ILLUMINATION DESIGN
OF
ULU MOSQUE

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88002
DEPARTMENT
OF
ELECTRICAL AND ELECTRONIC
ENGINEERING

GRADUATION PROJECT

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FAMAGUSTA

T.R.N.C

1993 JUNE

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A C K N O W L E D G E M E N T S

I would like to have a special thanks to my supervisor Prof.Haldun GURMEN for providing me all the required documents and directing me through my project.

Also I would like to thank to my friend Mr. Zafer YUKSEL for his helps to prepare this project.

INTRODUCTION

There is no doubt that floodligthing a building is one of the most spectacular achievements in lighting engineering. A floodlit building is a focal point in a town, when it is dark and colours are blurred.

Formerly it was mostly buildings of historic interest that were floodlit. Floodlighting of these old buildings, which often boast rich, ornate facades and beautiful architecture, is still very effective. Such wonderful results can be achieved that often these buildings are reinvested in this way with some of their former glory.

The different uses to which floodlight is put, whether they are primarily aesthetic or purely functional to achieve commercial ends, does not alter the fact that the quality of the end product should be as high as possible. Even a modern office block with a bare frontage can be made attractive by means of artifical lighting. However, it must be said that, whatever the reason, it is better to abondon the idea of a floodlight installation than to be satisfied with a mediocre result.

Lighting engineer must follow four steps in application of lighting |

1- Determine the desired level of illumination

2- Select a luminare that will produce this level

3- Calculate the required number of luminaries

4- Lay out the installation for uniformity of illumination

Illumination can be divided into two groups as :

a) INDOOR ILLUMINATION

b) OUTDOOR ILLUMINATION

In this project Ulu Mosque is illuminated as an outdoor illumination.

In outdoor illumination there are two methods of calculation |

1- LUMEN METHOD

2- DIRECT METHOD

1- LUMEN METHOD | It can be said that it is a very practical method to determine the number of fittings. The number of fittings can be calculated by dividing the total flux to flux used of one fitting only.

2- DIRECT METHOD | By using this method and appliying the computer program including the intensity matrix, the illuminance at each point on the surface of the walls are obtained.

In this project lumen method is used to calculate the number of fittings.

CHAPTER 1

OUTDOOR ILLUMINATION :

I) PLANNING :

A floodlighting installation project can only be carried out succesfully if a thorough study has been made of the building concerned. The lighting engineer should become familiar with all factors relating to lighting installation for the building. It is essential he should first study the feature of the facade under various conditions and with the sunlight falling upon it at different angles in order to decide which are the most attractive features. If an on-the-spot survey is impossible, daylight photos, drawings or a scale model can be useful aids. An informative part of the daylight study is the analysis of how given effects arise.

The appearance of the building at night is therefore taken into account when designing the building and it is more important if this is the case, there should already be good cooperation, at this stage, between te lighting engineer and architect, in order to avoid any risk of architest's conception being misinterpreted. During the planning daylight plays very important role to decide the place of the fittings. If there is a cloudless sky and bright sunshine, two natural source of light can thus be said to be present at one and the same time. As a result of this condition hard shadows falling under projections on the facade and caused by direct sunlight are softened by the diffused light from the sky. Fundemantally, illumination by sunlight is the ideal form of floodlighting. Sunlight streaming down on a building causes shadows to form under facade projections on the side facing the viewer. The result is a never ending interplay of light and darkness on the facade, emphasizing the architectural features. For the ever available direct sunlight, the bas relief of the ancient Greek temples was already sufficient to create an interesting pattern of light and shadow on that type of sculpture. In Western Europe, however, with its often dull weather and cloudy diffuse sky, more relief was needed in the facades of the gothic cathedrals found there, in order to create the same interplay of light and shadow. This phenomenon reveals one of the first principles of floodlighting, which is that te direction of the light and the direction of view should be at an angle to one or other, preferably between 45 and 135.

THE CONTRAST BETWEEN THE FACADE AND THE BACKGROUND:

The contrast between the facade and its background 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 than the background because of the grater reflection. Sunlight falling directly on the building causes hard shadows. When the sky is cloudless but the facade receives no direct rays from the sun the sky is brighter than the facade. The sky radiates light in all directions, while the facade merely reflects the light. Since the light is diffuse only soft shadows appear. If the sky is clouded over, diffuse light falls on the building. In such light a facade is less bright than the background, in that the light comes from the sky, moreover practically no shadows are seen. In practice, of course, all kinds of combinations of the cases, which have been considered above are possible.

It is not only the changing weather conditions and the varying contrasts between the facade and its background that are important in daylight studies, but also the changing aspects of the building over a given period of time. For example, during course of the day, the shadows move from one part of the facade to another owing the continuously changing position of the sun. Generally a building is at its best in the hours of the morning and just before sunset. This is because the sun is low in the sky at these times an we see the contrast in colour between the sunlight, which contains much red light, and the diffused light from the sky, which contains great of blue.

It is possible to imagine that, in studying a building, the lighting expert may be attracted at a given moment by a certain striking effect and that this mental image sticks in his mind as the effect he would like to retain. This mental image is in many cases the initial point of departure of a floodlighting design. Proceeding from this mental image he must translate the natural lighting effect, which he has seen, into an artifical lighting effect. One of the first things to be noted is that at night the position of the light sources is completely different from the day time situation. Whereas the natural light sources illuminate the building from above, artifical light sources are generally placed low down near the building or a little higher on an adjacent building. Thus a clear idea of how the installation is to be carried out may be gained by methodically collecting all details relevant to te possible positions of light sources, the appropriate fittings and lamps, the reflecting properties of the surface material of the facade, the various points from which the building can be observed.

II) CARRYING OUT A FLOOLIGHTING PROJECT :

The following points should be considered when planning a floolight installation.

i) Direction of view : Decide on the main direction from which the building is wieved. Generally there will be several, but often one can be decided upon as the main direction of view.

ii) Distance : Decide on the normal distance between the viewer and the building, based on the main direction of view. Whether one can see all or none of the architectural details on the facade will depend on the distance chosen.

iii) Surroundings and background : Obtain a clear idea of the background against which the building will be see. If the surrounding and the back ground are dark a relatively small amount of light is needed to make the building lighter than the background. The colours of the light already present in the background of the building, even street lighting, must than be taken into consideration.

iv) Obstacles : 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 :

1 - The light sources are not seen by viewer.

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

v) 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 sources. There many alternatives for mounting:

- On street lamps or other posts specially erected for the purpose
- On the penthouse roof
- On brackets on te house front
- On the ground behind flower-beds, bushes or copses

If the building is located along a main road it must be borne in mind that te ligting must not hinder the traffic. Fitting should be well screened from the drivers of oncomings vehicles.

vi) The form of the building : Once the main direction of view has been chosen, the choice of direction of the light depends on the shape of a building or rather the form of its ground plan or horizontal section. The position of the light sources which are to cover the builing may then be more or less fixed. In theory it is possible to reduce all ground plans of buildings to simple geometric figures ; square, rectangular or round. In the case of complex structures, the ground plan can be thought of as a group of such figures. For buildings with a square, rectangular or circular ground plan a basic lay-out exists which, in virtually all cases, leads to good results.

The characteristics of the facade show to best advantage when the incident light is at an angle smaller than 90. No definite angle can be given; on the horizontal and vertical planes the angle may vary between 0 and 90, calculating from the vertical to the facade. For deep profile the angle should be between 0 and 60, for a flat profile between 60 and 85 to the vertical.

III) ARCHITECTURE OF THE FACADE :

i) Flat facades : Flat facades without projections or architectural details do not lend themselves very well to floodlighting. Shadow effects may be achieved only when the light sources are placed very near to the facade. To prevent the result from being flat and uninteresting a certain unevenness in the brightness pattern should be created by the arrangement and adjustment of the floodlights.

ii) Facade with vertical lines : Vertical lines of a facade may comprise pillars or supporting columns or, for instance, in modern glass facades the beams or girders carrying the floors. The vertical line of the wall can be emphasized by illumination from the left and right sides of the facade with medium-beam floodlights. In most cases the shadows produced in this way are too strong and create too marked a contrast,so that lighting from the opposite direction is needed to soften the whole shadow pattern. Wide-beam floodlights are therefore used, with the direction of the light parallel to the main direction of view must be such that the bands of shadow face the viewer.

iii) Facades with horizontal lines : Some facades have a decorative element, a horizontal band or slightly projecting beam. If in such cases the light fittings are placed too close to the facade. The result is a rather dark band of shadow above this projecting beam. This gives the impression that the building consist of two parts and that the upper part is floating in the air. To keep the band of shadow narrow there should be grater distance between the facade and the light fittings.

iv) Facades with projections : Projecting features such as balconies, penthouses, parapets or balustrades can add to the attraction of the facade if included in the scheme. In this case the light fittings must be placed at some distance from the facade so as to prevent excessive shadow. If the site does not allow of this, supplementary lighting with small light sources may be mounted on projecting parts of the building.

v) Facades with recessed parts : These may be balconies which are set back or galleries with railings at the front. Obviously a large part of the built-in space will be in shadow if the floolights are placed only short distance from the facade. In such a case supplementary lighting will be required in the balcony and for this light of another colour may be used. If this is done, a particularly sitriking effect can be achieved, at the same time creating a greater impression of depth. Floodlighting from a larger distance, however, reduces shadow, making it less visible to the viewer, thus obviating the need for extra lighting.

vi) Mirror effects : Nearly every facade has a number of windows give a mirror effect especially when it is dark inside the builing. If, for instance, the floodlights are mounted on posts, the person viewing the building from below may be dazzled by the bright reflections from the ground-floor windows. This effect can be avoided by mounting light sources below eye level.

IV) SURFACE MATERIAL OF THE FACADE :

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

MATERIAL	STATE	REFLECTION FACTOR
White marble	fairly clean	.60 .65
Granite	fairly clean	.10 .15
Light concrete	fairly clean	.10 .50
Dark concrete	fairly clean	.25
Stone	very dirty	.05 .10
Imitation concrete paint	clean	.50
White brick	clean	.80
Yellow brick	new	.35
Red brick	dirty	.05

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

a) the material of the facade

b) the incident angle of the light

c) the position of the observer in relation to the reflecting material (specular reflections).

d) the colour of the material (it is accentuated if light of the same colour is used).

A distinction can be made between diffuse reflection and specular reflection and of variations between the extremes. These different types of reflection are due to the particular surface textures of the different materials. Four classes may be distinguished :

1- Very smooth surface : A very smooth surface acts more or less as a mirror, with the result that most of the reflected light is directed upword, away from the observer.

2- Smooth surface : Light is reflected somewhat diffusely from a smooth surface; small amount of this light reaches the observer.

3- Dull surface : Incident light reflected from a dull surface is even more diffused, so that a larger part of the light is directed towards the viewer.

4- Very dull surface : Light reflected from a very dull surface is diffused to a large degree, an therefore a great part of the light is directed towards the observer. It is obvious that these different reflection properties of surface material necessitate a different illumination of the facade, in each case, in order to achieve the brightness. Even the mount of grime on a building is important; the reflection factor of a clean facade can sometimes be more than twice that of a grimy facade. This was clearly illustrated recently when certain historic buildings were cleaned.

V) SHAPE OF ROOFS :

The appearence of a building at night is hardly complete if the roof, which is visible in the day time, is not visible when the building is floodlit. A flat roof is neither seen in the day time nor at night, and so lighting is restricted to the facade. In the case of a gable roof, however, the slope of the roof must be taken into account. If a building has a flat roof the top storey is often set back forming a gallery. The top storey can than be illuminated by setting the floodlight at a great distance from the facade. Alternatively the sharp - edged shadow can be softene by supplementary lighting using small light sources in the gallery itself. Another possibility is the use of light of a different colour in the gallery, which will then illuminate the whole of the top - storey facade.

VI) SELECTION OF THE LEVEL OF ILLUMINATION :

The lighting level needed on a facade to effect a certain brightness contrast depends upon such factors as the reflection factor of the surface building material, the location of the building in relation to its surrounding and the dimensions of the building. The table below presents some recommended illumination levels for various surface building materials used on buildings in either poorly lit, well lit or brightly lit surroundings.

		illumination in lux		
TYPE OF SURFACE	STATE	P.L.S	W.L.S	B.L.S
white marble	f.clean	25	50	100
light concrete imitation	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	f.clean	150	300	600
concrete	f.clean	75	150	300
red brick	f.clean	75	150	300
concrete	very dirty	requires at least		
red brick	dirty	150 - 300		

P.L.S : poorly lit surrounding

W.L.S : well lit surrounding

B.L.S : brightly lit surrounding

CHAPTER 2

EQUIPMENTS USED IN FLOODLIGHTING :

In illumination projects several types of armatures and lamps can be used.

Lamps can be devided into five groups as :

1 - Low pressure sodium vapour lamps

2 - Low pressure mercury vapour lamps

3 - High pressure sodium vapour lamps

4 - High pressure mercury vapour lamps

5 - Metal halide lamps

In this project high pressure sodium vapour lamp (SON - T 250W, 100W, 70W) and HNF 003 are used as a lamp and an armature respectively.

HIGH PRESSURE SODIUM VAPOUR LAMP :

They are efficient, versatile light sources to start with their high luminous capacity means more light for less money and feature of often decesive importance where lighting is employed for a long periods of time.

Reasons are written below that why high pressure sodium vapour lamp is chosen to this project :

* High luminous efficacy
* Golden white light
* Balanced colour rendering
* Long economic life
* Reliable, stable operation

* Excellent lumen maintenance
* Short re-ignition time

High-pressure sodium lamps combine very high efficacies (min.66 lm/W to max.130 lm/W) with moderate colour rendering, and are therefore suitable for many applications where such factors, together with good economics and long lamp life, are important. Experience has shown that, since the late sixties when SON lamps were introduced on to the market, these light sources have proved themselves particularly in terms of all-round reliability. Compared with the version orginally launched, today's high pressure sodium lamps enjoy improved life, together with a higher light output and better lumen maintenance. On top of this, the brief re-ignition time (the time taken for the discharge to restrike should an interruption in the mains supply occur) represents an added safety feature; this interval is normally less than two minutes for lamps with an external ignitor in the circuit.

Structure of the SON lamp : The tungsten electrodes and their niobium supports are sealed into this tube with a specially developed cement to give a highly reliable seal. During this process, the sodium, mercury and a rare gas (xenon for SON and SON-T, and neon/argon for SON-H) to faciliate starting are also introduced into the tube. Next, the tube is inserted into a clear, tubular envelope (SON-T) or built into an ovoid bulb with diffusing layer (SON). Here it is held in a place by the support wire. Extra protection is given by special support springs which cushion 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 throught 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 guaratees 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.

The initial discharge takes place in rare gas. Heat is thus dissipated, causing some of the mercury to evaporate. The sodium, with its lower excitation potential, then gradually takes over the discharge and after a short time the lamp burns stably, emitting its characteristic, pleasant, golden - white light at luminious efficacies of up to 130 lm/W.

Some 80 % of nominal light output is reached within an average of four minutes. An additional advantage is the fast restrike time; for lamps with an external ignition device, this factor can be of the utmost importance in applications where short power suppl interruptions might otherwise lead to dangerous situations owing to lack of light (figures and wiring diagram about this lamp is given in the appendix).

HNF 003 (ARMATURE) :

This armature is the most convinient one for the SON lamps because of that it is used in this project. These are the descriptions about armature :

- Housing and rear cover of high pressure die-cast aluminium.
- Casting of low copper-content to excellent corrosion-resistance, even in coastal and industrial areas.
- 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.

- Cast-on beam-aiming sight and protactor scale for quick daylight adjustment.

- Silicone rubber gasket for jet proof and dust proof sealing of front glass.

- Front glass is a 5.5 mm. thick toughened glass plate, which is attached to the housing by 4 stainless steel clips, 2 extra safety brackets.

Applications : Sports grounds, floodlight of buildings, car parks, sport halls, shipyards (Details are given in the appendix).

I) UNITS AND DEFINITIONS USED IN ILLUMINATION :

LIGHT INTENSITY (I) : Unit is called CANDELA and is equal to 1/60 of the light intensity emitted by 1 cm^2 of black body surface at the solidification temperature of platinium (2042 K). Light intensity is a vector quantity.

LIGHT FLUX (ϕ) : Unit is called LUMEN and is equal to the flux included in a solid angle of one steradian when the light intensity is 1cd in any direction.

ILLUMINANCE (E) : Unit is called LUX and is equal to the flux falling on 1m^2 of area. Sometimes "light level" is used instead of illuminance.

LUMINANCE (L) : Unit is called NIT and is defined as light intensity emitted per unit area of light emitting surface.

REFLECTION FACTOR (n) : The reflection factors describes the relationship between the incident luminous flux and the reflected luminous flux. This factors depends upon the reflection properties of the surface of the material to be illuminated.

MAXIMUM INTENSITY (Imax) : The maximum intensity of the beam is the maximum intensity candela per 1000 lumen of the lamp flux.

II) METHODS OF CALCULATION :

There are two methods for calculating the types and numbers of floodlights needed to achieve the desired illumination; the lumen and direct (luminous intensity) method. For large facade lumen method and for high and small objects direct method should be used.

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 this formula :

$$\varnothing = \frac{A \times E}{n}$$

where : $\varnothing$: is the total number of lumens prodeced by all lamps,

A : is the surface of the facade to be illuminated,

E : is the desired illumination on that facade,

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

The presence of a utilization factor in this formula indicates that not all the lamp lumens contribute to the illumination level on the facade. The lumens produced by the lamps are concentrated by reflectors, inwhich process some loss is involved. If the initial output is 100 % lamp lumens, 60 to 75 % are projected through the lighting equipment and 40 to 25 % are lost fitting itself through interreflection in the reflector and absobtion by the other parts of the fitting.

After the floodlight has been in operation 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.

Finally a percentage of the losses is accounted for by wasted light, that is light not incident to the building facade. In this project utuilization factor is taken as 0.70. After finding the total luminous flux, the number of fittings (N) can be calculated easly as:

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

2 / DIRECT METHOD (LUMINOUS INTENSITY) :

In this method starting point is the luminous intensity, in candela, radiated by a light source in a particular direction. This luminous intensity may be derived from the luminous intensity diagram or from a table. The calculation is made by this formula :

$$E = \frac{I}{h} \cos(x)^{3}$$

where; E : is the vertical illumination on the facade,

I : is the luminous intensity at the angle (x),

h : is the height of the object above the level on which the fittings are arranged,

x : is the angle at which the light beam strikes the normal on the plane to be illuminated.

CALCULATION OF THE PROJECT

BY USING LUMEN METHOD : Details about this method are given in the METHODS OF CALCULATION part of the project.These are the results of the calculations for each side of the building :

RIGHT HAND SIDE OF THE BUILDING :

width = 19.5 m   height = 14.5 m   area = 282.75 m^2

Ø SON-T 250W = 27,000 lumen

Ø = 50 * 282.75 = 14,135.5 lumen

Ø = 14,135.5 / 0.7 = 20,196.4 lumen

N = 20,196.4 / 27,000 = 0.748 lamp

LEFT HAND SIDE OF THE BUILDING :

width = 20.5 m   height = 14.5 m   area = 297.25 m^2

Ø SON-T 100W = 10,000 lumen

Ø = 50 * 297.25 = 14,862.2 lumen

Ø = 14,862.2 / 0.7 = 21,232.1 lumen

N = 21,232.1 / 10,000 = 2.1 lamps

FRONT & BACK SIDE OF THE BUILDING :

width = 36.5 m   height = 14.5 m   area = 529.25 m^2

Ø SON-T 250W = 27,000 lumen

Ø = 50 * 529.25 = 26,462.5 lumen

Ø = 26,462.25 / 0.7 = 37,803.5 lumen

N = 37,803.5 / 27,000 = 1.4 lamp

TOWER :

width = 5 m   height = 23.5 m   area = 117.5 m^2

ϕ SON-T 70W = 6,500 lumen

ϕ = 50 * 117.5 = 5875 lumen

ϕ = 5875 / 0.7 = 8,392.8 lumen

N = 8,392.8 / 6,500 = 1.29 lamp

This lumen method is not an adequate method to calculate the number of fittings for such buildings. Because by using this method place of the projectors can not be found. This is a very important thing in floodlighting to know the place of the fittings. And also by using this method distribution of the illuminance on the wall of the building can not be calculated. So it is impossible to know illuminance at desired point of the building.

But direct (luminous) method gives all these requirements which are written above. So that in this project to illuminate this building direct method is used.

BY USING DIRECT (LUMINIOUS) METHOD :

Details about direct method is given in the METHODS OF CALCULATION part of the this project.

How to use direct method :These are the formulas to calculate C & GAMA angles.

$$B = \mathrm{Tan}^{-1} \frac{X' \sqrt{1+Yo'^{2}}}{1+Y'Yo'} - \mathrm{Tan}^{-1} \frac{Xo'}{\sqrt{1+Yo'^{2}}}$$

$$\beta = \mathrm{Cos}^{-1} \frac{1+Y'Yo'+X'^{2}\,\dfrac{1+Yo'^{2}}{1+Y'Yo'}}{\sqrt{\left[(1+X'^{2}+Y'^{2})\left(1+Yo'^{2}+X'^{2}\left[\dfrac{1+Yo'^{2}}{1+Y'Yo'}\right]^{2}\right)\right]}}$$

$$\mathrm{Tan}\ C = \frac{(\mathrm{Tan}\quad)\sqrt{1+\mathrm{Tan}^{2}\ B}}{\mathrm{Tan}\ B}$$

$$\mathrm{Tan}\ \gamma = \sqrt{(\mathrm{Tan}^{2}\beta)\ (1+\mathrm{Tan}^{2}\ B) + \mathrm{Tan}^{2}\ B}$$

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

$$E = \frac{I_{c,\gamma}}{h^{2}}\ \mathrm{Cos}^{3}\theta$$

In the formulas :

$$X \dashrightarrow X' \quad , \quad X' = X / h$$

$$Y \dashrightarrow Y' \quad , \quad Y' = Y / h$$

$$XO \dashrightarrow XO' \quad , \quad XO = XO / h$$

$$YO \dashrightarrow YO' \quad , \quad YO = YO / h$$

where : **X & Y** represents the coordinates of the point at which the calculating of illuminance needed.

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

Results of the this formulas and computer program is given at the following pages.

T O W E R

Son sayfa computer program.

X0 = 0 Y0 = 5 h = 4

S O N - T : 70W

X	Y	GAMA	C	E
2	4	20.43	342.65	101.94
2	6	16.25	17.35	75.32
2	8	17.40	43.10	72.27
2	10	19.79	57.36	20.00
2	12	22.05	65.43	17.35
2	14	23.95	70.42	7.63
2	16	25.51	73.78	3.93
2	18	26.80	76.11	3.49
2	20	27.87	77.96	2.29
2	22	28.77	79.33	1.53
-2	4	20.43	197.34	101.94
-2	6	16.25	162.65	75.32
-2	8	17.40	136.86	72.27
-2	10	19.79	122.64	20.00
-2	12	22.05	114.57	17.35
-2	14	23.95	109.56	3.49
-2	16	25.51	106.22	7.63
-2	18	26.80	103.83	3.93
-2	20	27.87	102.04	2.29
-2	22	28.77	100.66	1.53

R I G H T - H A N D   S I D E   O F   T H E   B U I L D I N G

X0 = 0   Y0 = 0   S O N - T : 250W

X	Y	GAMA	C	E	h
2	0	7.59	0.00	65.30	15
4	0	14.90	0.00	51.90	15
6	0	21.80	0.00	39.45	15
8	0	28.07	0.00	27.60	15
10	0	3.69	0.00	15.80	15
-2	0	7.59	0.00	65.30	15
-4	0	14.90	0.00	51.90	15
-6	0	21.80	0.00	39.45	15
2	-2	8.04	315	110.60	20
4	-2	12.60	333.45	76.85	20
6	-2	17.54	341.56	67.16	20
8	-2	22.40	345.96	75.87	20
-2	-2	8.04	225.00	110.60	20
-4	-2	12.26	206.56	76.85	20
-6	-2	17.54	198.43	67.16	20
2	-4	10.14	296.56	46.41	25
4	-4	15.79	315.00	91.38	20
6	-4	16.08	326.30	63.95	30
-2	-4	11.49	243.43	127.91	22
-4	-4	14.42	225.00	76.50	22

X	Y	GAMA	C	E	h
-6	-4	18.14	213.69	77.18	22
2	-6	14.19	288.43	136.50	25
4	-6	16.08	303.69	55.00	25
6	-6	18.74	315.00	54.09	25
-2	-6	14.19	251.56	136.50	25
-4	-6	35.79	236.30	126.30	10
-6	-6	40.31	225.00	48.71	10
2	-8	13.20	284.03	31.60	35
4	-8	14.30	296.56	48.70	35
6	-8	15.94	306.80	45.04	35
-2	-8	28.79	255.96	92.61	15
-4	-8	30.80	243.43	58.30	15
-6	-8	33.69	233.10	47.80	15
2	-10	18.77	281.30	28.40	30
4	-10	19.74	291.80	25.18	30
6	-10	21.24	300.96	24.97	30
2	10	34.21	78.69	32.19	15
4	10	35.67	68.19	32.20	15
6	10	37.86	59.03	26.30	15
-2	0	7.59	0.00	65.30	15
-4	0	14.90	0.00	51.90	15
-6	0	21.80	0.00	39.45	15
2	2	8.41	45.00	110.60	20
4	2	12.60	26.56	76.85	20

X	Y	GAMA	C	E	h
6	2	17.54	18.43	67.16	20
8	2	22.40	14.03	75.87	20
-2	2	8.04	135.00	110.60	20
-4	2	12.26	153.43	76.85	20
-6	2	17.54	161.56	67.16	20
2	4	10.14	63.43	46.41	25
4	4	15.79	45.00	91.38	20
6	4	19.82	33.69	63.95	30
-2	4	11.49	116.56	127.91	22
-4	4	14.42	135.00	76.50	22
-6	4	18.14	146.30	77.18	22
2	6	14.19	71.56	136.50	25
4	6	16.08	56.30	55.00	25
6	6	18.74	45.00	54.09	25
-2	6	14.19	108.43	136.50	25
-4	6	35.79	123.69	126.30	10
-6	6	40.31	135.00	48.71	10
2	8	13.20	75.96	31.60	35
4	8	14.30	63.43	48.70	35
6	8	15.94	53.13	45.04	35
-2	8	28.79	104.03	92.61	15
-4	8	30.80	116.56	58.30	15
-6	8	33.69	126.86	47.80	15
2	10	18.77	78.69	28.40	30

X	Y	GAMA	C	E	h
4	10	19.74	68.19	25.18	30
6	10	21.24	59.06	24.97	30
2	-10	34.21	281.30	32.19	15
4	-10	35.67	291.18	32.20	15
6	-10	37.86	300.96	26.30	15

LEFT - HAND SIDE OF THE BUILDING

X0 = 5   Y0 = 6   S O N - T = 100W

X	Y	GAMA	C	E	h
0	2	34.47	223.20	104.50	8
0	4	28.30	202.10	88.80	8
0	6	26.56	00.00	28.01	8
0	8	27.69	162.29	115.20	8
0	10	29.90	150.00	13.67	8
0	12	32.49	141.80	53.62	8
2	0	36.60	257.30	122.09	8
4	0	30.60	275.59	89.80	9
6	0	30.50	294.70	65.40	9
2	2	24.97	243.20	108.10	8
2	4	16.20	216.30	147.20	9
2	6	15.25	00.00	36.20	8
2	8	18.23	152.45	82.40	9
2	10	22.30	139.60	16.40	8
2	12	25.30	130.00	10.80	9
4	2	20.40	93.20	105.80	8
4	4	9.60	257.40	96.80	8
4	6	4.76	00.00	37.50	8
4	8	10.30	131.90	50.16	8

X	Y	GAMA	C	E	h
4	10	15.70	119.00	37.46	9
4	12	20.74	114.80	30.84	9
6	2	21.61	301.58	79.38	8
6	4	7.58	302.30	41.40	15
6	6	3.17	00.00	17.54	15
6	8	7.35	77.39	53.72	8
6	10	13.09	93.20	72.70	8
6	12	18.10	96.50	26.02	8
8	3	15.80	320.00	16.60	13
8	5	11.14	343.00	39.90	13
8	7	9.74	18.70	29.20	13
8	10	13.50	57.90	26.30	13
8	12	17.39	70.00	9.87	13
10	3	20.40	332.00	23.92	13
10	5	15.40	349.20	22.09	15
10	7	15.10	11.30	22.11	13
10	9	15.09	32.10	77.15	15
10	11	17.29	47.70	18.25	15
10	13	20.00	58.40	13.82	15
12	3	24.80	338.80	17.66	13
12	5	21.73	352.30	19.10	13
12	7	20.08	7.99	16.08	13
12	9	19.90	23.80	14.15	13

X	Y	GAMA	C	E	h
12	11	20.97	37.50	15.71	13
12	13	22.70	48.50	12.57	13
14	10	23.89	24.60	15.60	13
14	12	24.60	35.40	9.30	13

B R I D G E   P A R T   O F   T H E   B U I L D I N G

X0 = 5   Y0 = 0   h = 5

S O N - T = 70W

X	Y	GAMA	C	E
1	0	33.69	00.00	56.23
2	0	23.19	00.00	83.53
4	0	6.34	00.00	71.45
2	5	47.65	113.00	39.84
4	5	38.43	98.05	24.39
5.5	5.2	35.06	86.11	17.24
2	-5	47.65	113.00	39.84
4	-5	38.43	98.05	24.39
5.5	-5.2	35.06	86.11	17.24

F R O N T & B A C K S I D E O F T H E B U I L D I N G

X0 = 1 Y0 = 0 S O N - T = 250W

X	Y	GAMA	C	E	h
0	2	5.11	116.55	50.40	25
0	4	9.37	104.03	83.50	25
0	6	16.93	99.97	70.80	20
0	8	21.97	97.13	61.40	20
2	0	2.84	00.00	39.80	20
4	0	8.44	00.00	35.56	20
6	0	13.80	00.00	29.15	20
-2	0	11.40	00.00	61.50	15
-4	0	18.70	00.00	47.28	15
-6	0	25.60	00.00	35.01	15
2	-2	5.78	296.50	137.60	22
4	-2	9.23	326.80	101.07	22
6	-2	12.04	338.10	121.60	25
2	-4	10.58	284.00	80.80	22
4	-4	12.70	306.80	118.00	22
6	-4	16.00	321.30	48.60	22
2	6	15.40	80.54	58.60	22
2	8	20.06	82.89	46.62	22

X	Y	GAMA	C	E	h
4	2	9.23	34.00	101.01	22
4	4	12.71	53.20	118.03	22
4	8	21.08	69.50	45.30	22
6	6	19.33	50.23	22.74	22
6	8	22.08	58.02	41.42	23
8	8	25.43	48.85	32.71	22
-2	-2	14.59	146.25	124.30	14
-2	-4	19.80	126.80	114.90	14
-2	-6	25.87	116.61	100.80	14
-4	-2	20.08	150.26	89.40	15
-4	-4	25.04	141.37	89.60	14
-4	-8	34.57	128.00	43.62	14
-4	-10	39.24	116.50	32.54	14
0	-2	5.11	116.65	50.40	25
0	-4	9.37	104.00	83.50	25
0	-6	16.93	119.46	70.80	20
0	-8	21.97	97.12	61.40	20
2	2	5.78	63.45	137.60	22
4	2	9.23	33.20	101.07	22
6	2	12.04	21.90	121.60	25
6	4	16.00	38.70	48.60	22
-2	2	14.59	146.25	124.30	14
-2	4	19.80	126.80	114.90	14
-2	6	25.87	116.51	100.80	14

X	Y	GAMA	C	E	h
-4	2	20.08	158.16	89.40	15
-4	4	25.04	141.28	89.60	14
-4	8	34.57	121.94	43.62	14
-4	10	39.24	116.51	32.54	14

DIMENSIONS :

X0, Y0, X, Y, h = meter

GAMA, C = degree

E = lux

COMPUTER PROGRAM FOR DIRECT ILLUMINATION

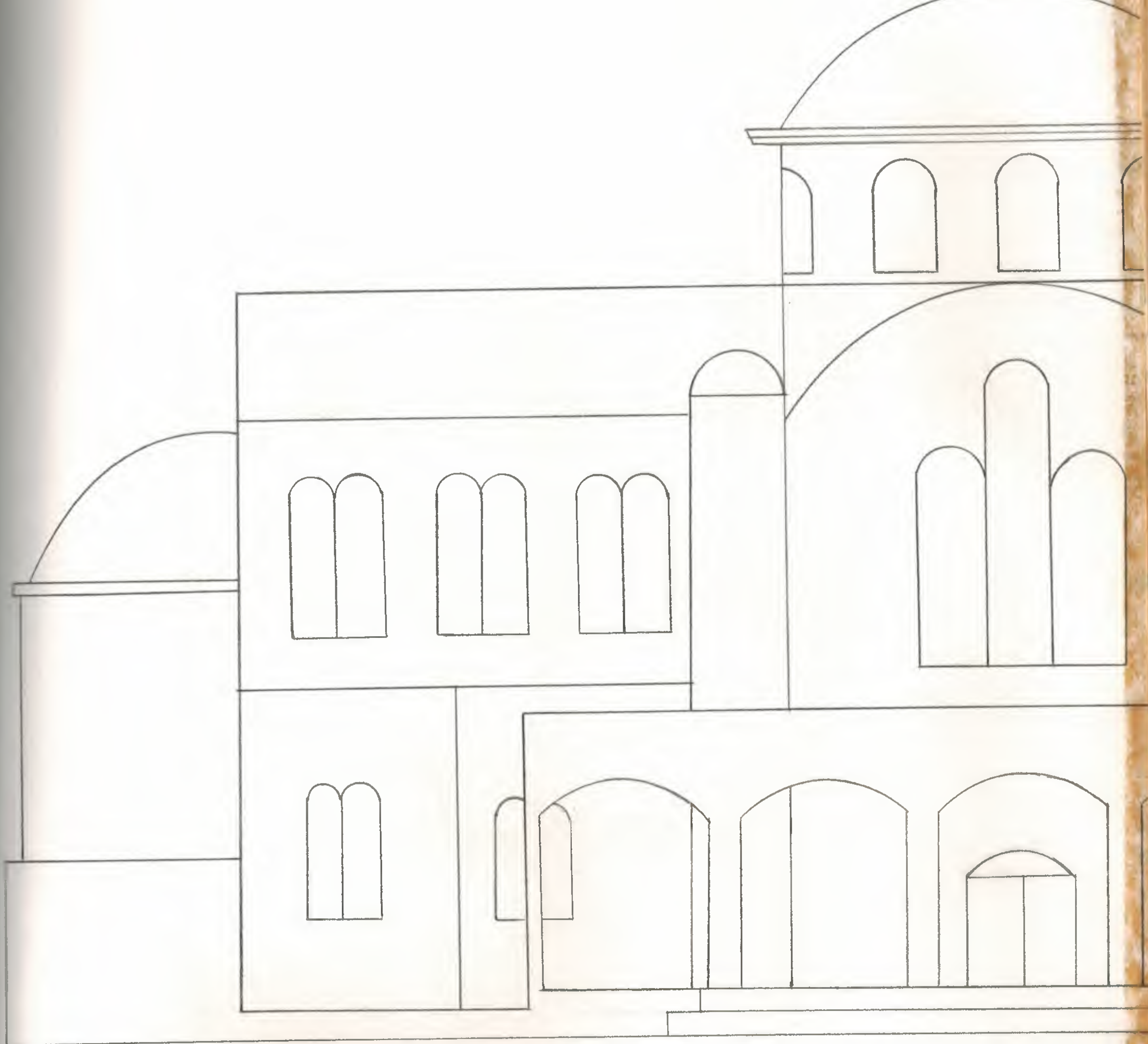
```
      DIMENSION OGA(37.37)
      REAL E,X,h,GAMA,X0,Y0,X1,Y1,C,B,B1,B2,BETA
      REAL C3,T,R,O,O1,O2,T1,INT,PR1,PR2,R1,R2
      OPEN(1,FILE='MATRIX')
      DO 10 I=1,37
      DO 10 J=1,19
      READ(1.*)OGA(I,J)
10    CONTINUE
      CLOSE(1)
      DO 20 I=1,37
      DO 20 J=1,18
20    OGA(I,19+J)=OGA(I,19-J)
      WRITE(*.*)'PLS, ENTER X0,YO POINTS'
      READ(*.*)X0,Y0
      WRITE(*.*)'PLS, ENTER DISTANCE '
      READ(*.*)h
      OPEN(2,FILE='OUT')
      WRITE(5,9)X0,YO
      WRITE(2,9)XO,Y0
9     FORMAT(6X,'XO=',F6.4,4X,'YO=',F6.4,5X,)
      WRITE(5,*)'       X          Y          GAMA        C
   $      E     h   '
      WRITE(2,*)'                                           '
      WRITE(2,*)'       X          Y          GAMA        C
   $      E     h   '
      WRITE(2,19)
19    FORMAT(7X,60('-'))
      OPEN(1,FILE='F77')
5     WRITE(*.*)' PLS, ENTER X,Y POINTS '
      READ(*.*) X,Y
      X1=X/h
      Y1=Y/h
      XO1=XO/h
      YO1=YO/h
      B1=ATAN((X1*SQRT(1+YO1*YO1)/(1+Y1*YO1))
      B2=ATAN(XO1/SQRT(1+YO1*YO1))
      B=B1-B2
      BETA=ACOS((1+Y1*YO1)+(X1*X1(1+YO1*YO1)/(1+Y1*YO1)))
   $  / SQRT((1+X1*X1+Y1*Y1)(YO1*YO1+XO1*XO1((1+YO1*YO1)
   $  /(1+Y*YO)(1+Y*YO)))
      C=ATAN(TAN(BETA)SQRT(((TAN(B)*TAN(B))+1)/(TAN(B))))
      GAMA=ATAN(SQRT(((TAN(BETA))*(TAN(BETA)))*(1+((TAN
   $    (B))*(TAN(B)))+((TAN(B)*(TAN(B))))
      C3=1/((1+(X1*X1)+(Y1*Y1))**(1.5))
      C=(C*180)/3.1415926
      GAMA=(GAMA*180)/3.1415926
      IF((X.LE.0).AND.(Y.GE.0)) C=180+C
```

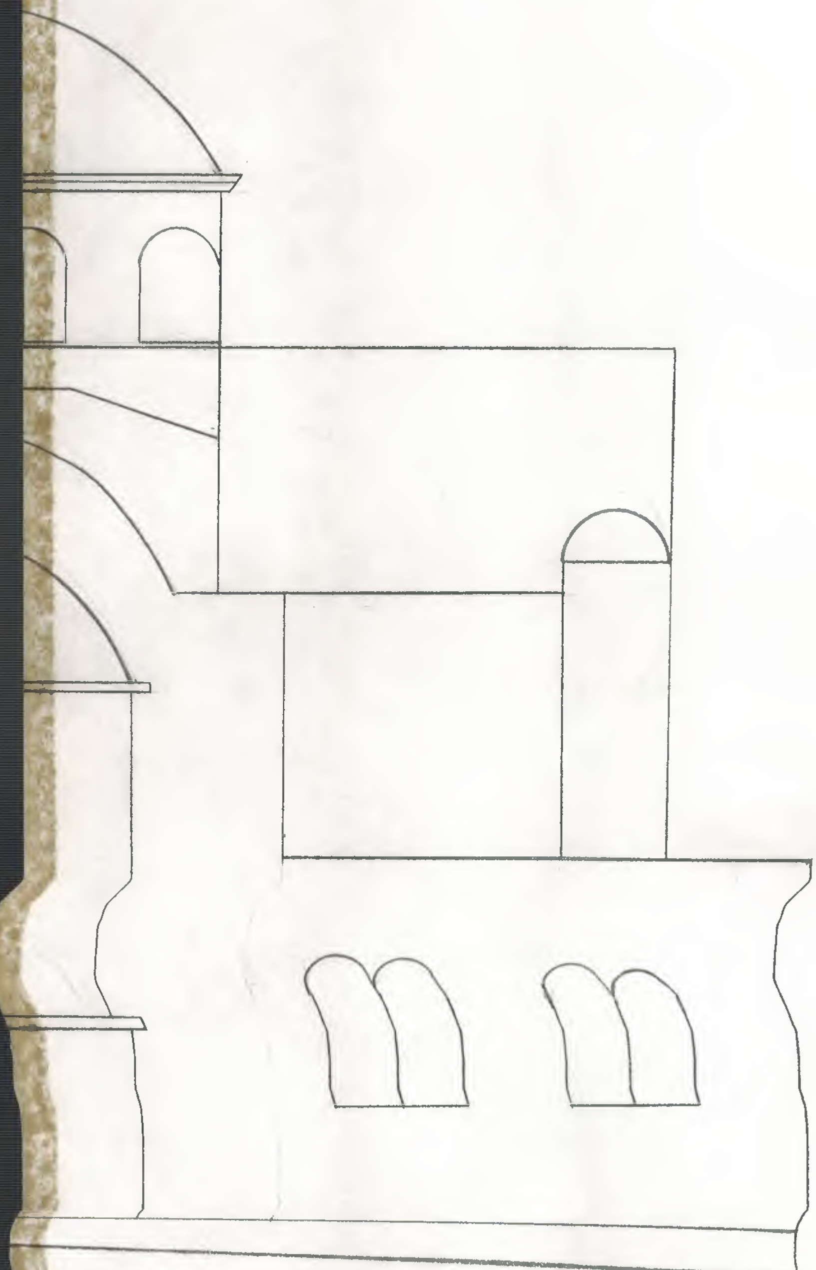
```
      IF((X.LE.0).AND.(Y.LE.0)) C=180-C
      IF((X.GE.0).AND.(Y.LE.0)) C=360-C
      I=GAMA/2.5+1
      J=C/10+1
      IF(MOD(0,10).NE.0)THEN
      T=OGA(I,J)
      R=OGA(I,J+1)
      O1=10*(R-O)/(R-T)+T
      T=OGA(I+1,J)
      R=OGA(I+1,J+1)
      O2=10*(R-O)/(R-T)+T
      T1=OGA(I,J)
      INT=T1-2.5*(GAMA-T1)/(O2-O1)
      ELSEIF(MOD(GAMA,2.5).NE.0)THEN
      PR1=OGA(I,J)
      PR2=OGA(I,J+1)
      R1=2.5*(PR2-GAMA)/(PR2-PR1)+PR1
      PR1=OGA(I+1,J)
      PR2=OGA(I+1,J+1)
      R2=2.5*(PR2-GAMA)/(PR2-PR1)+PR1
      O1=OGA(I,J)
      INT=O1-10*(O-O1)/(R2-R1)
      ELSE
      INT=OGA(I,J)
      ENDIF
      E=(INT*10*C3)/(h*h)
      WRITE(5,80)X,Y,GAMA,C,E,h
      WRITE(2,80)X,Y,GAMA,C,E,h
80    FORMAT(6F10.3)
      GOTO 5
      CLOSE(1)
      END
```

CHAPTER 3

FRONT 1:100 scale

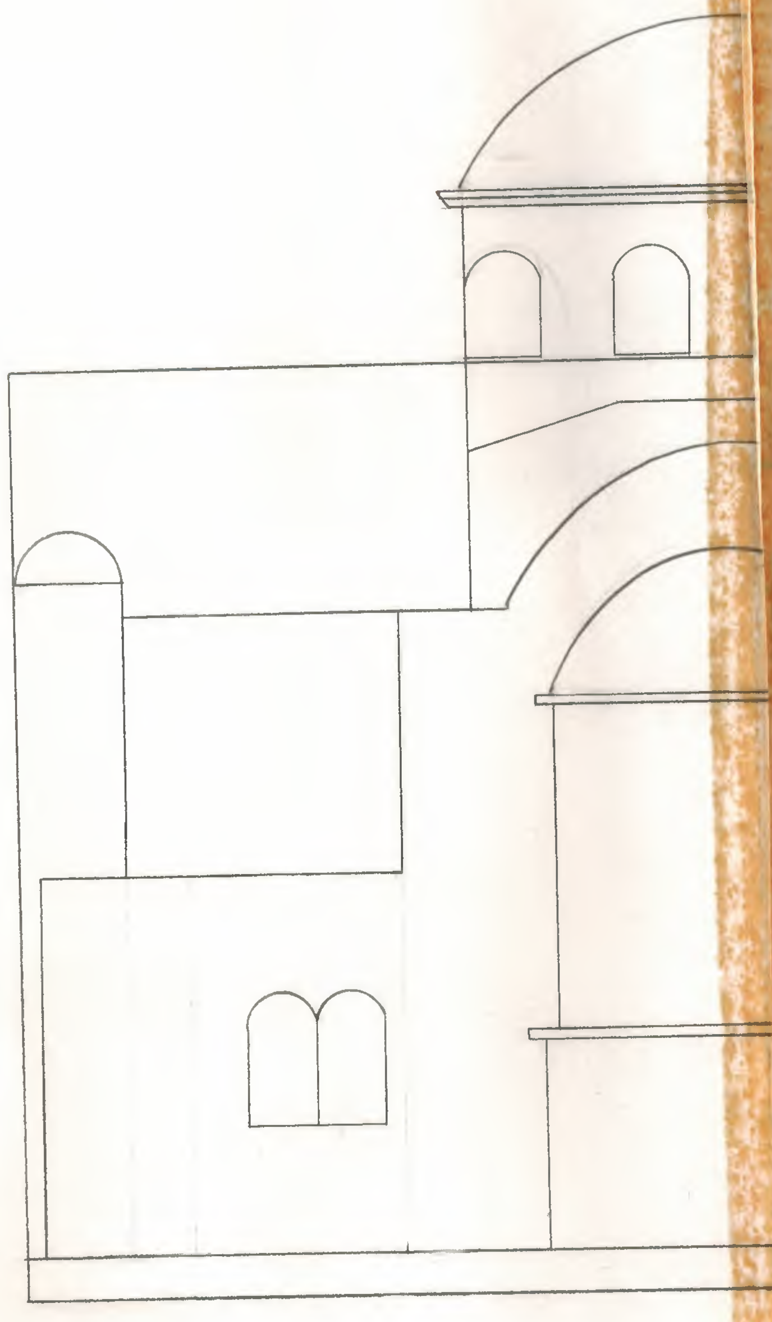
SIDE

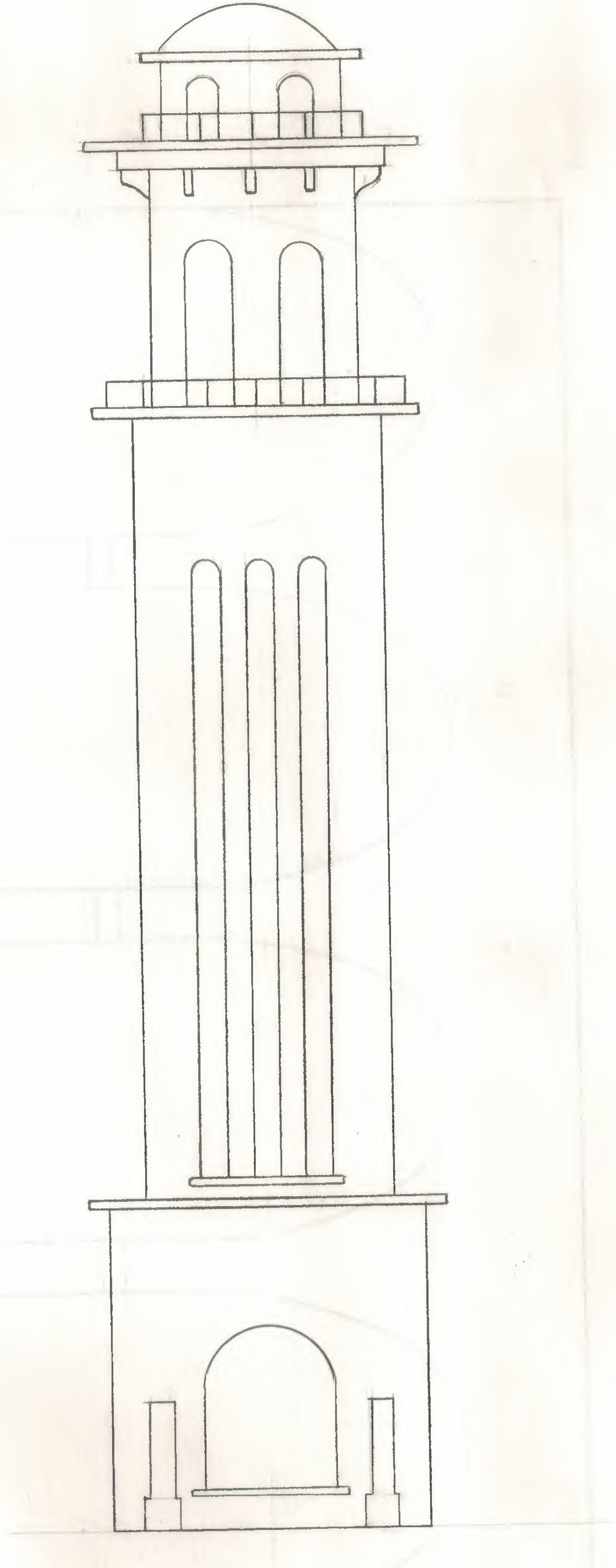




Left Hand Side

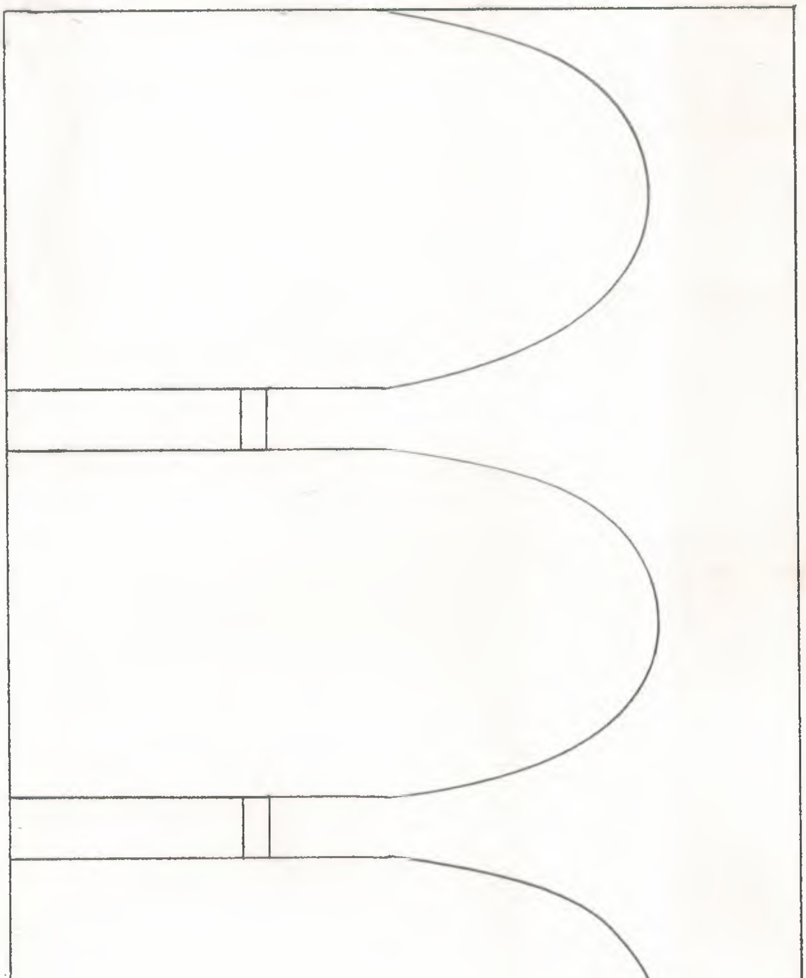
SCALE 1:100





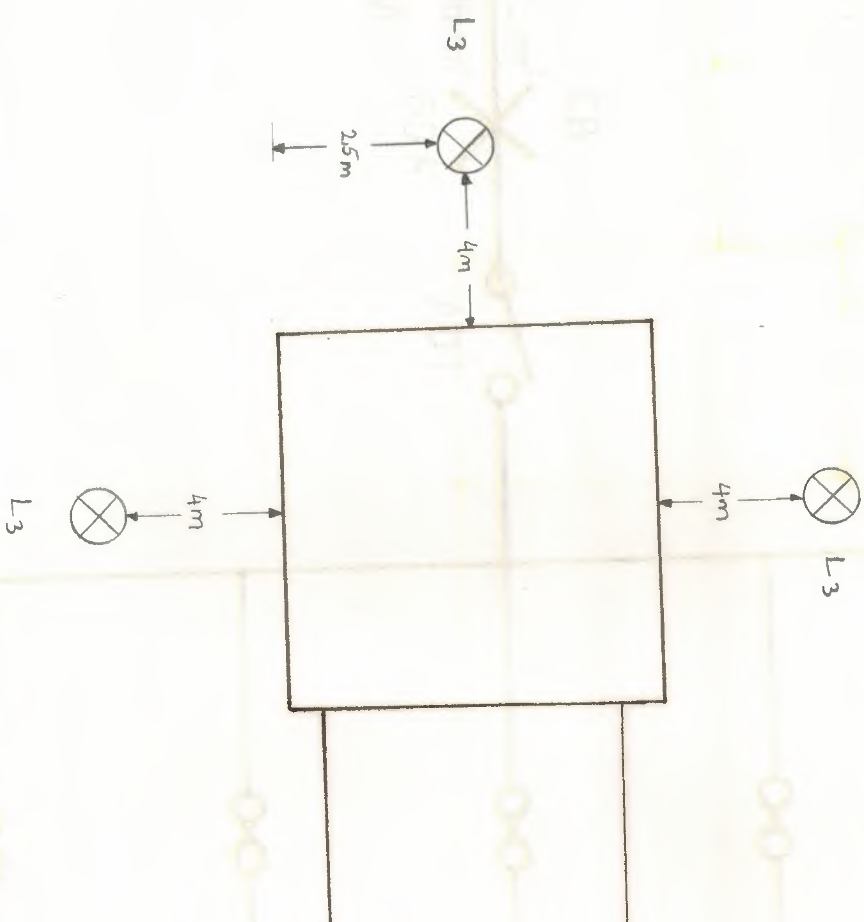
SCALE 1:100

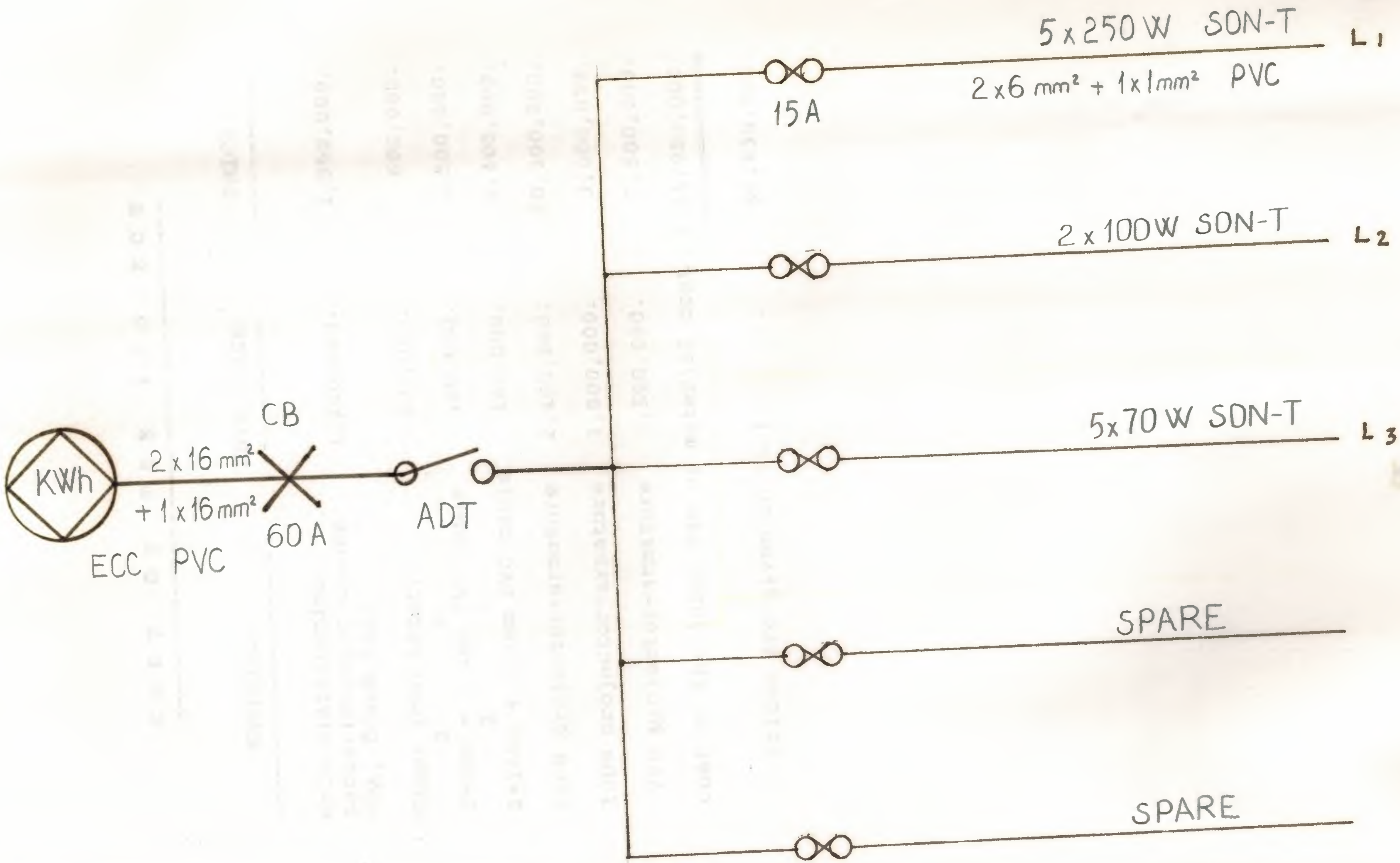
TOWER



SCALE 1:50
BRIDGE PART

scale 1/50


L3
2.5m
4m
4m
4m
L3
L3
5m
5m
L3
L3
11m
A
A'


KWh
2 x 16 mm²
+ 1 x 16 mm²
ECC PVC
CB
60 A
ADT
15 A
5 x 250 W SON-T
2 x 6 mm² + 1 x 1 mm² PVC
L1
2 x 100 W SON-T
L2
5x70 W SON-T
L3
SPARE
SPARE

COST OF THE PROJECT

MATERIAL	UNIT PRICE	PRICE
Main distribution table.(circuit breaker 60A, fuses 13A)	1,350,000.	1,350,000.
Timer (kWh meter)	600,000.	600,000.
2*6mm^2 + 1*1mm^2 PVC cable	100,000.	1,500,000.
2*16mm^2 + 1*1mm^2 PVC cable	140,000.	1,400,000.
250W projector+armature	2,100,000.	10,500,000.
100W projector+armature	1,800,000.	3,600,000.
70W projector+armature	1,500,000.	7,500,000.
Cost of the labor %40 of material cost	:	15,980,000.
(Prices are given in TL)		55,930,000.

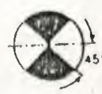
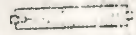
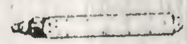
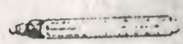
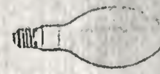
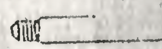
DISCUSSION & CONCLUSION

Floodlighting is the lighting, usually by projection of the whole of a scene or object to a level considerably grater than that of its surroundings. There are some factors that floodlighting engineer should be very careful in order to get good results. For example, average illuminance, choice of light sources, coefficient of regularity, number of armatures and so on. According to convenient choosing of these factors, project can be successful or not. Because, in designing an installation of floodlighting for a building, the all important consideration is the final appearence of the building as whole as seen by the majority of the observers. The project must be to make picture which will have the right impact on the passer by.

In this project by considering all these features (which are written above) I tried to get beauties of this building to reveal by night as well as by day.

Aim of this project to improve my knowledge about the outdoor illumination by using educational studies. During this project I have seen that what floodlighting is in practical life, and also I catched the chance to use my imagination while illuminating this building. Also during the calculation part of this project I have seen that lumen method is not an adequate method to do such a project. So that I used direct method as well as lumen method to get more accurate and acceptable results in this project.

APPENDIX

attage	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
50	2x R7s			11250	90	1,8	4		
250	2x FC2			20000	100	3,0	4		
70	2x R7s			5000	95	1,0	4		
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		
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		
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		
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		
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		
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		
210			•	18000	104	2,5	3	 Any	
350			•	34500	117	3,6	3		

00 burning hours.
mber of minutes after which the lamp has reached 80 per cent of its final luminous flux.
0 x 50.
lamps are connected directly to the mains. The data given in this table refer to the 220-230V version.
mended burning position, especially when undervoltage is expected.

Luminaire (INR) number	: 73			
Measuring code	: LVO 4147			
Luminaire type	: HNF 003-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	H90
Luminaire sizes [mm]	: 0	0	0	0
Symmetry code	: 4			

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

Luminaire (INR) number   : 73

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

* T-Table *

Gamma-angle \ 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	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	538	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	489	520	548	572	587	597	586
17.5	453	457	450	450	471	511	537	552	560	556	560
20.0	426	426	423	427	462	496	507	503	507	510	507
22.5	407	401	399	410	444	466	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	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	297	273	252	233	206	196	206
37.5	164	178	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	99	127	153	170	166	154	153	151	147	151
45.0	58	69	89	119	139	141	134	130	129	130	129
47.5	45	49	63	90	113	118	113	116	108	110	108
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	6	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

uminaire (INR) number : 73

easuring code : LVO 4147
uminaire type : HNF 003-W
amp type : SONT 400W

I-Table *

	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0	190.0	200.0	210.0 → C-plane
0.0	612	612	612	612	612	612	612	612	612	612	612
2.5	606	604	603	602	601	600	599	602	599	600	600
5.0	589	589	587	590	589	588	586	586	586	588	589
7.5	574	569	566	564	565	565	565	564	565	565	565
10.0	567	556	546	539	536	533	533	538	533	533	536
12.5	573	549	526	515	510	508	507	509	507	508	510
15.0	572	548	520	489	477	480	485	480	485	480	477
17.5	552	537	511	471	450	450	457	453	457	450	450
20.0	503	507	496	462	427	423	426	426	426	423	427
22.5	456	456	466	444	410	399	401	407	401	399	410
25.0	408	414	417	416	402	381	383	379	383	381	402
27.5	363	376	381	388	387	355	350	343	350	355	387
30.0	316	336	344	362	359	324	306	303	306	324	359
32.5	274	290	308	328	325	292	264	257	264	292	325
35.0	233	252	273	287	285	254	221	211	221	254	285
37.5	201	217	233	246	237	214	178	164	178	214	237
0.0	175	182	196	206	194	168	133	123	133	168	194
2.5	153	154	166	170	153	127	99	86	99	127	153
5.0	130	134	141	139	119	89	69	58	69	89	119
7.5	116	113	118	113	90	63	49	45	49	63	90
0.0	92	98	99	91	70	49	37	32	37	49	70
2.5	45	100	82	70	56	35	25	20	25	35	56
5.0	10	72	68	49	41	20	16	12	16	20	41
7.5	9	21	44	33	21	10	10	9	10	10	21
0.0	7	7	12	13	10	7	8	6	8	7	10
2.5	7	5	3	3	5	4	5	4	5	4	5
5.0	7	5	3	3	2	4	3	2	3	4	2
7.5	6	4	2	2	3	3	2	2	2	3	3
0.0	6	4	2	2	2	2	2	1	2	2	2
2.5	5	3	2	1	2	2	1	1	1	2	2
5.0	4	3	2	1	1	1	1	1	1	1	1
7.5	3	2	1	1	1	1	1	1	1	1	1
0.0	2	1	1	1	0	0	0	0	0	0	0
2.5	1	1	0	0	0	0	0	0	0	0	0
5.0	0	0	0	0	0	0	0	0	0	0	0
7.5	0	0	0	0	0	0	0	0	0	0	0
0.0	0	0	0	0	0	0	0	0	0	0	0

mma-angle

Luminaire (IHR) number : 13

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

* I-Table *

Gamma-angle \ 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	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	589	589	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	556	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	503	507	510	507	503	507	496	462
22.5	444	466	456	456	457	458	457	456	456	466	444
25.0	416	417	414	408	399	400	399	408	414	417	416
27.5	388	381	376	363	346	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	113	116	108	111	108	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	45	100	82	70
55.0	49	68	72	10	45	48	45	10	72	68	49
57.5	33	44	21	9	22	19	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

Luminaire (DIR) number : 73

Measuring code : LVC 4157
Luminaire type : HNF 003-W
Lamp type : SONT 400W

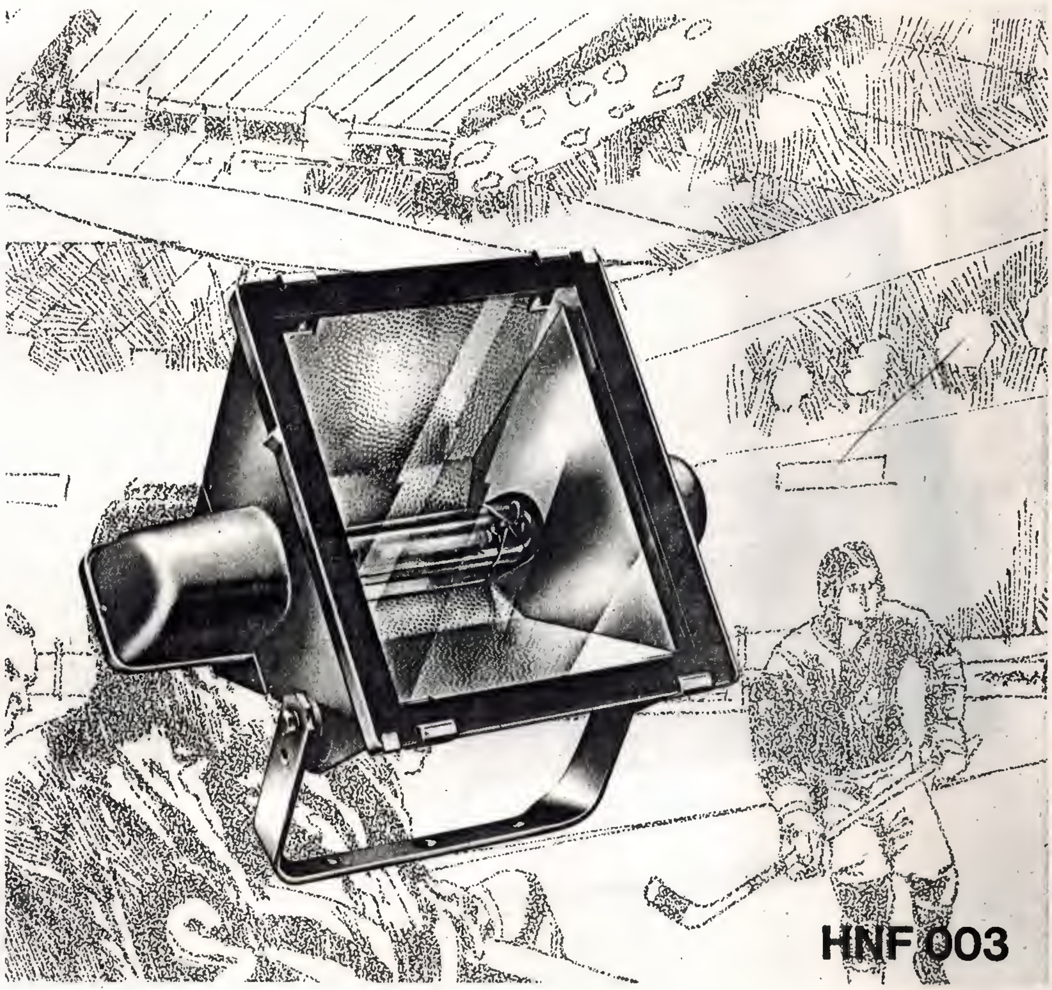
* I-Table *

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

NITION

light for one of the fol-
g lamps:
400 W metal halide lamp
400 W mercury vapour

T 250 W or 400 W high-
ure sodium lamp.



CRIPTION

using and rear cover of high-pressure die-cast aluminium
stings of low copper-content for excellent corrosion-
istance, even in coastal and industrial areas.
o beam-versions, as different reflectors are available:

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

gh-grade aluminium reflectors for accurate beam control
mp replacement is effected by removing the rear-cover, thus
ilitating servicing
sy-to-operate stainless steel clips on rear-cover; to be closed
hand and opened by using a simple tool.
e floodlight cannot be easily opened by unauthorized per-
ns.

- Cast-on beam-aiming sight and protractor scale for quick daylight 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

ERING DATA

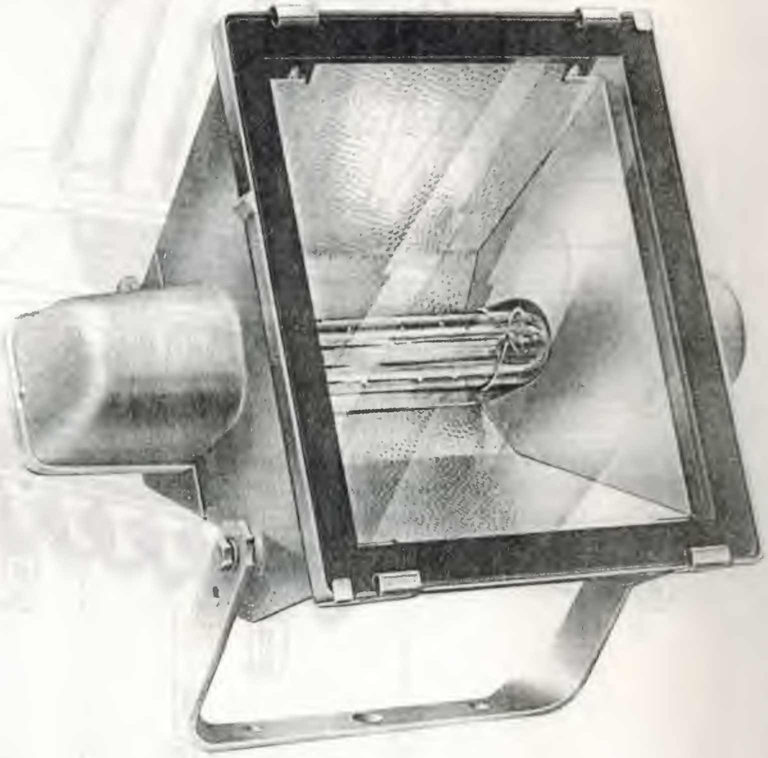
Designation	For lamps	Ordering number * Narrow-beam type	Ordering number * Wide-beam type	Weight kg
HNF 003	1 x SON/T 250 W	9112 702 302..	9112 702 303..	7,30
	1 x HP/T 400 W	9112 702 426..	9112 702 427..	7,30
	1 x SON/T 400 W or 1 x HPI/T 400 W	9112 702 448..	9112 702 449..	7,30

* Complete floodlight

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

HNF 003 - XNF 003 G

Classification	
P 55	
HNF 003 and XNF 003 G floodlights for:	
High-pressure sodium lamps	
x SON-T 250 W x SON-T 400 W	: HNF 003
Metal halide lamps	
x HPI-T 400 W	: HNF 003
Low-pressure sodium lamps	
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

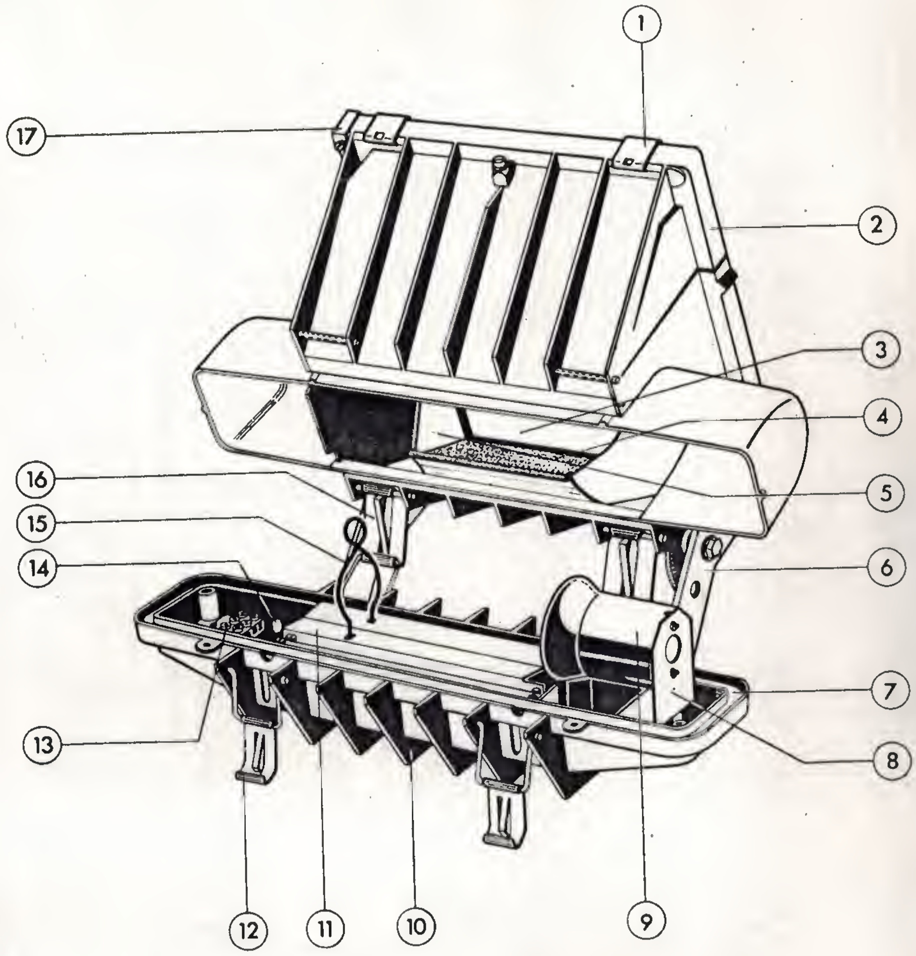
- Housing and rear cover of high-pressure die-cast aluminium.
- The front glass is a 5 mm thick toughened glass plate, which is attached to the housing by four stainless steel clips.
- High-grade aluminium reflectors for accurate beam control.
- Castings of low copper-content for excellent corrosion-resistance, 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.

RAWING

ass clips (4x)

ass
c reflector
lector

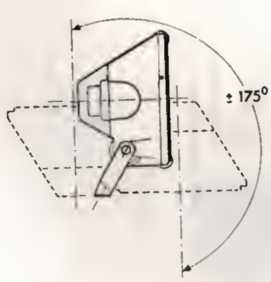
rear cover
lder bracket
lder
ver
flector
clip top (2 x)
al block
ntry
upport
clip bottom (2 x)
bracket (2 x)



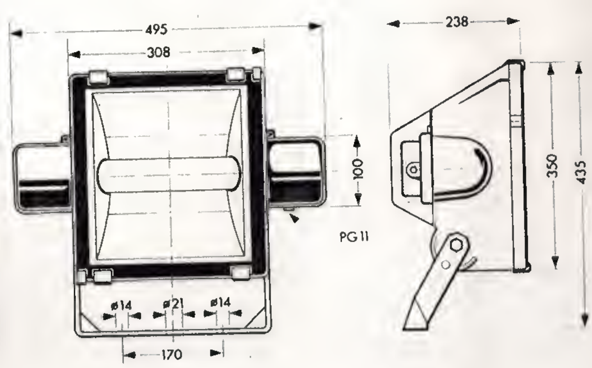
REPLACEMENT OF FRONT GLASS

- Remove the two safety brackets
- Open the four clips by placing a screwdriver in the appropriate holes

ADJUSTMENT POSSIBILITIES



DIMENSIONS



HIGH PRESSURE SODIUM (SON)

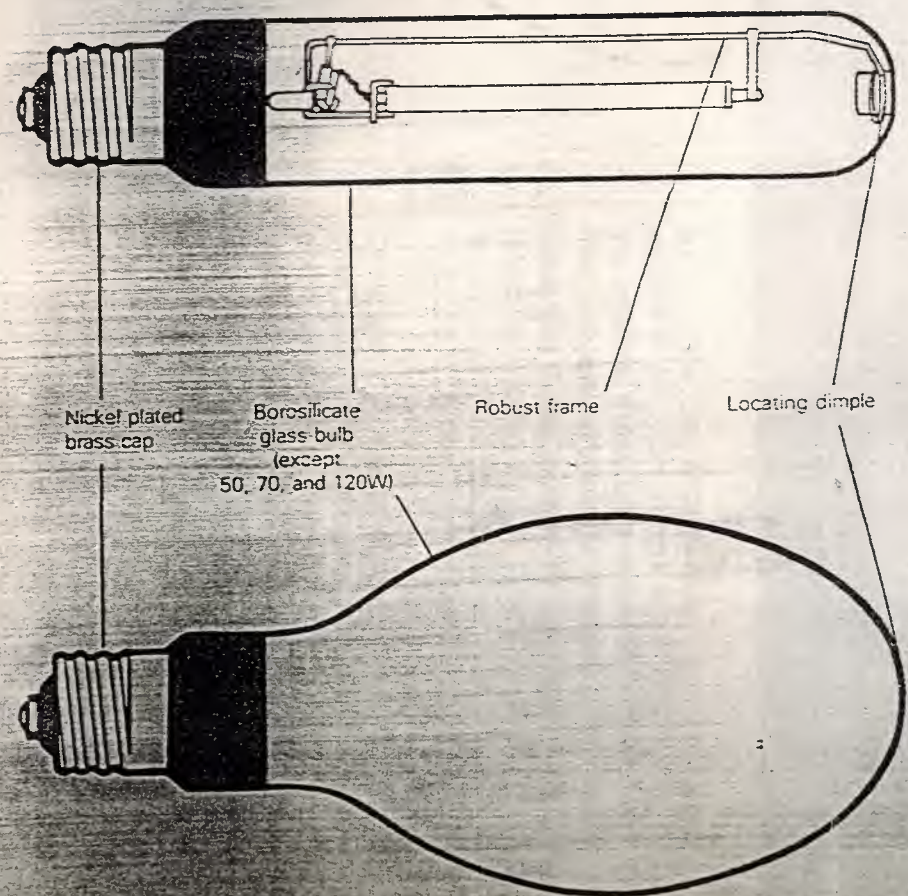
SOLARCOLOUR

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

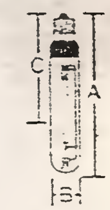
Solarcolour lamps are available in four shapes each with its own function, for use in specialised luminaires.

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.



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	15250
220	220	E40 (GES)	10		24000	22500
250	220	E40 (GES)	10		28000	27000
310/360	220	E40 (GES)	10	@ 310W	37000	35500
	230			@ 360W	43500	41500
400	220	E40 (GES)	10		50000	48000
600	380	E40 (GES)	10		70000	65000
1000	380	E40 (GES)	4		135000	130000



SON-T, SONP-T, SONDL-T

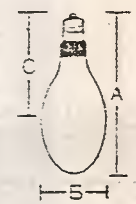
	A	B	C
120W	176	76	104
150W	211	52	130
220-250W	257	52	156
310-400W	285	52	175
600W	328	67	210
1000W	400	67	240

Clear Tubular SON-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	16000	15250
250	220	E40 (GES)	10	28000	27000
400	220	E40 (GES)	10	50000	48000
600	220	E40 (GES)	10	74000	70000
1000	220	E40 (GES)	10	132000	127000

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

Watts	Minimum Nominal Supply Volts	Cap	Std Pack		Initial Lumens 100 hrs	Lighting Design Lumens 2000 hrs
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		15250	14500
220	220	E40 (GES)	10		23000	21500
250	220	E40 (GES)	10		27000	26000
310/360	220	E40 (GES)	10	@ 310W	36000	34500
	230			@ 360W	42000	40000
400	220	E40 (GES)	10		48500	46500



SON-E, SONP-E, SONDL-E

	A	B	C
50-70W	157	72	100
120W	178	76	112
150-250W	227	91	160
310-400W	285	121	175

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

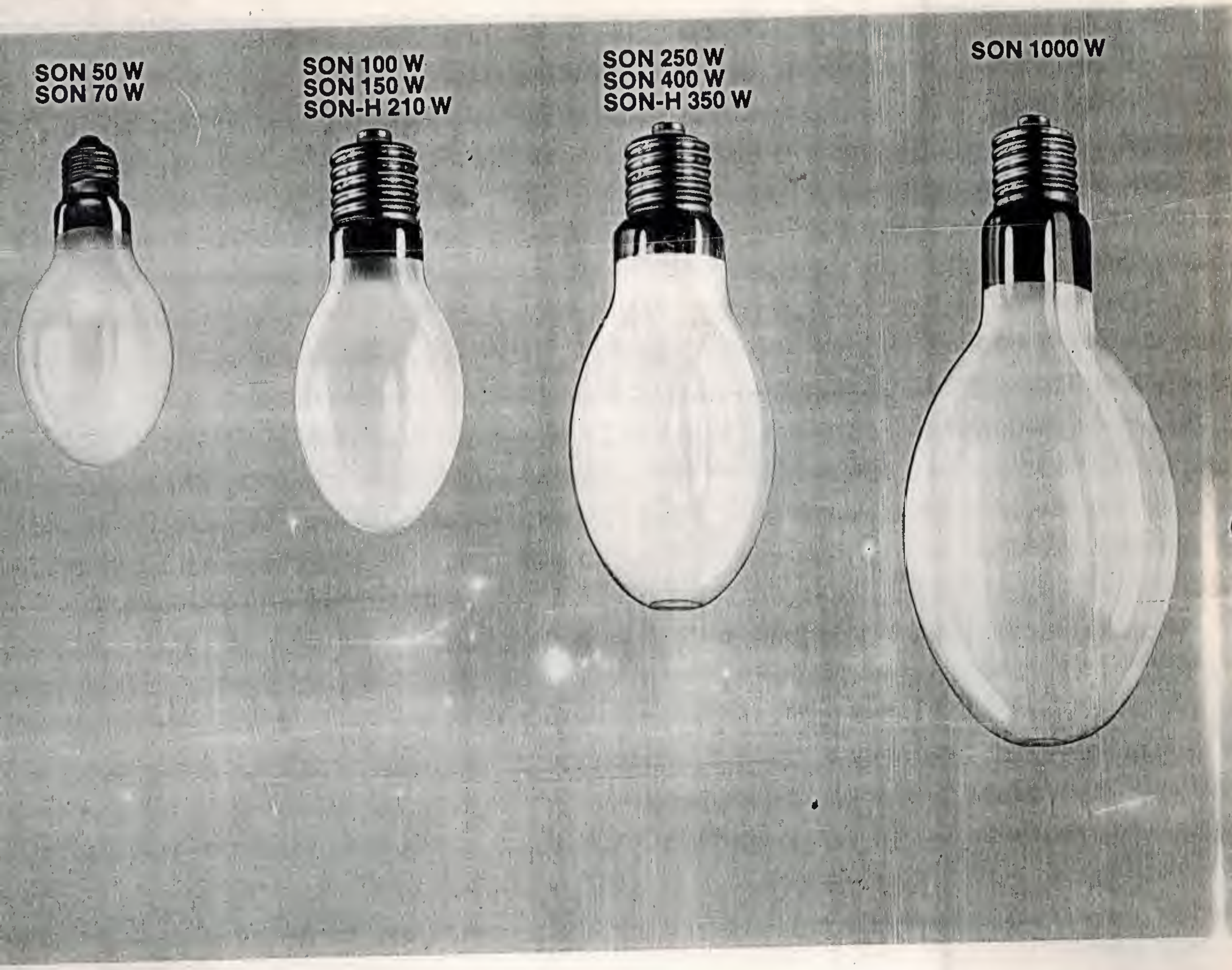
Watts	Minimum Nominal Supply Volts	Cap	Std Pack	Initial Lumens 100 hrs	Lighting Design Lumens 2000 hrs
150	220	E40 (GES)	10	15250	14500
250	220	E40 (GES)	10	27000	26000
400	220	E40 (GES)	10	48500	46500

(I) This international symbol which is marked on all Solarcolour lamps which have an internal snap starter switch, indicate that they can be used in luminaires whether or not they have an external starter fitted.

(E) Lamps marked with this symbol can only be used in luminaires fitted with an external starter.

Manufactured to IEC662

For further technical information see pages 226 and 227



ny high-pressure
dium lamps

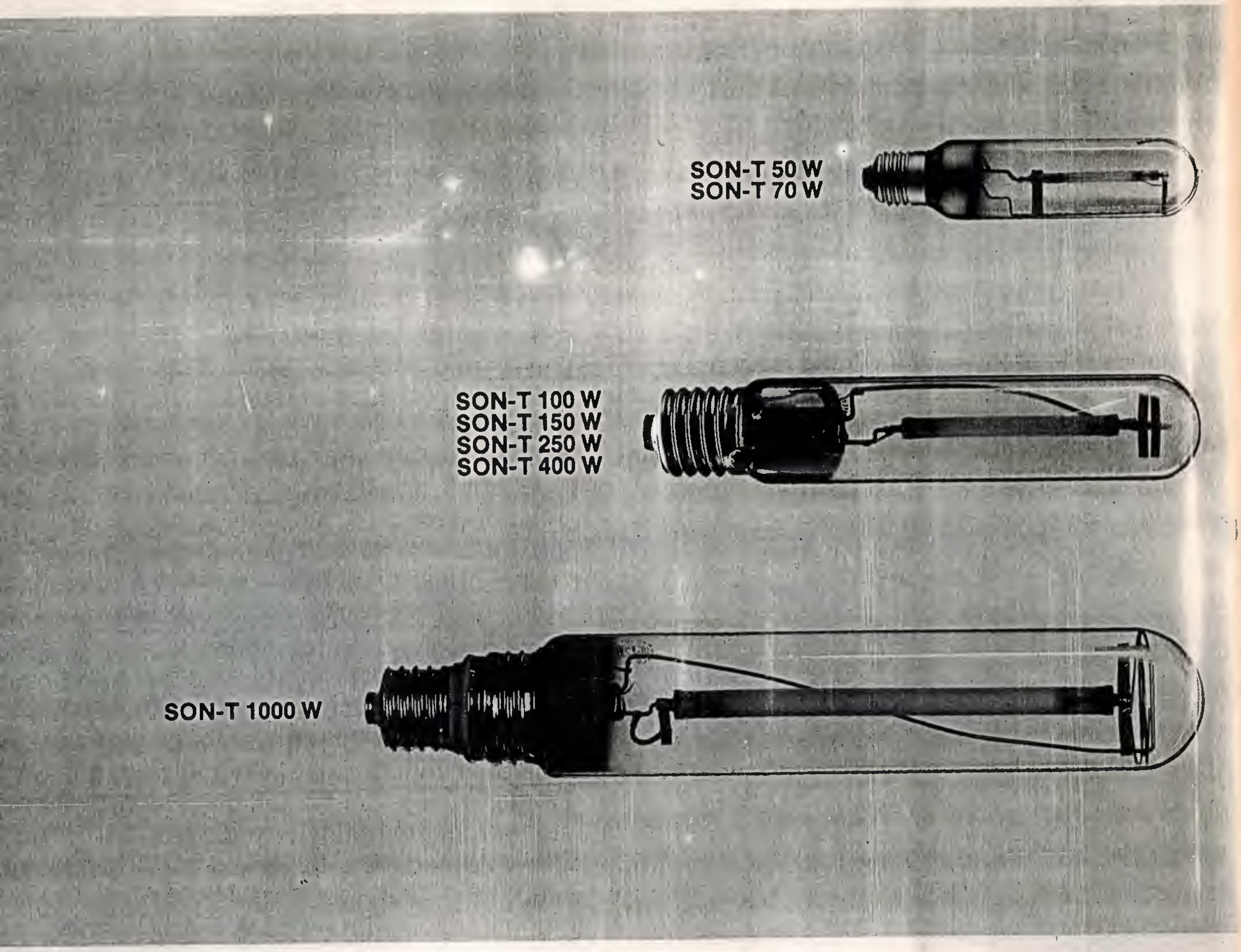
short answer to this question is:

- igh luminous efficacy
- iolden white light
- alanced colour rendering
- ong economic life
- Reliable, stable operation
- xcellent lumen maintenance
- Short re-ignition time

h-pressure sodium lamps combine very h efficacies (up to 130 lm/W) with moderate our rendering, and are therefore suitable for ny applications where such factors, together h good economics and long lamp life, are portant.

Experience has shown that, since the late sixties when SON lamps were introduced on to the market, these light sources have proved themselves particularly in terms of all-round reliability. Compared with the version originally launched, today's high-pressure sodium lamps enjoy improved life, together with a higher light output and better lumen maintenance.

On top of this, the brief re-ignition time — the time taken for the discharge to restrike should an interruption in the mains supply occur — represents an added safety feature; this interval is normally less than two minutes for lamps with an external ignitor in the circuit.



he range at a glance

ON 50.W-I, 70 W-I - Two ovoid-shaped, ated lamps, each with a built-in ignitor and ed with an E27 base; for residential area hting and particularly for the conversion of ercury lamp installations.

ON 50 W-E, 70 W-E - Similar to SON 50 W-I d SON 70 W-I, except that the lamps require external ignitor.

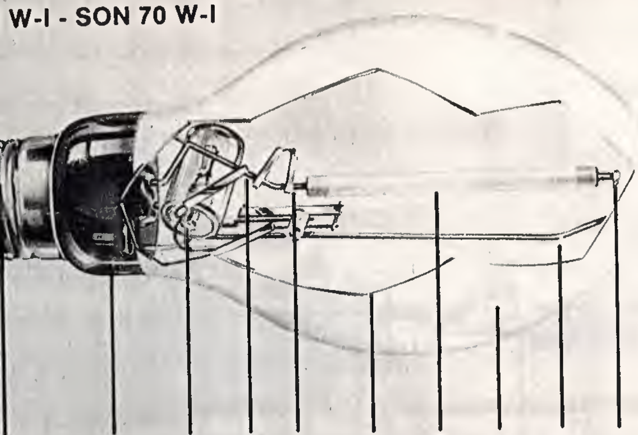
ON 100 W, 150 W, 250 W, 400 W, 1000 W - range of ovoid coated lamps suitable for a de selection of indoor and outdoor lighting plications; operate on a ballast plus an ternal ignitor; because of their ovoid shape, ese lamp types can also be used in optical stems designed for high-pressure mercury mps.

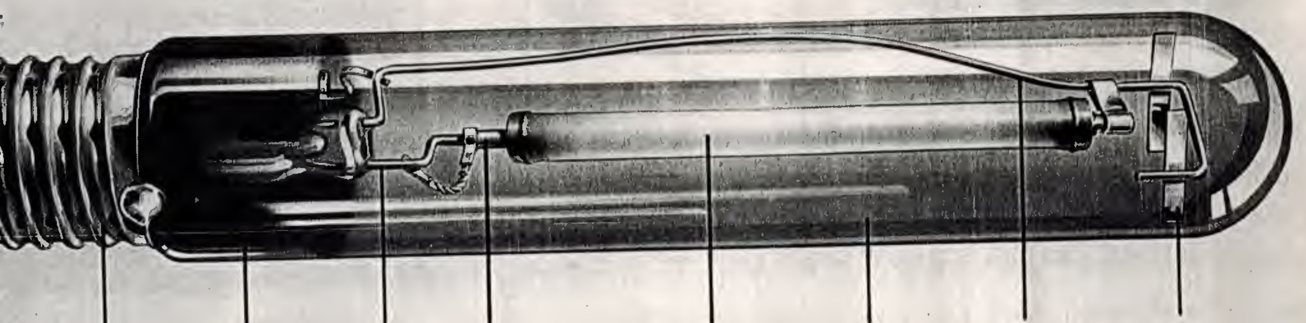
SON-T 50 W-E, 70 W-E, 100 W, 150 W, 250 W, 400 W, 1000 W - Seven clear tubular lamps ideal for application in precise optical systems such as floodlights and road lighting luminaires; require a ballast and an external ignitor.

SON-S 150 W, SON-ST 150 W - High efficacy versions of the SON 150 W and SON-T 150 W lamps respectively.

SON-H 210 W, 350 W - Intended for direct replacement of mercury vapour lamps, the 210 W version can be connected to a 250 W mercury lamp ballast whilst the 350 W lamp connects to a 400 W mercury lamp ballast, without requiring an ignitor in the circuit; both lamps have ovoid, internally coated bulbs and an incorporated ignition aid.

W-I - SON 70 W-I





w high-pressure sodium lamps rk

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

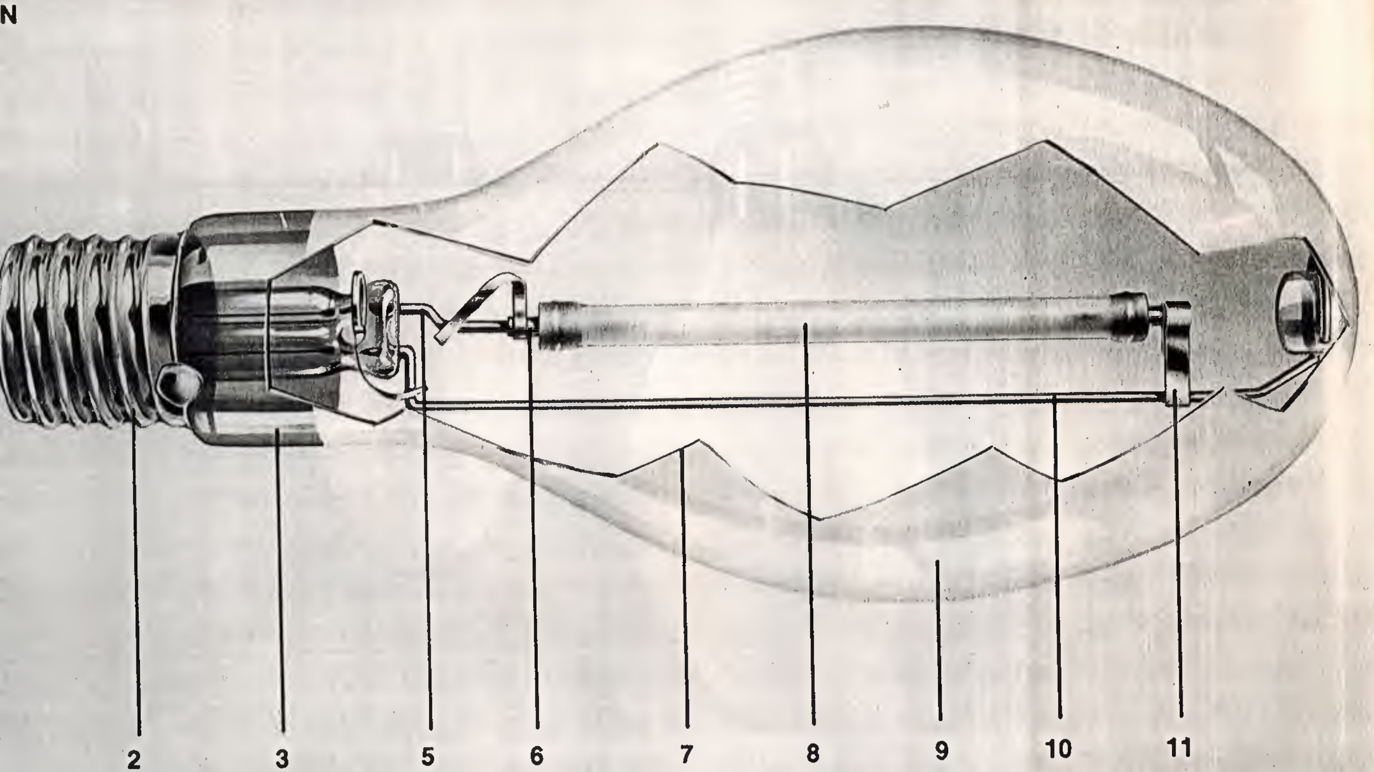
t, the tube is inserted into a clear, tubular elope (SON-T) or built into an ovoid bulb diffusing layer (SON). Here it is held in ce by the support wire. Extra protection is en by special support springs which hion the discharge tube against vibration.

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

N



0 W-I and 70 W-I and SON-H lamp types this jnition device is built-in. Where the ignitor is xternal, a number of low-energy, igh-frequency pulses are superimposed upon ne mains voltage across the lamp electrodes.

he initial discharge takes place in a rare gas. eat is thus dissipated, causing some of the nercury to evaporate.

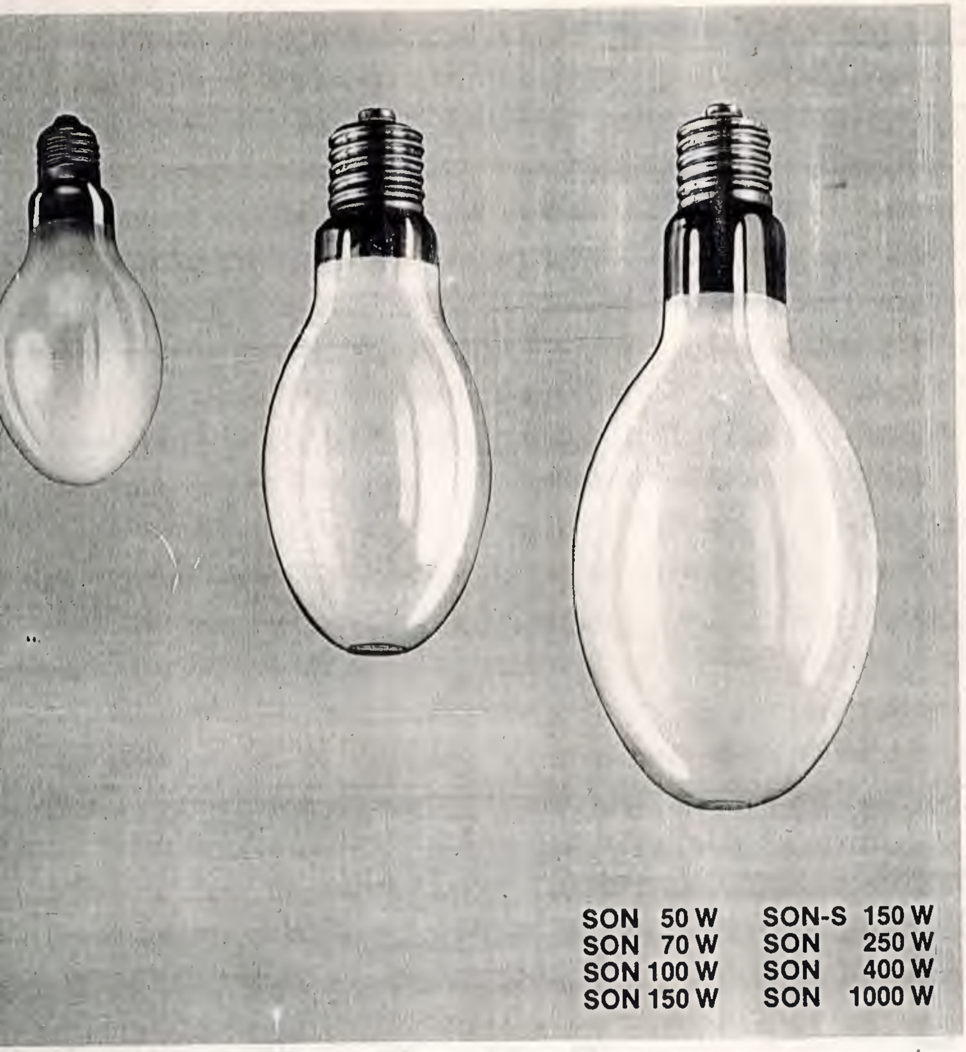
he sodium, with its lower excitation potential, nen gradually takes over the discharge and fter a short time the lamp burns stably, mitting its characteristic, pleasant, olden-white light at luminous efficacies of up o 130 lm/W.

ome 80% of nominal light output is reached vithin an average of four minutes. An additional dvantage is the fast restrike time; for lamps vith an external ignition device, this factor can be of the utmost importance in applications where short power supply interruptions might otherwise lead to dangerous situations owing to lack of light.

Cut-away view

1. Porcelain insulating disc in base.
2. E27/E40 screw base.
3. Getter to ensure high vacuum throughout life.
4. Internal ignitor for SON 50 W-I and 70 W-I, and SON-H.
5. Lead-in wire/support.
6. Expansion unit to eliminate temperature stresses on welds and discharge tube.
7. Inner phosphor coating.
8. Translucent aluminium oxide discharge tube.
9. Tubular or elliptical outer bulb, impervious to atmospheric conditions.
10. Support/lead-in wire, twisted for improved optical characteristics.
11. Support springs.

SON lamps



tion

ressure sodium vapour lamps, for outdoor and indoor use, sintered aluminium oxide discharge tube enclosed in a outer bulb.

ription

cause of the high sodium pressure, the lamp combines ery high luminous efficacy with a good colour appearance. e bulb wall is electrostatically coated with a very uniform er of calcium pyrophosphate.
e use of the coating results in very low light losses and sures constantly high quality performance throughout life. e geometry of the lamp makes it the ideal light source for e with the same reliable optical systems applied with rcury vapour discharge lamps.
ditional advantages:
ong economical life
Excellent lumen maintenance
Reliable, stable operation.

Applications

— Public lighting
— Parking lots
— Airports
— Floodlighting
— Industrial lighting
— Plant irradiation
— Sports lighting

Ballasts and ignitors

High-pressure sodium lamps require high quality ballasts for optimum operation, as well as ignitors to ensure reliable ignition. For ballasts and ignitors see relevant leaflets.

Temperatures

Max. permissible base temperature: 250 °C
Max. permissible bulb temperature: 350 °C

Dimensions

Lamp designation	A max.	B max.	C max.
SON 50 W	156	35	72
SON 70 W	156	35	72
SON 100 W	186	43	77
SON 150 W	227	53	92
SON-S 150 W	227	53	92
SON 250 W	227	53	92
SON 400 W	292	58	122
SON 1000 W	400	60	168

ositions

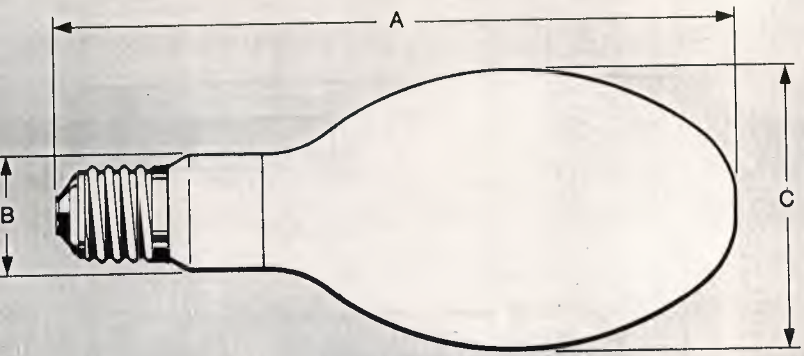
data

	Base	Min. supply voltage for ignition[1]) V +20° C	Min. supply voltage for ignition[1]) V −18° C[4])	Average lamp voltage[2]) V	Average lamp current[2]) A	Min. supply voltage for stable operation V	Max. starting current (mains current) A	Average luminous flux[2]) lm horizontal	Average luminance cd/cm²	Run-up time minutes[3])
W-I[5])	E27	198	220	85	0,76	200	1,08	3300	4,5	5
W-E[5])	E27	198	220	85	0,76	200	1,08	3300	4,5	5
W-I[5])	E27	198	220	90	1,00	200	1,35	5800	7	5
W-E[5])	E27	198	220	90	1,00	200	1,35	5800	7	5
W	E40/45	190	200	100	1,20	200	1,70	9500	15	5
W	E40/45	170	200	100	1,80	200	2,40	13500	10	5
W	E40/45	170	200	100	1,80	200	2,40	15500	12	4
W	E40/45	170	200	100	3,00	200	4,50	25000	19	5
W	E40/45	170	200	105	4,45	200	6,50	47000	24	5
W	E40/45	170	200	110	10,30	200	14,00	120000	36	6

. [2]) After 100 burning hours.
er of minutes after which the lamp has reached 80% of its final luminous flux.
l ignite even on nominal voltage at temperatures of −30° C.
ernal ignitor, I with internal ignitor.

and packing data

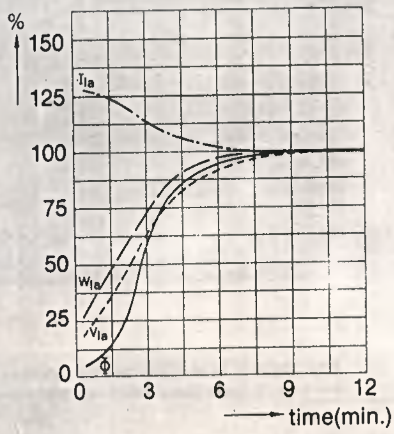
n	Ordering number	Nett weight kg	Packing unit Qty	Weight kg	Dimensions cm	Volume m³
0 W-I	9281 508 088 . .	0,050	24	3,80	44 x 36 x 39	0,062
0 W-E	9281 520 088 . .	0,050	24	3,80	44 x 36 x 39	0,062
0 W-I	9281 501 088 . .	0,050	24	3,80	44 x 36 x 39	0,062
0 W-E	9281 518 088 . .	0,050	24	3,80	44 x 36 x 39	0,062
00 W	9281 516 088 . .	0,105	12	3,90	45 x 35 x 30	0,052
50 W	9281 503 098 . .	0,178	12	3,90	45 x 35 x 30	0,052
50 W	9281 514 098 . .	0,178	12	3,90	45 x 35 x 30	0,052
50 W	9281 510 098 . .	0,178	12	3,90	45 x 35 x 30	0,052
00 W	9281 520 098 . .	0,250	6	2,98	44 x 31 x 35	0,056
00 W	9281 540 098 . .	0,450	6	6,40	58 x 41 x 47	0,112



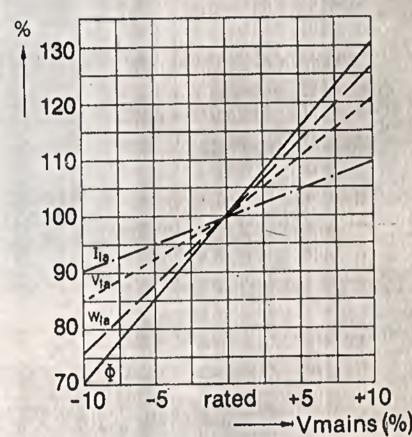
Typical curves

W_{la} = lamp wattage
V_{la} = lamp voltage
I_{la} = lamp current
Φ = luminous flux

Lamp performance during starting period

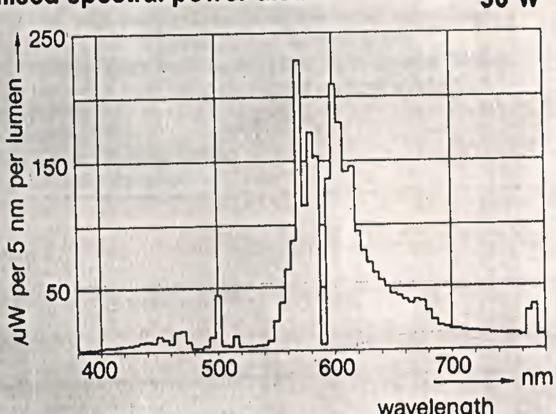


Effects of mains voltage variations

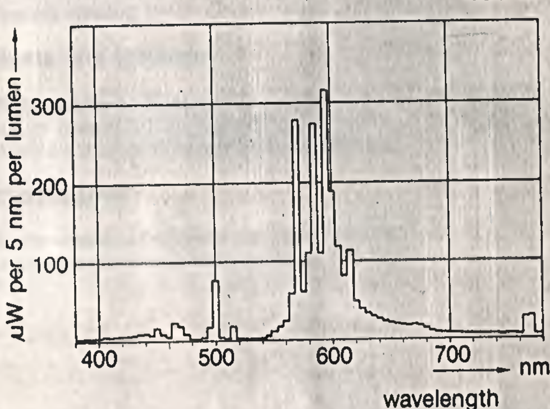


Normalised spectral power distributions

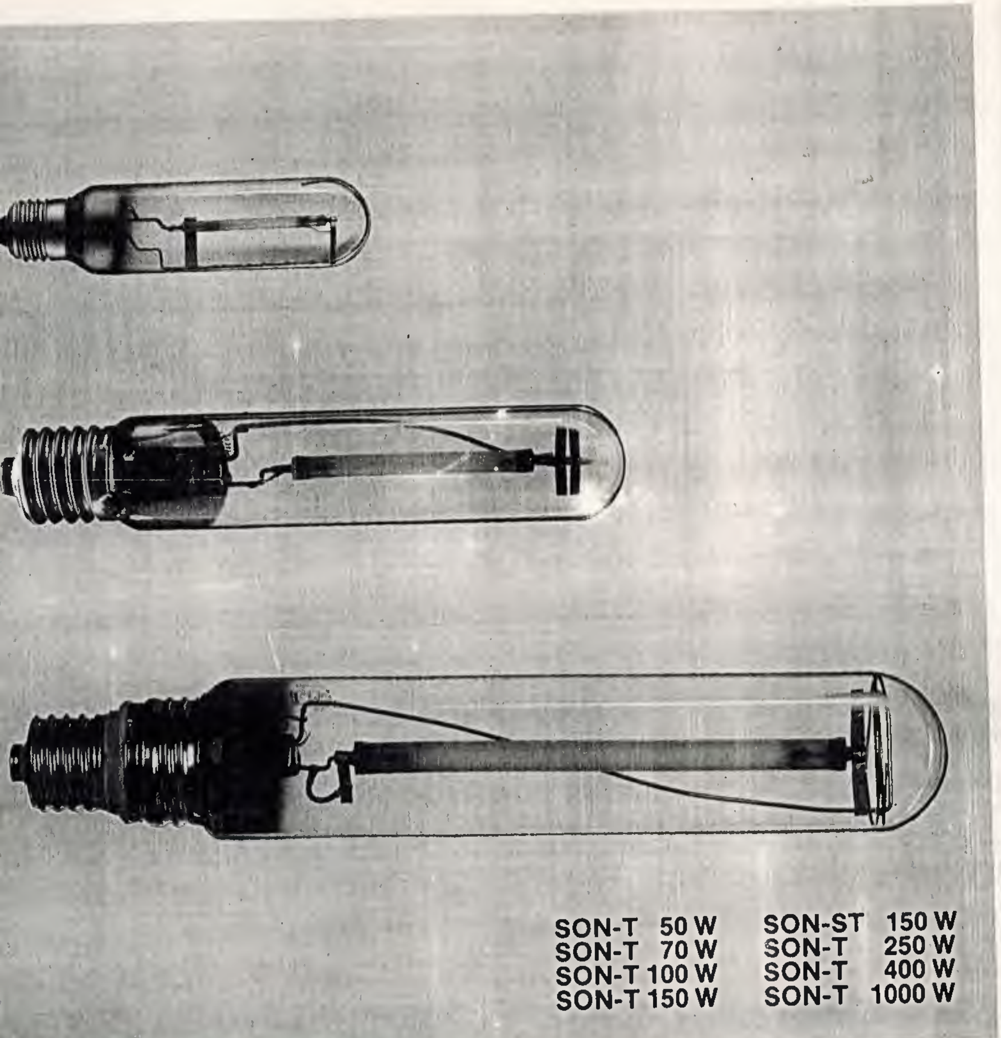
50 W



400 W



SON-T lamps



SON-T 50 W
SON-T 70 W
SON-T 100 W
SON-T 150 W
SON-ST 150 W
SON-T 250 W
SON-T 400 W
SON-T 1000 W

efinition

gh-pressure sodium vapour lamps, for outdoor and indoor use, th sintered aluminium oxide discharge tube enclosed in a ear, tubular hard-glass outer bulb.

escription

Because of the high sodium pressure the lamp has a high luminous efficacy and a good colour appearance.
The clear, tubular outer bulb makes this light source highly suitable for use with specially designed optical systems.
Additional assets:

- Long economical life
- Excellent lumen maintenance
- Reliable, stable operation.

Applications

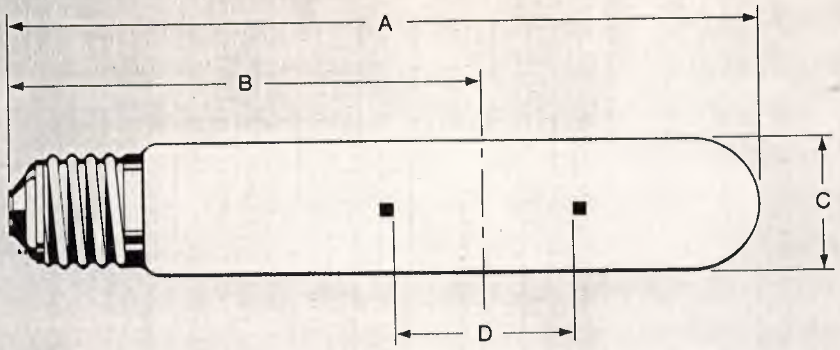
- Public lighting
- Parking lots
- Airports
- Floodlighting
- Industrial lighting
- Plant irradiation
- Sports lighting

Ballasts and ignitors

High-pressure sodium lamps require high quality ballasts for optimum operation, as well as ignitors to ensure reliable ignition. For ballasts and ignitors see relevant leaflets.

Temperatures

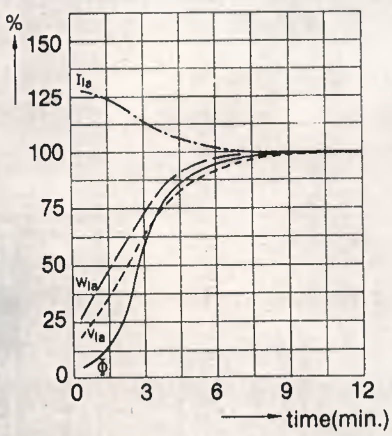
Max. permissible base temperature: 250 °C
Max. permissible bulb temperature: 450 °C



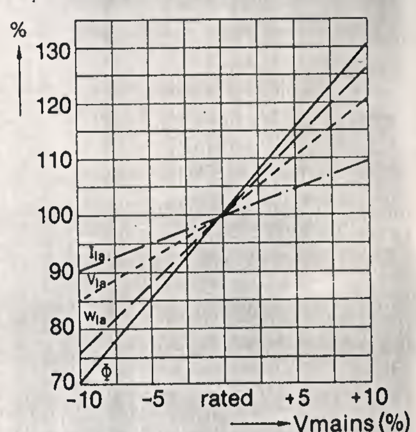
Typical curves

W_{la} = lamp wattage
V_{la} = lamp voltage
I_{la} = lamp current
Φ = luminous flux

Lamp performance during starting period

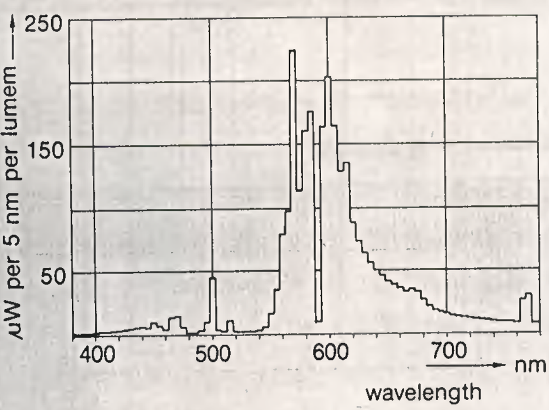


Effects of mains voltage variations

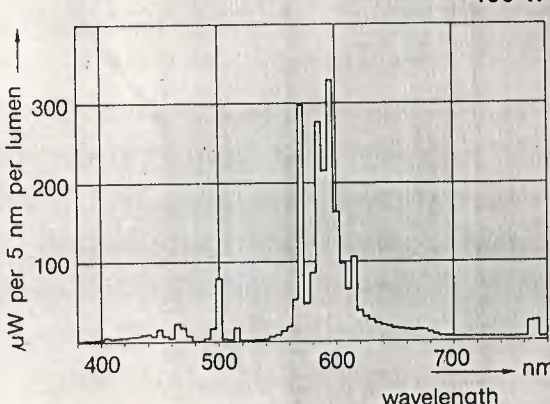


Normalised spectral power distributions

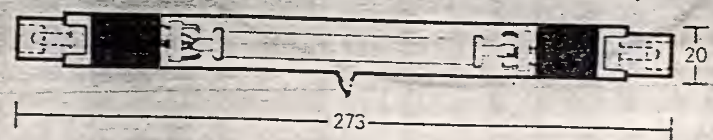
100 W



400 W

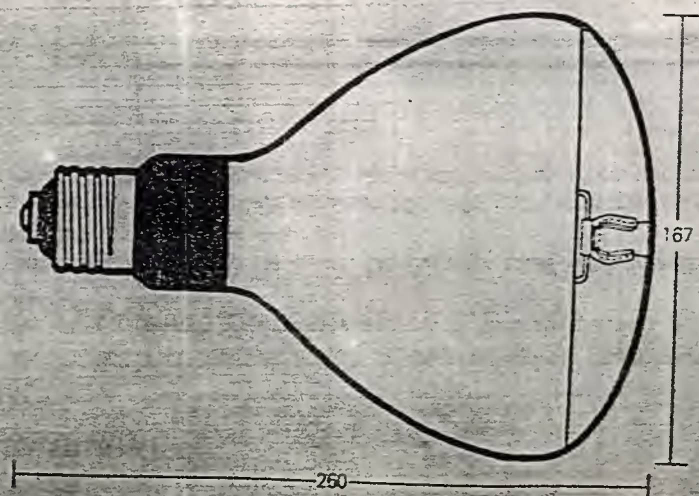


Watts	Minimum Nominal Supply Volts	Cap	Std Pack	Initial Lumens 100 hrs	Lighting Design Lumens 2000 hrs
250	220	R12.5S	10	28000	26500
310	220	R12.5S	10	37000	35000
400	220	R12.5S	10	50000	47000



Reflector SON-R (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



Manufactured to IEC662
For full technical specification see pages 226 and 227
For details of control gear see pages 166 and 167 and section 13

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 starters 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	32500
310	220	E40 (GES)	10	41000	40000
400	220	E40 (GES)	10	56500	55000

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

150	220	E40 (GES)	10	16500	16000
250	220	E40 (GES)	10	31500	31000
310	220	E40 (GES)	10	39500	38500
400	220	E40 (GES)	10	56000	53500

SOLARCOLOUR DE LUXE LAMPS

Improved colour rendering is the main benefit of De Luxe lamps. With increased sodium pressure compared with standard lamps, some of the yellow radiation is converted towards the red and blue ends of the spectrum

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

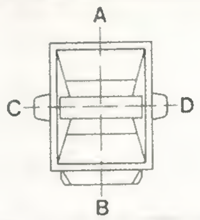
Watts	Minimum Nominal Supply Volts	Cap	Std Pack	Initial Lumens 100 hrs	Lighting Design Lumens 2000 hrs
150	220	E40 (GES)	10	12500	11500
250	220	E40 (GES)	10	23700	22000
400	220	E40 (GES)	10	38500	36000

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

150	220	E40 (GES)	10	12000	11000
250	220	E40 (GES)	10	21750	20000
400	220	E40 (GES)	10	37000	34500

Manufactured to IEC662
For full technical specifications see pages 226 and 227
For details of control ...

GHTING DATA cd/1000 lm

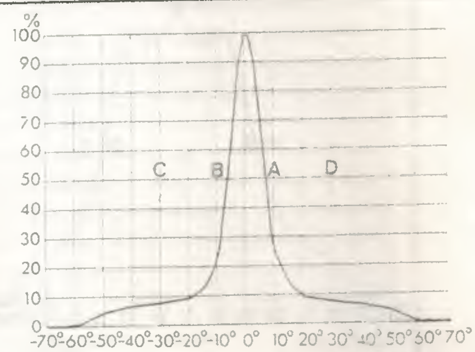


— VERTICAL PLANE
— HORIZONTAL PLANE
THROUGH 0°

ARROW BEAM

Light distribution diagrams

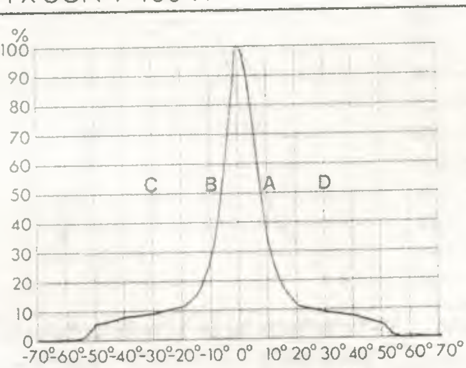
1 x SON-T 250 W



I max = 1780cd L.V.O. 4193

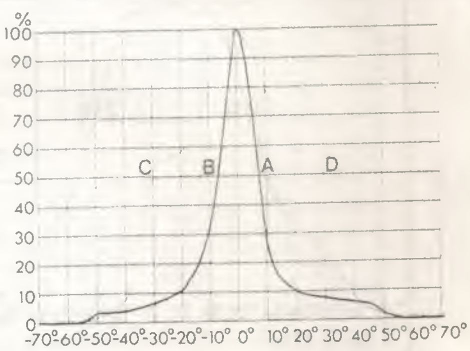
SON-T 250 W
rtical: 2 x 7°
orizontal: 2 x 28°

1 x SON-T 400 W



I max = 1882cd L.V.O. 6536

1 x HPI-T 400 W

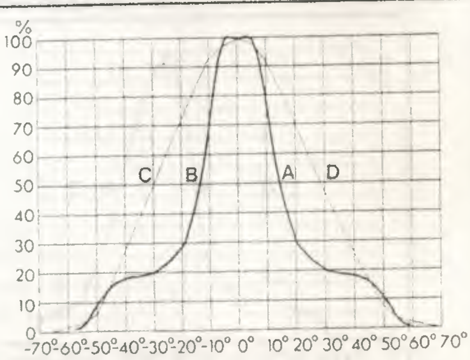


I max = 1840cd L.V.O. 4096

x SON-T 400 W
ertical: 2 x 7°
orizontal: 2 x 28°

x HPI-T 400 W
ertical: 2 x 7°
orizontal: 2 x 30°

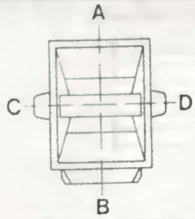
1 x SOX 35 W

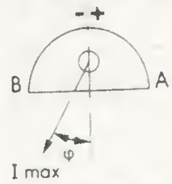


I max = 726cd L.V.O. 7337

x SOX 35 W
ertical: 2 x 15°
orizontal: 2 x 30°

NG DATA cd/1000 lm





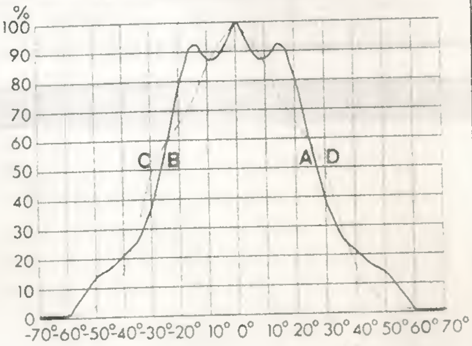
/ERTICAL PLANE
HORIZONTAL PLANE
THROUGH 0°

BEAM

Light distribution diagrams

N-T 250 W
2 x 27°
al: 2 x 30°

1 x SON-T 250 W

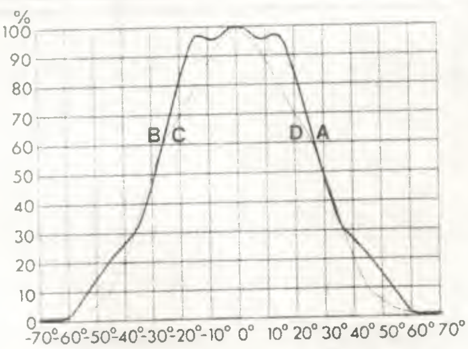


I max = 634cd L.V.O. 4149

N-T 400 W
2 x 29°
tal: 2 x 30°

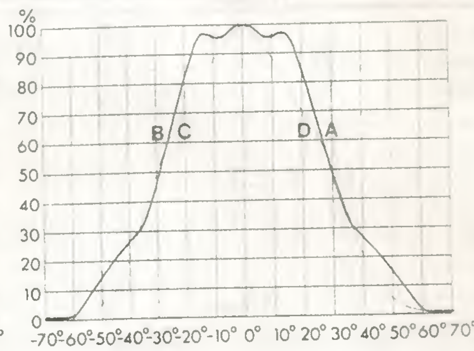
-T 400 W
2 x 29°
tal: 2 x 30°

1 x SON-T 400 W



I max = 612cd L.V.O. 4147

1 x HPI-T 400 W



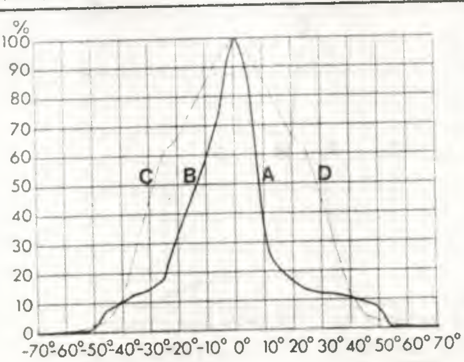
I max = 612cd L.V.O. 4146

IMETRICAL BEAM

ON-T 400 W
l: 1 x 9°/1 x 14°
ntal: 2 x 29°
_ HORIZONTAL PLANE
THROUGH −4°

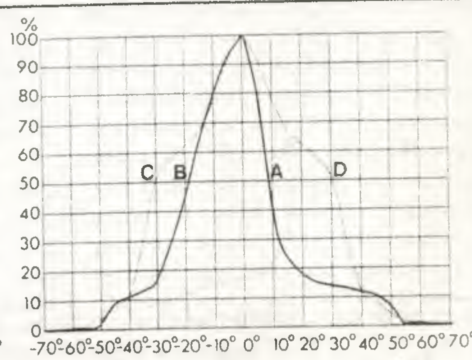
PI-T 400 W
l: 1 x 8°/1 x 19°
ntal: 2 x 30°
_ HORIZONTAL PLANE
THROUGH −4°

1 x SON-T 400 W



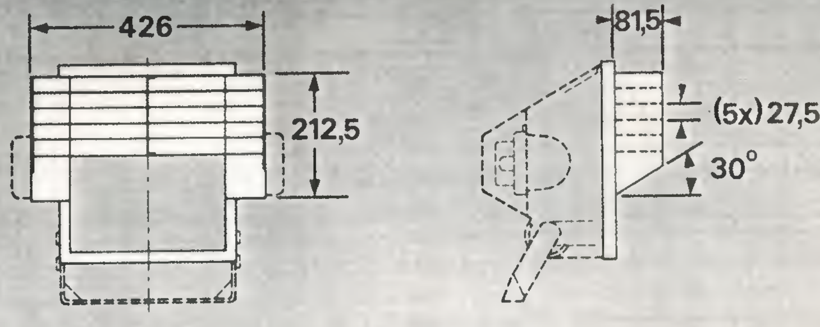
I max = 1380cd L.V.O. 6375
= −4°

1 x HPI-T 400 W

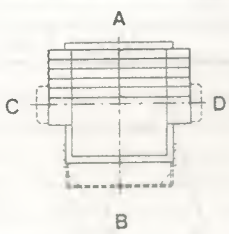


I max = 1118cd L.V.O. 6376
φ = −4°

MENSIONS HNF 003 with louvre



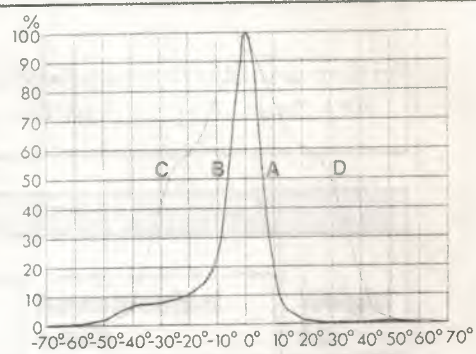
GHTING DATA cd/1000 lm HNF 003 with louvre



VERTICAL PLANE
HORIZONTAL PLANE
THROUGH 0°

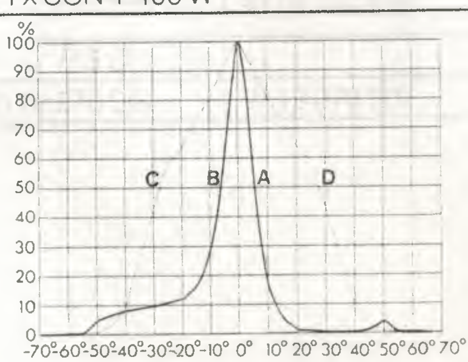
ARROW BEAM with louvre — Light distribution diagrams

1 x SON-T 250 W



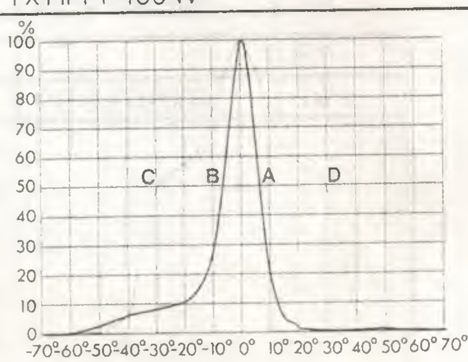
I_{max} = 1700cd L.V.O. 5530

1 x SON-T 400 W



I_{max} = 1810cd L.V.O. 6537

1 x HPI-T 400 W

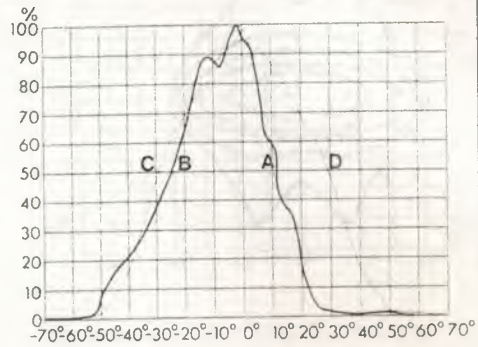


I_{max} = 1736cd L.V.O. 4305

NG DATA cd/1000 lm HNF 003 with louvre

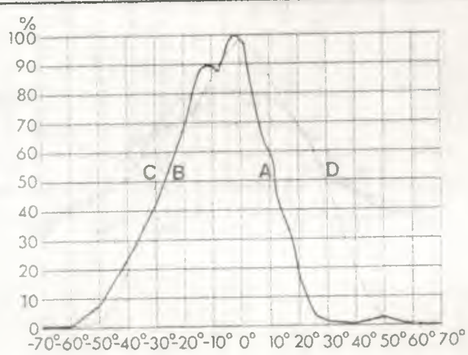
EAM with louvre | Light distribution diagrams

1 x SON-T 250 W



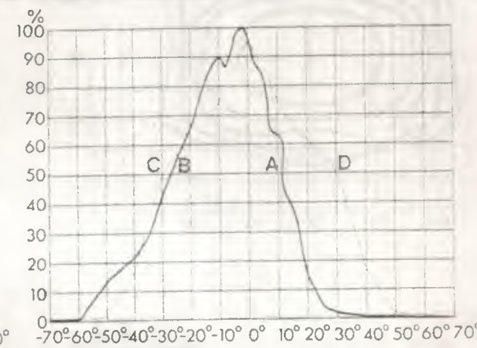
I_{max} = 597cd L.V.O. 5172

1 x SON-T 400 W



I_{max} = 587cd L.V.O. 4322

1 x HPI-T 400 W



I_{max} = 601cd L.V.O. 4304

RING DATA

		Ordering number[1]			
ation	**For lamps**	**Narrow beam**	**Wide beam**	**Asymmetrical beam**	**Weight kg**
03	1 x SON-T 250 W	9112 702 302 . .	9112 702 303 . .	–	7,3
	1 x SON-T 400 W or 1 x HPI-T 400 W	9112 702 448 . .	9112 702 449 . .	9112 702 428 . .	7,3
03G	1x SOX 35 W	9112 705 600 . .[2])	–	–	9,1
HNF 003		9119 270 007 . .	9119 270 007 . .	9119 270 007 . .	1,4

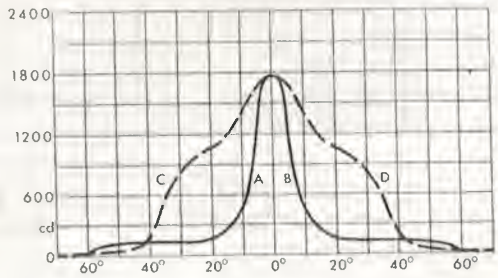
lete floodlight
lete floodlight with built-in gear, 220 V - 50 Hz.

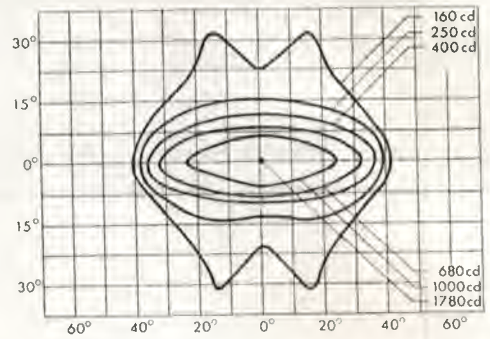
DATA
n

Light distribution diagrams

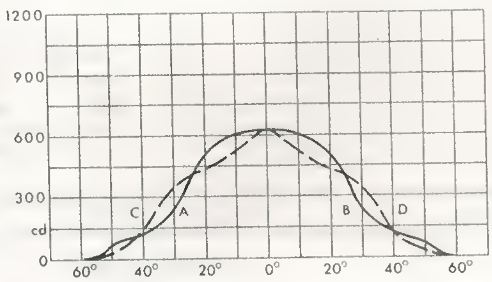
Isocandela diagrams

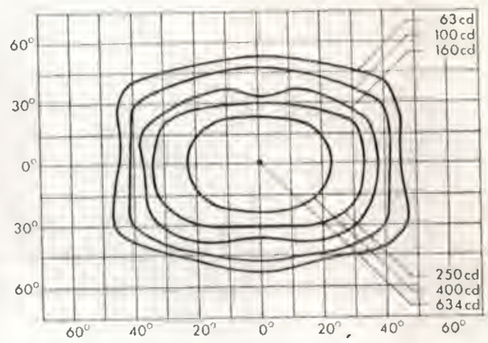
T 250 W narrow beam



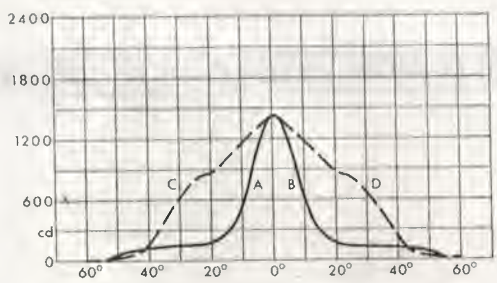


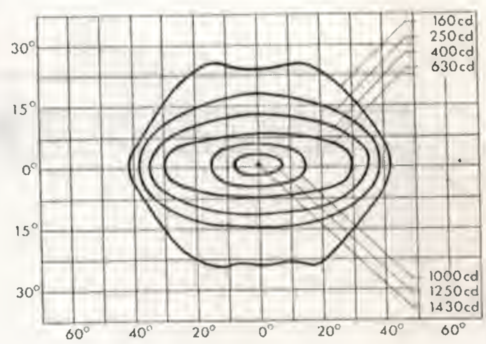
/T 250 W wide beam



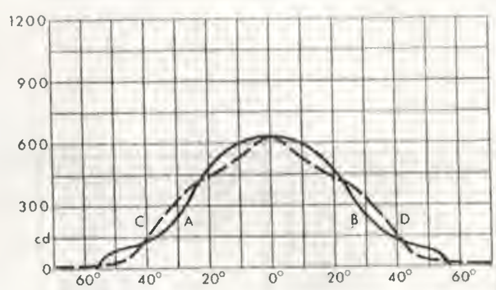


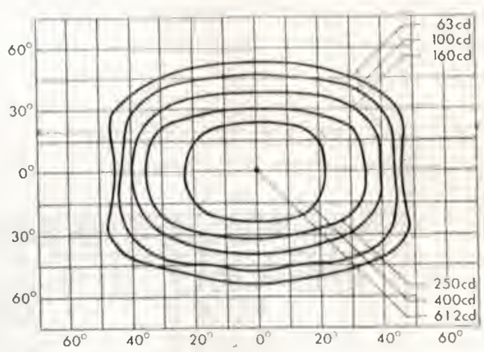
N/T 400 W narrow beam





N/T 400 W wide beam

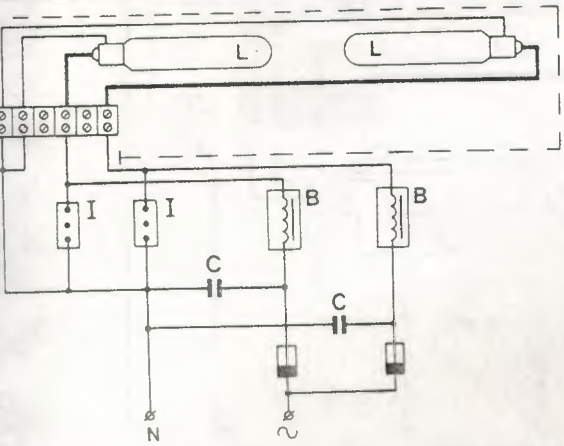




ICAL WIRING DIAGRAMS

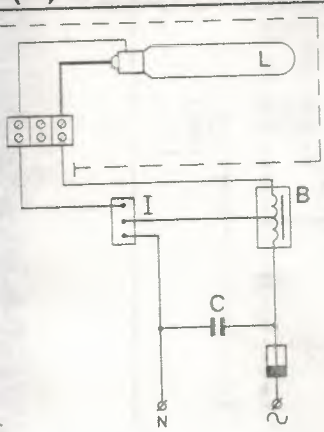
p
ast
acitor
or

-T) 400 W



MP	2 x HPI(-T) 400 W
oltage	220 V - 50 Hz
current	2 x 3,00 A
ng current	2 x 2,00 A
tors	2 x 30 µF / 250 V
	≧ 0,85

N(-T) 150 W SON(-T) 250 W SON(-T) 400 W SON(-T) 1000 W

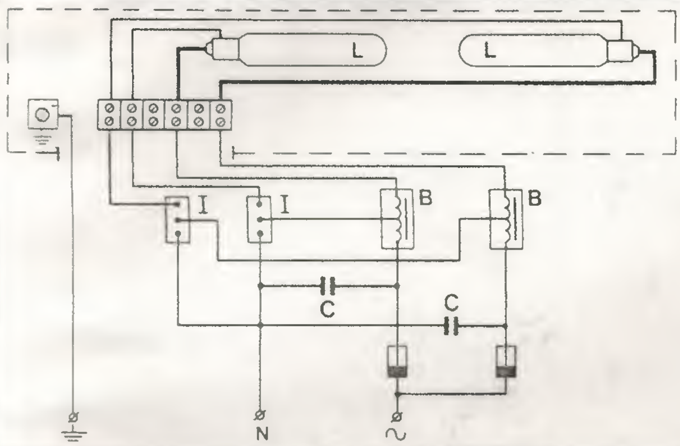


AMPS	SON(-T) 150 W	SON(-T) 250 W	SON(-T) 400 W	SON(-T) 1000 W
voltage	220 V - 50 Hz	220 V - 50 Hz	220 V - 50 Hz	220 V - 50 Hz
g current	1,00 A	2,30 A	3,60 A	9,30 A
ting current	0,85 A	1,40 A	2,20 A	5,60 A
itor	20 µF / 250 V	36 µF / 250 V	45 µF / 250 V	100 µF / 250 V
	≧ 0,85	≧ 0,85	≧ 0,85	≧ 0,85

ELECTRICAL WIRING DIAGRAMS

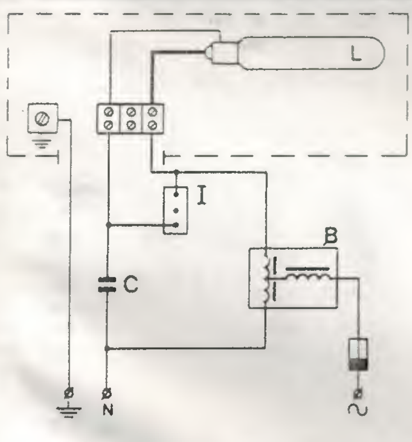
L = Lamp
B = Ballast
C = Capacitor
I = Ignitor

2 x SON(-T) 250 W SON(-T) 400 W



FOR LAMPS	2 x SON(-T) 250 W	2 x SON(-T) 400 W
Mains voltage	220 V - 50 Hz	220 V - 50 Hz
Starting current	2 x 2,30 A	2 x 3,60 A
Operating current	2 x 1,40 A	2 x 2,20 A
Capacitors	2 x 36 μF / 250 V	2 x 45 μF / 250 V
Cos φ	≧ 0,85	≧ 0,85

1 x SOX 90 W



FOR LAMP	1 x SOX 90 W
Mains voltage	220 V - 50 Hz
Starting current	0,57 A
Operating current	0,50 A
Capacitor	9,6 μF / 300 V
Cos φ	≧ 0,85