EASTERN MEDITERRANEAN UNIVERSITY

DEPARTMENT OF

ELECTRICAL AND ELECTRONICS ENGINEERING

OUTDOOR ILLIUMINATION OF ARSENAL TOWER

[T.R.N.C G.MAGOSA]

SUPERVISED BY :
PROF.HALDON GURMEN

PREPARED BY :
SAMER EL-REFAI

SPRING 1993

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a) **PLANING :**

A flood lighting installation project can only be carried out successfully if a true study has been made of the building concerned . The light engineer should become familiar with all factors relating to lighting installation for the building.It is essential she /he should first study the features of the facade under various conditions and with sunlight falling upon it at different angles in order to decide which are the most attractive features .

b) **THE CONTRAST BETWEEN THE FACADE AND THE BACKGROUND :**

The contrast between the facade and its background are changes continuously with changes in weather conditions when , for example , the rays of the sun fall directly on the facade and there is a cloudless sky, the facade will be brighter then the background because of the greater reflection . Sunlight falling directly on the building causes hard shadows .

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Trees and fences around the building can form a decorative part of an installation . An attractive way of dealing with these is to place the sources of light behind them .Two advantages are gained :

FIRSTLY the light sources are not seen by viewer ,and

SECONDLY the trees and fences are silhouetted against the light background of the facade .The impression of depth is therefore heightened .

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In determining the illumination level needed for a facade , in order to obtain the required brightness ,the reflection factor and way the building surface material reflected the lights are important to borne in mind . The table below indicates the reflection factors of a number of different material .

MATERIAL	STATE	REFLECTION FACTOR
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granite	fairly clean	0.10 -0.15
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dark concrete	fairly clean	0.25
or stone	very dirty	0.05 -0.10
imitation concrete paint	clean	0.50
white brick	clean	0.80
yellow brick	new	0.35 *
red brick	dirty	0.05

The total reflection from a facade depends on the following points:

i)The material of the facade

ii)The incident angle of the light

iii)The position of the observer in relation to the reflection material (specular reflections)

The color of the material is also an important factor.

The color of the surface material is accentuated if light of the color is used.

e)**SELECTION OF THE LEVEL OF ILLUMINATION :**

The lighting level needed of facade to effect a certain brightness contrast depends upon such factor as the reflection factor of the surface building material , the location of building in relation to its surroundings , the general brightness of this surroundings and the dimension of the building .

The following table presents some recommended illumination level for various surface building material used on building in either poorly lit ,well lit or brightly lit surroundings.

TYPES OF SURFACE	STATE	P.L.S	W.L.S	B.L.S
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light concrete im-itation	f.clean	50	100	200
concrete paint	f.clean	100	250	400
white brick	f.clean	20	40	80
yellow brick	f.clean	50	100 *	200
white granite concrete	f.clean	150	300	600
or dark stone	f.clean	75	150	300
red brick	f.clean	75	150	300
concrete	v.dirty	requires at least 150 - 300		
red brick	dirty	requires at least 150 - 300		

CHAPTER TWO

THE EQUIPMENT USED IN FLOODLIGHT a) Low pressure sodium lamps .

b)High pressure sodium vapor lamps .

c) Height pressure mercury vapor lamps

d) Metal hailed lamps .

In this project , the high pressure sodium vapor lamps (SON - T 400 W) were considered . **HIGH PRESSURE SODIUM VAPOR LAMPS (SON)**

They have played an important role in the expending field of floodlighting . SON lamp is efficient , versatile light sources to start with their high luminous capacity means more light for less money -a - feature for often decisive importance where lighting is implored for long periods of time . This plus the pleasing , warm golden white lights make , SON lamps an attractive proposition for a wide range of application both in and outdoors . Also SON lamps have balanced color rendering , reliable and stable operation excellent lumen maintenance and short re-ignition time .

TYPE OF HIGH PRESSURE SON:

i) SON lamps : High pressure sodium vapor lamps , for outdoor and indoor use , with assintered aluminum oxide discharge tube enclosed in cater bulb .

ii) SON - T lamps :with centered aluminum oxide discharge tube enclosed in a clear, tubular hard glass outer bulb .

APPLICATION :

a) Floodlightingb) Public lighting .

c) Industrial lighting .

d) Sports lighting .

e) Airports lighting .

f) Road lighting .

Note : Technical data of this type of lamp were given in appendix .

LIGHTING UNITS AND DEFINITION

CANDELA :

Units of luminous intensity , originally the luminous intensity of a specified candle burning at a specified rate .

CANDELA : (Cod)

unites of luminous intensity . Also called the new international candela . Equal to the luminous intensity of a surface of black - body radiator operated at the temperature of solidifying platinum .

LUMINANCE :(L)

The luminous intensity in a given direction by the area of the surface perpendicular to that direction .

LUMEN : (Lm)

The flux emitted in unit solid angle by a uniform point source of one candela . It is unit of luminous flux .

ILLUMINANCE : (E)

Luminous flux on a surface element divided by the area of the elements , in lumen per square meter of flux .

LUMINANCE INTENSITY : (symbol: I , unit :cod)

The quantity which describes the light giving power of a source in any particular direction . If F is the luminous flux emitted within a cone of very small angle W , having its apex the source and its axis .

REFLECTION FACTOR : (n)

The reflection factors describes the relationship between the incident luminous flux and the reflected luminous flux . This factor depends upon the reflection properties of the surface of the material to be illuminated .

MAXIMUM INTENSITY : (I max)

The maximum intensity of the beam is the maximum intensity candela 1000 lumen of the lamp flux .

CHAPTER THREE

METHOD OF CALCULATION :

There are two possible ways of calculating the types and numbers of flood lighting needed to achieve the desired illumination , the lumen method and the luminous intensity method . For a large facade the lumen methode should be used . This is upon a certain avarage luminous efficiency . For high and small object church steeples , chimneys ,etc..., the luminous intencity method should be used . This is based on the luminous intencity relation in a certain direction .

THE LUMEN METHOD :

This method consists in caculating the number of lumens to be directed on to facade in order to obtain a certain illumination level . The number of lumens can be calculated by means of formula below :

$$\not{\phi}t = \frac{A * E}{n}$$

Where

$\not{\phi}t$: is the total number of lamp lumens ,i.e. the total luminous flux produced by all lamps .

A : is the surface of the facade to be illuminated in m .

E : is the desired illumination in lux , on the facade .

n : is a factor which takes into account the efficency of the fitting and the light losses .

Once the total number of lumens is known , the number of fitting (N) needed can be calculated by dividig this ammout by the number of lumens installed per fitting :

$$N = \frac{\Phi \text{ total}}{\Phi \text{ fitting}}$$

LUMINOUSE INTENCITY METHODE :

In this methode the starting point is the luminous intencity related to the light source in a particular direction . This luminous intensity may be derived from the luminous intensity diagram or from a table . This data can usually be found in the apropriate catalogue and brochures . The calculation is made with the formula as shown below :

$$E = \frac{I}{h} \cos^3 \varphi$$

Where :

E: is the vertical illumination on the facade .

I: is the luminous intensity at the angle O

h: is the highest of the object above the level on which the fittings are arranged also can be said : the distance between the projector and the surface which of the facade illumenated

ø: Is the angle at which the light beam strikes normal on the plane to be illuminated .

THE WAY OF USING THE DIRECT METHODE

Calculation method

By using intensity approach method , we can calculate the (c) and ( ) angles , as the :

X -----> X ' , X ' = X / h

Y -----> Y ' , Y ' = Y / h

XO ----> XO ' , XO ' = XO / h

YO ----> YO ' , YO ' = YO / h

Where :

XO & YO are the coordinates of the surface of the point at which the projector axis intercept the plane which will illuminate .

X & Y reprecsent the coordinates of the point at which the calculating of the illuminance needed .

PROCEDURE :

i) Substituting these pointes into related formula , given in the appendix .

ii) By runing the related programe it can be obtained the angles , intensities per 1000 lumen and illuminances at each point on the surface .

USING COMPUTER PROGRAMING

```
INTEGER X,Y
REAL XMIN,XMAX,YMIN,YMAX,INCX,INCY,H
REAL XO,YOX1,Y1
REAL CUBE,B,D1,D2,ALFA1,ALFA,A,A1,C,C1,GAMA1,GAMA,FACTOR
OPEN (3,FILE='ILLUM.DAT',STATUS='NEW')
WRITE    (*,*)'ENTER    XMIN    AND    XMAX'
READ (*,*)XMIN,XMAX
WRITE (*,*)'ENTER YMIN AND YMAX '
READ (*,*)YMIN,YMAX
WRITE (*,*)'INCREAMENT FOR X AND Y'
READ (*,*)INCX,INCY
WRITE    (*,*)'INTER    XO    AND    YO'
WRITE (*,*)'INTER H'
READ        (*,*)H
X10=XO/H
Y10=YO/H
WRITE (3,100) XO,YO,H
FORMAT (21X,'XO=',F4.1,8X,'YO=',F4.1,8X,'H=',F4.1//
$16X,'X',6X,'Y',9X,'C',9X,'GAMA',8X,'COS CUBE',5X,'FACTOR'/
$14X,65('-'))
DO 7 Y=YMAX,YMIN,-INCY
DO 7 X=XMIN,XMAX,INCX
X1=X/H
Y1=Y/H
CUBE=1/(((1+X1*X1+Y1*Y1))**(1.5))
B=1+X1*X10+Y1*Y1((1+X10*X10)/(1+X1*X10))
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WRITE    (*,*)'ENTER    XMIN    AND    XMAX'
READ (*,*)XMIN,XMAX
WRITE (*,*)'ENTER YMIN AND YMAX '
READ (*,*)YMIN,YMAX
WRITE (*,*)'INCREAMENT FOR X AND Y'
READ (*,*)INCX,INCY
WRITE    (*,*)'INTER    XO    AND    YO'
WRITE (*,*)'INTER H'
READ        (*,*)H
X10=XO/H
Y10=YO/H
WRITE (3,100) XO,YO,H
FORMAT (21X,'XO=',F4.1,8X,'YO=',F4.1,8X,'H=',F4.1//
$16X,'X',6X,'Y',9X,'C',9X,'GAMA',8X,'COS CUBE',5X,'FACTOR'/
$14X,65('-'))
DO 7 Y=YMAX,YMIN,-INCY
DO 7 X=XMIN,XMAX,INCX
X1=X/H
Y1=Y/H
CUBE=1/(((1+X1*X1+Y1*Y1))**(1.5))
B=1+X1*X10+Y1*Y1((1+X10*X10)/(1+X1*X10))
```

```
D1=(1+X1*X1+Y1*Y1)*(1+X10**2+(Y1**2*((1+X10**2)/(1+X10*X1))**2)
D2=SQRT(D1)
ALFA1=ACOS(B/D2)
ALFA=((ALFA*180)/3.145926)
F=SQRT(1+X10**2)
A1=ATAN((Y1*SQRT(1+X10**2))/(1+X10*X1))-ATAN(Y10/F)
A=((A1*180)/3.145926)
C1=ATAN ((TAN(ALFA1*SQRT(1+TAN(A1)*TAN(A1)))/TAN(A1+.00001))
C=((C1*180)/3.145926)
GAMA1=ATAN(SQRT((TAN(ALFA1))**2*(1+(TAN(A1))**2)+(TAN(A1))**2))
GAMA=((GAMA1*180)/3.1415926)
IF ((A.LT.O).AND.(X.GT.XO))  C=180-C
IF ((A.LT.O).AND.(X.LT.XO))  C=180+C
IF ((A.GT.O).AND.(X.GT.XO))  C=360-C
IF ((A.GT.O).AND.(X.LT.XO))  C=C
FACTOR=CUBE*27/H**2
WRITE(3,200)X,Y,C,GAMA,CUBE,FACTOR
FORMAT(14X,13,4X,13,7X,F5.1,6X,F5.1,8X,F7.5,5X,F7.4)
CONTINUE
ENDFILE(3)
CLOSE(3)
STOP
END
```

[R E S U L T S]

DISTANCES	IN	(m)
ANGLES	IN	degree
INTENSITY	IN	(cd/k lm)
ILLUMINANCE	IN	(lux)

Results obtained by the computer program :

Distances in (m)

Angles in degrees

Light Intensity in (Cd /klm)

Illuminance in (lux) .

$X0' = 0.0$ $Y0' = 2.4$ $h = 5$

400W (SON-T)

X'	Y'	C	γ	$\cos^3\theta$	I	E
0.0	2.0	180.0	45.58	0.8	55.0	82.72
0.0	4.0	180.0	28.72	0.476	323.5	289.5
0.0	6.0	180.0	17.19	0.262	460.0	226.6
0.0	8.0	180.0	9.4	0.149	590.0	165.3
0.0	10.0	180.0	3.95	0.089	592.7	99.2
0.0	12.0	0.0	0.0	0.0568	612.0	65.4
0.0	14.0	0.0	2.97	0.038	599.0	42.8
0.0	16.0	0.0	5.27	0.0265	584.0	29.1
0.4	0.4	152.5	49.0	0.66	78.0	96.8
0.4	0.8	147.0	33.17	0.414	316.3	246.2
0.4	1.2	139.0	22.26	0.239	44.0	200.4
0.4	1.6	127.5	15.2	0.14	527.0	138.7
0.4	2.0	111.0	10.9	0.085	569.2	90.95
0.4	2.4	90.0	8.75	0.055	583.0	60.3
0.4	2.8	68.9	8.21	0.037	568.2	39.5
0.4	3.2	52.4	8.6	0.026	560.1	14.6
0.8	0.4	133.9	55.8	0.414	55.0	42.8
0.8	0.8	127.56	42.0	0.30	165.5	93.34

X′	Y′	C	γ	$\cos^3\theta$	I	E
0.8	1.2	120.0	31.76	0.185	303.6	105.6
0.8	1.6	111.0	24.78	0.116	409.7	89.34
0.8	2.0	100.9	20.0	0.075	505.2	71.23
0.8	2.4	90.0	17.1	0.05	588.1	55.3
0.8	2.8	97.1	15.34	0.034	585.6	37.43
0.8	3.2	68.95	14.4	0.024	566.7	25.6
1.2	0.4	122.65	62.13	0.239	5.4	24.3
1.2	0.8	117.15	50.2	0.185	96.3	33.5
1.2	1.2	111.0	40.72	0.131	137.4	42.7
1.2	1.6	104.4	33.65	0.089	240.9	40.3
1.2	2.0	97.3	28.74	0.061	322.4	37.0
1.2	2.4	90.0	24.78	0.043	403.8	32.6
1.2	2.8	82.7	2.2	0.03	456.2	25.73
1.2	3.2	75.6	20.4	0.022	505.1	20.9
1.6	0.4	115.64	67.0	0.139	5.1	1.33
1.6	0.8	111.0	56.77	0.116	9.3	2.03
1.6	1.2	106.1	48.14	0.089	104.6	17.5
1.6	1.6	100.9	41.2	0.066	161.4	20.0
1.6	2.0	95.5	35.78	0.048	200.3	18.1
1.6	2.4	0.0	31.6	0.035	227.8	15.0
1.6	2.8	84.5	28.4	0.026	324.6	15.9
1.6	3.2	79.0	26.0	0.02	324.8	12.2
2.0	0.4	111.0	70.6	0.085	5.8	1.0
2.0	0.8	107.1	61.8	0.075	6.5	1.0
2.0	1.2	103.0	54.0	0.061	44.6	5.1
2.0	1.6	98.7	47.4	0.048	112.1	10.12
2.0	2.0	94.4	42.0	0.037	149.0	10.36
2.0	2.4	90.0	37.57	0.028	178.2	9.38
2.0	2.8	85.6	34.0	0.022	216.4	8.98
2.0	3.2	81.25	31.2	0.017	271.4	8.7
2.4	0.4	107.8	73.35	0.055	5.2	0.54
2.4	0.8	104.33	65.7	0.05	6.7	0.36
2.4	1.2	100.9	58.65	0.043	17.0	1.4

X′	Y′	C	γ	$\cos^3\theta$	I	E
2.4	1.6	97.3	52.4	0.035	67.2	4.4
2.4	2.0	93.67	47.16	0.028	109.1	5.7
2.4	2.4	90.0	42.71	0.023	145.2	6.3
2.4	2.8	86.34	39.1	0.018	168.1	5.7
2.4	3.2	82.7	36.0	0.014	197.3	2.8
2.8	0.4	109.9	74.13	0.037	4.7	0.33
2.8	0.8	102.41	68.6	0.034	6.6	0.42
2.8	1.2	99.4	62.22	0.03	4.8	0.27
2.8	1.6	96.3	56.5	0.026	30.0	1.47
2.8	2.0	93.15	51.5	0.022	68.4	2.8
2.8	2.4	90.0	47.12	0.018	113.0	3.8
2.8	2.8	86.85	43.4	0.015	142.3	4.0
2.8	3.2	83.75	40.3	0.012	168.0	3.8
3.2	0.4	103.5	77.1	0.026	3.8	0.19
3.2	0.8	100.9	71.0	0.024	6.0	0.27
3.2	1.2	98.2	65.24	0.022	3.1	1.28
3.2	1.6	95.5	60.0	0.02	8.0	0.3
3.2	2.0	92.76	55.0	0.017	39.2	1.3
3.2	2.4	90.0	51.0	0.014	87.3	2.3
3.2	2.8	87.24	47.2	0.012	109.0	2.45
3.2	3.2	84.2	44.0	0.01	134.2	2.52

X0 =0′ YO =1.9′ h=5

SON-T 400W

X′	Y′	C	γ	$\cos^3\theta$	I	E
-1.6	0.4	113.6	64.85	0.139	6.2	1.62
-1.6	0.8	107.75	55.0	0.116	17.9	3.9
-1.6	1.2	101.5	47.0	0.089	109.0	18.24
-1.6	1.6	95.0	40.5	0.066	167.0	20.7
-1.6	2.0	88.32	35.6	0.048	198.0	17.87
-1.6	2.4	81.72	32.0	0.035	246.5	16.22
-1.6	2.8	75.33	29.3	0.026	303.7	14.85
-1.2	0.4	120.12	59.5	0.24	7.0	3.2
-1.2	0.8	113.12	48.0	0.19	114.5	41.2
-1.2	1.2	105.2	39.14	0.13	173.0	42.3
-1.2	1.6	96.65	32.71	0.09	243.3	41.2
-1.2	2.0	87.77	28.24	0.06	342.5	38.6
-1.2	2.4	79.0	25.27	0.043	399.0	32.3
-1.2	2.8	70.77	23.4	0.03	456.0	25.7
-0.8	0.4	131.1	52.34	0.414	82.0	63.8
-0.8	0.8	122.6	39.0	0.3	204.0	115.0
-0.8	1.2	112.2	29.5	0.185	320.0	111.3
-0.8	1.6	100.0	23.4	0.116	436.0	95.0
-0.8	2.0	86.7	19.7	0.075	508.2	71.7
-0.8	2.4	73.8	17.8	0.05	555.0	52.17
-0.8	2.8	62.4	17.1	0.034	540.6	34.6
-0.4	0.4	150.2	44.5	0.66	125.0	155.0
-0.4	0.8	142.0	29.0	0.414	363.0	282.5
-0.4	1.2	129.1	18.7	0.24	503.0	227.0
-0.4	1.6	109.2	12.7	0.14	573.0	151.0
-0.4	2.0	83.3	10.2	0.085	578.0	92.4
-0.4	2.4	59.8	10.14	0.055	556.0	57.5
-0.4	2.8	43.67	11.13	0.04	527.0	39.6
0.0	0.4	0.0	40.44	0.8	121.0	182.0
0.0	0.8	0.0	23.58	0.476	395.0	353.5
0.0	1.2	0.0	12.05	0.262	512.0	252.2
0.0	1.6	0.0	4.25	0.149	588.0	164.7

X′	Y′	C	γ	$\cos^3\theta$	I	E
0.0	2.0	0.0	1.2	0.089	608.0	101.7
0.0	2.4	0.0	5.14	0.057	583.0	62.5
0.0	2.8	0.0	8.1	0.038	550.0	39.3
0.4	0.4	150.2	44.5	0.66	125.0	155.0
0.4	0.8	142.0	29.0	0.414	363.0	282.5
0.4	1.2	129.1	18.7	0.24	503.0	227.0
0.4	1.6	109.2	12.7	0.14	573.0	151.0
0.4	2.0	83.3	10.2	0.085	578.0	92.4
0.4	2.4	59.8	10.14	0.055	556.0	57.5
0.4	2.8	43.67	11.13	0.04	527.0	39.6
0.8	0.4	131.1	52.34	0.413	82.0	63.8
0.8	0.8	122.6	39.0	0.3	204.0	115.0
0.8	1.2	112.2	29.5	0.185	320.0	111.3
0.8	1.6	100.0	23.4	0.116	436.0	95.0
0.8	2.0	86.7	19.7	0.075	508.2	71.7
0.8	2.4	73.8	17.8	0.05	555.0	52.17
0.8	2.8	62.4	17.1	0.034	540.6	34.6
1.2	0.4	120.12	59.5	0.24	7.0	3.2
1.2	0.8	113.12	48.0	0.19	114.5	41.2
1.2	1.2	105.2	39.14	0.13	173.0	42.3
1.2	1.6	96.65	32.71	0.09	243.3	41.2
1.2	2.0	87.77	28.24	0.06	342.5	38.6
1.2	2.4	79.0	25.27	0.043	399.0	32.3
1.2	2.8	70.77	23.4	0.03	456.0	25.7
1.6	0.4	113.6	64.85	0.139	6.2	1.62
1.6	0.8	107.75	55.0	0.116	17.9	3.9
1.6	1.2	101.5	47.0	0.089	109.0	18.24
1.6	1.6	95.0	40.5	0.066	167.0	20.7
1.6	2.0	88.32	35.6	0.048	198.0	17.87
1.6	2.4	81.72	32.0	0.035	246.5	16.22
1.6	2.8	75.33	29.3	0.026	33.7	14.85

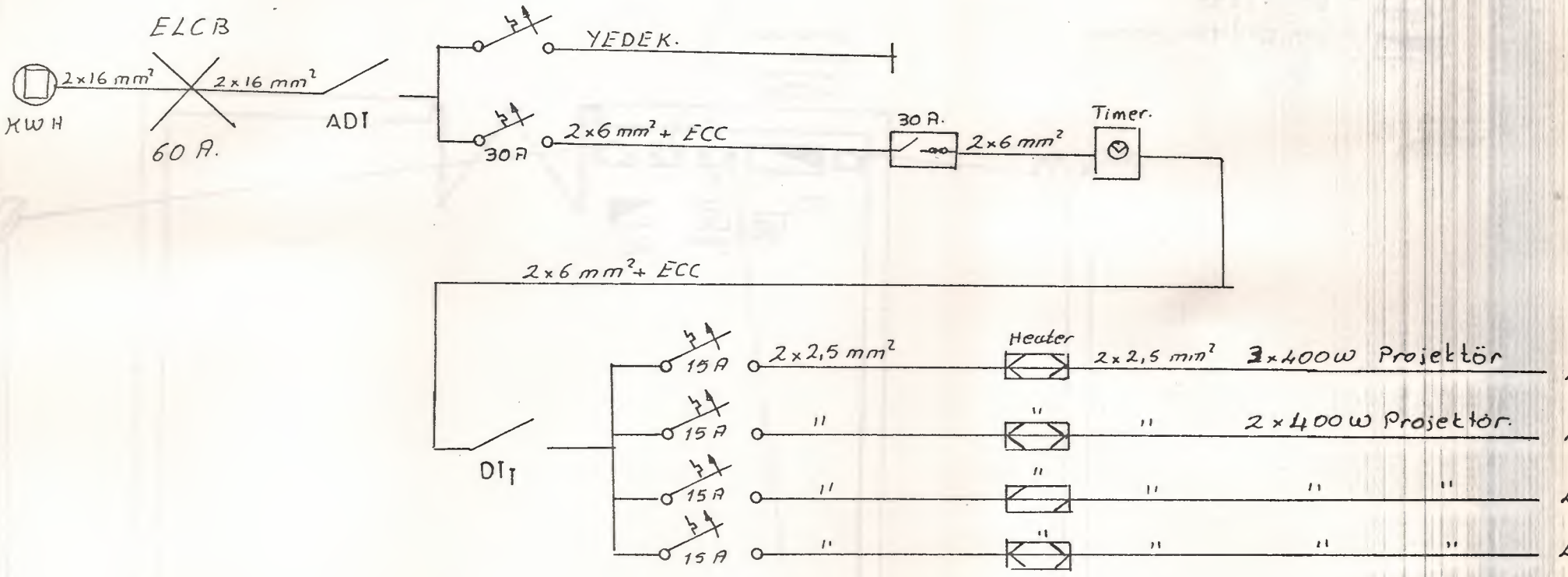
$X0' = 0 \quad Y0' = 1.56 \quad h = 5$

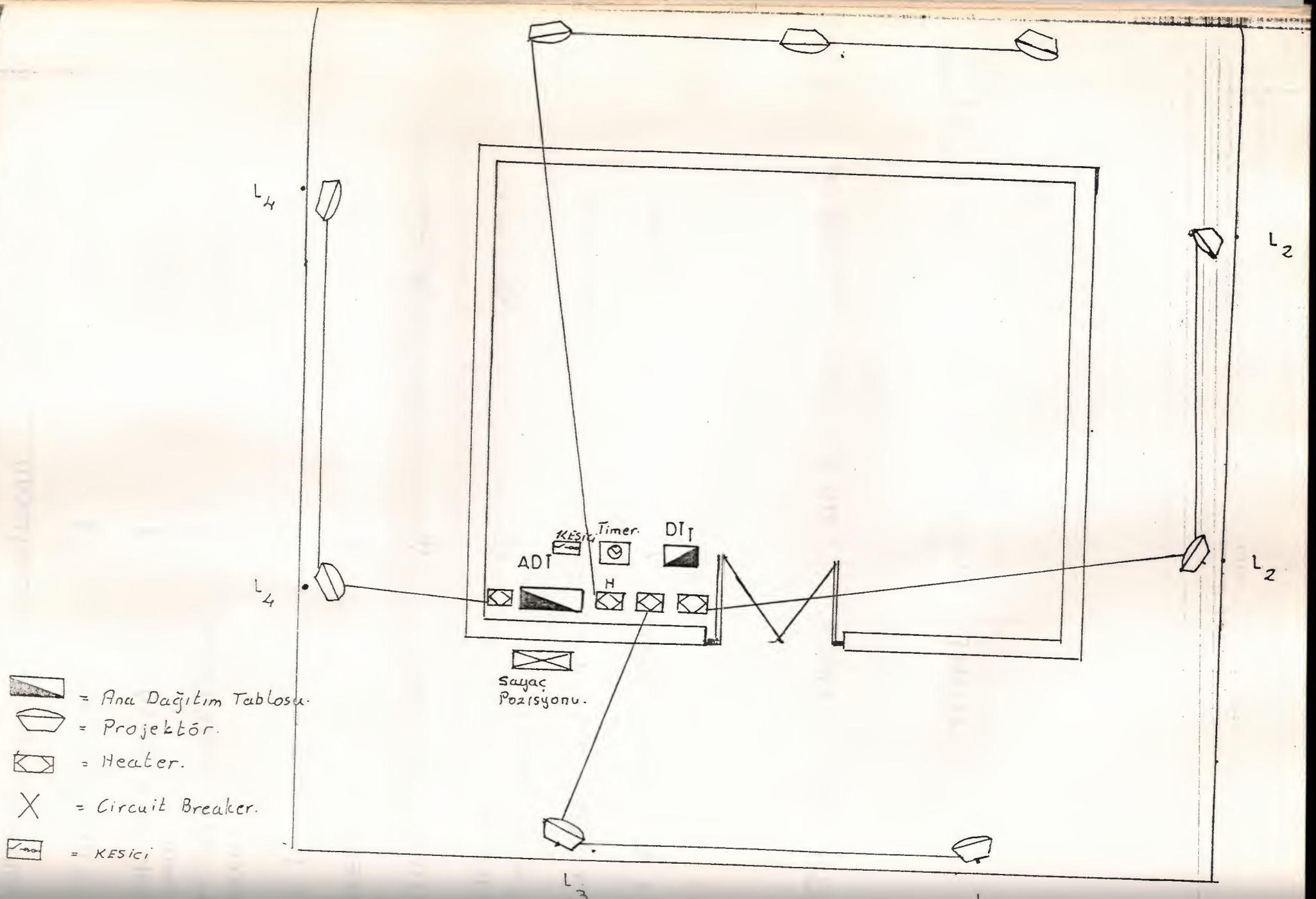
(SON-T 400W)

X′	Y′	C	γ	$\cos^3\theta$	I	E
-0.4	0.4	147.4	40.3	0.66	197.1	244.6
-0.4	0.8	135.7	25.3	0.414	412.0	320.7
-0.4	1.2	115.8	16.0	0.239	560.2	251.7
-0.4	1.6	86.9	12.0	0.14	584.4	153.8
-0.4	2.0	59.3	11.8	0.085	553.2	88.4
-0.4	2.4	41.4	13.3	0.055	520.4	27.6
-0.8	0.4	128.0	49.0	0.414	102.3	79.6
-0.8	0.8	117.1	36.5	0.29	231.7	126.3
-0.8	1.2	103.6	28.0	0.184	345.3	120.1
-0.8	1.6	88.5	23.0	0.116	448.7	97.9
-0.8	2.0	73.5	20.6	0.075	501.2	70.7
-0.8	2.4	60.6	19.7	0.05	505.4	47.5
-1.2	0.4	117.5	57.0	0.24	20.3	9.2
-1.2	0.8	109.0	46.3	0.185	123.1	42.8
-1.2	1.2	99.2	38.1	0.131	178.4	43.9
-1.2	1.6	89.0	32.5	0.089	235.1	39.3
-1.2	2.0	78.8	28.8	0.061	377.2	38.7
-1.2	2.4	69.4	26.6	0.043	385.1	31.1
-1.6	0.4	111.0	63.0	0.139	6.8	1.8
-1.6	0.8	104.4	53.7	0.116	41.3	9.0
-1.6	1.2	97.0	46.1	0.089	118.2	19.8
-1.6	1.6	89.2	40.3	0.066	169.2	21.0
-1.6	2.0	81.6	36.0	0.048	198.8	17.9
-1.6	2.4	74.0	33.0	0.035	284.1	18.7
-2.0	0.4	107.4	67.3	0.085	6.4	1.0
-2.0	0.8	101.6	59.3	0.075	12.1	1.7
-2.0	1.2	95.5	52.3	0.061	67.5	7.7
-2.0	1.6	89.4	46.7	0.048	120.2	10.9
-2.0	2.0	83.0	42.2	0.037	148.3	10.3


CEL'n VERİ
PEPSI
ÜLFET UÇAR

X′	Y′	C	γ	$\cos^3\theta$	I	E
-2.0	2.4	73.3	38.7	0.028	183.1	9.6
-2.4	0.4	104.6	70.5	0.055	5.9	0.6
-2.4	0.8	99.7	63.6	0.050	3.1	0.3
-2.4	1.2	94.6	57.3	0.043	20.5	1.7
-2.4	1.6	89.5	52.0	0.035	71.2	4.7
-2.4	2.0	84.3	47.3	0.028	109.2	5.7
-2.4	2.4	79.4	43.6	0.023	139.8	6.1
-2.8	0.4	102.6	73.0	0.037	5.8	0.4
-2.8	0.8	98.3	66.8	0.034	4.2	0.3
-2.8	1.2	94.0	61.0	0.03	7.4	0.4
-2.8	1.6	89.6	56.0	0.026	34.2	1.7
-2.8	2.0	85.2	51.7	0.022	78.1	3.2
-2.8	2.4	80.8	48.0	0.018	104.3	3.5
-3.2	0.4	101.1	75.0	0.026	4.9	0.2
-3.2	0.8	97.3	69.4	0.024	5.8	0.3
-3.2	1.2	93.5	64.2	0.022	5.1	0.2
-3.2	1.6	89.6	59.5	0.02	6.3	0.2
-3.2	2.0	85.8	55.3	0.017	39.8	1.3
-3.2	2.4	82.0	51.7	0.014	70.4	1.9
-3.6	0.4	100.0	76.5	0.019	4.6	0.16
-3.6	0.8	96.5	71.5	0.018	5.7	0.19
-3.6	1.2	93.1	66.7	0.017	5.8	0.19
-3.6	1.6	89.7	62.3	0.015	5.0	0.14
-3.6	2.0	86.3	58.4	0.013	12.1	0.3
-3.6	2.4	82.9	54.8	0.011	39.2	0.8


ELCB
2×16 mm²
2×16 mm²
KWH
60 A.
ADI
YEDEK.
30A
2×6 mm² + ECC
30 A.
2×6 mm²
Timer.
2×6 mm² + ECC
DI
15 A
2×2,5 mm²
Heater
2×2,5 mm²
3×400w Projektör
2×400w Projektör.


L4
L2
L4
L2
KESİCİ
Timer
DİT
ADİT
H
Sayaç
Pozisyonu.
L3
= Ana Dağıtım Tablosu.
= Projektör.
= Heater.
= Circuit Breaker.
= KESİCİ

COST OF THE PROJECT

ERIAL	NO/LENGTH	PRICE (TL)
UIT BREAKER	1	820,000
WAY DISTRIBUTION 3)	1	1,000,000
WAY DISTRIBUTION 3)	1	600,000
(CUTTER)	1	550,000
R	1	600,000
R SWITCH	4	600,000
TOR (400 W) T LAMP)	10	3000,000
2.5 mm^2 PVC	1	300,000
mm^2 PVC	1	150,000

T OF LABOR 40 % OF MATERIAL COST

TOTAL COST = 18,368,000 TL

CONCLUSTION

The most important aim of this project is to improve my knowledge about the outdoor illumination is relevant for my educational studies and the latest improvment in flood lighting calculations was used during the establishment.

I paid attention to some factors ,during the calculation of the flood lighting ,such as the selectionof the light source must sutisfy the illuminace needed , the color of light required , the area of the building , etc.... ,should be considered .

The light sources should be arranged so that illuminance must be sutisfied. The coefficient of regularity and reflection from walls of illuminated area will not effect the traffic or people who are working on the street

As aresult, this project is showing me how to organise things such that they lead to acceptable solutions .

APPENDIX

ED FORMULAS IN PROJECT

$$A = \tan^{-1}\left(\frac{Y' \sqrt{(1+XO'^2)}}{1+X'XO'}\right) - \tan^{-1}\left(\frac{YO'}{\sqrt{(1+XO'^2)}}\right)$$

$$\alpha = \cos^{-1}\left[\frac{1+X'XO'+Y'^2\left(\frac{1+XO'^2}{1+X'XO'}\right)}{\sqrt{\left((1+X'^2+Y'^2)\left(1+XO'^2+Y'^2\frac{(1+XO'^2)^2}{(1+X'XO')^2}\right)\right)}}\right]$$

$$B = \tan^{-1}\left(\tan\alpha \sqrt{(1+\tan^2 A)}\right)$$

$$\beta = \tan^{-1}\left[\frac{\tan A}{\sqrt{(1+\tan^2\alpha\,(1+\tan^2 A))}}\right]$$

$$C = \tan^{-1}\left[\frac{\tan\alpha \sqrt{(1+\tan^2 A)}}{\tan A}\right]$$

$$\gamma = \tan^{-1}\left(\sqrt{(\tan^2\alpha(1+\tan^2 A)+\tan^2 A)}\right)$$

$$\cos\theta = \frac{1}{(1+X'^2+Y'^2)^{1.5}}$$

PS LIGHTING B.V.	Computer Aided Lighting Design
ing Design and Engineering Centre	DATABASE 2.00 Spring 1990
ter Aided Lighting Design	Philips Lighting B.V.

aire (INR) number : 73

ring code : LVO 4147
aire type : HNF 003-W
type : SONT 400W

flux : 47.00 kLumen
f lamps per luminaire : 1
dissipation : 431.00 Watt

light output ratio : 67 %
ard light output ratio : 67 %

actor (Road lighting) : 0.00

	Lengthwise	Crosswise
um spacing/height ratio :	*	*

	Length	Width	H0	H90
aire sizes [mm] :	0	0	0	0

try code : 4

	N1	N2	N3	N4
luxcode [%] :	82	99	100	100

Date : 1990/06/07

PHILIPS LIGHTING B.V.
Lighting Design and Engineering Centre
Computer Aided Lighting Design

Computer Aided Lighting Design
DATABASE 2.00 Spring 1990
Philips Lighting B.V.

Luminaire (INR) number : 73

Measuring code : LVO 4147
Luminaire type : HNF 003-W
Lamp type : SONT 400W

I-Table *

	0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0
	+----------> C-plane										
0.0	612	612	612	612	612	612	612	612	612	612	612
2.5	602	599	600	601	602	603	604	606	608	610	608
5.0	586	586	588	589	590	587	589	589	592	597	592
7.5	564	565	565	565	564	566	569	574	577	583	577
10.0	530	533	533	536	539	546	556	567	574	583	574
12.5	509	507	508	510	515	526	549	573	585	597	585
15.0	480	485	480	477	480	520	548	572	587	597	586
17.5	453	457	450	450	471	511	537	552	560	566	560
20.0	426	426	423	427	462	496	507	503	507	510	507
22.5	407	401	399	410	444	468	456	456	457	455	457
25.0	379	383	381	402	416	417	414	408	399	400	399
27.5	343	350	355	387	388	381	376	369	346	341	346
30.0	303	306	324	359	362	344	336	316	293	297	293
32.5	267	284	292	325	328	300	290	274	248	234	248
35.0	211	221	254	285	287	273	252	233	206	196	206
37.5	164	170	214	237	246	233	217	201	181	179	181
40.0	123	133	168	194	206	196	182	175	171	163	171
42.5	86	89	127	153	170	166	154	153	151	147	151
45.0	58	69	89	119	139	141	134	130	128	130	129
47.5	45	49	63	90	113	110	113	116	108	110	108
50.0	32	37	49	70	91	99	98	82	87	90	87
52.5	20	25	35	56	70	82	100	45	66	89	66
55.0	12	16	20	41	49	60	72	10	45	37	45
57.5	9	10	10	21	33	44	21	9	22	19	22
60.0	6	8	7	10	13	12	7	7	11	5	11
62.5	4	5	4	5	3	3	5	7	4	5	4
65.0	2	3	4	2	3	3	5	7	2	6	2
67.5	2	2	3	3	2	2	4	6	7	6	7
70.0	1	2	2	2	2	4	4	6	6	5	6
72.5	1	1	2	2	1	2	3	5	6	5	6
75.0	1	1	1	1	1	2	3	4	5	3	5
77.5	1	1	1	1	1	1	2	3	4	2	4
80.0	0	0	0	0	1	1	1	2	2	1	2
82.5	0	0	0	0	0	0	1	1	1	0	1
85.0	0	0	0	0	0	0	0	0	0	0	0
87.5	0	0	0	0	0	0	0	0	0	0	0
90.0	0	0	0	0	0	0	0	0	0	0	0
	v										

IPS LIGHTING B.V.
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Computer Aided Lighting Design
DATABASE 2.00 Spring 1990
Philips Lighting B.V.

naire (INR) number : 73

uring code : LVO 4147
aire type : HNF 003-W
type : SONT 400W

able *

110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0	190.0	200.0	210.0	
											C-plane
612	612	612	612	612	612	612	612	612	612	612	
606	604	603	602	601	600	599	602	599	600	600	
589	589	587	590	589	588	586	586	586	589	589	
574	569	566	564	565	565	565	564	563	565	566	
567	556	546	539	536	533	533	530	532	533	536	
573	549	526	515	510	508	507	509	507	508	510	
672	648	620	489	477	480	485	480	485	480	477	
552	537	511	471	450	450	457	453	457	450	450	
503	507	496	462	427	423	426	426	426	423	427	
456	456	466	444	410	399	401	407	401	399	410	
408	414	417	416	402	381	383	379	383	381	402	
363	376	381	388	387	355	350	343	350	355	387	
316	336	344	362	359	324	306	303	300	324	360	
274	300	308	320	325	292	264	257	264	292	325	
233	252	273	287	285	254	221	211	221	254	286	
201	217	233	246	237	214	170	164	178	214	237	
175	182	196	208	194	168	133	123	133	168	194	
153	154	166	170	153	127	99	86	99	127	153	
130	134	141	139	119	89	69	56	69	89	110	
116	113	118	113	90	63	49	45	49	63	90	
92	99	99	91	70	49	37	32	37	40	70	
45	100	82	70	56	35	25	20	25	35	56	
10	72	68	49	41	20	16	12	16	20	41	
9	21	44	33	21	10	10	9	10	10	21	
7	7	12	13	10	7	8	6	8	7	10	
7	5	3	3	5	4	5	4	5	4	5	
7	5	3	3	2	4	3	2	3	4	2	
6	4	2	2	3	3	2	2	2	3	3	
6	4	2	2	2	2	2	1	2	2	2	
5	3	2	1	2	2	1	1	1	2	2	
4	3	2	1	1	1	1	1	1	1	1	
3	2	1	1	1	1	1	1	1	1	1	
2	1	1	1	0	0	0	0	0	0	0	
1	1	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	

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Computer Aided Lighting Design

Computer Aided Lighting Design
DATABASE 2.00 Spring 1990
Philips Lighting B.V.

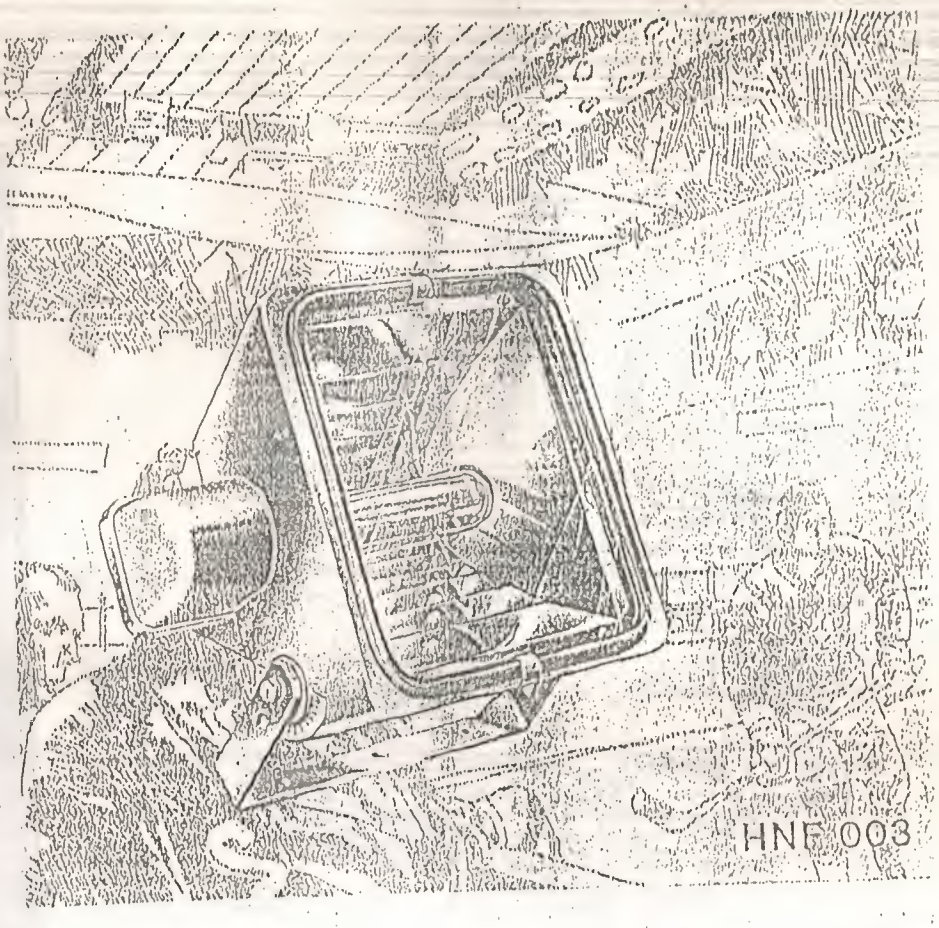
Luminaire (INR) number : 73

Measuring code : LVO 4.147
Luminaire type : HNF 003-W
Lamp type : SONT 400W

* I-Table *

gamma-angle	220.0	230.0	240.0	250.0	260.0	270.0	280.0	290.0	300.0	310.0	320.0
	↓										→ C-plane
0.0	612	612	612	612	612	612	612	612	612	612	612
2.5	602	603	604	606	608	610	608	606	604	603	602
5.0	590	587	588	588	592	597	592	589	589	587	590
7.5	564	566	569	574	577	583	577	574	569	566	564
10.0	539	546	556	567	574	583	574	567	559	546	539
12.5	515	526	549	573	585	597	585	573	549	526	515
15.0	489	520	548	572	586	597	586	572	548	520	489
17.5	471	511	537	552	560	568	560	552	537	511	471
20.0	462	496	507	509	507	510	507	509	507	496	462
22.5	444	466	456	456	457	458	457	456	456	466	444
25.0	416	417	414	400	399	400	399	400	414	417	416
27.5	388	381	376	363	348	344	346	363	376	381	388
30.0	362	344	336	316	293	287	293	316	336	344	362
32.5	328	308	290	274	248	239	248	274	290	308	328
35.0	287	273	252	233	206	196	206	233	252	273	287
37.5	246	233	217	201	181	172	181	201	217	233	246
40.0	206	196	182	175	171	163	171	175	182	196	206
42.5	170	166	154	153	151	146	151	153	154	166	170
45.0	139	141	134	130	129	130	129	130	134	141	139
47.5	113	118	119	116	100	111	100	116	113	118	113
50.0	91	99	98	92	87	90	87	92	98	99	91
52.5	70	82	100	45	66	69	66	46	100	82	70
55.0	49	60	72	10	45	48	45	10	72	60	49
57.5	33	44	21	9	22	10	22	9	21	44	33
60.0	13	12	7	7	11	5	11	7	7	12	13
62.5	3	3	5	7	4	5	4	7	5	3	3
65.0	3	3	5	7	2	5	2	7	5	3	3
67.5	2	2	4	6	7	6	7	6	4	2	2
70.0	2	2	4	6	6	5	6	6	4	2	2
72.5	1	2	3	5	6	5	6	5	3	2	1
75.0	1	2	3	4	5	4	5	4	3	2	1
77.5	1	1	2	3	4	2	4	3	2	1	1
80.0	1	1	1	2	2	1	2	2	1	1	1
82.5	0	0	1	1	1	0	1	1	1	0	0
85.0	0	0	0	0	0	0	0	0	0	0	0
87.5	0	0	0	0	0	0	0	0	0	0	0
90.0	0	0	0	0	0	0	0	0	0	0	0

e of the follow-
tal halide lamp
ercury vapour
or 400 W high-
lamp.



N

d rear cover: rugged all-cast aluminium construction
low copper-content for excellent corrosion-resis-
in coastal and industrial areas
versions, as different reflectors are available:

HPI/T 375 W and HP/T 400 W	SON/T 250 W	SON/T 400 W
2×7°	2×7°	2×7°
2×27°	2×27°	2×27°

aluminium reflectors for accurate beam control
acement is effected by removing the rear-cover, thus
servicing
erate stainless steel clips on rear-cover; to be closed
nd opened by using a simple tool. The floodlight can-
lly opened by unauthorized persons.

- Cast-on beam-aiming sight and protractor scale for quick daylight adjustment
- Ozone-resistant ethylene-propylene rubber gasket for jetproof and dustproof sealing of front glass; 2 extra safety clamps.

APPLICATIONS

- Sports grounds
- Floodlight of buildings
- Marshalling yards
- Car parks
- Skating rinks
- High-mast lighting
- Sports halls
- Shipyards

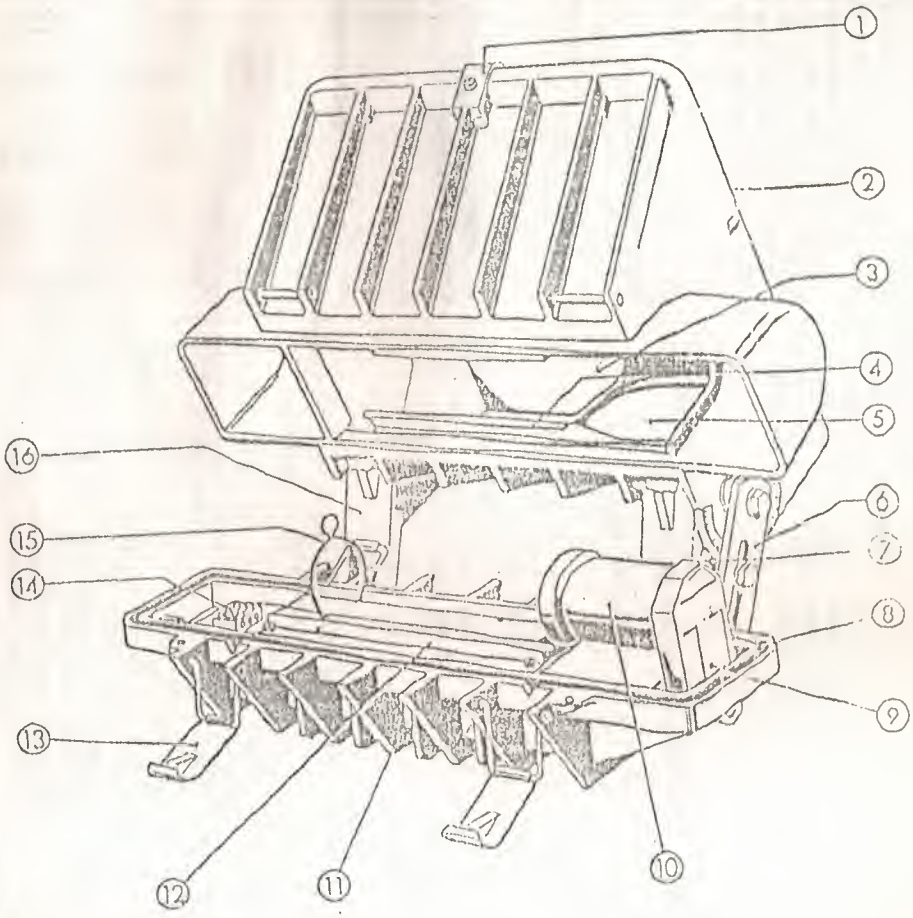
ORDERING DATA

Designation	For lamps	Ordering number*		Weight kg
		Narrow-beam type	Wide-beam type	
HNF 003	1× SON/T 250 W	9112 702 300..	9112 702 301..	9,10
	1× HP/T 400 W	9112 702 420..	9112 702 421..	9,10
	1× SON/T 400 W or 1× HPI/T 375 W	9112 702 422..	9112 702 423..	9,10

* Complete floodlight.

FLOODLIGHT FOR METAL HALIDE LAMPS, MERCURY VAPOUR LAMPS OR HIGH-PRESSURE SODIUM LAMPS

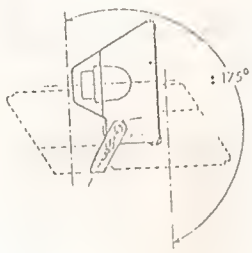
RAWING
s clamp (2×)
ss
reflector
ector (2×)
ront cover
lder insulating plate
lder
over
llector
clip top (2×)
ction block
support
clip bottom (2×)



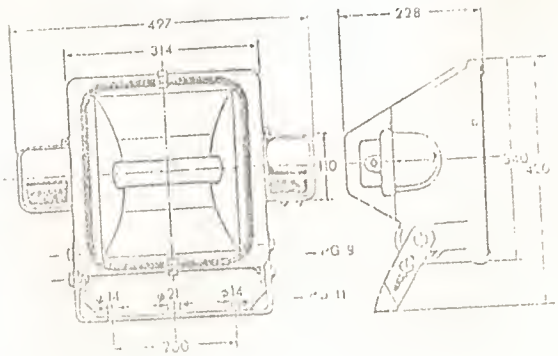
OOL

lass is provided with type of gasket. To e glass, a special ertion tool can be sisting of a handle with three removable clips to suit the different floodlights. Ordering number for complete set 9119 260 005 . .

ADJUSTMENT POSSIBILITIES



DIMENSIONS



HIGH PRESSURE SODIUM

Technical Data

1. Ambient Temperature

The light output of the lamp will not be adversely affected in the range −40°C to 100°C. However, in the design of luminaires the guide lines of IEC662 should be followed so that radiant heat rays from the lamp are not reflected by the luminaire optic back on to the arc tube.

2. Vibration

GEC Solarcolour lamps are designed to withstand conditions of severe vibration. In extreme cases, however, vertical cap-up is recommended.

3. Caps

GES (E40) ES (E27) Nickel plated brass.
R12.5s silver plated copper surrounded by a ceramic hood.

4. Outer bulbs

SON-E, SON-T 50W 70W, 120W	Soft glass
Remainder	Borosilicate glass
SON-L	Quartz

5. Hot Restrike time

(a) Lamps with electronic starter – 30-60 seconds

(b) Lamps with internal starter – 15-20 minutes

6. Run-up time[2]

80% Light output in 3 minutes.
100% Light output in 6 minutes.

Electrical Characteristics

Lamp Wattage	Minimum Nominal Supply Voltage[1]	Arc Tube Voltage ±	Arc Tube Starting Current[2]	Arc Tube Running Current	Lamp Watts
50	220	85 15	0.87	0.76	70
70	220	90 15	1.3	1.0	100
120	220	100 15	1.8	1.4	150
150	220	100 15	2.4	1.9	200
220	220	105 15	3.7	2.9	300
250	220	100 15	4.1	3.0	360
310/360 at 310	220	110 15	4.8	3.4	410
310/360 at 360	240	120 15	5.4	3.7	470
400	220	105 15	6.6	4.45	560
600	380	200 30	5.0	3.7	660
600	220	110 15	7.65	6.2	660
1000	380	200 30	7.5	5.7	1000
1000	220	110 15	13.0	10.3	1000

Percent change at 110% and 90% of Nominal Mains Voltage[3].

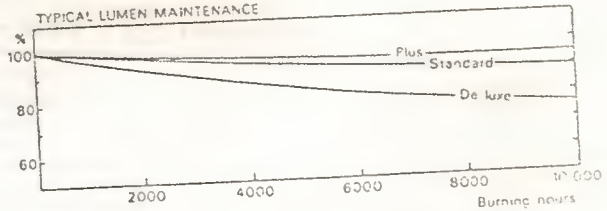
	110%	90%
Lumens	+18%	−26%
Arc current	+ 3%	− 4%
Arc voltage	+20%	−22%
Arc watts	+22%	−23%

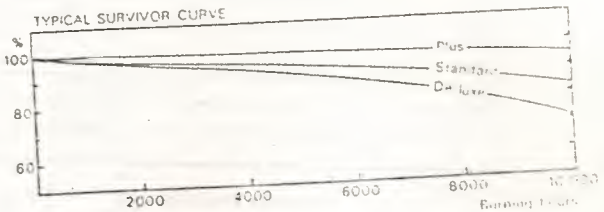
For maximum lamp and control gear life and efficacy the average supply voltage **during the hours of use** should be within ±5 volts of the rated voltage of the choke tapping.

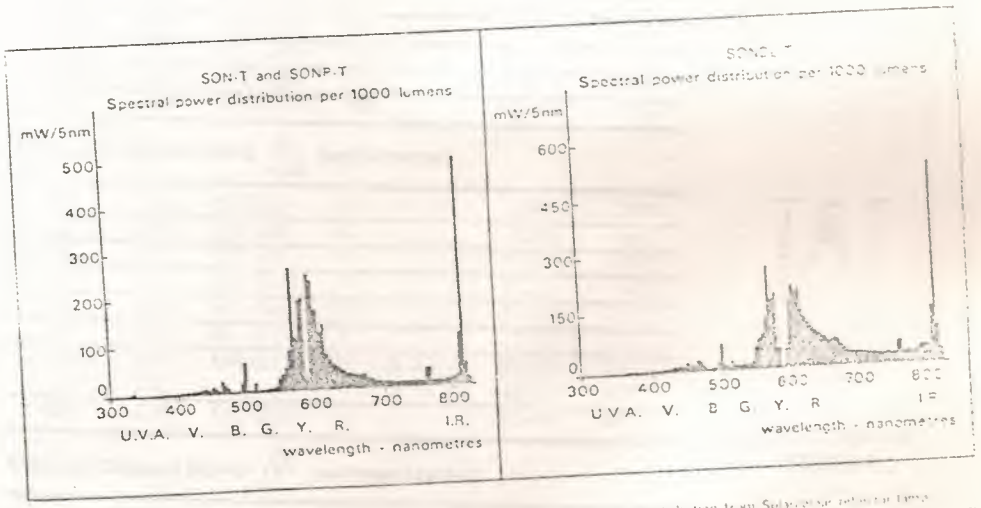
Extended periods of use when the supply voltage is more than 5% above the nominal may result in significant shortening of lamp and control gear life.

HIGH PRESSURE SODIUM

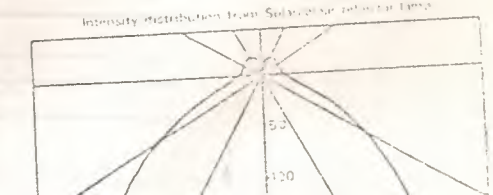
Technical Data







	Standard	Plus	De Luxe
Colour rendering Indices Ra	23	25	70
Chromaticity x	0.526	0.534	0.506



SOLARCOLOUR

High Pressure Sodium Lamps

HIGH PRESSURE SODIUM (SON)

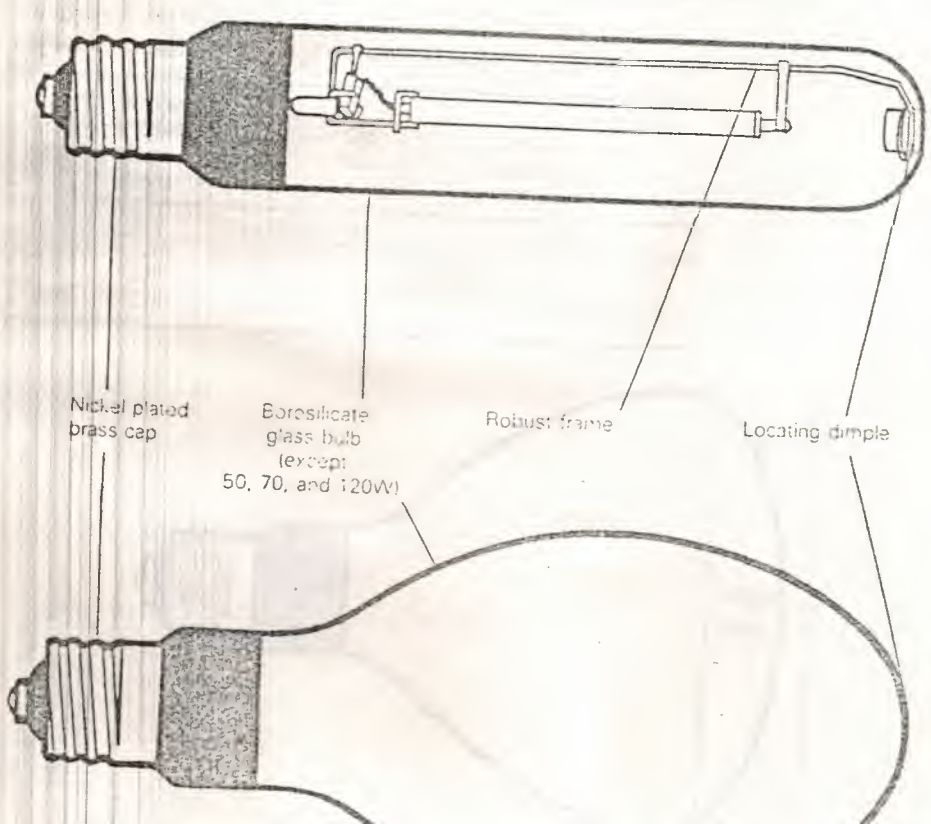
SOLARCOLOUR

The most extensive range of high pressure sodium lamps available from one manufacturer.

Solarcolour lamps are available in four shapes each with its own function, for use in specialised luminaires.

There are two colours (Standard and De Luxe). De Luxe for areas where better colour rendering is required, e.g. offices and shops etc.

The unique Plus range now not only offers between 10 to 20% more light than its standard equivalent, but maintains its light output better, and in addition Plus lamps last longer.



Clear Tubular SON-T (I) (with starter)

Watts	Minimum Nominal Supply Volts	Cap	Std Pack		Initial Lumens 100 hrs	Lighting Design Lumens 2000 hrs
120	220	E27 (ES)	10		10500	10000
150	220	E40 (GES)	10		16000	15200
250	220	E40 (GES)	10		29000	27500
310/360	220	E40 (GES)	10	@ 310W	37000	35500
	230			@ 360V	42500	41500
400	220	E40 (GES)	10		50000	48000
600	380	E40 (GES)	10		70000	65000
1000	380	E40 (GES)	4		135000	130000

Clear Tubular SON-T (E) (without starter)

150	220	E40 (GES)	10	16000	15200
250	220	E40 (GES)	10	29000	27500
400	220	E40 (GES)	10	50000	48000
600	220	E40 (GES)	10	74000	70000
1000	220	E40 (GES)	10	130000	125000

Elliptical Diffused SON-E (I) (with starter)

50	220	E27 (ES)	40		3500	3100
70	220	E27 (ES)	40		6000	5500
120	220	E27 (ES)	10		10500	10000
150	220	E40 (GES)	10		16000	15200
220	220	E40 (GES)	10		25000	24000
250	220	E40 (GES)	10		29000	27500
310/360	220	E40 (GES)	10	@ 310W	36000	34500
	230			@ 360V	42000	40000
400	220	E40 (GES)	10		49500	46500

Elliptical Diffused SON-E (E) (without starter)

150	220	E40 (GES)	10	16000	15200
250	220	E40 (GES)	10	29000	27500
400	220	E40 (GES)	10	49500	46500

(I) This international symbol which is marked on all Philips

SON-T, SONP-T, SONDL-T

	A	E	C
120	175	76	1
150	210	76	1
250	210	76	1
310/360	295	83	1
400	295	83	1
600	385	83	1
1000	400	83	1

SON-E, SONP-E, SONDL-E

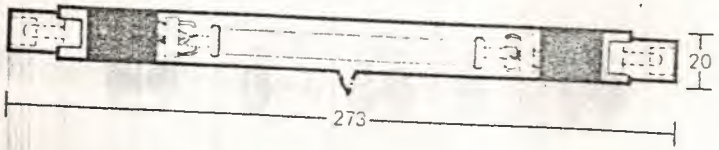
	A	E	C
50/70	155	76	1
120	175	76	1
150	210	76	1
220/250	295	83	1
310/400	295	83	1

SOLARCOLOUR

High Pressure Sodium Lamps

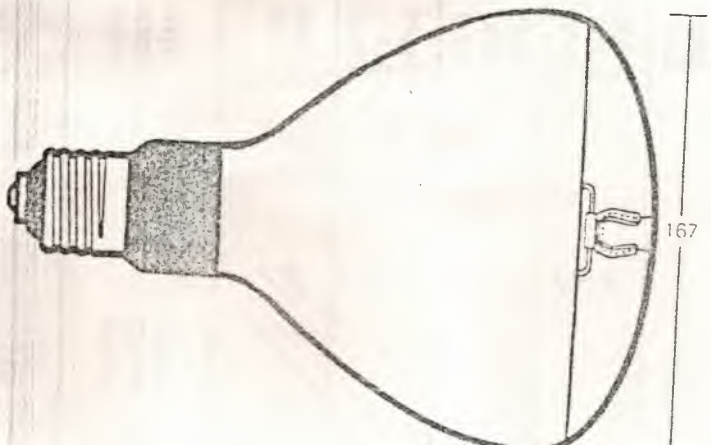
Double-ended Linear SON-L (E) (without starter)

Watts	Minimum Nominal Supply Volts	Cap	Std Pack	Initial Lumens 100 hrs	Lighting Design Lumens 2000 hrs
250	220	R12.5S	10	28000	26500
310	220	R12.5S	10	37000	35000
400	220	R12.5S	10	50000	47000



Reflector SON-R (I) (with starter)

Watts	Minimum Nominal Supply Volts	Cap	Std Pack		Initial Lumens 100 hrs	Lighting Design Lumens 2000 hrs
250	220	E40 (GES)	1		23000	21500
310/360	220	E40 (GES)	1	@ 310W	31500	29500
	230			@ 360W	37000	34000
400	220	E40 (GES)	1		42500	39000



High Pressure Sodium Lamps

SOLARCOLOUR

SOLARCOLOUR PLUS LAMPS

Between 10 and 20% fewer luminaires would be required when using Solarcolour Plus compared with standard high pressure sodium lamps of the same wattage. Longer life and improved lumen maintenance are also featured of these second generation SON lamps. Suitable external ignitors are required with Plus lamps.

Clear Tubular SONP-T (E) (without starter)

Watts	Minimum Nominal Supply Volts	Cap	Std Pack	Initial Lumens 100 hrs	Lighting Design Lumens 2000 hrs
150	220	E40 (GES)	10	17500	17000
250	220	E40 (GES)	10	33000	32000
310	220	E40 (GES)	10	41000	39000
400	220	E40 (GES)	10	54000	50000

Elliptical Diffused SONP-E (E) (without starter)

150	220	E40 (GES)	10	16500	16000
250	220	E40 (GES)	10	31500	30000
310	220	E40 (GES)	10	39000	37000
400	220	E40 (GES)	10	54000	50000

SOLARCOLOUR DE LUXE LAMPS

Improved colour rendering is the main benefit of De Luxe lamps. With increased arc tube pressure compared with standard lamps, some of the yellow radiation is converted towards the longer wavelengths of the spectrum.

Clear Tubular SONDL-T (E) (without starter)

Watts	Minimum Nominal Supply Volts	Cap	Std Pack	Initial Lumens 100 hrs	Lighting Design Lumens 2000 hrs
150	220	E40 (GES)	10	12500	11500
250	220	E40 (GES)	10	24000	22000
400	220	E40 (GES)	10	36000	33000

Elliptical Diffused SONDL-E (E) (without starter)

150	220	E40 (GES)	10	12500	11500
250	220	E40 (GES)	10	24000	22000

ARSENL TOWER RROI

DIMINTIONS ARE ALL IN METERS