

# **THE ILLUMINATION OF PORTA DI MARE**

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- I N T R O D U C T I O N -

This project aims to show the importance of illumination around some parts of the Famagusta Castle which is called ' Porta Di Mare '.

I believe that by means of this lighting system, the castle will look more attractive and beautiful to every one then it had been before.

Most of the tourists visiting our country will also be able to see how this fantastic castle looks at nights by the use of illumination. Moreover, it will lighten the shops which remain open until midnight. So, it will not only be useful for tourism but also for our own people living in Famagusta. They will have the chance to do shopping for the things they are urgently in need. I think this may be a good step for development.

## THE FLOODLIGHTING OF BUILDINGS

### Introduction:

There is no doubt that floodlighting 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.

In addition to being used for aesthetic purposes, floodlighting nowadays can be simply functional. This is specially true of industrial and commercial buildings where floodlighting is used for advertising and security reasons. In general, floodlighting of industrial and commercial buildings can be said to have a threefold purpose:

#### \* AS A RELATIVELY INEXPENSIVE MEANS OF ADVERTISING

A building which at night would otherwise be completely invisible or inconspicuous, will immediately attract attention when it is floodlit. If the name of the firm or the

trade mark is floodlit on the facade, advertising is possibly made even more effective.

#### \* PRESTIGE

In many cases the reason for wanting a building to be as spectacular as possible is that it is of local or national importance or has particular architectural qualities. After sunset, floodlighting is consequently an effective means of impressing visitors.

#### \* INCREASED SECURITY AROUND BUILDINGS.

Nowadays it is unfortunately necessary to take elaborate precautions in order to prevent illegal entry, theft or wilful destruction of factory and other industrial buildings. Floodlighting in the areas around buildings enables night watchman and police to have a clear view of the scene. The different uses to which floodlight is put, whether they are primarily aesthetic or purely functional to achieve commercial ends, do 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 artificial lighting. However, it must be said that, whatever the reason, it is better to abandon the idea of a floodlight installation with a mediocre result.

## CHAPTER - ONE

## 1.1 - PLANNING

A floodlighting installation project can only be carried out successfully if a thorough study has been made of the building concerned. The lighting engineer should become familiar with all factors relating to lighting installations for the building. It is essential that he should first study the features 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 used as aids. An informative part of the daylight study is the analysis of how given effects arise. Although this study is about the floodlighting of buildings by means of artificial light, it will none the less be useful first of all to go into certain features of the effects of daylight upon them.

In the past, an architect only thought in terms of a building being viewed in daylight when he was drawing up his plans. The architecture of the facade was therefore designed in those days with the idea in mind that it would be lit from above by the sun and the sky. Today, however, there is a

greater tendency to think that a building should also be attractive after dusk, when the various surfaces may be illuminated by a floodlighting installation. The appearance of the building at night is therefore taken into account when designing the building and it is most important that, if this is the case, there should already be good cooperation, at this stage, between the lighting engineer and the architect, in order to avoid any risk of the architect's conception being misinterpreted.

#### a) DIRECTION OF VIEW

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

#### b) 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.

#### c) SURROUNDINGS AND BACKGROUND

Obtain a clear idea of the background against which the building will be seen. If the surroundings and background are dark, a relatively small amount of light is needed to make the building lighter than the background. If there are other

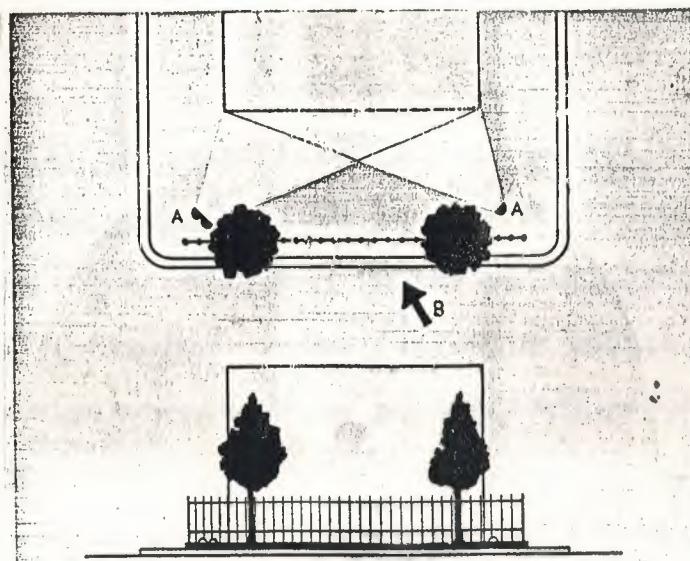
buildings in the close vicinity in which interior lighting is left on at night, the lighted windows will give an even greater impression of brightness and therefore more light will be needed for floodlighting the building if it is to have an impact. The same is true if, in addition, the background is bright. In such cases a maximum amount of light is needed to achieve the contrast between the building and its background. The actual values of the lighting-intensities to be used will be dealt with in the following chapters. Another solution for the two last mentioned cases can be found in the creation of a colour contrast instead of a brightness contrast. The colours of the light already present in the background of the building, even street lighting, must then be taken into consideration.

#### d) OBSTACLES

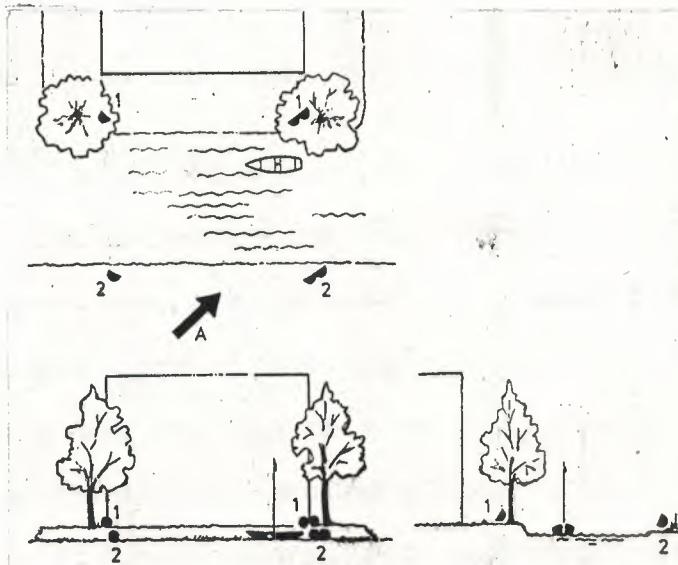
Trees and fences around the building can form a decorative part of an installation. An attractive way of dealing with this is to place the sources of light behind them.

Two advantages are gained:

- a) The light sources are not seen by the viewer.
- b) The trees and fences are silhouetted against the light background of the facade. The impression of depth is therefore heightened (Fig. a)



**Fig. A.**  
A. Light sources.  
B. Direction of view.



**Fig. B.** 1. Light sources. 2. Light sources. A. Direction of view.  
With arrangement 1, care should be taken to ensure that no light strikes the  
surface of the water or trees.

### e) WATER

The design can also take advantage of any expanse of water in the vicinity, such as a pond or canal. The lighted building will be reflected in the water, which serves as a black mirror (Fig.b). The following points should however be borne in mind when setting up the light sources in such a case:

- a) The rays of light must not strike the surface of the water.
- b) It is advisable to place the light sources as low down as possible; The rays are then either horizontal or slanting upwards.
- c) The water must be clean; slime or weeds floating on the surface of the water will weaken and distort the reflection.

### 1.2 - 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 building may then be more or less fixed. In theory it is possible to reduce all ground plans of buildings to simple geometrical 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 layout exists which, in

virtually all cases, leads to good results. It has been found that the best light source lay out for a square building. The characteristics of the facade show the best advantage when the incident light is at an angle smaller than 90 degree. No definite angle can be given; on the horizontal and vertical planes the angle may vary between 0 and 90 degrees, calculating from the vertical to the facade. For a deep profile the angle should be between 0 and 60 degrees, for a flat profile between 60 and 85 degrees. In order to show the structural details of the facade to advantage scattered light should be used, incident at angle of 80 to 85 degrees to the vertical. The situation is somewhat different in the case of round buildings, such as round towers or chimneys; here it is not so much a matter of accentuating the texture or the profile of the facade but more of emphasizing its rounded form. This effect can be achieved by means of narrow beam or medium beam floodlights set up at two or three points around the tower, the beams directed upwards as high as possible. It may then be assumed that the narrow beams of light reach the tower as more or less parallel rays, forming a strip of light over its entire height.

Because of the roundness of the tower, the angle of incidence varies between 0 and 90 degrees, calculated from the middle outwards to the edges. Consequently the direction of the reflection and also the brightness of the tower wall are

both affected. Thus a variation in brightness is effected around the circumference of the tower wall and this impression of depth emphasizes the roundness.

### 1.3 - DESIGN PROCEDURE FOR FLOODLIGHTING

The general design procedure for floodlighting consists of four basic steps:

- 1) Determining the desired effects.
- 2) Determining the level of illumination.
- 3) Determining the location of lighting equipment.
- 4) Determining the fixtures and lamps to be used, from the standpoints of engineering performance and economics of maintenance.

Lighting engineer Robert Faset has suggested the following checklist for selecting larger types of outdoor area lighting equipment. He points out that selecting lighting equipment requires a combination of common sense, good engineering economic evaluation and a feel for the aesthetics of lighting effects.

- 1) For 10 000 burning hours per year or less, use filament lamps. Otherwise use high intensity discharge sources or fluorescent fixtures in the largest practical size.
- 2) Use the largest wattage fixtures and the fewest locations that will deliver amount of light wanted. With area type luminaires spacing generally should exceed two to four

times distance from the surface being lighted to the light equipments.

- 3) Consider the cost of relamping and cleaning fixtures.
- 4) Keep in mind the stayling of the lighting equipment.
- 5) By top quality fixtures,lamps and poles,in order to achieve lowest total owning cost.

If uniformity is desired with large area out door lighting,these steps will help obtain it,provided that the flooutlightings are spaced at recommended distances from the building:

- 1) Beems should overlap so that any given area receives as much light from the floatlight on either side as from the one directly in front of it.
- 2) The widest beem spread available should be used consistent with reasonable utilization.
- 3) The largest lamp available should be used,consistent with acceptable uniformity.Obviously,proper aiming of floodlightings is important.Approximate aiming can be determined by scaled sketches showing beem overlap.Exact aiming, however must be adjusted in the field regardless of how carefully it was planned and laid out.

When the floodlighting equipmentis aimed upward from a low level,the shadows that exists in daylight will be reversed or perhaps even eliminated while flat,head on illumination destroys depth and perspective large brightness contrasts may not produce desirable effects either.The reason

is that bright areas appear closer and dark areas appear farther away to distance observers. For very tall structures apparent uniformity is achieved if the top portions are illuminated so that they are two to four times as bright as the lower portions. Greater illumination at the top also accentuates apparent height. Illuminating the lower portion of the building at a somewhat lesser level also minimizes possible annoyance to pedestrians.

Most lighting designers feel that shadows should appear as natural as practical. That is to say, if duplication of the type of shadows produced by the sun is not feasible, the shadows should at least present an interesting pattern and not destroy the basic form and depth of the architecture.

The basic floodlighting effects can be categorized as:

- 1) Flat floodlighting.
- 2) Grazing floodlighting.
- 3) Interior floodlighting.
- 4) Accent or outline floodlighting.

The type of equipment used, for the most part, will depend upon the size of the building. Monumental buildings will most generally be floodlighted by large units, except for interior lighting effects when fluorescent or quartz (tungsten halogen) lamps may be used at the windows to illuminate draperies or window surrounds. Buildings of lesser size often employ projector (PAR) and reflector (R) lamps, particularly for grazing floodlighting and accent floodlighting. Outline

lighting may be accomplished using general service incandescent lamps or sign lamps.

#### 1.4 - GRAZING FLOODLIGHTING

Grazing floodlighting often produces strong high lights and shadows, particularly when the floodlightings are mounted very close to the facade. In adition to being desirable aesthetically, the grazing technique will be suitable functionally where lack of space, appearance considerations, or other restrictions prevent maunting floodlights in front of the building. Incandescent, fluorescent, and high intensity discharge lamps have all been used for grazing floodlighting. Equipment may consist of spread lens and fresnel lens incandescent units, fluorescent floodlights with large specular reflectors, or tungsten halogen and high intensity discharge lamps in reflector type fixtures with clear glass covers. In some cases, even small, single lamp fluorescent units with white reflectors can be used effectively for low buildings.

#### 1.5 - CALCULATION PRODECURE OF FLOODLIGHTING

- a) Plan of the necessary place is taken from old buildings and museums office.
- b) Measure the lenght and the wide of the castle.
- c) Choose the direction of view.
- d) Choose the projector places.

- e) Measure the distance between the light source and the facade, which is going to be illuminate.
- f) Choose the required projector. ( 250 W , 400 W , 1000 W )
- g) Choose the type of lamps. ( HP SODIUM , LP SODIUM , HP MERCURY OR METAL HALIDE LAMPS. )
- h) By using the C - GAMA matrix, calculate the light intencity point by point on the facade which is going to be illuminated.

$$\text{i) By using } E_{av.} = \frac{I \cos^3 Q}{h^{**2}} \text{ formula, calculate } E_{av.}$$

point by point.

j) Faunt Eav. is tested by regularity coefficient  
(  $E_{\min} / E_{\max} = 0.3$  ) if it is regular or not.

USED FORMULAS IN PROJECT

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

$$\alpha = \cos^{-1} \frac{1+x'x_0' + y'^2 \frac{1+x_0'^2}{1+x'x_0'}}{\sqrt{(1+x'^2+y'^2)(1+x_0'^2+y'^2) \frac{(1+x_0'^2)^2}{(1+x'x_0')^2}}}$$

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

$$\beta = \tan^{-1} \frac{\tan A}{\sqrt{1+\tan^2 \alpha (1+\tan^2 A)}}$$

$$C = \tan^{-1} \frac{\tan \alpha \sqrt{1+\tan^2 A}}{\tan A}$$

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

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

$$x_0' = x_0/h, \quad y_0' = y_0/h, \quad x' = x/h, \quad y' = y/h$$

Where ;

$x_o$  is the X coordinate on the surface of the point at which the projector axis intercept the plane which will illuminate.

$y_o$ , is the Coordinate on the surface of the point at which the projector axis intercept the plane which will illuminate.

X , Y, Are represents the coordinates of the point at which we want to calculate the illuminance.

$\theta$  , Is the angle between the direction at which we want to calculate the illuminance and the normal to the surface which will illuminated.

## CHAPTER - TWO

### 2.1 - ARCHITECTURE OF THE FACADE

#### a) 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.

#### b) FACADES WITH VERTICAL LINES

Vertical lines of 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. The main direction of view must be such that the bands of shadow face the viewer.

### c) 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 wide dark band of shadow above this projecting beam. This gives the impression that the building consists of two parts and that the upper part is floating in the air. To keep the band of shadow narrow there should be a greater distance between the facade and the light fittings.

### e) 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.

### f) 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 shadow if the floodlights are placed only a 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 striking 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 (Fig. 45)

#### g) MIRROR EFFECTS

Nearly every facade has a number of windows which give a mirror effect especially when it is dark inside the building. 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 (Fig. 47 and 48)

#### 2.2 - 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 reflections factors of a number of different materials.

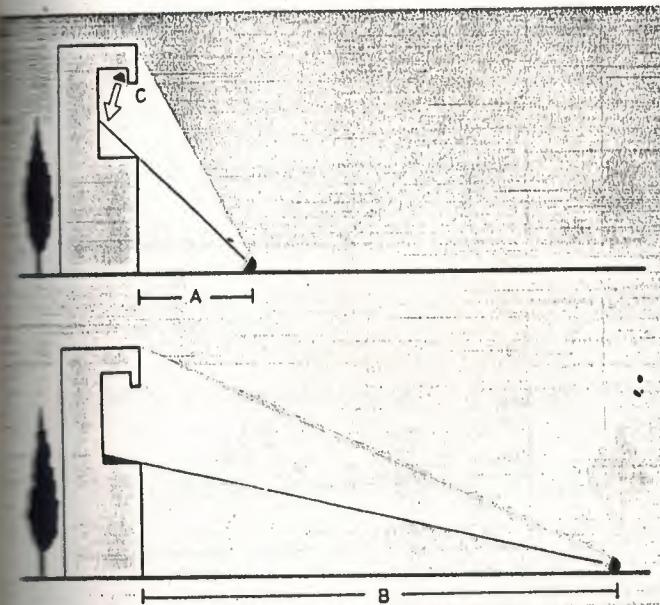


Fig. 45.  
Short distance A:  
supplementary lighting C required.  
Large distance B:  
no supplementary lighting required.

Fig. 46. If buildings with marked profiled façades cannot be floodlit from a distance, e.g. because of existing street furniture, extra lighting can be created locally by light source placed against the façade. The result is a lively interplay of light and dark, the silhouettes of trees in particular giving an excellent effect of depth.

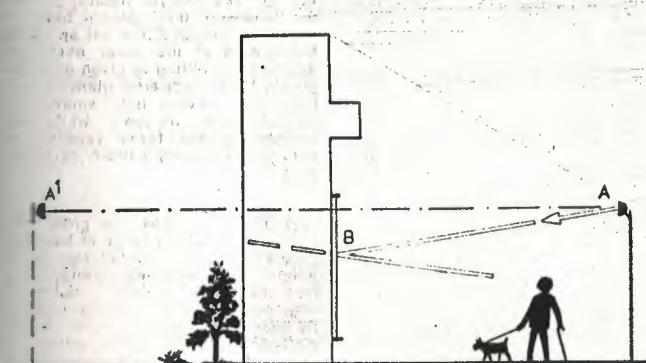


Fig. 47  
Reflection from mirror causes glare in observer's direction.  
A. Floodlight fitting mounted above eye level,  
B. Glass window or other reflecting material.

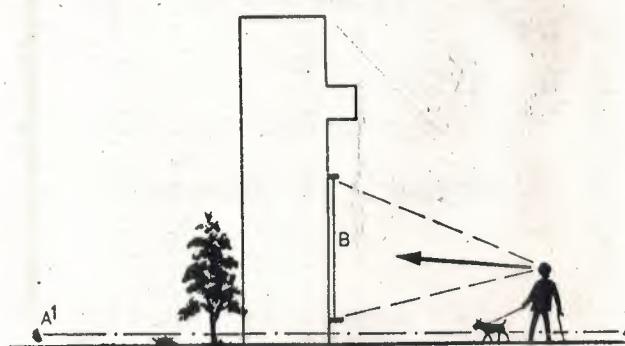


Fig. 48  
A. Floodlight fitting mounted below eye level.  
B. Glass window or other reflecting material.

material	state	reflection factor
White marble	fairly clean	0.60 - 0.65
Granite	fairly clean	0.10 - 0.15
Light concrete or stone	fairly clean	0.40 - 0.50
Dark concrete or stone	fairly clean very dirty	0.25 0.05 - 0.10
Imitation concrete	clean	0.50
White brick	clean	0.80
Yellow brick	new	0.35
Red brick	dirty	0.05

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

- \* The material of the facade
- \* The incident angle of the light
- \* The position of the observer in relation to the reflecting material (specular reflections)

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.

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 of surface may be distinguished.

a) 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 upward, away from the observer. (Fig.55)

b) SMOOTH SURFACE

Light is reflected somewhat diffusely from a smooth surface; a small amount of this light reaches the observer (Fig.56)

c) 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 (Fig.57)

d) VERY DULL SURFACE

Light reflected from a very dull surface is diffused to a large degree, and therefore a great part of the light is directed towards the observer (Fig.58)

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 required 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.

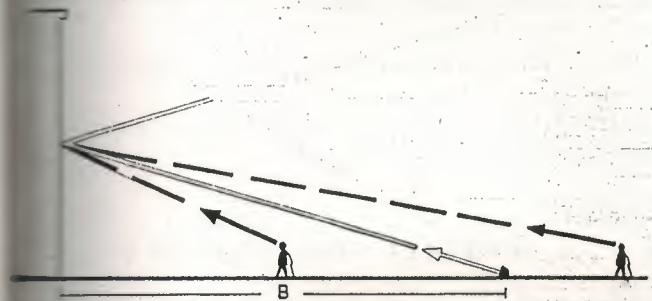
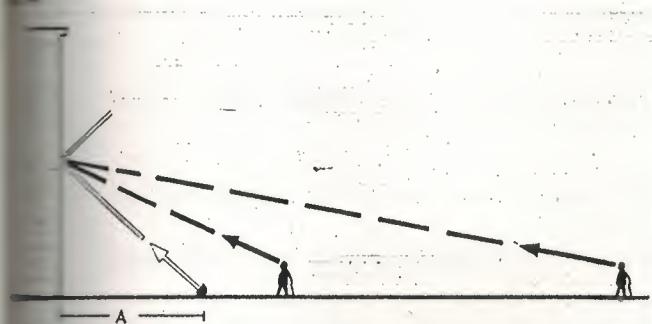


Fig. 56

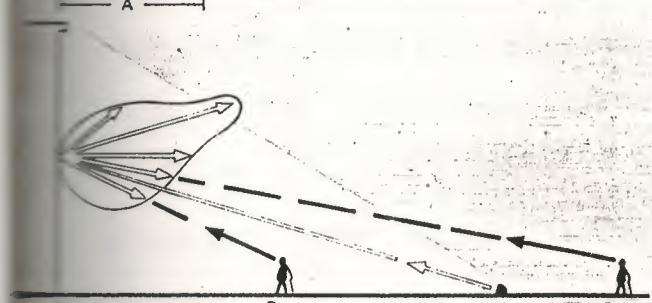
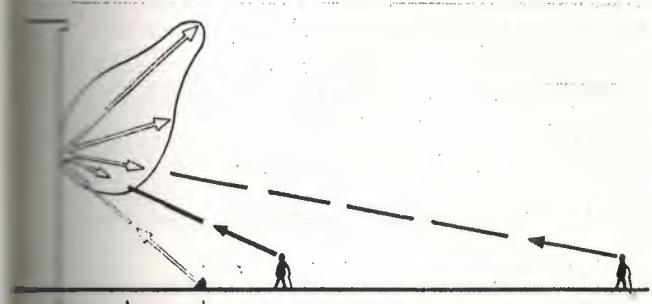
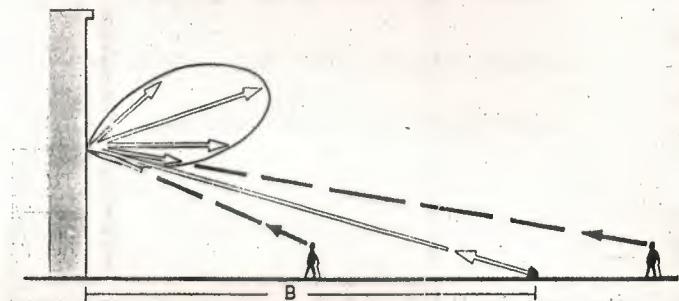
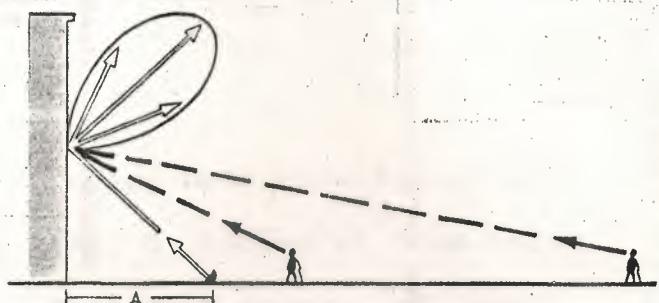
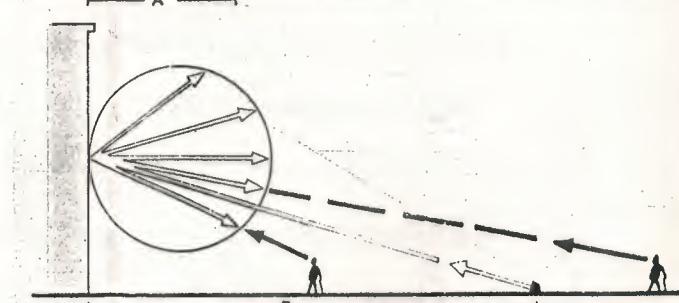
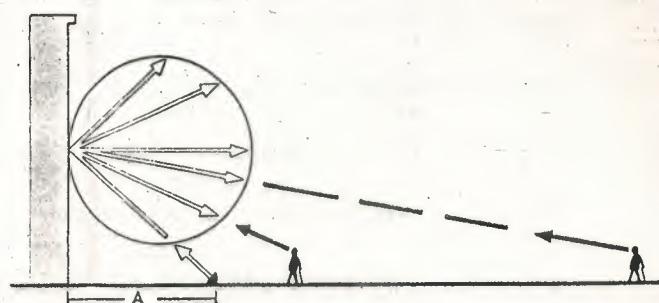


Fig. 58



## 2.3 - DAY LIGHT

### a) THE COMPOSITION OF DAYLIGHT

Daylight can be regarded as comprising both direct sunlight and the diffuse light of the sky (Fig. 9). Looked at from this point of view the sun is a point light source of small dimensions and great brightness. The sky, on the other hand, behaves like a very large diffuser of much lower brightness.

### b) DAYLIGHT EFFECTS

Assuming that here is a cloudless sky and bright sunshine, two natural sources of light can thus be said to be present at one and the same time.

As a result hard shadows falling under projections on the facade and caused by direct sun light are softened by the diffused light from the sky (Fig. 10). Fundamentally, 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 (Fig. 11). The result is 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 diffusesky, more relief was needed in the facades of the gothic cathedrals found there, in order to create the some interplay of light and shadow. This phenomenon reveals one the first principles of floodlighting, which is that the direction of the light and the direction of view should be at an angle to one or other, preferably between 45 and 135 degre.

In one of the following sections this aspect will be looked at more closely.

#### 2.4 - THE CONTRAST BETWEEN THE FAÇADE AND THE BACKGRAUND

The contrast between the façade and its background changes continuously with changesin weather condition. When for example the rays of the sun fall directlyon the façade and there is a cloudless sky, the façade will be brighter than the backgraund because of the greater reflection. Sunlight falling directly on the building causes hard shadows (Fig.13) when the sky is cloudless but the façade receives no direct rays from the sun (a situation which may be faund if the façade is facing north or if there is a skyscraper close to the building, shutting out the direct sunlight) the sky is brighther than the façade. The sky radiates light in all directions, while the façademereley reflects the light. Since the light is diffuse only soft shadows appear (Fig.14). 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. The facade therefore looks flat and uninteresting (Fig. 15).

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 contrast 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 the course of the day, the shadows move from one part of the facade to another owing to the continuously changing position of the sun. Generally a building is at its best in the early hours of the morning and just before sunset. This is because the sun is low in the sky at these times and we see the contrast in colour between the sunlight, which contains much red light, and the diffused light from the sky, which contains a great deal of blue.

## 2.5 - MENTAL IMAGE

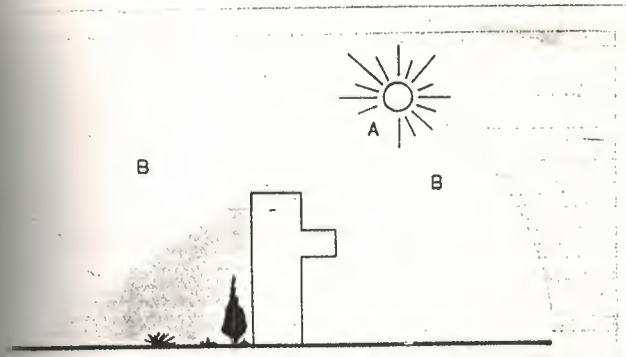
It is possible to imagine that, in studying a building, the lighting expert may be attracted at a given moment by a certain striking effect and that this mental image sticks in his mind as the effect he would like to retain:

This mental image i.e. the lighting experts conception of the building when floodlit, is in many cases the initial point of departure for a floodlighting design. Proceeding from this mental image he must translate the natural lighting effect, which he has seen, into an artificial 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, artificial light sources are generally placed low down near the building from above, artificial light sources are generally placed low down near the building or a little higher on an adjacent building.

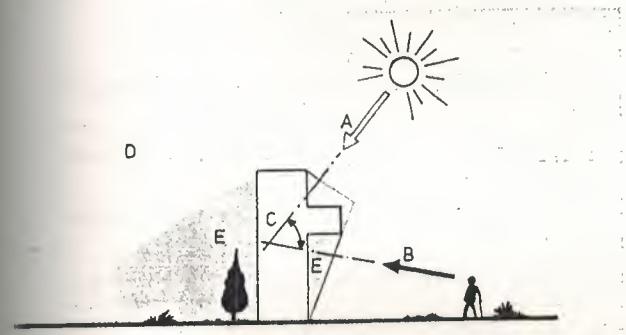
A comparision of Fig.11 and Fig.16 will make this abundantly clear. Thus a clear idea of how the installation is to be carried out may be gained by methodically collecting all details relevant to the possible positions of light sources, the appropriate fittings and lamps, the reflecting properties of the surface material of the facade, the various points from which the building can be observed, etc.

## 2.6 - EXTERIOR LIGHTING

Exterior lighting requires an architect's attention if it is to suit his architectural concept and not seem merely applied. This understanding of the situation is becoming increasingly accepted.



A. Sun: Point light source, small dimensions, high brightness. Creates sharp shadow. B. Sky: Diffuser, large dimensions, low brightness. Creates soft shadow.



A. Direction of sunlight. B. Direction of view. C. Angle between direction of sunlight and direction of view. D. Light from the sky softens sun shadow. E. Shadow caused by sunlight.

A. Direction of sunlight. B. Direction of view. C. Shadow part opposite of view. D. Direction of shadow.

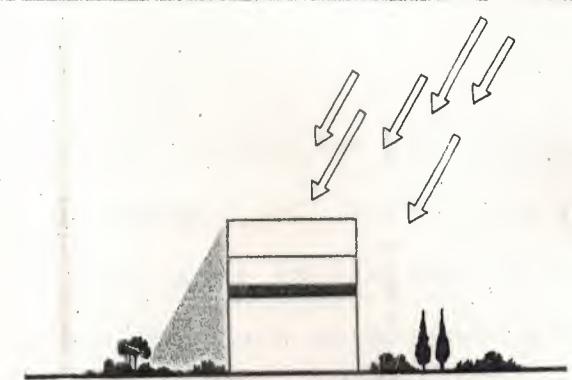
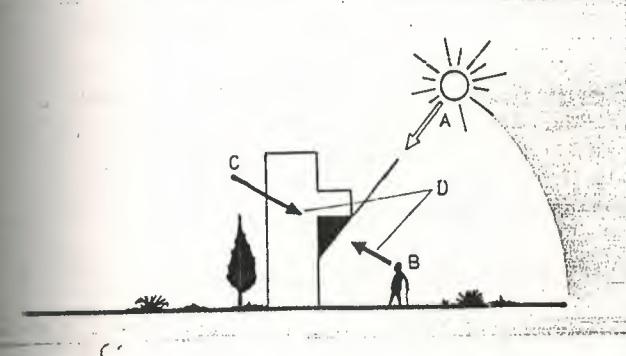


Fig. 13

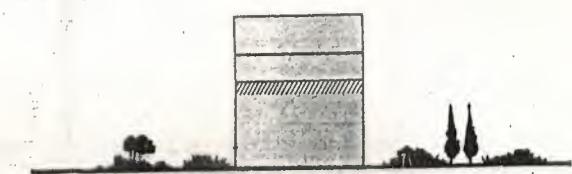


Fig. 14

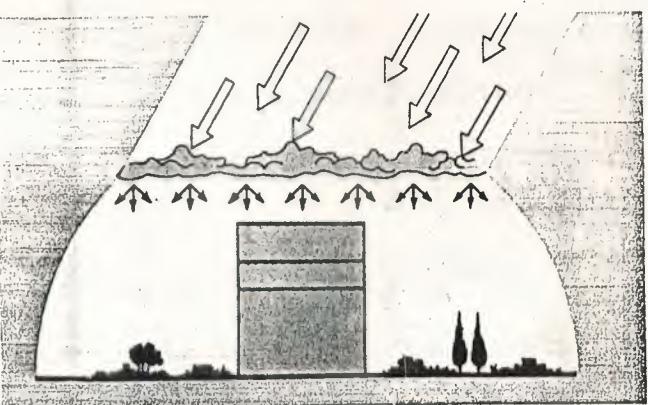


Fig. 15

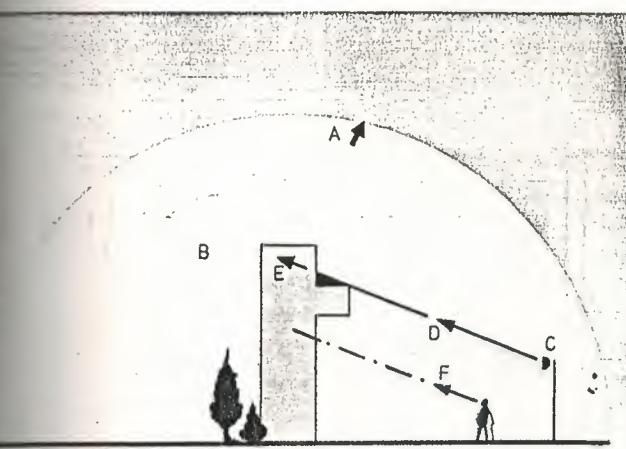


Fig. 16.  
A. Dark background.  
B. Brightness of the building is greater than the brightness of the black sky.  
C. Artificial light source.  
D. Direction of light.  
E. Direction of shadow.  
F. Direction of view.

Architects are playing increasing attention to how buildings look at night. Now, however, not only are manufacturers offering architects much more in the way of hardware but, beyond this, the architects have developed a more personal and vital interest in exterior lighting.

Of course, it must be recognized that building exteriors themselves have changed very often a facade is texture by bold patterns of exposed structural elements or by the missing of a series of volumes, both of which lend themselves to strongly accented patterns of light. But even when the exterior is flat, such as a sheer glass facade, the client still may want his building to stand out at night. Then the architect may want to consider some sort of internal lighting that will make the building glow from within a technique that has grown to be more commonly used with glass walled structures.

It is important for the architect to realize that lighting cannot possibly make a building look the same at night as it does during the day. What is important is that the night lighted building create a favorable visual impression, not merely be an indefinite blob of brightness.

## CHAPTER - THREE

### 3.1 - THE PURPOSE OF ILLUMINATION

Sufficient illumination answers more than one necessity, when an illumination system is set up, usually a priority is given to one of these necessities, this means that, the basic purpose of that illumination is to answer to that necessity which was given a priority, but while answering the necessity, we should not forget about the other necessities either.

Illumination can be divided in to three groups according to its purposes;

#### A) PHYSIOLOGIC ILLUMINATION

The aim by physiologic illumination is to be able to see the objects easily and faster by their shapes, details and colours. So, an illumination which has these requirements called physiologic illumination. In this illumination we should take care of the things that can damage the seeing ability of eye as in other types of illumination.

#### b) DECORATIVE ILLUMINATION

The aim by this illumination is not show the objects which are asked to be seen in details, it is done to create artistic effects by the decorative illumination. In this concept, the help of the architecturer is very big.

### c) ATTRACTIVE ILLUMINATION:

The aim by this type of illumination is to be attractive which, in other words, is to make advertisement. For this reason, higher illumination levels colour lights or lamps which turns on or off automatically are used. In this type, the artistic and decorative illuminations are also used.

## 3.2 THE TYPES OF ILLUMINATION :

Illuminations are devided into two groups as natural and artificial illumination according to the base of light and devided into two groups as indoor, and autdoor illumination according to the place to be illuminated.

### a) NATURAL ILLUMINATION

It deals with the distrubition of the natural light in a most suitable way. On the other hand, the use of artificial illumination with natural illumination and the application of the buildings are also the subject of natural illumination.

### b) ARTIFICIAL ILLUMINATION

Artificial illumination nowadays is almost obtained by the light sources. This illumination, according to the used light source, are devived into two grops as illumination with

incandescent lamps, discharge lamps, fluorescent lamps.

### I) INDOOR ILLUMINATION

This is a type of illumination where inside of the every kind of building is illuminated. In this type, illumination can be devided into three groups, such as direct semi direct, indirect illumination according to the characteristics of the place to be illuminated light sources. For instance : if the 90 - 100 % of the light flux of the source is going away to the space to be illuminated, this illumination system is said to be direct illumination system.

### II) OUTDOOR ILLUMINATION

This is, as can be under stood from its name , the type of illumination which is used to illuminate open places such as floodlighthing of buildings, stadium and sports graund lighting, area lighting, security lighting building sides, car parks, factory compaunds, public parks, road etc.

### 3.3 - THE SUBJECT OF ILLUMINATION

The basic concept of illumination consists of the production, distrubution, economics and measurment of light, also examines the effect of light on human body. Today, illumination technique has a very important role in engineering specially in America and Europe. Putting a lamp

in the middle of the ceiling does not satisfy people any more. Every place to be illuminated should be examined as a special problem. In this examining, beside the psychological and economic conditions, architectural and technical conditions take important part. The solution of an illumination problem can only be solved by the help of an electrical engineer who has technical ability and by the help of an architect who has the artistic ability in illumination.

By a sufficient illumination the followings are gained;

- 1) Artistic and comfort feelings are answered
- 2) The performance of the work is increased.
- 3) The economic potential is increased.
- 4) The volume of the bussiness in commerce gets larger.
- 5) The security is provided.
- 6) Seeing ability of eye.
- 7) The health of eye is protected.
- 8) The accidents are decreased.

## CHAPTER FOUR

### 4.1 - SELECTION OF LIGHT SOURCES

Selection of light source depence upon a combination of factor, among which are in size, shape and type of building, desired lighting effect, colour preference, extend of beam control required from the floodlighting, and relative economics (first cost versus owning cost ).

For overal lighting of building facades, the number of floodlight generally can be determined by deciding what footcadle level is desired and then using the beam lumen method to find out how many floodlight are required. Floodlight selection for overal lighting as regards beam angle is governed primarily by floodlight location.

( floodlights are divided into seven types by the National Electrical Manufacturers Association, on the bases of beam spread. Beam efficiencies ( ratio of luminaire output lumens to lamp lumens ) For example , for a low building , a wide beam floodlight would be indicated if the luminaires must be mounted close to the building; narrow beam if they are far back. But with a tall building, on the other hand, narrow \_ beam floodlights may be needed if the luminaires must be mounted close in. The reason is that otherwise there would be too great a difference in illumination between top and bottom of the building as result of the building and the grazing angle. But with a low height building, the foodlights can be

strung out in a row and overlap of beams will produce the desired uniformity.

The beam lumen formula is ;

$$N = ( A * fc ) / ( BL * CBU * MF )$$

N : is the number of luminaires.

A : is the area to be floodlighted.

fc : is the footcandle level.

BL : is the beam lumens of the luminaire.

CBU : is the coefficient of beam utilization.

MF : is the maintenance factors.

The footcandle of illumination to be used will depend upon just how bright the building is to appear against its surroundings. Of course, the darker the colour of surface of the building, the more light will be needed to achieve a given brightness. Typical footcandle values for exposed concrete facades might be between 5 and 10 fc, provided that there is not too much competing brightness in the surroundings. A figure sometimes given as to how much brighter a building should be than the competing surround is in the range of 4/1 to 5/1.

Another way of helping to make a building stand out against its surroundings is through the use of colour.

Psychologically, the difference in colour may attract attention. The illuminating engineering society has recommendations for illumination levels depending upon the

reflectance of surface material and the competing brightness. These values, of course, are not absolute but should be used with judgment based upon experience.

The coefficient of beam utilization is that fraction of the beam lumens intercepted by the building surface. Beam lumens of a luminaire are the total lumens within the beam spread of the luminaire. Designers try to select a floodlight so that the CBU is at least between 75 and 80 per cent. If half, or more than half, of the floodlights are aimed so that all their lumens fall on the lighted surface, the overall utilization factor will be about 0.75; if one quarter to one\_half of the floodlights are aimed in that manner, 0.60; less than one quarter, not 0.40 (with towers and steeples the utilization factor may be less than 0.25).

Maintaince factor is equal to the lamp lumen depreciation factor multiplied by the luminaire dirt depreciation factor. This factor compensates for reduce illumination as the installation becomes older the loss of illumination results from the combined effects of gradual reduction of lumen output during lamp life and the loss caused by collection of dirt. A reasonable maintenance factor to be assumed for enclosed equipment is 0.75.

It has been mentioned how location of equipment effects the selection of floodlights. As a general rule, it is desirable to have floodlights located a distance out from the building equal to at least one\_ fourth to one\_ third the

height of the building. The farther back the floodlights are from the building., generally speaking, the wider the choice possible in floodlight and lamp selection.

Whether the floodlights are concentrated in banks or lined up in rows depends upon several factors. They may be arranged in rows if;

1- Illumination is to be even and modeling need not to be too strong.

2- There is a series of tall columns each of which is to be accented.

3- Space availability is no problem and the luminaires can be easily concealed.

Floodlights may be arranged in banks if;

1- Space availability is a problem.

2- Concealment is difficult.

3- Fairly strong modeling effects are desired.

For lower buildings, floodlights mounted at ground or near ground level will be aimed with the center of their beams striking the building near the top - a typical point might be 2/3 of the height. Even with a building of, say, eight to ten stories, the floodlights might be aimed near the top to accent a cornice and still illuminated the facade fairly evenly. A very tall building, on the other hand, if lighted from floodlights close to the base of the building may have to be illuminated in segment in order to achieve reasonable uniformity.

Obviously there can be no exact rules for location or aiming of floodlights because of the many variables. Nature of building facade ( materials and design ) available areas for mounting floodlights, desired effect, etc.. It may be that the architect does not want uniformity of illumination but rather a graded wash or even bright accents. But "accidental " lighting effects and unintentional spottiness surley should be avoided. In the point by point method, the most exact method for determining footcandle levels produced by a single or over lapping floodlight beams. A point is selected on the building surface; then, knowing the candlepower of the floodlight beam aimed at that point, the designer can determine the footcandle contribution of the cosine law and the inverse \_ square law.

A more visual method of getting a picture of the amount of illumination on various portions of the building facade is to used the isocandle curves presented in manufacturers photometric data, and to draw this curves on the building facade by projection. To get and accurate trace of the curves on the facade by this method can be a quite time \_ consuming process. However and experienced floodlighting designer can sketch the projected isocandle curve by projecting a few points, and with these projected curves he can predict with sufficient accuracy what footcandle levels can be expected. Through experience, the lighting designer will be able to establish trail aiming points,once he has determined the

number of floodlights necessary. Then he can check his results to see whether "re \_ aiming" on paper might be necessary.

If the building floodlighting situation is such that PAR or R lamps seem indicated, the footcandle levels can easily be calculated by tracing footcandle patterns of these lamps, which are provided in the literature, at the given angle of protection ( 0, 30, 45, 60, 70 degrees ) on a scale drawing of the area to be lighted.

#### 4.2 SETTING UP THE LIGHT SOURCES

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

- \* on street lamps or other posts specially erected for the purpose
- \* on a penthouse roof
- \* on brackets on the house front
- \* 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 of oncoming vehicles (fig. 25). In order to set up the light sources in

the most advantageous position it may be necessary, in certain cases, to call in the help of the town council or the owner of the adjacent or opposite property where, for instance, local conditions may prevent the light sources from being set up on the actual site.

#### 4.3 - SELECTION OF THE LEVEL OF ILLUMINATION

The lighting level needed on 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 surroundings, the general brightness of these surroundings and the dimentions of the building. The table below presents some recomended illumination levels for various surface building materials used on buildings in either poorly lit,well lit or brightly lit surroundings.

Type of surface State	illumination in lux			
	poorly- lit	well- lit	brightly lit	
	surroun- dings	surroun- dings	surroun- dings	
White marble	fairly clean	25	50	100
Light concrete	fairly clean	50	100	200
Imitation				
concrete paint	fairly clean	100	250	400
White brick	fairly clean	20	40	80
Yellow brick	fairly clean	50	100	200
White granite	fairly clean	150	300	600
Concrete or				
dark stone	fairly clean	75	150	300
Red brick	fairly clean	75	150	300
Concrete	very dirty )	requires at least 150_300		
Red brick	dirty )	requires at least 150_300		

## CHAPTER FIVE

### 5.1 - CALCULATION TECHNIQUES:

Once the lighting requirements have been decided, floodlighting design falls into three stages. Firstly a partial assessment is made of where to locate the floodlights, the light distribution required, and the light source characteristics which suit the particular application.

Secondly, a "lumen calculation" is carried out to establish the number and the loading of the luminaires to achieve the design objectives.

Thirdly, "point -by - point calculations" are performed to determine the precise aiming of the floodlights to give a stated illuminance diversity: this in turn may necessitate slight modifications to the preliminary calculation.

For a large facade the lumen method should be used. This based upon a certain average luminous efficiency. For high and small objects, castle steeples chimneys, minaret etc, the luminous intensity method should be used. This is based on the luminous intensity radiation in a certain directions.

There is no doubt that floodlighting a historical places is one the most spectacular achievements in

lighting engineering.

Floodlighting of these old buildings, which often boast rich, ornate facades and beautiful architecture, is still very effective. Such wonderful results can be achieved by considering the two methods in illumination.

1. Lumen Method.

2. Direct Illuminance Calculation Method.

**1. LUMEN METHOD:**

First method is lumen method, whose flux formula given below.

$$Q = \frac{A * E}{T - n}$$

Where : A is the surface area

E is the desired illuminance in lux.

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

This is the practical method to determine the number of fittings. The number of fittings can be calculated by dividing total flux of one fitting only. In this method there is no justification about the point where the projector will be directed. Only information is about where the projector can be placed.

## 2. DIRECT ILLUMINANCE CALCULATION METHOD:

Second method is direct illuminance calculation method. For this method the illuminance can be calculated by using the formula.

Where :  $E$  is illuminance.

$I$  is intensity.

$\theta$  is angle of incidence.

$h$  is distance of the light source.

Direct illuminance calculation method is better. Because the illumination at each point is calculated point by point. Although this is more accurate. But if the area to be illuminated is so large, sometimes it is not possible to calculate illumination point by point. To overcome this problem some techniques have been developed. One of the most important technique is to use computer programming by the help of the isocandela diagrams (Intensity approach), and we can calculate the illumination at each point in minute time. Rather than this computer can be programmed, so that the place of projectors, directed points and the distance between wall and projectors,  $E / E$  etc. can be calculated. Of course this is more complex process but it is very obvious that computer plays very imp. role in illumination engineering as well as other areas.

## 5.2 - THE EQUIPMENTS USED IN FLOODLIGHTINGS:

- a) Low pressure sodium lamps.
- b) High pressure sodium vapour lamps.
- c) High pressure mercury vapour lamps.
- d) metal halide lamps.

I only use high pressure sodium vapour lamps in my project.

### b) HIGH - PRESSURE SODIUM VAPOUR LAMPS. (SON)

#### INTRODUCTION:

Ever since their introduction, in fact the high pressure sodiumvapour lamps have played an important role in the expanding field of floodlightings.

SON lamps are efficient, versatile light sources to start with their high luminous capacity means more light for less money - a feature of often decisive importance where lighting is employed for long periods of time. This plus the pleasing, warm , golden - white light, make SON lamps an attractive proposition for a wide range of applications both in and outdoors.

As a result, the philips high pressure sodium vapour lamp is a fundamental contributor in the quest for ever

more efficient light sources, meeting the increasingly stringent demands of our daily lives.

#### WHY HIGH-PRESSURE SODIUM VAPOUR LAMPS USED?

The short answer to this question is:

- High luminous capacity
- Golden white light
- Balanced colour rendering
- Long economic life
- Reliable, Stable operation
- Excellent lumen maintenance
- Short re-ignition time

#### HOW HIGH - PRESSURE SODIUM LAMPS WORK ?

At the heart of the SON lamps stands the discharge tube, fabricated from sintered aluminium oxide. The tungsten electrodes and their niobium supports are sealed into this tube with specially developed cement to give a highly reliable seal. During this process, the sodium, mercury and a rare gas to facilitate starting are also introduced into tube.

The initial discharge takes place in a 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 luminous capacity of up to 130 lm/w.

#### THE TYPES OF HIGH - PRESSURE SODIUM VAPOUR LAMPS:

- 1) SON LAMPS: High pressure sodium vapour lamps, for outdoor and indoor use, with a sintered aluminium oxidized discharge tube enclosed in a coater outer bulb.
- 2) SON - T LAMPS: With sintered aluminium oxidized discharge tube enclosed in a clear, tubular hard-glass outer bulb.
- 3) SON - H LAMPS: With internally coated hard-glass outer bulb.

#### THEIR APPLICATIONS:

- 1) Flood Lighting
- 2) Public Lighting
- 3) Industrial Lighting
- 4) Sports Lighting
- 5) Parking Lots
- 6) Airports
- 7) Road Lighting

Technical data and Pictures of the lamps are given at the back of this part.

### c) HIGH - PRESSURE MERCURY VAPOUR LAMPS:

#### INTRODUCTION:

Since the first mercury vapour lamp was introduced to the market, a whole range of - discharge lamps has been built on the reliability of this " father " of the family.

Not only has this range been exstended over the years to make full use of the mercury light source, but the dependability and lighting performance of the original versions have also been continually improved.

In fact, through this process of improvement their capacity more than doubled since their introduction. Indeed, the reliability and ease of installation of mercury vapour lamps will be difficult to duplicate. There is still a vital role for these lamps to play.

#### WHY HIGH - PRESSURE MERCURY VAPOUR LAMPS USED ?

Mercury vapour lamps are staple in operation and reliable in their considerable light output. They can perform well even where there are slight variations in the supply voltage. Their simple circuitry also makes them attractive light sources which are easily to install, since

they do not need an external ignition device. The ballasts needed to operate mercury vapour lamps are basic chokes regulating the correct operating current, and this contributes other benefits to the dependability of mercury vapour lamps. These lamps are very versatile, because of their remarkable reliability in a whole host of applications both in and outdoors. Mercury vapour lamps are used where spectacular lighting is not needed but a clear whitish light and reasonable colour qualities are still important.

#### HOW HIGH - PRESSURE MERCURY VAPOUR LAMPS WORK ?

All of the lamp types described in this part have one thing in common: they operate on the principle of the gas discharge, that is to say, part of the energy to generate light. The most important part of the lamp is therefore the discharge tube, this is a small tube with electrodes sealed in, and filled with a specific amount of mercury and a starting gas. An auxiliary electrode is also incorporated. Voltage applied to the electrodes affects the free electrons, which then start to accelerate towards the positive pole. In doing so, they collide with the atoms of the gas. Depending on the speed of the electrons,

## THE TYPES OF HIGH - PRESSURE MERCURY VAPOUR LAMPS:

High - pressure mercury vapour lamps are divided into five types as follows:

- 1) HP lamps - quartz discharge tube enclosed in a clear ovoid outer bulb.
- 2) HPL - N lamps - Internally coated ovoid outer bulb.
- 3) HPL - B lamps - Coated with a special phosphor to ensure a pleasant warm colour appearance.
- 4) HPL - R lamps - With an internal reflector.
- 5) MIS~~C~~ed lamps.

## THEIR APPLICATIONS:-

- 1) Food lighting
- 2) Public lighting
- 3) Photograph
- 4) Factories
- 5) Railways stations
- 6) Sport grounds
- 7) Parking lots
- 8) Schools
- 9) Decorative lighting
- 10) Paper mills
- 11) Quarries

Technical data and pictures of the lamps are given at the back of this project.

### 5.3 - LIGHTING UNITS AND DEFINITIONS :

#### Luminance : (1)

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

#### Candela : ( cd )

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

#### Candela - Power :

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

#### Illuminance : (E)

Luminous flux on a surface element divided by the area of the element; in lumens per square meter or lux.

#### Lumen : (lm)

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

#### Lux : ( lx )

Unit of illuminations, the illumination

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

Flux, radiant : (Qe)

Power emitted, transferred or received as radiation : in watts.

Luminous flux : (Q , F , unit : lumen )

The rated of passage of radiant energy evaluated by reference to the luminous sensation produced thereby.

Luminance intensity : (symbol ; I , unit : candela)

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

Objective brightness :

This is a luminous intensity of a light source. It is the light output divided by the projected area of the light source in the particular direction, measured in candela per unit area

The ratio of reflection factor :

$$\frac{\text{Lumens reflection from a source}}{\text{Lumens received by the light surface}}$$

Coefficient of utilization :

New called the utilization factor is a factor used in planning schemes, which allows for loss of light by absorption in reflectors, ceilings, walls, etc. It is the ratio :

$$\frac{\text{Lumens received at the working plane}}{\text{Lumens generated by the light source}}$$

Reflection factor :

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

Maximum intensity :

The maximum intensity of the beam is the maximum intensity in candela per 1000 lumen of the lamp flux (Fig. 1 a)

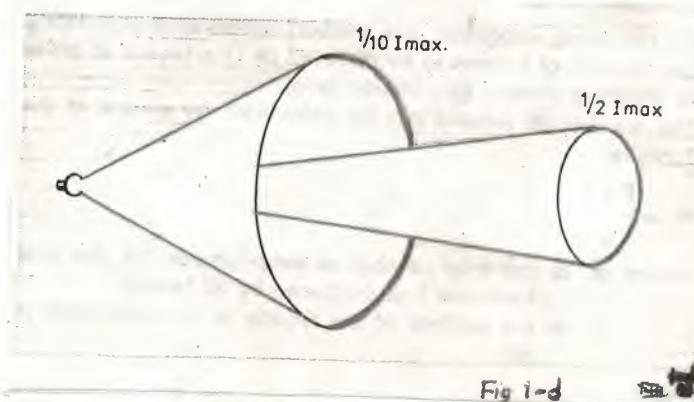
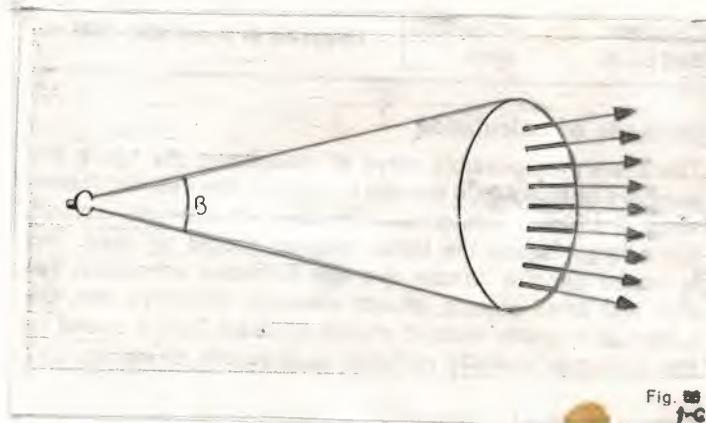
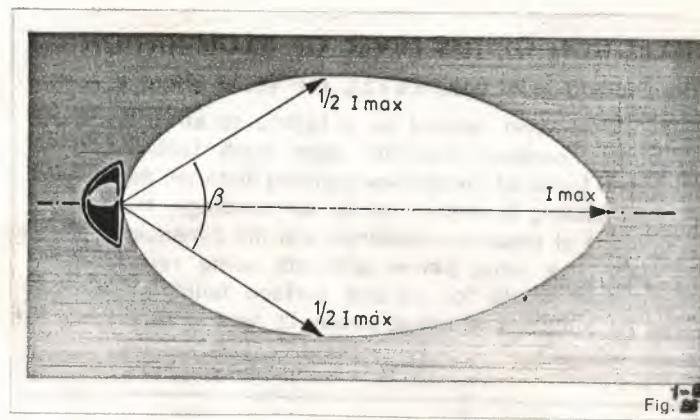
Beam lumens :

The terms beam lumens refers to the quantity of light (figs. 1-c and 1-d)

contained within the beam for  $I = 0.5 I_{\max}$   
(Europe).

#### Beam efficiency :

It is the ratio between the luminous flux in the beam and total luminous flux of the lamps.



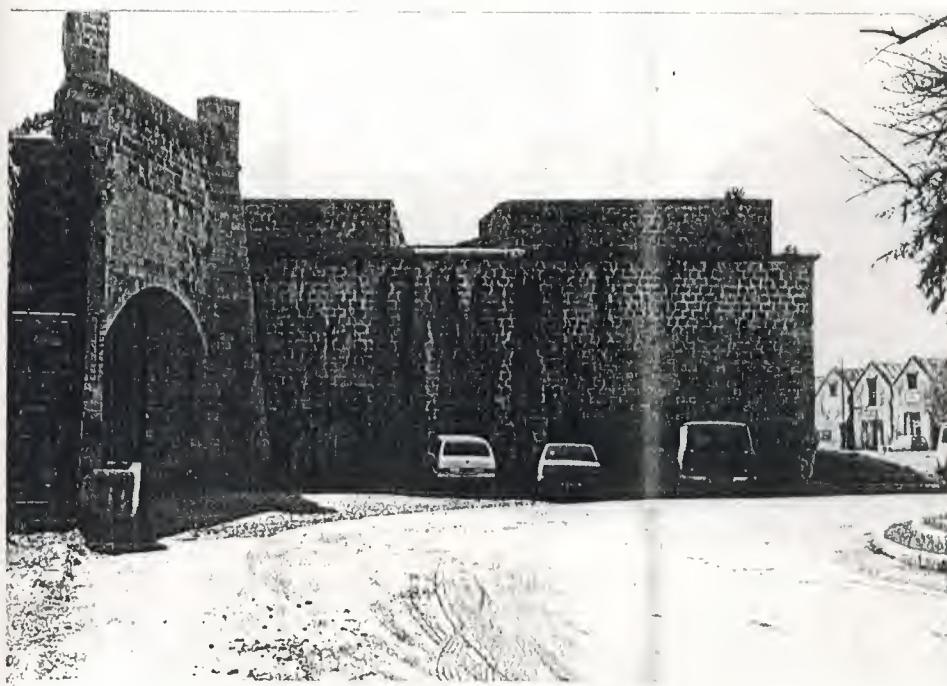
- C O N C L U S I O N -

In this project I have tried to illustrate the importance of Floodlighting. Especially the floodlighting of Famagusta Castles.

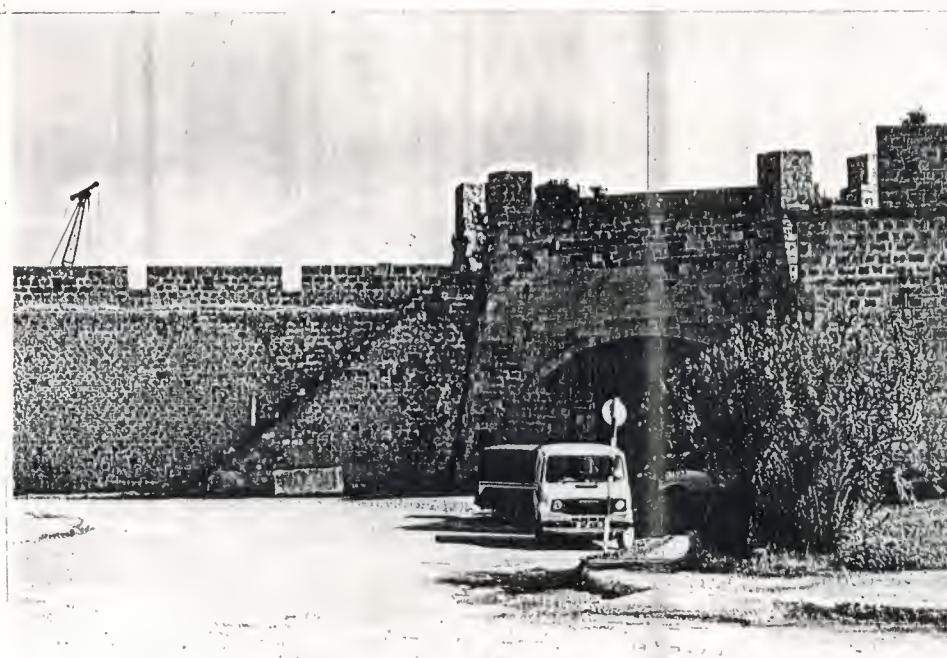
Recently we have seen the rapid development of the use of artificial lighting out of doors, not only for the commonplace street - lighting, but for sports areas, building sites, carparks, gardens, castles, open area industrial premises, recreation ground swimming pools and so on. The exteriors of buildings of historic and architectural interest are also floodlit to enhance the buildings appearance during the hours of darkness and special type of lamps have been developed to produce colours of light designed to show up the aesthetic beauty ancient stinwork.

In the preperation of this project I used high pressure sodium vapour lamp, which is called SON-T 400 W. It provides a source of high light output with exceptionally good golden white colour appearance and colour rending almost like the warmth of the setting sun. It is the best lamp for outdoor illumination because of the high sodium pressure . The lamp has a high luminous efficiency and colour appearance; it has long economical life, excellent maintenance

Finally, I can say that, this project taught me the way I should follow in floodlighting calculations, and it gave me a practical knowledge about the outdoor illumination.

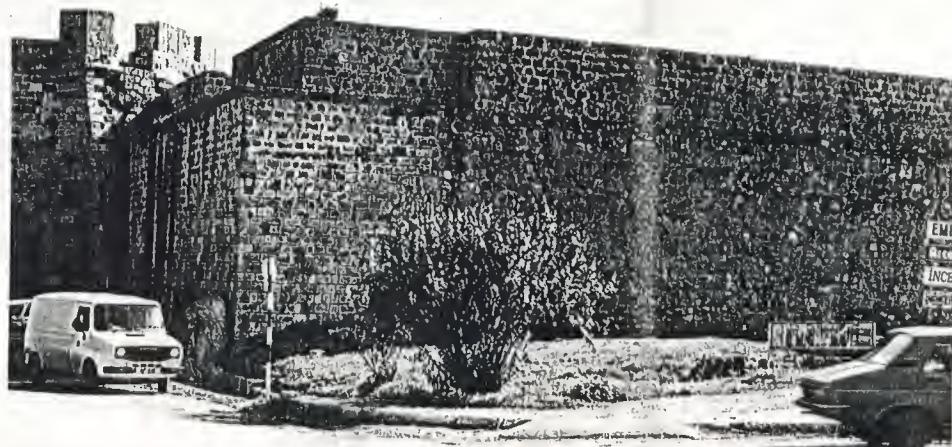


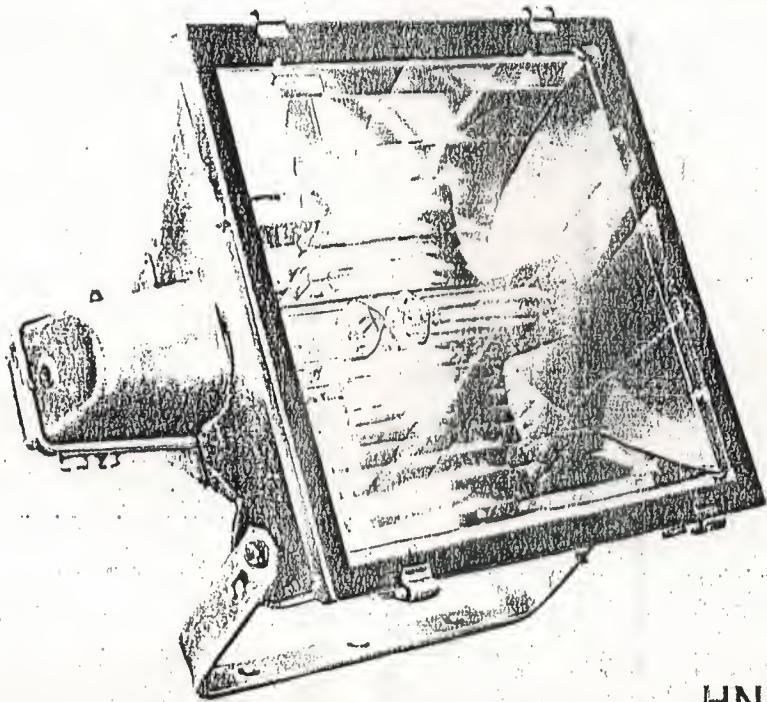
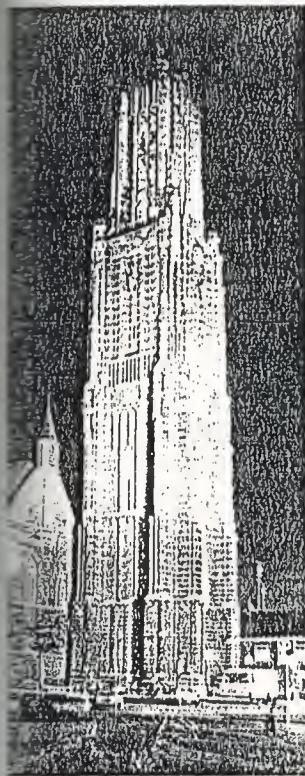
VIEWS OF PORTA DI MARE





Front views of Porta Di Mare




**HNF 001**

### Definition

Floodlight for use with one or two lamps: One HPI-T 1000 W metal halide lamp, one SON-T 1000 W high-pressure sodium lamp, or 400 W high-pressure sodium lamps, two HPI-T 400 W metal halide lamps.

### Description

- Housing and rear cover of high-pressure die-cast aluminium construction.
- Castings of low copper-content for excellent corrosion-resistance, even in coastal and industrial areas.
- Two symmetrical (narrow and wide) and one asymmetrical beam version available.
- High-grade aluminium reflector 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 daylight adjustment.

### Ordering data

Designation	For lamps	Ordering number *				Weight kg
		Symmetrical narrow beam	Symmetrical wide beam	Asymmetrical beam		
HNF 001	2 x SON-T 400 W 2 x HPI-T 400 W	9112 708 609..	9112 708 610..	9112 708 611..	13,5	
	1 x SON-T 1000 W 1 x HPI-T 1000 W	9112 708 508..	9112 708 509..	9112 708 510..	13,5	
Louvre HNF 001		9119 270 020..	9119 270 020..	—	2,7	

\* Complete floodlight.

- One PG 16 and one PG 11 gland for cable entry.
- Silicone rubber gaskets for jet-proof and dust-proof sealing (IP 55).
- The front glass is a 5,5 mm thick toughened glass plate, which is attached to the housing by 4 stainless steel clips.
- A matt-black silicone lacquered sheet aluminium louvre is available as an accessory to prevent excessive glare.

### Applications

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>- Sports grounds</li> <li>- Floodlighting of buildings</li> <li>- Marshalling yards</li> <li>- Car parks</li> <li>- Skating rinks</li> </ul> | <ul style="list-style-type: none"> <li>- High-mast lighting</li> <li>- Sports halls</li> <li>- Shipyards</li> <li>- Container terminals</li> </ul> |
|---|--|

Classification: IP 55



Insulation class I



## Floodlight for metal halide lamps or high-pressure sodium lamps

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Luminaire (INR) number	:	69				
Measuring code	:	LVO8074G				
Luminaire type	:	HNF 001-W				
Lamp type	:	SONT 400W				
Lamp flux	:	47.00	klumen			
No. of lamps per luminaire	:	2				
Power dissipation	:		Watt			
Total light output ratio	:	71	%			
Downward light output ratio	:	71	%			
SLI-factor (Road lighting)	:					
Maximum spacing/height ratio	:	*	Lengthwise	Crosswise	*	*
Luminaire sizes [mm]	:		Length	Width	H0	H90
Symmetry code	:	4				
CIE Fluxcode [%]	:	N1 73	N2 97	N3 100	N4 100	

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Luminaire (INR) number : 69

Measuring code : LVO8074G  
 Luminaire type : HNF 001-W  
 Lamp type : SONT 400W

\* I-Table \*

	0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0
-> C-plane											
0.0	619	619	619	619	619	619	619	619	619	619	619
2.5	614	611	611	611	610	610	609	610	610	605	610
5.0	604	604	602	594	591	590	588	585	585	587	585
7.5	585	588	579	575	572	569	567	566	564	565	564
10.0	568	566	554	548	544	544	542	541	538	541	538
12.5	556	550	535	525	517	512	514	514	512	516	512
15.0	543	530	517	504	491	483	484	485	486	487	486
17.5	531	514	497	481	467	453	447	452	452	454	452
20.0	514	496	477	456	440	426	414	416	414	413	414
22.5	493	471	449	431	413	399	381	370	367	358	367
25.0	464	441	418	401	385	366	342	319	310	305	310
27.5	426	404	381	367	353	330	299	274	260	248	260
30.0	385	360	337	328	311	289	259	226	211	203	211
32.5	335	318	295	280	269	249	217	193	178	172	178
35.0	296	275	252	240	229	207	187	171	159	150	159
37.5	271	240	221	208	192	176	168	156	144	137	144
40.0	247	221	197	183	159	155	152	149	138	131	138
42.5	224	199	181	161	137	138	143	146	137	136	137
45.0	201	179	161	140	124	126	138	153	145	137	145
47.5	180	157	140	116	108	115	139	149	143	134	143
50.0	152	133	117	94	92	106	130	134	135	128	135
52.5	109	105	94	75	76	98	113	120	123	125	123
55.0	74	67	72	60	67	82	97	111	107	104	107
57.5	49	45	54	48	58	65	83	84	70	44	70
60.0	31	35	41	40	48	52	57	25	12	8	12
62.5	24	26	32	36	40	35	14	6	6	6	6
65.0	17	20	26	30	34	11	4	4	4	5	4
67.5	10	13	17	22	21	1	4	3	3	4	3
70.0	5	6	8	11	3	3	3	3	3	3	3
72.5	3	2	3	4	2	3	2	3	3	3	3
75.0	1	0	1	1	1	2	1	2	3	3	3
77.5	0	0	0	0	1	1	1	1	2	1	2
80.0	0	0	0	0	0	1	0	0	0	0	0
82.5	0	0	0	0	0	0	0	0	0	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

v

Gamma-angle

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DATABASE 1.20 April 1989

Philips Lighting B.V.

Luminaire (INR) number

: 69

Measuring code

: LVO8074G

Luminaire type

: HNF 001-W

Lamp 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	619	619	619	619	619	619	619	619	619	619	619	619
2.5	610	609	610	610	611	611	611	614	611	611	611	610
5.0	585	588	590	591	594	602	604	604	603	602	592	573
7.5	566	567	569	572	575	579	588	585	587	577	573	547
10.0	541	542	544	544	548	554	566	568	565	553	525	525
12.5	514	514	512	517	525	535	550	556	550	534	504	504
15.0	485	484	483	491	504	517	530	543	531	518	498	481
17.5	452	447	453	467	481	497	514	531	514	496	477	456
20.0	416	414	426	440	456	477	496	514	496	471	449	431
22.5	370	381	399	413	431	449	471	493	471	441	418	401
25.0	319	342	366	385	401	418	441	464	441	418	381	365
27.5	274	299	330	353	367	381	404	426	405	381	336	326
30.0	226	259	289	311	328	337	360	385	362	336	300	280
32.5	193	217	249	269	280	295	318	335	322	295	255	241
35.0	171	187	207	229	240	252	275	296	278	244	224	208
37.5	156	168	176	192	208	221	240	271	244	224	200	182
40.0	149	152	155	159	183	197	221	247	224	202	183	160
42.5	146	143	138	137	161	181	199	224	202	183	160	140
45.0	153	138	126	124	140	161	179	201	181	161	140	117
47.5	149	139	115	108	116	140	157	180	158	139	117	95
50.0	134	130	106	92	94	117	133	152	134	116	94	75
52.5	120	113	98	76	75	94	105	109	106	94	73	60
55.0	111	97	82	67	60	72	67	74	68	68	56	49
57.5	84	83	65	58	48	54	45	49	46	46	42	40
60.0	25	57	52	48	40	41	35	31	37	37	33	37
62.5	6	14	35	40	36	32	26	24	28	28	27	31
65.0	4	4	11	34	30	26	20	17	20	20	17	22
67.5	3	4	1	21	22	17	13	10	12	12	17	19
70.0	3	3	3	3	11	8	6	5	5	5	8	5
72.5	3	2	3	2	4	3	2	3	1	2	0	0
75.0	2	1	2	1	1	1	0	0	0	0	0	0
77.5	1	1	1	1	0	0	0	0	0	0	0	0
80.0	0	0	1	0	0	0	0	0	0	0	0	0
82.5	0	0	0	0	0	0	0	0	0	0	0	0
85.0	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	0
90.0	0	0	0	0	0	0	0	0	0	0	0	0

V

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Luminaire (INR) number : 69

Measuring code : LVO8074G  
 Luminaire type : HNF 001-W  
 Lamp type : SONT 400W

\* I-Table \*

	220.0	230.0	240.0	250.0	260.0	270.0	280.0	290.0	300.0	310.0	320.0	
	> C-plane											
0.0	619	619	619	619	619	619	619	619	619	619	619	619
2.5	610	609	609	609	610	611	610	609	609	609	609	610
5.0	590	588	586	583	584	586	584	583	586	588	588	590
7.5	570	567	565	565	563	565	563	565	565	567	570	570
10.0	542	542	541	541	539	542	539	541	541	542	542	542
12.5	516	511	515	515	514	517	514	515	515	511	511	516
15.0	490	484	487	488	489	490	489	488	487	484	490	490
17.5	468	457	452	455	454	455	454	455	452	457	468	468
20.0	443	431	418	417	414	414	414	417	418	431	443	443
22.5	416	402	383	371	366	363	366	371	383	402	416	416
25.0	387	368	344	321	310	304	310	321	344	368	387	387
27.5	353	331	302	274	258	250	258	274	302	331	353	353
30.0	311	290	259	220	205	197	205	220	259	290	311	311
32.5	269	248	211	186	175	168	175	186	211	248	269	269
35.0	228	202	182	173	162	155	162	173	182	202	228	228
37.5	190	171	167	159	147	140	147	159	167	171	190	190
40.0	159	153	153	148	136	129	136	148	153	153	159	159
42.5	138	137	142	143	132	125	132	143	142	137	138	138
45.0	124	125	134	145	136	128	136	145	134	125	124	124
47.5	105	113	133	141	135	127	135	141	133	113	105	105
50.0	89	103	125	129	133	127	133	129	125	103	89	89
52.5	75	96	111	118	122	119	122	118	111	96	75	75
55.0	67	81	98	113	109	105	109	113	98	81	67	67
57.5	59	66	92	86	72	66	72	86	92	66	59	59
60.0	49	60	65	25	11	8	11	25	65	60	49	49
62.5	41	44	15	5	6	6	6	5	15	44	41	41
65.0	36	12	5	4	4	4	4	4	5	12	36	36
67.5	22	4	3	3	3	3	3	3	3	4	22	22
70.0	2	3	2	2	3	3	3	2	2	3	2	2
72.5	2	2	1	2	3	3	3	2	1	2	2	2
75.0	1	1	1	1	3	3	3	1	1	1	1	1
77.5	0	0	1	1	2	2	2	1	1	0	0	0
80.0	0	0	0	0	0	0	0	0	0	0	0	0
82.5	0	0	0	0	0	0	0	0	0	0	0	0
85.0	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	0
90.0	0	0	0	0	0	0	0	0	0	0	0	0

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Luminaire (INR) number : 69

Measuring code : LVO8074G  
 Luminaire type : HNF 001-W  
 Lamp type : SONT 400W

\* I-Table \*

	330.0	340.0	350.0	360.0	
0.0	619	619	619	619	
2.5	610	611	611	614	
5.0	592	602	603	604	
7.5	573	577	587	585	
10.0	547	553	565	568	
12.5	525	534	550	556	
15.0	504	518	531	543	
17.5	481	498	514	531	
20.0	456	477	496	514	
22.5	431	449	471	493	
25.0	401	418	441	464	
27.5	365	381	405	426	
30.0	326	336	362	385	
32.5	280	295	322	335	
35.0	241	255	278	296	
37.5	208	224	244	271	
40.0	182	200	224	247	
42.5	160	183	202	224	
45.0	140	161	181	201	
47.5	117	139	158	180	
50.0	95	116	134	152	
52.5	75	94	106	109	
55.0	60	73	68	74	
57.5	49	56	46	49	
60.0	40	42	37	31	
62.5	37	33	28	24	
65.0	31	27	20	17	
67.5	22	17	12	10	
70.0	19	8	5	5	
72.5	5	2	1	3	
75.0	0	0	0	1	
77.5	0	0	0	0	
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	

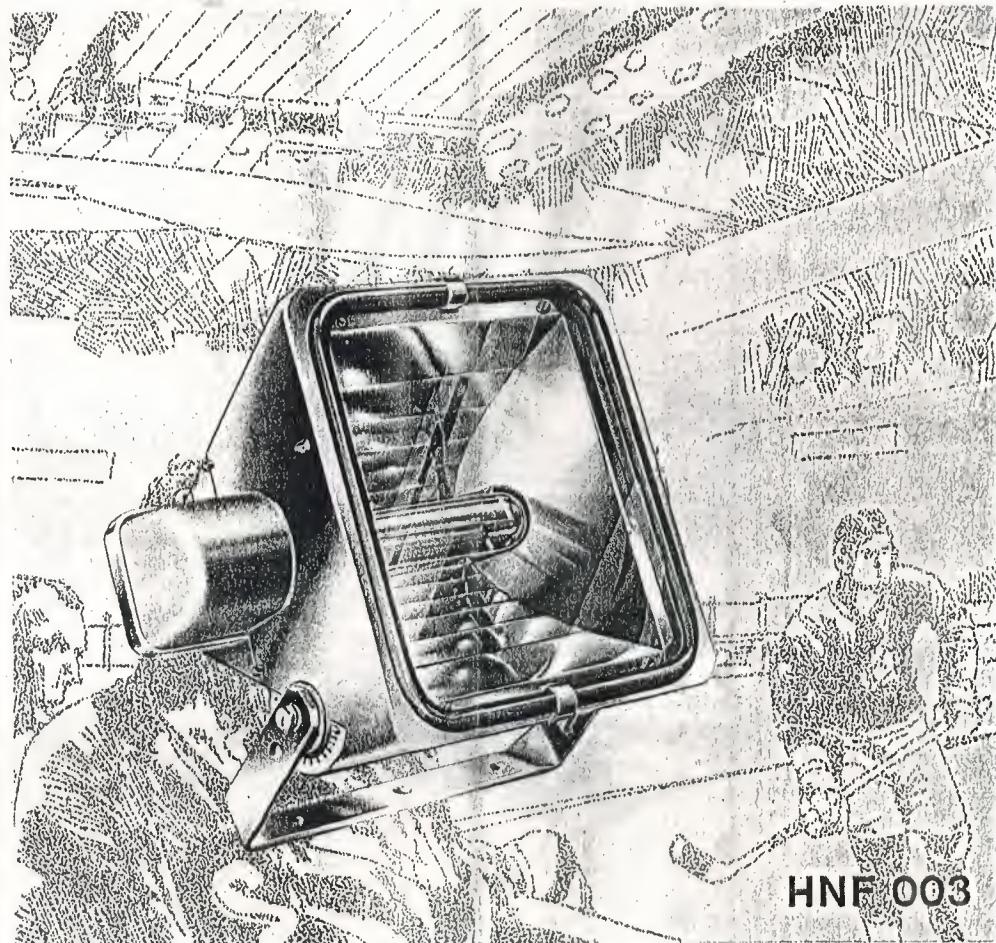
V

Gamma-angle



## DEFINITION

Floodlight for one of the following lamps:  
 HPI/T 375 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: rugged all-cast aluminium construction
- 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 375 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 daylight adjustment
- Ozone-resistant ethylene-propylene rubber gasket for jetproof and dustproof sealing of front glass; 2 extra safety clamps.

## APPLICATIONS

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

## ORDERING DATA

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

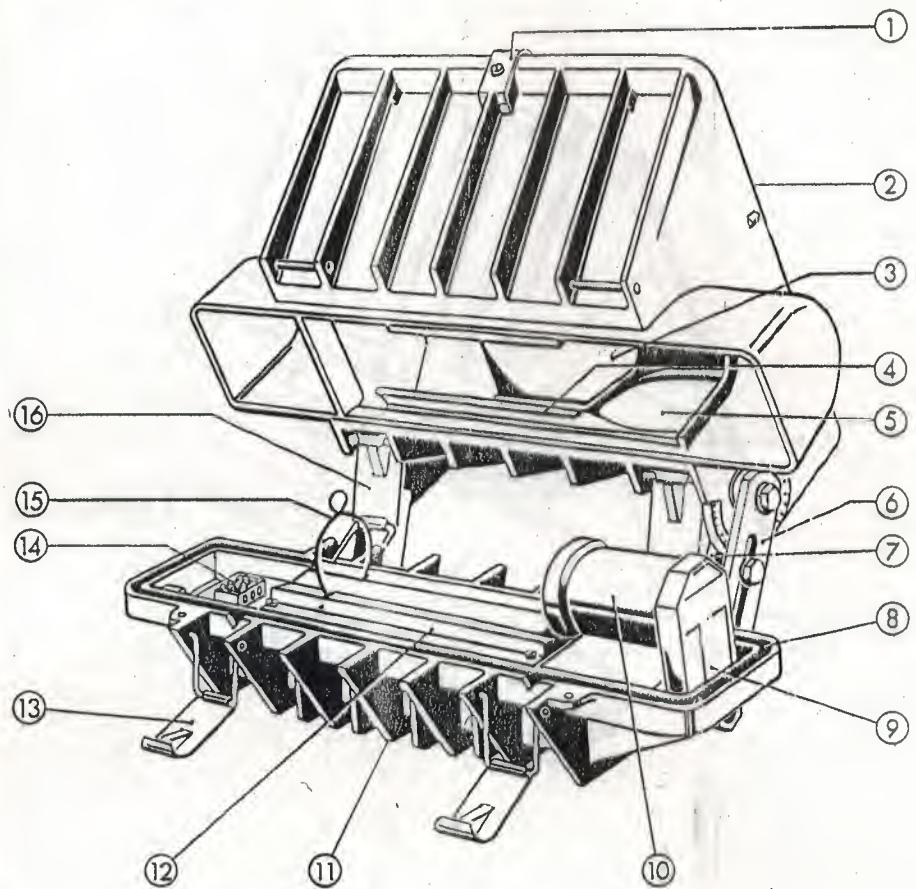
\* Complete floodlight



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

#### DETAILED DRAWING

1. Front-glass clamp (2×)
2. Housing
3. Front glass
4. Parabolic reflector
5. Side reflector (2×)
6. Bracket
7. Clamp
8. Gasket rear cover
9. Lampholder insulating plate
10. Lampholder
11. Rear cover
12. Rear reflector
13. Closing clip top (2×)
14. Connection block
15. Lamp support
16. Closing clip bottom (2×)

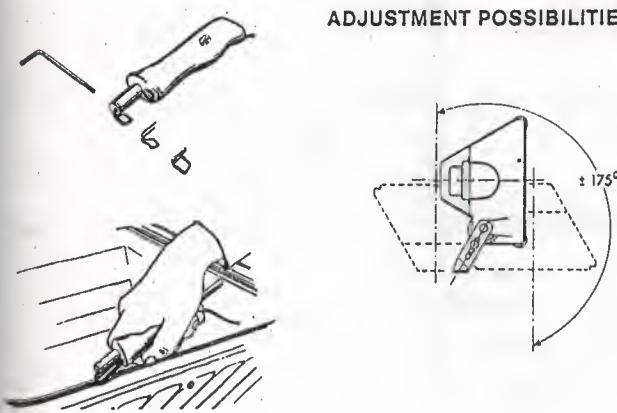


#### SPECIAL TOOL

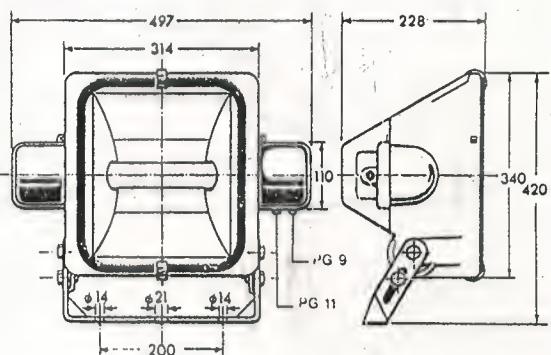
The front glass is provided with a special type of gasket. To replace the glass, a special gasket insertion tool can be used, consisting of a handle

with three removable clips to suit the different floodlights. Ordering number for complete set 9119 260 005 ..

#### ADJUSTMENT POSSIBILITIES

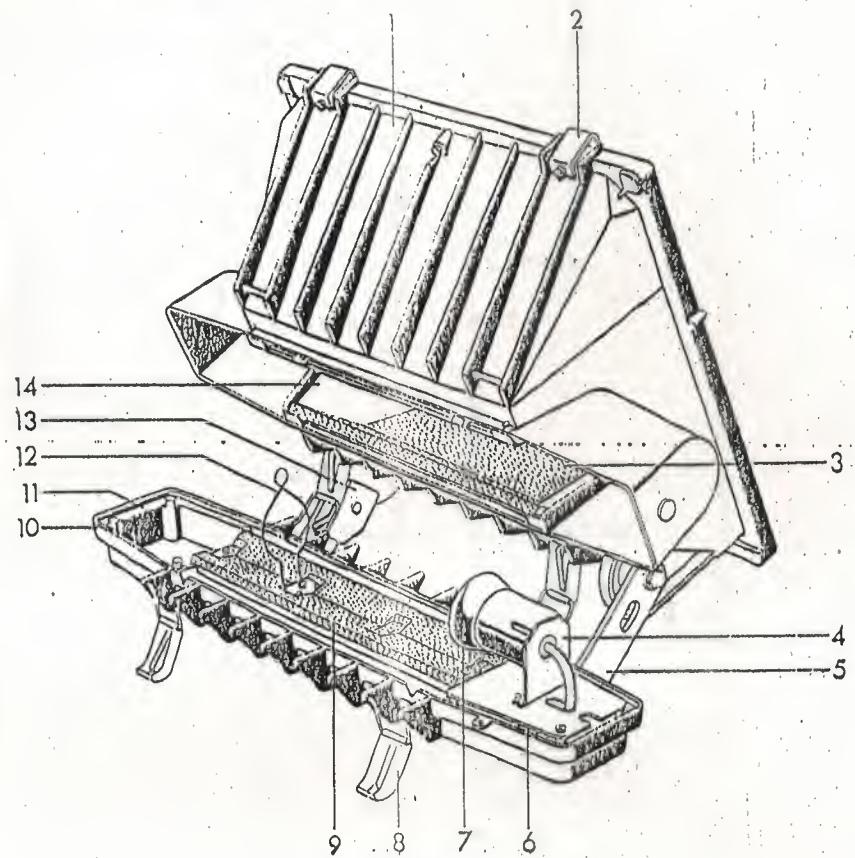


#### DIMENSIONS

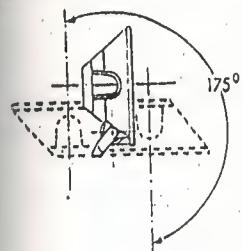


### Detailed drawing

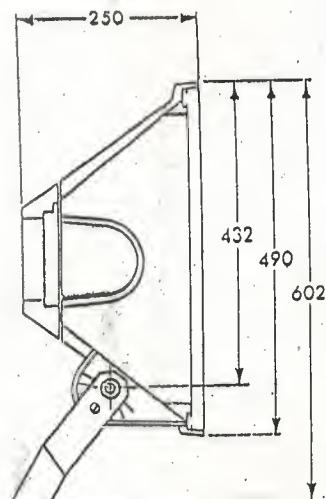
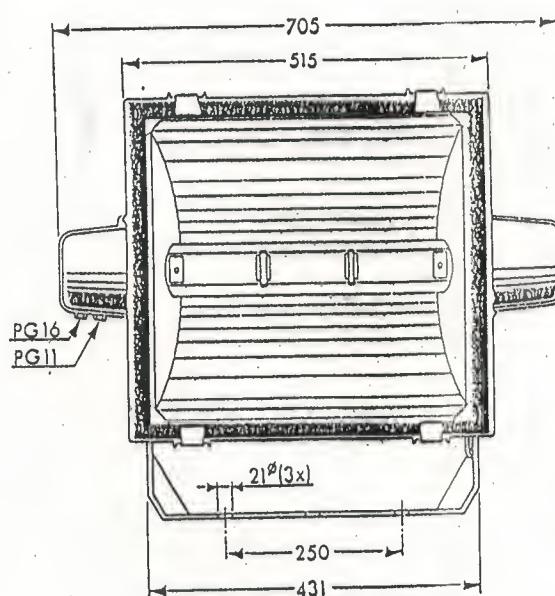
1. Housing
2. Front-glass clamp (4x)
3. Reflector
4. Lampholder bracket
5. Bracket
6. Terminal block
7. Lampholder
8. Closing clip (4x)
9. Reflector rear cover
10. Rear cover
11. Gasket
12. Lamp support
13. Clamp
14. Side reflector



### Adjustment possibilities



### Dimensions



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

Maximum spacing/height ratio : \* Lengthwise \* Crosswise  
Luminaire sizes [mm] : \* Length \* Width \* H0 \* H90  
Symmetry code : 4  
CIE Fluxcode [%] : N1 N2 N3 N4  
: 82 99 100 100

Luminaire (INR) number : 73

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

\* I-Table \*

	0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	> C-plane
0.0	612	612	612	612	612	612	612	612	612	612	612	612
2.5	602	599	600	601	602	603	604	606	608	610	610	608
5.0	586	586	588	589	590	587	589	589	592	597	597	592
7.5	564	565	565	565	564	566	569	574	577	583	577	577
10.0	538	533	533	536	539	546	556	567	574	583	574	574
12.5	509	507	508	510	515	526	549	573	585	597	585	585
15.0	480	485	480	477	489	520	548	572	587	597	586	586
17.5	453	457	450	450	471	511	537	552	560	556	560	560
20.0	426	426	423	427	462	496	507	503	507	510	507	507
22.5	407	401	399	410	444	466	456	456	457	455	457	457
25.0	379	383	381	402	416	417	414	408	399	400	399	399
27.5	343	350	355	387	388	381	376	363	346	341	346	346
30.0	303	306	324	359	362	344	336	316	293	287	293	293
32.5	257	264	292	325	328	308	290	274	248	234	248	248
35.0	211	221	254	285	287	273	252	233	206	196	206	206
37.5	164	178	214	237	246	233	217	201	181	179	181	181
40.0	123	133	168	194	206	196	182	175	171	163	171	171
42.5	86	99	127	153	170	166	154	153	151	147	151	151
45.0	58	69	89	119	139	141	134	130	129	130	129	129
47.5	45	49	63	90	113	118	113	116	108	110	108	108
50.0	32	37	49	70	91	99	98	92	87	90	87	87
52.5	20	25	35	56	70	82	100	45	66	69	66	66
55.0	12	16	20	41	49	68	72	10	45	37	45	45
57.5	9	10	10	21	33	44	21	9	22	19	22	22
60.0	6	8	7	10	13	12	7	7	11	5	11	11
62.5	4	5	4	5	3	3	5	7	4	5	4	4
65.0	2	3	4	2	3	3	5	7	2	6	2	2
67.5	2	2	3	3	2	2	4	6	7	6	7	7
70.0	1	2	2	2	2	2	4	6	6	5	6	6
72.5	1	1	2	2	1	2	3	5	5	5	5	5
75.0	1	1	1	1	1	2	3	4	5	3	4	4
77.5	1	1	1	1	1	1	2	3	4	2	4	2
80.0	0	0	0	0	1	1	1	2	2	1	1	2
82.5	0	0	0	0	0	0	0	1	1	1	0	1
85.0	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	0
90.0	0	0	0	0	0	0	0	0	0	0	0	0

v

Luminaire (INR) number : 73

Measuring code : LVO 4147  
 Luminaire type : HNF 003-W  
 Lamp 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
40.0	175	182	196	206	194	168	133	123	133	168	194
42.5	153	154	166	170	153	127	99	86	99	127	153
45.0	130	134	141	139	119	89	69	58	69	89	119
47.5	116	113	118	113	90	63	49	45	49	63	90
50.0	92	98	99	91	70	49	37	32	37	49	70
52.5	45	100	82	70	56	35	25	20	25	35	56
55.0	10	72	68	49	41	20	16	12	16	20	41
57.5	9	21	44	33	21	10	10	9	10	10	21
60.0	7	7	12	13	10	7	8	6	8	7	10
62.5	7	5	3	3	5	4	5	4	5	4	5
65.0	7	5	3	3	2	4	3	2	3	4	2
67.5	6	4	2	2	3	3	2	2	2	3	3
70.0	6	4	2	2	2	2	2	1	1	2	2
72.5	5	3	2	1	2	2	1	1	1	2	2
75.0	4	3	2	1	1	1	1	1	1	1	1
77.5	3	2	1	1	1	1	1	1	1	1	1
80.0	2	1	1	1	0	0	0	0	0	0	0
82.5	1	1	0	0	0	0	0	0	0	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

v

Gamma-angle

Luminaire (INR) number : 73

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

## \* I-Table \*

	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	119	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

Gamma-angle

Luminaire (INR) number

: 73

Measuring code

: LVO 4147

Luminaire type

: HNF 003-W

Lamp type

: SONT 400W

\* I-Table \*

	330.0	340.0	350.0	360.0	> C-plane
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	

v  
Gamma-angle

# USED COMPUTER PROGRAM

```
DIMENSION AT(40,40) TT(50,50)

90  WRITE(5,*) 'ENTER THE VALUES OF xo, xo and h'
      READ(5,*) xo,yo,h
      WRITE(5,*) 'ENTER THE xmin xmax ymin AND ymax'
      READ(5,*) xmin,xmax,ymin,ymax
      T=xmin
      I=1
50  J=1
      xmin=T
      30  x1o=xo/h
          x1=xmin/h
          y1o=yo/h
          y1=ymax/h
          C0=1/SQRT((1+x1**2+y1**2)**3)
          B=1+x1*x1o+y1**2*((1+x1o**2)/(1+x1**x1o))
          C=SQRT((1+x1**2+y1**2)*(1+x1o**2+y1**2*((1+x1o**2)/(1+
          * x1**x1o))**2))
          A=ACOS(B/C)
          D=ATAN(y1*SQRT(1+x1o**2)/(1+x1**x1o))
          E=ATAN(y1o/SQRT(1+x1o**2))
          F=D-E
          FB=F*180/3.1415926
          B1=ATAN(TAN(TAN(A)*SQRT(1+(TAN(F))**2)))
          IF(F.EQ.0) GO TO 999
```

GO TO 997

999 CT=90

GO TO 998

997 CT=ATAN(TAN(B1/TAN(F))\*180/3.1415926

998 IF(xmin.LT.xo.AND.FB.GT.0)CT=CT

IF(xmin.LT.xo.AND.FB.LT.0)CT=180+CT

IF(xmin.GT.xo.AND.FB.LT.0)CT=180-CT

IF(xmin.GT.xo.AND.FB.GT.0)CT=360-CT

IF(xmin.GT.xo.AND.FB.EQ.0)CT=270

IF(xmin.LT.xo.AND.FB.EQ.0)CT=90

IF(xmin.EQ.xo.AND.FB.EQ.0.AND.xo.LT.0)CT=180

IF(xmin.EQ.xo.AND.FB.EQ.0.AND.xo.GT.0)CT=0

IF(xmin.EQ.xo.AND.FB.GT.0)CT=0

IF(xmin.EQ.xo.AND.FB.LT.0)CT=180

C1=CT

A3=(1+x1\*x1o+y1o\*y1)

C2=(1+x1\*\*2+y1\*\*2)

C3=(1+x1o\*\*2+y1o\*\*2)

B3=SQRT(C2\*C3)

G1=ACOS(A3/B3)

G=G1\*180/3.1415926

AT(1,1)=619

AT(1,2)=619

AT(1,3)=619

:

:

:

AT(37,36)=0

AT(37,37)=0

YT=6/2.5  
LL3=INT(YT)  
LL1=LL3+1  
LL2=LL1+1  
TY=C1/10  
KK3=INT(TY)  
KK1=KK3+1  
KK2=KK1+1  
XA=(AT(LL1,KK2)-AT(LL1,KK1))\*(KK3\*10-C1)/(-10)  
\* +AT(LL1,KK1)  
XB=(AT(LL2,KK2)-AT(LL2,KK1))\*(KK3\*10-C1)/(-10)  
+AT(LL2,KK1)  
ZZ=(XB-XA)/(LL3\*2.5-LL1\*2.5)\*(LL3\*2.5-6)+XA  
TT(i,j)=ZZ\*94.0\*C0/h\*\*2  
IF(xmin.LT.xmax) GO TO 10  
GO TO 20  
10 xmin=xmin+2  
j=j+1  
GO TO 30  
20 IF(ymax.GT.ymin) GO TO 40  
GO TO 50  
40 ymax=ymax-1  
i=i+1  
GO TO 60  
50 DO 55 mm=1,i  
WRITE(5,\*) (TT(mm,kk),kk=1,j)

55      CONTINUE

STOP

END

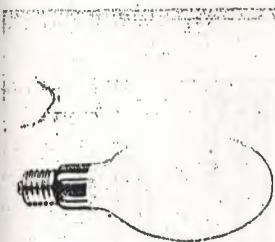
## HIGH-INTENSITY SODIUM LAMPS

### SON LAMPS

High luminous efficacy, golden white light and universal burning position:  
SON high-pressure sodium vapour discharge lamps are suitable for indoor or outdoor use. Their long life and excellent lumen maintenance make them first-rate light sources for all kinds of applications.

### SON-H LAMPS

Designed as a replacement for HPL-N lamps in existing installations, without the necessity of changing the ballast or adding a starter system. The 210 W version can replace the HPL-N 250 W, the 350 W version is an alternative to the HPL-N 400 W. Improvement in efficacy of 75%.



Type	Base	Luminous flux (lm)	Min. supply voltage V	Max. length	Max. dia.	Weight	Ordering number
SON 50 W <sup>1)</sup>	E27	3300	200	156	.72	.58	9281 508 088-
SON 70 W <sup>1)</sup>	E27	5800	200	156	.72	.58	9281 501 088-
SON 70 W-E <sup>2)</sup>	E27	5800	200	156	.72	.58	8222 341 018-
SON 100 W	E40/45	9500	200	186	.76	.95	9281 516 088-
SON 150 W	E40/45	13500	200	227	.92	1.70	9281 503 098-
SON-S 150 W	E40/45	15500	200	227	.92	1.70	9281 514 098-
SON 250 W	E40/45	25000	200	227	.92	1.90	9281 510 088-
SON 400 W	E40/45	47000	200	292	1.22	2.50	9281 520 098-
SON 1000 W	E40/45	120000	200	400	1.68	4.80	9281 540 098-

<sup>1)</sup> After 100 burning hours.

<sup>2)</sup> E: with external ignitor; I: with internal ignitor.

Maximum short-time voltage variation:  $\pm 5\%$  of rated voltage.



### SON-T LAMPS

Tubular high-pressure sodium-vapour discharge lamps for optical systems.  
Universal burning position, high luminous efficacy, golden white light.

Type	Base	Luminous flux (lm)	Min. supply voltage V	Max. length	Max. dia.	Weight	Ordering number
SON-T 70W-E <sup>1)</sup>	E27/30	6500	200	156	.38	.50	8222 341 145-
SON-T 100 W	E40/45	10000	200	211	.48	.60	9281 517 092-
SON-T 150 W	E40/45	14000	200	211	.48	.70	9281 504 092-
SON-ST 150 W	E40/45	16000	200	257	.48	1.70	9281 509 092-
SON-T 250 W	E40/45	27000	200	283	.48	2.00	9281 445 092-
SON-T 400 W	E40/45	47000	200	390	.67	4.50	9281 545 092-
SON-T 1000 W	E40/80x50	125000	200				

<sup>1)</sup> After 100 burning hours.

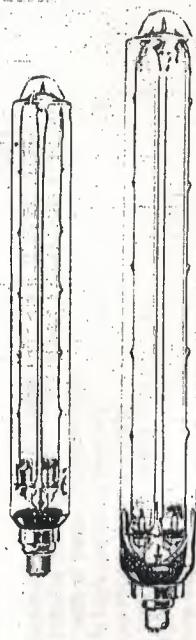
<sup>2)</sup> E: with external ignitor.

## LOW-PRESSURE SODIUM LAMPS



### SOX LAMPS

Low-pressure sodium-vapour discharge lamps with the highest luminous efficacy of any light source in the world. High visual acuity, sharp contrast, low luminosity, little glare.



### SOX-E LAMPS

Low-pressure sodium-vapour lamps for outdoor and indoor use, with a discharge tube enclosed in a clear tubular outer bulb. New technologies have made it possible to increase the lamp efficacy even further, so that now the 200 lm/W barrier has been broken for the highest wattage lamp. Lamps of this new generation are called SOX-E. The 200 lm/W can only be obtained in combination with an appropriate hybrid ballast.

The system efficacy is considerably improved, reaching 170 lm/W for the highest wattage and still more than 100 lm/W for a lamp of only 25 watt. In comparison with other artificial light sources, the lamp and system efficacy is significantly higher.

Since the objective was to obtain maximum system efficacy in the new generation SOX-E lamps, the power absorbed is kept to a minimum, resulting in lumen packages which are more in line with those of the other H.I.D. streetlighting lamps but lower than the existing SOX range.

Type	Base	Luminous flux lm <sup>1</sup> )	Min. supply voltage V	Max. length	Max. dia.	Weight	Ordering number
SOX18 W	BY22	1800	200	216	54	148	9281 450000..
SOX35 W	BY22	4500	200	310	54	235	9281 455000..
SOX35 W	BY22	7400	200	425	54	360	9281 460000..
SOX39 W	BY22	13000	200	528	68	540	9281 465000..
SOX35 W	BY22	21500	200	775	68	850	9281 470000..
SOX180 W	BY22	30500	200	1120	68	1080	9281 475000..

<sup>1)</sup> After 100 burning hours.

<sup>2)</sup> When used in combination with gear and starting device.

Type	Average luminous flux lm <sup>1</sup> )	Lamp efficacy lm/W	System efficacy lm/W	Max. length	Max. dia.	Ordering number
SOX-E 131	26000	200	170	1120	68	8222 341 09700
SOX-E 91	17500	194	165	775	68	8222 341 19100
SOX-E 66	10700	165	135	528	68	8222 341 14800
SOX-E 36	5700	163	135	425	52	8222 341 19000
SOX-E 26	3500	140	109	310	52	8222 341 18900

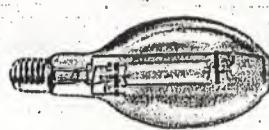
8

## HIGH-PRESSURE MERCURY LAMPS

### HP LAMPS

With its cold bluish light, the standard high-pressure mercury vapour discharge lamp cannot compare with the mercury vapour fluorescent lamps for colour rendering or colour appearance.

It has applications of its own including photochemical processes, microscopic examination and egg testing. HP discharge lamps are enclosed in an ovoid clear glass outer bulb.



Type	Base	Luminous flux (m <sup>2</sup> )	Max. length	Max. dia.	Weight	Ordering number
HP 80 W	E27	3500	156	72	55	9280510000..
	B22	3500	152	72	55	9280511000..
HP 125 W <sup>2)</sup>	E27	5800	177	77	90	9280520092..
	B22	5800	173	77	90	9280521092..
HP 175 W <sup>2)</sup>	E40	8100	227	92	170	9280525092..
HP 250 W <sup>2)</sup>	E40	11750	227	92	170	9280530092..
HP 400 W <sup>2)</sup>	E40	21000	292	122	260	9280535092..

<sup>1)</sup> After 100 burning hours. <sup>2)</sup> Hardglass.

### HP-T LAMPS

A range of tubular standard mercury vapour lamps designed for high luminous efficacy, long life and reliable starting. Their bluish light colour may give special effects in floodlighting installations.



Type	Base	Luminous flux (m <sup>2</sup> )	Max. length	Max. dia.	Weight	Ordering number
HPL-N 50 W	E27	1800	129	56	46	9280505073..
	B22	1800	125	56	46	9280506073..
HPL-N 80 W	E27	3700	156	72	55	9280510073..
	B22	3700	152	72	55	9280511073..
HPL-N 125 W	E27	6300	177	77	90	9280520073..
	B22	6300	173	77	90	9280521073..
	E40	6300	186	77	110	9280523073..
HPL-N 175 W <sup>2)</sup>	E27	6300	177	77	90	9280520074..
	B22	6300	173	77	90	9280521074..
	E40	6300	186	77	110	9280523074..
HPL-N 250 W <sup>2)</sup>	E40	13000	227	92	170	9280530074..
HPL-N 400 W <sup>2)</sup>	E40	22000	292	122	260	9280535074..

<sup>1)</sup> After 100 burning hours. <sup>2)</sup> Hardglass.

Type	Base	Luminous flux (m <sup>2</sup> )	Max. length	Max. dia.	Weight	Ordering number
HP-T 250 W <sup>2)</sup>	E40	11500	257	47	175	9280565092..
HP-T 400 W <sup>2)</sup>	E40	21000	292	47	197	9280565092..
HP-T 1000 W <sup>2)</sup>	E40	52000	382	67	347	9280605092..

<sup>1)</sup> After 100 burning hours. <sup>2)</sup> Hardglass.

### HPL-N LAMPS

High light output, good colour quality, long life, reliable starting and economy, with all these characteristics the HPL-N high-pressure mercury-vapour fluorescent lamp is a truly universal light source for indoor and outdoor lighting.

Applications include:

Public lighting; sports grounds, factories, garages and petro stations, car parks and railway stations.



Type	Base	Luminous flux (m <sup>2</sup> )	Max. length	Max. dia.	Weight	Ordering number
HPL-N 50 W	E27	1800	129	56	46	9280505073..
	B22	1800	125	56	46	9280506073..
HPL-N 80 W	E27	3700	156	72	55	9280510073..
	B22	3700	152	72	55	9280511073..
HPL-N 125 W	E27	6300	177	77	90	9280520073..
	B22	6300	173	77	90	9280521073..
	E40	6300	186	77	110	9280523073..
HPL-N 175 W <sup>2)</sup>	E40	8400	227	92	170	9280525074..
HPL-N 250 W <sup>2)</sup>	E40	13000	227	92	170	9280530074..
HPL-N 400 W <sup>2)</sup>	E40	22000	292	122	260	9280535074..
HPL-N 700 W <sup>2)</sup>	E40	40000	329	142	360	9280540074..
HPL-N 1000 W <sup>2)</sup>	E40	58000	400	168	550	9280545074..
HPL-N 2000 W <sup>2)</sup>	E40	125000	445	185	650	9280555074..

<sup>1)</sup> After 100 burning hours. <sup>2)</sup> Hardglass.

## METAL HALIDE LAMPS

### HPI LAMPS

High-pressure metal halide gas-discharge lamps, have a very high luminous efficacy and excellent colour rendering properties. With an internal diffusing coating on the hard-glass outer bulb, and a stable lumen output throughout their long life, HPI lamps are very suitable for:

- Industrial and commercial indoor lighting
- Public lighting
- Floodlighting
- Plant irradiation.



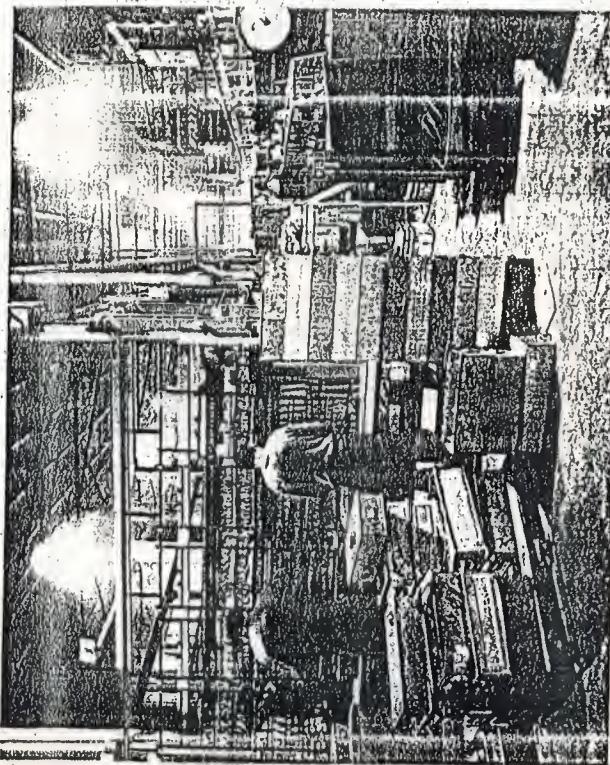
HPI-T 400 W



HPI-T 1000 W



HPI-T 2000 W



### HPI-T LAMPS

Tubular metal halide lamps for optical systems providing high illuminance levels and good colour rendering. Combined with the appropriate optical systems, they are a highly efficient source of accurately controlled light. The lamps are therefore highly suitable for the lighting of CTV broadcast studios and colour filming of, for instance, sports events.

Type	Base	Luminous flux (lm <sup>2</sup> )	Max. length	Max. dia.	Weight	Ordering number
HPI 250 W BUS <sup>2)</sup>	E40	17500	227	92	180	9280 760 098
HPI 400 W	E40	27600	292	122	260	9280 731 098
HPI 400 W BUS <sup>2)</sup>	E40	30600	292	122	260	9280 743 098
HPI 400 W BUS <sup>2)</sup>	E40	30600	292	122	260	9280 747 098

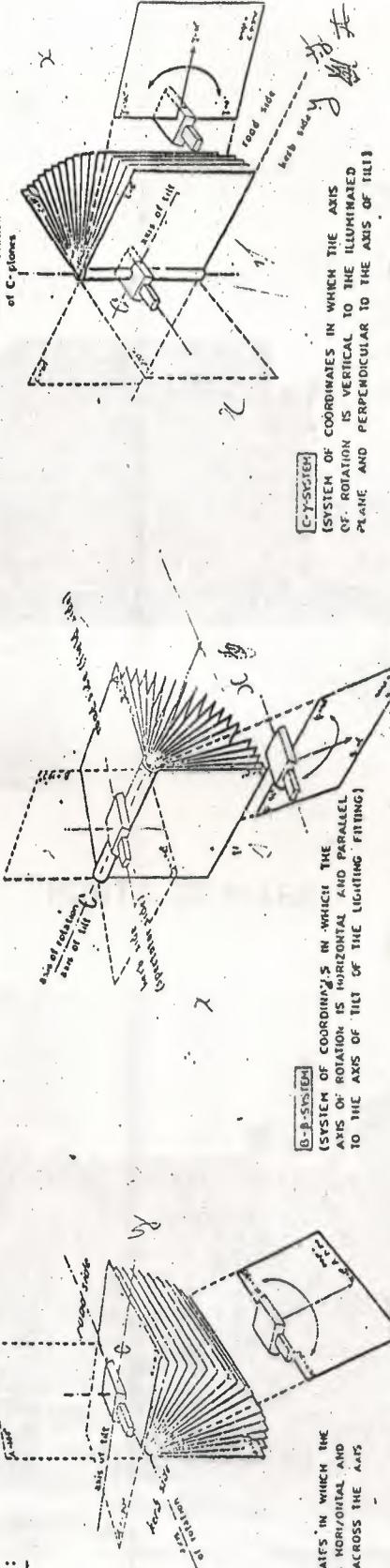
<sup>2)</sup> After 100 burning hours. <sup>2)</sup> BU = Base up. BUS = Base up. self-starting.

Type	Base	Luminous flux (lm <sup>2</sup> )	Max. length	Max. dia.	Weight	Ordering number
HPI-T 250 W	E40	17000	257	47	150	9280 761 092
HPI-T 400 W	E40	31500 <sup>1)</sup>	283	52	180	9280 734 092
HPI-T 1000 W	E40	81000	382	67	400	9280 740 092
HPI-T 2000 W/220 V	E40	189000	430	102	650	9280 736 092
HPI-T 2000 W/380 V	E40	183000	430	102	670	9280 718 092

<sup>1)</sup> After 100 burning hours.

Transformation data:

### Standard systems:



## Measuring data and measuring coordinates



WIEVS OF PORTA DI MARE





Front view of Porta Di Mare



$X_0 = -6$

$Y_0 = 0$

$h = 16.5$

FIRST - PROJECTOR

HINT 003

SON-T 400W.

41.4	48	56	64	67	61	66	50	33	21	13	6
4	50	58	67	70	74	69	52	33	21	14	6
3	55	64	74	78	83	75	55	35	23	14	7
2	59	69	81	85	91	81	58	35	24	15	8
1	62	72	85	90	97	86	59	35	24	15	8
0	64	75	88	93	101	88	60	34	24	16	9
-10	-8	<del>-6</del>	<del>-4</del>	-2	0	<del>2</del>	4	6	8	10	
-1	62	72	85	90	97	86	59	35	24	15	9
-2	59	69	81	85	91	81	58	35	24	15	8
-3	55	64	74	78	83	75	55	35	23	14	8
-4	50	58	67	70	74	69	52	33	21	14	7
-4.4	48	56	64	67	61	66	50	33	21	13	6

$X_0 = 14$   
 $Y_0 = 0$   
 $h = 16.5$

## SECOND - PROJECTOR

SON - T 400W

HNI 003

4.4	3	16	24	35	48	55	56	48	43	38	31	26	22	19	14	11	9	6	6
4	3	16	25	36	50	58	59	50	44	39	32	27	22	20	17	14	11	9	6
3	3	17	22	37	53	63	64	54	48	42	35	29	24	21	17	14	11	9	6
2	6	18	28	38	55	67	69	58	51	44	37	30	25	21	18	15	12	9	6
1	8	19	28	38	57	71	73	61	54	46	38	31	25	22	18	15	12	10	6
0	8	19	28	37	54	72	75	63	55	47	39	31	26	23	19	15	12	10	6
-4	-4	-2	0	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34
-1	8	19	28	38	57	71	73	61	54	46	38	31	25	22	18	15	12	10	6
-2	6	18	28	38	55	67	69	58	51	44	37	30	25	21	18	15	12	9	6
-3	3	17	22	37	53	63	64	54	48	42	35	29	24	21	17	14	11	9	6
-4	3	16	25	36	50	58	59	50	44	39	32	27	22	20	17	14	11	9	6
-4.4	3	16	24	35	48	55	56	48	43	38	31	26	22	19	14	11	9	6	6

X0=20  
Y0=0  
h=22

### THIRD - PROJECTOR

HNF 001 - SON-T 400 W.

5	9	20	25	27	27	32	41	51	56	56	55	52	48	43	37	32	27	23	20	17	14	12	11	
10	10	21	26	27	28	32	43	53	58	59	57	54	56	45	39	33	28	24	20	17	15	13	11	
4	10	22	27	26	27	33	44	55	61	62	60	56	52	46	40	34	29	24	21	18	15	13	11	
3	10	22	26	27	27	33	45	58	64	64	62	58	53	48	41	34	29	25	21	18	15	13	11	
2	9	23	26	26	27	33	46	59	65	65	63	59	54	48	41	35	29	25	21	19	15	13	11	
1	8	23	26	26	27	33	45	59	66	67	63	59	54	49	42	35	30	25	21	18	15	13	11	
0	6	-6	-1	-2	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38
-1	7	23	26	26	27	33	46	59	65	65	63	59	54	48	41	35	29	25	21	19	15	13	11	
-2	10	22	26	27	27	33	45	58	64	64	62	58	53	48	41	34	29	25	21	18	15	13	11	
-3	10	22	27	26	27	33	46	55	61	62	60	56	52	46	40	34	29	24	21	18	15	13	11	
-4	10	21	26	27	28	32	43	53	58	59	57	54	50	45	39	33	28	24	20	19	15	13	11	
-5	9	20	25	27	27	32	41	51	56	56	55	52	48	43	37	32	27	23	20	17	15	13	11	
																				14	12			

$x_0 = -4$   
 $y_0 = 0$   
 $h = 26$

#### FOURT - PROJECTOR

SON - T 400 W.

44	9	11	15	21	28	35	43	51	59	66	72	70	66	60	53	43
4	9	11	15	21	28	37	45	53	61	69	75	73	69	63	55	45
3	9	11	16	22	29	38	47	56	64	72	78	77	72	66	58	46
2	9	11	16	22	30	39	48	57	66	74	81	79	75	68	59	48
1	9	12	16	22	30	39	47	58	67	76	82	81	76	70	61	49
0	9	12	16	22	30	40	49	60	68	76	83	82	77	70	69	49
-1	9	12	16	22	30	39	49	58	67	76	82	81	76	70	61	49
-2	9	11	16	22	30	39	48	57	66	74	81	79	75	68	59	48
-3	9	11	16	22	30	38	47	56	64	72	78	77	72	66	58	46
-4	9	11	15	21	28	37	45	53	61	69	75	73	69	63	55	45
-44	9	11	15	21	28	35	43	51	59	66	72	70	66	60	53	43

$$Y_0 \approx 0$$

## FIFTH - PROJECTOR

HNF 003  
SON-T 4

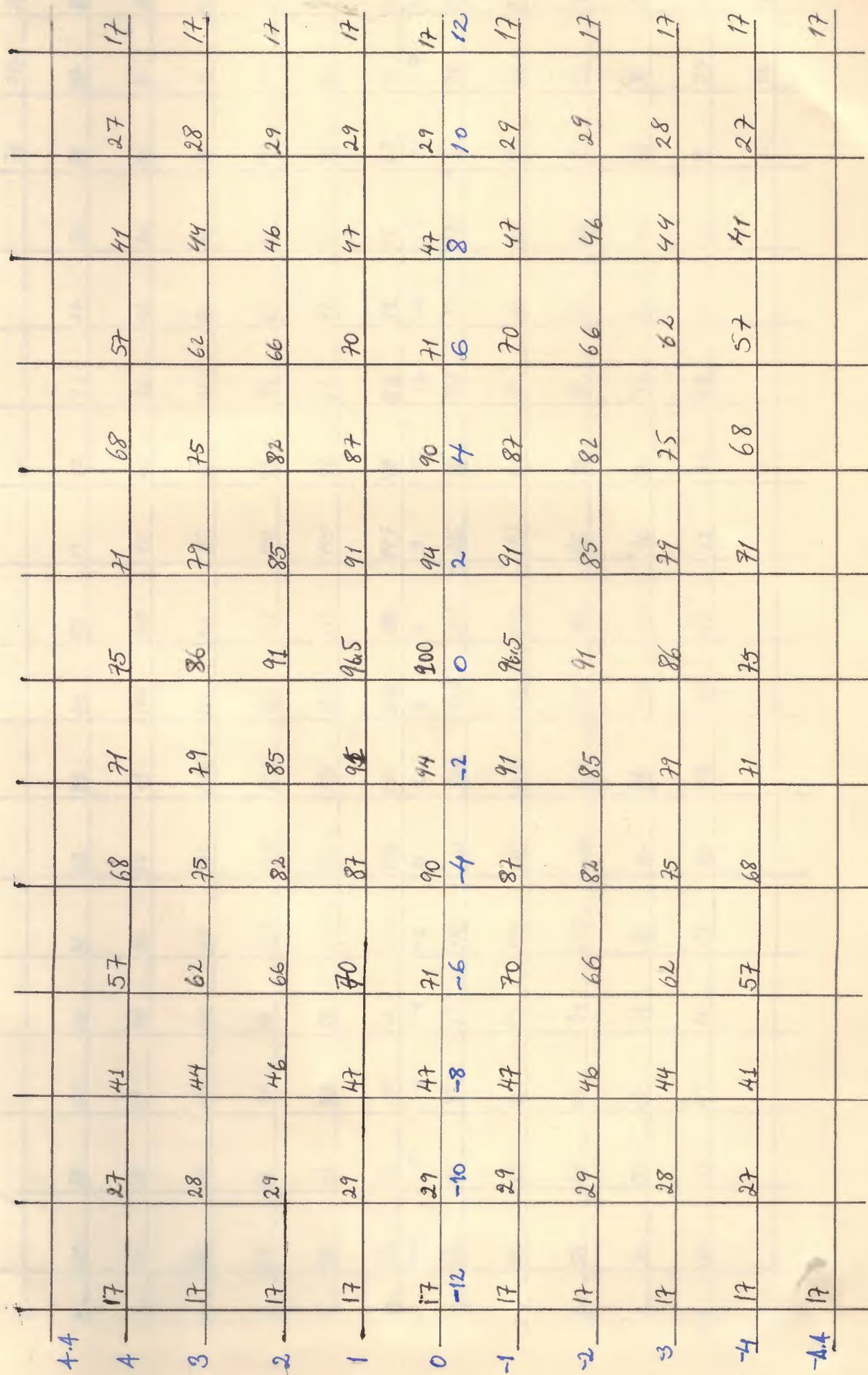
SON-T 400W.

$$y_0 \neq 0$$

SIXTH - PROJECTOR

HNF 003  
SON-T 400 W

h=17



ILLUMINATION OF PORTA DI MARE

6	45	53	60	66	81	88	89	95	97	91	77	73	77	86	81	77	78	74	76	78	
5	58	67	74	90	94	98	104	105	90	84	76	82	85	85	81	81	82	77	74	74	
4	64	74	84	100	102	102	110	113	95	88	81	86	90	90	86	90	86	86	86	86	
3	59	69	81	93	109	110	106	112	117	110	93	84	89	95	94	89	89	92	90	92	
2	62	73	85	98	116	114	106	115	121	115	96	87	92	97	96	90	90	94	90	94	
1	64	75	88	101	120	116	105	115	122	117	99	88	92	98	97	93	93	95	93	95	
0	-10	-8	-6	-4	-2	0	-2	4	6	8	10	12	14	16	18	20	20	22	20	22	
-1	62	73	85	98	116	114	106	115	121	115	96	87	92	97	96	90	90	94	90	94	
-2	59	69	81	93	109	110	106	112	110	93	84	89	95	94	89	89	92	90	90	92	
-3	55	64	74	84	100	102	102	110	113	95	88	81	86	90	90	86	86	86	86	86	
-4	50	58	67	74	90	94	96	94	98	104	105	90	84	76	83	85	85	81	81	86	
-5	45	53	60	66	81	88	89	95	97	91	77	73	77	86	81	77	82	82	77	82	
-6																		76	74	78	

ILLUMINATION OF PORTA DI MARE

5	44	51	58	61	63	60	63	57	58	65	68	65	67	63	61	52	38
4.4	47	54	65	68	64	60	64	59	60	67	72	70	73	68	63	54	40
4	49	56	65	68	71	67	69	61	63	71	75	73	75	71	68	57	42
3	53	62	71	75	79	73	72	63	67	72	84	83	86	79	75	66	44
2	57	66	77	84	86	79	75	64	69	82	91	89	91	86	82	66	46
1	60	69	81	86	92	83	76	64	70	86	96	94	97	91	82	70	47
0	61	72	84	89	95	85	77	65	71	87	99	97	100	94	90	71	48
-10(52)	-8(54)	-6(56)	-4(58)	-2(60)	0(62)	2(64)	4(66)	6(68)	8(70)	10(72)	12(74)	14(76)	16(78)	18(80)	20(82)	22(84)	
-1	60	69	81	86	92	83	76	64	70	86	96	94	97	91	87	70	47
-2	57	66	77	81	86	79	75	64	69	82	91	89	91	86	83	66	46
-3	53	62	71	75	79	73	72	63	67	77	84	83	86	79	75	62	49
-4	49	56	65	68	71	67	64	59	60	67	72	70	73	68	63	54	40
-4.4	42	54	65	68	70	64	60	59	60	67	71	75	73	71	68	57	42
-5	44	51	58	61	63	60	63	57	58	65	68	65	67	63	61	52	38

The Cost of the project

<u>Material</u>	<u>No.</u>	<u>Length</u>	<u>unit cost (Tl)</u>	<u>Total cos. (TL)</u>
60A c/o Automatic	1	—	250,000	250,000
MCB fuse	4	—	30,000	120,000
Distribution board	1	—	150,000	150,000
2x2.5 mm <sup>2</sup> Electrc	—	97	6000	582,000
Metal P.c.k	3	5 meters	70,000	210,000
HNF 001	2	—	1,000,000	2,000,000
HNF 003	4	—	750,000	3,000,000
Timer	1	—	100,000	100,000
Cost of labour	5% of material cost			<u>3,206,000</u>
				9,618,000