EASTERN MEDITERRANEAN UNIVERSITY

ELECTRICAL AND ELECTRONICS ENGINEERING
DEPARTMENT

THE OUTDOOR ILLUMINATION OF THE CHURCH OF ST.GEORGE OF THE GREEKS

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INTRODUCTION

Now , more than ever before , artificial light , where light is an electromagnetic wave phenomenon , is an integral part of our every day world .

It is a prime determinant of our standard of living and apowerfull factor in the general and economic life of our society .

Illumination can be classified mainly into two parts :

a : Indoor Illumination

b : outdoor Illumination

Indoor illumination : which is a type of Illumination where inside of every kind of building is illuminated .

This type of illumination can be devided into , direct , semi - direct , mixed , semi - indirect and indirect illumination ; each type of them has its own used according to the characteristics of the place to be illuminated , for example semi - direct type of illumination is used in illuminating the drawing rooms inorder to avoid the formation of shadow , and the suitable light source is to be chosen to handle this particular case .

Outdoor Illumination :

Once we deal with outdoor illumination we shall introduce the **Flood lighting** , where the flood lit building is defined to be as a focal point in a town; where it is dark and colours are blurred.

In flood lighting we shall take into account that the building must be attractive after being illuminated , and inorder to achieve this lots of factors are to be studied such as the surrounding and the background of the building ,and the features of the facade under various conditions and with the sun light falling upon it at different angles inorder to decide which are the most attractive features.

The appearance of the building at night is to be taken into account , and if this is the case there must be a good cooperation between the lighting engineer and the architect ,inorder to avoid any risk of the architect's conception being misinterpreted .

CHAPTER ONE

Lighting UNITS and DEFINITION

Brightness(luminance) Symbol: B or L

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

Candela(abb :cd)

Unit of luminous intensity .Equal to 1/60 of the light intensity per cm^2 of the black body radiator at the solidifying temperature of platinum.

Colour rendering

The effect of a light source on the colour appearance of objects compared with their colour appearance under a reference light source .

General lighting

Lighting design to illuminate an area without provision for special local requirements.

Illumination:Symbol:E

The incident luminous flux per unit of area of surface.

Lumen(abbr:lm)

The amount of light flux contained (limitted) by a solid angle of one steradian(abbr:str) emitting light having 1 cd light intensity in all directions.

Solid angle

The ratio of the area intersected by a cone on a sphere of radius r to the square of the radius.

Lux (abbr:lx)

Unit of illuminance .The illumination produced on the surface of a sphere , having radius of one meter , by a uniform point source of one candela situated at its center.It corresponds to a flux density of one lumen per square meter.

Reflection factor

The ratio

$$= \frac{\text{lumens reflected from a surface}}{\text{lumens received by the surface}}$$

Luminous intensity. Symbol (I),Unit:candela
The quantity which descries the light-giving power of a source in any particular direction.If ϕ is the luminous flux emitted within a cone of very small angle ω ,having its apex at the source and its axis in the direction considered,the luminous intensity in this direction is equal to (ϕ/ω).

CHAPTER TWO

LIGHT SOURCES

Light sources can be classified into a three main types:

a.Filament Lamps

b.Discharge lamps

c.Electromagnetic Lamps(QL Induction Lighting)

2.1 Filament lamps

Filament lamps fall into a group of light-producing devices called 'incandescents '.They give light as a result of heating the filament to a very high temperature .Another name for this group of lamps is 'temperature radiator'.

2.2 Discharge lamps

The discharge lamp consists of a glass tube containing a gas . At each end of the tube there is an electrode .If a sufficiently high voltage is applied across these electrodes a discharge takes place between them.The gas now becomes an electrical conductor and light is produced .

The colour of the light produced by a discharge lamp depends on the gas in the tube . Neon - red ; mercury vapour - bluish white ; helium - ivory ; sodium vapour - yellow .

The discharge lamps can be categorized as follow :

a:low pressure sodium vapour lamps

b:high pressure sodium vapour lamps

c:low pressure mercury vapour lamps

d:high pressure mercury vapour lamps

2.2.a High Pressure Sodium Lamps

2.2.a.1 SON Lamp

SON lamps are high pressure sodium lamps , with sintered aluminum oxide discharged tube enclose in a void outer bulb coated with a diffusing layer .The result of the high pressure is that the light produced by SON lamps has a much wider spectrum of radiation . The difference in colour appearance is immediately visible : the light of high pressure sodium lamps can best be characterized as golden - white .

In the light of the high pressure lamps a certain colour distinction is possible .

The luminous efficacy is lower than that of low - pressure lamps. Their place in the range of HID lamps is between low - pressure sodium lamps and high - pressure mercury lamps.They have economic advantage of high efficacy , and importance is attached to a pleasant , warm colour impression.Examples are :road , and street lighting in built areas , shopping centers , parking lots and workshops in industry .

2.2.a.2. SON-T Lamps

SON - T lamps are the lamps which are used in this project.

SON - T lamps are a high pressure sodium lamps , with a sintered aluminum oxide discharge tube enclosed in a clear , tubular hard-glass outer bulb .The clear tubular outer bulb makes these light sources highly suitable for use with specially designed optical systems , they are successfully used for plant irradiation also .

2.2.a.3 SON-H Lamps

High pressure sodium lamps , with a sintered aluminum oxide discharge tube enclosed in an internally - coated hard - glass outer bulb .

A special integrated ignition aid enables these lamps to be used for direct replacement of mercury lamps in existing installations .The SON - H lamps are specially designed for the conversion of HPL - N installations .

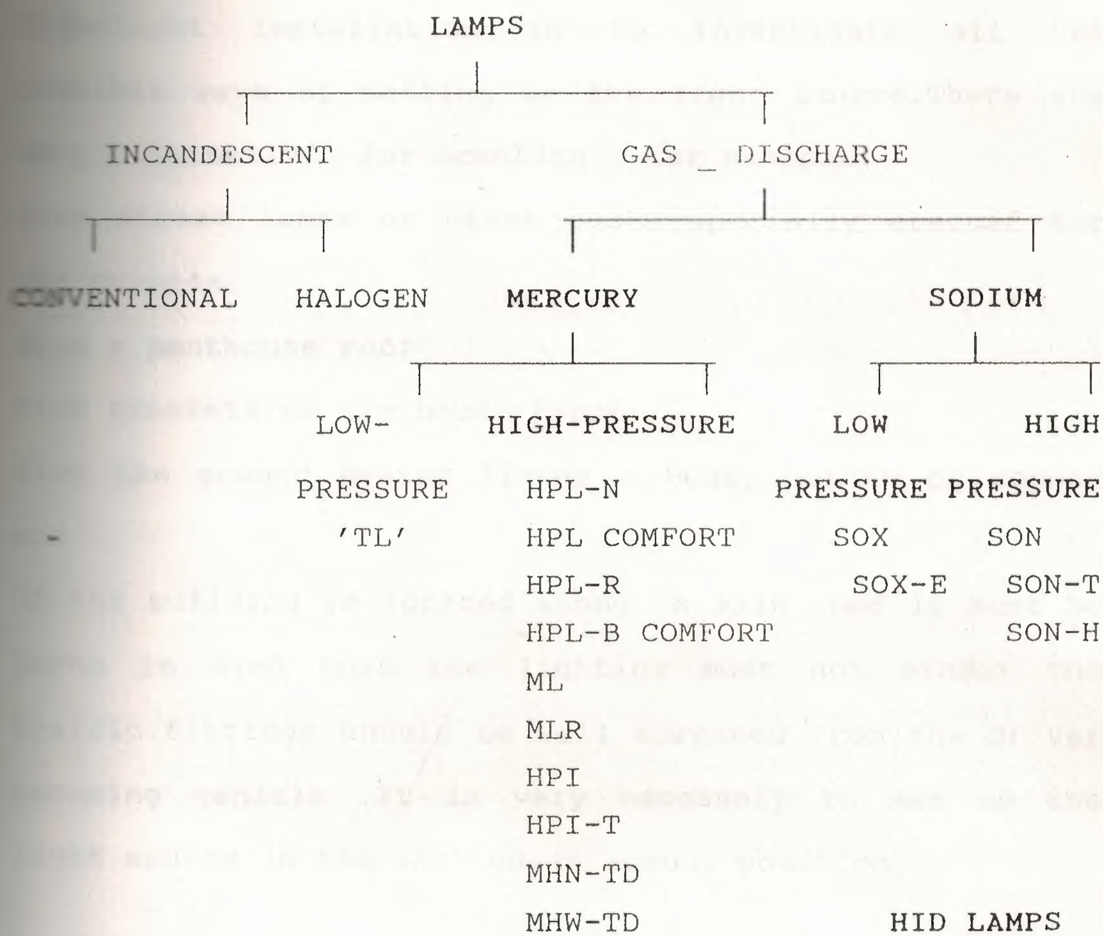
2.3 QL Induction Lighting

Induction lighting is based on the combination of two well-known principles , namely electromagnetic induction and the gas discharge as applied in tubular fluorescent lamps .

The QL induction system is fundamentally different from conventional incandescent and gas discharge lamps in that it has no filaments or electrodes.Instead a high frequency [2.65 MHz] energy flow is induced in a low pressure gas by means of an induction coil.

The lifetime of the lamp is determined largely by the electronic components in the power supply and control unit , resulting in a lifetime of 60000 hours .The first lamps in the new system will be coated with a tri-phosphor fluorescent powder and will be available in two 85 W , 5500 lumen version .The system offers an efficacy of 65 lm/W which compares favorably both with high-intensity discharge lamp systems such as the 125 W high-pressure mercury lamp's 6500 lumen , giving 47 lm/W, or the 70 W metal halide lamp's 5100 lumen ,yielding 60 lm/W , whose economic lifetime are 16000 and 6000 hours , respectively.The QL system is an attractive proposition for professional applications where access for relamping and maintenance is difficult or where safety hazards may be present, as for example in lobbies, tunnels, shoping malls etc.The long lifetime of QL system and the interesting architectural possibilities open new perspectives in lighting design.

The classification of the light sources can be shown in the following diagram:



The diagram drawn above shows the sub-division of the Family of Electric Light Sources.

2.4 Setting up the Light Sources

One of the most important points in designing a floodlight installation is to investigate all the possible ways of setting up the light source.There are many alternatives for mounting , for example:

a:on street lamps or other posts specially erected for the purpose.

b:on a penthouse roof

c:on brackets on the house front

d:on the ground behind flower - beds, bushes or copses etc .

If the building is located along a main road it must be borne in mind that the lighting must not hinder the traffic.Fittings should be well screened from the drivers oncoming vehicle .It is very necessary to set up the light source in the most advantageous position.

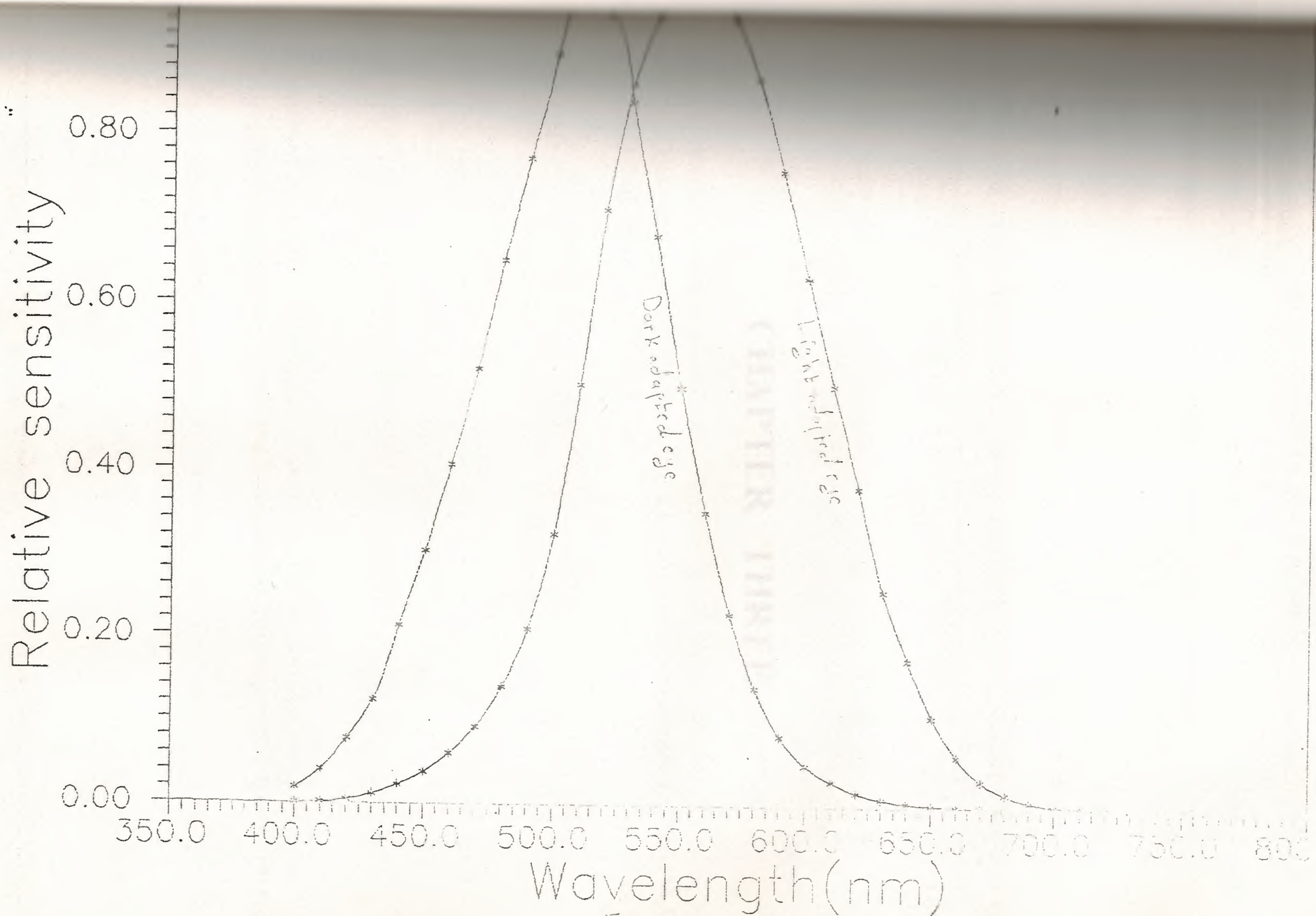
2.5 Colour

Colour is an important subjective phenomenon .What one is concerned is how the colour of the light source appears to the human eye ; that is to say whether it creates a cool , warm or intermidiate impression . So we have to study the sensitivity of the human eye corresponding to different colours , which appears very clearly in the Eye Sensitivity Curve which is shown in fig 2.1.

As it can be seen from fig 2.1 ,for the dark adapted eye the maximum sensitivity is shifted towards shorter wave length.This shift is called purkinje effect , and it results in bluish colour rendering .Purkinje effect has an important psychological applications too . Moon light has a most identical spectral distribution compared to that of sun light . In spite of that , as the light level is low in moon - light colour rendering is bluish and coolness of the night is psychologically associated to bluish colour rendering . So that , in practice ,bluish light is used in hot countries to creat a more fresh atmosphere while pinkish colours are preferred in lighting places in cold countries to create warmth impression .

It is always worthwhile to consider the question of the colour quality of a particular light source ;i.e.how a lamp denotes colours is referred to as its 'colour rendering'.

In addition the colour appearance of a lamp should be taken into account.


Relative sensitivity
0.00
0.20
0.40
0.60
0.80
350.0
400.0
450.0
500.0
550.0
600.0
650.0
700.0
750.0
Wavelength(nm)
Dark adapted eye
Light adapted eye
Fig. 2.1

CHAPTER THREE

CHOICE OF THE LEVEL OF ILLUMINATION

The lighting level needed on a facade to affect a certain brightness contrast depends upon such factors as :

1. The reflection factor of the surface building material , and the way the building surface material reflects the light , Table -3.1 shown below indicates the reflection factors of a number of different materials :

Material	State	Reflection Factor
White marble	fairly clean	0.60 - 0.65
Granite	fairly clean	0.10 - 0.15
Light concret.s	fairly clean	0.40 - 0.50
Dark concret	fairly clean	0.25
or stone	very dirty	0.05 - 0.10
Imitation con-crete paint	clean	0.50
White brick	clean	0.80
Yellow brick	new	0.35
Read brick	dirty	0.05

Table - 3.1

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

.the material of the facade

.the incident angle of the light

.the position of the observer in relation to the reflection material

The colour of the material is also an important factor . The colour of the surface material is accentuated if light of the same colour is used .

2. The location of the building in relation to its surroundings ,and the general brightness of these surroundings, in addition to the background of the building.

Obtaining a clear idea of the background against which the building will be seen is important. If the surroundings and background dark a relatively small amount of light is needed to make the building lighter than the background.

If there are other buildings in the close vicinity in which interrior lighting is left on at night , the lighted windows will give an even greater impression of brightness and therefore more light will be needed for floodlighting if it is to have an impact .

3. The dimensions of the building ,is also another factor which should be taken into account for determining the lighting level needed on a given facade .

In this project the illuminance level is chosen to be 50 lux ,and this value is obtained from Table 3 - 2 shown below ,because the type of the surface of the church is yellow brick , and the surrounding is poor lit .

In Table 3 - 2 shown below , some illuminance levels for various surface buildings in either poorly lit , well lit or brightly lit surroundings .

Type of the Surface	State	Illumination in Lux		
		poor lit surround	well lit surround	brigh lit.S
White marble	fairly clea	25	50	100
light Concrete	fairly clea	50	100	200
Imitatiom Concrete Paint	fairly clea	100	250	400
White Brick	fairly clea	20	40	80
Yellow Brick	fairly clea	50	100	200
White Granite	fairly clea	150	300	600
Concrete or Dark Stone	fairly clea	75	150	300
Red Brick	fairly clea	75	150	300
Concrete	very dirty	requires at least 150-300		
Red Brick	dirty	requires at least 150-300		

Table - 3.2

CHAPTER FOUR

LIGHT CALCULATION

The illumination which is recieved directly (i.e , without any reflection) from a single light source of negligible dimensions varies inversely as the square of the distance between the source and the surface being illuminated ; Fig 4.1 shown below is considered :

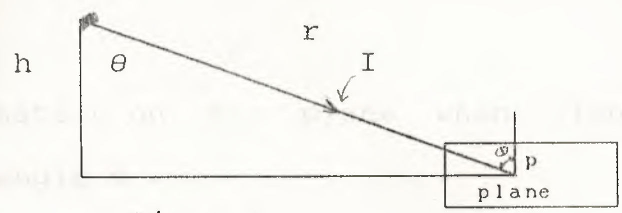


Fig 4.1

So the inverse square law is stated

$$E = \frac{I}{r^2} \text{ lux}$$

When light falls on to a surface from a light source of an angle , the illumination of the surface is less than when the light falls on to it perpendicularly.

The reduction factor is the cosine of the angle between the perpendicular and the direction of the light .

The cosine law is stated

$$E = \frac{I \cos \theta}{r^2}$$

$$E = \frac{\phi}{A} \text{ lux}$$

$$\phi = I \cdot \Omega$$

$$\Omega = \frac{A}{r^2}$$

$$E = \frac{I}{r^2}$$

$$\cos\theta = h / r$$

$$E = \frac{I \cdot \cos^3\theta}{h^2}$$

Where

E :illumination on any plane when light ray hits a plane at angle θ .

Ω : solid angle

I : intensity of light source in the direction of point p

r : distance from light source to point p .

h :vertical distance between horizontal plane and light source .

θ :angle between light ray and a perpendicular line through light .

Methods of Calculation

There are two possible ways of calculating types and numbers of floodlights needed to achieve the desired illumination ; the Direct method and the Lumen method .

4.1 .Lumen Method

This method consists in calculating the number of lumens to be directed on to a facade in order to obtain a certain illumination level .

The number of lumens can be calculated by means of the following formula :

$$\phi = \frac{A \cdot E}{\eta}$$

Where ϕ is the total number of lamp-lumens ,i.e the luminous flux produced by all lamps ;

A :the surface area of the facade to be illuminated in m^2

E : the desired illumination in lux on that facade

and

η is a factor which takes into account the efficiency of the fitting and the light losses (luminous efficiency).

The lumens produced by the lamps are concentrated by reflectors ,in which process some loss is involved .If the initial out put is 100% lamp lumens , 60 to 75% are projected through the lighting equipment and 40 to 25% are lost in the fitting itself through interreflection in the reflector and absorption by other parts of the fitting .

After the floodlight has been in operation for some time , a further percentage of the actual number of lamp lumens is lost because of the decrease in luminous flux due to the ageing of the lamp and dirt which collects on the lamp and fitting .

In practice an average utilization factor varying between 0.25 and 0.35 may be reckoned with . Using this figure in

The formula given above , the total luminous flux needed $= \phi_t$, can be calculated . Once the total number of lumens is known ; the number of fittings (N) needed can be calculated by deciding this amount by the number of lumens installed per fitting .

$$N = \frac{\phi_{total}}{\phi_{fitting}}$$

The calculation of the number of lamps used in eliminating The Church of the St.George of the Greeks are shown below :

The Church of St. George of the Greeks consists of four walls , and the area of each surface is calculated by multiplying the length with the height of each facade as follow:

$A_1 = 24 * 15 = 360\ m^2$

$A_2 = 42 * 15 = 630\ m^2$

$A_3 = 24 * 18 = 432\ m^2$

$A_4 = 42 * 15 = 630\ m^2$

where A_1 , A_2 , A_3 and A_4 are the areas of the facades of the church to be illuminated .

E is chosen , as shown in chapter 3 , to be 50 lux and the number of lumens of the SON - T lamp (400 W) is 47,000 lm.

For facade no 1:

$$\phi_1 = \frac{A_1 . E}{\eta}$$

η is equal to 0.75

Hence , $\phi_1 = \frac{360 * 50}{0.75} = 24,000$ lm

$N_1 = \frac{24,000}{47,000} = 0.5100 \cong 1$ tube

Fore facade no 2:

$\phi_2 = \frac{A_2 . E}{\eta}$

$= \frac{630 * 50}{0.75} = 42,000$ lm

$N_2 = \frac{42,000}{47,000} = 0.89 \cong 1$ tube

but , since facade no 2 is large ,and inorder to have regular lighting we shall replace the 1x400 W SON - T lamp ,for facade no 2 , by 2x250 W SON - T lamp . And the same is applied for facade no 4 since they are equal.

For facade no 3

$\phi_3 = \frac{A_3 . E}{\eta}$

$= \frac{432 * 50}{0.75} = 28,800$ lm

$N_3 = \frac{28,800}{47,000} = 0.61 \cong 1$ tube

Total number of lamps used in this project is

4x250 W SON - T lamp and 2x400 W SON - T lamp .

4.1. Direct Method (Luminous Intensity Method)

In this method the starting point is the luminous intensity , in candela , radiated by a light source in a particular direction .

The illuminance is defined to be

$$E = \frac{I(c,\gamma)\ \cos^3\theta}{h^2}$$

As we see from the expression of E , the light intensity is a function of c and γ angles ,which are shown in fig 4 .2 below :

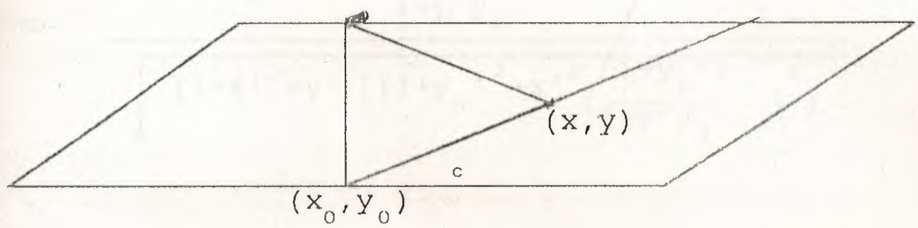


Fig 4.2

where c and γ angles are dependent of x' , y' and x_0' , y_0' , where $x' = \frac{x}{h}$, $y' = \frac{y}{h}$, $x_0' = \frac{x_0}{h}$ and $y_0' = \frac{y_0}{h}$

and (x,y) :represents the coordinates of the point at which the calculation of the illuminance is required .

(x_0, y_0): represents the coordinates of the point at which the projector axis intercept the plane which it will illuminate .

hence ,
$$E = \frac{I(c,\ \gamma)\ \cos^3\theta}{h^2}$$

γ and c angles are found , in terms of x', y' , x_0' and y_0' , to be as follow :

$$\gamma = \tan^{-1} \sqrt{\tan^2\beta(1+\tan^2 B)\ +\tan^2 B}$$

where ;

$$\beta = \cos^{-1} \frac{1+y'y_0'+x'^2\ \dfrac{1+y_0'^2}{1+y'y_0'}}{\sqrt{(1+x'^2+y'^2)(1+y_0'^2+x'^2\left(\dfrac{1+y_0'^2}{1+y'y_0'}\right)^2)}}$$

$$= \frac{x'\sqrt{1+y_0'^2}}{1+y'y_0'} - \tan^{-1}\frac{x_0'}{\sqrt{1+y_0}}$$

$$= \left[\frac{\tan\beta\sqrt{1+\tan^2 B}}{\tan B}\right]$$

$$\cos^3\theta = \frac{1}{(1+x'^2+y'^2)^{3/2}}$$

I exists in a ready matrix for a given c and γ, for each type of light sources.

So all these parameters $I(c,\gamma)$, $\cos\theta$ and h are taken and placed in the illuminance equation

$$E = \frac{I(c,\gamma)\cos^3\theta}{h^2}$$

where ;

E : is the illuminance on the facade

I : is the luminous intensity t the angle θ

h : is the light of the object above the level on which the fittings are arranged or (the distance between the projector and the surface which is to be illuminated.

θ: is the angle , at which the light beam strikes normal to the plane to be illuminated .

A computer program is prepared to calculate both C and γ ,then goes to the given matrix ,which is related to the SON - T lamp , to find the given light intensity $I(c,\gamma)$ per klm ,then it calculates the illuminance at any point (x,y) , the formula

$$E = \frac{I(c,\gamma)\cos^3\theta}{h^2} \quad \text{lux / klm}$$

```
mohd;

y,yo,xx,yy,yyo,xxo,h,a,b,c,gm,cm,t,e,k1,bb,bbo,zz,dd,cct,gmm:real;
icm,igm,icmr,igmr,temp:integer;
r,tabv,tabv1,tabv2:real;
array[0..36,0..36] of real;

tan(si:real):real;

=sin(si)/cos(si);



f,'pm.dat');
f);
' enter x,y,xo,y0,h : ');
(x,y,xo,yo,h);
(xo/h);
(yo/h);
h;
h;
ctan((xx*sqrt(1+(yyo*yyo)))/(1+(yy*yyo)))-arctan(xxo/sqrt(1+(yyo*yyo)

1+(yy*yyo)+(xx*xx)*((1+yyo*yyo)/(1+(yy*yyo))));
sqrt((1+xx*xx+yy*yy)*(1+yyo*yyo+xx*xx * sqr((1+yyo*yyo)/(1+yy*yyo))));
=bb/dd;
sqrt(sqr(dd)-sqr(bb));
ctan(zz/bb);
ctan((tan(b)*sqrt(1+sqr(tan(a))))/tan(a));
c>=0) and (c < pi/2) then
=2*pi-c
se if ( (c>=pi) and (c<3*pi/2)) or ((c>-pi) and (c<= (-pi/2))) then
 c:=c+pi
 else if ((c>=3*pi/2) and (c<2*pi)) or ((c>-pi/2) and (c<0)) then
   c:=pi-c;
arctan(sqrt((sqr(tan(b)))*(1+sqr(tan(a)))+sqr(tan(a))));
=sqrt(sqr(1+sqr(xx)+sqr(yy))*(1+sqr(xx)+sqr(yy)));
=180*gm/pi;
80*c/pi;
eln(gm);
eln(c);
=round(gm)*10 div 25;
=round(gm)*10 mod 25;
:=igmr/10;
=round(c) div 10;
=round(c) mod 10;
i:=0 to 36 do
r j:=0 to 36 do
 readln(f,mat[i,j]);
icmr=0) and (igmr=0) then
tabv:=mat[igm,icm]
e if (icmr=0) and (igmr<> 0) then
in
```

```
igmr1*mat[igm+1,icm];
(2.5-igmr1)*mat[igm,icm];
:=(a+b)/(igmr1+(2.5-igmr1));

if (icmr <> 0) and (igmr =0) then

(10-icmr)*mat[igm,icm];
icmr*mat[igm,icm+1];
:=mat[igm,icm]+(a+b)/((10-icmr)+icmr);

if (icmr<> 0) and (igmr<> 0) then

igmr1*mat[igm+1,icm];
(2.5-igmr1)*mat[igm,icm];
1:=(a+b)/(igmr1+(2.5-igmr1));
:=icm+1;
igmr1*mat[igm+1,temp];
(2.5-igmr1)*mat[igm,temp];
2:=(a+b)/(igmr1+(2.5-igmr1));
(10-icmr)*tabv1;
icmr*tabv2;
:=tabv1+(a+b)/(10-icmr)+icmr;

ln('tabular value = ',tabv);
1/((1+sqr(xx)+sqr(yy))*sqrt(1+sqr(xx)+sqr(yy)));
tabv*cct*47/sqr(h);
ln('E=',e);
```

THE RESULTS OF THE COMPUTER PROGRAM

(x_0, y_0) : (12,0) SON-T 250

h : 15

x	y	γ	c	E
0	0	38.6	360	16.7
0	2	39.2	192	40.97
0	4	41	203	41.5
0	8	46.4	220.4	10.6
0	10	49.5	226.8	31.5
0	12	52.4	232	10.3
2	-2	31.9	194.3	85.1
2	-4	34	207.1	131.7
2	-6	37.2	217.5	142.5
2	-8	40.7	225.6	53.7
2	-10	44.4	232	23
2	-12	47.8	236.9	27.7
4	0	23.7	360	42.3
4	2	24.8	197.9	80.7
4	4	27.6	212.6	91.4
4	6	31.4	223.8	81
4	8	35.5	232	43.8
4	10	39.7	238	24.5
4	12	43.6	242.5	17.2
6	0	16.8	360	44
6	-2	18.2	203.1	101.7
6	-4	21.7	220.7	39.7
6	-8	30.9	239.6	22.0
6	-10	35.5	244.9	41.4
6	-12	39.8	248.7	17.8
8	0	10.6	360	43.4

8	4	16.9	232	88.4
8	6	22	242.5	69.5
8	10	32.1	252.7	35.8
8	12	36.6	255.4	27.1
10	-2	8	232	86
10	-4	13.4	248.7	88
10	-6	19	255.4	86.2
10	-10	29.4	261.1	30.7
10	-12	33.9	262.6	21.5
14	0	4.3	360	27.8
14	2	7	308	158.8
14	6	16.9	284.5	70.1
14	8	21.7	281	37.4
14	10	26.3	278.9	141.8
14	12	30.6	277.4	35.7
16	0	8.1	360	21.4
16	-2	9.7	327.4	40.8

16	-4	13.2	308	117.1
16	-6	17.3	297.5	113
16	-8	21.6	291.3	31.3
16	-10	25.8	287.3	48.4
16	-12	29.7	284.6	15.5
18	0	11.5	360	16.2
18	2	12.5	336.9	68.1
18	4	15	315.9	16.7
18	6	18.3	307	88.8
18	8	22	300.4	12.4
18	10	25.7	295.1	83.8
18	12	29.3	291.3	15.8

$(x_0, y_0) = (9,0)$ SON-T 150

$h = 9$

X	Y	γ	C	E
0	0	42	360	25.2
0	2	43.2	196.7	120
0	4	46.4	210.9	49.7
0	6	50.4	221.9	31.3
0	8	54.5	230	18.7
0	10	58.3	236	18.9
0	12	61.6	240.8	8.9
0	14	64.4	244.4	13.3
0	16	66.8	247.3	23
0	18	68.8	249.6	16.8
0	21	71.4	252.3	21.9
2	-2	34.4	210	67.7
2	-4	36.8	217.6	105.3
2	-6	42.2	229.1	105.1
2	-8	47.5	237	65.1
2	-10	52.1	242.5	76.1
2	-12	65.2	246.6	92
2	-14	59.6	249.6	36
2	-16	62.5	252	68
4	0	20.2	360	92
4	2	22.7	208.3	169
4	4	28.4	227.1	140.6
4	6	34.9	238.2	76
4	10	55.1	255.1	64.9
6	0	11	360	89.6
6	-2	14.7	221.9	160.4
	4	21.8	240.1	135.8

6	-12	46.8	259.5	72.4
6	-18	57.7	263	59.6
8	0	3.33	360	77
8	2	13.6	256	152
8	6	25.3	262.9	76.2
8	10	38.1	256.7	39
8	12	43.2	266.4	25.6
8	16	51.4	276.5	17.6
8	21	58.6	267.9	14
12	0	8.2	360	39.9
12	-2	10.9	318.1	49.6
12	-4	16.5	299.1	65.7
12	-8	28.2	285.6	60.3
12	-14	42.5	279	47.2
12	-18	49.6	277.1	35.6
12	-21	53.8	276.1	29.9
15	0	14.3	360	26.6
15	2	15.6	335.8	76.7
15	4	18.9	318.1	123.2
15	6	23.2	306.6	136.1
15	16	43.6	285.6	19.5
15	18	46.7	284	15
15	21	50.9	281.9	8.4

CHAPTER FIVE

INSTALLATION

One of the first steps in the design of the installation is to classify the installation under a type heading .To do this successfully requires a knowledge of the building and particularly whether it is intended for short - or long - term occupation .

A building which is designed to last no more than five years would not justify an expensive installation with a normal life of 20 years . However ; if the building included a hazardous area , the necessary extra expense in meeting safety requirements would be the over riding consideration rather than cost.

In the design of installation , two main and important items should be taken into account :

a . Diversity factor

b .Voltage drop

5.1. Diversity Factor

Diversity factor is an important element in the design of an installation and its final costing .

Diversity factor is a factor which is applied to sub-mains and mains cables and their associated swichgear to reduce (i) the c.s.a of the cable conductors and (ii)the capacity of the switchgear

The factor is based on the assumption that the whole of the connected load will not be on at the same time .
One of the IEE Regulation indicates that a factor for diversity shall not be allowed for when calculating the the size of circuit conductors and switchgear of final subcircuits. The provision of an allowance for diversity is a matter which calls for special knowledge and experience .
In the case of lighting for each type of installation it will be noticed that the more the total lighting load is likely to be switched on over definite periods , the smaller is the allowance made for diversity . In a domestic installation , it is estimated that some two - thirds of lighting load will be on at any one time .The diversity factor for this project is 1 .

5.2 Voltage Drop

The size of every bare conductor or cable conductor shall be such that the drop in voltage from consumer's terminals to any point in the installation does not exceed 2.5 percent of the declared or nominal voltage when the conductors are carrying the full - load current ,but disregarding starting condition . This requirement shall not apply to wiring fed to extra - low voltage secondary of a transformer .

Thus for a given load , the final factor which will govern the value of voltage drop in the load circuit is the total length involved .However , the voltage drop figure obtained can also be modified by other factors which are related to the type of cable , the conditions of installation , the ambient temperature , and the class for excess - current protection , among other things .

The two main rating factors used are related to the ambient temperature of the surrounding medium in which a cable is installed , and the class of excess - current protection .

The temperature factor is important because an increase in temperature of a conductor will result in increase in its resistance . Thus , the increased I^2R watts loss in the cable will cause a further increase in temperature .

This cumulative effect is minimized by reducing the current rating of the cable .Certain types of installation may be damaged when they are subjected to high temperatures , well above the limits stipulated for continuous operation .

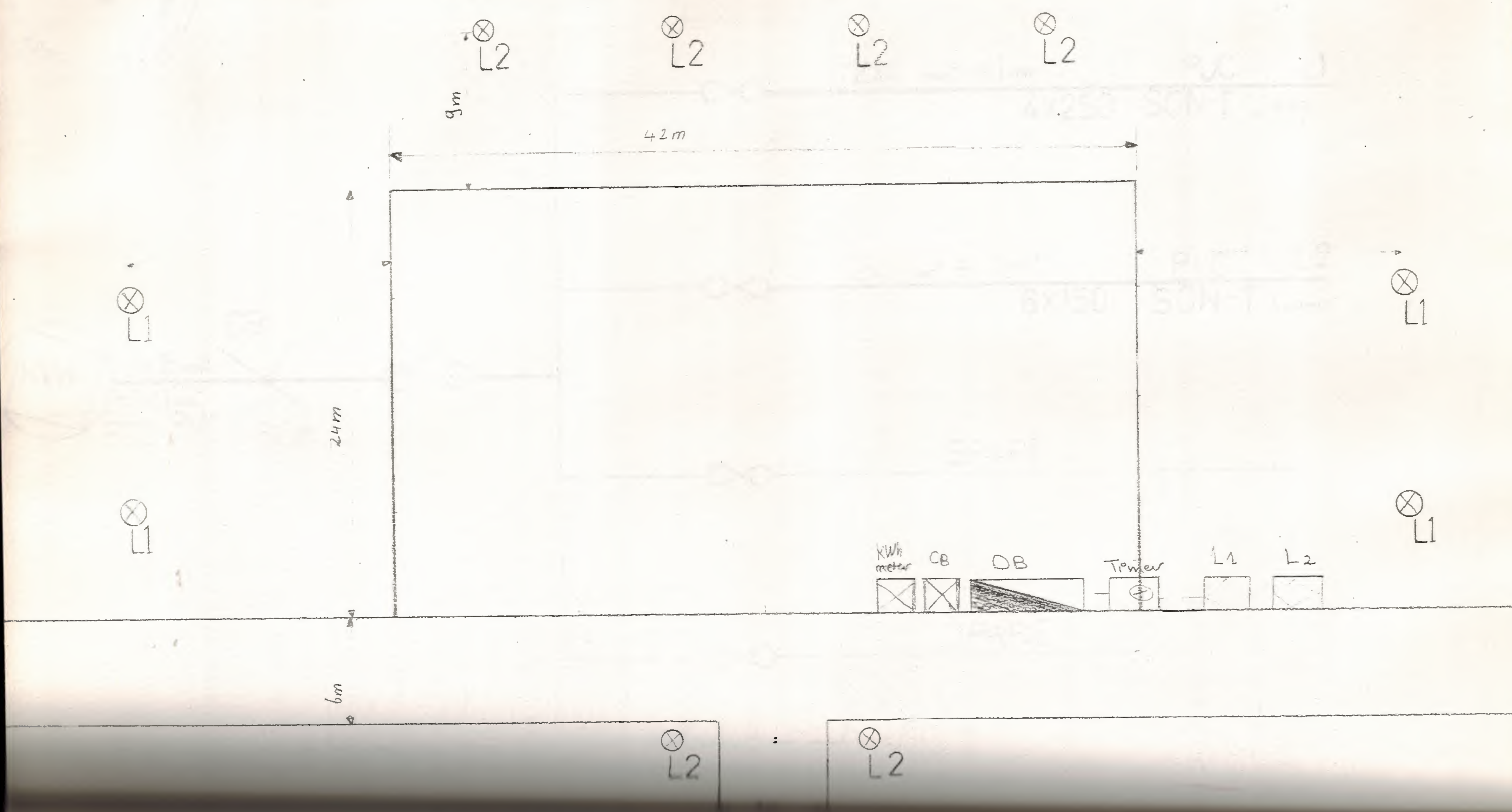
Close excess- current protection is provided by fuses and circuit-breakers which operate within a period of 4 hours when carrying 1.5 times the current rating of the circuit to be protected .

When several cables are run in one conduit , an increase in temperature can arise ,each cable , while it carries current, adding its own quota of heat to the whole . The disposition of the cables must also be taken into account.

5.3 . **Circuit for Discharge Lamps**

One of the main requirements is a consideration of the 'rating' of a discharge lamp outlet , for it has a rather different meaning from that used for other lighting points . The reason for this is that , owing to the losses in the lamp control gear plus the low power factor , it is necessary to multiply the rated lamp watts by a factor of 1.8 and divide the product of the lamp - rated voltage to obtain the actual current flowing in the circuit . This factor also takes into account consideration harmonic currents in the circuit . It indicated that certain switches may not be suitable for controlling highly inductive circuits associated with discharge lighting . If a switch is not specifically designed to break an inductive load , it should have a current rating of not less than twice the total steady current which it is required to carry .

ELECTRICAL INSTALLATION PLAN



LIST of MATERIAL USED

MATERIAL	COST(TL)
4x250 SON-T + 4xHNF 003-w	8,400,000
6x150 SON-T + 6xHNF 003-w	11,400,000
KWh meter	600,000
Circuit Breaker	1,350,00
Cables	12,600,000
Total material cost	34,350,000
Labour cost 40% material cost	13,740,000
Total cost of the Project	48,090,000

CONCLUSION

In conclusion ; I would like to give some more informations and explanations about the floodlighting , its applications, advantages and purposes. Floodlighting is the lighting of the whole of a scene or object to a level considerably greater than that of its surrounding . In designing an installation of floodlighting for a building , the all - important consideration is the final appearance of the building as a whole as seen by the majority of observers . The object must be to make a picture which will have the right impact on the passer-by.

The subject for floodlighting may be of a purely commercial character or it may be an ancient monument whose beauties it is hoped to reveal by night as well as by day . In either case the type of light chosen and the colours , must be carefully planned to give a designed result .

Area floodlighting ; i.e .football grounds ; the system using four towers is frequently used , now a days , in illuminating first class grounds.

This system gives minimum glare to spectators and also to the players, because there is no glare kick or throw-in can be taken without fear oi a player being dazzled as the ball passes between him and the lights . The only disadvantage of the system is the high first cost .

The provision of safety and working light for building sites is another application of floodlighting .

A specialized use of floodlights which is becoming more important in the modern world is known as security floodlighting .

Basically such lighting is arranged to cause as much glare as possible to persons approaching the prohibited area .

APPENDIX

THE CHURCH OF ST.GEORGE OF THE GREEKS

In the 14th C ,when the Latin Civil and religious authorities adopted a less rigorous attitude towards the Greeks , and after the Greek merchants of Famagusta had become prosperous , a Greek Orthodox cathedral in the Gothic style was built on the edge of the Greek quarter ; it was dedicated to St.George. Veneration for this ancient sanctuary prevented its demolition ; all that was done to restore it and to incorporate its north wall in the wall of the southern aisle of the new cathedral, turning it into a chapel .

Unfortunately , there is no documentary evidence for the foundation date of the church of St.George.The church recorded under that name in which were buiried the Genoese victims of the riots that broke out at Peter II's coronation. There is a possibility that this building was abondoned after 1571 ; it had suffered saverely from the fire of the battery established by the turks on the rock to the south - east of the harbour. Because St.George of the Greeks can be dated as SS Peter and Paul , which is from 1360 to 1370 , so the building may have been erected one decade later .

Today it is more than half ruined ; it consists of a nave of five bays , ending in an apse almost as wide and of the same height , and two aisles , without buttresses , ending in apisal chaple..

The nave and the aisles had ribbed vaults and pointed arcades decorated with mouldings ; they were carried on massive circular piers in the shape of columns .

The interior of the church of St.George is covered with paintings accompanied by inscriptions in greek .The paintings decoration is later than the construction work ,it was probably done in the 16thC .The character of the paintings is clearly Italian .

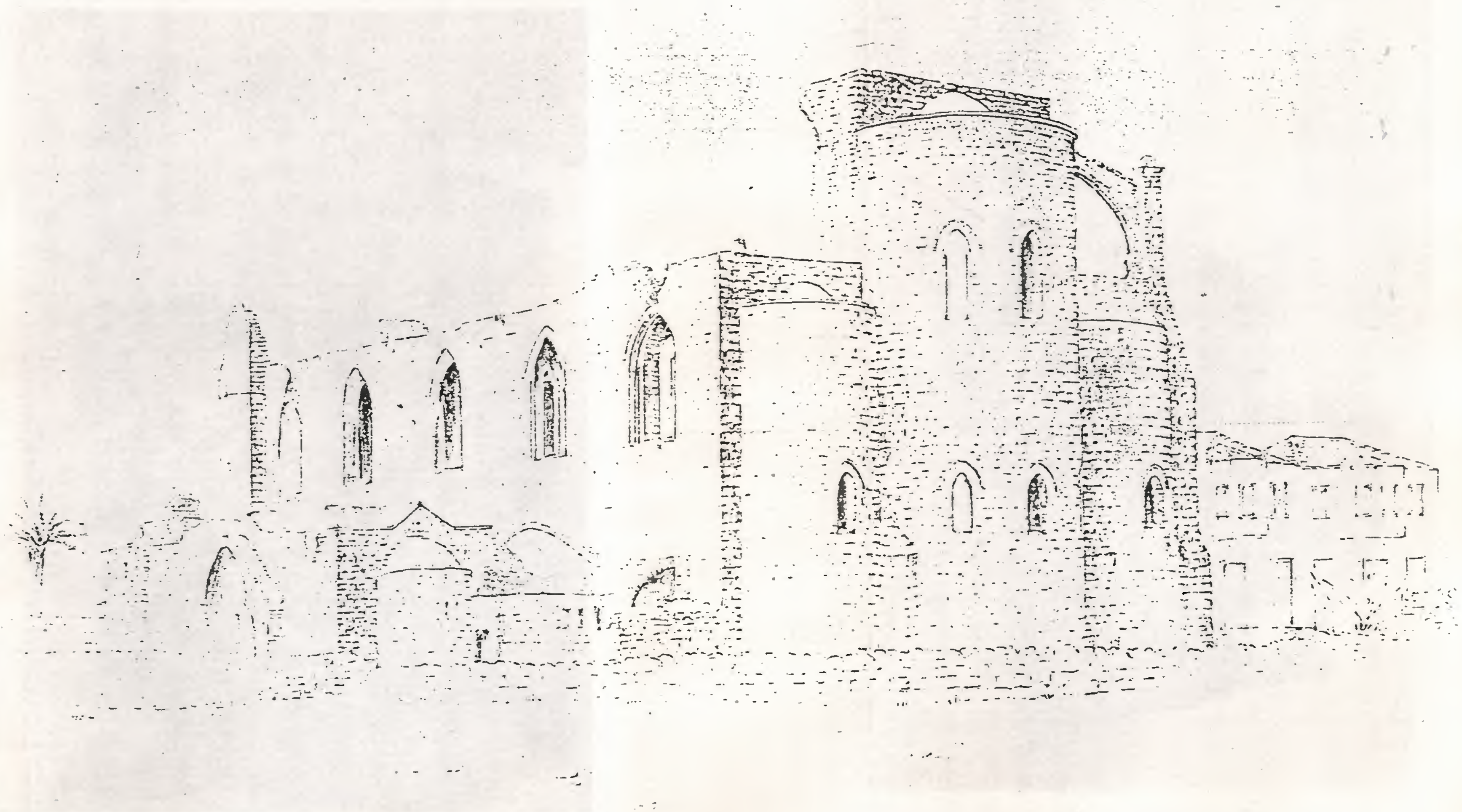


PLATE XXXIX. The church of St. George of the Greeks, Famagusta; from south-east.

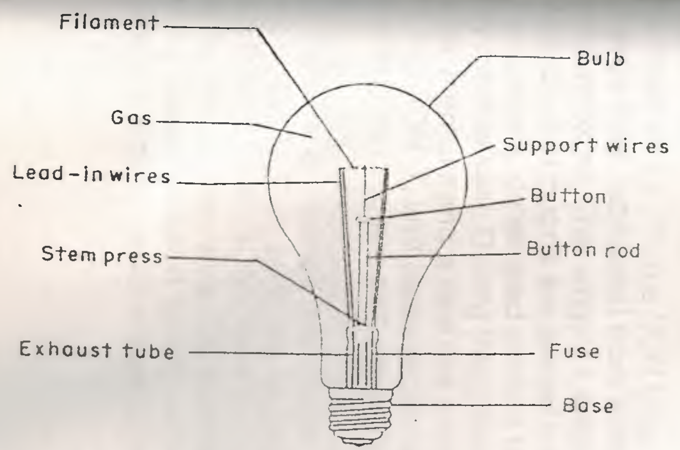


FIG. 26-3 Incandescent filament lamp construction.

that of all other elements except carbon, is the most common filament material used today. Filament forms, sizes, and support constructions vary with different types of lamps as determined by lamp use. Filament forms are designated by a letter or group of letters followed by an arbitrary number. See Fig. 26-4. Most commonly used letters are C, for a helical coil; CC, for a coiled coil or a double helical coil; and S, for straight uncoiled wire. Coiling the filament increases the lamp's luminous efficacy. Coiling the coil further increases efficacy.

Mechanical problems associated with tungsten filaments make the incandescent lamp an inherently compact, somewhat spherical structure. The filament's length and diameter limit its

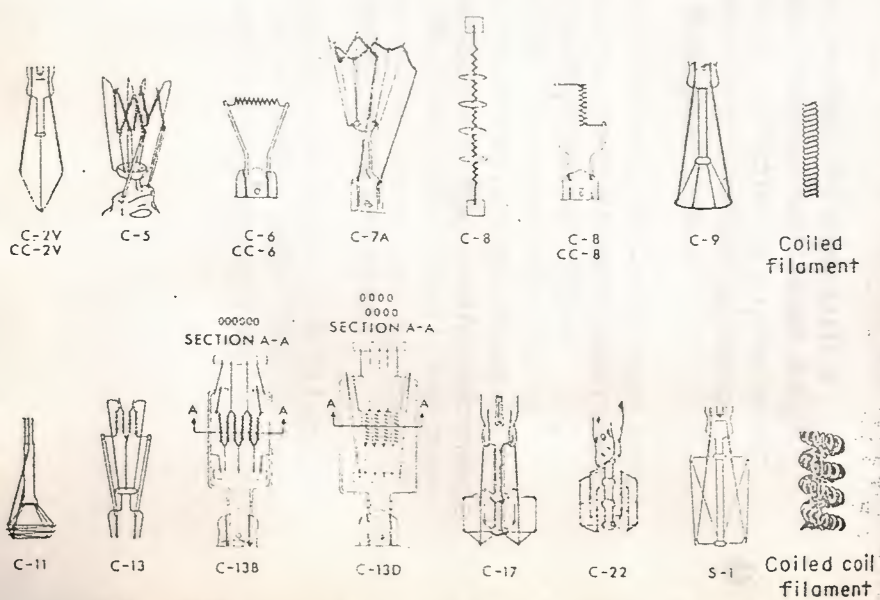


FIG. 26-4 Typical incandescent lamp filament construction (not to scale).

range of operation between 1.5 and 300 V. At 1.5 V, the filament is very short and thick, and it becomes difficult to heat it without excessively heating its support wires. The lamps in the low-voltage (6- to 12-V) class, however, are relatively rugged and will withstand the shocks of motor-vehicle and similar applications. At voltages near 300, the filament is very long and slender; it is fragile and difficult to support.

14. Bulbs. Bulb shape, size, material, and finish vary according to application needs. Shapes range from tubular to spherical and from parabolic to flame form. Bulbs are designated by a letter referring to the shape (see Fig. 26-5) and by a number which is the maximum diameter

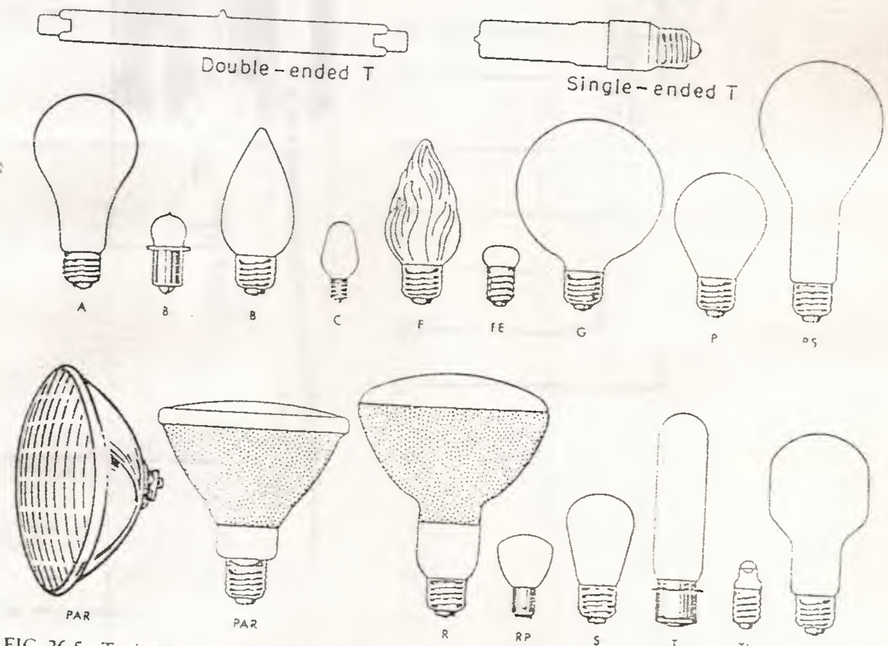


FIG. 26-5 Typical bulb shapes and designations (not to scale).

in eighths of an inch; for example, A-19 designates an A shaped bulb with a diameter of 1⅜ or 2⅜ in.

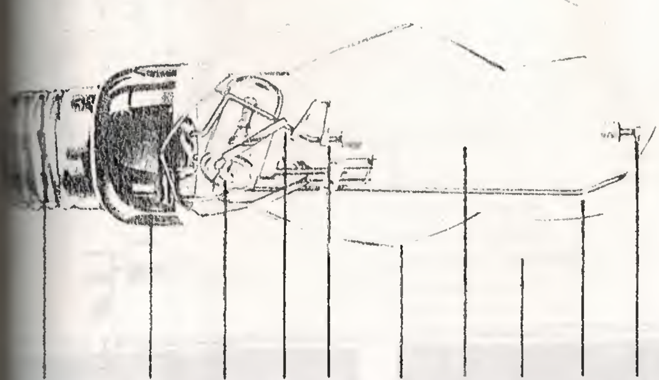
Most bulbs are made of lead or lime soft glass, although heat-resisting hard glass is used for high-temperature applications, and are frosted on the inside for moderate diffusion of the light without appreciably reducing light output. Clear, unfrosted lamps are used where accurate control of light is needed from a point or line source. Fused quartz and high-silica glass are used for other lamps.

15. Base types also vary according to application needs. They range from screw types for most general-service lamps to bipost and prefocus types where a high degree of accuracy in lamp positioning is important, such as in projection systems. Figure 26-6 shows some typical base shapes. Base size varies with lamp wattage, for heat dissipation, and voltage.

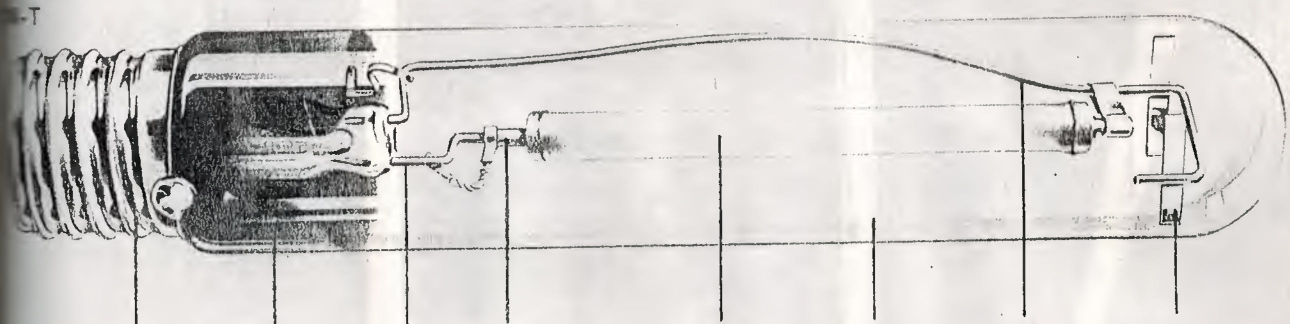
16. Fill gas is used in incandescent-filament lamps to reduce the rate of evaporation of the heated filament. Inert gases such as nitrogen, argon, and krypton are in common use today, with krypton used where its increased cost is justified by increased efficacy or increased lamp life. Halogen gases, for example, bromine and iodine, are also used in tungsten-halogen incandescent lamps to improve light output over the life of the lamp.

17. Energy Characteristics. Only a small percentage of the total radiation from incandescent lamps is in the visible spectrum, with the main

50 W-I - SON 70 W-I



-T



ow high-pressure sodium lamps ork

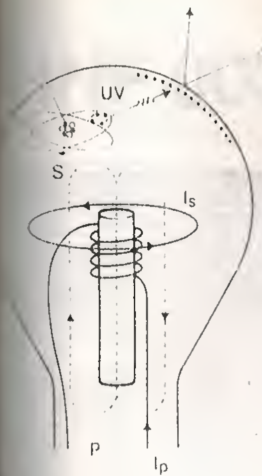
he heart of the Philips SON lamp stands the scharge tube, fabricated from sintered minium oxide. The tungsten electrodes and ir niobium supports are sealed into this tube h a specially developed cement to give a hly reliable seal. During this process, the dium, mercury and a rare gas (xenon for N and SON-T, and neon/argon for SON-H) facilitate starting are also introduced into the e.

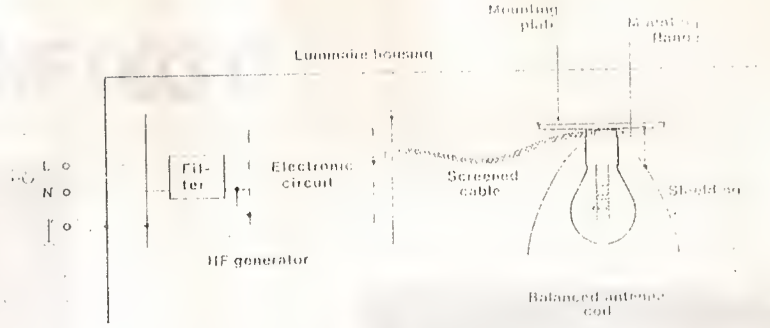
ext, the tube is inserted into a clear, tubular velope (SON-T) or built into an ovoid bulb h diffusing layer (SON). Here it is held in ce by the support wire. Extra protection is en by special support springs which shion the discharge tube against vibration.

After these are fitted, the outer bulb is evacuated to minimise heat losses, a high vacuum being maintained by a getter which assists in ensuring maximum operating efficiency throughout lifetime.

SON lamps in the range are ovoid types where the bulb wall has been electrostatically coated with a very uniform layer of calcium pyrophosphate. The use of this diffusing powder results in very low light losses and guarantees constantly high quality performance during the life of the lamp. Added to that, there is less glare so that simpler and less costly optical systems can be employed.

Like all gas-discharge lamps the SON lamps require a current limiting device, plus an ignitor to ensure rapid, reliable starting. With the SON



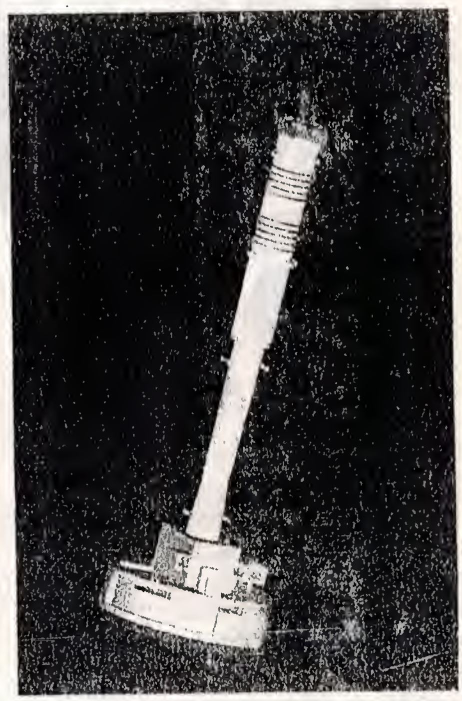


3

Fig. 2 Induction lighting is based on the combination of two well-known principles, namely electromagnetic induction and the gas discharge as applied in tubular fluorescent lamps.

Fig. 3 System shielding and earthing.

5



6

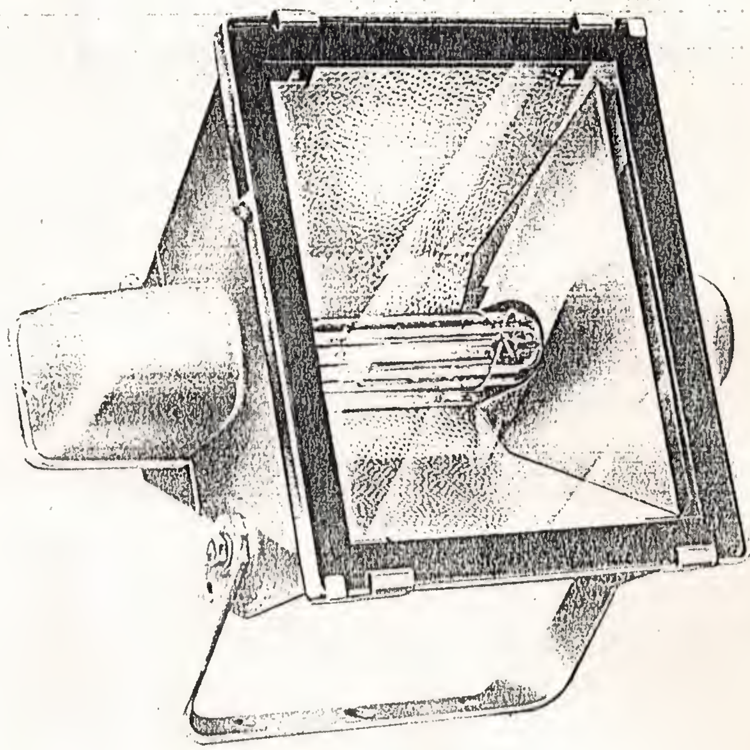
8

HNF 003 - XNF 003 G

Classification

IP 55

HNF 003 and XNF 003 G floodlights for:	
High-pressure sodium lamps	
1 x SON-T 250 W 1 x SON-T 400 W	: HNF 003
Metal halide lamps	
1 x HPI-T 400 W	: HNF 003
Low-pressure sodium lamps	
1 x SOX 35 W	: XNF 003 G



General description of the HNF 003 and XNF 003G floodlights

Exceptionally good photometrical performance, excellent mechanical construction and easy maintenance characterise HNF 003/XNF 003G floodlights.
A choice of lamp types in various beam widths are available.
The HNF 003 is suitable for a great number of different floodlighting projects, such as:
- Sports facilities: sports grounds, sports halls, skating rinks,
- Traffic areas: marshalling yards, shipyards, car parks, high-mast traffic junction lighting,
- Floodlighting of buildings.

If required, the HNF 003 floodlights can be equipped with a matt-black anodized sheet-aluminium louvre, to screen the lamps from direct view and thus limit glare.
The XNF 003G floodlight, with built-in gear for 1 SOX 35W lamp is used for rather confined areas, such as smaller marshalling yards and shipyards, for fence lighting and other security lighting objects.
The floodlights have a cast-on beam-aiming sight and protractor scale for quick daylight adjustment.
Lamp replacement is effected by removing the rear cover, thus facilitating servicing.

Materials

- Housing and rear cover of high-pressure die-cast aluminium.
- The front glass is a 5 mm thick toughened glass plate, which is attached to the housing by four stainless steel clips.
- High-grade aluminium reflectors for accurate beam control.
- Castings of low copper-content for excellent corrosion-resistance, even in coastal and industrial areas.
- Easy-to-operate stainless-steel clips on rear cover; to be closed by hand and opened by using a simple tool. The floodlight cannot be easily opened by unauthorized persons.
- One PG 11 gland for cable entry.
- Silicone rubber gaskets for jetproof and dustproof sealing of the front glass and rear housing.

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Luminaire (INR) number : 73

Measuring code : LVO 4147
Luminaire type : HNF 002-W
Lamp type : SONT 400W

Lamp flux : 47.00 kLumen
No. of lamps per luminaire : 1
Power dissipation : 431.00 Watt

Total light output ratio : 67 %
Downward light output ratio : 67 %

SLI-factor (Road lighting) : 0.00

		Lengthwise	Crosswise
Maximum spacing/height ratio	:	*	*

		Length	Width	H0	H
Luminaire sizes [mm]	:	0	0	0	0

Symmetry code : 4

		N1	N2	N3	N4
CIE Fluxcode [%]	:	82	99	100	100

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Luminaire (INR) number : 73

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

* I-Table *

--------> C-plane

	0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0
0.0	612	612	612	612	612	612	612	612	612	612	[illegible]
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	[illegible]
7.5	564	565	565	565	564	566	569	574	577	583	[illegible]
10.0	538	533	533	536	539	546	556	567	574	583	[illegible]
12.5	509	507	508	510	515	526	549	573	585	597	[illegible]
15.0	480	485	480	477	489	520	548	572	587	597	[illegible]
17.5	453	457	450	450	471	511	537	552	560	556	[illegible]
20.0	426	426	423	427	462	496	507	503	507	510	[illegible]
22.5	407	401	399	410	444	466	456	456	457	455	[illegible]
25.0	379	383	381	402	416	417	414	408	399	400	399
27.5	343	350	355	387	388	381	376	363	346	341	346
30.0	303	306	324	359	362	344	336	316	293	287	293
32.5	257	264	292	325	328	308	290	274	248	234	248
35.0	211	221	254	285	287	273	252	233	206	196	206
37.5	164	178	214	237	246	233	217	201	181	179	[illegible]
40.0	123	133	168	194	206	196	182	175	171	163	[illegible]
42.5	86	99	127	153	170	166	154	153	151	147	[illegible]
45.0	58	69	89	119	139	141	134	130	129	130	[illegible]
47.5	45	49	63	90	113	119	113	116	108	110	[illegible]
50.0	32	37	49	70	91	99	98	92	87	90	87
52.5	20	25	35	56	70	82	100	45	66	69	66
55.0	12	16	20	41	49	68	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	2	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
Gamma-angle

Luminaire (INR) number : 73

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

* I-Table *

Gamma angle \ 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	612	612	612	612	612	612	612	612	612	612	[illegible]
2.5	606	604	603	602	601	600	599	602	599	600	[illegible]
5.0	589	589	587	590	589	588	586	586	586	588	[illegible]
7.5	574	569	566	564	565	565	565	564	565	565	[illegible]
10.0	567	556	546	539	536	533	533	538	533	533	[illegible]
12.5	573	549	526	515	510	508	507	509	507	500	[illegible]
15.0	572	548	520	489	477	480	485	480	485	480	[illegible]
17.5	552	537	511	471	450	450	457	453	457	450	[illegible]
20.0	503	507	496	462	427	423	426	426	426	423	[illegible]
22.5	456	456	466	444	410	399	401	407	401	399	[illegible]
25.0	408	414	417	416	402	381	383	379	383	381	[illegible]
27.5	363	376	381	388	387	355	350	343	350	355	[illegible]
30.0	316	336	344	362	359	324	306	303	306	324	[illegible]
32.5	274	290	308	328	325	292	264	257	264	292	[illegible]
35.0	233	252	273	287	285	254	221	211	221	254	[illegible]
37.5	201	217	233	246	237	214	178	164	178	214	[illegible]
40.0	175	182	196	206	194	168	133	123	133	168	[illegible]
42.5	153	154	166	170	153	127	99	86	99	127	[illegible]
45.0	130	134	141	139	119	89	69	58	69	89	[illegible]
47.5	116	113	118	113	90	63	49	45	49	63	[illegible]
50.0	92	98	99	91	70	49	37	32	37	49	[illegible]
52.5	45	100	82	70	56	35	25	20	25	35	[illegible]
55.0	10	72	68	49	41	20	16	12	16	20	[illegible]
57.5	9	21	44	33	21	10	10	9	10	10	[illegible]
60.0	7	7	12	13	10	7	8	6	8	7	[illegible]
62.5	7	5	3	3	5	4	5	4	5	4	[illegible]
65.0	7	5	3	3	2	4	3	2	3	4	[illegible]
67.5	6	4	2	2	3	3	2	2	2	3	[illegible]
70.0	6	4	2	2	2	2	2	1	2	2	[illegible]
72.5	5	3	2	1	2	2	1	1	1	2	[illegible]
75.0	4	3	2	1	1	1	1	1	1	1	[illegible]
77.5	3	2	1	1	1	1	1	1	1	1	[illegible]
80.0	2	1	1	1	0	0	0	0	0	0	[illegible]
82.5	1	1	0	0	0	0	0	0	0	0	[illegible]
85.0	0	0	0	0	0	0	0	0	0	0	[illegible]
87.5	0	0	0	0	0	0	0	0	0	0	[illegible]
90.0	0	0	0	0	0	0	0	0	0	0	[illegible]

Gamma angle

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ire (INR) number : 73

ing code : LVO 4147
ire type : HNF 003-W
type : SONT 400W

able *

220.0	230.0	240.0	250.0	260.0	270.0	280.0	290.0	300.0	310.0	320.0
612	612	612	612	612	612	612	612	612	612	612
602	603	604	606	608	610	608	606	604	603	602
590	587	589	589	592	597	592	589	589	587	590
564	566	569	574	577	583	577	574	569	566	564
539	546	556	567	574	583	574	567	556	546	539
515	526	549	573	585	597	585	573	549	526	515
489	520	548	572	586	597	586	572	548	520	489
471	511	537	552	560	568	560	552	537	511	471
462	496	507	503	507	510	507	502	507	496	462
444	466	456	456	457	458	457	456	456	466	444
416	417	414	408	399	400	399	408	414	417	416
388	381	376	363	346	344	346	363	376	381	388
362	344	336	316	293	287	293	316	336	344	362
328	308	290	274	248	239	248	274	290	308	328
287	273	252	233	206	196	206	233	252	273	287
246	233	217	201	181	172	181	201	217	233	246
206	196	182	175	171	163	171	175	182	196	206
170	166	154	153	151	146	151	153	154	166	170
139	141	134	130	129	130	129	130	134	141	139
113	118	113	116	108	111	108	115	113	118	113
91	99	98	92	87	90	87	92	98	99	91
70	82	100	45	66	69	66	45	100	82	70
49	68	72	10	45	48	45	10	72	68	49
33	44	21	9	[illegible]	19	22	9	21	44	33
13	12	7	7	11	5	11	7	7	12	13
3	3	5	7	4	5	4	7	5	3	3
3	3	5	7	2	5	2	7	5	3	3
2	2	4	6	7	6	7	6	4	2	2
2	2	4	6	6	5	6	6	4	2	2
1	2	3	5	6	5	6	5	3	2	1
1	2	2	4	5	4	5	4	3	2	1
1	1	2	3	4	2	4	3	2	1	1
1	1	1	2	2	1	2	2	1	1	1
0	0	1	1	1	0	1	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

---> C-plane

mma-angle

| Computer Aided Lighting Design

Luminaire (INR) number : 73

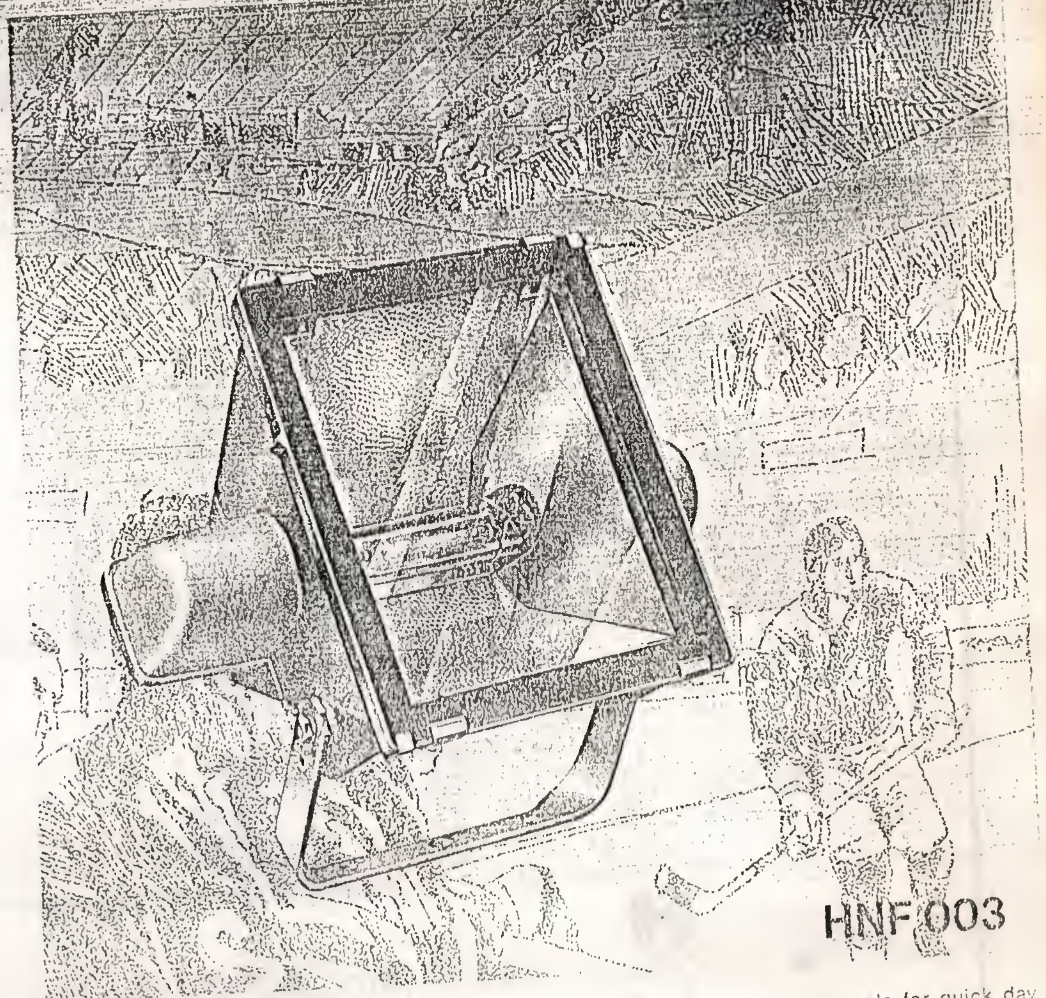
Measuring code : LVO 4147
Luminaire type : HNF 003-W
Lamp type : SONT 400W

* I-Table *

Gamma-angle \ C plane	330.0	340.0	350.0	360.0
0.0	612	612	612	612
2.5	600	600	599	602
5.0	589	588	586	586
7.5	565	565	565	564
10.0	536	533	533	538
12.5	510	508	507	509
15.0	477	480	485	480
17.5	450	450	457	453
20.0	427	423	426	426
22.5	410	399	401	407
25.0	402	381	383	379
27.5	387	355	350	343
30.0	359	324	306	303
32.5	325	292	264	257
35.0	285	254	221	211
37.5	237	214	178	164
40.0	194	168	133	123
42.5	153	127	99	86
45.0	119	89	69	58
47.5	90	63	49	45
50.0	70	49	37	32
52.5	56	35	25	20
55.0	41	20	16	12
57.5	21	10	10	9
60.0	10	7	8	6
62.5	5	4	5	4
65.0	2	4	3	2
67.5	3	3	2	2
70.0	2	2	2	1
72.5	2	2	1	1
75.0	1	1	1	1
77.5	1	1	1	1
80.0	0	0	0	0
82.5	0	0	0	0
85.0	0	0	0	0
87.5	0	0	0	0
90.0	0	0	0	0

DEFINITION

Floodlight for one of the following lamps:
HPI/T 400 W metal halide lamp
HP/T 400 W mercury vapour lamp
SON/T 250 W or 400 W high-pressure sodium lamp.



HNF 003

DESCRIPTION

- Housing and rear cover of high-pressure die-cast aluminium
- Castings of low copper-content for excellent corrosion-resistance, even in coastal and industrial areas.
- Two beam-versions, as different reflectors are available:

	HPI/T 400 W and HP/T 400 W	SON/T 250 W	SON/T 400 W
narrow beam:	2 x 7°	2 x 7°	2 x 7
wide beam:	2 x 27°	2 x 27°	2 x 27°

- High-grade aluminium reflectors for accurate beam control
- Lamp replacement is effected by removing the rear-cover, thus facilitating servicing
- Easy-to-operate stainless steel clips on rear-cover; to be closed by hand and opened by using a simple tool. The floodlight cannot be easily opened by unauthorized persons.
- Cast-on beam-aiming sight and protractor scale for quick day light adjustment.
- Silicone rubber gasket for jetproof and dustproof sealing of front glass.
- The front glass is a 5,5 mm-thick toughened glass plate, which is attached to the housing by 4 stainless steel clips; two extra safety brackets.

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 * Narrow-beam type	Wide-beam type	Weight kg
HNF 003	1 x SON/T 250 W	9112 702 302..	9112 702 303 .	7,30
	1 x HP/T 400 W	9112 702 426..	9112 702 427..	7,30
	1 x SON/T 400 W or 1 x HPI/T 400 W	9112 702 443..	9112 702 440..	7,30

* Complete floodlight

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

PHILIPS

Type	Wattage W	Type of base E27	B22	E40/45	Luminous flux lm	Average lamp voltage V[1]	Average lamp current A[1]	Run-up time min.[2]	Burning position	Bulb shape
MHN-TD	150	2x R7s			11250	90	1,8	4		
	250	2x FC2			20000	100	3,0	4		
MHW-TD	70	2x R7s			5000	95	1,0	4		
SOX	35		•[6]		4500	68	0,62	7		
	55		•[6]		7400	107	0,59	7		
	90		•[6]		13000	117	0,83	9		
	135		•[6]		21500	176	0,82	10		
	180		•[6]		33000	250	0,83	12		
SOX-E	18		•[6]		1800	57	0,35	11		
	26		•[6]		3500	83	0,35	15		
	36		•[6]		5700	114	0,35	15		
	66		•[6]		10700	115	0,62	15		
	91		•[6]		17500	165	0,62	15		
	131		•[6]		26000	245	0,62	15		
SON	50	•			3300	85	0,76	5	Any	
	70	•			5600	90	1,0	5		
	100			•	9500	100	1,2	5		
	150			•	13500	100	1,8	5		
S	150			•	15500	100	1,8	4		
	250			•	25000	100	3,0	5		
	400			•	47000	105	4,4	5		
	1000			•[3]	120000	110	10,3	6		
SON-T	50	•			4000	86	0,75	5	Any	
	70	•			6500	86	1,0	5		
	100			•	10000	100	1,2	5		
	150			•	14000	100	1,8	5		
S	150			•	16000	100	1,8	4		
	250			•	27000	100	3,0	5		
	400			•	47000	100	4,6	5		
	1000			•[3]	125000	100	10,6	6		
SON-H	210			•	18000	104	2,5	3	Any	
	350			•	34500	117	3,6	3		

1) After 100 burning hours.
2) The number of minutes after which the lamp has reached 80 per cent of its final luminous flux.
3) E40/80 x 50.
4) These lamps are connected directly to the mains. The data given in this table refer to the 220-230V version.
5) Recommended burning position, especially when undervoltage is expected.
6) BY 22.