THE PROPOSAL OF THE BUILDING APPLICATION FOR MORE BENEFITING FROM SOLAR LIGHT

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ABSTRACT:

There is a proverb, that emphasizes the importance of sunlight for human health, which is "Where the sun does not enter the physician enters". It is one of the most important elements to see the sunlight of the buildings for both healthy life and energy saving. The positioning may be desirable to take the advantage of the morning and evening sunlight of the buildings to be constructed in the housing area. Indeed, in 1985 constructed blocks of buildings in Eskisehir Yenikent in public housing projects, designed and applicated according to the this principle. This study was made with the purpose of the application and to be designed to see the sunlight during the day of the blocks will be the method of discrete structures in accordance with the development plan will be built the individual or collective housing project in the Eastern Mediterranean. At the beginning of this study, the azimuth angles were calculated in the sunrise and sunset in four provinces forming region, baseline, throughout the year and annual sun graphics arranged, by meteorological data help received from meteorological stations in the region. Information of sun tanning about the province of Adana was found sufficient to represent the region according to the results of the evaluation. It describes the inning information building design and application in accordance with the principles for provinces in the region at the end of the study.

KEY WORDS: Solar Energy, Urban Design, the Building Application.

1. INTRODUCTİON

As a necessary factor of production and an essential of public welfare, energy is one of the basic inputs of economical and sociological growth. To meet the human needs and to maintain its sustainable and healthy development, energy is needed and it has many areas of usage like industry, buildings, transport and agriculture (Koç, 2008).

What kind of a residence we live in, in what kind of structures we continue our lives? What is the cost of this living to us, to our region, our country? What are the construction and utilization methods that make our lives easier, increase our quality of life and production, and allow us to save energy? For example; a housing in Ankara requires "4.5 times" more energy to live as against a housing in Berlin (Erengezgin, 2016).

In this study, information about the sunshine durations, solar energy potential and solar angles of our provinces in Eastern Mediterranean Region have been given, and azimuth angles of every month of the year and several days have been calculated. Taking the advantage of these solar angles; the azimuth angle needed for positioning the structure determined and in the fields, it is examined how to applique these angles to the corners of the building that will be made, application made on the subject, and the findings have been presented in the results section.

2. HEALTH BENEFITS OF THE SUN

The effects of weather conditions and other factors on which life depends, on human psychology is very large, especially sunlight. Sunshine also effects our mental health. **If there is no sun, there is depression.** Experts warn those who want to get a home: "Prefer sun-exposed buildings." Indicating that living in a dark environment makes it easier to fall into depression, the darkness narrowing the imaginary world and people without sun couldn't look forward to life and could become more aggressive

and angry, experts add "Sunlessness reduce people's energy, leading them to introversion, making them unhappy." (URL-1).

"Hazelnut-sized pineal gland in our brain produces the hormone melatonin. In a dark environment, the gland increases the production of its hormones. The hormone melatonin slows the physical movement of people, which makes them sleepy and exhausted. Being able to fall asleep in the dark is an indicator of this. Light reduces the production of melatonin and contrary symptoms begin to format. Person starts to cheer up and becomes more active." According to researches, suicidal tendencies are at an increasingly higher rate and people become more depressed in the Nordic countries (i.e. Sweden, Norway) (URL-2).

3. SOLAR ENERGY POTENTIAL IN TURKEY

Nowadays, it is known that solar radiation energy has many benefits such as heating, hot water and air conditioning (Akıncıtürk, 1999a). Although our country is located in a region called sunbelt which is rich in solar energy, we don't benefit enough from solar energy. In terms of the solar energy potential due to its geographical location, our country is very fortunate compared to other countries. Monthly average solar potential of Turkey is given in Table 1 (URL-3).

In Turkey, Southeastern Anatolia Region has the maximum field of solar energy, followed by Mediterranean Region. Regional distribution of solar energy potential of Turkey and sunshine durations are given in Table 2.

Months	Monthly Total Solar Energy		Sunshine Duration (hours /month)
	(Kcal/cm^2 - month)	(kWh/m^2- month)	
January	4,45	51,75	103,0
February	5,44	63,27	115,0

March	8,31	96,65	165,0
April	10,51	122,23	197,0
May	13,23	153,86	273,0
June	14,51	168,75	325,0
July	15,08	175,38	365,0
August	13,62	158,40	343,0
September	10,60	123,28	280,0
October	7,73	89,90	214,0
November	5,23	60,82	157,0
December	4,03	46,87	103,0
Total	112,74	1311	2640
Average	308,0 kcal/cm²-day	3,6 kWh/m²-day	7,2 hours/day

Table 1. Monthly Average Solar Potential of Turkey (URL-3).

However, it was found through later studies that these values are lower than the true potential of Turkey. Since 1992 EİE and DMİ make evaluations in order to get more healthy results about solar energy. As a result of these evaluations in progress, these values of solar energy potential of Turkey are expected to increase further 20-25% more than the old results (URL-3).

Region	Total Solar Energy (kWh/m²-year)	Sunshine Duration (hours/year)
Southeastern Anatolia	1460	2993
Mediterranean	1390	2956
Eastern Anatolia	1365	2664
Central Anatolia	1314	2628
Aegean	1304	2738
Marmara	1168	2409
Black Sea	1120	1971

Table 2. Regional Distribution of Solar Energy Potential of Turkey (URL-3).

In our day, applications are performing to make the best of the sunshine in the buildings that will be constructed in collective housing areas. Thus in Eskişehir Yenikent district, building blocks that are located in the development area which has been constructed in 1985 for 1860 dwellers, are positioned to take advantage of sunlight during the day. As in this Eskişehir Yenikent housing estate example, "it is necessary to position buildings in housing estates according to the sunlight to save energy, to produce hot water and heating" in our country (Akıncıtürk, 1999b; İnce, 2005).

4. AZIMUTH

While positioning the structures to benefit from sunlight, incidence direction angles of sun rays (azimuth angles) being utilized. Azimuth angle of the sun consist of the latitude of the construction site (φ), the declination angle of the sun for a particular day of the year (δ) and the angle of the sunrise and sunset according to local noon. These angles are called azimuth (Deriş, 1975; Aksoy, 1975; Kılıç ve Öztürk, 1980).

Latitude (angle) φ : It is the angle of the line which combines the aboveground N point to the centrosphere, with the equatorial plane. It is marked with a (+) from the Equator to north and with a (-) to south (İnce, 2005).

Hour Angle (h) : It is the angle between the line which combines the longitude of the taken into account point on earth with the centrosphere and the longitude indicated by the sun rays. Hour angle is calculated from "sun noon", when the longitude of the sun and the longitude of the point which is being taken into account are the same. The difference is marked with a (–) for before the local noon, and with a (+) for after the local noon. Every one hour time difference is considered as a hour angle of 15° (İnce, 2005).

Declination Angle (δ) : It is the angle of the sun rays to the equatorial plane (Figure 1). This angle results from 23° 27' degree which is between the rotational axis of the world and the normal of the orbital plane. Absolute value in solstices is maximum (June 21 summer solstice = $+23^O.45$, December 22 winter solstice = -23°,45). Declination angle is obtained from the equation of (İnce, 2005):

$$\delta = 23^o,45 \sin \left(360 \left(\frac{n+284}{365} \right) \right) \qquad (1)$$
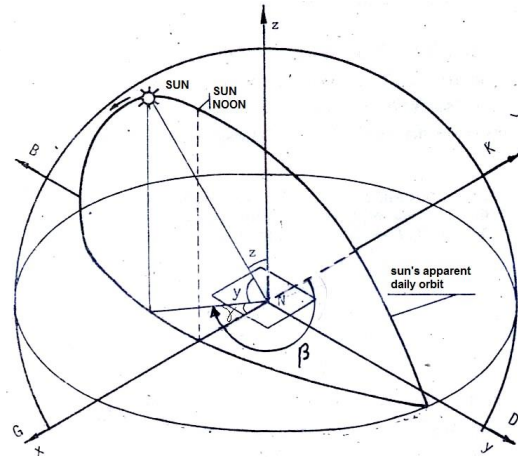
Here, n is the number of days.

Figure 1. Schematic of the Sun Zenith Angle, Elevation and Azimuth Angle, at the Spherical Triangle from the Point on Earth of N (İnce, 2005).

Zenith angle (z): It is the angle of direct sun rays with the normal of horizontal plane (Figure 2). At sunrise and sunset $z=90^o$. Zenith angle is obtained from the below formula (Aksoy, 1975).

$$\cos z = \cos \delta \cos \varphi \cos h + \sin \delta \sin \varphi \qquad (2)$$

Solar elevation angle (y): It is the angle of the horizontal rays of the sun. As seen on Figure 1, $z+y=90^o$. Solar elevation angle is obtained from the formula (İnce, 2005): y=90 - z.

Solar azimuth angle (β) : This angle represents the deviation of sun rays rotation compared to the clockwise direction of north (Figure 1). β as follows (İnce, 2005);

Before the local noon (in degrees) $\beta=180^o -\gamma^o$, (or in grade $\beta=200 -\gamma^G$) $\qquad (3)$

After the local noon (in degrees) $\beta=180^o +\gamma^o$, (or in grade $\beta=200+\gamma^G$) $\qquad (4)$

$$\cos\gamma = \frac{\cos\delta\cos\varphi\cosh - \sin\delta\cos\varphi}{\cos y} \qquad (5)$$

5. PRESENTATION OF APPLICATION AREA

Eastern Mediterranean Region containing Adana, Mersin, Hatay and Osmaniye provinces have been chosen for application. Sunshine duration is the time between the sunrise and the sunset on sunny days. From the relevant researches, in the provinces of Eastern Mediterranean Region (Figure 2) , sunshine duration by months, number of overcast and foggy days have been investigated and given as an abstract below.
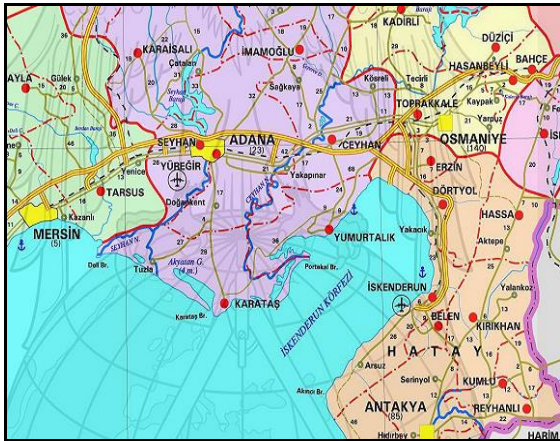

Figure 2. Locations of Hatay, Adana, Mersin and Osmaniye provinces which are located in Eastern Mediterranean Region (URL-4).

5.1. Hatay Province

The annual sunshine duration of Hatay and its surrounding areas is around 2600-3000 hours. The annual monthly average sunshine duration has been determined as 7.15 hours/day (Figure 3). Annual temperature average is of 18°C. Maximum temperature recorded in August as 34.0, the minimum is recorded in December and January as of 2,0°C. Lowest temperature ranges between -4,-10°C below zero in high and inlands. The annual average temperature of Hatay and its districts are determined as 16°C and more. Average relative humidity is around 67%. Annual average of foggy days is between 1-50 days (Erarslan, 2012).
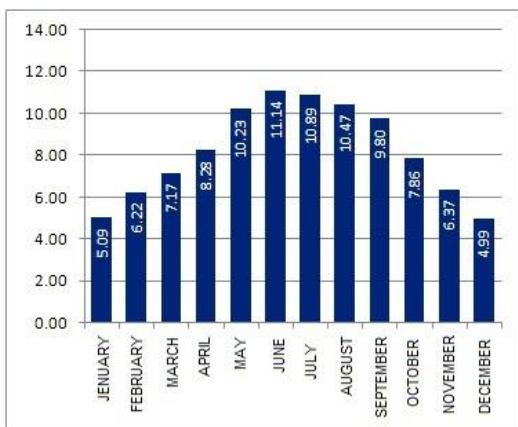

Figure 3. Sunshine duration of Hatay Province (URL-3).

5.2. Adana Province

The number of summer days which the temperature rises to or above 25˚C is 179. Adana has fair weather. The annual average of sunshine duration in 2015 is 7.13 hours (Figure 4), and the annual average of daily sunshine duration is determined as 345.92 cal/cm²/min. Days of the overcast weather is 49,2. Lowland and seaside daily average of sunshine duration is 8,60 hours. Sunshine duration is at its maximum at July, and it is at its minimum at December and January. Relative humidity average is around 65%. According to the 67 years of annual measurements by Regional Directorate of Meteorology, annual average temperature is 18.8˚C, highest temperature is 45.6 ˚C, and lowest temperature is –8.4˚C. Due to the climatic conditions of this region, sun can be seen in every season (URL-5).
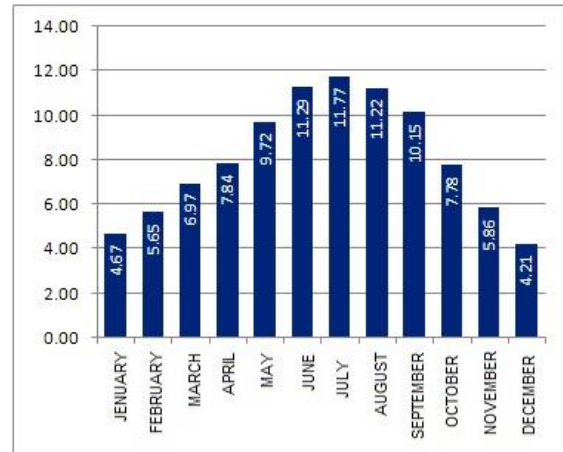

Figure 4. Sunshine duration of Adana Province (URL-3).

5.3. Mersin Province

According to the measurements, annual number of days with overcast weather is 25,3. Majority of the year passes sunny and with some clouds. Mersin is one of the provinces with the highest sunshine duration in our country (Figure 5). Average daily sunshine duration is 7,4 hours and this can change up to 8-10 hours on summer days (URL-3).
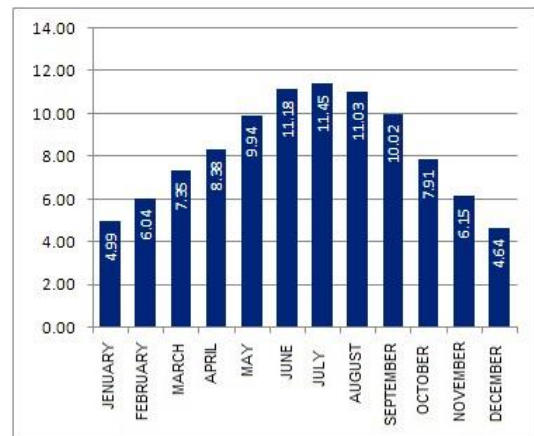

Figure 5. Sunshine duration of Mersin Province (URL-3).

The average annual temperature in Mersin is 18,7°C. Being detected in the 50-years long observation, the highest temperature is 40°C (21.06.1942), and the lowest temperature is -6,6°C (06.02.1950). Average temperature of summer days ranges between 25- 33°C. In winter the average temperature ranges between 9–15°C. Some years, the temperature goes below 0°C. Snowfall can not be seen in coastal areas. However,

there are varying amounts of snow at the Toros Mountains piedmonts in winter days. Annual average of relative humidity is 69%, and ranges between 65% - 75% through months. As a result of 50-years long observations, there were snow cover of 2 cm thickness only in 01.01.1950 in city centrum. In the last 10-year period, a total of 27 days with fog incident have occured. The annual average number of foggy days is approximately 2 days (URL-6).

5.4. Osmaniye Province

Since there aren't any researches on annual average solar radiation and the annual total amount of solar energy have been made in this province, State Meteorology General Directorate and Osmaniye Directorate of Meteorology Station were not able to grant us any information. Highest temperature in 2007 was recorded in May 29 is 42.5 (°C), the lowest temperature is recorded in December 31 is -4.0°C. Maximum daily temperature difference is not recorded. Annual average of sunshine duration is 7.45 hours (Figure 6). Only the measured ones of the meteorological elements like numbers of snowy, snow covered, foggy, frosty days and the highest snow cover thickness in 2013 have been examined (Dolgun et al., 2013).
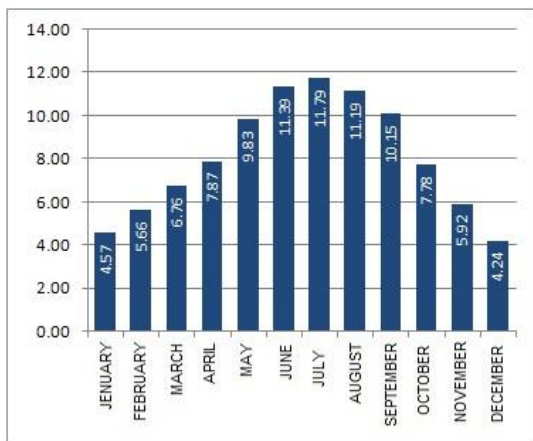

Figure 6. Sunshine duration of Osmaniye Province (URL-3).

It is concluded that in Eastern Mediterranean Region annual sunshine duration is at its maximum on summer months, at its minimum on winter months, number of foggy days is rather high in November, December, January and February, number of the days with overcast weather is in its minimum in July and August.

6. CALCULATING THE SOLAR AZIMUTH ANGLE IN EASTERN MEDITERRANEAN REGION AND DETERMINING THE SUITABLE LOCATION FOR THE HOUSINGS

6.1- Calculating the Solar Azimuth Angle in Eastern Mediterranean Region

Solar azimuth angle consists of the declination angle of the sun (δ), latitude of the place (φ), hour angle of the sun (h) and elevation angle of the sun (y). These factors that is being used to determine the solar azimuth angle are obtained through;

1- As declination angle of the sun – for a perscrutation – values of 1. and 15. days of every months and June 21 and December 22 are calculated with relation no (1).

2- Eastern Mediterranean Region is between 32º 56' – 36º 42' longitudes and 35º 52' – 38º 00' latitudes. 36º, 37º and 38º considered as latitudes, on an examination of an example (Table 11), it has been seen that the acquired solar azimuth angles are in a close range, thereby the mean for the region used as $\varphi=37º$.

3- When sun is on the longitude of the considered point, in other words in local noon, hour angle is zero. The differences between the local noon and the sunrise and sunset are calculated as hour angles at sunrise and sunset (İnce, 2005). Information about hour angles of sunrise and sunset of Eastern Mediterranean Region provinces (Adana, Hatay, Osmaniye and Mersin) are obtained from the calendars showing the relevant time. In Table 3, the time of sunrise, sunset and noon in Adana, Hatay, Osmaniye and Mersin at June 21 and the hour angles and solar azimuth angles calculated from them have been given.

Provinces and Latitudes	Sunrise		Sunset	
	Hour Angle (h)	Azimuth Angle (β)	Hour Angle (h)	Azimuth Angle (β)
Adana 37º	12.48-5.12=7.36 -114. 00	57ᵍ,6796	20.11-12.48=7.23 110º.75	335ᵍ,1951
Osmaniye 37º	12.47-5.09=7.38 -114,50	59ᵍ,4092	20.07-12.47=7.20 110º,00	335ᵍ,9738
Hatay 36º	12.48-5.12=7.36 -114.00	58ᵍ,5893	20.05-12.48=7.17 109º,25	335ᵍ,4981
Mersin 36º	12.54-5.16=7.38 -114.50	59ᵍ,0572	20.13-12.54=7.19 109º,75	336ᵍ,0029

Table 3. The time of sunrise, sunset and noon in Adana, Hatay, Osmaniye and Mersin at June 21 and the hour angles and solar azimuth angles.

In the examination at Table 3, it has been seen that there is only a 5 or 6 minutes of difference with every other four provinces sunrise, sunset and noon times, and it has not effected the solar azimuth calculation results significantly. In this respect, to easily calculate the solar azimuth angle for Eastern Mediterranean Region; angles of sunset and sunrise of Adana -which is located in the middle of the region- have been used and the obtained results have been given in Figure 7.
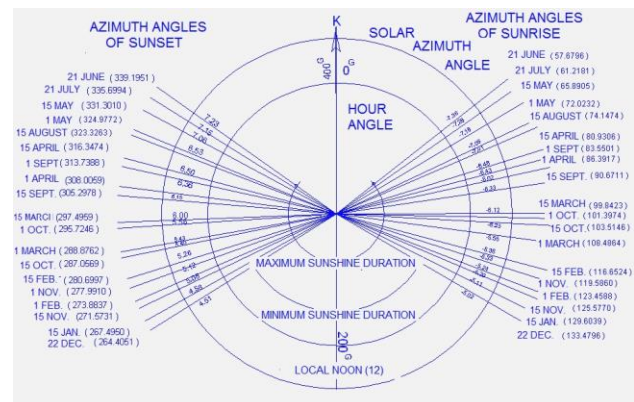

Figure 7. Solar azimuth angles calculated with sunset and sunrise hour angles for Eastern Mediterranean Region in some days of the year (it is arranged from İnce, 2005).

6.2. Determining the Suitable Location for the Housings

For a housing in Eastern Mediterranean Region to benefit from solar energy through sunrise to sunset all year long at maximum, the maximum value of azimuth angle at sunrise, and the minimum value at sunset should be taken into consideration. If we are to examine Figure 7; we can see that on December 22, sunrise is at its maximum azimuth angle (133^G,4796), and sunset is at its minimum azimuth angle value (264^G,4051).

A building that has been considered with a rectangular default structure can be located as shown in Figure 5; between its maximum sunrise azimuth angle value (GD) and minimum sunset azimuth angle value (GB). In Figure 7, December 22 β_{GD}=Sunrise azimuth angle (133^G,4796), β_{GB} =Sunset azimuth angle (264^G,4051). ϕ between β_{GB} and β_{GD} obtained from the formula (İnce, 2005):

$$\phi=\beta_{GB} - \beta_{GD} =130^G,9255 \qquad (6)$$

In Figure 8, between the facades that are crossing at the corner A of the building, there is usually a right angle ($\varepsilon=90^o=100^G$). If the AB jamb of the building diverted from the left of GD direction, and the AD jamb of the building diverted from the right of GB with an angle of ω, considering ω, the azimuth angles of AB and AD is (İnce, 2005):

$$\omega=(\phi - \varepsilon)/2=15^G,4628, \qquad (7)$$
$$(AB)= \beta_{GD} +\omega=148^G,9424, \qquad (8)$$
$$(AD)= \beta_{GB} -\omega=248^G,9423 \qquad (9)$$

Approximately, (AB)=150^G, (AD)=250^G can be considered to ease the application.
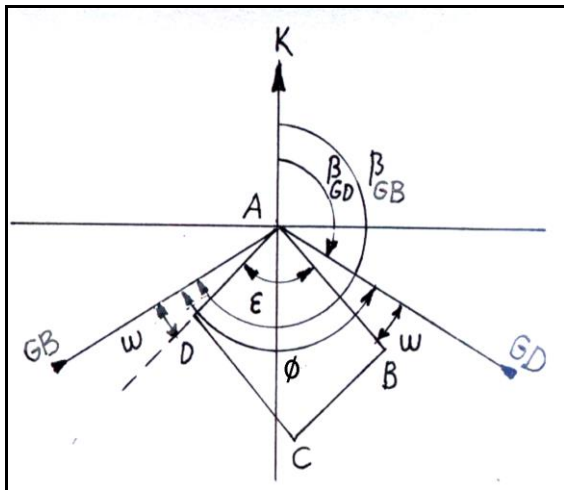

Figure 8. Location of a building between its solar azimuth angles of maximum sunrise and minimum sunset (İnce, 2005).

If a building is located as its C corner is applicated to the ground in compliance with AB and AD, the building would benefit from the sunlight to the utmost. If corners of the building will be applicated through polar method (Figure 8), application elements, netcad, eghas, geocad... etc. can be obtained with computer-aided mapping programs. According to the application elements that have been calculated with rectangular coordinate method, building corners should be sketched with computer-assisted cartography to the related building blocks and thereby the coordinates of these corner points should be obtained. From the building corner points that have been calculated with benchmark, polar applique elements of the building should be calculated and polar application should be done (İnce, 2005).

In Eastern Mediterranean Region, before the application of the buildings to the property, in the related building block; it is determined how many buildings will be constructed in the field considering the size of the area, determined building type, size of the buildings, TAKS, KAKS and the garden distances (Yıldız, 1999). And related building corner application elements calculated with rectangular coordination method (Tüdeş, 1995).

6.3-Calculation of the Application Elements that are Necessary for the Application of the Building Corners to the Field

In Eastern Mediterranean Region, before the application of the buildings to the property, in the related building block; it is determined how many buildings will be constructed in the field considering the size of the area, determined building type, size of the buildings, TAKS, KAKS and the garden distances (Yıldız, 1999). Later, related building corner application elements calculated with rectangular coordination method (Figure 9) or polar method (Tüdeş, 1995).
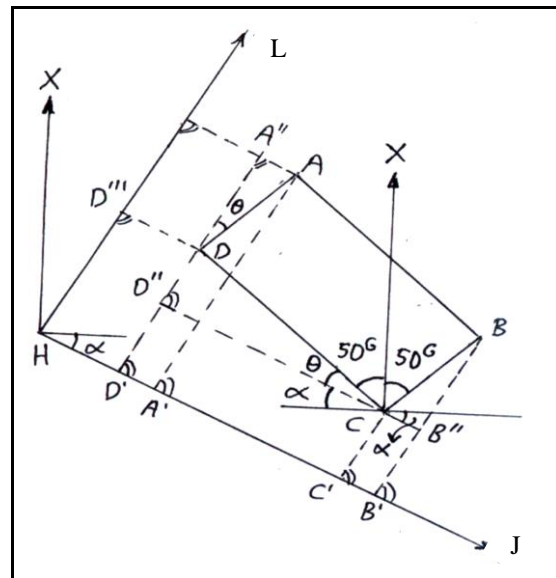

Figure 9. The application of building corner points to a building block with prismatic method (İnce, 2005).

Necessary application elements for application of a building to a block corner point with prismatic method is calculated with below relations (Figure 6).

In Figure 9; CC'=Front Yard Distance (ÖBM), DD"=Side Yard Distance (YBM). First, the azimuth angle (HJ) is calculated using H and J coordinates (Y_H, X_H; Y_J, X_J) with this relation:

$$(HJ)=\arctan(\Delta Y_{HJ}/\Delta X_{HJ})$$

In Figure 6; α and θ angles;

$$(HJ)>150^G$$
$$\alpha=(HJ)-100^G$$
$$\theta=100^G-(50^G+\alpha)$$

stated as per above, then using DAA", DCD" and CBB" right-angled triangles, frontage of the building (CD=AB) and the depth (DA=CB) taken into consideration, elements needed for the application of the building corner points with prismatic method;

A'A=Right extent of the building's A corner
B'B=Right extent of the building's B corner
C'C=Right extent of the building's C corner =ÖBM
D'D=Right extent of the building's D corner
HA'=Right-foot length of the building's A corner
HB'=Right-foot length of the building's B corner
HC'=Right-foot length of the building's C corner
HD'=Right-foot length of the building's D corner

$$D"C=D'C'=CD*\cos\theta \qquad (10)$$
$$DD"=CD*\sin\theta \qquad (11)$$
$$HC'=YBM+D"C \qquad (12)$$
$$D'D=C'C+D"D=ÖBM+D"D \qquad (13)$$
$$DA"=DA*\cos\theta \qquad (14)$$
$$A'A=D'A"=D'D+DA" \qquad (15)$$
$$AA"=D'A'=DA*\sin\theta \qquad (16)$$
$$HA'=YBM+D'A' \qquad (17)$$
$$HD'=D'''D=YBM \qquad (18)$$
$$HC'=YBM+D'C' \qquad (19)$$
$$C'B'=CB"=CB*\cos(\alpha+50^G) \qquad (20)$$
$$B"B=CB*\sin(\alpha+50^G) \qquad (21)$$
$$B'B=ÖBM+B"B \qquad (22)$$
$$HB'=HC'+C'B' \qquad (23)$$

Obtained with above relations.

If the application of the building corner points with polar method is wanted; first, the coordinations of corner points:

$$Y_A=Y_H+HA'*\sin(HJ)+A'A*\sin[(HJ)+300^G]$$
$$X_A=X_H+HA'*\cos(HJ)+A'A*\cos[(HJ)+300^G]$$
$$Y_B=Y_H+HB'*\sin(HJ)+B'B*\sin[(HJ)+300^G]$$
$$X_B=X_H+HB'*\cos(HJ)+B'B*\cos[(HJ)+300^G]$$
$$Y_C=Y_H+HC'*\sin(HJ)+C'C*\sin[(HJ)+300^G]$$
$$X_C=X_H+HC'*\cos(HJ)+C'C*\cos[(HJ)+300^G]$$
$$Y_D=Y_H+HD'*\sin(HJ)+D'D*\sin[(HJ)+300^G]$$
$$X_D=X_H+HD'*\cos(HJ)+D'D*\cos[(HJ)+300^G]$$

are obtained with above relations (İnce, 2000), then H point being the station, J being the junction, application elements of building corner points from H, considering the coordinates of the points, calculated with geodetic basic relations (Table 4).

D.N.	B.N.	Y	X	Horizontal Distance	Azimuth Angle	Horizontal Angle
H		Y_H	X_H			
	J	Y_J	X_J	HJ	(HJ)	0.0000
	A	Y_A	X_A	HA	(HA)	(HA)-(HJ)
	B	Y_B	X_B	HB	(HB)	(HB)-(HJ)
	C	Y_C	X_C	HC	(HC)	(HC)-(HJ)
	D	Y_D	X_D	HD	(HD)	(HD)-(HJ)

Table 4. Necessary application elements for a building's corner points that will be located to benefit from sunlight at most

7. QUANTITATIVE APPLICATION

An empty building block from Osmaniye Municipality's building site that has not yet any constructions made has been chosen for quantitative application (Figure 10). According to the zoning data from the zoning plan, for the buildings that will be made in this building block in the order of discrete structures; TAKS=0.35, KAKS=1.75. According to the Planned Area Regulations which is in use for the building areas in our country; In this building block, minimum facades should be 9 m, side yard distance should be 5.00 m, front yard distance should be 5.00 m, total building floor =KAKS/TAKS = 5, adjacent yard distance should be 3.50 m, back yard distance=building eaves height/2= (0.50+5*3)/2=7.75 m. obtained.
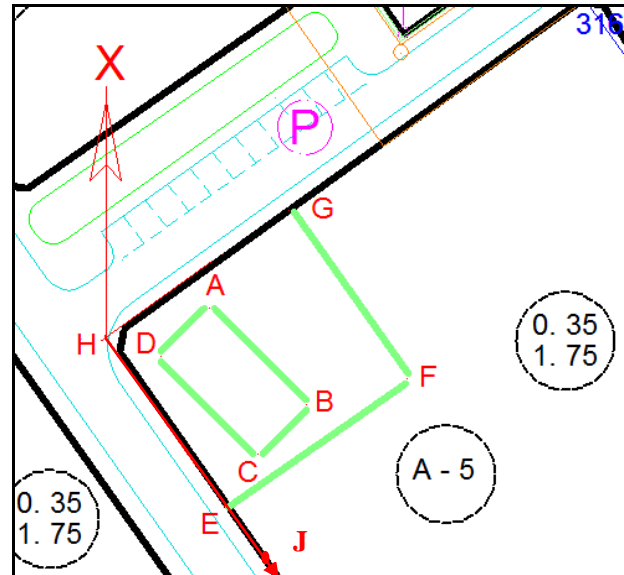

Figure 10. Osmaniye Municipality construction plan example.

Since the terminal points (H, J) of south-west side of the building block are not apparent, frontal lines of the indicated building block has been made by crossing the lines and quantitative results of the coordinates have been given in Table 5.

Point	Y	X
H	520770.857	4103402.259
J	520820.798	4103330.930

Table 5. Coordinates of H and J points.

Availing from the coordinates of the H and J points, with geodetic basic relations, azimuth angle (HJ) is

(HJ)=161.1134.

With a building that will be constructed as two departments on the base, for every department 100 m² space and facade DC=AB= 20 m., depth of building=DA=BC=10 m. designed.

According to the design in Figure 6, for the building that will be applicated in the corner parcel of building block,

$$\alpha=(HJ)-100^G=61^G.1134$$
$$\theta=(HJ)-150^G=11^G.1134$$

above values have been found, then as prismatic application elements;

AA"=YBM=5.00 m
DD'=ÖBM=5.00 m

AD"=BC"'=10.00*cosθ=9.848 m
DD"=A'D'=10.00*sinθ=1.737 m

DC''=D'C'=20.00*cosθ=19.696 m
CC''=20.00*sinθ=3.474 m

AA'=ÖBM+AD''=14.848 m
CC'=ÖBM+CC''=8.474 m
BB'=CC'+BC'''=18.322 m

HA'=AA''=5.00 m
HD'=HA'+A'D'=6.737 m
HC'HD'+D'C'=26.433 m
HB'=HC'-CC'''=24.696 m

values are obtained.

Because the building's prismatic applique elements of A, B, C, D corners and the coordinate of H is located in the left side of the HJ azimuth angle; (P'P)=(HJ)+300=61.1134 values taken into consideration;

$Y_A=Y_H+5.00*\sin(HJ)+14.848*\sin61.1134=520785.888$ m
$X_A=X_H+5.00*\cos(HJ)+14.848*\cos61.1134=4103406.679$ m

$Y_B=Y_H+24.696*\sin(HJ)+18.322*\sin61.1134=520800.030$ m
$X_B=X_H+24.696*\cos(HJ)+18.322*\cos61.1134=4103392.537$ m

$Y_C=Y_H+26.433*\sin(HJ)+8.474*\sin61.1134=520792.959$ m
$X_C=X_H+26.433*\cos(HJ)+8.474*\cos61.1134=4103385.466$ m

$Y_D=Y_H+6.737*\sin(HJ)+5.000*\sin61.1134=520778.817$ m
$X_D=X_H+6.737*\cos(HJ)+5.000*\cos61.1134=4103399.608$ m

And for the calculation of corner parcel E, F and G coordinates;

HE=HC'+3.50=29.933 m.

Assuming the EF is perpendicular to HJ, considering the distance of the backyard, with the values of EF=BB'+7.75=32.446 m ve HG=EF, these results were obtained:

$Y_E=Y_H+29.933*\sin(HJ)=520788.025$ m
$X_E=X_H+29.933*\cos(HJ)=4103377.739$ m

$Y_F=Y_H+29.933*\sin(HJ)+32.446*\sin61.1134=520814.604$ m
$X_F=X_H+29.933*\cos(HJ)+32.446*\cos61.1134=4103396.348$ m

$Y_G=Y_H+0.00*\sin(HJ)+32.446*\sin61.1134=520797.436$ m
$X_G=X_H+0.00*\cos(HJ)+32.446*\cos61.1134=4103420.868$ m

For the applique of the corners of the building that will be constructed in the HGFE block corner point parcel with polar method; considering H as the station and the J as the junction point, necessary applique elements are calculated with geodetic basic linkage pursuant to the coordinates, the results have been given in Table 6.

D.N.	B.N.	Y	X	Horizontal Distance	Azimuth Angle	Horizontal Angle
H						
	J				161.1134	0.0000
	A			15.667	81.7928	320.6794
	B			30.750	120.4787	359.3653
	C			27.758	141.3638	380.2504
	D			8.390	120.4665	359.3531
	E			29.933	161.1134	0.0000
	F			44.144	108.5501	347.4367
	G			32.446	61.1134	300.0000

Table 6. Application elements calculated from the H station point, for the applique of A, B, C, D, E, F, G points with polar method.

8. CONCLUSION AND RECOMMENDATIONS

The contribution of buildings being able to see the sun to our country's economy would be much higher than annuity value of the land that the building in question be found. In the study, it has been seen that the Eastern Mediterranean Region is located between the latitudes of 36°-38°, while it is not making major differences in solar azimuth angle calculations, calculations have been made with mean latitude value (37°). At the summer solstice of the year, the effect of the local noon and sunrise (and sunset) time differences (thus hour angles) of Adana, Hatay, Osmaniye and Mersin provinces are not important in the context of azimuth angle calculation, thereby the calculations have been made with the hour angles of Adana for the region. Overall assessment of the research results are summarized as follows:

1- To be focused on the sun should not be considered only as an energy based requirement. Because the sun is not only an energy source, it is the source of the life itself, unlike other energy sources.

2- To make the housings in Eastern Mediterranean Region benefit from the solar energy preeminently; the values of solar azimuth angle should be at its maximum at sunrise, and its minimum at sunset.

3- The researches about the sunshine duration in Eastern Mediterranean Region have showed us that the annual sunshine duration is at its maximum when it is summer, and at its minimum when is winter. And the number of sunny days in a year is approximately 90%.

4- The hour angle in solar azimuth angle calculation is zero at local noon time. Information about hour angles at sunrise and sunset are all obtained from the calendars that indicates the time of noon and the time of the sunrise and sunset (İnce, 2005).

5- To make a building that will be constructed in Eastern Mediterranean Region benefit from sunlight all year long, it is determined that the azimuth angle of the line that connects the upper north side of the building and the corner which is located to its right side corner point should be 150G, and the azimuth angle of the line that connects the top corner to its left side corner point should be 250G. The building can be applicated after the calculation of the applique elements that belongs to the building corner points has been done using rectangular coordinate method or polar coordinate method considering the garden distances of the building blocks, frontage length and depth of the building.

6- If the corners of the building will be applicated using the polar method, necessary applique elements should be gathered after their sketching on housings with computer, or after the calculation of coordinates of the building corners.

7- For the buildings that will be constructed in the area, if the front of the development blocks planned as north-west or south-east, it will be much more easier to applique the parcels and the corners of the buildings that will be constructed on. Thereby the south side of the building can benefit from the sunlight all year long much more efficiently. It is suitable to locate active working areas and living areas in south.

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8- Because the solar energy is not taken into consideration, buildings facing to all directions started to emerge while we create our cities. This is why while creating the new city blocks, new systems should be designed to make an efficient use of solar energy.

9- Annual air conditioning expenses can be lowered in new housing areas with this research in Eastern Mediterranean Region with its mean latitude of 37º and with a high solar energy potential. Also, it will provide a big economical gain, and the effects of the combustion of typical fossil fuel gases and other waste materials would be minimized.

10- Humankind's biological clock is adjusted to the sunlight. Inadequate natural lighting in an environment of working and living can cause: Drowsiness, laziness and depressive feelings. The solution is to direct the buildings to the sun while constructing them.

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