5	0	14.0	0	12.9	0	11.9	0	12.1	0	11.5	0	10.5	0	11.2	0	11.6	0	12.3	0	11.5	0	11.0	0	9.7	0	9.9	0
3	14.4	0	14.1	0	13.7	0	12.4	0	11.8	0	11.5	0	11.0	0	10.1	0	11.0	0	11.1	0	12.0	0	11.3	0	10.8	0	9.4	0	9.8	0
4	14.2	0	13.8	0	13.0	0	11.9	0	11.5	0	11.2	0	10.7	0	9.8	0	10.7	0	10.7	0	11.7	0	11.1	0	10.6	0	9.2	0	9.5	0
5	14.0	0	13.5	0	12.6	0	11.9	0	11.3	0	11.0	0	10.2	0	9.6	0	10.5	0	10.4	0	11.2	0	11.0	0	10.3	0	9.1	0	9.1	0
6	13.7	0	13.4	0	12.4	0	11.8	0	11.1	0	10.7	0	10.0	0	9.6	0	10.5	0	10.2	0	11.0	0	11.1	0	10.2	0	9.0	0	8.9	0
7	13.9	310	13.6	234.44	12.6	191.11	12.2	297	11.4	265	10.5	215.5	10.1	174.4	9.6	164	10.6	216.3	10.4	186	11.1	228.8	11.1	128.6	10.3	105	8.9	147.5	8.7	133.8
8	15.7	1122	15.4	930	14.6	984	13.9	1176	13.4	1044	13.3	1146	13.3	1398	11.8	942	12.0	804	12.3	948	13.1	792	12.4	606	11.8	504	10.5	828	10.0	624
9	18.5	2400	18.6	2100	18.1	2148	17.1	2130	16.1	2178	16.9	2124	17.1	2352	15.4	1920	15.4	1716	16.1	1950	15.8	1722	14.9	1476	13.7	1506	12.6	1728	12.3	1374
10	21.0	3096	20.4	2916	20.4	3006	19.1	3168	18.6	2958	19.0	2988	19.6	3210	18.1	2646	17.7	2598	18.7	2970	17.7	2616	17.1	2124	15.0	2478	14.0	2556	13.7	2190
11	22.3	3648	21.4	3768	21.5	3576	20.7	3804	19.8	3528	20.2	3618	20.7	3636	19.3	3252	19.1	2868	20.3	3432	19.1	3066	18.8	2862	16.0	2844	15.2	2994	14.7	2580
12	23.0	3756	22.5	4218	22.2	3798	21.5	4086	20.6	3816	20.9	3966	21.6	4194	20.3	3474	20.0	3324	21.2	3642	19.8	3018	19.8	3102	16.3	2928	16.1	3198	15.6	2790
13	23.0	3408	23.2	4026	22.7	3504	22.0	4032	21.3	3684	21.7	4062	22.1	4080	20.8	3216	20.4	3270	22.0	3432	20.4	3216	20.0	2856	16.2	2748	16.6	3156	16.2	3018
14	23.0	2988	23.5	3462	23.0	3288	22.4	3246	21.5	3144	22.3	3630	22.5	3396	21.1	2910	21.0	2922	22.2	3078	20.7	2880	20.2	2826	16.0	2340	16.7	2652	16.4	2760
15	23.0	2262	23.1	2682	23.0	2682	21.8	2688	21.3	2502	22.0	2892	22.0	2790	20.9	2232	20.9	2136	22.0	2400	20.6	2262	19.9	2304	15.6	1866	16.8	2070	16.6	2202
16	22.3	1560	22.3	1896	22.0	1890	20.7	1740	20.4	1650	21.2	2046	21.1	1632	20.1	1524	20.3	1398	21.1	1476	19.8	1332	19.0	1374	14.8	1128	16.0	1200	15.7	1254
17	20.8	738	20.8	876	20.0	720	19.2	764	19.0	690	19.2	810	19.1	576	18.1	582	18.8	490	19.5	540	18.2	507	17.4	593.3	13.7	432	14.8	358.5	14.4	478.9
18	19.4	200	19.0	240.83	18.2	149.17	17.5	232	17.1	298	17.0	135.6	17.0	26.67	16.5	136	17.0	147.5	17.4	85	16.5	75	15.9	105	12.9	130	13.7	55	13.0	96.7
19	18.2	0	17.4	0	16.9	0	16.3	360	15.8	300	15.6	0	15.4	0	15.2	0	15.4	0	16.0	0	15.1	0	14.6	0	12.0	0	12.9	0	12.0	0
20	17.3	0	16.7	0	15.8	0	15.5	0	15.1	0	14.7	0	14.3	0	14.1	0	14.6	0	15.1	0	14.2	0	13.8	0	11.6	0	12.1	0	11.4	0
21	16.7	0	16.3	0	15.1	0	14.8	0	14.2	0	14.0	0	13.5	0	13.4	0	13.9	0	14.6	0	13.5	0	13.3	0	11.1	0	11.5	0	10.7	0
22	16.0	0	15.5	0	14.4	0	14.2	0	13.5	0	13.4	0	12.7	0	12.8	0	13.1	0	13.9	0	12.9	0	12.7	0	10.7	0	11.0	0	10.0	0
23	15.6	0	15.0	0	13.8	0	13.6	0	13.1	0	12.9	0	11.9	0	12.4	0	13.0	0	13.4	0	12.4	0	12.2	0	10.4	0	10.8	0	9.6	0
24	15.2	0	14.6	0	13.5	0	13.2	0	12.9	0	12.5	0	11.5	0	12.0	0	12.6	0	13.0	0	12.1	0	11.7	0	10.3	0	10.5	0	9.2	0

	NOVEMBER																															
	DAYS																															
	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
D	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	8.9	0	9.5	0	9.8	0	10.1	0	9.5	0	9.2	0	9.5	0	8.8	0	9.6	0	9.4	0	9.6	0	8.3	0	8.1	0	7.6	0	7.2	0	7.7	0
2	8.7	0	9.2	0	9.6	0	9.8	0	9.2	0	8.9	0	9.1	0	8.6	0	9.2	0	9.3	0	9.4	0	8.1	0	7.6	0	7.2	0	7.0	0	7.3	0
3	8.5	0	8.9	0	9.4	0	9.5	0	9.0	0	8.5	0	8.5	0	8.3	0	9.2	0	9.1	0	9.3	0	7.6	0	7.3	0	7.0	0	7.0	0	7.1	0
4	8.3	0	8.7	0	9.3	0	9.3	0	8.7	0	8.3	0	8.6	0	8.3	0	9.0	0	9.0	0	9.0	0	7.4	0	7.0	0	6.8	0	6.9	0	6.7	0
5	8.0	0	8.6	0	9.0	0	9.2	0	8.6	0	8.0	0	8.7	0	8.0	0	8.9	0	8.9	0	8.9	0	7.0	0	6.7	0	6.7	0	6.7	0	6.7	0
6	7.8	0	8.2	0	8.8	0	9.0	0	8.4	0	7.7	0	8.5	0	7.9	0	8.8	0	8.7	0	8.6	0	6.9	0	6.4	0	6.5	0	6.6	0	6.5	0
7	8.1	165	8.2	145	9.0	105	8.8	88.6	8.4	114	7.3	100.7	8.3	112.9	8.1	80	8.9	80	8.7	81.43	8.3	152.5	6.9	75	6.5	106.25	6.2	91.43	6.5	56	6.5	70
8	10.2	846	10.2	636	10.9	597	10.5	519	10.0	738	8.8	594	10.4	642	10.7	828	10.6	630	9.9	414	9.7	624	8.7	654	8.3	762	7.9	573.3	8.0	580	8.5	435
9	13.7	1878	13.5	1602	13.5	1284	13.7	1422	13.2	1794	12.3	1674	13.3	1596	13.5	1710	13.4	1470	12.5	1212	12.6	1518	12.0	1572	12.0	1794	11.0	1326	11.1	1416	11.6	1338
10	15.5	2748	15.8	2436	15.8	1974	16.1	2166	15.5	2592	14.6	2424	14.9	2166	15.6	2676	15.3	2244	14.3	2178	14.8	2394	14.3	2442	14.7	2664	13.7	2232	13.4	2244	13.9	2064
11	17.1	3372	17.4	3138	17.3	2652	17.6	2508	17.0	3396	15.5	2580	16.3	2724	17.3	3330	16.6	2898	15.7	2832	16.4	3036	15.6	2892	16.3	3204	15.1	2910	14.7	2628	15.3	2916
12	17.8	3546	18.2	3354	18.1	2934	18.3	2676	18.0	3402	16.1	2886	16.9	2934	17.8	3504	17.5	3090	16.5	3102	16.9	3288	16.6	3258	17.1	3216	16.1	3114	15.4	2898	16.1	3324
13	18.6	3420	18.8	3246	18.5	2808	18.7	2754	18.3	3222	16.3	2736	17.2	2658	18.4	3252	17.7	2790	16.8	2742	17.6	3072	17.6	3228	17.8	3228	16.5	2928	16.1	2814	16.6	3114
14	18.5	2994	18.8	2820	18.8	2502	18.3	2382	18.6	2856	16.6	2388	17.5	2244	18.5	2712	17.9	2418	17.1	2430	17.8	2556	17.9	2760	18.0	2700	16.7	2640	16.1	2490	16.7	2778
15	18.3	2094	18.8	2334	18.7	2112	17.9	1902	18.1	2142	16.5	1836	17.1	1776	18.3	1986	17.6	1740	16.8	2046	17.3	1794	17.6	2160	17.5	1950	16.7	1938	16.0	1938	16.4	2088
16	16.8	1296	17.8	1392	17.9	1248	17.0	1188	17.0	1182	15.6	1113	16.1	960	17.3	1074	16.7	966	16.1	1098	16.1	924	16.3	1176	16.5	945	15.5	1086	15.0	1044	15.3	1080
17	15.0	396.7	15.8	381	16.1	507	15.5	368	15.1	291	14.0	255	14.5	273	15.5	325.6	14.8	288.8	14.4	236.7	14.5	270	14.5	195	14.1	220	13.4	240	13.1	246.7	13.2	180
18	13.7	120	14.2	105	14.6	630	14.0	720	13.1	60	12.9	0	13.1	60	13.7	120	13.3	0	12.8	0	12.8	0	12.8	0	12.2	0	11.5	240	11.6	90	11.8	60
19	12.7	0	12.8	0	13.3	210	12.7	210	12.0	0	12.0	0	11.9	0	12.6	0	12.4	0	11.9	0	11.7	0	11.7	0	10.8	0	10.3	0	10.4	0	10.5	0
20	12.0	0	12.0	0	12.5	0	11.9	0	11.3	0	11.5	0	11.0	0	11.8	0	11.9	0	11.3	0	10.7	0	10.7	0	10.0	0	9.7	0	9.8	0	9.9	0
21	11.7	0	11.4	0	12.1	0	11.5	0	10.7	0	11.0	0	10.6	0	11.4	0	11.2	0	10.8	0	10.2	0	9.9	0	9.5	0	9.0	0	9.2	0	9.3	0
22	10.8	0	10.7	0	11.4	0	10.8	0	10.1	0	10.5	0	10.0	0	10.9	0	10.6	0	10.4	0	9.5	0	9.2	0	8.7	0	8.4	0	8.6	0	8.8	0
23	10.4	0	10.4	0	11.0	0	10.3	0	9.7	0	10.1	0	9.5	0	10.5	0	10.4	0	10.2	0	9.2	0	8.7	0	8.3	0	7.8	0	8.2	0	8.4	0
24	10.0	0	10.1	0	10.6	0	10.0	0	9.4	0	9.8	0	9.1	0	10.0	0	9.9	0	9.9	0	8.9	0	8.4	0	7.8	0	7.5	0	7.9	0	8.1	0

	NOVEMBER																											
	DAYS																											
D	17		18		19		20		21		22		23		24		25		26		27		28		29		30	
H	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	7.6	0	8.3	0	8.1	0	7.1	0	7.8	0	7.7	0	5.1	0	5.3	0	6.1	0	5.2	0	5.1	0	5.1	0	5.2	0	5.5	0
2	7.4	0	8.0	0	7.7	0	6.8	0	7.5	0	7.2	0	4.8	0	5.0	0	5.7	0	5.1	0	4.9	0	5.0	0	4.7	0	5.3	0
3	7.3	0	7.6	0	7.6	0	6.6	0	7.2	0	6.6	0	4.5	0	4.7	0	5.6	0	4.8	0	4.8	0	4.8	0	4.5	0	5.1	0
4	7.2	0	7.3	0	7.5	0	6.5	0	6.9	0	6.2	0	4.3	0	4.6	0	5.2	0	4.5	0	4.7	0	4.5	0	4.4	0	5.1	0
5	7.2	0	7.3	0	7.3	0	6.3	0	6.7	0	5.5	0	4.0	0	4.3	0	4.9	0	4.3	0	4.5	0	4.3	0	4.3	0	5.1	0
6	7.3	0	7.1	0	7.1	0	6.1	0	6.6	0	5.0	0	3.8	0	4.2	0	4.6	0	4.1	0	4.2	0	4.0	0	4.3	0	5.0	0
7	7.3	61.43	7.0	45	6.9	105	6.0	57	6.6	42	5.4	66.67	3.5	63.75	4.1	80	4.4	65	4.1	95	4.1	212	3.8	48	4.3	22.5	4.9	90
8	8.3	462	8.4	360	8.2	345	7.3	396	7.7	408	6.2	534	5.1	375	5.5	486	5.0	313.3	4.9	483.3	5.1	597	4.9	306	5.0	333.75	5.4	333
9	11.6	1428	10.8	1122	10.5	1128	10.3	1254	10.0	1026	8.7	1452	8.4	1272	8.6	1230	7.4	1027	7.7	1287	7.8	1350	7.7	1140	7.6	900	7.2	798
10	14.1	2076	12.8	1974	12.3	2022	12.0	2064	11.9	1680	11.3	2178	10.5	2022	10.3	1758	9.2	1410	9.4	1662	9.8	2130	9.8	1866	9.6	1602	8.6	1218
11	15.2	2628	13.8	2484	13.5	2568	13.5	2622	13.4	2064	12.1	2532	12.3	2730	11.5	2142	10.6	1842	10.7	2244	11.1	2718	11.3	2298	10.8	2118	10.0	1836
12	16.3	2760	14.7	2760	14.7	2808	14.3	2772	14.0	2310	13.0	2682	13.2	3216	12.2	2280	11.3	2256	11.6	2436	12.2	2970	12.3	2532	11.4	2280	10.8	2010
13	16.6	2730	15.0	2640	15.4	2868	14.7	2550	14.4	2496	13.4	2442	13.8	2904	13.0	2364	11.6	1878	12.1	2292	12.9	2766	13.0	2724	11.8	2358	11.0	1884
14	16.7	2310	15.2	2364	15.4	2394	14.8	2076	14.8	2274	13.6	2112	13.9	2586	13.0	2184	11.7	1608	12.6	1968	13.4	2442	13.4	2358	11.7	1956	11.1	1680
15	16.4	1686	14.9	1782	15.2	1812	14.7	1596	14.3	1710	13.3	1626	13.6	1974	12.6	1626	11.4	1302	12.1	1368	13.1	1848	13.4	1812	11.4	1428	11.0	1308
16	15.3	978	14.1	990	14.3	996	13.7	920	13.2	846	12.1	918	12.4	954	11.6	768	10.7	620	11.1	750	11.7	909	12.3	816	10.6	756	10.4	594
17	13.5	183	12.4	232.5	12.3	241.5	12.1	180	11.6	158	10.5	166.7	10.4	179	9.8	195	9.4	150	9.4	223.8	10.2	145.7	10.4	161.3	9.4	156.67	9.1	163.1
18	12.2	0	11.2	0	11.0	90	11.1	0	10.6	0	9.0	60	8.9	180	8.9	0	8.4	0	8.2	240	8.9	0	9.1	0	8.3	60	8.0	0
19	11.0	0	10.5	0	9.9	0	10.0	0	9.8	0	8.0	0	7.9	0	8.0	0	7.5	0	7.5	0	7.9	0	8.0	0	7.6	0	7.4	0
20	10.4	0	10.0	0	9.3	0	9.4	0	9.3	0	7.2	0	7.3	0	7.7	0	6.9	0	7.1	0	7.1	0	7.4	0	7.1	0	6.8	0
21	9.9	0	9.7	0	8.7	0	9.1	0	9.1	0	6.6	0	6.8	0	7.4	0	6.6	0	6.8	0	6.6	0	6.9	0	6.7	0	6.5	0
22	9.2	0	9.0	0	7.9	0	8.5	0	8.5	0	6.1	0	6.2	0	7.0	0	6.2	0	6.2	0	6.1	0	6.3	0	6.2	0	6.0	0
23	9.1	0	8.7	0	7.5	0	8.2	0	8.2	0	5.7	0	5.8	0	6.7	0	5.9	0	5.8	0	5.7	0	6.0	0	6.1	0	5.6	0
24	8.8	0	8.4	0	7.4	0	8.0	0	7.9	0	5.4	0	5.6	0	6.3	0	5.5	0	5.4	0	5.5	0	5.5	0	5.8	0	5.3	0

	DECEMBER																															
	DAYS																															
	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
D	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	5.0	0	4.8	0	5.8	0	5.5	0	4.8	0	5.6	0	5.6	0	5.7	0	6.2	0	5.3	0	3.7	0	3.1	0	3.9	0	3.3	0	4.3	0	2.8	0
2	4.8	0	4.8	0	5.6	0	5.2	0	4.5	0	5.5	0	5.3	0	5.6	0	6.0	0	5.0	0	3.4	0	2.9	0	3.6	0	2.8	0	4.1	0	2.5	0
3	4.6	0	4.6	0	5.3	0	4.9	0	4.1	0	5.2	0	5.1	0	5.4	0	5.8	0	4.9	0	3.0	0	2.7	0	3.4	0	2.6	0	4.0	0	2.4	0
4	4.2	0	4.5	0	4.9	0	4.6	0	3.9	0	4.9	0	5.0	0	5.3	0	5.5	0	4.6	0	2.8	0	2.5	0	3.1	0	2.4	0	3.9	0	2.1	0
5	4.0	0	4.4	0	4.7	0	4.1	0	3.7	0	4.6	0	4.8	0	5.1	0	5.3	0	4.3	0	2.5	0	2.4	0	2.9	0	2.1	0	3.9	0	2.1	0
6	3.7	0	4.3	0	4.5	0	3.8	0	3.5	0	4.4	0	4.7	0	5.0	0	5.2	0	4.3	0	2.5	0	2.4	0	2.6	0	2.0	0	3.7	0	2.1	0
7	3.5	40	4.2	40	4.5	35	3.7	30	3.4	45	4.5	60	4.6	10	5.1	0	5.3	0	4.3	45	2.3	20	2.3	0	2.5	127.5	2.0	30	3.6	0	2.1	0
8	4.9	327	5.6	258	5.3	310	4.4	234	4.4	220	5.1	136.7	5.1	183	5.3	109	5.6	155	4.9	288	2.8	223.3	2.7	163.3	3.1	218.57	2.6	140	3.7	243.3	2.6	207
9	8.0	1134	8.0	852	7.9	864	7.0	876	6.8	792	7.3	624	6.6	666	6.9	450	7.1	510	7.6	918	5.9	840	5.6	780	4.7	600	5.4	666	4.9	926.7	4.2	726
10	10.3	1974	10.2	1614	9.8	1410	9.8	1506	9.6	1542	9.2	1380	8.4	1248	8.0	1020	8.8	1002	9.4	1794	8.6	1632	7.5	1320	7.1	1176	7.5	1452	5.8	1370	5.6	1206
11	11.6	2526	11.3	2166	11.3	1902	11.2	2022	11.5	2226	10.4	1854	9.8	1830	9.0	1308	9.7	1392	10.8	2358	10.1	2268	9.0	1956	8.3	1794	8.7	2034	6.7	1674	6.8	1782
12	12.5	2688	12.6	2250	12.0	2100	11.9	2166	12.3	2352	10.8	1926	10.4	1884	9.4	1398	10.4	1578	11.6	2376	10.7	2526	10.0	2256	8.9	1770	9.3	1824	7.0	1764	7.5	1944
13	12.8	2640	13.1	2268	12.3	2112	12.7	2280	12.8	2298	11.5	2016	10.8	1812	10.0	1452	10.8	1848	12.2	2472	11.0	2304	10.5	2076	9.4	1932	9.6	1854	7.5	1980	8.3	2202
14	13.0	2154	13.2	2058	12.7	1872	12.7	2100	13.2	2262	11.4	1836	11.1	1662	10.3	1368	11.1	1758	12.2	2196	11.3	2118	10.6	1794	9.5	1788	9.8	1836	7.7	1638	8.5	1920
15	12.5	1656	13.0	1578	12.3	1548	12.5	1524	12.7	1632	10.8	1224	10.7	1254	10.2	1200	10.8	1380	12.0	1662	10.9	1500	10.2	1398	9.3	1266	9.6	1332	7.5	1386	8.4	1308
16	11.5	894	11.8	750	11.2	846	11.5	702	11.5	840	9.9	576	10.1	642	9.8	572	10.2	618	11.1	822	10.0	696	8.9	684	8.4	630	8.9	618	6.9	820	7.8	654
17	9.4	170	10.2	195	10.0	134.44	9.8	164	9.9	170	8.9	124.5	8.7	183.8	8.6	165	9.1	190	8.7	150	8.2	107.8	7.7	196.7	7.0	154.44	8.0	150	5.8	162.2	6.5	150
18	8.1	0	9.0	0	8.8	0	8.6	0	8.8	0	8.1	90	7.9	0	8.0	0	7.9	0	7.2	0	6.9	0	6.9	240	6.0	0	7.1	0	4.9	0	5.6	0
19	7.3	0	8.3	0	7.7	0	7.6	0	7.9	0	7.5	0	7.3	0	7.5	0	7.1	0	6.1	0	5.8	0	6.1	0	5.4	0	6.4	0	4.6	0	5.1	0
20	6.7	0	7.7	0	7.2	0	6.7	0	7.3	0	7.0	0	6.9	0	7.0	0	6.8	0	5.6	0	5.3	0	5.5	0	5.0	0	5.9	0	4.2	0	4.7	0
21	6.2	0	7.3	0	6.9	0	6.2	0	6.9	0	6.7	0	6.6	0	6.8	0	6.7	0	5.2	0	5.0	0	5.2	0	4.7	0	5.6	0	4.0	0	4.2	0
22	5.5	0	6.9	0	6.3	0	5.7	0	6.5	0	6.4	0	6.3	0	6.5	0	6.2	0	4.7	0	4.3	0	4.9	0	4.2	0	5.0	0	3.7	0	3.8	0
23	5.1	0	6.5	0	6.1	0	5.5	0	6.2	0	6.1	0	6.1	0	6.4	0	5.9	0	4.4	0	3.8	0	4.5	0	3.8	0	4.8	0	3.5	0	3.6	0
24	4.9	0	6.4	0	5.8	0	5.2	0	5.9	0	5.9	0	5.9	0	6.3	0	5.6	0	4.0	0	3.5	0	4.2	0	3.6	0	4.6	0	3.1	0	3.4	0

	DECEMBER																													
	DAYS																													
	17		18		19		20		21		22		23		24		25		26		27		28		29		30		31	
D																														
H	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I	To	I
1	3.3	0	4.3	0	3.6	0	2.2	0	1.6	0	1.8	0	3.1	0	2.1	0	2.3	0	2.3	0	1.4	0	1.5	0	2.5	0	2.1	0	2.9	0
2	3.3	0	4.1	0	3.5	0	2.0	0	1.4	0	1.5	0	2.9	0	2.1	0	2.1	0	2.0	0	1.1	0	1.3	0	2.1	0	1.7	0	2.7	0
3	3.2	0	4.0	0	3.2	0	1.8	0	1.1	0	1.2	0	2.8	0	2.1	0	1.9	0	1.8	0	0.8	0	1.3	0	1.8	0	1.5	0	2.6	0
4	3.1	0	3.9	0	3.0	0	1.7	0	0.9	0	1.0	0	2.6	0	1.9	0	1.9	0	1.6	0	0.4	0	1.2	0	1.5	0	1.0	0	2.5	0
5	2.9	0	3.8	0	2.9	0	1.7	0	0.4	0	0.9	0	2.6	0	1.7	0	1.7	0	1.4	0	0.2	0	1.2	0	1.4	0	0.8	0	2.5	0
6	2.8	0	3.6	0	2.8	0	1.6	0	0.3	0	0.7	0	2.5	0	1.6	0	1.6	0	1.2	0	0.0	0	1.3	0	1.2	0	0.8	0	2.5	0
7	2.8	15	3.5	17.5	2.7	0	1.6	0	0.2	0	0.9	15	2.4	0	1.7	0	1.6	0	1.0	30	0.2	0	1.2	0	1.1	0	0.7	0	2.5	0
8	3.2	270	3.6	184.29	2.8	202.78	1.8	169	0.5	177	1.1	165	2.4	131.3	1.8	146.3	1.8	125.8	1.0	125	0.1	148.1	1.6	92.86	1.4	111	1.0	216.1	2.7	103.1
9	5.2	813.3	5.2	529.5	3.8	726	3.4	603	2.4	762	2.7	720	3.3	477	3.2	697.5	3.2	606.7	2.9	593.3	1.9	666.7	3.2	594	3.1	582	3.0	853.3	3.8	564
10	7.3	1440	6.7	1020	4.8	1236	4.9	1254	5.0	1554	4.7	1242	4.1	942	4.0	1153	4.7	1071	3.9	1236	4.3	1314	5.0	1224	4.9	1170	5.2	1494	5.8	1332
11	8.2	1866	7.9	1428	6.2	1596	6.1	1830	6.2	2094	6.1	1806	4.9	1302	4.7	1373	5.3	1746	4.8	1596	5.1	1830	6.2	1890	5.7	1716	6.3	1968	6.8	1830
12	9.1	1956	8.4	1512	6.7	1728	6.7	1860	7.3	2268	6.9	2076	5.4	1428	5.1	1453	6.1	1908	5.6	1458	5.8	1896	7.2	2094	6.0	1812	7.3	2244	7.6	1980
13	9.6	1986	8.9	1650	7.4	1920	7.2	1974	8.2	2502	7.6	2382	5.7	1446	5.6	1332	6.4	1710	6.1	1692	6.3	2004	8.1	1980	6.1	1710	8.4	2310	8.4	1992
14	9.7	1752	9.0	1590	7.4	1608	7.4	1992	8.4	2280	7.8	2058	5.9	1368	6.0	1386	6.6	1500	6.5	2022	6.6	2112	8.5	1962	6.2	1428	8.6	1926	8.7	1770
15	9.7	1158	8.9	1062	7.0	1212	7.2	1458	8.2	1602	7.5	1410	5.7	942	5.9	1008	6.4	1290	6.4	1386	6.3	1660	8.1	1362	6.2	1092	8.6	1452	8.9	1482
16	9.0	570	8.4	666	6.5	696	6.6	714	7.4	834	6.7	666	5.3	495	5.4	750	5.9	720	6.0	642	5.6	956.7	7.3	740	5.8	630	7.8	746.7	8.5	906.7
17	7.6	96.7	7.4	178.89	5.7	126.43	5.5	132	6.0	189	5.7	117.5	4.6	150.6	5.1	150	4.9	180	5.0	164.4	4.6	266.3	6.0	370	5.0	134.7	6.5	238.6	7.0	202.8
18	6.8	0	6.2	0	4.9	0	4.5	0	5.0	0	4.8	0	4.0	0	4.4	0	4.3	30	4.1	0	3.8	45	5.1	0	4.4	15	5.7	0	5.8	30
19	6.2	0	5.4	0	4.3	0	3.6	0	4.3	0	4.5	0	3.4	0	4.0	0	3.7	0	3.3	0	3.2	0	4.3	0	3.9	0	5.1	0	5.1	0
20	5.8	0	5.0	0	3.9	0	3.1	0	3.4	0	4.1	0	3.0	0	3.7	0	3.3	0	3.1	0	2.6	0	3.9	0	3.4	0	4.8	0	4.4	0
21	5.5	0	4.7	0	3.7	0	3.0	0	2.9	0	3.9	0	2.7	0	3.3	0	3.0	0	2.7	0	2.4	0	3.6	0	3.2	0	4.3	0	3.9	0
22	5.0	0	4.5	0	3.2	0	2.5	0	2.6	0	3.7	0	2.6	0	3.0	0	2.9	0	2.3	0	1.9	0	3.2	0	2.8	0	3.9	0	3.5	0
23	4.7	0	4.2	0	2.9	0	2.2	0	2.3	0	3.4	0	2.4	0	2.8	0	2.7	0	2.1	0	1.8	0	3.0	0	2.5	0	3.6	0	3.3	0
24	4.6	0	3.9	0	2.4	0	2.0	0	1.9	0	3.2	0	2.2	0	2.7	0	2.5	0	1.8	0	1.7	0	2.8	0	2.3	0	3.2	0	3.0	0

APPENDIX D

Results of CLTD values

Table D.1. CLTD values of some cities of Turkey and Iraq

Ankara (Light) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W1 - 2 cm outer plaster + 19 cm Brick + 2 cm inner plaster (Light surface)																							
N	9.4	8.8	7.8	6.8	5.9	4.9	3.8	2.7	1.7	1.8	2.1	2.2	2.6	3.8	5.0	6.1	7.0	7.9	8.5	8.9	9.1	10.8	10.1	9.9
E	9.5	8.9	7.9	6.9	6.0	4.9	3.9	2.7	1.8	1.8	2.1	2.3	2.4	3.1	3.4	4.8	6.1	7.2	8.1	8.7	9.1	11.0	10.2	10.1
S	9.7	9.1	8.1	7.1	6.1	5.0	4.0	2.8	1.8	1.9	2.4	2.5	3.6	4.7	5.8	6.8	7.6	8.3	8.9	9.4	9.7	11.6	10.6	10.3
W	10.2	9.5	8.4	7.3	6.3	5.2	4.1	2.9	2.1	2.2	3.1	4.0	5.4	6.6	5.8	6.6	7.1	7.7	8.3	9.8	9.3	11.5	10.8	10.7
	W2 - 2 cm outer plaster + 20 cm AAC + 2 cm inner plaster (Light surface)																							
N	10.6	9.5	8.2	6.8	5.5	4.2	2.8	1.5	0.9	1.0	1.1	1.4	1.6	2.6	4.5	6.3	7.9	9.3	10.3	10.9	11.2	10.8	11.5	11.5
E	10.7	9.6	8.3	6.9	5.6	4.2	2.9	1.5	1.0	1.1	1.3	1.5	1.7	2.7	2.9	5.0	7.0	8.6	9.9	10.7	11.2	11.0	11.6	11.7
S	10.9	9.8	8.5	7.1	5.7	4.3	3.0	1.6	1.1	1.0	1.4	1.6	1.9	3.5	5.3	7.0	8.5	9.7	10.7	11.4	11.8	11.6	12.0	11.9
W	11.4	10.2	8.8	7.3	5.9	4.5	3.1	1.7	1.3	1.2	1.5	2.0	3.7	5.4	5.3	6.8	8.0	9.1	10.1	11.8	11.4	11.5	12.2	12.3
	W3 - 2 cm outer plaster + 20 cm Blokbims + 2 cm inner plaster (Light surface)																							
N	10.8	9.9	8.8	7.5	6.4	5.2	3.8	2.6	1.6	1.0	0.9	0.9	1.3	1.7	2.2	2.7	4.6	6.5	8.2	9.5	10.7	11.2	11.6	11.4
E	10.9	10.0	8.9	7.6	6.5	5.2	3.9	2.6	1.4	1.1	1.0	1.0	1.3	1.9	2.3	2.4	3.7	5.8	7.8	9.3	10.7	11.4	11.7	11.6
S	11.1	10.2	9.1	7.8	6.6	5.3	4.0	2.7	1.8	1.2	1.1	1.1	1.5	2.1	2.5	3.4	5.2	6.9	8.6	10.0	11.3	12.0	12.1	11.8
W	11.6	10.6	9.4	8.0	6.8	5.5	4.1	2.8	1.8	1.3	1.3	1.4	1.7	2.4	2.7	3.2	4.7	6.3	8.0	10.4	10.9	11.9	12.3	12.2
	W4 - 2 cm outer plaster + 8.5 cm Brick + 3 cm XPS + 8.5 cm Brick+ 2 cm inner plaster (Light surface)																							
N	10.3	10.1	9.5	8.7	8.0	7.1	6.0	4.9	3.7	2.4	1.7	2.1	2.1	2.1	2.5	2.3	2.5	3.8	5.2	6.6	7.9	8.8	9.8	10.2
E	10.4	10.2	9.6	8.8	8.1	7.1	6.1	4.9	3.4	1.7	1.8	2.1	2.2	2.3	2.4	2.4	2.6	3.1	4.8	6.4	7.9	9.0	9.9	10.4
S	10.6	10.4	9.8	9.0	8.2	7.2	6.2	5.0	3.9	2.9	1.9	2.3	2.4	2.5	2.6	2.8	3.1	4.2	5.6	7.1	8.5	9.6	10.3	10.6
W	11.1	10.8	10.1	9.2	8.4	7.4	6.3	5.1	3.9	2.8	2.0	2.7	2.7	2.8	2.9	3.1	3.1	3.6	5.0	7.5	8.1	9.5	10.5	11.0
	W5 - 2 cm outer plaster + 20 cm Briquette + 2 cm inner plaster (Light surface)																							
N	8.6	7.8	6.8	5.7	4.7	3.7	2.6	1.6	0.9	0.7	1.1	1.8	2.7	2.9	4.4	5.8	7.1	8.3	9.1	9.7	10.0	9.8	9.8	9.3
E	8.7	7.9	6.9	5.8	4.8	3.7	2.7	1.6	1.0	0.1	1.2	1.9	2.9	3.1	3.8	4.5	6.2	7.6	8.7	9.5	10.0	10.0	9.9	9.5

S	8.9	8.1	7.1	6.0	4.9	3.8	2.8	1.7	1.1	1.0	1.5	2.1	3.5	3.8	5.2	6.5	7.7	8.7	9.5	10.2	10.6	10.6	10.3	9.7
W	9.4	8.5	7.4	6.2	5.1	4.0	2.9	1.8	1.3	1.5	1.7	2.9	4.3	5.7	5.2	6.3	7.2	8.1	8.9	10.6	10.2	10.5	10.5	10.1
	W6 - 2cm plaster +19cm Brick +2cm plaster +3cmXPS (Light surface)																							
N	8.3	8.6	8.6	8.5	8.4	8.2	7.7	7.2	6.5	5.4	4.3	3.3	2.3	1.8	1.4	1.3	1.6	2.2	3.0	3.8	4.9	5.8	6.9	7.7
E	8.4	8.7	8.7	8.6	8.5	8.2	7.8	7.2	6.2	4.7	3.4	1.7	0.5	1.2	1.1	0.9	0.7	1.5	2.6	3.6	4.9	6.0	7.0	7.9
S	8.6	8.9	8.9	8.8	8.6	8.3	7.9	7.3	6.7	5.9	4.9	4.1	3.3	2.7	2.2	2.0	2.2	2.6	3.4	4.3	5.5	6.6	7.4	8.1
W	9.1	9.3	9.2	9.0	8.8	8.5	8.0	7.4	6.7	5.8	5.0	5.6	5.1	4.6	2.2	1.8	1.7	2.0	2.8	4.7	5.1	6.5	7.6	8.5
	W7 - 2cm plaster +13.5cm Brick +2.5cm EPS + 8.5cm Brick+2cm plaster (Light surface)																							
N	9.8	10.2	10.1	9.9	9.6	9.1	8.4	7.5	6.4	4.9	3.5	2.2	2.0	1.9	1.0	1.2	1.3	1.3	2.5	3.8	5.4	6.7	8.2	9.2
E	9.9	10.3	10.2	10.0	9.7	9.1	8.5	7.5	6.1	4.2	2.6	2.4	2.1	2.1	1.1	1.3	1.4	0.5	2.1	3.6	5.4	6.9	8.3	9.4
S	10.1	10.5	10.4	10.2	9.8	9.2	8.6	7.6	6.6	5.4	4.1	3.1	2.7	2.3	1.3	1.5	1.6	1.7	2.9	4.3	6.0	7.5	8.7	9.6
W	10.6	10.9	10.7	10.4	10.0	9.4	8.7	7.7	6.6	5.3	4.2	4.4	3.6	2.8	1.5	1.7	1.8	2.1	2.3	4.7	5.6	7.4	8.9	10.0
	W8 - 2cm plaster +19cm Brick + 2cm plaster +30mm XPS + Siding (Light surface)																							
N	11.0	11.2	11.1	10.8	10.6	10.2	9.6	8.9	8.0	6.8	5.7	4.6	3.8	3.3	3.2	3.3	3.8	4.6	5.5	6.6	7.7	8.6	9.8	10.5
E	11.1	11.3	11.2	10.9	10.7	10.2	9.7	8.9	7.7	6.1	4.8	3.0	2.0	1.4	1.6	2.0	2.9	3.9	5.1	6.4	7.7	8.8	9.9	10.7
S	11.3	11.5	11.4	11.1	10.8	10.3	9.8	9.0	8.2	7.3	6.3	5.4	4.8	4.2	4.0	4.0	4.4	5.0	5.9	7.1	8.3	9.4	10.3	10.9
W	11.8	11.9	11.7	11.3	11.0	10.5	9.9	9.1	8.2	7.2	6.4	6.9	6.6	6.1	4.0	3.8	3.9	4.4	5.3	7.5	7.9	9.3	10.5	11.3
	R1 - 4cm concrete+5cm XPS+12cm concrete+2cm plaster (Light surface)																							
	14	14	13	12	9.6	8.9	8.4	7.6	7.5	8.4	8.5	11	13	17	19	20	22	22.4	23.3	23	22	21	20	17.9
	R2 - 12cm concrete +2cm inner plaster (Light surface)																							
	4.5	4.1	2.4	1.8	1.1	0.4	0.3	2.4	6.5	12	19	26	32	38	40	41	41	36.9	31.9	25	18	14	9.8	7.6

Ankara (Dark) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W1 - 2 cm outer plaster + 19 cm Brick + 2 cm inner plaster (Dark surface)																							
N	12.6	11.3	9.7	8.2	6.8	5.4	4.0	2.8	1.6	1.8	2.3	3.6	5.5	7.7	10.0	12.0	13.6	14.9	15.6	15.8	15.5	16.5	14.9	13.9
E	12.9	11.6	10.0	8.4	7.0	5.5	4.2	2.9	1.7	1.8	2.5	3.6	5.6	7.9	10.3	12.5	14.3	15.6	16.4	16.6	16.2	17.2	15.4	14.4
S	13.1	11.7	10.1	8.6	7.1	5.6	4.2	2.9	1.7	1.9	2.9	4.5	6.7	9.1	11.5	13.6	15.2	16.4	17.0	17.1	16.6	17.6	15.7	14.5
W	15.3	13.6	11.7	9.9	8.2	6.6	5.0	3.6	2.2	2.3	3.3	6.2	8.5	10.8	11.1	13.0	14.6	16.1	17.3	18.0	18.2	19.7	18.0	16.8
	W2 - 2 cm outer plaster + 20 cm AAC + 2 cm inner plaster (Dark surface)																							
N	13.8	12.0	10.1	8.2	6.4	4.7	3.0	1.6	1.6	1.2	1.7	1.6	3.8	6.5	9.5	12.2	14.5	16.3	17.4	17.8	17.6	16.5	16.3	15.5
E	14.1	12.3	10.4	8.4	6.6	4.8	3.2	1.7	1.7	1.3	1.8	1.6	3.9	6.7	9.8	12.7	15.2	17.0	18.2	18.6	18.3	17.2	16.8	16.0
S	14.3	12.4	10.5	8.6	6.7	4.9	3.2	1.7	1.9	1.5	1.9	2.5	5.0	7.9	11.0	13.8	16.1	17.8	18.8	19.1	18.7	17.6	17.1	16.1
W	16.5	14.3	12.1	9.9	7.8	5.9	4.0	2.4	2.1	1.6	2.6	4.2	6.8	9.6	10.6	13.2	15.5	17.5	19.1	20.0	20.3	19.7	19.4	18.4
	W3 - 2 cm outer plaster + 20 cm Blokbims + 2 cm inner plaster (Dark surface)																							
N	14.0	12.4	10.7	8.9	7.3	5.7	4.0	2.7	1.7	1.2	1.6	0.4	1.6	3.5	5.9	8.6	11.2	13.5	15.3	16.4	17.1	16.9	16.4	15.4
E	14.3	12.7	11.0	9.1	7.5	5.8	4.2	2.8	1.8	1.3	1.9	0.4	1.7	3.7	6.2	9.1	11.9	14.2	16.1	17.2	17.8	17.6	16.9	15.9
S	14.5	12.8	11.1	9.3	7.6	5.9	4.2	2.8	1.9	1.5	2.1	1.3	2.8	4.9	7.4	10.2	12.8	15.0	16.7	17.7	18.2	18.0	17.2	16.0
W	16.7	14.7	12.7	10.6	8.7	6.9	5.0	3.5	2.4	1.7	2.3	3.0	4.6	6.6	7.0	9.6	12.2	14.7	17.0	18.6	19.8	20.1	19.5	18.3
	W4 - 2 cm outer plaster + 8.5 cm Brick + 3 cm XPS + 8.5 cm Brick+ 2 cm inner plaster (Dark surface)																							
N	13.5	12.6	11.4	10.1	8.9	7.6	6.2	5.0	3.8	2.9	2.4	2.3	2.8	3.9	5.5	7.2	9.1	10.8	12.3	13.5	14.3	14.5	14.6	14.2
E	13.8	12.9	11.7	10.3	9.1	7.7	6.4	5.1	3.8	2.9	2.6	2.3	2.9	4.1	5.8	7.7	9.8	11.5	13.1	14.3	15.0	15.2	15.1	14.7
S	14.0	13.0	11.8	10.5	9.2	7.8	6.4	5.1	4.0	3.3	3.0	3.2	4.0	5.3	7.0	8.8	10.7	12.3	13.7	14.8	15.4	15.6	15.4	14.8
W	16.2	14.9	13.4	11.8	10.3	8.8	7.2	5.8	4.5	3.7	3.4	4.9	5.8	7.0	6.6	8.2	10.1	12.0	14.0	15.7	17.0	17.7	17.7	17.1
	W5 - 2 cm outer plaster + 20 cm Briquette + 2 cm inner plaster (Dark surface)																							
N	11.8	10.3	8.7	7.1	5.6	4.2	2.8	1.7	1.0	1.2	1.4	2.5	4.4	6.8	9.4	11.7	13.7	15.3	16.2	16.6	16.4	15.5	14.6	13.3
E	12.1	10.6	9.0	7.3	5.8	4.3	3.0	1.8	1.0	1.3	1.5	2.5	4.5	7.0	9.7	12.2	14.4	16.0	17.0	17.4	17.1	16.2	15.1	13.8

S	12.3	10.7	9.1	7.5	5.9	4.4	3.0	1.8	1.2	1.4	1.9	3.4	5.6	8.2	10.9	13.3	15.3	16.8	17.6	17.9	17.5	16.6	15.4	13.9
W	14.5	12.6	10.7	8.8	7.0	5.4	3.8	2.5	1.7	1.8	2.3	5.1	7.4	9.9	10.5	12.7	14.7	16.5	17.9	18.8	19.1	18.7	17.7	16.2
	W6 - 2cm plaster +19cm Brick +2cm plaster +3cmXPS (Dark surface)																							
N	11.5	11.1	10.5	9.9	9.3	8.7	7.9	7.3	6.6	5.9	5.4	5.2	5.2	5.7	6.4	7.2	8.2	9.2	10.1	10.7	11.3	11.5	11.7	11.7
E	11.8	11.4	10.8	10.1	9.5	8.8	8.1	7.4	6.6	5.9	5.6	5.2	5.3	5.9	6.7	7.7	8.9	9.9	10.9	11.5	12.0	12.2	12.2	12.2
S	12.0	11.5	10.9	10.3	9.6	8.9	8.1	7.4	6.8	6.3	6.0	6.1	6.4	7.1	7.9	8.8	9.8	10.7	11.5	12.0	12.4	12.6	12.5	12.3
W	14.2	13.4	12.5	11.6	10.7	9.9	8.9	8.1	7.3	6.7	6.4	7.8	8.2	8.8	7.5	8.2	9.2	10.4	11.8	12.9	14.0	14.7	14.8	14.6
	W7 - 2cm plaster +13.5cm Brick +2.5cm EPS + 8.5cm Brick+2cm plaster (Dark surface)																							
N	13.0	12.7	12.0	11.3	10.5	9.6	8.6	7.6	6.5	5.4	4.6	4.0	3.7	3.9	4.6	5.6	6.9	8.3	9.6	10.7	11.8	12.4	13.0	13.2
E	13.3	13.0	12.3	11.5	10.7	9.7	8.8	7.7	6.5	5.4	4.8	4.0	3.8	4.1	4.9	6.1	7.6	9.0	10.4	11.5	12.5	13.1	13.5	13.7
S	13.5	13.1	12.4	11.7	10.8	9.8	8.8	7.7	6.7	5.8	5.2	4.9	4.9	5.3	6.1	7.2	8.5	9.8	11.0	12.0	12.9	13.5	13.8	13.8
W	15.7	15.0	14.0	13.0	11.9	10.8	9.6	8.4	7.2	6.2	5.6	6.6	6.7	7.0	5.7	6.6	7.9	9.5	11.3	12.9	14.5	15.6	16.1	16.1
	W8 - 2cm plaster +19cm Brick + 2cm plaster +30mm XPS + Siding (Dark surface)																							
N	14.2	13.7	13.0	12.2	11.5	10.7	9.8	9.0	8.1	7.3	6.8	6.5	6.7	7.2	8.2	9.2	10.4	11.6	12.6	13.5	14.1	14.3	14.6	14.5
E	14.5	14.0	13.3	12.4	11.7	10.8	10.0	9.1	8.1	7.3	7.0	6.5	6.8	7.4	8.5	9.7	11.1	12.3	13.4	14.3	14.8	15.0	15.1	15.0
S	14.7	14.1	13.4	12.6	11.8	10.9	10.0	9.1	8.3	7.7	7.4	7.4	7.9	8.6	9.7	10.8	12.0	13.1	14.0	14.8	15.2	15.4	15.4	15.1
W	16.9	16.0	15.0	13.9	12.9	11.9	10.8	9.8	8.8	8.1	7.8	9.1	9.7	10.3	9.3	10.2	11.4	12.8	14.3	15.7	16.8	17.5	17.7	17.4
	R1 - 4cm concrete+5cm XPS+12cm concrete+2cm plaster (Dark surface)																							
	19	19.7	18.1	16.3	14.2	13.4	12.5	11.5	11.0	11.5	12.2	14	17	21	24.3	26.1	28.6	29.5	31.2	30.8	30	28.1	25.8	23.1
	R2 - 12cm concrete +2cm inner plaster (Dark surface)																							
	8.6	7.6	4.8	3.9	3	1.9	2.1	4.5	9.1	15.5	21.9	30	35.6	41.6	44.7	45.5	45.9	42	37.8	31	26	20.5	15.6	12.5

Istanbul (Light) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W1 - 2 cm outer plaster + 19 cm Brick + 2 cm inner plaster (Light surface)																							
N	6.5	6.1	5.4	4.7	4.2	3.6	2.9	2.4	2.4	2.1	2.0	2.0	2.3	3.0	3.9	4.0	5.1	6.1	6.8	7.3	7.6	7.5	7.5	7.2
E	6.6	6.2	5.5	4.8	4.3	3.6	3.0	2.3	2.2	2.0	1.9	1.8	2.5	2.1	3.3	3.7	4.2	5.4	6.4	7.1	7.6	7.7	7.6	7.4
S	6.8	6.4	5.7	5.0	4.4	3.7	3.1	2.5	2.5	2.3	2.6	2.8	3.3	3.9	4.7	4.7	5.7	6.5	7.2	7.8	8.2	8.3	8.0	7.6
W	7.3	6.8	6.0	5.2	4.6	3.9	3.2	2.5	2.4	2.6	2.7	4.3	5.1	5.8	4.7	4.5	5.2	5.9	6.6	7.2	7.8	8.2	8.2	8.0
	W2 - 2 cm outer plaster + 20 cm AAC + 2 cm inner plaster (Light surface)																							
N	7.5	6.5	5.4	4.3	3.5	2.7	1.9	1.2	1.0	0.5	0.3	0.3	0.8	1.8	3.2	3.8	5.5	7.1	8.3	9.1	9.6	9.3	9.1	8.4
E	7.6	6.6	5.5	4.4	3.6	2.7	2.0	1.1	0.8	0.4	0.2	0.1	1.0	0.9	2.6	3.5	4.6	6.4	7.9	8.9	9.6	9.5	9.2	8.6
S	7.8	6.8	5.7	4.6	3.7	2.8	2.1	1.3	1.1	0.7	0.9	1.1	1.8	2.7	4.0	4.5	6.1	7.5	8.7	9.6	10.2	10.1	9.6	8.8
W	8.3	7.2	6.0	4.8	3.9	3.0	2.2	1.3	1.0	1.0	1.0	2.6	3.6	4.6	4.0	4.3	5.6	6.9	8.1	9.0	9.8	10.0	9.8	9.2
	W3 - 2 cm outer plaster + 20 cm Blokbims + 2 cm inner plaster (Light surface)																							
N	7.8	7.0	6.1	5.1	4.4	3.6	2.8	2.1	1.8	1.2	0.9	0.7	0.8	1.6	2.6	3.0	4.5	6.0	7.3	8.2	8.9	8.9	8.9	8.5
E	7.9	7.1	6.2	5.2	4.5	3.6	2.9	2.0	1.6	1.1	0.8	0.5	1.0	0.7	2.0	2.7	3.6	5.3	6.9	8.0	8.9	9.1	9.0	8.7
S	8.1	7.3	6.4	5.4	4.6	3.7	3.0	2.2	1.9	1.4	1.5	1.5	1.8	2.5	3.4	3.7	5.1	6.4	7.7	8.7	9.5	9.7	9.4	8.9
W	8.6	7.7	6.7	5.6	4.8	3.9	3.1	2.2	1.8	1.7	1.6	3.0	3.6	4.4	3.4	3.5	4.6	5.8	7.1	8.1	9.1	9.6	9.6	9.3
	W4 - 2 cm outer plaster + 8.5 cm Brick + 3 cm XPS + 8.5 cm Brick+ 2 cm inner plaster (Light surface)																							
N	7.9	7.7	7.2	6.6	6.0	5.4	4.7	4.1	3.8	3.0	2.5	1.8	1.4	1.5	1.8	1.5	2.4	3.5	4.6	5.6	6.6	7.1	7.8	8.0
E	8.0	7.8	7.3	6.7	6.1	5.4	4.8	4.0	3.6	2.9	2.4	1.6	1.6	0.6	1.2	1.2	1.5	2.8	4.2	5.4	6.6	7.3	7.9	8.2
S	8.2	8.0	7.5	6.9	6.2	5.5	4.9	4.2	3.9	3.2	3.1	2.6	2.4	2.4	2.6	2.2	3.0	3.9	5.0	6.1	7.2	7.9	8.3	8.4
W	8.7	8.4	7.8	7.1	6.4	5.7	5.0	4.2	3.8	3.5	3.2	4.1	4.2	4.3	2.6	2.0	2.5	3.3	4.4	5.5	6.8	7.8	8.5	8.8
	W5 - 2 cm outer plaster + 20 cm Briquette + 2 cm inner plaster (Light surface)																							
N	5.9	5.3	4.6	3.8	3.2	2.7	2.1	1.7	1.9	1.9	2.3	2.7	3.4	4.4	5.6	5.7	6.6	7.3	7.8	7.8	7.7	7.2	6.9	6.4
E	6.0	5.4	4.7	3.9	3.3	2.7	2.2	1.6	1.7	1.8	2.2	2.5	3.6	3.5	5.0	5.4	5.7	6.6	7.4	7.6	7.7	7.4	7.0	6.6

S	6.2	5.6	4.9	4.1	3.4	2.8	2.3	1.8	2.0	2.1	2.9	3.5	4.4	5.3	6.4	6.4	7.2	7.7	8.2	8.3	8.3	8.0	7.4	6.8
W	6.7	6.0	5.2	4.3	3.6	3.0	2.4	1.8	1.9	2.4	3.0	5.0	6.2	7.2	6.4	6.2	6.7	7.1	7.6	7.7	7.9	7.9	7.6	7.2
	W6 - 2cm plaster +19cm Brick +2cm plaster +3cmXPS (Light surface)																							
N	6.6	6.9	7.0	6.9	6.9	6.8	6.5	6.3	6.2	5.6	4.9	4.0	3.1	2.5	2.1	1.0	1.2	1.6	2.2	2.9	3.8	4.5	5.5	6.1
E	6.7	7.0	7.1	7.0	7.0	6.8	6.6	6.2	6.0	5.5	4.8	3.8	3.3	1.6	1.5	0.7	0.3	0.9	1.8	2.7	3.8	4.7	5.6	6.3
S	6.9	7.2	7.3	7.2	7.1	6.9	6.7	6.4	6.3	5.8	5.5	4.8	4.1	3.4	2.9	1.7	1.8	2.0	2.6	3.4	4.4	5.3	6.0	6.5
W	7.4	7.6	7.6	7.4	7.3	7.1	6.8	6.4	6.2	6.1	5.6	6.3	5.9	5.3	2.9	1.5	1.3	1.4	2.0	2.8	4.0	5.2	6.2	6.9
	W7 - 2cm plaster +13.5cm Brick +2.5cm EPS + 8.5cm Brick+2cm plaster (Light surface)																							
N	7.8	8.2	8.1	7.9	7.6	7.1	6.4	5.6	5.0	3.7	2.5	1.1	-0.2	-1.0	-1.4	-2.3	-1.7	-0.8	0.5	1.8	3.4	4.7	6.2	7.2
E	7.9	8.3	8.2	8.0	7.7	7.1	6.5	5.5	4.8	3.6	2.4	0.9	0.0	-1.9	-2.0	-2.6	-2.6	-1.5	0.1	1.6	3.4	4.9	6.3	7.4
S	8.1	8.5	8.4	8.2	7.8	7.2	6.6	5.7	5.1	3.9	3.1	1.9	0.8	-0.1	-0.6	-1.6	-1.1	-0.4	0.9	2.3	4.0	5.5	6.7	7.6
W	8.6	8.9	8.7	8.4	8.0	7.4	6.7	5.7	5.0	4.2	3.2	3.4	2.6	1.8	-0.6	-1.8	-1.6	-1.0	0.3	1.7	3.6	5.4	6.9	8.0
	W8 - 2cm plaster +19cm Brick + 2cm plaster +30mm XPS + Siding (Light surface)																							
N	9.0	9.2	9.1	8.8	8.6	8.2	7.6	7.0	6.6	5.6	4.7	3.6	2.8	2.3	2.2	1.3	1.8	2.6	3.5	4.6	5.7	6.6	7.8	8.5
E	9.1	9.3	9.2	8.9	8.7	8.2	7.7	6.9	6.4	5.5	4.6	3.4	3.0	1.4	1.6	1.0	0.9	1.9	3.1	4.4	5.7	6.8	7.9	8.7
S	9.3	9.5	9.4	9.1	8.8	8.3	7.8	7.1	6.7	5.8	5.3	4.4	3.8	3.2	3.0	2.0	2.4	3.0	3.9	5.1	6.3	7.4	8.3	8.9
W	9.8	9.9	9.7	9.3	9.0	8.5	7.9	7.1	6.6	6.1	5.4	5.9	5.6	5.1	3.0	1.8	1.9	2.4	3.3	4.5	5.9	7.3	8.5	9.3
	R1 - 4cm concrete+5cm XPS+12cm concrete+2cm plaster (Light surface)																							
	17	16	14	13	10	10	8.9	8.1	7.5	8.4	9.5	12	14	17	20	22	24	25	24	23	23	22	20	18.9
	R2 - 12cm concrete +2cm inner plaster (Light surface)																							
	5.4	4.5	2.8	2	1.1	0.5	0.3	2.8	7	13	19	26	32	38	41	42	41	38	32	26	18	14	10	8.1

Istanbul (Dark) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W1 - 2 cm outer plaster + 19 cm Brick + 2 cm inner plaster (Dark surface)																							
N	11.7	10.6	9.3	8.1	7.1	6.1	5.1	4.4	3.9	3.8	4.1	4.9	6.2	7.9	9.9	11.9	13.7	15.1	15.9	16.2	16.0	15.2	14.3	13.2
E	12.0	10.9	9.6	8.3	7.3	6.2	5.3	4.5	3.9	3.8	4.1	4.9	6.3	8.1	10.2	12.4	14.4	15.8	16.7	17.0	16.7	15.9	14.8	13.7
S	12.2	11.0	9.7	8.5	7.4	6.3	5.3	4.5	4.1	4.2	4.7	5.8	7.4	9.3	11.4	13.5	15.3	16.6	17.3	17.5	17.1	16.3	15.1	13.8
W	14.4	12.9	11.3	9.8	8.5	7.3	6.1	5.2	4.6	4.6	5.1	7.5	9.2	11.0	11.0	12.9	14.7	16.3	17.6	18.4	18.7	18.4	17.4	16.1
	W2 - 2 cm outer plaster + 20 cm AAC + 2 cm inner plaster (Dark surface)																							
N	12.7	11.0	9.3	7.7	6.4	5.2	4.1	3.2	2.5	2.2	2.4	3.2	4.7	6.7	9.2	11.7	14.1	16.1	17.4	18.0	18.0	17.0	15.9	14.4
E	13.0	11.3	9.6	7.9	6.6	5.3	4.3	3.3	2.5	2.2	2.4	3.2	4.8	6.9	9.5	12.2	14.8	16.8	18.2	18.8	18.7	17.7	16.4	14.9
S	13.2	11.4	9.7	8.1	6.7	5.4	4.3	3.3	2.7	2.6	3.0	4.1	5.9	8.1	10.7	13.3	15.7	17.6	18.8	19.3	19.1	18.1	16.7	15.0
W	15.4	13.3	11.3	9.4	7.8	6.4	5.1	4.0	3.2	3.0	3.4	5.8	7.7	9.8	10.3	12.7	15.1	17.3	19.1	20.2	20.7	20.2	19.0	17.3
	W3 - 2 cm outer plaster + 20 cm Blokbims + 2 cm inner plaster (Dark surface)																							
N	13.0	11.5	10.0	8.5	7.3	6.1	5.0	4.1	3.3	2.9	3.0	3.6	4.7	6.5	8.6	10.9	13.1	15.0	16.4	17.1	17.3	16.6	15.7	14.5
E	13.3	11.8	10.3	8.7	7.5	6.2	5.2	4.2	3.3	2.9	3.0	3.6	4.8	6.7	8.9	11.4	13.8	15.7	17.2	17.9	18.0	17.3	16.2	15.0
S	13.5	11.9	10.4	8.9	7.6	6.3	5.2	4.2	3.5	3.3	3.6	4.5	5.9	7.9	10.1	12.5	14.7	16.5	17.8	18.4	18.4	17.7	16.5	15.1
W	15.7	13.8	12.0	10.2	8.7	7.3	6.0	4.9	4.0	3.7	4.0	6.2	7.7	9.6	9.7	11.9	14.1	16.2	18.1	19.3	20.0	19.8	18.8	17.4
	W4 - 2 cm outer plaster + 8.5 cm Brick + 3 cm XPS + 8.5 cm Brick+ 2 cm inner plaster																							
N	13.1	12.2	11.1	10.0	8.9	7.9	6.9	6.1	5.3	4.7	4.6	4.7	5.3	6.4	7.8	9.4	11.0	12.5	13.7	14.5	15.0	14.8	14.6	14.0
E	13.4	12.5	11.4	10.2	9.1	8.0	7.1	6.2	5.3	4.7	4.6	4.7	5.4	6.6	8.1	9.9	11.7	13.2	14.5	15.3	15.7	15.5	15.1	14.5
S	13.6	12.6	11.5	10.4	9.2	8.1	7.1	6.2	5.5	5.1	5.2	5.6	6.5	7.8	9.3	11.0	12.6	14.0	15.1	15.8	16.1	15.9	15.4	14.6
W	15.8	14.5	13.1	11.7	10.3	9.1	7.9	6.9	6.0	5.5	5.6	7.3	8.3	9.5	8.9	10.4	12.0	13.7	15.4	16.7	17.7	18.0	17.7	16.9
	W5 - 2 cm outer plaster + 20 cm Briquette + 2 cm inner plaster (Dark surface)																							
N	11.1	9.8	8.5	7.2	6.1	5.2	4.3	3.7	3.4	3.6	4.4	5.6	7.3	9.3	11.6	13.6	15.2	16.3	16.9	16.7	16.1	14.9	13.7	12.4
E	11.4	10.1	8.8	7.4	6.3	5.3	4.5	3.8	3.4	3.6	4.4	5.6	7.4	9.5	11.9	14.1	15.9	17.0	17.7	17.5	16.8	15.6	14.2	12.9

S	11.6	10.2	8.9	7.6	6.4	5.4	4.5	3.8	3.6	4.0	5.0	6.5	8.5	10.7	13.1	15.2	16.8	17.8	18.3	18.0	17.2	16.0	14.5	13.0
W	13.8	12.1	10.5	8.9	7.5	6.4	5.3	4.5	4.1	4.4	5.4	8.2	10.3	12.4	12.7	14.6	16.2	17.5	18.6	18.9	18.8	18.1	16.8	15.3
	W6 - 2cm plaster +19cm Brick +2cm plaster +3cmXPS (Dark surface)																							
N	11.8	11.4	10.9	10.3	9.8	9.3	8.7	8.3	7.7	7.3	7.0	6.9	7.0	7.4	8.1	8.9	9.8	10.6	11.3	11.8	12.2	12.2	12.3	12.1
E	12.1	11.7	11.2	10.5	10.0	9.4	8.9	8.4	7.7	7.3	7.0	6.9	7.1	7.6	8.4	9.4	10.5	11.3	12.1	12.6	12.9	12.9	12.8	12.6
S	12.3	11.8	11.3	10.7	10.1	9.5	8.9	8.4	7.9	7.7	7.6	7.8	8.2	8.8	9.6	10.5	11.4	12.1	12.7	13.1	13.3	13.3	13.1	12.7
W	14.5	13.7	12.9	12.0	11.2	10.5	9.7	9.1	8.4	8.1	8.0	9.5	10.0	10.5	9.2	9.9	10.8	11.8	13.0	14.0	14.9	15.4	15.4	15.0
	W7 - 2cm plaster +13.5cm Brick +2.5cm EPS + 8.5cm Brick+2cm plaster (Dark surface)																							
N	13.0	12.7	12.0	11.3	10.5	9.6	8.6	7.6	6.5	5.4	4.6	4.0	3.7	3.9	4.6	5.6	6.9	8.3	9.6	10.7	11.8	12.4	13.0	13.2
E	13.3	13.0	12.3	11.5	10.7	9.7	8.8	7.7	6.5	5.4	4.6	4.0	3.8	4.1	4.9	6.1	7.6	9.0	10.4	11.5	12.5	13.1	13.5	13.7
S	13.5	13.1	12.4	11.7	10.8	9.8	8.8	7.7	6.7	5.8	5.2	4.9	4.9	5.3	6.1	7.2	8.5	9.8	11.0	12.0	12.9	13.5	13.8	13.8
W	15.7	15.0	14.0	13.0	11.9	10.8	9.6	8.4	7.2	6.2	5.6	6.6	6.7	7.0	5.7	6.6	7.9	9.5	11.3	12.9	14.5	15.6	16.1	16.1
	W8 - 2cm plaster +19cm Brick + 2cm plaster +30mm XPS + Siding (Dark surface)																							
N	14.2	13.7	13.0	12.2	11.5	10.7	9.8	9.0	8.1	7.3	6.8	6.5	6.7	7.2	8.2	9.2	10.4	11.6	12.6	13.5	14.1	14.3	14.6	14.5
E	14.5	14.0	13.3	12.4	11.7	10.8	10.0	9.1	8.1	7.3	6.8	6.5	6.8	7.4	8.5	9.7	11.1	12.3	13.4	14.3	14.8	15.0	15.1	15.0
S	14.7	14.1	13.4	12.6	11.8	10.9	10.0	9.1	8.3	7.7	7.4	7.4	7.9	8.6	9.7	10.8	12.0	13.1	14.0	14.8	15.2	15.4	15.4	15.1
W	16.9	16.0	15.0	13.9	12.9	11.9	10.8	9.8	8.8	8.1	7.8	9.1	9.7	10.3	9.3	10.2	11.4	12.8	14.3	15.7	16.8	17.5	17.7	17.4
	R1 - 4cm concrete+5cm XPS+12cm concrete+2cm plaster (Dark surface)																							
	22	21	19	17	15	15	13	12	11	12	13	15	18	22	25	28	30	31.7	32	31	30	29	26	24.1
	R2 - 12cm concrete +2cm inner plaster (Dark surface)																							
	9.5	8	5.2	4.1	3	2	2.1	4.9	9.6	16	23	30	36	42	45	46	46	43	38.2	32	26	21	16	13

Gaziantep (Light) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W1 - 2 cm outer plaster + 19 cm Brick + 2 cm inner plaster (Light surface)																							
N	10.5	9.4	8.3	7.2	6.2	5.2	4.3	3.6	3.2	3.2	3.8	4.7	6.0	7.6	9.3	10.9	12.3	13.4	14.2	14.5	14.4	13.8	12.8	11.7
E	10.8	9.6	8.5	7.3	6.3	5.3	4.4	3.7	3.5	3.8	4.8	6.2	7.9	9.6	11.2	12.7	14.0	14.9	15.4	15.5	15.1	14.3	13.2	12.0
S	10.7	9.5	8.4	7.3	6.2	5.3	4.4	3.6	3.2	3.2	3.7	4.8	6.2	8.0	9.9	11.7	13.3	14.4	15.1	15.3	15.0	14.2	13.1	11.9
W	12.5	11.1	9.8	8.5	7.3	6.1	5.1	4.3	3.8	3.7	4.1	5.0	6.3	7.8	9.5	11.3	13.1	14.6	15.8	16.6	16.8	16.3	15.2	13.9
	W2 - 2 cm outer plaster + 20 cm AAC + 2 cm inner plaster (Light surface)																							
N	11.6	10.2	8.8	7.5	6.2	5.0	4.0	3.1	2.5	2.2	2.4	3.2	4.5	6.2	8.1	10.0	11.9	13.5	14.7	15.3	15.5	15.2	14.3	13.1
E	11.8	10.3	8.9	7.5	6.2	5.1	4.0	3.1	2.5	2.5	3.1	4.4	6.2	8.2	10.3	12.2	13.9	15.2	16.2	16.6	16.5	15.8	14.7	13.3
S	11.8	10.3	8.9	7.5	6.2	5.1	4.0	3.1	2.4	2.1	2.4	3.2	4.6	6.4	8.6	10.8	12.9	14.6	15.8	16.4	16.4	15.8	14.7	13.3
W	13.9	12.2	10.5	8.9	7.4	6.0	4.8	3.7	2.9	2.6	2.7	3.4	4.7	6.3	8.2	10.3	12.4	14.3	16.0	17.3	17.9	17.9	17.0	15.6
	W3 - 2 cm outer plaster + 20 cm Blokbims + 2 cm inner plaster (Light surface)																							
N	11.8	10.5	9.3	8.0	6.9	5.8	4.7	3.8	3.2	2.8	2.9	3.5	4.6	6.1	7.7	9.5	11.2	12.7	13.8	14.6	14.9	14.7	14.0	13.0
E	12.0	10.7	9.4	8.2	6.9	5.8	4.8	3.9	3.3	3.1	3.6	4.6	6.1	7.9	9.8	11.5	13.1	14.4	15.4	15.9	15.9	15.4	14.6	13.4
S	12.0	10.7	9.4	8.1	6.9	5.8	4.8	3.9	3.2	2.8	2.9	3.5	4.7	6.3	8.2	10.2	12.1	13.7	14.9	15.6	15.7	15.3	14.5	13.3
W	14.0	12.5	11.0	9.5	8.1	6.8	5.6	4.6	3.8	3.3	3.3	3.8	4.8	6.2	7.9	9.8	11.7	13.5	15.1	16.4	17.1	17.2	16.6	15.4
	W4 - 2 cm outer plaster + 8.5 cm Brick + 3 cm XPS + 8.5 cm Brick+ 2 cm inner plaster (Light surface)																							
N	11.6	10.8	10.0	9.1	8.1	7.2	6.3	5.5	4.8	4.4	4.4	4.6	5.3	6.2	7.3	8.5	9.8	10.9	11.9	12.6	13.0	13.1	12.8	12.3
E	12.1	11.3	10.3	9.4	8.4	7.4	6.5	5.6	5.0	4.8	5.0	5.5	6.5	7.6	8.8	10.1	11.3	12.4	13.3	13.9	14.1	14.0	13.6	12.9
S	12.0	11.1	10.2	9.2	8.3	7.3	6.4	5.6	4.9	4.4	4.4	4.7	5.4	6.4	7.7	9.0	10.4	11.7	12.7	13.4	13.7	13.7	13.3	12.7
W	13.6	12.7	11.7	10.6	9.5	8.4	7.4	6.5	5.7	5.1	5.0	5.2	5.7	6.5	7.6	8.9	10.3	11.7	13.0	14.1	14.8	15.0	14.9	14.3
	W5 - 2 cm outer plaster + 20 cm Briquette + 2 cm inner plaster (Light surface)																							
N	10.1	9.0	7.9	6.8	5.8	4.8	4.0	3.4	3.1	3.3	4.0	5.1	6.5	8.2	9.9	11.5	12.8	13.8	14.4	14.6	14.3	13.6	12.5	11.3
E	10.3	9.2	8.0	6.9	5.9	4.9	4.1	3.5	3.4	3.9	5.1	6.7	8.5	10.2	11.8	13.2	14.4	15.2	15.6	15.5	15.0	14.1	12.9	11.6

S	10.3	9.1	8.0	6.9	5.8	4.9	4.1	3.4	3.0	3.2	3.9	5.2	6.8	8.7	10.6	12.4	13.8	14.8	15.3	15.3	14.8	13.9	12.7	11.5
W	12.0	10.6	9.3	8.0	6.8	5.7	4.8	4.0	3.6	3.7	4.3	5.4	6.8	8.4	10.2	12.0	13.7	15.2	16.3	16.9	16.8	16.1	14.8	13.4
	W6 - 2cm plaster +19cm Brick +2cm plaster +3cmXPS (Light surface)																							
N	10.3	10.0	9.5	9.1	8.6	8.1	7.6	7.1	6.7	6.5	6.4	6.5	6.8	7.2	7.8	8.4	9.0	9.7	10.2	10.6	10.9	10.9	10.9	10.6
E	11.0	10.6	10.1	9.6	9.1	8.6	8.1	7.6	7.2	7.0	7.0	7.3	7.8	8.3	8.9	9.6	10.2	10.8	11.3	11.7	11.8	11.8	11.7	11.4
S	10.7	10.3	9.8	9.4	8.9	8.3	7.8	7.4	6.9	6.6	6.5	6.6	7.0	7.5	8.1	8.8	9.5	10.2	10.8	11.2	11.4	11.4	11.3	11.0
W	11.9	11.5	11.0	10.5	9.9	9.3	8.8	8.2	7.8	7.4	7.3	7.3	7.5	7.9	8.5	9.1	9.8	10.6	11.3	11.9	12.3	12.5	12.5	12.2
	W7 - 2cm plaster +13.5cm Brick +2.5cm EPS + 8.5cm Brick+2cm plaster (Light surface)																							
N	11.4	11.1	10.6	10.0	9.3	8.7	8.0	7.3	6.6	6.1	5.7	5.6	5.7	6.1	6.6	7.4	8.2	9.1	9.9	10.6	11.2	11.6	11.8	11.7
E	12.2	11.7	11.1	10.5	9.8	9.1	8.3	7.6	6.9	6.4	6.2	6.2	6.5	7.1	7.8	8.6	9.5	10.4	11.2	11.9	12.4	12.7	12.7	12.6
S	11.9	11.4	10.9	10.3	9.6	8.9	8.2	7.4	6.8	6.2	5.8	5.7	5.8	6.2	6.9	7.7	8.6	9.6	10.5	11.3	11.9	12.2	12.3	12.2
W	13.2	12.8	12.2	11.6	10.8	10.1	9.3	8.5	7.7	7.1	6.6	6.4	6.4	6.7	7.2	7.9	8.8	9.8	10.8	11.7	12.5	13.1	13.4	13.4
	W8 - 2cm plaster +19cm Brick + 2cm plaster +30mm XPS + Siding (Light surface)																							
N	12.6	12.2	11.7	11.1	10.5	9.9	9.3	8.7	8.3	7.9	7.8	7.9	8.3	8.8	9.5	10.3	11.1	11.8	12.5	13.0	13.3	13.4	13.3	13.0
E	13.5	13.0	12.4	11.8	11.2	10.5	9.9	9.3	8.8	8.6	8.6	9.0	9.5	10.2	11.0	11.8	12.5	13.3	13.9	14.3	14.5	14.5	14.3	13.9
S	13.1	12.6	12.0	11.5	10.8	10.2	9.6	9.0	8.5	8.1	8.0	8.1	8.5	9.1	9.9	10.8	11.7	12.5	13.2	13.7	13.9	14.0	13.8	13.5
W	14.6	14.0	13.5	12.8	12.1	11.4	10.8	10.1	9.5	9.1	8.9	9.0	9.2	9.7	10.4	11.2	12.1	13.0	13.8	14.6	15.1	15.3	15.3	15.0
	R1 - 4cm concrete+5cm XPS+12cm concrete+2cm plaster (Light surface)																							
	17.8	15.8	14.3	12.9	11.4	10.1	9.1	8.4	8.6	9.6	10.5	12.5	14.9	17.4	19.9	22.1	23.8	24.6	24.4	23.8	23.2	22.1	20.9	19.7
	R2 - 12cm concrete +2cm inner plaster (Light surface)																							
	6.4	4.7	3.8	2.4	1.3	0.7	0.6	2.8	7.0	12.7	19.4	26.4	32.7	37.7	41.1	42.3	41.4	38.3	32.7	25.8	18.9	13.8	10.6	8.3

Gaziantep (Dark) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W1 - 2 cm outer plaster + 19 cm Brick + 2 cm inner plaster (Dark surface)																							
N	15.7	13.9	12.2	10.6	9.1	7.7	6.5	5.6	5.3	5.7	6.9	8.6	10.9	13.5	16.3	18.8	20.9	22.4	23.3	23.4	22.8	21.5	19.6	17.7
E	16.2	14.3	12.6	10.8	9.3	7.9	6.7	5.9	5.9	7.0	9.0	11.7	14.7	17.6	20.1	22.4	24.2	25.3	25.7	25.4	24.2	22.5	20.4	18.3
S	16.1	14.1	12.4	10.8	9.2	7.9	6.6	5.6	5.3	5.6	6.8	8.8	11.3	14.4	17.6	20.5	22.9	24.5	25.2	25.0	23.9	22.2	20.2	18.1
W	19.6	17.2	15.1	13.1	11.2	9.5	8.0	7.0	6.4	6.6	7.5	9.2	11.4	14.0	16.8	19.7	22.6	25.0	26.8	27.8	27.7	26.5	24.4	22.0
	W2 - 2 cm outer plaster + 20 cm AAC + 2 cm inner plaster (Dark surface)																							
N	16.8	14.7	12.7	10.9	9.1	7.5	6.2	5.1	4.6	4.7	5.5	7.1	9.4	12.1	15.1	17.9	20.5	22.5	23.8	24.2	23.9	22.9	21.1	19.1
E	17.2	15.0	13.0	11.0	9.2	7.7	6.3	5.3	4.9	5.7	7.3	9.9	13.0	16.2	19.2	21.9	24.1	25.6	26.5	26.5	25.6	24.0	21.9	19.6
S	17.2	14.9	12.9	11.0	9.2	7.7	6.2	5.1	4.5	4.5	5.5	7.2	9.7	12.8	16.3	19.6	22.5	24.7	25.9	26.1	25.3	23.8	21.8	19.5
W	21.0	18.3	15.8	13.5	11.3	9.4	7.7	6.4	5.5	5.5	6.1	7.6	9.8	12.5	15.5	18.7	21.9	24.7	27.0	28.5	28.8	28.1	26.2	23.7
	W3 - 2 cm outer plaster + 20 cm Blokbims + 2 cm inner plaster (Dark surface)																							
N	17.0	15.0	13.2	11.4	9.8	8.3	6.9	5.8	5.3	5.3	6.0	7.4	9.5	12.0	14.7	17.4	19.8	21.7	22.9	23.5	23.3	22.4	20.8	19.0
E	17.4	15.4	13.5	11.7	9.9	8.4	7.1	6.1	5.7	6.3	7.8	10.1	12.9	15.9	18.7	21.2	23.3	24.8	25.7	25.8	25.0	23.6	21.8	19.7
S	17.4	15.3	13.4	11.6	9.9	8.4	7.0	5.9	5.3	5.2	6.0	7.5	9.8	12.7	15.9	19.0	21.7	23.8	25.0	25.3	24.6	23.3	21.6	19.5
W	21.1	18.6	16.3	14.1	12.0	10.2	8.5	7.3	6.4	6.2	6.7	8.0	9.9	12.4	15.2	18.2	21.2	23.9	26.1	27.6	28.0	27.4	25.8	23.5
	W4 - 2 cm outer plaster + 8.5 cm Brick + 3 cm XPS + 8.5 cm Brick+ 2 cm inner plaster																							
N	16.8	15.3	13.9	12.5	11.0	9.7	8.5	7.5	6.9	6.9	7.5	8.5	10.2	12.1	14.3	16.4	18.4	19.9	21.0	21.5	21.4	20.8	19.6	18.3
E	17.5	16.0	14.4	12.9	11.4	10.0	8.8	7.8	7.4	8.0	9.2	11.0	13.3	15.6	17.7	19.8	21.5	22.8	23.6	23.8	23.2	22.2	20.8	19.2
S	17.4	15.7	14.2	12.7	11.3	9.9	8.6	7.6	7.0	6.8	7.5	8.7	10.5	12.8	15.4	17.8	20.0	21.8	22.8	23.1	22.6	21.7	20.4	18.9
W	20.7	18.8	17.0	15.2	13.4	11.8	10.3	9.2	8.3	8.0	8.4	9.4	10.8	12.7	14.9	17.3	19.8	22.1	24.0	25.3	25.7	25.2	24.1	22.4
	W5 - 2 cm outer plaster + 20 cm Briquette + 2 cm inner plaster (Dark surface)																							
N	15.3	13.5	11.8	10.2	8.7	7.3	6.2	5.4	5.2	5.7	7.0	9.0	11.4	14.1	16.8	19.3	21.4	22.9	23.5	23.5	22.7	21.2	19.3	17.3
E	15.8	13.9	12.1	10.4	8.9	7.5	6.4	5.7	5.8	7.1	9.3	12.2	15.2	18.2	20.7	22.9	24.6	25.7	25.9	25.4	24.1	22.2	20.0	17.8

S	15.6	13.8	12.0	10.3	8.8	7.5	6.3	5.4	5.1	5.7	7.0	9.1	11.9	15.1	18.3	21.2	23.5	24.9	25.4	25.0	23.8	22.0	19.8	17.7
W	19.0	16.7	14.6	12.6	10.7	9.1	7.7	6.6	6.2	6.6	7.7	9.5	11.9	14.5	17.4	20.4	23.2	25.6	27.3	28.1	27.8	26.2	24.0	21.5
	W6 - 2cm plaster +19cm Brick +2cm plaster +3cmXPS (Dark surface)																							
N	16.4	15.7	15.0	14.2	13.5	12.7	12.0	11.3	10.7	10.4	10.4	10.6	11.1	11.9	12.8	13.9	15.0	15.9	16.7	17.3	17.6	17.6	17.4	16.9
E	17.7	17.0	16.2	15.4	14.5	13.7	12.9	12.2	11.7	11.5	11.7	12.3	13.1	14.1	15.2	16.3	17.4	18.3	19.0	19.4	19.6	19.4	19.0	18.4
S	17.0	16.3	15.6	14.8	14.0	13.2	12.4	11.7	11.1	10.7	10.7	10.9	11.5	12.4	13.5	14.8	16.0	17.1	17.9	18.4	18.7	18.6	18.2	17.7
W	19.5	18.7	17.9	17.0	16.1	15.2	14.3	13.5	12.8	12.3	12.2	12.3	12.7	13.4	14.3	15.4	16.6	17.8	18.9	19.9	20.5	20.8	20.6	20.1
	W7 - 2cm plaster +13.5cm Brick +2.5cm EPS + 8.5cm Brick+2cm plaster (Dark surface)																							
N	16.6	16.4	15.7	14.8	13.9	13.2	12.1	11.2	10.1	9.2	9.4	9.5	10.0	10.9	12.0	13.3	14.6	16.2	17.8	18.7	18.7	18.5	17.9	16.9
E	12.2	11.7	11.1	10.5	9.8	9.1	8.3	7.6	6.9	6.4	6.2	6.2	6.5	7.1	7.8	8.6	9.5	10.4	11.2	11.9	12.4	12.7	12.7	12.6
S	16.0	14.9	13.3	12.4	11.5	10.4	10.0	9.5	9.4	9.3	9.2	9.3	9.6	10.3	11.2	12.3	13.4	14.7	16.4	17.8	19.0	19.0	18.1	17.1
W	13.2	12.8	12.2	11.6	10.8	10.1	9.3	8.5	7.7	7.1	6.6	6.4	6.4	6.7	7.2	7.9	8.8	9.8	10.8	11.7	12.5	13.1	13.4	13.4
	W8 - 2cm plaster +19cm Brick + 2cm plaster +30mm XPS + Siding (Dark surface)																							
N	17.8	17.5	16.8	15.9	15.1	14.4	13.4	12.6	11.8	11.0	11.5	11.8	12.6	13.6	14.9	16.2	17.5	18.9	20.4	21.1	20.8	20.3	19.4	18.2
E	13.5	13.0	12.4	11.8	11.2	10.5	9.9	9.3	8.8	8.6	8.6	9.0	9.5	10.2	11.0	11.8	12.5	13.3	13.9	14.3	14.5	14.5	14.3	13.9
S	17.2	16.1	14.4	13.6	12.7	11.7	11.4	11.1	11.1	11.2	11.4	11.7	12.3	13.2	14.2	15.4	16.5	17.6	19.1	20.2	21.0	20.8	19.6	18.4
W	14.6	14.0	13.5	12.8	12.1	11.4	10.8	10.1	9.5	9.1	8.9	9.0	9.2	9.7	10.4	11.2	12.1	13.0	13.8	14.6	15.1	15.3	15.3	15.0
	R1 - 4cm concrete+5cm XPS+12cm concrete+2cm plaster (Dark surface)																							
	23.0	21.1	19.4	17.7	16.0	14.6	13.2	12.3	12.1	12.7	14.2	16.4	19.2	22.2	25.3	28.0	30.2	31.7	32.3	31.9	30.7	29.0	27.0	24.9
	R2 - 12cm concrete +2cm inner plaster (Dark surface)																							
	10.5	8.2	6.2	4.5	3.2	2.2	2.4	4.9	9.6	15.8	22.8	30.0	36.5	41.8	45.4	46.9	46.2	43.4	38.6	32.3	26.0	20.6	16.4	13.2

Antaliya (Light) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W1 - 2 cm outer plaster + 19 cm Brick + 2 cm inner plaster (Light surface)																							
N	6.5	6.1	5.4	4.7	4.2	3.6	2.9	2.4	2.4	2.1	2.0	2.0	2.3	3.0	3.9	4.0	5.1	6.1	6.8	7.3	7.6	7.5	7.5	7.2
E	6.6	6.2	5.5	4.8	4.3	3.6	3.0	2.3	2.2	2.0	1.9	1.8	2.5	2.1	3.3	3.7	4.2	5.4	6.4	7.1	7.6	7.7	7.6	7.4
S	12.5	11.7	10.8	9.9	9.1	8.4	7.9	7.3	7.5	7.5	8.3	9.1	10.1	11.3	12.5	12.7	13.8	14.5	15.1	15.3	15.2	14.8	14.1	13.3
W	7.3	6.8	6.0	5.2	4.6	3.9	3.2	2.5	2.4	2.6	2.7	4.3	5.1	5.8	4.7	4.5	5.2	5.9	6.6	7.2	7.8	8.2	8.2	8.0
	W2 - 2 cm outer plaster + 20 cm AAC + 2 cm inner plaster (Light surface)																							
N	12.7	11.4	10.1	8.8	7.9	7.0	6.2	5.7	5.6	5.4	4.8	6.4	7.5	9.2	11.1	12.1	14.0	15.7	16.7	17.1	16.9	16.1	15.3	14.1
E	12.8	11.5	10.2	8.9	8.0	7.0	6.3	5.6	5.4	5.3	4.7	6.2	7.7	8.3	10.5	11.8	13.1	15.0	16.3	16.9	16.9	16.3	15.4	14.3
S	13.0	11.7	10.4	9.1	8.1	7.1	6.4	5.8	5.7	5.6	5.4	7.2	8.5	10.1	11.9	12.8	14.6	16.1	17.1	17.6	17.5	16.9	15.8	14.5
W	13.5	12.1	10.7	9.3	8.3	7.3	6.5	5.8	5.6	5.9	5.5	8.7	10.3	12.0	11.9	12.6	14.1	15.5	16.5	17.0	17.1	16.8	16.0	14.9
	W3 - 2 cm outer plaster + 20 cm Blokbims + 2 cm inner plaster (Light surface)																							
N	13.3	12.2	11.0	9.9	8.9	8.1	7.3	6.7	6.5	6.1	6.2	6.6	7.4	8.7	10.4	11.1	12.8	14.4	15.5	16.1	16.3	15.8	15.3	14.4
E	13.4	12.3	11.1	10.0	9.0	8.1	7.4	6.6	6.3	6.0	6.1	6.4	7.6	7.8	9.8	10.8	11.9	13.7	15.1	15.9	16.3	16.0	15.4	14.6
S	13.6	12.5	11.3	10.2	9.1	8.2	7.5	6.8	6.6	6.3	6.8	7.4	8.4	9.6	11.2	11.8	13.4	14.8	15.9	16.6	16.9	16.6	15.8	14.8
W	14.1	12.9	11.6	10.4	9.3	8.4	7.6	6.8	6.5	6.6	6.9	8.9	10.2	11.5	11.2	11.6	12.9	14.2	15.3	16.0	16.5	16.5	16.0	15.2
	W4 - 2 cm outer plaster + 8.5 cm Brick + 3 cm XPS + 8.5 cm Brick+ 2 cm inner plaster (Light surface)																							
N	13.9	13.4	12.6	11.8	11.1	10.4	9.6	9.0	8.7	8.1	7.8	7.6	7.6	8.2	8.9	8.9	10.0	11.3	12.3	13.1	13.8	14.0	14.4	14.2
E	14.0	13.5	12.7	11.9	11.2	10.4	9.7	8.9	8.5	8.0	7.7	7.4	7.8	7.3	8.3	8.6	9.1	10.6	11.9	12.9	13.8	14.2	14.5	14.4
S	14.2	13.7	12.9	12.1	11.3	10.5	9.8	9.1	8.8	8.3	8.4	8.4	8.6	9.1	9.7	9.6	10.6	11.7	12.7	13.6	14.4	14.8	14.9	14.6
W	14.7	14.1	13.2	12.3	11.5	10.7	9.9	9.1	8.7	8.6	8.5	9.9	10.4	11.0	9.7	9.4	10.1	11.1	12.1	13.0	14.0	14.7	15.1	15.0
	W5 - 2 cm outer plaster + 20 cm Briquette + 2 cm inner plaster (Light surface)																							
N	11.1	10.3	9.4	8.5	7.9	7.4	6.8	6.6	7.1	7.5	8.4	9.4	10.7	12.3	13.7	14.0	14.9	15.5	15.5	15.1	14.5	13.5	12.8	12.0
E	11.2	10.4	9.5	8.6	8.0	7.4	6.9	6.5	6.9	7.4	8.3	9.2	10.9	11.4	13.1	13.7	14.0	14.8	15.1	14.9	14.5	13.7	12.9	12.2

S	11.4	10.6	9.7	8.8	8.1	7.5	7.0	6.7	7.2	7.7	9.0	10.2	11.7	13.2	14.5	14.7	15.5	15.9	15.9	15.6	15.1	14.3	13.3	12.4
W	11.9	11.0	10.0	9.0	8.3	7.7	7.1	6.7	7.1	8.0	9.1	11.7	13.5	15.1	14.5	14.5	15.0	15.3	15.3	15.0	14.7	14.2	13.5	12.8
	W6 - 2cm plaster +19cm Brick +2cm plaster +3cmXPS (Light surface)																							
N	12.7	12.9	12.8	12.6	12.5	12.3	12.0	11.7	11.7	11.1	10.6	9.9	9.2	8.9	8.7	7.7	8.0	8.6	9.2	9.8	10.6	11.1	11.9	12.4
E	12.8	13.0	12.9	12.7	12.6	12.3	12.1	11.6	11.5	11.0	10.5	9.7	9.4	8.0	8.1	7.4	7.1	7.9	8.8	9.6	10.6	11.3	12.0	12.6
S	13.0	13.2	13.1	12.9	12.7	12.4	12.2	11.8	11.8	11.3	11.2	10.7	10.2	9.8	9.5	8.4	8.6	9.0	9.6	10.3	11.2	11.9	12.4	12.8
W	13.5	13.6	13.4	13.1	12.9	12.6	12.3	11.8	11.7	11.6	11.3	12.2	12.0	11.7	9.5	8.2	8.1	8.4	9.0	9.7	10.8	11.8	12.6	13.2
	W7 - 2cm plaster +13.5cm Brick +2.5cm EPS + 8.5cm Brick+2cm plaster (Light surface)																							
N	14.4	14.4	14.1	13.6	13.3	12.8	12.1	11.5	11.2	10.2	9.4	8.4	7.5	7.2	7.1	6.4	7.1	8.2	9.3	10.5	11.7	12.6	13.6	14.1
E	14.5	14.5	14.2	13.7	13.4	12.8	12.2	11.4	11.0	10.1	9.3	8.2	7.7	6.3	6.5	6.1	6.2	7.5	8.9	10.3	11.7	12.8	13.7	14.3
S	14.7	14.7	14.4	13.9	13.5	12.9	12.3	11.6	11.3	10.4	10.0	9.2	8.5	8.1	7.9	7.1	7.7	8.6	9.7	11.0	12.3	13.4	14.1	14.5
W	15.2	15.1	14.7	14.1	13.7	13.1	12.4	11.6	11.2	10.7	10.1	10.7	10.3	10.0	7.9	6.9	7.2	8.0	9.1	10.4	11.9	13.3	14.3	14.9
	W8 - 2cm plaster +19cm Brick + 2cm plaster +30mm XPS + Siding (Light surface)																							
N	16.8	16.8	16.6	16.3	16.0	15.7	15.2	14.8	14.7	14.1	13.6	12.9	12.4	12.3	12.3	11.6	12.1	12.9	13.6	14.3	15.1	15.6	16.3	17.3
E	16.9	16.9	16.7	16.4	16.1	15.7	15.3	14.7	14.5	14.0	13.5	12.7	12.6	11.4	11.7	11.3	11.2	12.2	13.2	14.1	15.1	15.8	16.4	8.7
S	17.1	17.1	16.9	16.6	16.2	15.8	15.4	14.9	14.8	14.3	14.2	13.7	13.4	13.2	13.1	12.3	12.7	13.3	14.0	14.8	15.7	16.4	16.8	8.9
W	17.6	17.5	17.2	16.8	16.4	16.0	15.5	14.9	14.7	14.6	14.3	15.2	15.2	15.1	13.1	12.1	12.2	12.7	13.4	14.2	15.3	16.3	17.0	9.3
	R1 - 4cm concrete+5cm XPS+12cm concrete+2cm plaster (Light surface)																							
	19	18	15	15	11	11	11	9.6	8.9	8.4	11	13	15	19	21	23	26	27	26	25	25	24	21	20
	R2 - 12cm concrete +2cm inner plaster (Light surface)																							
	6.4	5.8	4.8	4	3.3	1.9	1.8	3.8	9	15	20	28	35	40	42	43	42	39	33	27	19	16	12	10

Antaliya (Dark) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W1 - 2 cm outer plaster + 19 cm Brick + 2 cm inner plaster (Dark surface)																							
N	11.7	10.6	9.3	8.1	7.1	6.1	5.1	4.4	3.9	3.8	4.1	4.9	6.2	7.9	9.9	11.9	13.7	15.1	15.9	16.2	16.0	15.2	14.3	13.2
E	12.0	10.9	9.6	8.3	7.3	6.2	5.3	4.5	3.9	3.8	4.1	4.9	6.3	8.1	10.2	12.4	14.4	15.8	16.7	17.0	16.7	15.9	14.8	13.7
S	17.9	16.3	14.8	13.4	12.1	11.0	10.1	9.3	9.1	9.4	10.4	12.1	14.2	16.7	19.2	21.5	23.4	24.6	25.2	25.0	24.1	22.8	21.2	19.5
W	14.4	12.9	11.3	9.8	8.5	7.3	6.1	5.2	4.6	4.6	5.1	7.5	9.2	11.0	11.0	12.9	14.7	16.3	17.6	18.4	18.7	18.4	17.4	16.1
	W2 - 2 cm outer plaster + 20 cm AAC + 2 cm inner plaster (Dark surface)																							
N	17.9	15.9	14.0	12.2	10.8	9.5	8.4	7.7	7.1	7.1	6.9	9.3	11.4	14.1	17.1	20.0	22.6	24.7	25.8	26.0	25.3	23.8	22.1	20.1
E	18.2	16.2	14.3	12.4	11.0	9.6	8.6	7.8	7.1	7.1	6.9	9.3	11.5	14.3	17.4	20.5	23.3	25.4	26.6	26.8	26.0	24.5	22.6	20.6
S	18.4	16.3	14.4	12.6	11.1	9.7	8.6	7.8	7.3	7.5	7.5	10.2	12.6	15.5	18.6	21.6	24.2	26.2	27.2	27.3	26.4	24.9	22.9	20.7
W	20.6	18.2	16.0	13.9	12.2	10.7	9.4	8.5	7.8	7.9	7.9	11.9	14.4	17.2	18.2	21.0	23.6	25.9	27.5	28.2	28.0	27.0	25.2	23.0
	W3 - 2 cm outer plaster + 20 cm Blokbims + 2 cm inner plaster (Dark surface)																							
N	18.5	16.7	14.9	13.3	11.8	10.6	9.5	8.7	8.0	7.8	8.3	9.5	11.3	13.6	16.4	19.0	21.4	23.4	24.6	25.0	24.7	23.5	22.1	20.4
E	18.8	17.0	15.2	13.5	12.0	10.7	9.7	8.8	8.0	7.8	8.3	9.5	11.4	13.8	16.7	19.5	22.1	24.1	25.4	25.8	25.4	24.2	22.6	20.9
S	19.0	17.1	15.3	13.7	12.1	10.8	9.7	8.8	8.2	8.2	8.9	10.4	12.5	15.0	17.9	20.6	23.0	24.9	26.0	26.3	25.8	24.6	22.9	21.0
W	21.2	19.0	16.9	15.0	13.2	11.8	10.5	9.5	8.7	8.6	9.3	12.1	14.3	16.7	17.5	20.0	22.4	24.6	26.3	27.2	27.4	26.7	25.2	23.3
	W4 - 2 cm outer plaster + 8.5 cm Brick + 3 cm XPS + 8.5 cm Brick+ 2 cm inner plaster																							
N	19.1	17.9	16.5	15.2	14.0	12.9	11.8	11.0	10.2	9.8	9.9	10.5	11.5	13.1	14.9	16.8	18.6	20.3	21.4	22.0	22.2	21.7	21.2	20.2
E	19.4	18.2	16.8	15.4	14.2	13.0	12.0	11.1	10.2	9.8	9.9	10.5	11.6	13.3	15.2	17.3	19.3	21.0	22.2	22.8	22.9	22.4	21.7	20.7
S	19.6	18.3	16.9	15.6	14.3	13.1	12.0	11.1	10.4	10.2	10.5	11.4	12.7	14.5	16.4	18.4	20.2	21.8	22.8	23.3	23.3	22.8	22.0	20.8
W	21.8	20.2	18.5	16.9	15.4	14.1	12.8	11.8	10.9	10.6	10.9	13.1	14.5	16.2	16.0	17.8	19.6	21.5	23.1	24.2	24.9	24.9	24.3	23.1
	W5 - 2 cm outer plaster + 20 cm Briquette + 2 cm inner plaster (Dark surface)																							
N	16.3	14.8	13.3	11.9	10.8	9.9	9.0	8.6	8.6	9.2	10.5	12.3	14.6	17.2	19.7	21.9	23.5	24.5	24.6	24.0	22.9	21.2	19.6	18.0
E	16.6	15.1	13.6	12.1	11.0	10.0	9.2	8.7	8.6	9.2	10.5	12.3	14.7	17.4	20.0	22.4	24.2	25.2	25.4	24.8	23.6	21.9	20.1	18.5

S	16.8	15.2	13.7	12.3	11.1	10.1	9.2	8.7	8.8	9.6	11.1	13.2	15.8	18.6	21.2	23.5	25.1	26.0	26.0	25.3	24.0	22.3	20.4	18.6
W	19.0	17.1	15.3	13.6	12.2	11.1	10.0	9.4	9.3	10.0	11.5	14.9	17.6	20.3	20.8	22.9	24.5	25.7	26.3	26.2	25.6	24.4	22.7	20.9
	W6 - 2cm plaster +19cm Brick +2cm plaster +3cmXPS (Dark surface)																							
N	17.9	17.4	16.7	16.0	15.4	14.8	14.2	13.7	13.2	12.8	12.7	12.8	13.1	13.8	14.7	15.6	16.6	17.6	18.3	18.7	19.0	18.8	18.7	18.4
E	18.2	17.7	17.0	16.2	15.6	14.9	14.4	13.8	13.2	12.8	12.7	12.8	13.2	14.0	15.0	16.1	17.3	18.3	19.1	19.5	19.7	19.5	19.2	18.9
S	18.4	17.8	17.1	16.4	15.7	15.0	14.4	13.8	13.4	13.2	13.3	13.7	14.3	15.2	16.2	17.2	18.2	19.1	19.7	20.0	20.1	19.9	19.5	19.0
W	20.6	19.7	18.7	17.7	16.8	16.0	15.2	14.5	13.9	13.6	13.7	15.4	16.1	16.9	15.8	16.6	17.6	18.8	20.0	20.9	21.7	22.0	21.8	21.3
	W7 - 2cm plaster +13.5cm Brick +2.5cm EPS + 8.5cm Brick+2cm plaster (Dark surface)																							
N	19.6	18.9	18.0	17.0	16.2	15.3	14.3	13.5	12.7	11.9	11.5	11.3	11.4	12.1	13.1	14.3	15.7	17.2	18.4	19.4	20.1	20.3	20.4	20.1
E	19.9	19.2	18.3	17.2	16.4	15.4	14.5	13.6	12.7	11.9	11.5	11.3	11.5	12.3	13.4	14.8	16.4	17.9	19.2	20.2	20.8	21.0	20.9	20.6
S	20.1	19.3	18.4	17.4	16.5	15.5	14.5	13.6	12.9	12.3	12.1	12.2	12.6	13.5	14.6	15.9	17.3	18.7	19.8	20.7	21.2	21.4	21.2	20.7
W	22.3	21.2	20.0	18.7	17.6	16.5	15.3	14.3	13.4	12.7	12.5	13.9	14.4	15.2	14.2	15.3	16.7	18.4	20.1	21.6	22.8	23.5	23.5	23.0
	W8 - 2cm plaster +19cm Brick + 2cm plaster +30mm XPS + Siding (Dark surface)																							
N	22.0	21.3	20.5	19.7	18.9	18.2	17.4	16.8	16.2	15.8	15.7	15.8	16.3	17.2	18.3	19.5	20.7	21.9	22.7	23.2	23.5	23.3	23.1	23.3
E	22.3	21.6	20.8	19.9	19.1	18.3	17.6	16.9	16.2	15.8	15.7	15.8	16.4	17.4	18.6	20.0	21.4	22.6	23.5	24.0	24.2	24.0	23.6	15.0
S	22.5	21.7	20.9	20.1	19.2	18.4	17.6	16.9	16.4	16.2	16.3	16.7	17.5	18.6	19.8	21.1	22.3	23.4	24.1	24.5	24.6	24.4	23.9	15.1
W	24.7	23.6	22.5	21.4	20.3	19.4	18.4	17.6	16.9	16.6	16.7	18.4	19.3	20.3	19.4	20.5	21.7	23.1	24.4	25.4	26.2	26.5	26.2	17.4
	R1 - 4cm concrete+5cm XPS+12cm concrete+2cm plaster (Dark surface)																							
	24	23	21	19	16	16	15	13.5	12.4	11.5	14.2	16	19	23.5	26.4	29	32	34	33.4	33	32.1	31	27	25
	R2 - 12cm concrete +2cm inner plaster (Dark surface)																							
	11	9.3	7.2	6.1	5.2	3.4	3.6	5.9	11.6	17.8	23.8	31	39	43.8	46.4	47	46	44	39.2	33	26.5	23	18	15

Diyarbakir (Light) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W1 - 2 cm outer plaster + 19 cm Brick + 2 cm inner plaster (Light surface)																							
N	6.5	6.1	5.4	4.7	4.2	3.6	2.9	2.4	2.4	2.1	2.0	2.0	2.3	3.0	3.9	4.0	5.1	6.1	6.8	7.3	7.6	7.5	7.5	7.2
E	6.6	6.2	5.5	4.8	4.3	3.6	3.0	2.3	2.2	2.0	1.9	1.8	2.5	2.1	3.3	3.7	4.2	5.4	6.4	7.1	7.6	7.7	7.6	7.4
S	15.2	14.3	13.2	12.0	10.8	9.6	8.5	7.4	6.9	6.4	6.7	7.1	7.9	9.0	10.2	10.7	12.3	13.7	15.0	16.0	16.8	16.9	16.6	16.1
W	7.3	6.8	6.0	5.2	4.6	3.9	3.2	2.5	2.4	2.6	2.7	4.3	5.1	5.8	4.7	4.5	5.2	5.9	6.6	7.2	7.8	8.2	8.2	8.0
	W2 - 2 cm outer plaster + 20 cm AAC + 2 cm inner plaster (Light surface)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W2 - 2 cm outer plaster + 20 cm AAC + 2 cm inner plaster (Light surface)																							
N	16.2	14.7	13.1	11.4	10.0	8.5	7.1	5.8	5.0	4.1	3.8	3.9	4.7	6.3	8.2	9.5	11.9	14.3	16.2	17.6	18.5	18.5	18.3	17.4
E	16.3	14.8	13.2	11.5	10.1	8.5	7.2	5.7	4.8	4.0	3.7	3.7	4.9	5.4	7.6	9.2	11.0	13.6	15.8	17.4	18.5	18.7	18.4	17.6
S	16.5	15.0	13.4	11.7	10.2	8.6	7.3	5.9	5.1	4.3	4.4	4.7	5.7	7.2	9.0	10.2	12.5	14.7	16.6	18.1	19.1	19.3	18.8	17.8
W	17.0	15.4	13.7	11.9	10.4	8.8	7.4	5.9	5.0	4.6	4.5	6.2	7.5	9.1	9.0	10.0	12.0	14.1	16.0	17.5	18.7	19.2	19.0	18.2
	W3 - 2 cm outer plaster + 20 cm Blokbims + 2 cm inner plaster (Light surface)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W3 - 2 cm outer plaster + 20 cm Blokbims + 2 cm inner plaster (Light surface)																							
N	16.4	15.3	13.9	12.4	11.0	9.7	8.3	7.0	6.2	5.2	4.7	4.5	5.0	6.1	7.7	8.7	10.8	13.0	14.9	16.4	17.5	17.8	17.9	17.3
E	16.5	15.4	14.0	12.5	11.1	9.7	8.4	6.9	6.0	5.1	4.6	4.3	5.2	5.2	7.1	8.4	9.9	12.3	14.5	16.2	17.5	18.0	18.0	17.5
S	16.7	15.6	14.2	12.7	11.2	9.8	8.5	7.1	6.3	5.4	5.3	5.3	6.0	7.0	8.5	9.4	11.4	13.4	15.3	16.9	18.1	18.6	18.4	17.7
W	17.2	16.0	14.5	12.9	11.4	10.0	8.6	7.1	6.2	5.7	5.4	6.8	7.8	8.9	8.5	9.2	10.9	12.8	14.7	16.3	17.7	18.5	18.6	18.1
	W4 - 2 cm outer plaster + 8.5 cm Brick + 3 cm XPS + 8.5 cm Brick + 2 cm inner plaster (Light surface)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W4 - 2 cm outer plaster + 8.5 cm Brick + 3 cm XPS + 8.5 cm Brick + 2 cm inner plaster (Light surface)																							
N	16.1	15.6	14.9	13.9	13.0	12.0	10.8	9.7	8.9	7.8	7.1	6.4	6.1	6.4	7.0	7.1	8.4	10.0	11.6	13.0	14.4	15.1	16.0	16.2
E	16.2	15.7	15.0	14.0	13.1	12.0	10.9	9.6	8.7	7.7	7.0	6.2	6.3	5.5	6.4	6.8	7.5	9.3	11.2	12.8	14.4	15.3	16.1	16.4
S	16.4	15.9	15.2	14.2	13.2	12.1	11.0	9.8	9.0	8.0	7.7	7.2	7.1	7.3	7.8	7.8	9.0	10.4	12.0	13.5	15.0	15.9	16.5	16.6
W	16.9	16.3	15.5	14.4	13.4	12.3	11.1	9.8	8.9	8.3	7.8	8.7	8.9	9.2	7.8	7.6	8.5	9.8	11.4	12.9	14.6	15.8	16.7	17.0
	W5 - 2 cm outer plaster + 20 cm Briquette + 2 cm inner plaster (Light surface)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W5 - 2 cm outer plaster + 20 cm Briquette + 2 cm inner plaster (Light surface)																							
N	14.0	12.9	11.7	10.4	9.3	8.2	7.0	6.2	6.0	5.9	6.4	7.1	8.2	9.8	11.4	12.1	13.7	15.1	16.0	16.5	16.6	16.1	15.7	14.9
E	14.1	13.0	11.8	10.5	9.4	8.2	7.1	6.1	5.8	5.8	6.3	6.9	8.4	8.9	10.8	11.8	12.8	14.4	15.6	16.3	16.6	16.3	15.8	15.1

S	14.3	13.2	12.0	10.7	9.5	8.3	7.2	6.3	6.1	6.1	7.0	7.9	9.2	10.7	12.2	12.8	14.3	15.5	16.4	17.0	17.2	16.9	16.2	15.3
W	14.8	13.6	12.3	10.9	9.7	8.5	7.3	6.3	6.0	6.4	7.1	9.4	11.0	12.6	12.2	12.6	13.8	14.9	15.8	16.4	16.8	16.8	16.4	15.7
	W6 - 2cm plaster +19cm Brick +2cm plaster +3cmXPS (Light surface)																							
N	13.9	14.1	14.1	13.8	13.7	13.4	12.8	12.3	12.1	11.2	10.4	9.4	8.6	8.1	7.8	6.9	7.3	8.0	8.9	9.8	10.9	11.7	12.8	13.5
E	14.0	14.2	14.2	13.9	13.8	13.4	12.9	12.2	11.9	11.1	10.3	9.2	8.8	7.2	7.2	6.6	6.4	7.3	8.5	9.6	10.9	11.9	12.9	13.7
S	14.2	14.4	14.4	14.1	13.9	13.5	13.0	12.4	12.2	11.4	11.0	10.2	9.6	9.0	8.6	7.6	7.9	8.4	9.3	10.3	11.5	12.5	13.3	13.9
W	14.7	14.8	14.7	14.3	14.1	13.7	13.1	12.4	12.1	11.7	11.1	11.7	11.4	10.9	8.6	7.4	7.4	7.8	8.7	9.7	11.1	12.4	13.5	14.3
	W7 - 2cm plaster +13.5cm Brick +2.5cm EPS + 8.5cm Brick+2cm plaster (Light surface)																							
N	15.7	15.9	15.8	15.3	14.9	14.3	13.5	12.6	13.0	10.6	9.4	8.0	6.9	6.2	6.0	4.0	5.9	7.0	8.4	9.9	11.5	12.8	14.3	15.2
E	15.8	16.0	15.9	15.4	15.0	14.3	13.6	12.5	12.8	10.5	9.3	7.8	7.1	5.3	5.4	3.7	5.0	6.3	8.0	9.7	11.5	13.0	14.4	15.4
S	16.0	16.2	16.1	15.6	15.1	14.4	13.7	12.7	13.1	10.8	10.0	8.8	7.9	7.1	6.8	4.7	6.5	7.4	8.8	10.4	12.1	13.6	14.8	15.6
W	16.5	16.6	16.4	15.8	15.3	14.6	13.8	12.7	13.0	11.1	10.1	10.3	9.7	9.0	6.8	4.5	6.0	6.8	8.2	9.8	11.7	13.5	15.0	16.0
	W8 - 2cm plaster +19cm Brick + 2cm plaster +30mm XPS + Siding (Light surface)																							
N	18.3	18.4	18.2	17.8	17.4	17.0	16.2	15.6	15.1	14.2	13.4	12.4	11.7	11.3	11.3	10.6	11.2	12.1	13.2	14.3	15.5	16.3	17.4	18.0
E	18.4	18.5	18.3	17.9	17.5	17.0	16.3	15.5	14.9	14.1	13.3	12.2	11.9	10.4	10.7	10.3	10.3	11.4	12.8	14.1	15.5	16.5	17.5	18.2
S	18.6	18.7	18.5	18.1	17.6	17.1	16.4	15.7	15.2	14.4	14.0	13.2	12.7	12.2	12.1	11.3	11.8	12.5	13.6	14.8	16.1	17.1	17.9	18.4
W	19.1	19.1	18.8	18.3	17.8	17.3	16.5	15.7	15.1	14.7	14.1	14.7	14.5	14.1	12.1	11.1	11.3	11.9	13.0	14.2	15.7	17.0	18.1	18.8
	R1 - 4cm concrete+5cm XPS+12cm concrete+2cm plaster (Light surface)																							
	19.8	17.7	16.2	14.4	12.5	12.4	11.1	10.0	9.6	11.2	11.5	13.2	13.6	19.1	21.7	23.4	26.1	25.8	26.2	25.1	24.7	24.5	22.2	20.8
	R2 - 12cm concrete +2cm inner plaster (Light surface)																							
	7.1	6.4	4.8	4.0	3.2	1.7	1.7	4.7	8.6	14.1	19.7	28.5	33.7	39.0	42.7	42.3	43.0	39.9	34.6	27.4	20.3	15.7	11.3	10.3

Diyarbakir (Dark) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W1 - 2 cm outer plaster + 19 cm Brick + 2 cm inner plaster (Dark surface)																							
N	11.7	10.6	9.3	8.1	7.1	6.1	5.1	4.4	3.9	3.8	4.1	4.9	6.2	7.9	9.9	11.9	13.7	15.1	15.9	16.2	16.0	15.2	14.3	13.2
E	12.0	10.9	9.6	8.3	7.3	6.2	5.3	4.5	3.9	3.8	4.1	4.9	6.3	8.1	10.2	12.4	14.4	15.8	16.7	17.0	16.7	15.9	14.8	13.7
S	20.6	18.9	17.2	15.5	13.8	12.2	10.7	9.4	8.5	8.3	8.8	10.1	12.0	14.4	16.9	19.5	21.9	23.8	25.1	25.7	25.7	24.9	23.7	22.3
W	14.4	12.9	11.3	9.8	8.5	7.3	6.1	5.2	4.6	4.6	5.1	7.5	9.2	11.0	11.0	12.9	14.7	16.3	17.6	18.4	18.7	18.4	17.4	16.1
	W2 - 2 cm outer plaster + 20 cm AAC + 2 cm inner plaster (Dark surface)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W2 - 2 cm outer plaster + 20 cm AAC + 2 cm inner plaster (Dark surface)																							
N	21.4	19.2	17.0	14.8	12.9	11.0	9.3	7.8	6.5	5.8	5.9	6.8	8.6	11.2	14.2	17.4	20.5	23.3	25.3	26.5	26.9	26.2	25.1	23.4
E	21.7	19.5	17.3	15.0	13.1	11.1	9.5	7.9	6.5	5.8	5.9	6.8	8.7	11.4	14.5	17.9	21.2	24.0	26.1	27.3	27.6	26.9	25.6	23.9
S	21.9	19.6	17.4	15.2	13.2	11.2	9.5	7.9	6.7	6.2	6.5	7.7	9.8	12.6	15.7	19.0	22.1	24.8	26.7	27.8	28.0	27.3	25.9	24.0
W	24.1	21.5	19.0	16.5	14.3	12.2	10.3	8.6	7.2	6.6	6.9	9.4	11.6	14.3	15.3	18.4	21.5	24.5	27.0	28.7	29.6	29.4	28.2	26.3
	W3 - 2 cm outer plaster + 20 cm Blokbims + 2 cm inner plaster (Dark surface)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W3 - 2 cm outer plaster + 20 cm Blokbims + 2 cm inner plaster (Dark surface)																							
N	21.6	19.8	17.8	15.8	13.9	12.2	10.5	9.0	7.7	6.9	6.8	7.4	8.9	11.0	13.7	16.6	19.4	22.0	24.0	25.3	25.9	25.5	24.7	23.3
E	21.9	20.1	18.1	16.0	14.1	12.3	10.7	9.1	7.7	6.9	6.8	7.4	9.0	11.2	14.0	17.1	20.1	22.7	24.8	26.1	26.6	26.2	25.2	23.8
S	22.1	20.2	18.2	16.2	14.2	12.4	10.7	9.1	7.9	7.3	7.4	8.3	10.1	12.4	15.2	18.2	21.0	23.5	25.4	26.6	27.0	26.6	25.5	23.9
W	24.3	22.1	19.8	17.5	15.3	13.4	11.5	9.8	8.4	7.7	7.8	10.0	11.9	14.1	14.8	17.6	20.4	23.2	25.7	27.5	28.6	28.7	27.8	26.2
	W4 - 2 cm outer plaster + 8.5 cm Brick + 3 cm XPS + 8.5 cm Brick+ 2 cm inner plaster																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W4 - 2 cm outer plaster + 8.5 cm Brick + 3 cm XPS + 8.5 cm Brick+ 2 cm inner plaster																							
N	21.3	20.1	18.8	17.3	15.9	14.5	13.0	11.7	10.4	9.5	9.2	9.3	10.0	11.3	13.0	15.0	17.0	19.0	20.7	21.9	22.8	22.8	22.8	22.2
E	21.6	20.4	19.1	17.5	16.1	14.6	13.2	11.8	10.4	9.5	9.2	9.3	10.1	11.5	13.3	15.5	17.7	19.7	21.5	22.7	23.5	23.5	23.3	22.7
S	21.8	20.5	19.2	17.7	16.2	14.7	13.2	11.8	10.6	9.9	9.8	10.2	11.2	12.7	14.5	16.6	18.6	20.5	22.1	23.2	23.9	23.9	23.6	22.8
W	24.0	22.4	20.8	19.0	17.3	15.7	14.0	12.5	11.1	10.3	10.2	11.9	13.0	14.4	14.1	16.0	18.0	20.2	22.4	24.1	25.5	26.0	25.9	25.1
	W5 - 2 cm outer plaster + 20 cm Briquette + 2 cm inner plaster (Dark surface)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W5 - 2 cm outer plaster + 20 cm Briquette + 2 cm inner plaster (Dark surface)																							
N	19.2	17.4	15.6	13.8	12.2	10.7	9.2	8.2	7.5	7.6	8.5	10.0	12.1	14.7	17.4	20.0	22.3	24.1	25.1	25.4	25.0	23.8	22.5	20.9
E	19.5	17.7	15.9	14.0	12.4	10.8	9.4	8.3	7.5	7.6	8.5	10.0	12.2	14.9	17.7	20.5	23.0	24.8	25.9	26.2	25.7	24.5	23.0	21.4

S	19.7	17.8	16.0	14.2	12.5	10.9	9.4	8.3	7.7	8.0	9.1	10.9	13.3	16.1	18.9	21.6	23.9	25.6	26.5	26.7	26.1	24.9	23.3	21.5
W	21.9	19.7	17.6	15.5	13.6	11.9	10.2	9.0	8.2	8.4	9.5	12.6	15.1	17.8	18.5	21.0	23.3	25.3	26.8	27.6	27.7	27.0	25.6	23.8
	W6 - 2cm plaster +19cm Brick +2cm plaster +3cmXPS (Dark surface)																							
N	19.1	18.6	18.0	17.2	16.6	15.9	15.0	14.3	13.6	12.9	12.5	12.3	12.5	13.0	13.8	14.8	15.9	17.0	18.0	18.7	19.3	19.4	19.6	19.5
E	19.4	18.9	18.3	17.4	16.8	16.0	15.2	14.4	13.6	12.9	12.5	12.3	12.6	13.2	14.1	15.3	16.6	17.7	18.8	19.5	20.0	20.1	20.1	20.0
S	19.6	19.0	18.4	17.6	16.9	16.1	15.2	14.4	13.8	13.3	13.1	13.2	13.7	14.4	15.3	16.4	17.5	18.5	19.4	20.0	20.4	20.5	20.4	20.1
W	21.8	20.9	20.0	18.9	18.0	17.1	16.0	15.1	14.3	13.7	13.5	14.9	15.5	16.1	14.9	15.8	16.9	18.2	19.7	20.9	22.0	22.6	22.7	22.4
	W7 - 2cm plaster +13.5cm Brick +2.5cm EPS + 8.5cm Brick+2cm plaster (Dark surface)																							
N	20.9	20.4	19.7	18.7	17.8	16.8	15.7	14.6	14.5	12.3	11.5	10.9	10.8	11.1	12.0	11.9	14.5	16.0	17.5	18.8	19.9	20.5	21.1	21.2
E	21.2	20.7	20.0	18.9	18.0	16.9	15.9	14.7	14.5	12.3	11.5	10.9	10.9	11.3	12.3	12.4	15.2	16.7	18.3	19.6	20.6	21.2	21.6	21.7
S	21.4	20.8	20.1	19.1	18.1	17.0	15.9	14.7	14.7	12.7	12.1	11.8	12.0	12.5	13.5	13.5	16.1	17.5	18.9	20.1	21.0	21.6	21.9	21.8
W	23.6	22.7	21.7	20.4	19.2	18.0	16.7	15.4	15.2	13.1	12.5	13.5	13.8	14.2	13.1	12.9	15.5	17.2	19.2	21.0	22.6	23.7	24.2	24.1
	W8 - 2cm plaster +19cm Brick + 2cm plaster +30mm XPS + Siding (Dark surface)																							
N	23.5	22.9	22.1	21.2	20.3	19.5	18.4	17.6	16.6	15.9	15.5	15.3	15.6	16.2	17.3	18.5	19.8	21.1	22.3	23.2	23.9	24.0	24.2	24.0
E	23.8	23.2	22.4	21.4	20.5	19.6	18.6	17.7	16.6	15.9	15.5	15.3	15.7	16.4	17.6	19.0	20.5	21.8	23.1	24.0	24.6	24.7	24.7	24.5
S	24.0	23.3	22.5	21.6	20.6	19.7	18.6	17.7	16.8	16.3	16.1	16.2	16.8	17.6	18.8	20.1	21.4	22.6	23.7	24.5	25.0	25.1	25.0	24.6
W	26.2	25.2	24.1	22.9	21.7	20.7	19.4	18.4	17.3	16.7	16.5	17.9	18.6	19.3	18.4	19.5	20.8	22.3	24.0	25.4	26.6	27.2	27.3	26.9
	R1 - 4cm concrete+5cm XPS+12cm concrete+2cm plaster (Dark surface)																							
	25.0	23.0	21.3	19.2	17.1	16.9	15.2	13.9	13.1	14.3	15.2	17.1	17.9	23.9	27.1	29.3	32.5	32.9	34.1	33.2	32.2	31.4	28.3	26.0
	R2 - 12cm concrete +2cm inner plaster (Dark surface)																							
	11.2	9.9	7.2	6.1	5.1	3.2	3.5	6.8	11.2	17.2	23.1	32.1	37.5	43.1	47.0	46.9	47.8	45.0	40.5	33.9	27.4	22.5	17.1	15.2

Kars (Light) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W1 - 2 cm outer plaster + 19 cm Brick + 2 cm inner plaster (Light surface)																							
N	1.6	1.1	0.7	0.6	0.5	0.4	0.3	0.3	0.1	0.2	0.8	1.2	1.5	2.7	3.7	1.9	1.5	1.4	1.1	1.1	1.5	1.9	2.3	1.9
E	1.7	1.2	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.3	0.9	1.3	1.6	2.8	3.8	2.1	1.6	1.5	1.2	1.2	1.6	2.0	2.4	2.1
S	1.9	1.4	0.9	0.8	0.7	0.6	0.5	0.4	0.2	0.4	1.0	1.4	1.7	2.9	3.9	2.3	1.7	1.6	1.4	1.4	1.7	2.4	2.6	2.3
W	2.4	1.8	1.0	0.9	0.8	0.7	0.6	0.5	0.3	0.5	1.0	1.5	1.8	3.5	4.3	2.5	1.9	1.7	1.6	1.5	1.9	2.5	2.8	2.7
	W2 - 2 cm outer plaster + 20 cm AAC + 2 cm inner plaster (Light surface)																							
N	2.6	1.7	0.7	0.7	0.7	0.6	0.5	0.0	0.3	0.3	0.2	0.2	1.0	3.7	4.1	2.5	1.0	0.6	1.4	2.6	3.8	3.8	3.8	3.4
E	2.7	1.8	0.8	0.8	0.8	0.7	0.6	-0.2	0.4	0.3	0.3	0.3	1.1	3.8	4.2	2.6	1.0	0.7	1.5	2.8	3.8	4.0	3.9	3.6
S	2.9	2.0	1.0	0.9	0.9	0.8	0.7	0.0	0.5	0.4	0.3	0.4	1.2	3.9	4.4	2.8	1.2	0.8	1.5	2.8	3.9	4.4	4.3	3.8
W	3.4	2.4	1.3	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.5	1.3	4.1	4.5	3.0	1.4	0.9	1.7	2.9	4.0	4.5	4.5	4.2
	W3 - 2 cm outer plaster + 20 cm Blokbims + 2 cm inner plaster (Light surface)																							
N	2.7	2.1	1.2	1.2	1.3	0.6	0.5	0.0	0.1	0.1	0.3	0.5	0.9	3.9	4.6	3.4	1.9	1.5	0.8	2.0	2.9	3.2	3.5	3.2
E	2.8	2.2	1.3	1.3	1.3	0.8	0.6	0.2	0.1	0.2	0.4	0.6	0.9	3.9	4.7	3.5	2.0	1.6	0.9	2.4	2.9	3.4	3.6	3.4
S	3.0	2.4	1.5	1.5	1.4	0.9	0.7	0.0	0.2	0.4	0.5	0.7	1.1	4.1	4.9	3.6	2.1	1.7	1.2	2.5	3.5	4.0	4.0	3.6
W	3.5	2.8	1.8	1.7	1.5	1.1	0.8	0.6	0.3	0.5	0.6	0.8	1.3	4.5	5.0	3.7	2.4	1.9	1.7	2.6	3.1	3.9	4.2	4.0
	W4 - 2 cm outer plaster + 8.5 cm Brick + 3 cm XPS + 8.5 cm Brick+ 2 cm inner plaster (Light surface)																							
N	2.5	2.4	2.0	1.4	0.8	0.2	0.1	0.0	0.0	0.0	0.4	0.4	0.4	0.6	0.6	0.7	0.8	1.0	1.0	1.1	1.3	1.1	2.0	2.4
E	2.6	2.5	2.1	1.5	0.9	0.2	0.2	0.1	0.1	0.1	0.4	0.5	0.4	0.6	0.6	0.7	0.9	1.0	1.1	1.2	1.3	1.3	2.1	2.6
S	2.8	2.7	2.3	1.7	1.0	0.3	0.3	0.2	0.1	0.1	0.5	0.6	0.5	0.7	0.7	0.8	0.9	1.1	1.2	1.3	1.4	1.8	2.5	2.8
W	3.3	3.1	2.6	1.9	1.2	0.5	0.4	0.3	0.1	0.2	0.6	0.7	0.6	0.8	0.8	0.9	1.0	1.2	1.3	1.5	1.6	1.8	2.7	3.2
	W5 - 2 cm outer plaster + 20 cm Briquette + 2 cm inner plaster (Light surface)																							
N	0.8	0.2	0.5	0.5	0.4	0.3	0.2	0.4	0.0	0.1	0.3	0.6	0.8	1.2	1.5	1.5	1.3	1.3	1.5	1.8	2.0	1.7	1.6	1.3
E	0.9	0.3	0.6	0.5	0.5	0.4	0.3	0.3	0.1	0.2	0.5	0.7	0.9	1.3	1.6	1.6	1.4	1.4	1.5	1.6	2.0	1.9	1.7	1.5

S	1.4	0.7	0.7	0.6	0.6	0.5	0.4	0.4	0.2	0.3	0.6	0.8	1.0	1.5	1.7	1.7	1.6	1.6	1.7	1.7	2.1	2.3	2.1	2.0
W	1.6	0.9	0.9	0.8	0.7	0.6	0.5	0.5	0.3	0.5	0.7	0.9	1.1	1.6	1.8	1.8	1.7	1.7	1.8	1.9	2.2	2.4	2.3	2.1
	W6 - 2cm plaster +19cm Brick +2cm plaster +3cmXPS (Light surface)																							
N	0.9	1.2	1.3	1.3	1.3	1.2	0.9	0.5	0.3	0.2	0.1	0.1	1.2	2.1	2.8	3.3	4.4	4.5	3.7	2.6	1.6	1.2	0.9	0.5
E	1.0	1.3	1.4	1.4	1.4	1.2	1.0	0.4	0.0	0.2	0.2	0.2	1.2	2.2	2.9	3.4	4.5	4.6	3.8	2.7	1.7	1.3	1.0	0.7
S	1.2	1.5	1.6	1.6	1.5	1.3	1.1	0.6	0.5	0.3	0.2	0.3	1.3	2.3	3.1	3.9	4.8	4.8	4.1	2.8	1.8	1.4	1.1	0.9
W	1.7	1.9	1.9	1.8	1.7	1.5	1.2	0.6	0.5	0.4	0.3	0.3	1.4	2.4	3.5	4.5	5.1	5.0	4.3	3.4	2.1	1.6	1.4	1.1
	W7 - 2cm plaster +13.5cm Brick +2.5cm EPS + 8.5cm Brick+2cm plaster (Light surface)																							
N	2.2	2.6	2.6	2.4	2.3	1.9	1.4	1.5	0.8	0.7	0.7	0.5	0.5	1.9	2.7	3.5	4.0	4.7	5.0	5.0	3.8	3.5	2.7	1.6
E	2.3	2.7	2.7	2.5	2.4	1.9	1.5	1.5	0.9	0.8	0.8	0.6	0.5	2.0	2.7	3.6	4.1	4.8	5.1	5.1	3.9	3.6	2.9	1.8
S	2.5	2.9	2.9	2.7	2.5	2.4	1.6	1.9	1.2	1.0	0.9	0.7	0.6	2.1	2.9	3.9	4.2	5.0	5.4	5.6	4.2	3.8	3.1	2.0
W	3.4	3.3	3.2	2.9	2.7	2.6	2.4	2.2	1.9	1.7	1.5	0.8	0.7	2.8	3.1	4.1	4.8	5.3	5.7	5.8	4.6	4.1	3.4	2.4
	W8 - 2cm plaster +19cm Brick + 2cm plaster +30mm XPS + Siding (Light surface)																							
N	1.9	2.2	2.2	2.0	1.9	1.6	1.2	1.0	0.3	0.3	0.2	0.3	1.0	1.6	2.7	2.9	3.7	3.8	2.8	1.9	1.5	1.4	1.1	0.9
E	2.0	2.3	2.3	2.1	2.0	1.6	1.3	0.9	0.4	0.4	0.3	0.4	1.1	1.7	2.8	3.0	3.8	3.9	2.9	1.9	1.6	1.6	1.1	1.0
S	2.2	2.5	2.5	2.3	2.1	1.7	1.4	1.1	0.6	0.5	0.4	0.5	1.2	1.9	3.1	3.4	4.0	4.1	3.1	2.1	1.7	1.5	1.2	1.1
W	2.9	2.9	2.8	2.5	2.3	1.9	1.5	1.1	0.9	0.6	0.5	0.6	1.4	2.5	3.4	3.7	4.5	4.4	3.3	2.3	1.9	1.6	1.4	1.2
	R1 - 4cm concrete+5cm XPS+12cm concrete+2cm plaster (Light surface)																							
	12.3	10.9	10.0	8.3	6.6	5.0	3.5	1.2	0.0	0.8	0.9	2.9	4.6	6.0	8.1	12.6	15.7	18.5	18.2	19.0	18.6	17.2	17.0	16.0
	R2 - 12cm concrete +2cm inner plaster (Light surface)																							
	2.4	1.9	0.8	0.8	0.7	0.6	0.0	0.3	0.3	0.0	0.3	12.7	21.5	28.3	31.3	36.0	29.8	28.0	23.9	19.9	14.2	10.0	5.3	4.9

Kars (Dark) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	W1 - 2 cm outer plaster + 19 cm Brick + 2 cm inner plaster (Dark surface)																							
N	4.8	3.6	2.3	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.9	4.9	6.5	7.6	8.1	8.1	7.5	6.9	5.9
E	5.1	3.9	2.6	1.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	3.4	5.6	7.2	8.4	8.9	8.8	8.2	7.4	6.4
S	5.3	4.0	2.7	1.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	4.5	6.5	8.0	9.0	9.4	9.2	8.6	7.7	6.5
W	7.5	5.9	4.3	2.8	1.3	1.0	0.8	0.7	0.5	0.4	0.4	1.7	1.8	1.7	1.9	3.9	5.9	7.7	9.3	10.3	10.8	10.7	10.0	8.8
	W2 - 2 cm outer plaster + 20 cm AAC + 2 cm inner plaster (Dark surface)																							
N	5.8	4.2	2.6	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	5.1	7.4	9.0	9.9	10.2	9.5	8.6	7.4
E	6.1	4.5	2.9	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	5.8	8.1	9.8	10.7	10.9	10.2	9.1	7.9
S	6.3	4.6	3.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	4.0	6.7	8.9	10.4	11.2	11.3	10.6	9.4	8.0
W	8.5	6.5	4.6	2.7	1.1	1.0	0.8	0.7	0.5	0.4	0.4	1.7	1.8	1.7	0.8	3.4	6.1	8.6	10.7	12.1	12.9	12.7	11.7	10.3
	W3 - 2 cm outer plaster + 20 cm Blokbims + 2 cm inner plaster (Dark surface)																							
N	5.9	4.6	3.1	1.6	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	4.1	6.3	7.9	8.9	9.3	8.9	8.3	7.2
E	6.2	4.9	3.4	1.8	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	4.8	7.0	8.7	9.7	10.0	9.6	8.8	7.7
S	6.4	5.0	3.5	2.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	3.3	5.7	7.8	9.3	10.2	10.4	10.0	9.1	7.8
W	8.6	6.9	5.1	3.3	1.7	1.0	0.8	0.7	0.5	0.4	0.4	1.7	1.8	1.7	0.3	2.7	5.1	7.5	9.6	11.1	12.0	12.1	11.4	10.1
	W4 - 2 cm outer plaster + 8.5 cm Brick + 3 cm XPS + 8.5 cm Brick+ 2 cm inner plaster																							
N	5.7	4.9	3.9	2.8	1.7	0.7	0.0	0.0	0.1	0.1	0.3	1.1	1.0	1.3	1.6	1.8	2.2	3.8	5.2	6.1	6.8	6.8	6.8	6.4
E	6.0	5.2	4.2	3.0	1.9	0.8	0.2	0.1	0.1	0.1	0.4	1.1	1.1	1.5	1.7	1.9	2.9	4.5	6.0	6.9	7.5	7.5	7.3	6.9
S	6.2	5.3	4.3	3.2	2.0	0.9	0.2	0.1	0.2	0.3	0.6	1.2	1.2	1.7	1.9	2.0	3.8	5.3	6.6	7.4	7.9	7.9	7.6	7.0
W	8.4	7.2	5.9	4.5	3.1	1.9	1.0	0.8	0.7	0.7	0.8	2.9	3.0	1.9	2.3	2.9	3.9	5.8	6.9	8.3	9.5	10.0	9.9	9.3
	W5 - 2 cm outer plaster + 20 cm Briquette + 2 cm inner plaster (Dark surface)																							
N	4.0	2.7	1.4	0.1	0.0	0.3	0.4	0.4	0.1	0.1	0.2	1.2	1.3	2.0	2.4	4.6	6.5	7.9	8.6	8.7	8.4	7.4	6.4	5.3
E	4.3	3.0	1.7	0.3	0.2	0.4	0.6	0.5	0.1	0.1	0.2	1.3	1.3	2.1	2.7	5.1	7.2	8.6	9.4	9.5	9.1	8.1	6.9	5.8

S	4.5	3.1	1.8	0.5	0.3	0.5	0.6	0.5	0.3	0.2	0.3	1.4	1.6	2.4	3.9	6.2	8.1	9.4	10.0	10.0	9.5	8.5	7.2	5.9
W	6.7	5.0	3.4	1.8	1.4	1.5	1.4	1.2	0.8	0.6	0.7	3.1	3.4	4.1	3.5	5.6	7.5	9.1	10.3	10.9	11.1	10.6	9.5	8.2
	W6 - 2cm plaster +19cm Brick +2cm plaster +3cmXPS (Dark surface)																							
N	4.1	3.7	3.2	2.7	2.2	1.7	1.1	0.5	0.4	0.3	0.2	0.5	0.3	0.2	0.1	0.1	0.6	2.2	3.0	3.6	4.1	4.2	4.4	4.3
E	4.4	4.0	3.5	2.9	2.4	1.8	1.3	0.6	0.4	0.3	0.2	0.5	0.4	0.4	0.4	0.6	1.3	2.9	3.8	4.4	4.8	4.9	4.9	4.8
S	4.6	4.1	3.6	3.1	2.5	1.9	1.3	0.6	0.6	0.7	0.8	1.4	1.5	1.6	1.6	1.7	2.2	3.7	4.4	4.9	5.2	5.3	5.2	4.9
W	6.8	6.0	5.2	4.4	3.6	2.9	2.1	1.3	1.1	1.1	1.2	1.6	1.7	1.8	1.8	1.9	2.4	3.4	4.7	5.8	6.8	7.4	7.5	7.2
	W7 - 2cm plaster +13.5cm Brick +2.5cm EPS + 8.5cm Brick+2cm plaster (Dark surface)																							
N	5.4	5.1	4.5	3.8	3.2	2.4	1.6	0.8	0.6	0.5	0.7	0.5	0.3	0.2	0.5	0.5	1.5	1.4	2.6	3.7	4.6	5.0	5.5	5.6
E	5.7	5.4	4.8	4.0	3.4	2.5	1.8	0.9	0.6	0.5	0.7	0.5	0.4	0.4	0.8	1.0	1.6	2.1	3.4	4.5	5.3	5.7	6.0	6.1
S	5.9	5.5	4.9	4.2	3.5	2.6	1.8	0.9	0.8	0.9	1.3	1.4	1.5	1.6	2.0	2.1	1.7	2.9	4.0	5.0	5.7	6.1	6.3	6.2
W	8.1	7.4	6.5	5.5	4.6	3.6	2.6	1.6	1.3	1.5	1.6	2.2	2.3	2.4	2.4	2.5	2.5	3.1	4.3	5.9	7.3	8.2	8.6	8.5
	W8 - 2cm plaster +19cm Brick + 2cm plaster +30mm XPS + Siding (Dark surface)																							
N	5.1	4.7	4.1	3.4	2.8	2.1	1.4	1.0	0.5	0.1	0.0	0.4	0.2	0.0	0.1	0.8	2.0	3.1	4.0	4.7	5.3	5.3	5.5	5.4
E	5.4	5.0	4.4	3.6	3.0	2.2	1.6	1.1	0.5	0.1	0.0	0.4	0.3	0.2	0.4	1.3	2.7	3.8	4.8	5.5	6.0	6.0	6.0	5.9
S	5.6	5.1	4.5	3.8	3.1	2.3	1.6	1.1	0.7	0.5	0.6	1.3	1.4	1.4	1.6	2.4	3.6	4.6	5.4	6.0	6.4	6.4	6.3	6.0
W	7.8	7.0	6.1	5.1	4.2	3.3	2.4	1.8	0.9	0.7	0.8	1.6	1.7	1.7	1.9	2.7	3.0	4.3	5.7	6.9	8.0	8.5	8.6	8.3
	R1 - 4cm concrete+5cm XPS+12cm concrete+2cm plaster (Dark surface)																							
	17.5	16.2	15.1	13.1	11.2	9.5	7.6	5.1	3.5	2.9	3.6	5.8	7.9	9.8	13.5	18.5	22.1	25.6	26.1	27.1	26.1	24.1	23.1	21.2
	R2 - 12cm concrete +2cm inner plaster (Dark surface)																							
	6.5	5.4	3.2	2.9	2.6	2.1	1.8	1.5	1.3	0.9	1.5	14.5	23.4	31.2	35.6	40.6	34.6	33.1	29.8	26.4	21.3	16.8	11.1	9.8

Baghdad (Light) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	WA - 20mm plaster +240mm Brick+20mm plaster (Light surface)																							
N	15.2	15.1	14.7	14.1	13.6	12.9	12.0	11.2	10.2	9.1	8.2	7.4	6.9	6.8	7.0	7.4	8.2	9.2	10.4	11.7	12.9	14.0	14.8	15.1
E	17.4	17.0	16.3	15.7	14.9	14.0	13.1	12.0	11.0	10.0	9.5	9.3	9.5	9.9	10.7	11.3	12.1	13.0	14.0	15.1	16.1	16.9	17.4	17.5
S	16.5	16.2	16.8	17.3	15.5	14.8	14.0	12.9	11.7	10.5	9.1	7.8	6.9	6.2	6.1	6.5	7.5	8.8	10.4	12.2	14.0	15.5	16.6	16.5
W	16.2	16.1	15.7	15.2	14.6	13.8	13.0	11.9	10.9	9.8	8.8	7.9	7.2	6.8	6.6	6.8	7.4	8.5	9.9	11.4	13.0	14.4	15.4	16.0
	WB - 20mm plaster +240mm Thermiston +20mm plaster (Light surface)																							
N	16.3	16.0	15.4	14.6	13.8	12.9	11.9	10.9	9.7	8.4	7.4	6.5	6.0	6.0	6.2	7.0	8.0	9.3	10.8	12.4	13.9	15.1	16.0	16.3
E	18.4	17.7	16.8	15.9	14.9	13.9	12.7	11.5	10.2	9.0	8.3	8.1	8.5	9.3	10.4	11.5	12.6	13.8	15.0	16.2	17.4	18.2	18.7	18.7
S	17.6	17.2	16.4	15.5	14.5	13.5	12.5	11.4	10.1	9.0	7.8	6.9	6.5	6.4	6.8	7.8	9.1	10.7	12.4	14.2	15.8	17.0	17.7	17.9
W	17.7	17.4	16.7	15.8	15.0	13.9	12.9	11.6	10.4	9.0	7.9	6.9	6.2	5.8	5.7	6.1	6.9	8.2	10.0	12.0	14.0	15.7	17.0	17.6
	WC - 20mm plaster +200mm Block +20mm plaster (Light surface)																							
N	14.6	14.5	14.2	13.7	13.2	12.6	11.9	11.1	10.2	9.3	8.5	7.9	7.5	7.4	7.5	7.9	8.5	9.4	10.5	11.6	12.6	13.5	14.2	14.5
E	16.8	16.4	15.8	15.3	14.6	13.8	13.0	12.1	11.3	10.5	10.2	10.1	10.2	10.5	11.1	11.6	12.2	12.9	13.8	14.7	15.6	16.3	16.7	16.8
S	15.8	15.6	15.2	14.6	14.0	13.3	12.6	11.7	10.8	10.0	9.1	8.5	8.2	8.1	8.3	8.8	9.6	10.6	11.8	13.0	14.2	15.1	15.6	15.8
W	15.4	15.4	15.0	14.6	14.1	13.4	12.7	11.8	10.9	10.0	9.1	8.3	7.8	7.3	7.2	7.4	8.0	9.0	10.2	11.5	12.8	13.9	14.7	15.2
	WD - 20mm plaster +240mm Brick+50mm hilan Stone (Light surface)																							
N	15.2	15.4	15.3	15.1	15.6	14.2	14.5	12.8	11.7	10.6	9.4	8.3	7.4	6.7	6.3	5.4	5.7	6.4	7.5	8.8	10.4	12.0	13.6	14.7
E	17.9	17.8	17.5	17.0	16.5	15.8	15.0	13.9	12.8	11.4	10.3	9.4	8.9	8.8	9.2	9.6	10.3	11.2	12.3	13.5	14.9	16.0	17.0	17.5
S	16.6	16.7	16.6	16.2	15.7	15.1	14.4	13.6	12.5	11.3	10.1	8.9	7.9	7.1	6.8	6.9	7.5	8.4	9.7	11.3	13.0	14.4	15.5	16.2
W	15.9	16.4	16.4	16.2	15.9	15.3	14.7	13.7	12.7	11.5	10.3	9.1	8.0	7.1	6.4	6.1	6.1	6.6	7.7	9.1	10.8	12.5	14.0	15.2
	WE - 20mm plaster+240mm Brick+50mm insu.+120mm Brick Veneer (Light surface)																							
N	5.6	6.4	7.2	7.8	8.4	8.8	9.2	9.3	9.1	8.6	7.9	6.9	5.7	4.5	3.2	2.2	1.4	0.9	0.8	1.1	1.7	2.5	3.6	4.6
E	7.7	8.5	9.3	9.9	10.5	10.9	11.1	11.1	10.8	9.8	8.5	7.0	5.5	4.1	3.0	2.2	1.6	1.5	1.7	2.2	3.2	4.3	5.5	6.6

S	6.3	7.3	8.1	8.7	9.3	9.7	10.1	10.2	10.0	9.6	8.7	7.6	6.3	4.8	3.3	2.0	1.1	0.5	0.6	1.0	2.0	3.1	4.2	5.3
W	4.6	5.8	6.8	7.7	8.5	9.1	9.6	9.8	9.8	9.4	8.7	7.7	6.6	5.3	4.0	2.7	1.4	0.4	-0.3	-0.5	-0.1	0.8	2.0	3.3
	WF- 20mm plaster+200mm Block +50mm ins.+80mm Block +20mm plaster (Light surface)																							
N	10.1	10.8	11.5	12.0	12.5	12.9	13.2	13.4	13.3	12.9	12.3	11.5	10.4	9.4	8.3	7.4	6.7	6.3	6.2	6.4	6.9	7.6	8.5	9.3
E	12.9	13.6	14.2	14.8	15.3	15.7	16.0	16.1	15.9	15.1	14.1	12.8	11.4	10.2	9.3	8.5	8.0	7.8	7.9	8.3	9.1	10.0	11.1	12.0
S	11.2	12.0	12.6	13.1	13.6	14.0	14.4	14.6	14.5	14.2	13.5	12.6	11.5	10.2	8.8	7.7	6.9	6.4	6.4	6.8	7.6	8.5	9.4	10.4
W	9.7	10.7	11.5	12.2	12.9	13.4	14.0	14.2	14.3	13.9	13.4	12.6	11.7	10.6	9.5	8.4	7.2	6.3	5.7	5.5	5.8	6.5	7.5	8.7
	RA - 2cm plaster+15cm concrete+2cm felt+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Light surface)																							
	32	29	26	23	20	17	15	13	12	13	14	16	20	23	27	31	35	37	39	39	40	39	37	35
	RB - 2cm plaster+15cm concrete+2cm felt+2.5cm insu.+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Light surface)																							
	26	26	27	27	26	26	25	25	24	24	24	24	24	24	25	25	26	26	25	25	24	24	25	26

Baghdad (Dark) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	WA - 20mm plaster +240mm Brick+20mm plaster (Dark surface)																							
N	20.4	19.6	18.6	17.5	16.5	15.4	14.2	13.2	12.3	11.6	11.3	11.3	11.8	12.7	14.0	15.3	16.8	18.2	19.5	20.6	21.3	21.7	21.6	21.1
E	22.8	21.7	20.4	19.2	17.9	16.6	15.4	14.2	13.4	13.2	13.7	14.8	16.3	17.9	19.6	21.0	22.3	23.4	24.3	25.0	25.2	25.1	24.6	23.8
S	21.9	20.8	20.8	20.8	18.5	17.4	16.2	14.9	13.8	12.9	12.2	11.8	12.0	12.6	13.8	15.3	17.1	18.9	20.5	21.9	22.9	23.5	23.7	22.7
W	23.3	22.2	21.0	19.8	18.5	17.2	15.9	14.6	13.5	12.7	12.2	12.1	12.3	13.0	13.9	15.2	16.9	18.9	20.9	22.6	23.9	24.6	24.6	24.1
	WB - 20mm plaster +240mm Thermiston +20mm plaster (Dark surface)																							
N	21.5	20.5	19.3	18.0	16.7	15.4	14.1	12.9	11.8	10.9	10.5	10.4	10.9	11.9	13.2	14.9	16.6	18.3	19.9	21.3	22.3	22.8	22.8	22.3
E	23.8	22.4	20.9	19.4	17.9	16.5	15.0	13.7	12.6	12.2	12.5	13.6	15.3	17.3	19.3	21.2	22.8	24.2	25.3	26.1	26.5	26.4	25.9	25.0
S	23.0	21.8	20.4	19.0	17.5	16.1	14.7	13.4	12.2	11.4	10.9	10.9	11.6	12.8	14.5	16.6	18.7	20.8	22.5	23.9	24.7	25.0	24.8	24.1
W	24.8	23.5	22.0	20.4	18.9	17.3	15.8	14.3	13.0	11.9	11.3	11.1	11.3	12.0	13.0	14.5	16.4	18.6	21.0	23.2	24.9	25.9	26.2	25.7

	WC - 20mm plaster +200mm Block +20mm plaster (Dark surface)																							
N	19.8	19.0	18.1	17.1	16.1	15.1	14.1	13.1	12.3	11.8	11.6	11.8	12.4	13.3	14.5	15.8	17.1	18.4	19.6	20.5	21.0	21.2	21.0	20.5
E	22.2	21.1	19.9	18.8	17.6	16.4	15.3	14.3	13.7	13.7	14.4	15.6	17.0	18.5	20.0	21.3	22.4	23.3	24.1	24.6	24.7	24.5	23.9	23.1
S	21.2	20.2	19.2	18.1	17.0	15.9	14.8	13.7	12.9	12.4	12.2	12.5	13.3	14.5	16.0	17.6	19.2	20.7	21.9	22.7	23.1	23.1	22.7	22.0
W	22.5	21.5	20.3	19.2	18.0	16.8	15.6	14.5	13.5	12.9	12.5	12.5	12.9	13.5	14.5	15.8	17.5	19.4	21.2	22.7	23.7	24.1	23.9	23.3
	WD - 20mm plaster +240mm Brick+50mm hilan Stone (Dark surface)																							
N	20.4	19.9	19.2	18.5	18.5	16.7	16.7	14.8	13.8	13.1	12.5	12.2	12.3	12.6	13.3	13.3	14.3	15.4	16.6	17.7	18.8	19.7	20.4	20.7
E	23.3	22.5	21.6	20.5	19.5	18.4	17.3	16.1	15.2	14.6	14.5	14.9	15.7	16.8	18.1	19.3	20.5	21.6	22.6	23.4	24.0	24.2	24.2	23.8
S	22.0	21.3	20.6	19.7	18.7	17.7	16.6	15.6	14.6	13.7	13.2	12.9	13.0	13.5	14.5	15.7	17.1	18.5	19.8	21.0	21.9	22.4	22.6	22.4
W	23.0	22.5	21.7	20.8	19.8	18.7	17.6	16.4	15.3	14.4	13.7	13.3	13.1	13.3	13.7	14.5	15.6	17.0	18.7	20.3	21.7	22.7	23.2	23.3
	WE - 20mm plaster+240mm Brick+50mm insu.+120mm Brick Veneer (Dark surface)																							
N	10.8	10.9	11.1	11.2	11.3	11.3	11.4	11.3	11.2	11.1	11.0	10.8	10.6	10.4	10.2	10.1	10.0	9.9	9.9	10.0	10.1	10.2	10.4	10.6
E	13.1	13.2	13.4	13.4	13.5	13.5	13.4	13.3	13.2	13.0	12.7	12.5	12.3	12.1	11.9	11.9	11.8	11.9	12.0	12.1	12.3	12.5	12.7	12.9
S	11.7	11.9	12.1	12.2	12.3	12.3	12.3	12.2	12.1	12.0	11.8	11.6	11.4	11.2	11.0	10.8	10.7	10.6	10.7	10.7	10.9	11.1	11.3	11.5
W	11.7	11.9	12.1	12.3	12.4	12.5	12.5	12.5	12.4	12.3	12.1	11.9	11.7	11.5	11.3	11.1	10.9	10.8	10.7	10.7	10.8	11.0	11.2	11.4
	WF- 20mm plaster+200mm Block +50mm ins.+80mm Block +20mm plaster (Dark surface)																							
N	15.3	15.3	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3
E	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.3	18.3
S	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.6
W	16.8	16.8	16.8	16.8	16.8	16.8	16.9	16.9	16.9	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.8
	RA - 2cm plaster+15cm concrete+2cm felt+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Dark surface)																							
	37.1	33.9	30.8	27.7	24.6	21.6	18.8	16.5	15.4	15.8	17.5	20.3	24	28	33	37	41	44	46.4	47.4	47.1	45.5	43.1	40
	RB - 2cm plaster+15cm concrete+2cm felt+2.5cm insu.+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Dark surface)																							
	30.0	29.5	29.1	28.6	28.1	27.7	27.2	26.8	26.6	26.7	26.9	27.3	27.8	28.4	29.1	29.7	30.3	30.8	31.2	31.4	31.4	31.2	30.8	30.4

Kirkuk (Light) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	WA - 20mm plaster +240mm Brick+20mm plaster (Light surface)																							
N	13.1	13.0	12.6	12.0	11.5	10.8	9.9	9.1	8.1	7.0	6.1	5.3	4.8	4.7	4.9	7.0	8.1	9.1	10.3	11.6	11.8	12.9	13.7	13.0
E	15.3	14.9	14.2	13.6	12.8	11.9	11.0	9.9	8.9	7.9	7.4	7.2	7.4	7.8	8.6	11.2	12.0	12.9	13.9	15.0	15.0	15.8	16.3	15.4
S	14.4	14.1	14.7	15.2	13.4	12.7	11.9	10.8	9.6	8.4	7.0	5.7	4.8	4.1	4.0	6.4	7.4	8.7	10.5	12.1	12.9	14.4	15.5	14.4
W	14.1	14.0	13.6	13.1	12.5	11.7	10.9	9.8	8.8	7.7	6.7	5.8	5.1	4.7	4.5	5.7	7.3	8.4	10.8	12.3	13.9	14.3	15.3	13.9
	WB - 20mm plaster +240mm Thermiston +20mm plaster (Light surface)																							
N	14.2	13.9	13.3	12.5	11.7	10.8	9.8	8.8	7.6	6.3	5.3	4.4	3.9	3.9	4.1	6.6	7.9	9.2	10.7	12.3	12.8	14.0	14.9	14.2
E	16.3	15.6	14.7	13.8	12.8	11.8	10.6	9.4	8.1	6.9	6.2	6.0	6.4	7.2	8.3	11.4	12.5	13.7	14.9	16.1	16.3	17.1	17.6	16.6
S	15.5	15.1	14.3	13.4	12.4	11.4	10.4	9.3	8.0	6.9	5.7	4.8	4.4	4.3	4.7	7.7	9.0	10.6	12.5	14.1	14.7	15.9	16.6	15.8
W	15.6	15.3	14.6	13.7	12.9	11.8	10.8	9.5	8.3	6.9	5.8	4.8	4.1	3.7	3.6	5.0	6.8	8.1	10.9	12.9	14.9	15.6	16.9	15.5
	WC - 20mm plaster +200mm Block +20mm plaster (Light surface)																							
N	12.5	12.4	12.1	11.6	11.1	10.5	9.8	9.0	8.1	7.2	6.4	5.8	5.4	5.3	5.4	7.5	8.4	9.3	10.4	11.5	11.5	12.4	13.1	12.4
E	14.7	14.3	13.7	13.2	12.5	11.7	10.9	10.0	9.2	8.4	8.1	8.0	8.1	8.4	9.0	11.5	12.1	12.8	13.7	14.6	14.5	15.2	15.6	14.7
S	13.7	13.5	13.1	12.5	11.9	11.2	10.5	9.6	8.7	7.9	7.0	6.4	6.1	6.0	6.2	8.7	9.5	10.5	11.9	12.9	13.1	14.0	14.5	13.7
W	13.3	13.3	12.9	12.5	12.0	11.3	10.6	9.7	8.8	7.9	7.0	6.2	5.7	5.2	5.1	6.3	7.9	8.9	11.1	12.4	13.7	13.8	14.6	13.1
	WD - 20mm plaster +240mm Brick+50mm hilan Stone (Light surface)																							
N	13.1	13.3	13.2	13.0	13.5	12.1	12.4	10.7	9.6	8.5	7.3	6.2	5.3	4.6	4.2	5.0	5.6	6.3	7.4	8.7	9.3	10.9	12.5	12.6
E	15.8	15.7	15.4	14.9	14.4	13.7	12.9	11.8	10.7	9.3	8.2	7.3	6.8	6.7	7.1	9.5	10.2	11.1	12.2	13.4	13.8	14.9	15.9	15.4
S	14.5	14.6	14.5	14.1	13.6	13.0	12.3	11.5	10.4	9.2	8.0	6.8	5.8	5.0	4.7	6.8	7.4	8.3	9.8	11.2	11.9	13.3	14.4	14.1
W	13.8	14.3	14.3	14.1	13.8	13.2	12.6	11.6	10.6	9.4	8.2	7.0	5.9	5.0	4.3	5.0	6.0	6.5	8.6	10.0	11.7	12.4	13.9	13.1
	WE - 20mm plaster+240mm Brick+50mm insu.+120mm Brick Veneer (Light surface)																							
N	3.5	4.3	5.1	5.7	6.3	6.7	7.1	7.2	7.0	6.5	5.8	4.8	3.6	2.4	1.1	1.8	1.3	0.8	0.7	1.0	0.6	1.4	2.5	2.5
E	5.6	6.4	7.2	7.8	8.4	8.8	9.0	9.0	8.7	7.7	6.4	4.9	3.4	2.0	0.9	2.1	1.5	1.4	1.6	2.1	2.1	3.2	4.4	4.5

S	4.2	5.2	6.0	6.6	7.2	7.6	8.0	8.1	7.9	7.5	6.6	5.5	4.2	2.7	1.2	1.9	1.0	0.4	0.7	0.9	0.9	2.0	3.1	3.2
W	2.5	3.7	4.7	5.6	6.4	7.0	7.5	7.7	7.7	7.3	6.6	5.6	4.5	3.2	1.9	1.6	1.3	0.3	0.6	0.4	0.8	0.7	1.9	1.2
	WF- 20mm plaster+200mm Block +50mm ins.+80mm Block +20mm plaster (Light surface)																							
N	8.0	8.7	9.4	9.9	10.4	10.8	11.1	11.3	11.2	10.8	10.2	9.4	8.3	7.3	6.2	7.0	6.6	6.2	6.1	6.3	5.8	6.5	7.4	7.2
E	10.8	11.5	12.1	12.7	13.2	13.6	13.9	14.0	13.8	13.0	12.0	10.7	9.3	8.1	7.2	8.4	7.9	7.7	7.8	8.2	8.0	8.9	10.0	9.9
S	9.1	9.9	10.5	11.0	11.5	11.9	12.3	12.5	12.4	12.1	11.4	10.5	9.4	8.1	6.7	7.6	6.8	6.3	6.5	6.7	6.5	7.4	8.3	8.3
W	7.6	8.6	9.4	10.1	10.8	11.3	11.9	12.1	12.2	11.8	11.3	10.5	9.6	8.5	7.4	7.3	7.1	6.2	6.6	6.4	6.7	6.4	7.4	6.6
	RA - 2cm plaster+15cm concrete+2cm felt+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Light surface)																							
	37.7	34.4	31.4	28.7	26.0	23.3	21.1	19.2	18.9	19.8	21.0	23.6	26.9	30.6	34.4	38.1	41.4	43.7	44.9	45.6	45.7	44.6	42.9	40.9
	RB - 2cm plaster+15cm concrete+2cm felt+2.5cm insu.+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Light surface)																							
	25.8	25.9	26.6	26.4	26.1	26.1	25.3	24.6	23.9	23.5	23.4	23.6	23.9	24.2	24.7	25.0	25.4	25.6	25.2	24.8	24.2	24.3	24.9	25.4

Kirkuk (Dark) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	WA - 20mm plaster +240mm Brick+20mm plaster (Dark surface)																							
N	18.3	17.5	16.5	15.4	14.4	13.3	12.1	11.1	10.2	9.5	9.2	9.2	9.7	10.6	11.9	13.2	14.7	16.1	17.4	18.5	19.2	19.6	19.5	19.0
E	20.7	19.6	18.3	17.1	15.8	14.5	13.3	12.1	11.3	11.1	11.6	12.7	14.2	15.8	17.5	18.9	20.2	21.3	22.2	22.9	23.1	23.0	22.5	21.7
S	19.8	18.7	18.7	18.7	16.4	15.3	14.1	12.8	11.7	10.8	10.1	9.7	9.9	10.5	11.7	13.2	15.0	16.8	18.4	19.8	20.8	21.4	21.6	20.6
W	21.2	20.1	18.9	17.7	16.4	15.1	13.8	12.5	11.4	10.6	10.1	10.0	10.2	10.9	11.8	13.1	14.8	16.8	18.8	20.5	21.8	22.5	22.5	22.0
	WB - 20mm plaster +240mm Thermiston +20mm plaster (Dark surface)																							
N	19.4	18.4	17.2	15.9	14.6	13.3	12.0	10.8	9.7	8.8	8.4	8.3	8.8	9.8	11.1	12.8	14.5	16.2	17.8	19.2	20.2	20.7	20.7	20.2
E	21.7	20.3	18.8	17.3	15.8	14.4	12.9	11.6	10.5	10.1	10.4	11.5	13.2	15.2	17.2	19.1	20.7	22.1	23.2	24.0	24.4	24.3	23.8	22.9
S	20.9	19.7	18.3	16.9	15.4	14.0	12.6	11.3	10.1	9.3	8.8	8.8	9.5	10.7	12.4	14.5	16.6	18.7	20.4	21.8	22.6	22.9	22.7	22.0
W	22.7	21.4	19.9	18.3	16.8	15.2	13.7	12.2	10.9	9.8	9.2	9.0	9.2	9.9	10.9	12.4	14.3	16.5	18.9	21.1	22.8	23.8	24.1	23.6

	WC - 20mm plaster +200mm Block +20mm plaster (Dark surface)																							
N	17.7	16.9	16.0	15.0	14.0	13.0	12.0	11.0	10.2	9.7	9.5	9.7	10.3	11.2	12.4	13.7	15.0	16.3	17.5	18.4	18.9	19.1	18.9	18.4
E	20.1	19.0	17.8	16.7	15.5	14.3	13.2	12.2	11.6	11.6	12.3	13.5	14.9	16.4	17.9	19.2	20.3	21.2	22.0	22.5	22.6	22.4	21.8	21.0
S	19.1	18.1	17.1	16.0	14.9	13.8	12.7	11.6	10.8	10.3	10.1	10.4	11.2	12.4	13.9	15.5	17.1	18.6	19.8	20.6	21.0	21.0	20.6	19.9
W	20.4	19.4	18.2	17.1	15.9	14.7	13.5	12.4	11.4	10.8	10.4	10.4	10.8	11.4	12.4	13.7	15.4	17.3	19.1	20.6	21.6	22.0	21.8	21.2
	WD - 20mm plaster +240mm Brick+50mm hilan Stone (Dark surface)																							
N	18.3	17.8	17.1	16.4	16.4	14.6	14.6	12.7	11.7	11.0	10.4	10.1	10.2	10.5	11.2	11.2	12.2	13.3	14.5	15.6	16.7	17.6	18.3	18.6
E	21.2	20.4	19.5	18.4	17.4	16.3	15.2	14.0	13.1	12.5	12.4	12.8	13.6	14.7	16.0	17.2	18.4	19.5	20.5	21.3	21.9	22.1	22.1	21.7
S	19.9	19.2	18.5	17.6	16.6	15.6	14.5	13.5	12.5	11.6	11.1	10.8	10.9	11.4	12.4	13.6	15.0	16.4	17.7	18.9	19.8	20.3	20.5	20.3
W	20.9	20.4	19.6	18.7	17.7	16.6	15.5	14.3	13.2	12.3	11.6	11.2	11.0	11.2	11.6	12.4	13.5	14.9	16.6	18.2	19.6	20.6	21.1	21.2
	WE - 20mm plaster+240mm Brick+50mm insu.+120mm Brick Veneer (Dark surface)																							
N	8.7	8.8	9.0	9.1	9.2	9.2	9.3	9.2	9.1	9.0	8.9	8.7	8.5	8.3	8.1	8.0	7.9	7.8	7.8	7.9	8.0	8.1	8.3	8.5
E	11.0	11.1	11.3	11.3	11.4	11.4	11.3	11.2	11.1	10.9	10.6	10.4	10.2	10.0	9.8	9.8	9.7	9.8	9.9	10.0	10.2	10.4	10.6	10.8
S	9.6	9.8	10.0	10.1	10.2	10.2	10.2	10.1	10.0	9.9	9.7	9.5	9.3	9.1	8.9	8.7	8.6	8.5	8.6	8.6	8.8	9.0	9.2	9.4
W	9.6	9.8	10.0	10.2	10.3	10.4	10.4	10.4	10.3	10.2	10.0	9.8	9.6	9.4	9.2	9.0	8.8	8.7	8.6	8.6	8.7	8.9	9.1	9.3
	WF- 20mm plaster+200mm Block +50mm ins.+80mm Block +20mm plaster (Dark surface)																							
N	13.2	13.2	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
E	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.2	16.2
S	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.5
W	14.7	14.7	14.7	14.7	14.7	14.7	14.8	14.8	14.8	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.7
	RA - 2cm plaster+15cm concrete+2cm felt+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Dark surface)																							
	42.9	39.7	36.5	33.5	30.6	27.8	25.2	23.1	22.4	22.9	24.7	27.5	31.2	35.4	39.8	44.0	47.8	50.8	52.8	53.7	53.2	51.5	49.0	46.1
	RB - 2cm plaster+15cm concrete+2cm felt+2.5cm insu.+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Dark surface)																							
	29.9	29.4	29.0	28.5	28.0	27.6	27.1	26.7	26.5	26.6	26.8	27.2	27.7	28.3	29.0	29.6	30.2	30.7	31.1	31.3	31.3	31.1	30.7	30.3

Basra (Light) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	WA - 20mm plaster +240mm Brick+20mm plaster (Light surface)																							
N	17.3	17.2	16.8	16.2	15.7	15.0	14.1	13.3	12.3	11.2	10.3	9.5	9.0	8.9	9.1	9.5	10.3	11.3	12.5	13.8	15.0	16.1	16.9	17.2
E	19.5	19.1	18.4	17.8	17.0	16.1	15.2	14.1	13.1	12.1	11.6	11.4	11.6	12.0	12.8	13.4	14.2	15.1	16.1	17.2	18.2	19.0	19.5	19.6
S	18.6	18.3	18.9	19.4	17.6	16.9	16.1	15.0	13.8	12.6	11.2	9.9	9.0	8.3	8.2	8.6	9.6	10.9	12.5	14.3	16.1	17.6	18.7	18.6
W	18.3	18.2	17.8	17.3	16.7	15.9	15.1	14.0	13.0	11.9	10.9	10.0	9.3	8.9	8.7	8.9	9.5	10.6	12.0	13.5	15.1	16.5	17.5	18.1
	WB - 20mm plaster +240mm Thermiston +20mm plaster (Light surface)																							
N	18.4	18.1	17.5	16.7	15.9	15.0	14.0	13.0	11.8	10.5	9.5	8.6	8.1	8.1	8.3	9.1	10.1	11.4	12.9	14.5	16.0	17.2	18.1	18.4
E	20.5	19.8	18.9	18.0	17.0	16.0	14.8	13.6	12.3	11.1	10.4	10.2	10.6	11.4	12.5	13.6	14.7	15.9	17.1	18.3	19.5	20.3	20.8	20.8
S	19.7	19.3	18.5	17.6	16.6	15.6	14.6	13.5	12.2	11.1	9.9	9.0	8.6	8.5	8.9	9.9	11.2	12.8	14.5	16.3	17.9	19.1	19.8	20.0
W	19.8	19.5	18.8	17.9	17.1	16.0	15.0	13.7	12.5	11.1	10.0	9.0	8.3	7.9	7.8	8.2	9.0	10.3	12.1	14.1	16.1	17.8	19.1	19.7
	WC - 20mm plaster +200mm Block +20mm plaster (Light surface)																							
N	16.7	16.6	16.3	15.8	15.3	14.7	14.0	13.2	12.3	11.4	10.6	10.0	9.6	9.5	9.6	10.0	10.6	11.5	12.6	13.7	14.7	15.6	16.3	16.6
E	18.9	18.5	17.9	17.4	16.7	15.9	15.1	14.2	13.4	12.6	12.3	12.2	12.3	12.6	13.2	13.7	14.3	15.0	15.9	16.8	17.7	18.4	18.8	18.9
S	17.9	17.7	17.3	16.7	16.1	15.4	14.7	13.8	12.9	12.1	11.2	10.6	10.3	10.2	10.4	10.9	11.7	12.7	13.9	15.1	16.3	17.2	17.7	17.9
W	17.5	17.5	17.1	16.7	16.2	15.5	14.8	13.9	13.0	12.1	11.2	10.4	9.9	9.4	9.3	9.5	10.1	11.1	12.3	13.6	14.9	16.0	16.8	17.3
	WD - 20mm plaster +240mm Brick+50mm hilan Stone (Light surface)																							
N	17.3	17.5	17.4	17.2	17.7	16.3	16.6	14.9	13.8	12.7	11.5	10.4	9.5	8.8	8.4	7.5	7.8	8.5	9.6	10.9	12.5	14.1	15.7	16.8
E	20.0	19.9	19.6	19.1	18.6	17.9	17.1	16.0	14.9	13.5	12.4	11.5	11.0	10.9	11.3	11.7	12.4	13.3	14.4	15.6	17.0	18.1	19.1	19.6
S	18.7	18.8	18.7	18.3	17.8	17.2	16.5	15.7	14.6	13.4	12.2	11.0	10.0	9.2	8.9	9.0	9.6	10.5	11.8	13.4	15.1	16.5	17.6	18.3
W	18.0	18.5	18.5	18.3	18.0	17.4	16.8	15.8	14.8	13.6	12.4	11.2	10.1	9.2	8.5	8.2	8.2	8.7	9.8	11.2	12.9	14.6	16.1	17.3
	WE - 20mm plaster+240mm Brick+50mm insu.+120mm Brick Veneer (Light surface)																							
N	7.7	8.5	9.3	9.9	10.5	10.9	11.3	11.4	11.2	10.7	10.0	9.0	7.8	6.6	5.3	4.3	3.5	3.0	2.9	3.2	3.8	4.6	5.7	6.7
E	9.8	10.6	11.4	12.0	12.6	13.0	13.2	13.2	12.9	11.9	10.6	9.1	7.6	6.2	5.1	4.3	3.7	3.6	3.8	4.3	5.3	6.4	7.6	8.7

S	8.4	9.4	10.2	10.8	11.4	11.8	12.2	12.3	12.1	11.7	10.8	9.7	8.4	6.9	5.4	4.1	3.2	2.6	2.7	3.1	4.1	5.2	6.3	7.4
W	6.7	7.9	8.9	9.8	10.6	11.2	11.7	11.9	11.9	11.5	10.8	9.8	8.7	7.4	6.1	4.8	3.5	2.5	1.8	1.6	2.0	2.9	4.1	5.4
N	12.2	12.9	13.6	14.1	14.6	15.0	15.3	15.5	15.4	15.0	14.4	13.6	12.5	11.5	10.4	9.5	8.8	8.4	8.3	8.5	9.0	9.7	10.6	11.4
E	15.0	15.7	16.3	16.9	17.4	17.8	18.1	18.2	18.0	17.2	16.2	14.9	13.5	12.3	11.4	10.6	10.1	9.9	10.0	10.4	11.2	12.1	13.2	14.1
S	13.3	14.1	14.7	15.2	15.7	16.1	16.5	16.7	16.6	16.3	15.6	14.7	13.6	12.3	10.9	9.8	9.0	8.5	8.5	8.9	9.7	10.6	11.5	12.5
W	11.8	12.8	13.6	14.3	15.0	15.5	16.1	16.3	16.4	16.0	15.5	14.7	13.8	12.7	11.6	10.5	9.3	8.4	7.8	7.6	7.9	8.6	9.6	10.8
	RA - 2cm plaster+15cm concrete+2cm felt+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Light surface)																							
	41.9	38.6	35.6	32.9	30.2	27.5	25.3	23.4	23.1	24.0	25.2	27.8	31.1	34.8	38.6	42.3	45.6	47.9	49.1	49.8	49.9	48.8	47.1	45.1
	RB - 2cm plaster+15cm concrete+2cm felt+2.5cm insu.+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Light surface)																							
	30.0	30.1	30.8	30.6	30.3	30.3	29.5	28.8	28.1	27.7	27.6	27.8	28.1	28.4	28.9	29.2	29.6	29.8	29.4	29.0	28.4	28.5	29.1	29.6

Basra (Dark) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	WA - 20mm plaster +240mm Brick+20mm plaster (Dark surface)																							
N	22.5	21.7	20.7	19.6	18.6	17.5	16.3	15.3	14.4	13.7	13.4	13.4	13.9	14.8	16.1	17.4	18.9	20.3	21.6	22.7	23.4	23.8	23.7	23.2
E	24.9	23.8	22.5	21.3	20.0	18.7	17.5	16.3	15.5	15.3	15.8	16.9	18.4	20.0	21.7	23.1	24.4	25.5	26.4	27.1	27.3	27.2	26.7	25.9
S	24.0	22.9	22.9	22.9	20.6	19.5	18.3	17.0	15.9	15.0	14.3	13.9	14.1	14.7	15.9	17.4	19.2	21.0	22.6	24.0	25.0	25.6	25.8	24.8
W	25.4	24.3	23.1	21.9	20.6	19.3	18.0	16.7	15.6	14.8	14.3	14.2	14.4	15.1	16.0	17.3	19.0	21.0	23.0	24.7	26.0	26.7	26.7	26.2
	WB - 20mm plaster +240mm Thermiston +20mm plaster (Dark surface)																							
N	23.6	22.6	21.4	20.1	18.8	17.5	16.2	15.0	13.9	13.0	12.6	12.5	13.0	14.0	15.3	17.0	18.7	20.4	22.0	23.4	24.4	24.9	24.9	24.4
E	25.9	24.5	23.0	21.5	20.0	18.6	17.1	15.8	14.7	14.3	14.6	15.7	17.4	19.4	21.4	23.3	24.9	26.3	27.4	28.2	28.6	28.5	28.0	27.1
S	25.1	23.9	22.5	21.1	19.6	18.2	16.8	15.5	14.3	13.5	13.0	13.0	13.7	14.9	16.6	18.7	20.8	22.9	24.6	26.0	26.8	27.1	26.9	26.2
W	26.9	25.6	24.1	22.5	21.0	19.4	17.9	16.4	15.1	14.0	13.4	13.2	13.4	14.1	15.1	16.6	18.5	20.7	23.1	25.3	27.0	28.0	28.3	27.8

	WC - 20mm plaster +200mm Block +20mm plaster (Dark surface)																							
N	21.9	21.1	20.2	19.2	18.2	17.2	16.2	15.2	14.4	13.9	13.7	13.9	14.5	15.4	16.6	17.9	19.2	20.5	21.7	22.6	23.1	23.3	23.1	22.6
E	24.3	23.2	22.0	20.9	19.7	18.5	17.4	16.4	15.8	15.8	16.5	17.7	19.1	20.6	22.1	23.4	24.5	25.4	26.2	26.7	26.8	26.6	26.0	25.2
S	23.3	22.3	21.3	20.2	19.1	18.0	16.9	15.8	15.0	14.5	14.3	14.6	15.4	16.6	18.1	19.7	21.3	22.8	24.0	24.8	25.2	25.2	24.8	24.1
W	24.6	23.6	22.4	21.3	20.1	18.9	17.7	16.6	15.6	15.0	14.6	14.6	15.0	15.6	16.6	17.9	19.6	21.5	23.3	24.8	25.8	26.2	26.0	25.4
	WD - 20mm plaster +240mm Brick+50mm hilan Stone (Dark surface)																							
N	22.5	22.0	21.3	20.6	20.6	18.8	18.8	16.9	15.9	15.2	14.6	14.3	14.4	14.7	15.4	15.4	16.4	17.5	18.7	19.8	20.9	21.8	22.5	22.8
E	25.4	24.6	23.7	22.6	21.6	20.5	19.4	18.2	17.3	16.7	16.6	17.0	17.8	18.9	20.2	21.4	22.6	23.7	24.7	25.5	26.1	26.3	26.3	25.9
S	24.1	23.4	22.7	21.8	20.8	19.8	18.7	17.7	16.7	15.8	15.3	15.0	15.1	15.6	16.6	17.8	19.2	20.6	21.9	23.1	24.0	24.5	24.7	24.5
W	25.1	24.6	23.8	22.9	21.9	20.8	19.7	18.5	17.4	16.5	15.8	15.4	15.2	15.4	15.8	16.6	17.7	19.1	20.8	22.4	23.8	24.8	25.3	25.4
	WE - 20mm plaster+240mm Brick+50mm insu.+120mm Brick Veneer (Dark surface)																							
N	12.9	13.0	13.2	13.3	13.4	13.4	13.5	13.4	13.3	13.2	13.1	12.9	12.7	12.5	12.3	12.2	12.1	12.0	12.0	12.1	12.2	12.3	12.5	12.7
E	15.2	15.3	15.5	15.5	15.6	15.6	15.5	15.4	15.3	15.1	14.8	14.6	14.4	14.2	14.0	14.0	13.9	14.0	14.1	14.2	14.4	14.6	14.8	15.0
S	13.8	14.0	14.2	14.3	14.4	14.4	14.4	14.3	14.2	14.1	13.9	13.7	13.5	13.3	13.1	12.9	12.8	12.7	12.8	12.8	13.0	13.2	13.4	13.6
W	13.8	14.0	14.2	14.4	14.5	14.6	14.6	14.6	14.5	14.4	14.2	14.0	13.8	13.6	13.4	13.2	13.0	12.9	12.8	12.8	12.9	13.1	13.3	13.5
N	17.4	17.4	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4
E	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.4	20.4
S	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.6	18.6	18.6	18.6	18.6	18.6	18.6	18.6	18.6	18.7
W	18.9	18.9	18.9	18.9	18.9	18.9	19.0	19.0	19.0	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.8	18.8	18.8	18.8	18.8	18.8	18.8	18.9
	RA - 2cm plaster+15cm concrete+2cm felt+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Dark surface)																							
	47.1	43.9	40.7	37.7	34.8	32.0	29.4	27.3	26.6	27.1	28.9	31.7	35.4	39.6	44.0	48.2	52.0	55.0	57.0	57.9	57.4	55.7	53.2	50.3
	RB - 2cm plaster+15cm concrete+2cm felt+2.5cm insu.+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Dark surface)																							
	34.1	33.6	33.2	32.7	32.2	31.8	31.3	30.9	30.7	30.8	31.0	31.4	31.9	32.5	33.2	33.8	34.4	34.9	35.3	35.5	35.5	35.3	34.9	34.5

Najaf (Light) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	WA - 20mm plaster +240mm Brick+20mm plaster (Light surface)																							
N	17.9	17.8	17.4	16.8	16.3	15.6	14.7	13.9	12.9	11.8	10.9	10.1	9.6	9.5	9.7	10.1	10.9	11.9	13.1	14.4	15.6	16.7	17.5	17.8
E	20.1	19.7	19.0	18.4	17.6	16.7	15.8	14.7	13.7	12.7	12.2	12.0	12.2	12.6	13.4	14.0	14.8	15.7	16.7	17.8	18.8	19.6	20.1	20.2
S	19.2	18.9	19.5	20.0	18.2	17.5	16.7	15.6	14.4	13.2	11.8	10.5	9.6	8.9	8.8	9.2	10.2	11.5	13.1	14.9	16.7	18.2	19.3	19.2
W	18.9	18.8	18.4	17.9	17.3	16.5	15.7	14.6	13.6	12.5	11.5	10.6	9.9	9.5	9.3	9.5	10.1	11.2	12.6	14.1	15.7	17.1	18.1	18.7
	WB - 20mm plaster +240mm Thermiston +20mm plaster (Light surface)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	WB - 20mm plaster +240mm Thermiston +20mm plaster (Light surface)																							
N	19.0	18.7	18.1	17.3	16.5	15.6	14.6	13.6	12.4	11.1	10.1	9.2	8.7	8.7	8.9	9.7	10.7	12.0	13.5	15.1	16.6	17.8	18.7	19.0
E	21.1	20.4	19.5	18.6	17.6	16.6	15.4	14.2	12.9	11.7	11.0	10.8	11.2	12.0	13.1	14.2	15.3	16.5	17.7	18.9	20.1	20.9	21.4	21.4
S	20.3	19.9	19.1	18.2	17.2	16.2	15.2	14.1	12.8	11.7	10.5	9.6	9.2	9.1	9.5	10.5	11.8	13.4	15.1	16.9	18.5	19.7	20.4	20.6
W	20.4	20.1	19.4	18.5	17.7	16.6	15.6	14.3	13.1	11.7	10.6	9.6	8.9	8.5	8.4	8.8	9.6	10.9	12.7	14.7	16.7	18.4	19.7	20.3
	WC - 20mm plaster +200mm Block +20mm plaster (Light surface)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	WC - 20mm plaster +200mm Block +20mm plaster (Light surface)																							
N	17.3	17.2	16.9	16.4	15.9	15.3	14.6	13.8	12.9	12.0	11.2	10.6	10.2	10.1	10.2	10.6	11.2	12.1	13.2	14.3	15.3	16.2	16.9	17.2
E	19.5	19.1	18.5	18.0	17.3	16.5	15.7	14.8	14.0	13.2	12.9	12.8	12.9	13.2	13.8	14.3	14.9	15.6	16.5	17.4	18.3	19.0	19.4	19.5
S	18.5	18.3	17.9	17.3	16.7	16.0	15.3	14.4	13.5	12.7	11.8	11.2	10.9	10.8	11.0	11.5	12.3	13.3	14.5	15.7	16.9	17.8	18.3	18.5
W	18.1	18.1	17.7	17.3	16.8	16.1	15.4	14.5	13.6	12.7	11.8	11.0	10.5	10.0	9.9	10.1	10.7	11.7	12.9	14.2	15.5	16.6	17.4	17.9
	WD - 20mm plaster +240mm Brick+50mm hilan Stone (Light surface)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	WD - 20mm plaster +240mm Brick+50mm hilan Stone (Light surface)																							
N	17.9	18.1	18.0	17.8	18.3	16.9	17.2	15.5	14.4	13.3	12.1	11.0	10.1	9.4	9.0	8.1	8.4	9.1	10.2	11.5	13.1	14.7	16.3	17.4
E	20.6	20.5	20.2	19.7	19.2	18.5	17.7	16.6	15.5	14.1	13.0	12.1	11.6	11.5	11.9	12.3	13.0	13.9	15.0	16.2	17.6	18.7	19.7	20.2
S	19.3	19.4	19.3	18.9	18.4	17.8	17.1	16.3	15.2	14.0	12.8	11.6	10.6	9.8	9.5	9.6	10.2	11.1	12.4	14.0	15.7	17.1	18.2	18.9
W	18.6	19.1	19.1	18.9	18.6	18.0	17.4	16.4	15.4	14.2	13.0	11.8	10.7	9.8	9.1	8.8	8.8	9.3	10.4	11.8	13.5	15.2	16.7	17.9
	WE - 20mm plaster+240mm Brick+50mm insu.+120mm Brick Veneer (Light surface)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	WE - 20mm plaster+240mm Brick+50mm insu.+120mm Brick Veneer (Light surface)																							
N	8.3	9.1	9.9	10.5	11.1	11.5	11.9	12.0	11.8	11.3	10.6	9.6	8.4	7.2	5.9	4.9	4.1	3.6	3.5	3.8	4.4	5.2	6.3	7.3
E	10.4	11.2	12.0	12.6	13.2	13.6	13.8	13.8	13.5	12.5	11.2	9.7	8.2	6.8	5.7	4.9	4.3	4.2	4.4	4.9	5.9	7.0	8.2	9.3

S	9.0	10.0	10.8	11.4	12.0	12.4	12.8	12.9	12.7	12.3	11.4	10.3	9.0	7.5	6.0	4.7	3.8	3.2	3.3	3.7	4.7	5.8	6.9	8.0
W	7.3	8.5	9.5	10.4	11.2	11.8	12.3	12.5	12.5	12.1	11.4	10.4	9.3	8.0	6.7	5.4	4.1	3.1	2.4	2.2	2.6	3.5	4.7	6.0
	WF- 20mm plaster+200mm Block +50mm ins.+80mm Block +20mm plaster (Light surface)																							
N	12.8	13.5	14.2	14.7	15.2	15.6	15.9	16.1	16.0	15.6	15.0	14.2	13.1	12.1	11.0	10.1	9.4	9.0	8.9	9.1	9.6	10.3	11.2	12.0
E	15.6	16.3	16.9	17.5	18.0	18.4	18.7	18.8	18.6	17.8	16.8	15.5	14.1	12.9	12.0	11.2	10.7	10.5	10.6	11.0	11.8	12.7	13.8	14.7
S	13.9	14.7	15.3	15.8	16.3	16.7	17.1	17.3	17.2	16.9	16.2	15.3	14.2	12.9	11.5	10.4	9.6	9.1	9.1	9.5	10.3	11.2	12.1	13.1
W	12.4	13.4	14.2	14.9	15.6	16.1	16.7	16.9	17.0	16.6	16.1	15.3	14.4	13.3	12.2	11.1	9.9	9.0	8.4	8.2	8.5	9.2	10.2	11.4
	RA - 2cm plaster+15cm concrete+2cm felt+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Light surface)																							
	39.8	36.5	33.5	30.8	28.1	25.4	23.2	21.3	21.0	21.9	23.1	25.7	29.0	32.7	36.5	40.2	43.5	45.8	47.0	47.7	47.8	46.7	45.0	43.0
	RB - 2cm plaster+15cm concrete+2cm felt+2.5cm insu.+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Light surface)																							
	27.9	28.0	28.7	28.5	28.2	28.2	27.4	26.7	26.0	25.6	25.5	25.7	26.0	26.3	26.8	27.1	27.5	27.7	27.3	26.9	26.3	26.4	27.0	27.5

Najaf (Dark) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	WA - 20mm plaster +240mm Brick+20mm plaster (Dark surface)																							
N	23.1	22.3	21.3	20.2	19.2	18.1	16.9	15.9	15.0	14.3	14.0	14.0	14.5	15.4	16.7	18.0	19.5	20.9	22.2	23.3	24.0	24.4	24.3	23.8
E	25.5	24.4	23.1	21.9	20.6	19.3	18.1	16.9	16.1	15.9	16.4	17.5	19.0	20.6	22.3	23.7	25.0	26.1	27.0	27.7	27.9	27.8	27.3	26.5
S	24.6	23.5	23.5	23.5	21.2	20.1	18.9	17.6	16.5	15.6	14.9	14.5	14.7	15.3	16.5	18.0	19.8	21.6	23.2	24.6	25.6	26.2	26.4	25.4
W	26.0	24.9	23.7	22.5	21.2	19.9	18.6	17.3	16.2	15.4	14.9	14.8	15.0	15.7	16.6	17.9	19.6	21.6	23.6	25.3	26.6	27.3	27.3	26.8
	WB - 20mm plaster +240mm Thermiston +20mm plaster (Dark surface)																							
N	24.2	23.2	22.0	20.7	19.4	18.1	16.8	15.6	14.5	13.6	13.2	13.1	13.6	14.6	15.9	17.6	19.3	21.0	22.6	24.0	25.0	25.5	25.5	25.0
E	26.5	25.1	23.6	22.1	20.6	19.2	17.7	16.4	15.3	14.9	15.2	16.3	18.0	20.0	22.0	23.9	25.5	26.9	28.0	28.8	29.2	29.1	28.6	27.7
S	25.7	24.5	23.1	21.7	20.2	18.8	17.4	16.1	14.9	14.1	13.6	13.6	14.3	15.5	17.2	19.3	21.4	23.5	25.2	26.6	27.4	27.7	27.5	26.8
W	27.5	26.2	24.7	23.1	21.6	20.0	18.5	17.0	15.7	14.6	14.0	13.8	14.0	14.7	15.7	17.2	19.1	21.3	23.7	25.9	27.6	28.6	28.9	28.4

	WC - 20mm plaster +200mm Block +20mm plaster (Dark surface)																							
N	22.5	21.7	20.8	19.8	18.8	17.8	16.8	15.8	15.0	14.5	14.3	14.5	15.1	16.0	17.2	18.5	19.8	21.1	22.3	23.2	23.7	23.9	23.7	23.2
E	24.9	23.8	22.6	21.5	20.3	19.1	18.0	17.0	16.4	16.4	17.1	18.3	19.7	21.2	22.7	24.0	25.1	26.0	26.8	27.3	27.4	27.2	26.6	25.8
S	23.9	22.9	21.9	20.8	19.7	18.6	17.5	16.4	15.6	15.1	14.9	15.2	16.0	17.2	18.7	20.3	21.9	23.4	24.6	25.4	25.8	25.8	25.4	24.7
W	25.2	24.2	23.0	21.9	20.7	19.5	18.3	17.2	16.2	15.6	15.2	15.2	15.6	16.2	17.2	18.5	20.2	22.1	23.9	25.4	26.4	26.8	26.6	26.0
	WD - 20mm plaster +240mm Brick+50mm hilan Stone (Dark surface)																							
N	23.1	22.6	21.9	21.2	21.2	19.4	19.4	17.5	16.5	15.8	15.2	14.9	15.0	15.3	16.0	16.0	17.0	18.1	19.3	20.4	21.5	22.4	23.1	23.4
E	26.0	25.2	24.3	23.2	22.2	21.1	20.0	18.8	17.9	17.3	17.2	17.6	18.4	19.5	20.8	22.0	23.2	24.3	25.3	26.1	26.7	26.9	26.9	26.5
S	24.7	24.0	23.3	22.4	21.4	20.4	19.3	18.3	17.3	16.4	15.9	15.6	15.7	16.2	17.2	18.4	19.8	21.2	22.5	23.7	24.6	25.1	25.3	25.1
W	25.7	25.2	24.4	23.5	22.5	21.4	20.3	19.1	18.0	17.1	16.4	16.0	15.8	16.0	16.4	17.2	18.3	19.7	21.4	23.0	24.4	25.4	25.9	26.0
	WE - 20mm plaster+240mm Brick+50mm insu.+120mm Brick Veneer (Dark surface)																							
N	13.5	13.6	13.8	13.9	14.0	14.0	14.1	14.0	13.9	13.8	13.7	13.5	13.3	13.1	12.9	12.8	12.7	12.6	12.6	12.7	12.8	12.9	13.1	13.3
E	15.8	15.9	16.1	16.1	16.2	16.2	16.1	16.0	15.9	15.7	15.4	15.2	15.0	14.8	14.6	14.6	14.5	14.6	14.7	14.8	15.0	15.2	15.4	15.6
S	14.4	14.6	14.8	14.9	15.0	15.0	15.0	14.9	14.8	14.7	14.5	14.3	14.1	13.9	13.7	13.5	13.4	13.3	13.4	13.4	13.6	13.8	14.0	14.2
W	14.4	14.6	14.8	15.0	15.1	15.2	15.2	15.2	15.1	15.0	14.8	14.6	14.4	14.2	14.0	13.8	13.6	13.5	13.4	13.4	13.5	13.7	13.9	14.1
	WF- 20mm plaster+200mm Block +50mm ins.+80mm Block +20mm plaster (Dark surface)																							
N	18.0	18.0	18.1	18.1	18.1	18.1	18.1	18.1	18.1	18.1	18.1	18.1	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
E	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	21.0	21.0
S	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.3
W	19.5	19.5	19.5	19.5	19.5	19.5	19.6	19.6	19.6	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.5
	RA - 2cm plaster+15cm concrete+2cm felt+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Dark surface)																							
	45.0	41.8	38.6	35.6	32.7	29.9	27.3	25.2	24.5	25.0	26.8	29.6	33.3	37.5	41.9	46.1	49.9	52.9	54.9	55.8	55.3	53.6	51.1	48.2
	RB - 2cm plaster+15cm concrete+2cm felt+2.5cm insu.+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Dark surface)																							
	32.0	31.5	31.1	30.6	30.1	29.7	29.2	28.8	28.6	28.7	28.9	29.3	29.8	30.4	31.1	31.7	32.3	32.8	33.2	33.4	33.4	33.2	32.8	32.4

Sulaimani (Light) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	WA - 20mm plaster +240mm Brick+20mm plaster (Light surface)																							
N	11.8	11.7	11.3	10.7	10.2	9.5	8.6	7.8	6.8	5.7	4.8	4.0	3.5	3.4	4.6	5.7	7.8	8.8	10.0	11.3	11.5	12.6	12.4	11.7
E	14.0	13.6	12.9	12.3	11.5	10.6	9.7	8.6	7.6	6.6	6.1	5.9	6.1	6.5	8.3	9.9	11.7	12.6	13.6	14.7	14.7	15.5	15.0	14.1
S	13.1	12.8	13.4	13.9	12.1	11.4	10.6	9.5	8.3	7.1	5.7	4.4	3.5	2.8	3.7	5.1	7.1	8.4	10.2	11.8	12.6	14.1	14.2	13.1
W	12.8	12.7	12.3	11.8	11.2	10.4	9.6	8.5	7.5	6.4	5.4	4.5	3.8	3.4	4.2	4.4	7.0	8.1	10.5	12.0	13.6	14.0	14.0	12.6
	WB - 20mm plaster +240mm Thermiston +20mm plaster (Light surface)																							
N	12.9	12.6	12.0	11.2	10.4	9.5	8.5	7.5	6.3	5.0	4.0	3.1	2.6	2.6	3.8	5.3	7.6	8.9	10.4	12.0	12.5	13.7	13.6	12.9
E	15.0	14.3	13.4	12.5	11.5	10.5	9.3	8.1	6.8	5.6	4.9	4.7	5.1	5.9	8.0	10.1	12.2	13.4	14.6	15.8	16.0	16.8	16.3	15.3
S	14.2	13.8	13.0	12.1	11.1	10.1	9.1	8.0	6.7	5.6	4.4	3.5	3.1	3.0	4.4	6.4	8.7	10.3	12.2	13.8	14.4	15.6	15.3	14.5
W	14.3	14.0	13.3	12.4	11.6	10.5	9.5	8.2	7.0	5.6	4.5	3.5	2.8	2.4	3.3	3.7	6.5	7.8	10.6	12.6	14.6	15.3	15.6	14.2
	WC - 20mm plaster +200mm Block +20mm plaster (Light surface)																							
N	11.2	11.1	10.8	10.3	9.8	9.2	8.5	7.7	6.8	5.9	5.1	4.5	4.1	4.0	5.1	6.2	8.1	9.0	10.1	11.2	11.2	12.1	11.8	11.1
E	13.4	13.0	12.4	11.9	11.2	10.4	9.6	8.7	7.9	7.1	6.8	6.7	6.8	7.1	8.7	10.2	11.8	12.5	13.4	14.3	14.2	14.9	14.3	13.4
S	12.4	12.2	11.8	11.2	10.6	9.9	9.2	8.3	7.4	6.6	5.7	5.1	4.8	4.7	5.9	7.4	9.2	10.2	11.6	12.6	12.8	13.7	13.2	12.4
W	12.0	12.0	11.6	11.2	10.7	10.0	9.3	8.4	7.5	6.6	5.7	4.9	4.4	3.9	4.8	5.0	7.6	8.6	10.8	12.1	13.4	13.5	13.3	11.8
	WD - 20mm plaster +240mm Brick+50mm hilan Stone (Light surface)																							
N	11.8	12.0	11.9	11.7	12.2	10.8	11.1	9.4	8.3	7.2	6.0	4.9	4.0	3.3	3.9	3.7	5.3	6.0	7.1	8.4	9.0	10.6	11.2	11.3
E	14.5	14.4	14.1	13.6	13.1	12.4	11.6	10.5	9.4	8.0	6.9	6.0	5.5	5.4	6.8	8.2	9.9	10.8	11.9	13.1	13.5	14.6	14.6	14.1
S	13.2	13.3	13.2	12.8	12.3	11.7	11.0	10.2	9.1	7.9	6.7	5.5	4.5	3.7	4.4	5.5	7.1	8.0	9.5	10.9	11.6	13.0	13.1	12.8
W	12.5	13.0	13.0	12.8	12.5	11.9	11.3	10.3	9.3	8.1	6.9	5.7	4.6	3.7	4.0	3.7	5.7	6.2	8.3	9.7	11.4	12.1	12.6	11.8
	WE - 20mm plaster+240mm Brick+50mm insu.+120mm Brick Veneer (Light surface)																							
N	2.2	3.0	3.8	4.4	5.0	5.4	5.8	5.9	5.7	5.2	4.5	3.5	2.3	1.1	0.8	0.5	1.0	0.5	0.4	0.7	0.3	1.1	1.2	1.2
E	4.3	5.1	5.9	6.5	7.1	7.5	7.7	7.7	7.4	6.4	5.1	3.6	2.1	0.7	0.6	0.8	1.2	1.1	1.3	1.8	1.8	2.9	3.1	3.2

S	2.9	3.9	4.7	5.3	5.9	6.3	6.7	6.8	6.6	6.2	5.3	4.2	2.9	1.4	0.9	0.6	0.7	0.1	0.4	0.6	0.6	1.7	1.8	1.9
W	1.2	2.4	3.4	4.3	5.1	5.7	6.2	6.4	6.4	6.0	5.3	4.3	3.2	1.9	1.6	0.3	1.0	0.0	0.3	0.1	0.5	0.4	0.6	-0.1
	WF- 20mm plaster+200mm Block +50mm ins.+80mm Block +20mm plaster (Light surface)																							
N	6.7	7.4	8.1	8.6	9.1	9.5	9.8	10.0	9.9	9.5	8.9	8.1	7.0	6.0	5.9	5.7	6.3	5.9	5.8	6.0	5.5	6.2	6.1	5.9
E	9.5	10.2	10.8	11.4	11.9	12.3	12.6	12.7	12.5	11.7	10.7	9.4	8.0	6.8	6.9	7.1	7.6	7.4	7.5	7.9	7.7	8.6	8.7	8.6
S	7.8	8.6	9.2	9.7	10.2	10.6	11.0	11.2	11.1	10.8	10.1	9.2	8.1	6.8	6.4	6.3	6.5	6.0	6.2	6.4	6.2	7.1	7.0	7.0
W	6.3	7.3	8.1	8.8	9.5	10.0	10.6	10.8	10.9	10.5	10.0	9.2	8.3	7.2	7.1	6.0	6.8	5.9	6.3	6.1	6.4	6.1	6.1	5.3
	RA - 2cm plaster+15cm concrete+2cm felt+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Light surface)																							
	36.4	33.1	30.1	27.4	24.7	22.0	19.8	17.9	17.6	18.5	19.7	22.3	25.6	29.3	33.1	36.8	40.1	42.4	43.6	44.3	44.4	43.3	41.6	39.6
	RB - 2cm plaster+15cm concrete+2cm felt+2.5cm insu.+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Light surface)																							
	24.5	24.6	25.3	25.1	24.8	24.8	24.0	23.3	22.6	22.2	22.1	22.3	22.6	22.9	23.4	23.7	24.1	24.3	23.9	23.5	22.9	23.0	23.6	24.1

Sulaimani (Dark) - CLTD values

	Hours																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	WA - 20mm plaster +240mm Brick+20mm plaster (Dark surface)																							
N	17.0	16.2	15.2	14.1	13.1	12.0	10.8	9.8	8.9	8.2	7.9	7.9	8.4	9.3	10.6	11.9	13.4	14.8	16.1	17.2	17.9	18.3	18.2	17.7
E	19.4	18.3	17.0	15.8	14.5	13.2	12.0	10.8	10.0	9.8	10.3	11.4	12.9	14.5	16.2	17.6	18.9	20.0	20.9	21.6	21.8	21.7	21.2	20.4
S	18.5	17.4	17.4	17.4	15.1	14.0	12.8	11.5	10.4	9.5	8.8	8.4	8.6	9.2	10.4	11.9	13.7	15.5	17.1	18.5	19.5	20.1	20.3	19.3
W	19.9	18.8	17.6	16.4	15.1	13.8	12.5	11.2	10.1	9.3	8.8	8.7	8.9	9.6	10.5	11.8	13.5	15.5	17.5	19.2	20.5	21.2	21.2	20.7
	WB - 20mm plaster +240mm Thermiston +20mm plaster (Dark surface)																							
N	18.1	17.1	15.9	14.6	13.3	12.0	10.7	9.5	8.4	7.5	7.1	7.0	7.5	8.5	9.8	11.5	13.2	14.9	16.5	17.9	18.9	19.4	19.4	18.9
E	20.4	19.0	17.5	16.0	14.5	13.1	11.6	10.3	9.2	8.8	9.1	10.2	11.9	13.9	15.9	17.8	19.4	20.8	21.9	22.7	23.1	23.0	22.5	21.6
S	19.6	18.4	17.0	15.6	14.1	12.7	11.3	10.0	8.8	8.0	7.5	7.5	8.2	9.4	11.1	13.2	15.3	17.4	19.1	20.5	21.3	21.6	21.4	20.7
W	21.4	20.1	18.6	17.0	15.5	13.9	12.4	10.9	9.6	8.5	7.9	7.7	7.9	8.6	9.6	11.1	13.0	15.2	17.6	19.8	21.5	22.5	22.8	22.3

	WC - 20mm plaster +200mm Block +20mm plaster (Dark surface)																							
N	16.4	15.6	14.7	13.7	12.7	11.7	10.7	9.7	8.9	8.4	8.2	8.4	9.0	9.9	11.1	12.4	13.7	15.0	16.2	17.1	17.6	17.8	17.6	17.1
E	18.8	17.7	16.5	15.4	14.2	13.0	11.9	10.9	10.3	10.3	11.0	12.2	13.6	15.1	16.6	17.9	19.0	19.9	20.7	21.2	21.3	21.1	20.5	19.7
S	17.8	16.8	15.8	14.7	13.6	12.5	11.4	10.3	9.5	9.0	8.8	9.1	9.9	11.1	12.6	14.2	15.8	17.3	18.5	19.3	19.7	19.7	19.3	18.6
W	19.1	18.1	16.9	15.8	14.6	13.4	12.2	11.1	10.1	9.5	9.1	9.1	9.5	10.1	11.1	12.4	14.1	16.0	17.8	19.3	20.3	20.7	20.5	19.9
	WD - 20mm plaster +240mm Brick+50mm hilan Stone (Dark surface)																							
N	17.0	16.5	15.8	15.1	15.1	13.3	13.3	11.4	10.4	9.7	9.1	8.8	8.9	9.2	9.9	9.9	10.9	12.0	13.2	14.3	15.4	16.3	17.0	17.3
E	19.9	19.1	18.2	17.1	16.1	15.0	13.9	12.7	11.8	11.2	11.1	11.5	12.3	13.4	14.7	15.9	17.1	18.2	19.2	20.0	20.6	20.8	20.8	20.4
S	18.6	17.9	17.2	16.3	15.3	14.3	13.2	12.2	11.2	10.3	9.8	9.5	9.6	10.1	11.1	12.3	13.7	15.1	16.4	17.6	18.5	19.0	19.2	19.0
W	19.6	19.1	18.3	17.4	16.4	15.3	14.2	13.0	11.9	11.0	10.3	9.9	9.7	9.9	10.3	11.1	12.2	13.6	15.3	16.9	18.3	19.3	19.8	19.9
	WE - 20mm plaster+240mm Brick+50mm insu.+120mm Brick Veneer (Dark surface)																							
N	7.4	7.5	7.7	7.8	7.9	7.9	8.0	7.9	7.8	7.7	7.6	7.4	7.2	7.0	6.8	6.7	6.6	6.5	6.5	6.6	6.7	6.8	7.0	7.2
E	9.7	9.8	10.0	10.0	10.1	10.1	10.0	9.9	9.8	9.6	9.3	9.1	8.9	8.7	8.5	8.5	8.4	8.5	8.6	8.7	8.9	9.1	9.3	9.5
S	8.3	8.5	8.7	8.8	8.9	8.9	8.9	8.8	8.7	8.6	8.4	8.2	8.0	7.8	7.6	7.4	7.3	7.2	7.3	7.3	7.5	7.7	7.9	8.1
W	8.3	8.5	8.7	8.9	9.0	9.1	9.1	9.0	8.9	8.7	8.5	8.3	8.1	7.9	7.7	7.5	7.4	7.3	7.3	7.4	7.6	7.8	8.0	
	WF- 20mm plaster+200mm Block +50mm ins.+80mm Block +20mm plaster (Dark surface)																							
N	11.9	11.9	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9
E	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.9	14.9
S	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.2
W	13.4	13.4	13.4	13.4	13.4	13.4	13.5	13.5	13.5	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.4
	RA - 2cm plaster+15cm concrete+2cm felt+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Dark surface)																							
	41.6	38.4	35.2	32.2	29.3	26.5	23.9	21.8	21.1	21.6	23.4	26.2	29.9	34.1	38.5	42.7	46.5	49.5	51.5	52.4	51.9	50.2	47.7	44.8
	RB - 2cm plaster+15cm concrete+2cm felt+2.5cm insu.+10cm clay+4cm sand +4cm Slabs of concrete Mtstih (Dark surface)																							
	28.6	28.1	27.7	27.2	26.7	26.3	25.8	25.4	25.2	25.3	25.5	25.9	26.4	27.0	27.7	28.3	28.9	29.4	29.8	30.0	30.0	29.8	29.4	29.0

APPENDIX E

Input data and Results of Economic analysis

Table E.1. Input data used in economic solutions

	d	r	N (years)	PWF	COP	C _{E.T.} (TL/kW.h)	C _{E.I.} (ID/kW.h)			
General data	0.08	0.06	10	8.525	4.6	0.4	0.25			
Turkey Roofs and walls	C_{RI}	C_{RI2}	C_{w1}	C_{w2}	C_{w3}	C_{w4}	C_{w5}	C_{w6}	C_{w7}	C_{w8}
Structure cost (TL/m²)	65	45	20	30	15	35	19	30	33	37
Iraqi Roofs and walls	C_{RA}	C_{RB}	C_{WA}	C_{WB}	C_{WC}	C_{WD}	C_{WE}	C_{WF}		
Structure cost (ID/m²)	40	50	25	30	20	35	45	40		

Table E.2. Results of economic solution of Turkey

Roof and Wall Types	Roof -R1	Roof - R2	Brick-W1	AAC- W2	Blokbims-W3	XPS-W4	Briquette-W5	Covering-W6	EPS- W7	Siding-W8
Optimum Thickness (cm)	36.7	39.1	25.1	10.1	18	23.4	29.1	20.2	24.4	19.9
Optimum Insulation Thickness (cm)	11.5	11.1	7.35	7.36	7.39	7.39	7.35	7.39	7.39	8.17
Total cost exact struct. (TL)*	32865.8	187803.2	47360.6	15378.9	21933.1	17785.1	52946.1	17493.1	20020.4	17428
Saving mony by ins. (TL)*	23136.7	130271.9	25448.7	8269.5	11839	9596.9	28450.5	9439.5	10803.2	10168.2

Table E.3. Results of economic solution of Iraq

Roof and Wall Types	Roof -R _A	Roof -R _B	Brick-W _A	Thermiston-W _B	Block-W _C	Hilan-W _D	Brick ins.-W _E	Block insW _F
Optimum Thickness (cm)	32.2	24.5	26.4	22.2	31.6	20.6	10.8	17.6
Optimum Insulation Thickness (cm)	9.7	9.3	7.3	7.3	7.3	7.3	5.9	7
Total cost exact struct. (ID)**	27913.5	14792	26752	13176.4	35382.5	25824.4	4553.8	8005.5
Saving mony by ins. (ID)**	19269.3	10006.1	15753.2	7755.8	20838.2	15204.5	2228.2	4565.4

*1 \$ USD = 2.92 TL

**1 \$ USD = 1.24 ID