NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical and Electronic Engineering

THE OUTSIDE ILLUMINATION OF ORTAKÖY MOSQUE

Graduation Project
EE- 400

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Lefkoşa - 2001

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ACKNOWLEDGMENTS

First I want to thank Prof. Dr Haldun Gürmen. Under his guidance, I successfully overcome many difficulties and learn a lot about outside illuminations. In each discussion, he explained my questions patiently, and I felt my quick progress from his advice's. He always helps me a lot either in my study or my life. I asked him many questions in illumination and he always answered my questions quickly and in detail.

Special thanks to Haşim Üçler . With his kind help, I could use office programs successfully to perform computational problems. Thanks to Faculty of Engineering for having such a good computational environment.

I also want to thank my friends in NEU : Cemal Kavalcıoğlu, Hüseyin Önder and Burak Başeğmezler. Being with them make my 4 years in NEU full of fun.

Finally, I want to thank my family, especially my parents. Without their endless support and love for me, I would never achieve my current position. I wish my mother lives happily always, and my father in the heaven be proud of me. I also want to thank my brother Kasim Gülbay. Every time he helps to me for my problems.

INTRODUCTION

The outside illumination is very important part in illumination. Sometimes we travel some historical places and we can see perfect appearance if it is illuminate. In this book we will see how we are making this illumination calculations.

In this book you will see the terms of B, BETA, GAMMA, C. And we will see also how we will find this terms and which formulas we will use. This formulas was the invention by Prof. Dr Haldun Gürmen. Twenty years ago. He gave this project to Philips and unfortunately he has waiting the answers since twenty years. He also explained this outside illumination method in international conger. That's why you can not see this formulas any other books. I think I am the first one.

We will see the High Pressure Sodium Lamps and its structure. How they are working ? Is it useful for outside illumination? We will give answer to this questions.

There is C, GAMA tables. We will see that how we will use this table for our illumination. To find B, BETA, GAMMA, C is very difficult. It is taking very much time that's why I make a program for my calculator. I am only entering x, y, X, Y, h values and my calculator giving to me necessary values. In this book I will explain this program also.

1 HİGH PRESSURE SODİUM LAMPS

Physically, the SON lamp is quite different from the SOX lamp (See fig 1.1). This is because of the much higher vapour pressure in the SON lamp, a fact that is responsible for many other differences between the two lamps, including the properties of the light emitted.

The discharge tube in a high pressure sodium lamp contains an excessive sodium to give saturated vapour conditions when the lamp is running. An excess of mercury is also present to provide a buffer gas, and xenon is included, to facilitate ignition and limit heat conduction from discharge arc to tube wall. The discharge tube is housed in an evacuated protective glass envelope.

High pressure sodium lamps radiate energy across a good part of the visible spectrum. In comparison with the low pressure sodium lamp, therefore, they give quite acceptable colourrendering. They are available with luminous efficacious up to 130 lm / watt at a colour temperature of about 2000 K. The working temperature is 700 centigrade degrees. They are being used to an increasing extent for all types of outdoor lighting and for high-bay factory lighting. Special types are used for decorative and accent lighting.
In table 1.2 you will see that the characteristic values of some high pressure sodium lamps.

Principal parts of the SON lamps :
-discharge tube and supports
-electrodes and feed through
-filling
-outer bulb
-thermal switch and / or starting aid (where fitted)
-lamp cap

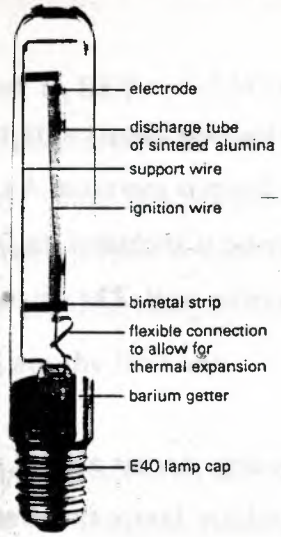


Figure 1.1 Constriction of a tubular high pressure sodium (SON-T Plus) lamp of 400W.

TABLE 1.1 Characteristic values of high pressure sodium lamps

Kind of lamp	Headgear	Flux of lamp (lm)	Min.voltage(V)	Max distance (mm)	Max diameter (mm)
SON 150W	E40/45	13500	200	227	92
SON 250W	E40/45	25000	200	227	92
SON 400W	E40/45	47000	210	292	122
SON 1000W	E40/45	120000	210	400	170
SON-T 150W	E40/45	14000	200	211	47
SON-T 250W	E40/45	27000	200	257	57
SON-T 400W	E40/45	47500	210	283	47
SON-T 1000W	E40/80*50	125000	210	390	67
SON-H 210W	E40	17000	200	227	92
SON-H 350W	E40	34500	200	292	122

2 OUTSİDE İLLUMİNATİONS FORMULAS AND DEFINITION

x , y : Small x,y are the co-ordinates that intersect of point to illuminate plane of projector axis.

X, Y : Big X and Y are co-ordinates that one point over plane of illuminated.

Ic. gamma : It is the light intensity that tends to illuminated point.

H : Big H is the height of the projector.

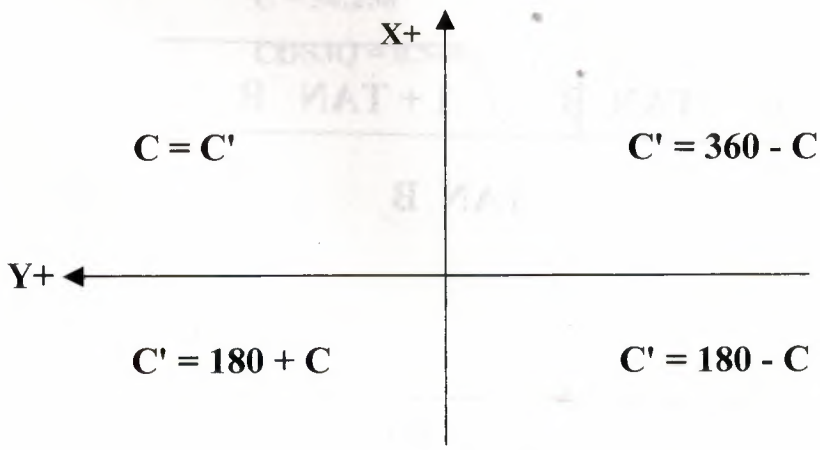
h : Small h is the distance between our projector and the illuminating place.

E (LUX) : Is the illumination at one point

$$E\,(LUX) = \frac{I_{C,GAMMA} * COS3Q * FLUX\ OF\ LAMP}{h^2}$$

Table 1.2 shows that how we find C . If x and y is in which region we are finding C' values. We are using this C' to find Ic. gamma from table.

TABLE 1.2 FINDING C



$$x' = x / h \qquad X' = X / h$$

$$y' = y / h \qquad Y' = Y / h$$

$$B = TAN^{-1} \frac{(X'\sqrt{(1+y'y')})}{1+y'Y'} - TAN^{-1} \frac{x'}{\sqrt{(1+y'y')}}$$

$$\beta = COS^{-1} \frac{1+y'Y'+X'X' \quad \frac{1+y'y'}{1+y'Y'}}{\sqrt{(1+X'X'+Y'Y')(1+y'y'+\left[\frac{X'(1+y'y')}{1+y'Y'}\right]^2}}$$

$$GAMA = TAN^{-1} \sqrt{TAN^2 B + TAN^2 \beta (1 + TAN^2 B)}$$

$$C = TAN^{-1} \frac{TAN \beta \sqrt{1 + TAN^2 B}}{TAN B}$$

$$COS3Q = \frac{1}{(1 + X' X' + Y' Y')^{(3/2)}}$$

3 THE C AND GAMMA PROGRAM FOR fx-6300G

```
Mcl:"kx"? → A : "ky" ? → B : "X" ? → C : "Y" ? → D : "H" ? → E:( A / E ) → F : (B / E ) → G : (C /
E ) → H : (D / E ) → I : (1+GG ) → K : (GI) → L : (1+(GI)) → M : COS^-1 ((( 1+L ) + ( HHK / M )) / √
((1 + HH + II )* (1+GG+( HK / M)^2 ))) → N : ((TAN^-1 (( √ KH / M )) - (TAN^-1 (F / √ K ))) → O :
( TAN^-1 √ (( TAN O )^2 + ( TAN N )^2 ( 1+ ( TAN O )^2 ))) → P : TAN^-1 (( TAN N √ ( 1 + ( TAN O
)^2 )) / TAN O ) → R : " BETA = ". N. " B = " . O . "GAMA = " . P . " C = ". R. (1 / √ ( 1 + HH + I I ) xy3 ) →
T : " COS3Q " . T .
```

This program for fx-6300G Casio calculators. The outside illumination calculation taking very long time that's why ı make this program to find the values easily. In this program ı am entering the useful values x, y, X, Y, h and then my calculator is giving to me B, BETA, GAMMA, C, COS3Q.

For example : x = 2m, y = 1m, X = 5m, Y = 5m, h=10m

And my calculators calculated that

B = 18.964

BETA = 14.318

GAMMA = 23.6

C = 54.256

COS3Q = 0.544

4 C AND GAMMA TABLES

Philips Lighting B.V
Lighting Design and Engineering centre
Computer Aided Lighting Design

Luminaire (INR) number	: 663				
Measuring code	: LVW 4030				
Luminaire type	: SGS 202 / T250				
Lamp type	: SONT 250W				
Lamp flux	: 27000 lumen				
Number of lamps Per luminaire	: 1				
Power dissipation	: watt				
Total light output ratio	: 86 %				
Downward light output ratio	: 86 %				
SLI-factor (road lighting)	: 4.60				
		Lengthwise	Crosswise		
Maximum spacing / height ratio	:	*	*		
		Lenght	Width	H0	HS0
Luminaire sizes (mm)	:				
Symmetry code	: 4				
		N1	N2	N3	N4
CIE Fluxcode (%)	: 39		74	98	100

Luminaire (INR) number : 663
Measuring code : LVW 4030
Luminaire type : SGS 202/T250
Lamp type : SONT 250W

C Plane

Gamma Plane	0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100
0.0	172	172	172	172	172	172	172	172	172	172	172
2.5	172	175	178	181	186	189	191	190	191	193	192
5.0	171	177	181	187	197	205	211	206	208	215	211
7.5	171	181	188	198	212	222	230	225	227	236	231
10.0	172	186	197	210	227	239	248	244	247	256	251
12.5	173	192	208	224	243	257	266	265	268	276	271
15.0	177	203	225	245	262	274	280	293	300	299	296
17.5	179	211	238	262	280	292	297	314	321	317	315
20.0	181	219	251	279	299	311	315	332	338	333	331
22.5	182	227	263	295	318	331	333	347	351	346	345
25.0	182	234	274	308	341	357	367	364	362	360	364
27.5	182	241	286	324	361	377	383	372	376	376	371
30.0	182	249	298	340	379	395	392	376	369	371	370
32.5	180	253	306	356	400	414	395	374	365	369	360
35.0	181	265	324	374	412	422	391	367	359	366	349
37.5	186	287	355	394	417	422	384	362	360	376	349
40.0	194	312	388	412	412	401	364	340	337	356	326
42.5	208	334	425	433	397	343	324	288	272	277	260
45.0	221	368	456	444	670	292	283	244	224	222	212
47.5	233	413	482	445	331	248	240	211	194	191	181
50.0	233	438	505	455	291	226	209	178	160	156	150
52.5	241	471	507	450	257	194	154	127	114	116	113
55.0	251	482	512	421	222	133	115	101	93	92	96
57.5	255	507	517	395	175	111	100	87	80	77	84
60.0	277	524	531	369	146	97	82	75	70	67	74
62.5	309	562	517	340	128	88	75	64	57	56	62
65.0	344	573	499	289	114	82	67	56	49	46	51
67.5	350	539	451	229	100	79	65	52	43	38	40
70.0	386	518	375	162	93	75	60	47	38	31	36
72.5	297	681	270	144	84	73	56	42	31	24	30
75.0	175	232	167	85	106	68	50	37	26	17	29
77.5	98	119	58	15	35	80	49	34	21	11	22
80.0	22	31	18	6	6	5	21	21	16	8	16
82.5	5	7	5	4	4	3	3	4	4	4	4
85.0	3	3	3	2	2	3	2	3	3	3	3
87.5	2	2	2	2	2	2	1	2	2	2	1
90.0	1	1	1	2	5	5	1	1	1	2	1

C Plane

	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0	190.0	200.0	210.0
0.0	172	172	172	172	172	172	172	172	172	172	172
2.5	190	189	187	184	181	178	174	171	168	166	165
5.0	208	205	201	196	190	183	176	170	165	160	156
7.5	226	222	216	209	199	190	178	169	161	154	149
10.0	241	239	232	222	209	196	181	168	157	149	143
12.5	264	257	248	235	119	203	184	167	153	144	138
15.0	288	277	265	249	231	210	186	164	146	137	133
17.5	307	295	282	263	242	217	189	163	142	132	129
20.0	324	312	300	278	253	224	193	162	138	129	126
22.5	339	329	318	293	264	231	197	161	135	126	124
25.0	362	353	344	314	275	233	200	160	134	126	123
27.5	371	367	361	329	286	242	206	160	132	125	122
30.0	372	376	375	342	297	253	214	161	131	125	121
32.5	364	381	389	355	306	266	222	163	130	125	120
35.0	354	380	393	363	318	284	234	166	130	125	120
37.5	348	375	391	366	335	307	252	169	132	124	121
40.0	326	356	370	364	348	331	274	175	133	124	121
42.5	276	323	320	363	358	357	302	187	133	124	117
45.0	231	279	271	346	365	385	334	197	134	124	115
47.5	192	225	223	313	368	414	369	206	136	123	115
50.0	161	190	197	279	368	442	368	214	137	123	112
52.5	127	156	175	249	367	450	428	216	137	121	111
55.0	105	118	135	218	349	466	449	218	137	120	111
57.5	92	100	111	183	337	473	461	229	139	124	110
60.0	79	82	95	153	316	487	479	243	141	123	111
62.5	68	74	85	131	303	498	507	259	138	122	110
65.0	58	67	81	117	270	486	539	281	134	121	108
67.5	49	74	78	101	222	474	548	326	152	119	104
70.0	45	60	72	94	178	413	521	342	167	137	106
72.5	41	55	67	76	188	281	394	273	101	82	100
75.0	39	47	62	99	84	190	257	171	41	31	25
77.5	34	48	75	32	18	84	138	106	20	13	8
80.0	19	16	6	6	8	28	47	33	12	8	6
82.5	4	3	3	4	5	8	12	7	5	4	3
85.0	3	2	2	3	3	4	4	4	3	3	2
87.5	1	1	2	2	2	2	2	2	2	2	1
90.0	1	1	3	3	3	1	1	1	1	1	1

Gamma Plane

C Plane

	220.0	230.0	240.0	250.0	260.0	270.0	280.0	290.0	300.0	310.0	320.0
0.0	172	172	172	172	172	172	172	172	172	172	172
2.5	163	162	162	162	161	162	161	161	162	163	163
5.0	151	150	148	147	147	147	146	146	149	150	152
7.5	143	141	139	138	137	138	136	137	140	142	144
10.0	136	134	132	130	130	131	129	130	133	135	138
12.5	131	129	127	125	125	126	124	124	128	130	133
15.0	129	127	127	127	127	126	126	126	127	129	132
17.5	126	125	124	125	125	124	124	124	124	126	129
20.0	124	122	122	123	123	122	122	122	122	124	127
22.5	122	120	120	121	121	120	120	120	120	122	125
25.0	122	118	118	120	121	120	120	120	118	122	123
27.5	121	117	116	117	118	117	118	117	116	120	121
30.0	119	115	113	114	114	113	114	114	114	118	120
32.5	117	114	110	109	108	107	108	110	113	115	120
35.0	115	112	107	104	102	101	103	106	110	112	119
37.5	114	107	103	100	97	95	96	100	105	110	117
40.0	113	103	99	95	92	90	91	94	100	108	116
42.5	112	100	96	89	86	86	85	88	94	105	115
45.0	109	98	91	84	81	81	80	83	90	102	113
47.5	105	96	84	79	76	76	76	80	88	100	110
50.0	101	93	79	74	71	71	69	73	84	98	107
52.5	100	90	76	71	68	66	66	69	77	95	104
55.0	98	88	74	66	63	63	63	67	75	92	102
57.5	97	84	70	62	59	59	59	64	72	89	99
60.0	96	81	64	58	54	52	55	60	69	85	101
62.5	96	80	61	53	48	46	50	56	63	80	97
65.0	93	77	60	49	43	42	45	52	62	80	94
67.5	91	73	56	46	40	38	39	46	59	76	92
70.0	87	70	53	38	30	31	32	40	54	70	89
72.5	70	54	39	28	23	23	23	28	38	54	70
75.0	34	29	22	14	11	12	13	16	22	28	30
77.5	7	7	6	5	6	8	5	4	5	5	7
80.0	4	3	3	3	4	6	4	3	3	3	4
82.5	2	2	2	2	4	6	3	2	2	2	3
85.0	2	2	2	2	3	6	3	1	1	1	2
87.5	1	1	1	0	5	17	5	1	1	1	1
90.0	1	1	1	1	5	21	5	1	1	1	1

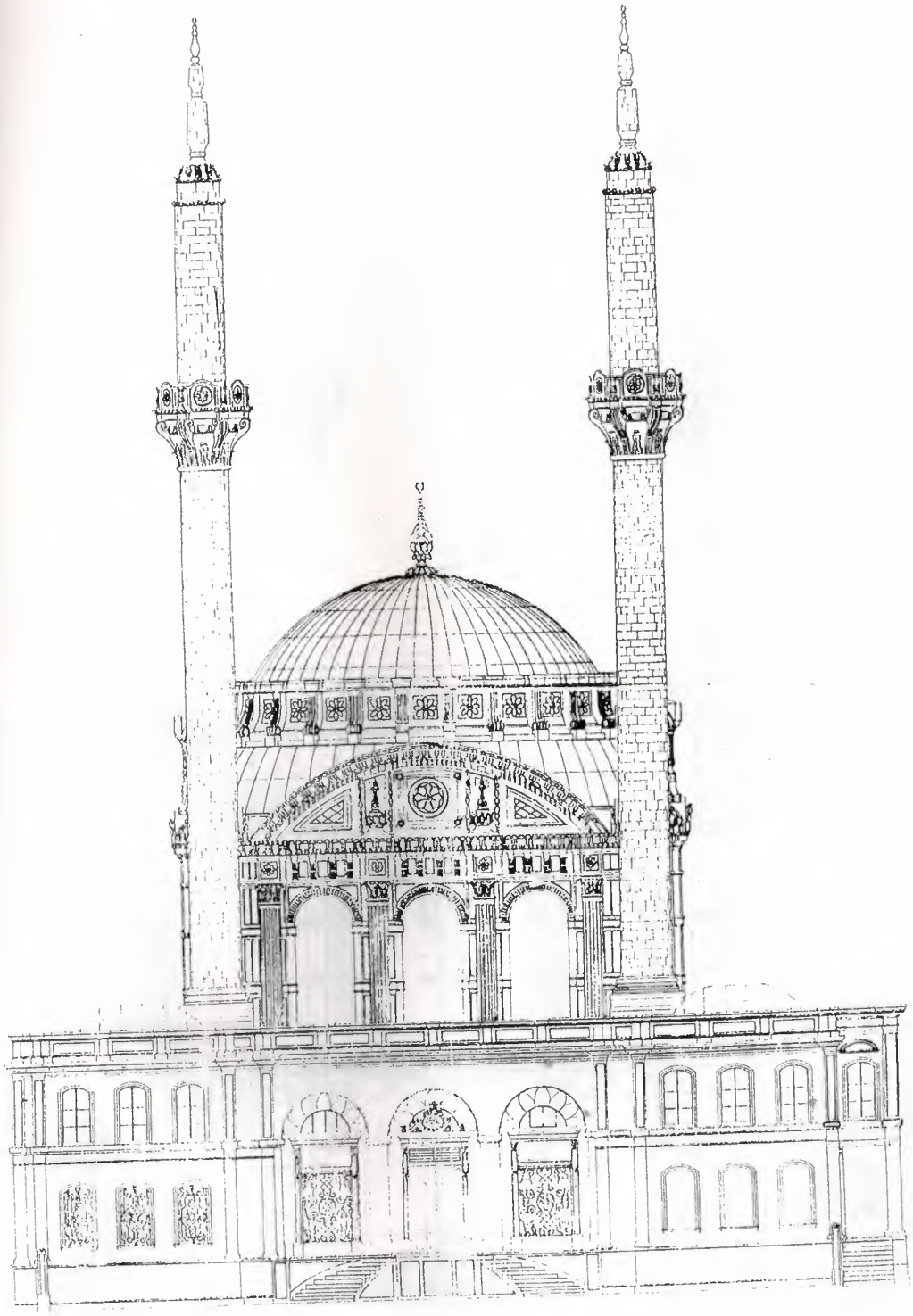
Gamma Plane

C Plane

	330.0	340.0	350.0	360.0
0.0	172	172	172	172
2.5	164	166	169	172
5.0	154	159	165	171
7.5	147	154	162	171
10.0	141	149	159	172
12.5	136	144	157	173
15.0	135	140	155	177
17.5	132	137	153	179
20.0	130	134	151	181
22.5	128	132	149	182
25.0	124	132	147	182
27.5	122	131	145	182
30.0	122	131	143	182
32.5	124	131	140	180
35.0	125	131	139	181
37.5	124	130	140	186
40.0	123	129	140	194
42.5	121	130	140	208
45.0	120	129	140	221
47.5	119	127	141	233
50.0	117	127	140	233
52.5	115	127	142	241
55.0	114	125	141	251
57.5	115	127	143	255
60.0	113	125	142	277
62.5	110	123	141	309
65.0	108	122	139	344
67.5	105	116	133	350
70.0	100	126	159	386
72.5	106	85	101	297
75.0	22	28	38	175
77.5	8	12	17	98
80.0	5	7	9	22
82.5	3	4	4	5
85.0	2	2	2	3
87.5	1	1	2	2
90.0	1	1	1	1

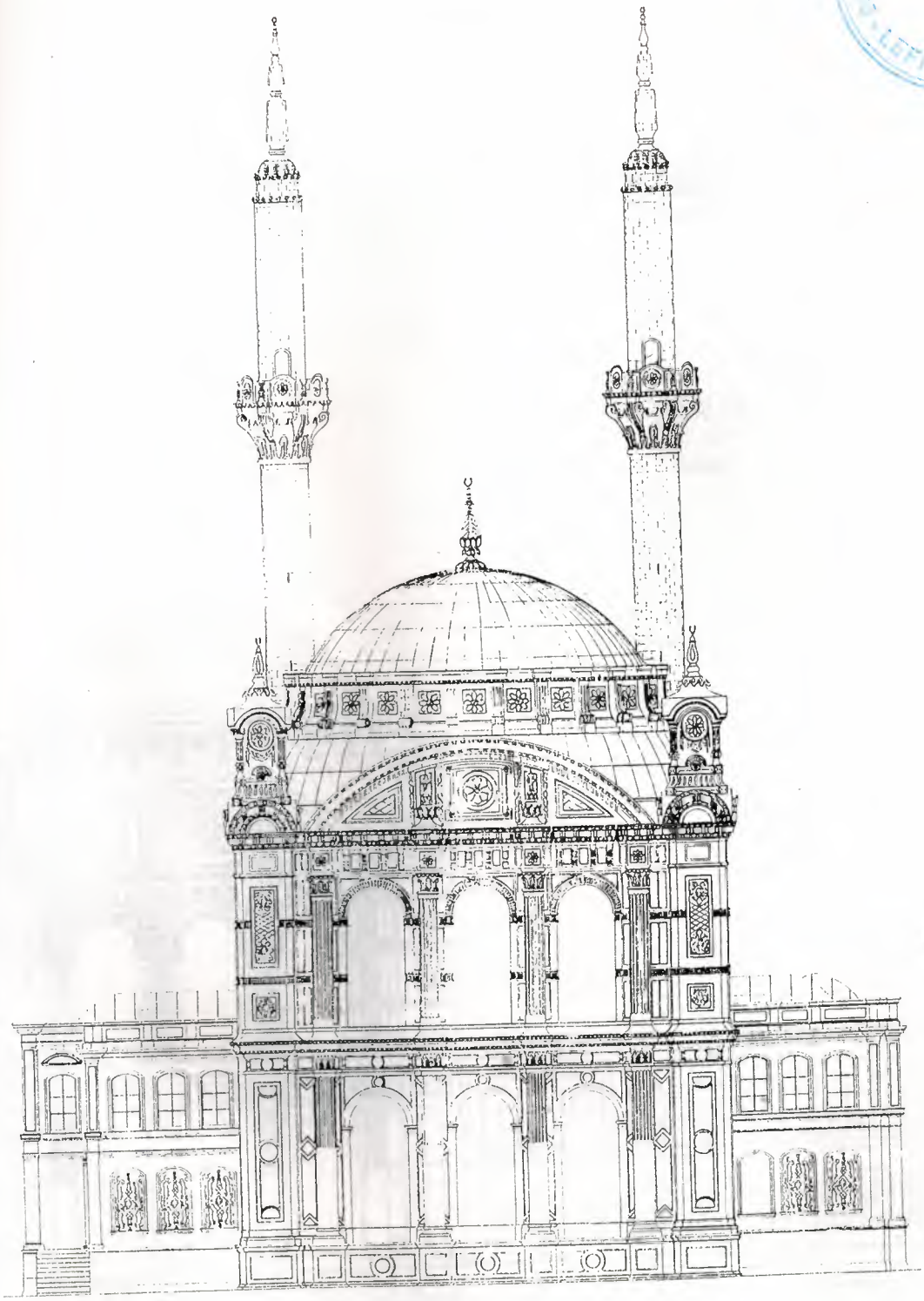
Gamma Plane

5 THE PLAN OF ORTAKÖY MOSQUE



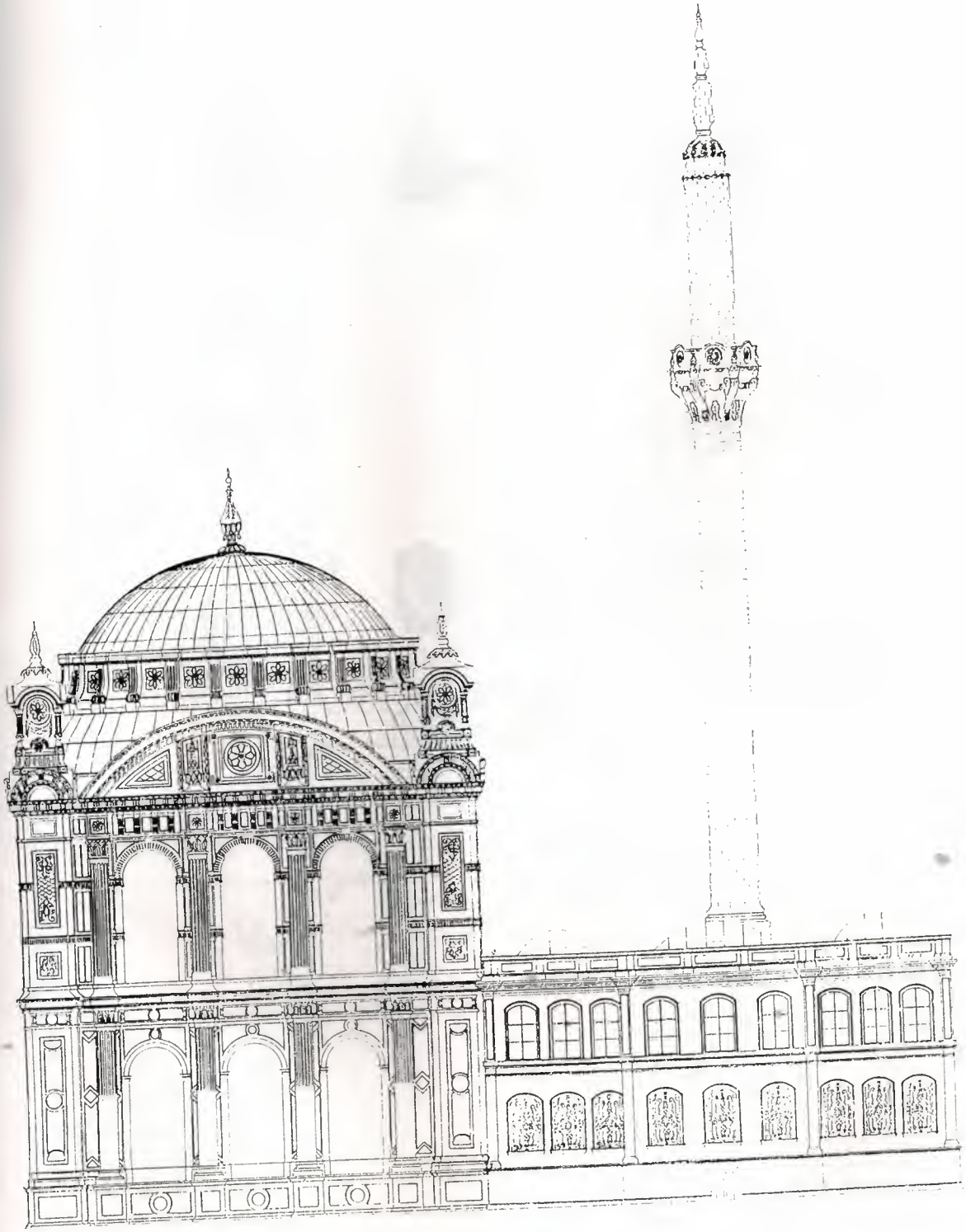
Infront of the mosque (entering place)

Scale = 1 / 175.5



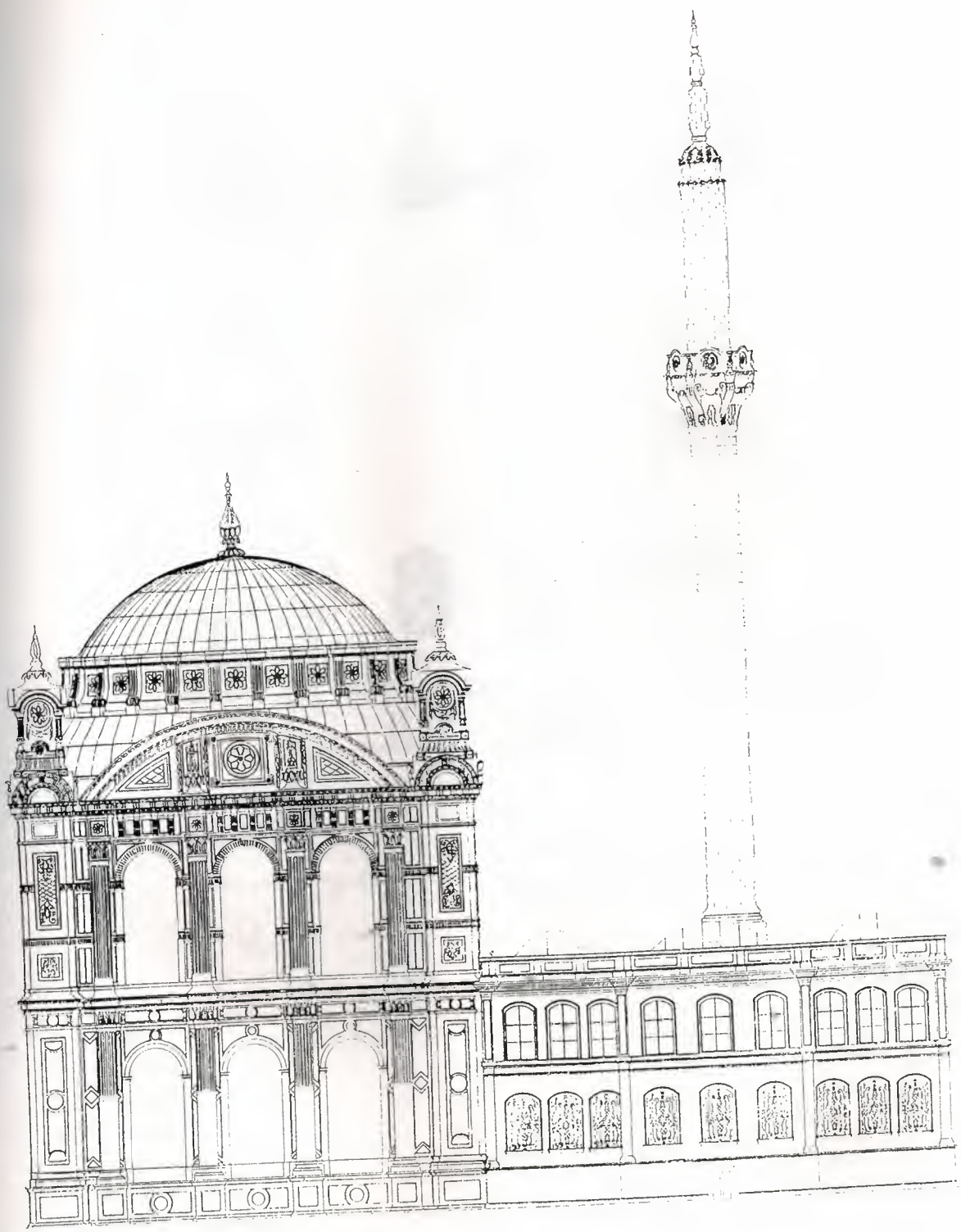
Back of the mosque (front of kıble)

Scale = 1 / 175.5



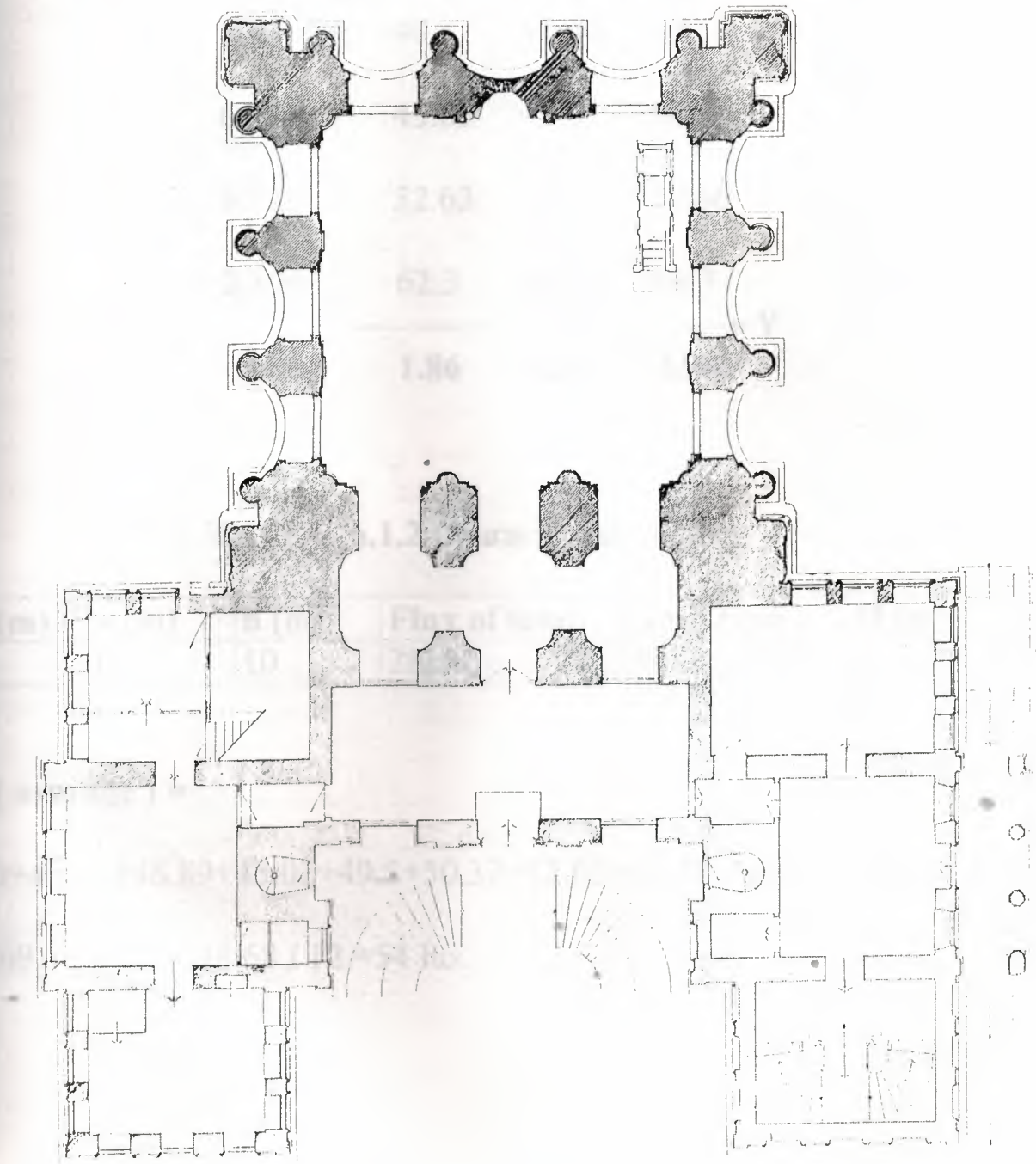
Right side of the mosque

Scale = 1 / 175.5



Right side of the mosque

Scale = 1 / 175.5



The plan of ground appearance

Scale = 1 / 175.5

6.1 The İnfront of the mosque (right side)

TABLE 6.1.1 Illumination at Some Points

7.02	40	45.46	46.89
6.318	43.02	49.5	50.32
4.212	52.63	61.28	59.66
2.106	62.3	68.32	69.3
	1.86	**3.32**	**4.98**

X

Y

TABLE 6.1.2 Characteristic Values

x (m)	y (m)	h (m)	Flux of lamp	Lamp type	H (m)
3	0	10	28klm	250W SONT	0

E (average) =

(40+45.46+46.89+43.02+49.5+50.32+52.63+61.28+59.66+62.3+68.3

2+69.3) / 12 =648.68 / 12 =54 lux

TABLE 6.1.3 Some Necessary Illumination Values

B	18.369	18.369	18.369
BETA	8.655	15.2	22.175
GAMMA	20.24	23.67	28.49
C	25.78	40.76	52.28
COS3Q	0.53	0.492	0.435
IC,GAMMA	266	330	385
B	15.585	15.585	15.585
BETA	8.936	15.678	22.831
GAMMA	17.91	21.96	27.4
C	30.33	46.25	57.45
COS3Q	0.582	0.539	0.473
IC,GAMMA	264	328	380
B	6.141	6.141	6.141
BETA	9.726	17.01	24.652
GAMMA	11.48	18.05	25.35
C	58.03	70.72	76.87
COS3Q	0.749	0.684	0.587
IC,GAMMA	251	320	363
B	-4.8	-4.8	-4.8
BETA	10.315	17.997	25.98
GAMMA	11.36	18.66	26.39
C	-65.27	-75.58	-80.24
COS3Q	0.89	0.8	0.68
IC,GAMMA	250	305	364

6.2 The İnfront of the mosque (left side)

TABLE 6.2.1 Illumination at Some Points

X			
7.02	39.84	47.9	45.7
6.318	43.33	51.83	46.87
4.212	52.85	60.67	55.87
2.106	59.45	69.89	63.61
	1.76	**3.52**	**4.82**

Y

TABLE 6.2.2 Characteristic Values

x (m)	y (m)	h (m)	Flux of lamp	Lamp type	H (m)
2.5	0	10	28klm	250W SONT	0

E (average) =

(39.84+47.9+45.7+43.33+51.83+46.87+52.85+60.67+55.87+59.45+

69.89+63.61) / 12 = 53.15 lux

TABLE 6.2.3 Some Necessary Illumination Values

B	21.03	21.03	21.03
BETA	8.197	16.07	25.47
GAMMA	22.5	26.24	32.57
C	21.86	38.75	53
COS3Q	0.531	0.486	0.403
IC,GAMMA	268	352	405
B	18.248	18.248	18.248
BETA	8.463	16.572	26.198
GAMMA	20	24.45	31.554
C	25.41	43.54	57.526
COS3Q	0.584	0.532	0.436
IC,GAMMA	265	348	384
B	8.8	8.8	8.8
BETA	9.213	17.972	28.2
GAMMA	12.71	19.94	29.44
C	46.65	64.74	74
COS3Q	0.752	0.673	0.535
IC,GAMMA	251	322	373
B	-2.143	-2.143	-2.143
BETA	9.771	19	29.661
GAMMA	10	19.12	29.73
C	-77.74	-83.8	-86.24
COS3Q	0.896	0.79	0.614
IC,GAMMA	247	316	370

6.3 The İnfront of the mosque (middle side)

TABLE 6.3.1 Illumination at Some Points

X				
7.02	44.59	49.29	43.68	38.2
6.318	47.84	55.03	45.99	40.85
4.212	56.89	59.49	53.72	35.92
2.106	59.23	62.31	58.74	38.4
	2.1	**4.2**	**6.3**	**8.4**

Y

TABLE 6.3.2 Characteristic Values

x (m)	y (m)	h (m)	Flux of lamp	Lamp type	H (m)
1	1	10.4	15klm	150W SONT	0

E (average) =

(44.59+49.29+43.68+38.1+47.84+55.03+45.99+40.85+56.89+59.49+

53.72+35.92+59.23+62.31+58.74+38.4) = 790.07/16 = 49.379 lux

TABLE 6.3.3 Some Necessary Illumination Values

B	28.164	29.198	27.667	29.736	27.184	30.288	26.712	30.856
BETA	4.937	14.037	13.929	23.028	22.07	31.167	29.197	38.292
GAMMA	28.55	32.12	30.72	36.95	34.47	42.36	38.76	47.64
C	10.37	27.13	28.1	40.59	41.58	50.17	51.18	56.99
COS3Q	0.546	0.546	0.485	0.485	0.406	0.406	0.346	0.346
IC,GAMMA	241	348	320	413	418	343	418	361
E (LUX)	18.24	26.36	21.52	27.77	23.53	20.15	20.05	18.05
B	25.44	26.43	24.966	26.946	24.5	27.477	24.056	28.024
BETA	5.087	14.47	14.326	23.7	22.644	23.025	23.878	39.857
GAMMA	25.91	29.88	28.55	35.29	32.88	41.22	37.64	41.22
C	11.7	30.1	31.17	44.1	45.16	53.58	54.64	53.58
COS3Q	0.597	0.597	0.527	0.527	0.437	0.437	0.347	0.347
IC,GAMMA	238	340	335	418	407	352	405	380
E (LUX)	19.7	28.14	24.48	30.55	24.66	21.33	21.08	19.77
B	16.29	17.067	15.62	17.475	15.563	17.898	15.216	18.336
BETA	5.504	15.683	15.418	25.596	24.203	34.380	31.703	41.879
GAMMA	17.17	23.01	22.02	30.65	28.51	38.24	34.82	45.02
C	18.95	43.73	45.15	57.91	59.16	65.81	66.97	70.66
COS3Q	0.756	0.756	0.60	0.60	0.520	0.520	0.408	0.408
IC,GAMMA	229	322	325	390	380	365	390	245
E (LUX)	23.4	33.49	27.04	32.45	27.4	26.32	22.06	13.86
B	5.818	6.253	5.612	6.483	5.414	6.722	5.2228	6.970
BETA	5.809	16.575	16.207	26.972	25.309	36.074	32.975	43.739
GAMMA	8.21	17.68	17.12	27.68	25.84	36.61	33.34	41.18
C	45.1	69.89	71.4	77.49	78.71	80.87	82.01	82.77
COS3Q	0.80	0.80	0.656	0.656	0.590	0.590	0.453	0.453
IC,GAMMA	220	314	315	370	360	358	367	226
E (LUX)	24.4	34.83	28.65	33.66	29.45	29.29	23.05	15.35

6.4 The İnfront of the mosque (upstair)

TABLE 6.4.1 Illumination at Some Points

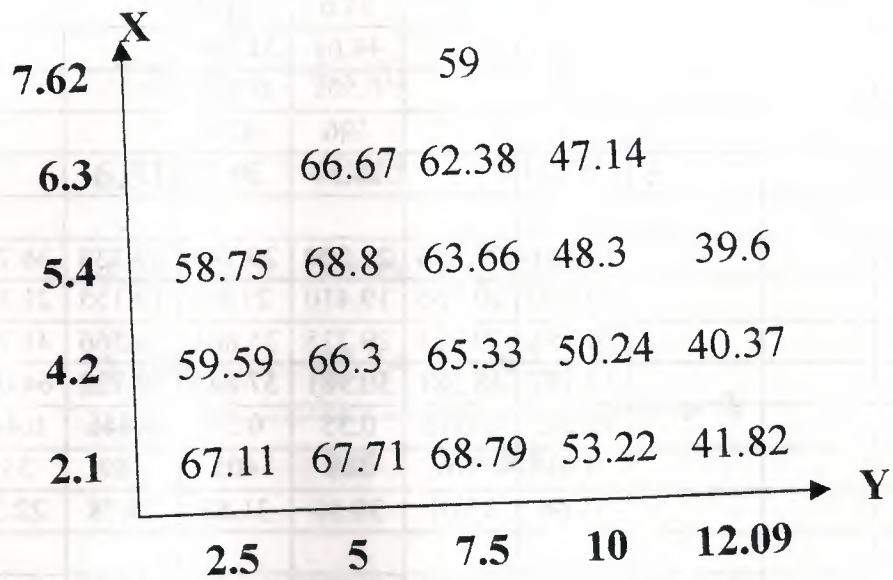


TABLE 6.4.2 Characteristic Values

x (m)	y (m)	h (m)	Flux of lamp	Lamp type	H (m)
1	1	14	28klm	250W SONT	0

E (average) =

(59+66.67+62.38+47.14+58.75+68.8+63.66+48.3+39.6+59.59+66.3+

65.33+50.24+40.37+67.11+67.71+68.79+53.22+41.82) = 57.62lux

TABLE 6.4.3 Some Necessary Illumination Values

BETA					21.595	28.77				
B					23.649	25.494				
GAMMA					31.6	37.701				
C					44.61	51.906				
COS3Q					0.501	0.501				
IC,GAMMA					396	429				
E(LUX)					28.34	30.7				
BETA			14.301	21.756	22.299	29.749	29.338	36.787		
B			19.620	20.766	19.410	21.05	19.155	21.351		
GAMMA			24.155	29.723	29.235	35.881	34.566	41.764		
C			37.147	48.381	50.981	57.845	59.722	64.038		
COS3Q			0.652	0.652	0.55	0.55	0.446	0.446		
IC,GAMMA			340	376	389	405	389	351		
E(LUX)			31.66	35.01	30.56	31.82	24.78	22.36		
BETA	5.644	13.267	14.611	22.233	22.736	30.358	29.857	37.478	35.032	42.654
B	16.822	17.314	16.585	17.568	16.352	17.828	16.124	18.094	15.937	18.322
GAMMA	17.718	21.688	21.966	28.058	27.750	34.770	33.376	41.033	38.061	45.719
C	18.854	38.387	42.405	53.557	56.104	62.402	64.181	67.948	68.610	71.159
COS3Q	0.779	0.779	0.693	0.693	0.581	0.581	0.467	0.467	0.42	0.42
IC,GAMMA	230	298	316	379	381	386	379	345	372	268
E(LUX)	25.59	33.16	31.28	37.52	31.62	32.03	25.28	23.01	22.32	17.28
BETA	5.79	13.616	14.967	22.793	23.244	31.069	30.457	38.282	35.673	43.498
B	12.464	12.868	12.27	13.076	12.079	13.290	11.893	13.509	11.741	13.697
GAMMA	13.725	18.651	19.255	26.103	26.04	33.53	32.488	40.249	37.311	45.89
C	25.167	47.405	51.517	61.701	64.022	69.115	70.685	73.511	74.573	75.988
COS3Q	0.841	0.841	0.7	0.7	0.618	0.618	0.494	0.494	0.45	0.45
IC,GAMMA	220	274	295	368	371	369	374	338	374	254
E(LUX)	26.43	33.15	29.5	36.8	32.75	32.57	26.39	23.85	24.04	16.32
BETA	5.974	14.054	15.411	23.491	23.872	31.952	31.194	39.274	36.454	44.535
B	4.37	4.5857	4.267	4.697	4.166	4.811	4.067	4.929	3.986	5.029
GAMMA	7.397	14.769	15.977	23.93	24.211	32.274	31.431	39.433	36.642	44.759
C	53.935	72.288	74.894	79.329	80.677	82.340	83.318	84	84.623	84.907
COS3Q	0.923	0.923	0.75	0.75	0.667	0.667	0.527	0.527	0.48	0.48
IC,GAMMA	214	295	294	338	362	360	367	340	378	232
E(LUX)	28.21	38.89	31.5	36.21	34.49	34.3	27.62	25.59	25.92	15.9

6.5 The Side of the mosque (right side)

TABLE 6.5.1 Illumination at Some Points

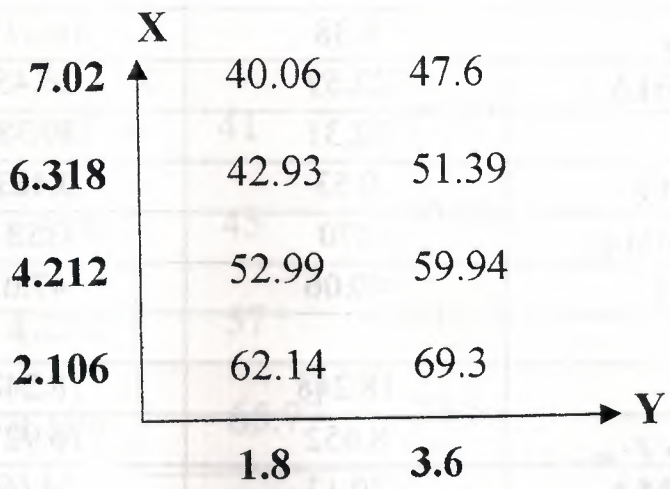


TABLE 6.5.2 Characteristic Values

x (m)	y (m)	h (m)	Flux of lamp	Lamp type	H (m)
2.5	0	10	28klm	250W SONT	0

E (average) = (40.06+47.6+42.93+51.39+52.99+59.94+62.14+69.3)

= 426.35 / 8 = 53.29lux

TABLE 6.5.3 Some Necessary Illumination Values

B	21.03	21.03
BETA	8.38	16.417
GAMMA	22.57	26.45
C	22.31	39.38
COS3Q	0.53	0.483
IC,GAMMA	270	352
E (lux)	40.06	47.6
B	18.248	18.248
BETA	8.652	16.927
GAMMA	20.13	24.69
C	25.91	44.18
COS3Q	0.583	0.529
IC,GAMMA	263	347
E(lux)	42.93	51.39
B	8.80	8.80
BETA	9.418	18.354
GAMMA	12.86	20.29
C	47.3	65.23
COS3Q	0.751	0.669
IC,GAMMA	252	320
E(lux)	52.99	59.94
B	-2.143	-2.143
BETA	9.989	19.40
GAMMA	10.21	19.51
C	-78	-83.93
COS3Q	0.895	0.75
IC,GAMMA	248	330
E(lux)	62.14	69.3

6.6 The Side of the mosque (middle side)

TABLE 6.6.1 Illumination at Some Points

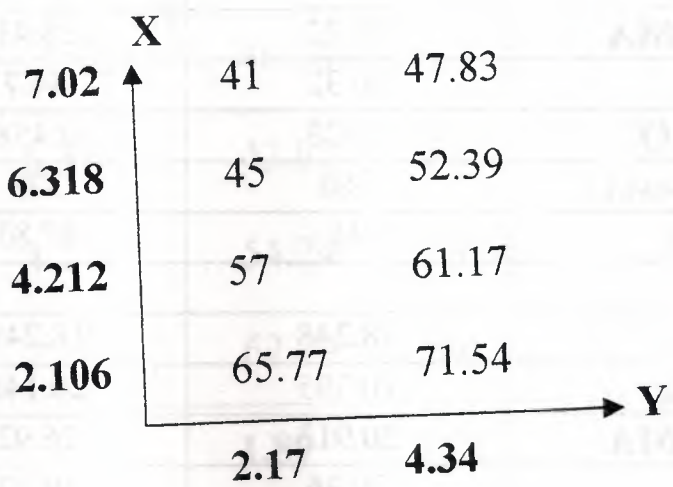


TABLE 6.6.2 Characteristic Values

x (m)	y (m)	h (m)	Flux of lamp	Lamp type	H (m)
2.5	0	10	28klm	250W SONT	0

E (average) = (41+47.83+45+52.39+57+61.17+65.77+71.54) = 55.21lux

TABLE 6.6.3 Some Necessary Illumination Values

B	21.032	21.032
BETA	10.071	19.556
GAMMA	23.22	28.41
C	26.32	44.7
COS3Q	0.523	0.458
IC,GAMMA	280	373
E(lux)	41	47.83
B	18.248	18.248
BETA	10.395	20.148
GAMMA	20.913	26.92
C	30.36	49.52
COS3Q	0.574	0.499
IC,GAMMA	280	375
E(lux)	45	52.39
B	8.804	8.804
BETA	11.309	21.799
GAMMA	14.29	23.43
C	52.57	69.05
COS3Q	0.738	0.626
IC,GAMMA	276	349
E(lux)	57	61.17
B	-2.1435	-2.1435
BETA	11.988	23.01
GAMMA	12.17	23.1
C	-80.01	-84.96
COS3Q	0.876	0.73
IC,GAMMA	270	350
E(lux)	65.77	71.54

6.7 The Side of the mosque (left side)

TABLE 6.7.1 Illumination at Some Points

X \ Y	1.89	3.78
7.02	40.43	47.91
6.318	43.92	52.47
4.212	54.24	59.96
2.106	62.79	69.72

TABLE 6.7.2 Characteristic Values

x (m)	y (m)	h (m)	Flux of lamp	Lamp type	H (m)
2.5	0	10	28klm	250W SONT	0

E (average) = (40.43+47.91+43.92+52.47+54.24+59.96+62.79+69.72)

= 53.93lux

TABLE 6.7.3 Some Necessary Illumination Values

B	21.032	21.032
BETA	8.793	17.19
GAMMA	22.71	26.91
C	23.31	40.76
COS3Q	0.529	0.478
IC,GAMMA	273	358
E(lux)	40.43	47.91
B	18.248	18.248
BETA	9.078	17.721
GAMMA	20.31	25.22
C	27.03	45.58
COS3Q	0.748	0.522
IC,GAMMA	270	359
E(lux)	43.92	52.47
B	8.804	8.804
BETA	9.88	17.526
GAMMA	13.2	21.01
C	48.69	66.27
COS3Q	0.748	0.659
IC,GAMMA	259	325
E(lux)	54.24	59.96
B	-2.1435	-2.1435
BETA	10.478	20.298
GAMMA	10.69	20.4
C	-78.56	-84.22
COS3Q	0.89	0.75
IC,GAMMA	252	332
E(lux)	62.79	69.72

6.8 The Side of the mosque (downstair)

TABLE 6.8.1 Illumination at Some Points

X \ Y	2.556	5.112	7.668	10.22	12.78
7.02	40.42	45.4	41.2	38.9	35.78
4.2	45.02	53.52	50	40.23	34.93
2.1	47	56.03	54.23	42.47	33.47

TABLE 6.8.2 Characteristic Values

x (m)	y (m)	h (m)	Flux of lamp	Lamp type	H (m)
3	0	15	48klm	400W SONT	0

E (average) =

(40.42+45.4+41.2+38.9+35.78+45.02+53.52+50+40.23+34.93+47+

56.03+54.23+42.47+33.47) / 15 = 44.51lux

TABLE 6.8.3 Some Necessary Illumination Values

B	11.472	11.472	11.472	11.472	11.472
BETA	8.928	17.443	25.235	32.146	38.150
GAMMA	14.5	20.77	27.56	33.92	39.58
C	38.3	57.66	67.12	72.43	75.79
COS3Q	0.755	0.68	0.58	0.48	0.481
$I_{C,GAMMA}$	251	313	333	371	339
E (lux)	40.42	45.4	41.2	38	34.78
B	4.3323	4.3323	4.3323	4.3323	4.3323
BETA	9.3185	18.168	26.209	33.279	39.367
GAMMA	10.26	18.66	26.54	33.52	39.56
C	65.28	77	81.27	83.43	84.73
COS3Q	0.858	0.765	0.644	0.521	0.43
$I_{C,GAMMA}$	246	328	364	362	348
E (lux)	45.02	53.52	50	40.23	31.92
B	-3.34	-3.34	-3.34	-3.34	-3.34
BETA	9.5786	18.649	26.851	34.02	40.156
GAMMA	10.13	18.93	27	34.16	40.27
C	70.95	-80.2	-83.43	-85	-86
COS3Q	0.90	0.826	0.689	0.553	0.44
$I_{C,GAMMA}$	245	318	369	360	346
E (lux)	47	56.03	54.23	42.47	32.47

6.9 The Side of the mosque (upstair)

TABLE 6.9.1 Illumination at Some Points

X \ Y	2.556	5.112	7.668	10.22	12.78
7.62			44.63		
6.3		45.4	41.2	38	
5.4	43.06	49.39	48.14	38.8	32.28
4.2	45.02	53.52	50	40.23	33.92
2.1	47	56.03	54.23	42.47	34.47

TABLE 6.9.2 Characteristic Values

x (m)	y (m)	h (m)	Flux of lamp	Lamp type	H (m)
3	0	15	48klm	400W SONT	7.02

E (average) =

(44.63+45.4+41.2+38+43.06+49.39+48.14+38.8+32.28+45.02+53.52

+50+40.23+33.92+47+56.03+54.23+42.47+34.47) = 44.09lux

TABLE 6.9.3 Some Necessary Illumination Values

B			20.608		
BETA			26.942		
GAMMA			25.8		
C			54.66		
COS3Q			0.578		
IC,GAMMA			362		
B		11.472	11.472	11.472	
BETA		17.443	25.235	32.146	
GAMMA		20.77	27.56	33.92	
C		57.66	67.12	72.43	
COS3Q		0.68	0.58	0.48	
IC,GAMMA		313	333	371	
B	8.488	8.488	8.488	8.488	8.488
BETA	9.108	17.778	25.686	32.672	38.716
GAMMA	12.42	19.64	26.96	33.63	39.49
C	47.36	65.28	72.93	77.03	79.56
COS3Q	0.801	0.719	0.61	0.497	0.42
IC,GAMMA	252	322	370	366	338
B	4.3323	4.3323	4.3323	4.3323	4.3323
BETA	9.3185	18.168	26.209	33.279	39.367
GAMMA	10.26	18.66	26.54	33.52	39.56
C	65.28	77	81.27	83.43	84.73
COS3Q	0.858	0.765	0.644	0.521	0.43
IC,GAMMA	246	328	364	362	348
B	-3.34	-3.34	-3.34	-3.34	-3.34
BETA	9.5786	18.649	26.851	34.02	40.156
GAMMA	10.13	18.93	27	34.16	40.27
C	-70.95	-80.2	-83.43	-85	-86
COS3Q	0.90	0.826	0.689	0.553	0.44
IC,GAMMA	245	318	369	360	346

6.10 The Back Side of The Mosque (upstair)

TABLE 6.10.1 Illumination at Some Points

X \ Y	2.5	5	7.5	10	12.9
5.4	58.75	68.8	63.66	48.3	39.6
4.2	59.59	66.3	65.33	50.24	40.37
2.1	67.11	67.71	68.79	53.22	41.82

TABLE 6.10.2 Characteristic Values

x (m)	y (m)	h (m)	Flux of lamp	Lamp type	H (m)
1	1	14	28klm	250W SONT	0

E (average) =

(58.75+68.8+63.66+48.3+33.15+59.59+66.3+55.33+50.24+32.37+

67.11+67.71+68.79+53.22+35.84) = 55.786lux

TABLE 6.10.3 Some Necessary Illumination Values

BETA	5.644	13.267	14.611	22.233	22.736	30.358	29.857	37.478	36.858	44.479
B	16.822	17.314	16.585	17.568	16.352	17.828	16.124	18.094	15.866	18.411
GAMMA	17.718	21.688	21.966	28.058	27.750	34.770	33.376	41.033	39.678	47.392
C	18.854	38.387	42.405	53.557	56.104	62.402	64.181	67.948	69.964	72.17
COS3Q	0.779	0.779	0.693	0.693	0.581	0.581	0.467	0.467	0.39	0.39
IC,GAMMA	230	298	316	379	381	386	379	345	342	218
E(LUX)	25.59	33.16	31.28	37.52	31.62	32.03	25.28	23.01	20	13.15
BETA	5.79	13.616	14.967	22.793	23.244	31.069	30.457	38.282	37.507	45.332
B	12.464	12.868	12.27	13.076	12.079	13.290	11.893	13.509	11.683	13.77
GAMMA	13.725	18.651	19.255	26.103	26.04	33.53	32.488	40.249	39.028	46.938
C	25.167	47.405	51.517	61.701	64.022	69.115	70.685	73.511	75.220	76.759
COS3Q	0.841	0.841	0.7	0.7	0.618	0.618	0.494	0.494	0.4	0.4
IC,GAMMA	220	274	295	368	371	369	374	338	339	221
E(LUX)	26.43	33.15	29.5	36.8	32.75	32.57	26.39	23.85	19.37	13
BETA	5.974	14.054	15.411	23.491	23.872	31.952	31.194	39.274	38.297	46.378
B	4.37	4.5857	4.267	4.697	4.166	4.811	4.067	4.929	3.955	5.069
GAMMA	7.397	14.769	15.977	23.93	24.211	32.274	31.431	39.433	38.47	46.591
C	53.935	72.288	74.894	79.329	80.677	82.340	83.318	84	85	85.186
COS3Q	0.923	0.923	0.75	0.75	0.667	0.667	0.527	0.527	0.42	0.42
IC,GAMMA	214	295	294	338	362	360	367	340	345	219
E(LUX)	28.21	38.89	31.5	36.21	34.49	34.3	27.62	25.59	20.7	13.14

6.11 The Back Side of The Mosque (downstair)

TABLE 6.11.1 Illumination at Some Points

X \ Y	**2.556**	**5.112**	**7.668**	**10.22**	**12.9**
7.02	40.42	45.4	41.2	38.9	35.78
4.2	45.02	53.52	50	40.23	34.93
2.1	47	56.03	54.23	42.47	33.47

TABLE 6.11.2 Characteristic Values

x (m)	y (m)	h (m)	Flux of lamp	Lamp type	H (m)
3	0	15	48klm	400W SONT	0

E (average) =

(40.42+45.4+41.2+38.9+35.78+45.02+53.52+50+40.23+34.93+47+

56.03+54.23+42.47+33.47) / 15 = 44.51lux

TABLE 6.11.3 Some Necessary Illumination Values

B	**11.472**	**11.472**	**11.472**	**11.472**	**11.472**
BETA	**8.928**	**17.443**	**25.235**	**32.146**	**38.150**
GAMMA	**14.5**	**20.77**	**27.56**	**33.92**	**39.58**
C	**38.3**	**57.66**	**67.12**	**72.43**	**75.79**
COS3Q	**0.755**	**0.68**	**0.58**	**0.48**	**0.481**
$I_{C,GAMMA}$	**251**	**313**	**333**	**371**	**339**
E (lux)	**40.42**	**45.4**	**41.2**	**38**	**34.78**
B	**4.3323**	**4.3323**	**4.3323**	**4.3323**	**4.3323**
BETA	**9.3185**	**18.168**	**26.209**	**33.279**	**39.367**
GAMMA	**10.26**	**18.66**	**26.54**	**33.52**	**39.56**
C	**65.28**	**77**	**81.27**	**83.43**	**84.73**
COS3Q	**0.858**	**0.765**	**0.644**	**0.521**	**0.43**
$I_{C,GAMMA}$	**246**	**328**	**364**	**362**	**348**
E (lux)	**45.02**	**53.52**	**50**	**40.23**	**31.92**
B	**-3.34**	**-3.34**	**-3.34**	**-3.34**	**-3.34**
BETA	**9.5786**	**18.649**	**26.851**	**34.02**	**40.156**
GAMMA	**10.13**	**18.93**	**27**	**34.16**	**40.27**
C	**70.95**	**-80.2**	**-83.43**	**-85**	**-86**
COS3Q	**0.90**	**0.826**	**0.689**	**0.553**	**0.44**
$I_{C,GAMMA}$	**245**	**318**	**369**	**360**	**346**
E (lux)	**47**	**56.03**	**54.23**	**42.47**	**32.47**

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