PROJECT WORK

THE ILLUMINATION OF ATATÜRK STADIUM

BY

SAMI FETHI

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ELECTRICAL & ELECTRONIC ENGINEERING DEPARTMENT

SUPERVISED BY

PROF. HALDUN GÜRMEN

EASTERN MEDITERRANEAN UNIVERSITY

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CONTENTS

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ABSTRACT

In this project, illumination of Lefkosa Ataturk Stadium is being made by using the up-to date stadium illumination technology. There is no doubt that, concerning about the illumination, the highest cost in financially is stadium illumination. The Stadium illumination needs a great deal of carefull and keen work. Even if the illumenence level on the playground is not equal at each point it should be distributed according to their approximate equality because the illumination of a stadium must be made in order to let the players and spectators to view the play without any difficulty. Also it is an important event that the motions of ball should be observed by the eye.

At the begining of this project, the greatest reason why I choosed this sensitive stadium illumination which is the most improtant among the illumation subject is because both the subject of illumination and football is my highest passion.

While I was preparing this project, I met with a lot of difficulties. Among these, there were insuffcent books and the lack of documents about this subject. Although noting detail, I obtained some documents about up-to date Stadium illumination by correspondence and with help of my course tutor. I tried my best to illuminate Lefkosa Ataturk Stadium with the documents and knowledge I gathered.

The main aim at this subject is to fully equalize the illuminance level that distributes at each point, if not to provide the equivalent of illuminance distribution. In addition to this, I used metal halide lamps which provides high "luminous efficiency" and high colour temperatures . In order to get 1000 lux average illuminance level. This is also reasonable for colour - tv broadcasting.
Besides this data, care should be taken taht the uniformity factor will be less then 0.3.

PART A

INTRODUCTION

Human beings have been depended very much, on light at all his duties. Natural lighting sources such as Sun, Moon and Stars had been insuffient for human beings to lead his life. For this reason , the necessity of artificail lighting has been arised.

As far as we are concerned, up to civilazation and especially till improvemnt of applicable sciences, in other words untill the middle of ninetenth century; illumination was done by candle oil lamps and wood. The oil lamps lost their importance by the invention of petroleum in 1859 in Northern America.
At last first in 1845 by H.Goebel and later in 1879 by A.Edison without any contact of each other, the double invention of incandesent lamp, opened a new century in illumination technique.

When Goebel invented the first incandesent lamp, there still wasn't good-enough powerfull electrical supples so the invention was easily forgotten as the time passed. But after the invention of first dynamo by W.Siemens in 1866, A.Edison invented the incondesent lamp in 1879 for the second time. There is no doubt that, the improvemnt of incondescent lamp needed very hard and long works. After a certain period of time, tungsten wires were used. At this duration, great improvemnts happened in discharge lamps. The illumination technique came to its up-to date position by the distribution of fluorescent lamp.
Today in short, the name of lighting has been given to the illuminating technique which is so improved as to be a branch of specialization.

1. The Subject of Illumination

The basic concept of illumination consist of the production, distritution, economics and measurement of light. Beside this, illunination examines the effect of light on human body. Nowadays specially in America and Europe, the technique of illumination has a very important role in engineering and architecture. So we need more than a lamp that is stuck in the middle of a ceiling in order to light a room. Every place to be lighted must be examined as a special problem. In this examining, besides the phycological and economical condtions architectural and technical condtions must be taken into consideration. The solution of an illumination problem, can only be solved by the help of an electrical engeneer who has technical ability and by an architect who has the artistic ability in illumination.

Today good lighting has been the necessity . In order both to answer the private whishes of people and to solve the various problems of societies who are in normal or in bad positions.

As a summary , the following advantages are gained by a sufficient illumination:-

a) Seeing ability of eye.

b) The health of eye is protected.

c) The accidents are decressed.

d) The performance of work is increased.

e) The capacity of work in commerce is enlarged.

f) The economical potential is increcent.

g) Security is provided (A street lamp is equivalent to a policeman)

h) The esthetic feelings and the necesity of comfort are an answer.

2. The Aim of Illumination

Because of a sufficient illumination meets more than one necessity when an illumination system is set up, usually a priority is given to one of these necessities in other words , this means that, the basic purpose of illumination is to meet the necessity which was given a priority. There is no doubt that when we meet this necessity other necessities mustn't be forgetten. According to its purpose, illumination can be divided into three grips;

a) Phycological Illumination :

The aim by, phsicologic 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 physicologic illumination. In physicologic illumination, we should take care of the things that can damage the seeng ability of an eye as in other types of illumination.

b) Decorative Illumination :

The main aim by this is not to show in details but rather it is done to feelings of esthetic effects. In this concept both the architect and the illuminating engineer play a great role.

c) Attractive Illumination

The aim by this type of illumination is to draw attention, in other words is to make advertisement. For this reason higher illumination levels , colour lights, flip-flop lamps or lamps which turns on or off automatically are used in great amount.

3. The Types of Illumination

Illumination is divided into two group as natural and artificial illumination according to the base of light and divided into two groups as indoor and outdoor illumination according to the place to be illuminated.

a) Natural Illumination

It deals with the distribution 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:

Today it is almost obtained only by sources of electrical illumintions. According to the light sources used, the artificial illumination are divided into groups as illumination with incondescent , discharge and fluorescent lamps.

c) Indoor Illumination

This is a type of illumination where inside of the every kind of building is illuminated. In this type of illumination, ceilings and walls send light to working place by reflections, so they help illuminating the working area. The illumination of a house, school, hospital, factory, theatre, cinema and the places like this are in the same catagory. In this type, illumination can be divided into groups such as direct, semi-direct and indirect illumination according to the characteristics of the light sources. For instance ; if the 90- 100 % of the light flux of the source is going away to space, this is called direct illumination system. And concequently 60 % - 90 %, 40 %, 60 %, 10 % , 40 % , and 0 %, - 10 % are called semi - direct, mix, semi - indirect and indirect illumination system.

d) Outdoor Illumination

This type of illumination is used to illuminate open places which the surfaces is usually illuminated by direct light. The places like roads, playgrounds, garages, stadiums and bus stations are in this group.

Because of my project is about stadium illumination which is included in this type of illumination. I'll not go into detail of other type of outdoor illumination I'll talk about the content of my project.

PART B

STADIUM ILLUMINATION

1. BASIC DATA

a) Football

Football and plays like Handball, Rugby, are played in open air. It is almost impossible to be played in saloons or even in smaller playgrounds. Because of our subject, football is played in open air, it is considered of the point view of Outdoor Illumination.

b) Measurements

Measurements of international standart football grounds by Federation of International Football Association (FIFA) is shown in Fig. 1. The width is between 45 m. - 90 m. and the length 90 m. - 120 m. of an international playground. The length and width of penalty area is 40.32 m and 16.5 m. consequently . The length of goal post area is 18.32 m and the width is 5.5 m. The diameter of pitch center is 9.15 m. The balls used in football are leather balls and their diameter is 25 cm.

c) Sport Centres

It is usually arranged according to the number of spectators. For this reason in solutions of illumination the maximum vision distances must be taken into consideration. For instance at centres which has equal spectators capacity,according to the building style different vision distances would be requirements. The playgrounds can be built with different materials such as sand,gravel and so on. Those playgrounds which has great spectators capacity are called "stadium".

- Stadiums with 30,000 spectators capacity is called small.
- Stadiums which has 60,000 spectators capacity is called middle .
- Big stadiums are those which has the capacity of 60,000 spectators.

The playgrounds in this stadiums is usually covered with lawn.

d) The Importance of Illumination

The illumination of an stadium should be made in a way that, players and the spectators must follow the play without any difficulty. The most important subject in vision area is to follow the motions of ball which is the smallest item in play. In this, the main function of eye is perceiving the speed. The experimental reserches is shown that, in order to perceive and identify a thing in motion, varies according to width of view angle contrast with illumination level and enviroment and degree of illumination level of environment. So the difference of illumination level between ball and playground should be as high as possible.

A playground which has Av. reflection degrees are 0.1 - 0.3, for instance. It is 0.1 - 0.15 at gravel playground and it is 0.15 - 0.25 at lawn playground according to its cut and humidity. According to the material and illumination used with a light colour ball (reflection degree $\rho \geqslant 0.5$) the intensity of illumination level between ball and playground varies between 2/1 and 5/1.

In this system, for both of them, equal illumination level and high illumination power are accepted, as the spectators distance increased, the view angle, of ball is decreased. As it is at graph 1. with a ball 25 cm in diameter the visibility angle can be decreased from 4 sec. to 8 min. depending to stadium figure. At a certain illumination level contrast and view angle as the illumination level of surrounding increased, at first the speed of perceiving increased fastly and as the illumination level increased more, the perceiving speed of eye decreased constantly.

For a good solution it is necessary to see and follow a ball which is in motion and to keep a certain perceiving duration.

- Therefore, when we apply practically those data obtained scientifically, the close relationship can be used between the perceiving duration of view angle, illumination level of surrounding and contrast.

e) <u>The Seeing Necessity of Players</u>

From the scientific point of view the view distance of a player is less than 100 m. At graph 4 , the perceiving duration is seen according the illumination level. According to this, illumination level of playground should be at least 10 abs (1 candele = 3.14 abs) and the proportion of reflection between 0.25 and 0.125. According to the spectators the view should be better. For this reason , illumination and illumination level for spectators stated in the other part is accepted as good-enough for the players.

f) <u>Seeing Necessity of Spectators</u>

The whole spectators have to be able to see all the motions of ball. It is necessary to relate with the position stated at graph 4 in order to succeed this. Also a spectator distance which is the very far away from the ball must be taken into consideration. While the illumination level of playground is determined by horizontal illumination power, the distance of spectators from the ball and spectators ability to see the ball depend on vertical illumination. The power of vertical illumination shows very much difference according to its place.

A certain measurements, would charge the power of vertical illumination which is situated at certain places in the middle and edges of playground. The contrast between playground and illumination level can only be at the top part of ball of which the contrast of this is only be determined by horizontal illumination.

At the first approach, the illumination level of top part of ball up to 45^0 angle is determined by horizontal illumination. It is shown at fig.2 . In this position, the diameter of top point be 0.7 of the whole diameter (d).

g) <u>Effect of Shadow</u>

The shadow shouldn't be very much at the playground. This is achieved by multi-directional illumination . Because of measured differences at different directions in vertical illumination usually give a plastical appearence on human body ; this kind of application is wanted.

h) <u>Mixture of Light</u>

The mixtures of light is examined in differnt for spectators and players. Spectators are usually exposed to a mixture of light which can be endured. The ideal position is that none of the direct light should fall on spectators. But this situation can not be done. The mixture of light for a spectator is inevitable because they are under high vertical illumination and always in motion so they are exposed to mixtures of light in different directions. And there are physical and phycological effects of this. At this subject, the physical effects can be examined because there aren't enough data about phscological effects.

i) <u>Colour</u>

It is important for spectators and player that colours should not be spoiled under light. Specially colour of skin must be kept and this needs adding red colour into illumination.

j) <u>Appropriateness for Camera and Television Broadcasts</u>

Television Cameras and films has different sensitivity than the human face. When choosing a light source, this situation should be taken into consideration. In a stadium before being made any surplus illumination a good black or white television broadcast , the vertical illumination should be the average of more than 250 lux, The quality of film is spoiled at fewer illumination. More illumination light source is needed for colour television broadcast . The average of 800-1000 lux is essential values for colour television broadcast.

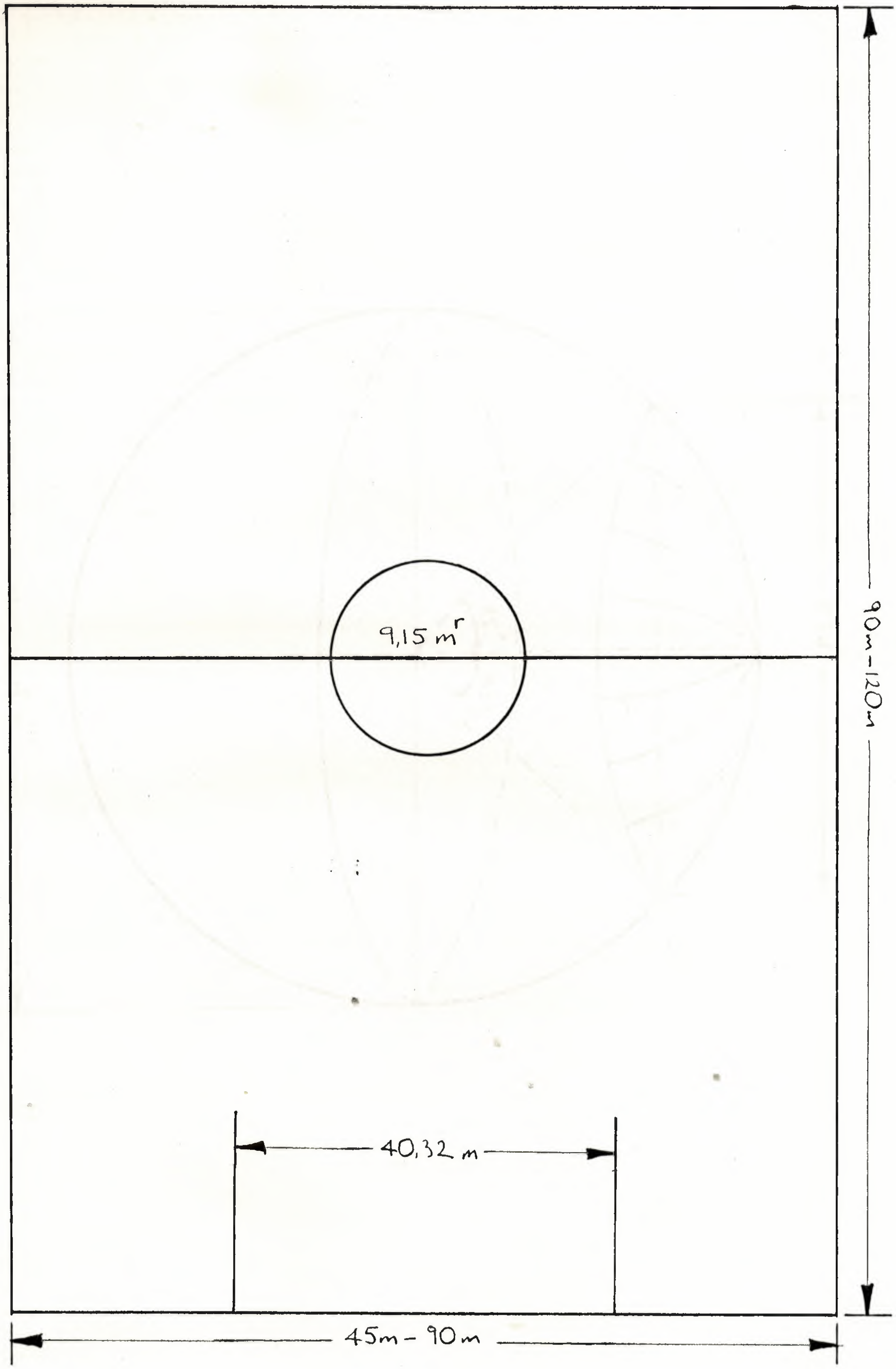
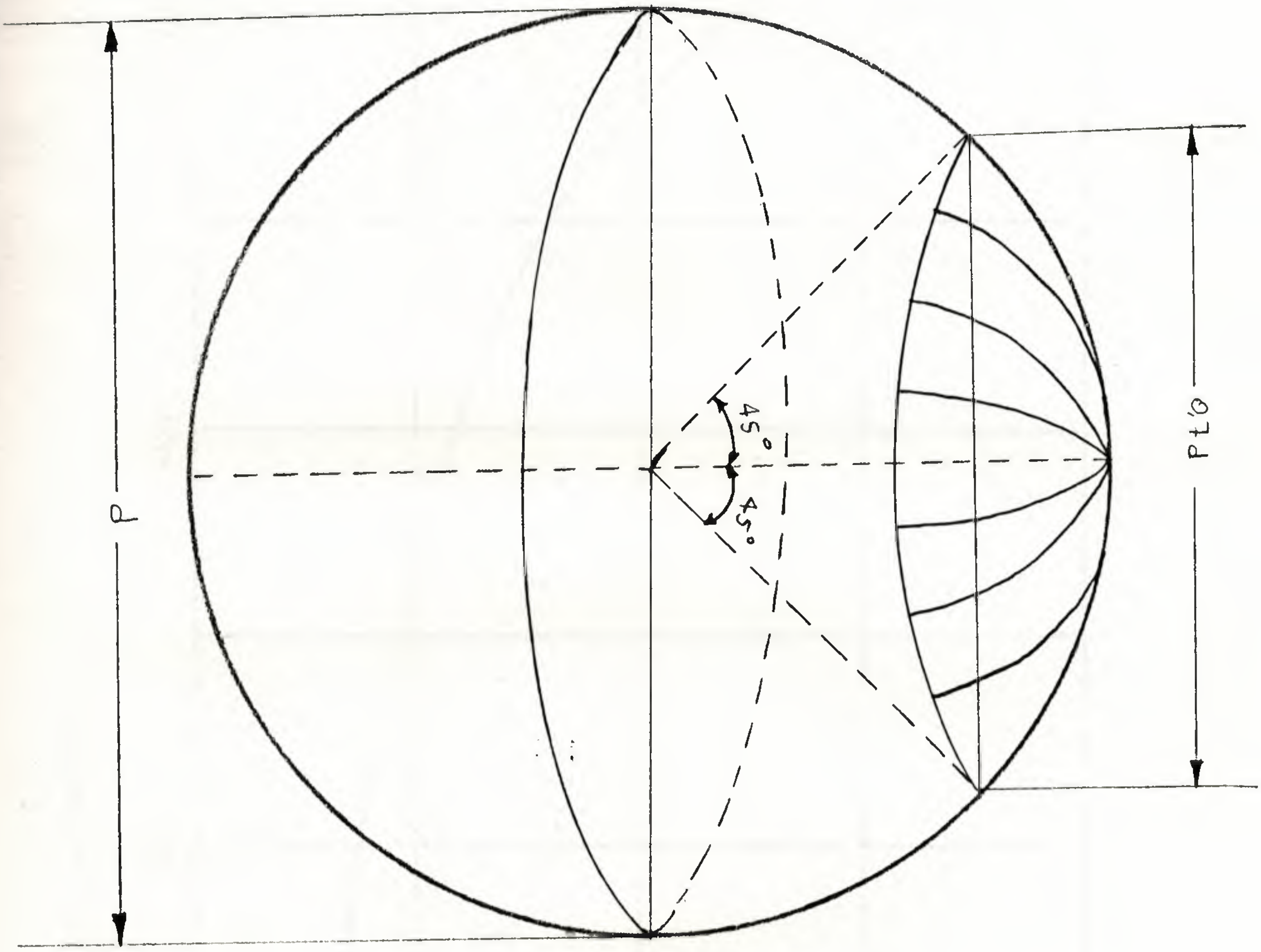
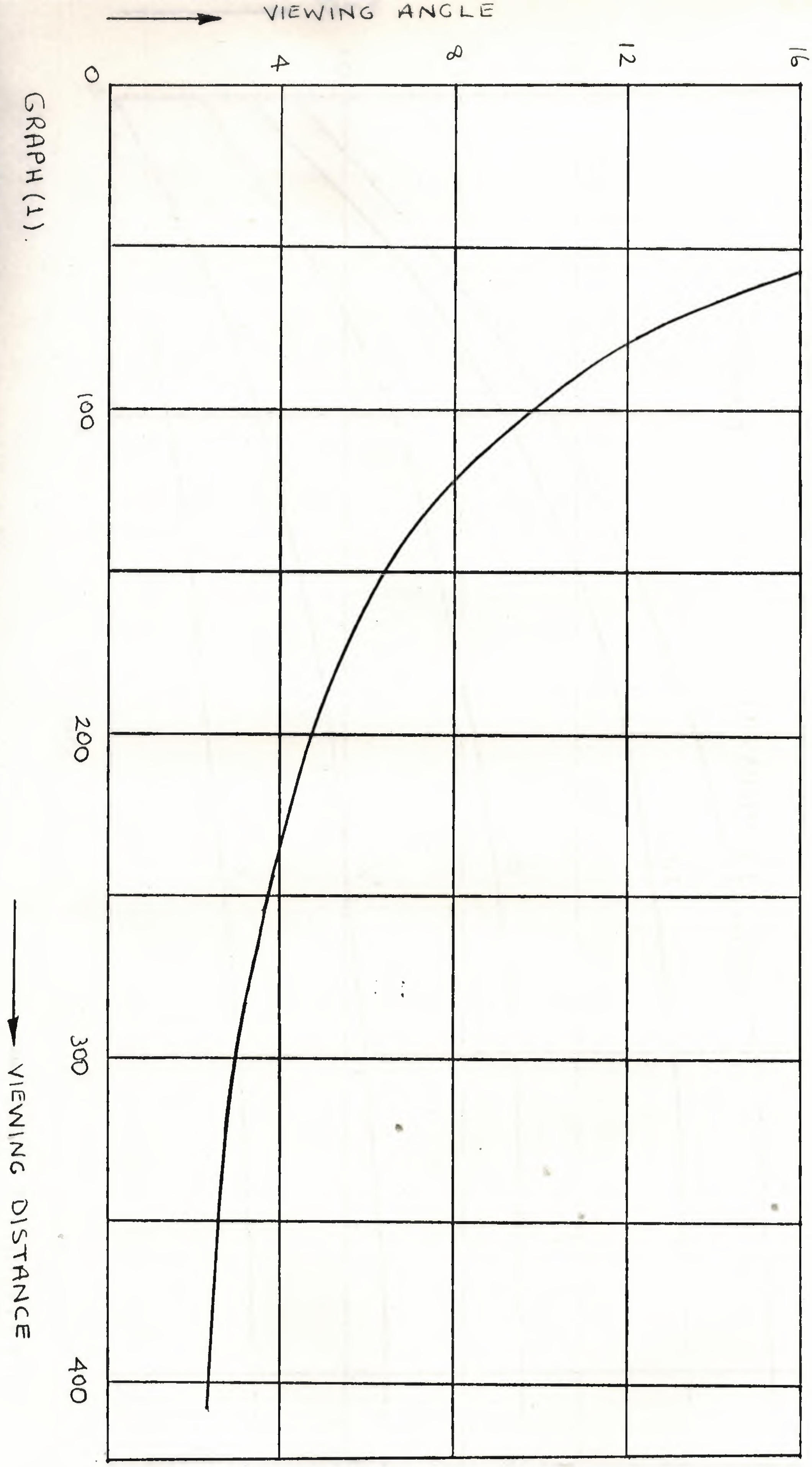


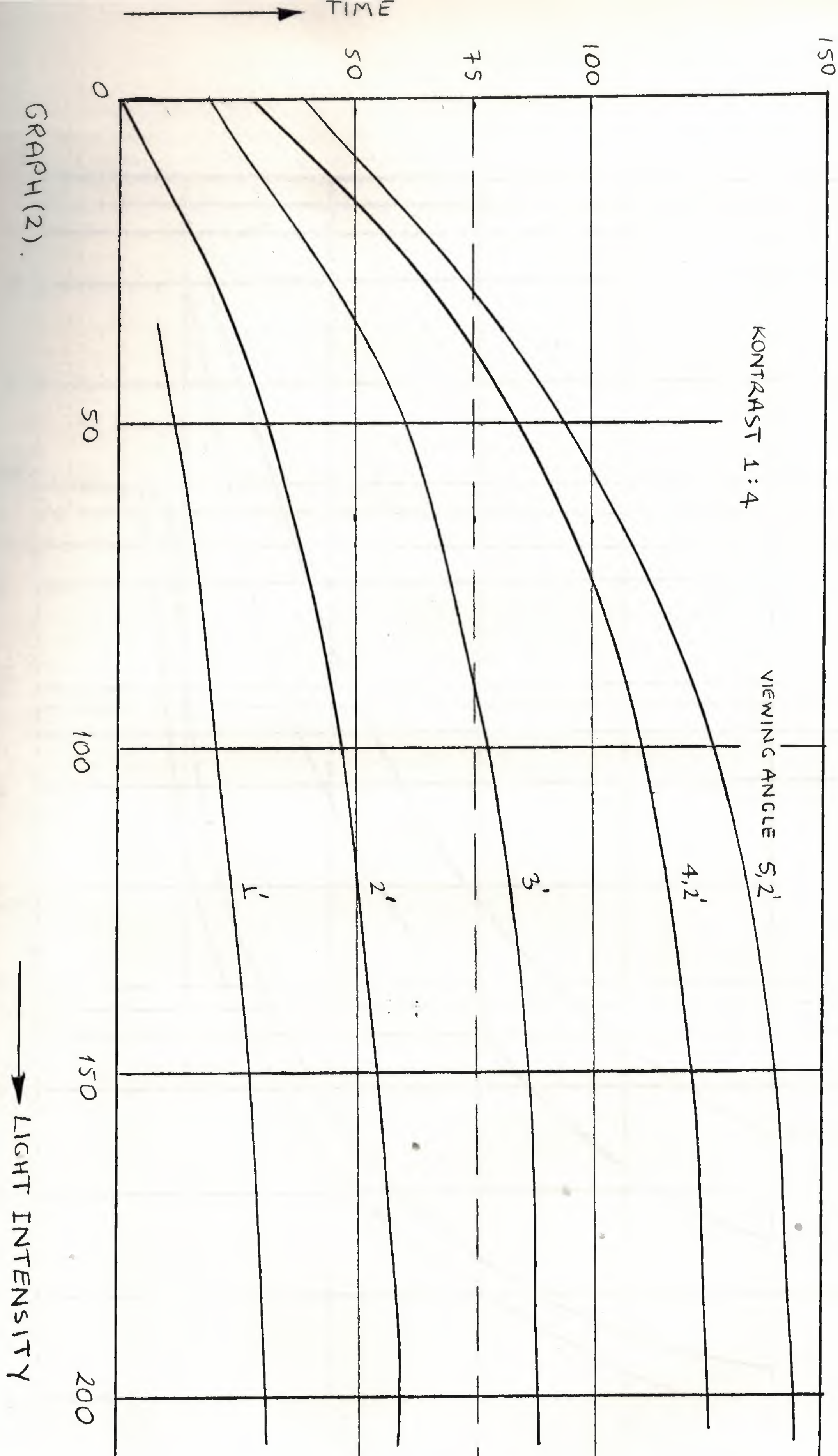
Fig.(1)

Fig.(2)

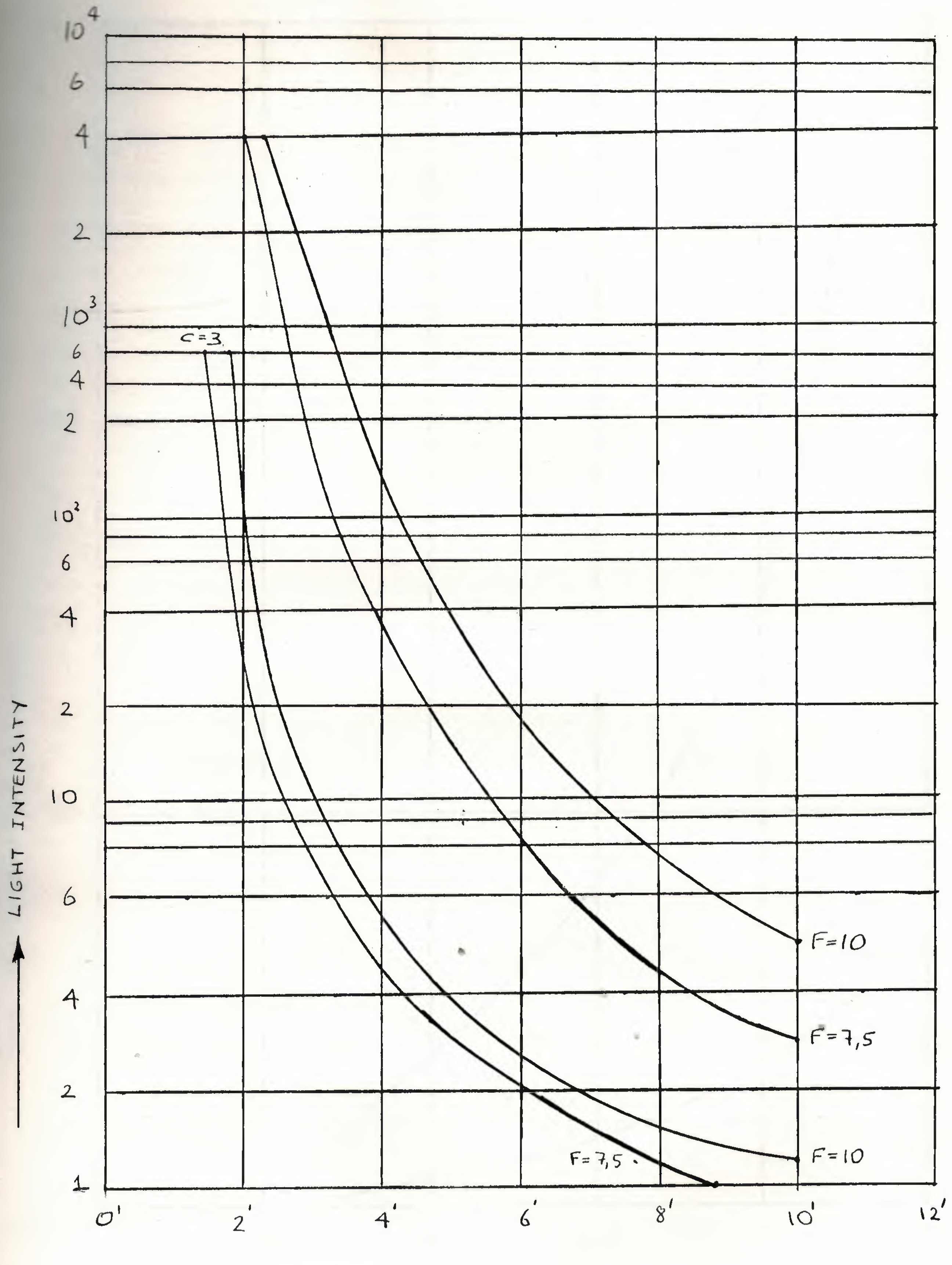




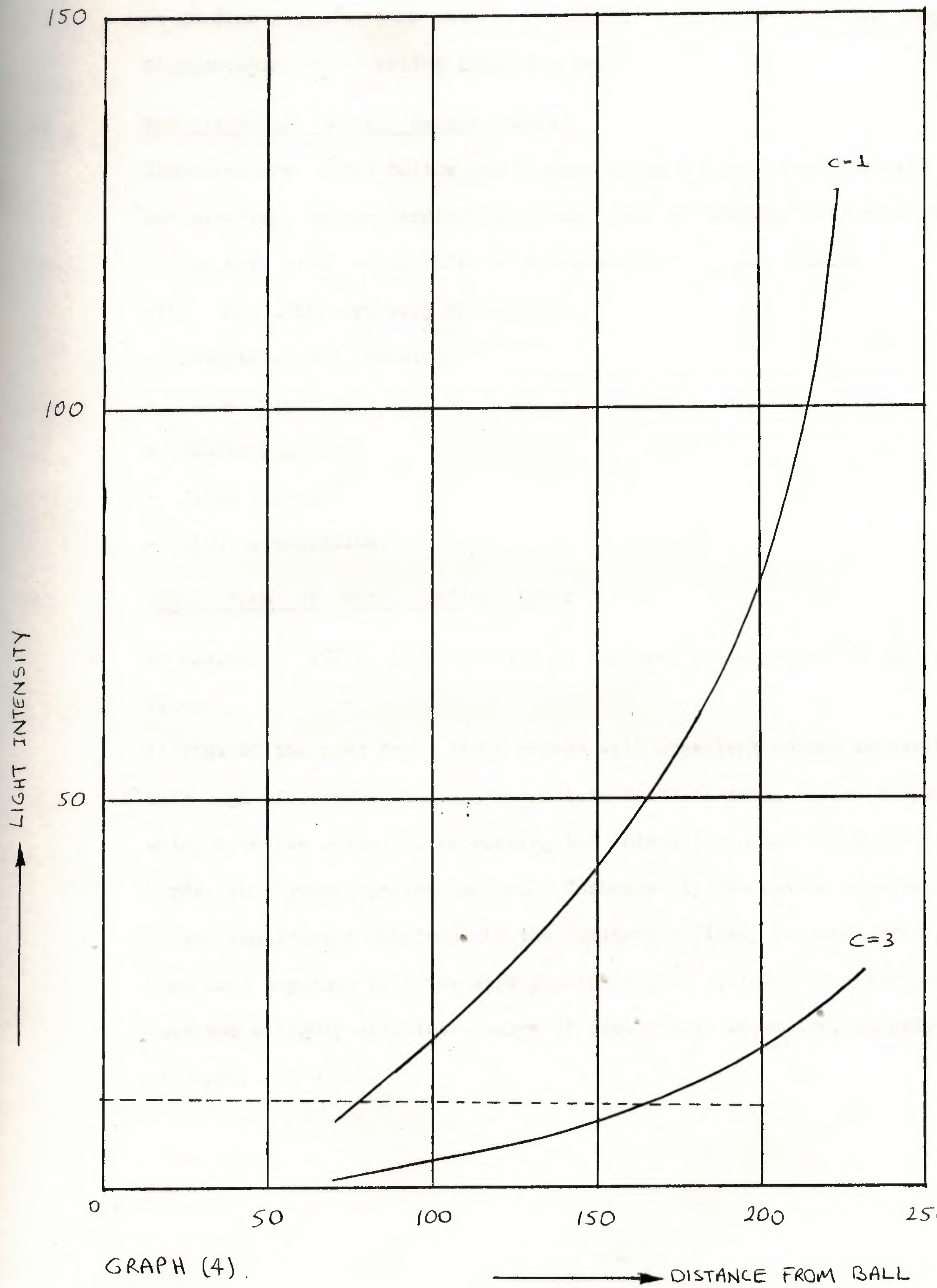
GRAPH (1).


TIME
0
50
75
100
150
KONTRAST 1:4
VIEWING ANGLE
1'
2'
3'
4,2'
5,2'
LIGHT INTENSITY
200

GRAPH(2).


10^4
6
4
2
10^3
C=3
6
4
2
10^2
6
4
2
10
6
4
2
1
LIGHT INTENSITY
F=10
F=7,5
F=10
F=7,5
0'
2'
4'
6'
8'
10'
12'
VIEWING ANGLE

GRAPH (3).


150
100
50
0
50
100
150
200
250
c=1
c=3
LIGHT INTENSITY
DISTANCE FROM BALL

GRAPH (4).

2. EQUIPMENT

a) Light Sources

At stadium illuminations usually as a light source, metal halide lamps or high-pressure metal halide lamps are used.

b) Definition of Metal Halide Lamps

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

- industrial and commercial
- indoor lighting
- public lighting
- flood lighting
- plant irradiation.

c) Description of Metal Halide Lamps

- Basically HPI-T lamps operate on the same principle as all gas-discharge lamps.

In view of the need for a light source with excellent colour rendering combined with high efficiency, the discharge tube contains metal halide compounds which have the effect if increasing the intensity in the three spectral bands blue, green, yellow and red. Consequently the colour appearence and colour rending are improved and the luminous efficacy is considerably increased. When used together with the appropriate optical systems, this combination provides a highly efficient source of accurately controlled, powerfull teams of light.

The spectrum of the metal halide lamps meets the requirements for colour film and colour tv. The lamps are therefore highly suitable for the lighting of colour television broadcasts.

d) The Lamp Characteristics of Metal Halide Lamps

- Very high luminous effiecacy
- Excellent colour rendering
- Reliable, long life.
- Stable lumen maintenance.

e) Applications of Metal Halide Lamp

- Lighting for colour TV. broadcasting.
- Lighting for colour films.
- Public lighting
- Sports ground lighting.
- Floodlighting.
- Industrial and commercial indoor lighting
- Plant irradiation.

f) Ballasts and Ignitors

Metal halide lamps require high quality ballasts for optimum operation, as well as ignitors to ensure reliable ignition for ballasts and ignitors.

g) Temperatures

Max. permissible base temperatures	250 °C	for 400 W.
	300 °C	for 1000 W.
	* 300 °C	for 2000 W.

DEFINITION

Floodlight for use with one SON/T 1000 W high-pressure sodium lamp or one HPI/T 2000 W metal halide lamp.

HNF 002

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 2000 W	SON/T 1000 W
narrow beam	2×9°	2×9°
wide beam	2×23°	2×27°

- 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 the rear-cover; to be closed by hand and opened with 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 jet-proof and dustproof sealing of front glass; 4 extra safety clamps.

APPLICATIONS

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

ORDERING DATA

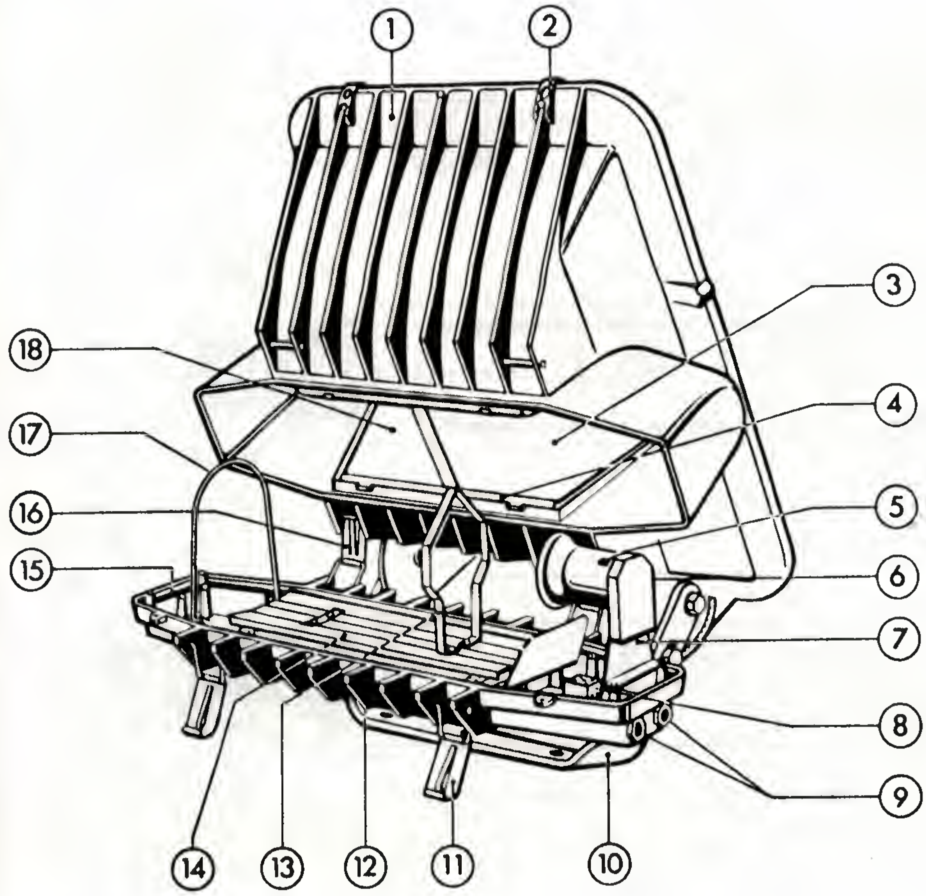
Designation	For lamps	Ordering number*) Narrow-beam type	Wide-beam type	Weight kg
HNF 002	1×HPI/T 2000 W	9112 718 502 ..	9112 718 503 ..	23,5
	1×SON/T 1000 W	9112 718 504 ..	9112 718 505 ..	23,5

*) Complete floodlight

FLOODLIGHT FOR HIGH-PRESSURE SODIUM LAMPS OR METAL HALIDE LAMPS

DETAILED DRAWING

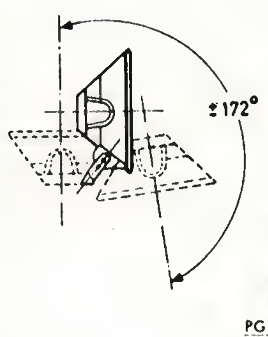
1. Housing
2. Safety clamp (4 ×)
3. Front glass
4. Reflector
5. Lampholder
6. Lampholder insulating plate
7. Lampholder bracket
8. Terminal block
9. Glands for dust-filters
10. Bracket
11. Closing clip top (2 ×)
12. Rear-cover
13. Lamp support
14. Reflector rear-cover
15. Gasket
16. Closing clip bottom (2 ×)
17. Additional lamp support
18. Side reflector



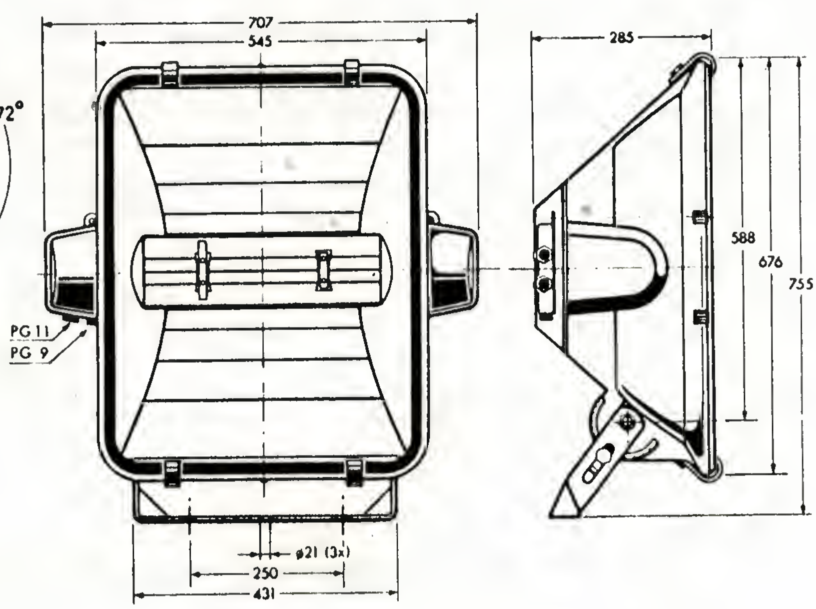
PECIAL TOOL

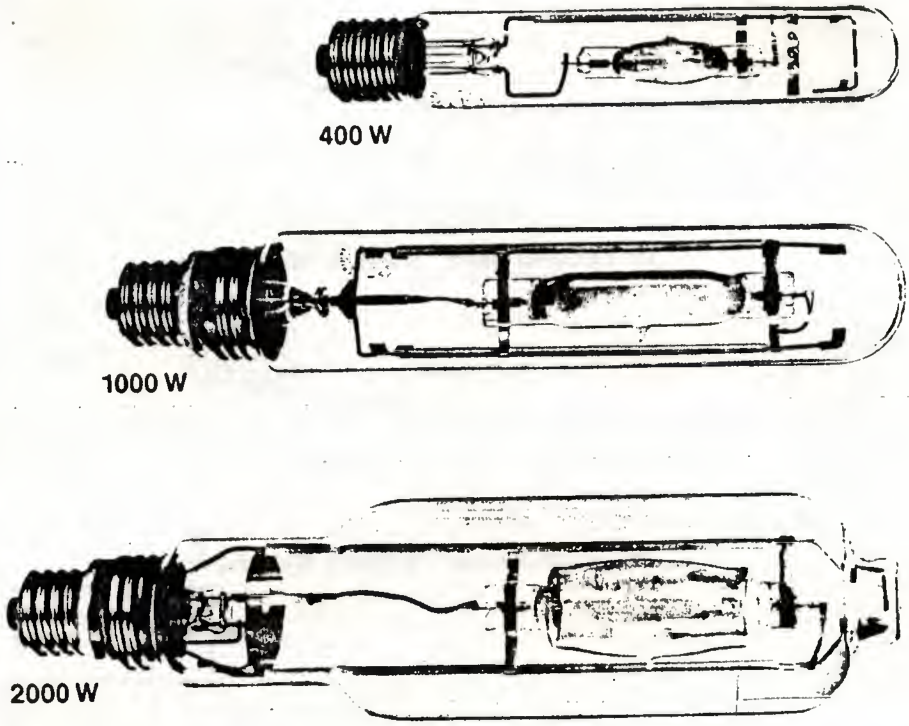
e front glass is provided with special type of gasket. To re-ace the glass, a special gas-t insertion tool can be used, onsisting of a handle with ree removable clips to suit e different floodlights. Order-g number for complete set 19 260 005 . .

ADJUSTMENT POSSIBILITIES



DIMENSIONS





HPI-T

Definition

High-pressure metal halide gas-discharge lamps, for indoor and outdoor use, with the iodide additives indium, thallium and sodium in the mercury discharge. The discharge tube is enclosed in a clear, tubular hard glass outer bulb.

Description

- Basically, HPI-T lamps operate on the same principle as all gas-discharge lamps.
- In view of the need for a light source with excellent colour rendering combined with high efficacy, the discharge tube contains metal halide compounds which have the effect of increasing the intensity in the three spectral bands blue, green and yellow-red. Consequently, the colour appearance and colour rendering are improved and the luminous efficacy is considerably increased.
- When used together with the appropriate optical systems, this combination provides a highly efficient source of accurately controlled, powerful beams of light.
- The spectrum of the metal halide lamp meets the requirements for colour film and colour television. The lamps are therefore highly suitable for the lighting of colour television broadcasts.

- Lamp characteristics:
  - Very high luminous efficacy
  - Excellent colour rendering
  - Reliable, long life
  - Stable lumen maintenance

Applications

- Lighting for colour TV broadcasting
- Lighting for colour films
- Public lighting
- Sports ground lighting
- Floodlighting
- Industrial and commercial indoor lighting
- Plant irradiation

Ballasts and ignitors

Metal halide lamps require high quality ballasts for optimum operation, as well as ignitors to ensure reliable ignition.
For ballasts and ignitors see relevant leaflet. If gear from third parties is used contact the Product Group – High Intensity Discharge Lamps.

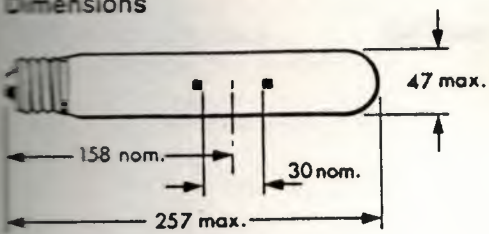
Temperatures

Max. permissible base temperatures:	250 °C for 400 W
	300 °C for 1000 W
	300 °C for 2000 W
Max. permissible bulb temperature:	600 °C

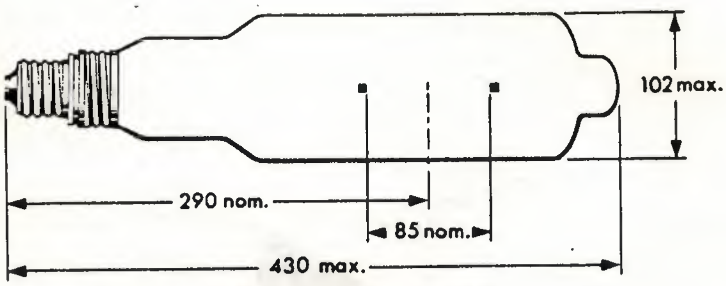
PHILIPS

High-pressure metal halide lamps

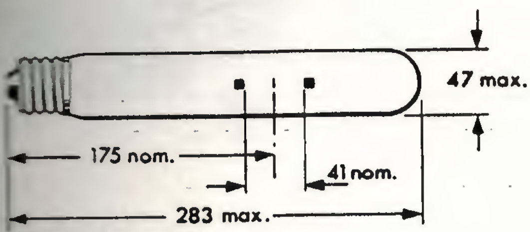
Dimensions



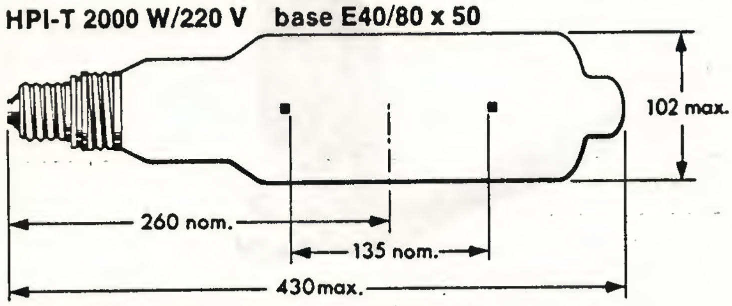
HPI-T 250 W base E40/45



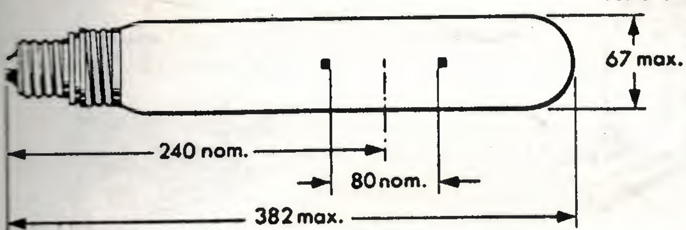
HPI-T 2000 W/220 V base E40/80 x 50



HPI-T 400 W base E40/45



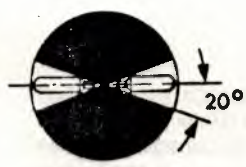
HPI-T 2000 W/380 V base E40/80 x 50



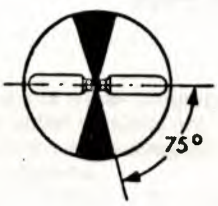
HPI-T 1000 W base E40/80 x 50

Burning positions

The HPI-T 250 W, HPI-T 400 W, HPI-T 1000 W and HPI-T 2000 W, 380 V lamps may burn in a horizontal position ±20° only, while the burning angle of the HPI-T 2000 W, 220 V lamp may be varied by approximately 75° from the horizontal. This means that the 2000 W, 220 V lamp can be used in rotational-symmetric floodlights in a declined position without the colour rendering properties being affected.



HPI-T 250 W
HPI-T 400 W
HPI-T 1000 W
HPI-T 2000 W/380 V



HPI-T 2000 W/220 V

Technical and ordering data

Lamp designation	Base	Min. supply voltage for ignition ¹) V +20°C	Min. supply voltage for ignition ¹) V −18°C	Average lamp voltage ²) ⁴) V	Average lamp current ²) ⁴) A	Lamp starting current A(max.)	Minimum permissible lamp wattage W ²)	Nominal lamp wattage ²) ⁴) W	Maximum permissible lamp wattage W ²)	Average luminous flux lm ²) ⁴)	Average luminance cd/m² ²) ⁴)	Run-up time ³) ⁴) min.	Ordering number
HPI-T 250 W	E40	200	200	125	2,1	5	210	245	285	17000	700 x 10⁴	3	9280 761 092..
HPI-T 400 W	E40	200	200	125	3,4	6	330	390	450	31500	770 x 10⁴	3	9280 734 092..
HPI-T 1000 W	E40	200	200	130	8,25	14	800	965	1100	81000	950 x 10⁴	3	9280 740 092..
HPI-T 2000 W/220	E40	200	200	135	16,5	24	1650	1960	2200	189000	1100 x 10⁴	3	9280 736 092..
HPI-T 2000 W/380	E40	330	340	240	8,6	14	1650	1900	2200	183000	870 x 10⁴	3	9280 718 092..

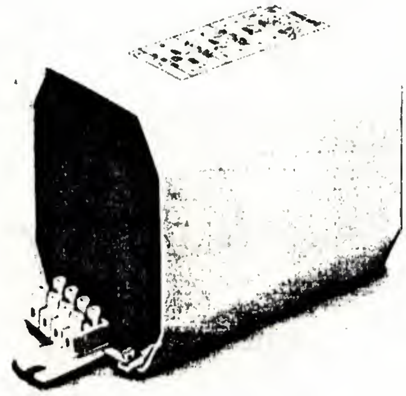
¹) At 0 hours.
²) After 100 burning hours.
³) The number of minutes after which the lamp has reached 80% of its final luminous flux. Final colour rendering properties will be reached after 10-15 minutes.
⁴) Measured at nominal supply voltage and reference ballast for a free burning lamp.

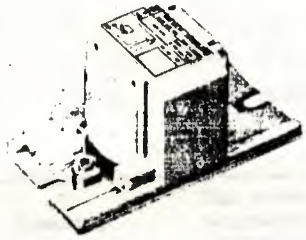
PHILIPS

Electronic ignitors **Ballasts**

SI 54

SI 51/52





HPI (-T)

Definition

A series of ballasts and electronic ignitors for operation with high-pressure metal halide gas-discharge lamps.

Description

- For satisfactory starting and correct running, a metal halide lamp must be operated in conjunction with an appropriate ballast and ignitor (except for BUS – Base Up Self-starting – lamp types which incorporate an internal starting device).
- Since the ignition voltage of a metal halide lamp is higher than the applied mains voltage, a starting device (electronic ignitor) serves to provide a high-voltage pulse per cycle across the lamp and, once the lamp has been started, the ignitor switches off automatically.
- During normal operation the current through the lamp is limited with the aid of a ballast.
- All ballast types are orthocyclically wound for maximum efficiency and minimum watts losses.
- Ballasts and ignitors are all fitted with pinch-screw terminal blocks; further, the ballasts, which have metal baseplates, are also equipped with an earth terminal.
- Ballast types 1000W and 2000W are of metal octagonal box construction whilst the 250W and 400W versions are nylon encapsulated, this latter technique resulting in reductions in both weight and dimensions.
- Maximum permissible winding temperatures in the ballasts under running conditions are 120°C (1000W, 2000W) and 130°C (250W, 400W) respectively; since the ignitors contain a number of temperature-sensitive components, the housing temperature should always lie between – 20°C and + 80°C.
- Thyristors employed in the ignitors ensure reliable functioning throughout their long service life.
- Electronic ignitors can only be used in combination with inductive ballasts.

Warning: The ignitor remains in operation without a lamp in the circuit or when the lamp is defective.

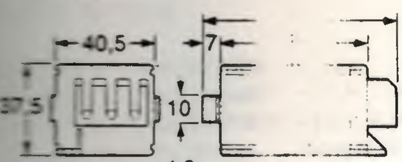
Applications

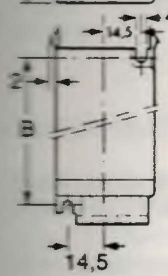
- Industrial and commercial lighting
- Public lighting
- Floodlighting
- Sports ground lighting
- Plant irradiation

PHILIPS

Ballasts and electronic ignitors for high-pressure metal halide lamps

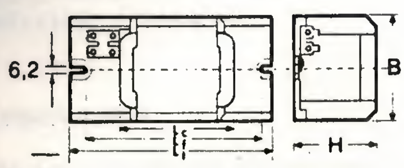
Dimensions

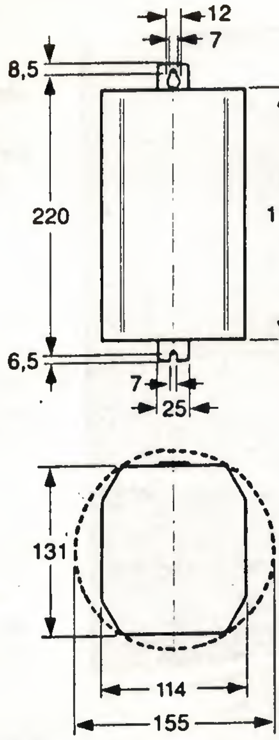




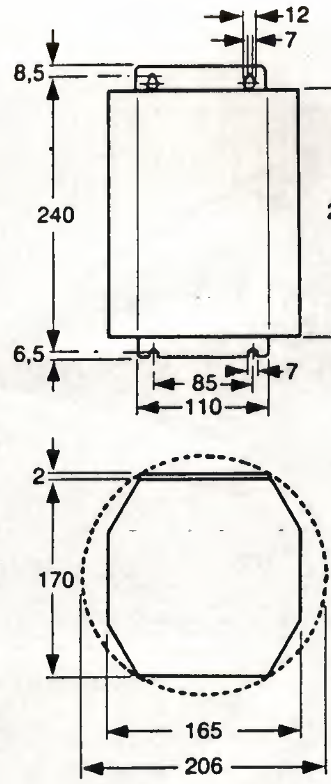
Ignitor

Type	A	B
SI 51	83,5	64
SI 52	83,5	64
SI 54	113,5	64





BHL 1000L 02



BHL 2000L 18

Ballast

Type	Lt mm	Lf mm	Lc mm	B mm	H mm
BHL 250L11	125	110	80	79	65
BHL 400L11	150	135	106	79	65

Technical and ordering data on ignitors

For lamps	Type number	Mains voltage V	Frequency Hz	Max. permissible temperature at 110% mains °C	Ordering number
HPI-T 250 W	SI 51	220 - 240	50 - 60	– 20 + 80	9136 195 199..
HPI-T 400 W	SI 51	220 - 240	50 - 60	– 20 + 80	9136 195 199..
HPI-T 1000 W	SI 52	220 - 240	50 - 60	– 20 + 80	9136 195 299..
HPI-T 2000 W	SI 52	220 - 240	50 - 60	– 20 + 80	9136 195 299..
HPI-T 2000 W	SI 54	380 - 415	50 - 60	– 20 + 80	9136 191 499..

Technical and ordering data on ballasts
Low power-factor (inductive) ballasts

For lamps	Type number	Nominal voltage[1]) V	Sec. peak voltage during ignition or without lamp V	Mains current A during ignition	Mains current A during operation	Power factor	Losses W	Power-factor correction[2]) Capacitor µF	Capacitor V	Mains current A during ignition	Mains current A during operation	Circuit/ wiring diagram	Ordering number
HPI-250 W BUS	BHL 250L11	220	–	3,6	2,2	0,55	18	20	250	1,85	1,30	1	9136 039 203..
HPI-T 250 W	BHL 250L11	220	580 - 750	3,6	2,2	0,55	18	20	250	1,85	1,30	2	9136 039 203..
HPI-400 W BUS	BHL 400L11	220	–	5,0	3,4	0,55	25	30	250	3,00	2,00	1	9136 049 203..
HPI-400 W BU	BHL 400L11	220	580 - 750	5,0	3,4	0,55	25	30	250	3,00	2,00	2	9136 049 203..
HPI-400 W	BHL 400L11	220	580 - 750	5,0	3,4	0,55	25	30	250	3,00	2,00	2	9136 049 203..
HPI-T 400 W	BHL 400L11	220	580 - 750	5,0	3,4	0,55	25	30	250	3,00	2,00	2	9136 049 203..
HPI-T 1000 W	BHL 1000L02	220	600 - 760	13,0	8,25	0,55	50	65	250	8,00	5,30	3	9136 060 103..
HPI-T 2000 W	BHL 1000L02[3])	220	600 - 760	26,00	16,5	0,55	100	125	250	16,00	10,50	4	9136 060 103..
HPI-T 2000 W	BHL 2000L18	380	1300	14,00	8,6	0,62	74	35	380	10,00	6,00	5	9136 070 089..
HPI-T 2000 W	BHL 2000L18[4])	380	1300									6	9136 070 089..

[1]) Consumers' voltage: 220 V = 210 - 230 V, 380 V = 350 - 410 V (50 Hz). Ballast data for other voltages and frequencies are given on request.

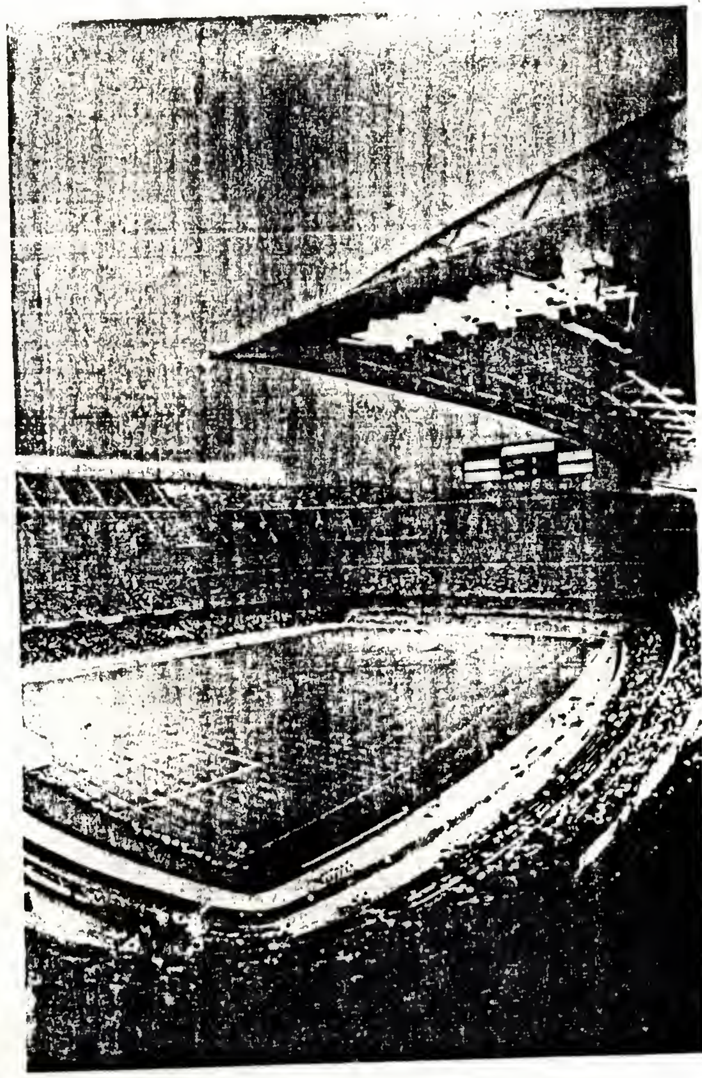
[2]) To obtain HPF circuit (cos $\varphi \geq 0{,}85$) by means of a parallel capacitor across the mains. Capacitance tolerance ± 10%. Capacitors to be ordered from C.D. Elcoma.

[3]) Two ballasts connected in parallel.

[4]) Compensation in star connection. For 3 lamps across 3 phases 100 µF/250 V between phase and neutral.

Lamp wattage

In the technical data the [illegible] and maximum permissible lamp wattages are given [illegible] mance of metal halide lamps (such as lifetime [illegible] aspects) will be negatively influenced if the lamps [illegible] operated outside these wattage ranges.



Conditions of use

Satisfactory performance of this type of lamp can only be expected if the ballast on which it is operated complies with specifications laid down by the lamp manufacturer. Moreover, the mains supply voltage may not fluctuate more than ±5% from the rated voltage of the ballast.

Luminaire requirements

In metal halide lamps discharge tubes are used in which, as with all other similar lamptypes, high pressures exist under normal operating conditions. These discharge tubes are designed to resist this pressure but it can never be completely excluded that a lamp may shatter. It is advisable to use luminaires which are specifically designed for their application.

Re-ignition time

The re-ignition time of metal halide lamps depends on the ambient temperature and, in the case of lamps with external ignition, the height of the ignition pulse. With reliable, low-voltage, Philips ignitors the re-ignition time will be approximately 15 minutes. However, when ignitors with a higher pulse (up to 4-5 kV) are used, this interval will be reduced to approximately 5 minutes. Immediate hot re-ignition is not possible.

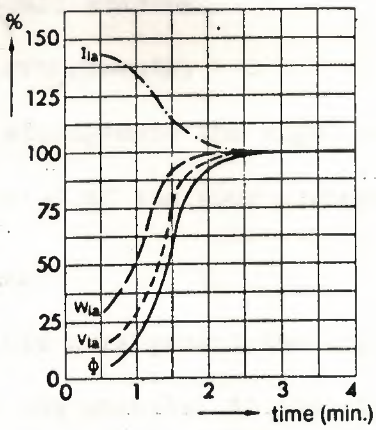
Installation requirements

The phase should be connected to the central contact of the lampholder for both safety reasons and to ensure reliable ignition.
Note: A long distance between control gear and the lamp can influence the reliability of ignition. Installations should be designed to ensure that the ignition requirements will be achieved at the lamp terminals.

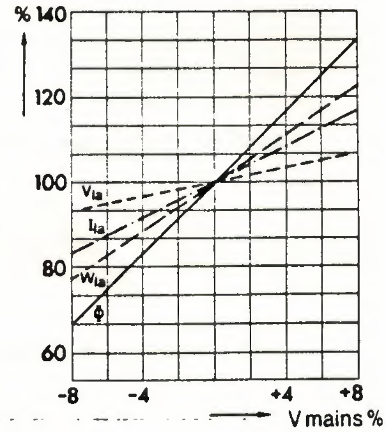
Typical curves

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

Lamp performance during starting period

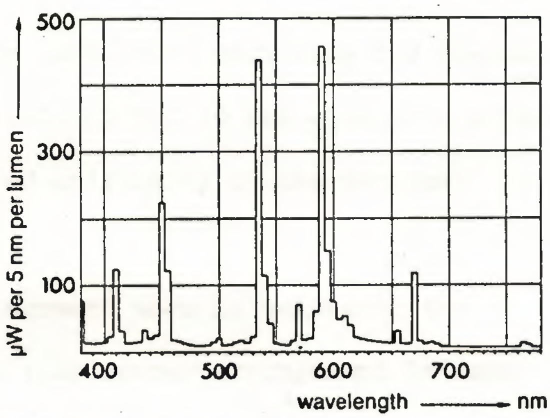


Effects of mains voltage variations



Normalised spectral power distribution

HPI-T 2000 W/380 V



Packing data

Lamp designation	Nett weight g	Packing unit Qty	Weight kg	Dimensions cm	Volume m³
HPI-T 250 W	180	12	4,46	36x29x39	0,041
HPI-T 400 W	180	12	4,46	36x29x39	0,041
HPI-T 1000 W	400	4	4,65	32x32x51	0,052
HPI-T 2000 W/220	650	4	5,00	35x35x60	0,074
HPI-T 2000 W/380	670	4	5,00	35x35x60	0,074

B. a) Masts Arrangements

There are basically two alternative lighting arrangements sutable for football stadium.

* Four Corner Arrangements.

In this arrangement the light sources are mounted on four columns or masts situated at the four corners of the ground.

* Side Arrangement

With this arrangement the light sources are mounted either on columns or in row parallel to the pitch.

If there is no roof for spectators area which surrounds the playing field, the four corner arrangement is the best one but to use side arrangement is the best if there is because there is good uniformity of the vertical illuminance.

We preferred the four corner arrangement when illuminating the Ataturk Stadium , the reason of this is the four corner arrangement is used for playing fields with huge capacity. In this type of arrangement vertical illumination is lower then the horizontal one. This situation is stated at the project.

According to the four-corner arrangemt, the maunting of masts creates 10^o and also 25^o from the goal post towards back. Masts are mounted to field in lines between 25^0 and 10^o of which starting from the middle of the playing field and it shouldn't be nearer from the line which makes 5^o angle to edge of the field.

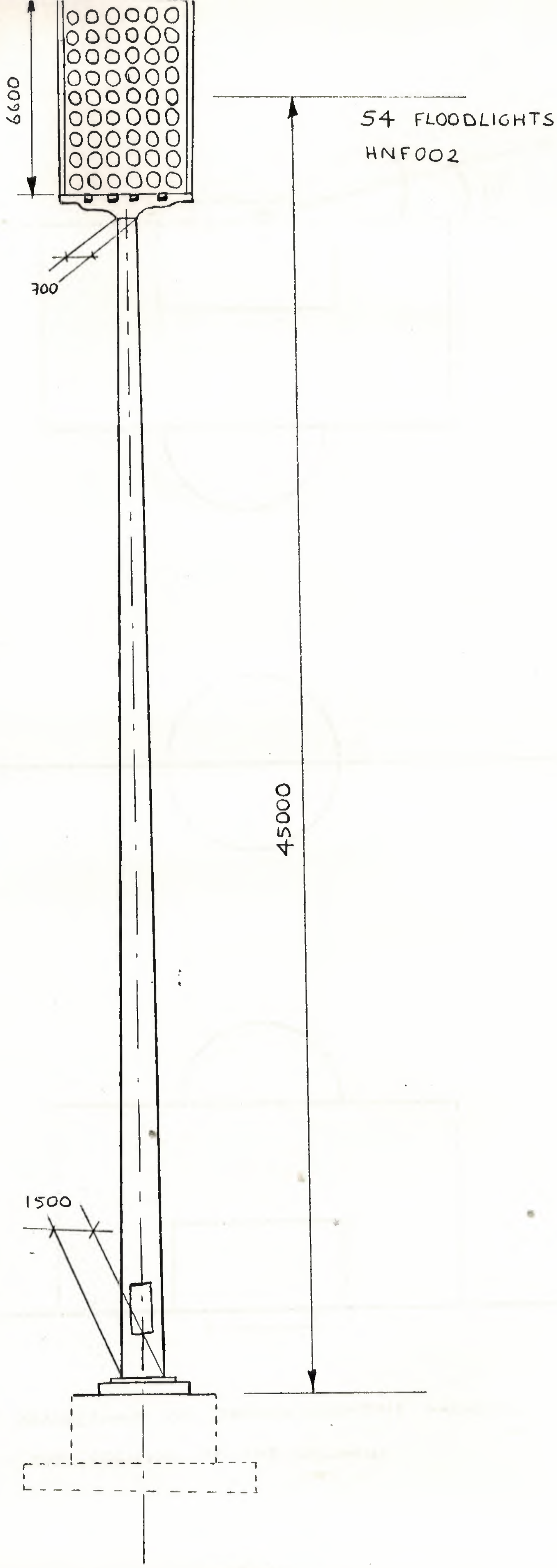
In this, the viewing distance is the part from farthest spectator to pitch center.

This is shown at the related figure.

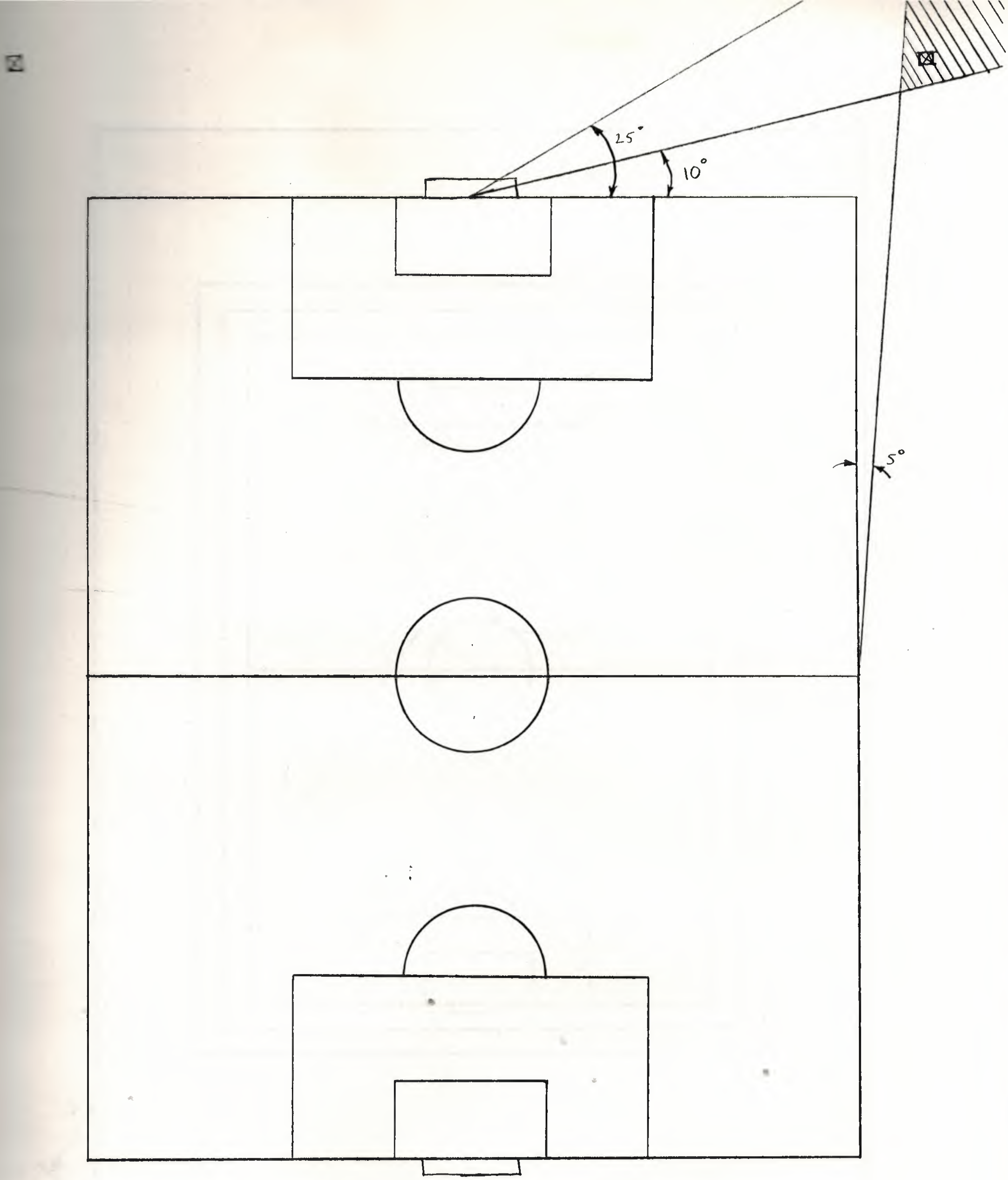
b) Mounting Heights and Glare

As the mounting height decreases so the danger of glare and the length of the shadows cast by the players increases. Advantages of using high columns are that they restrict glare and cast shorter shadows.

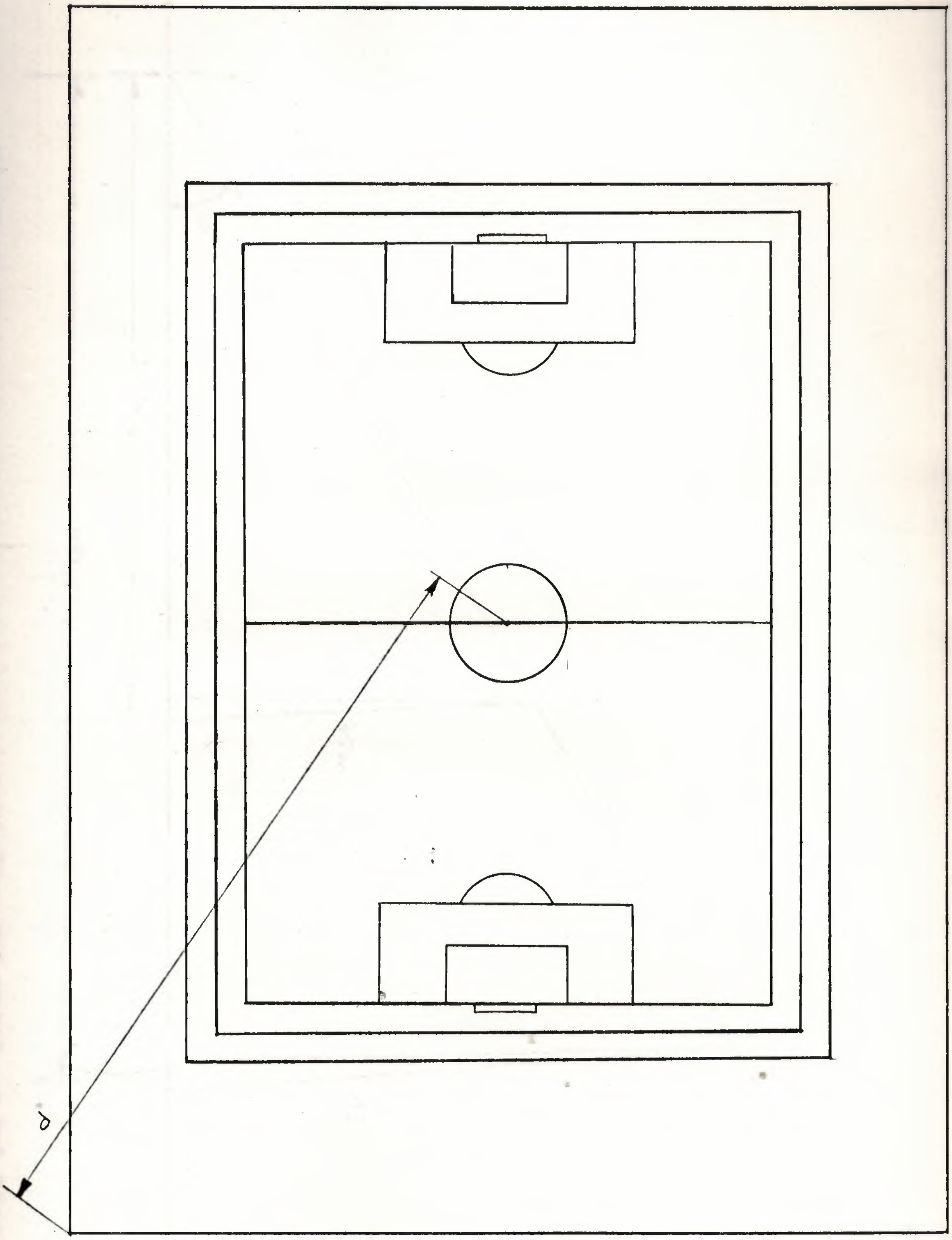
The type of floodlight used , it is desirable that the angles subtended at the centre of the pitch between the horizontal and the lowest point of each flood light battery, be at least 25 $^{\circ}$. (It is shown at fig.)



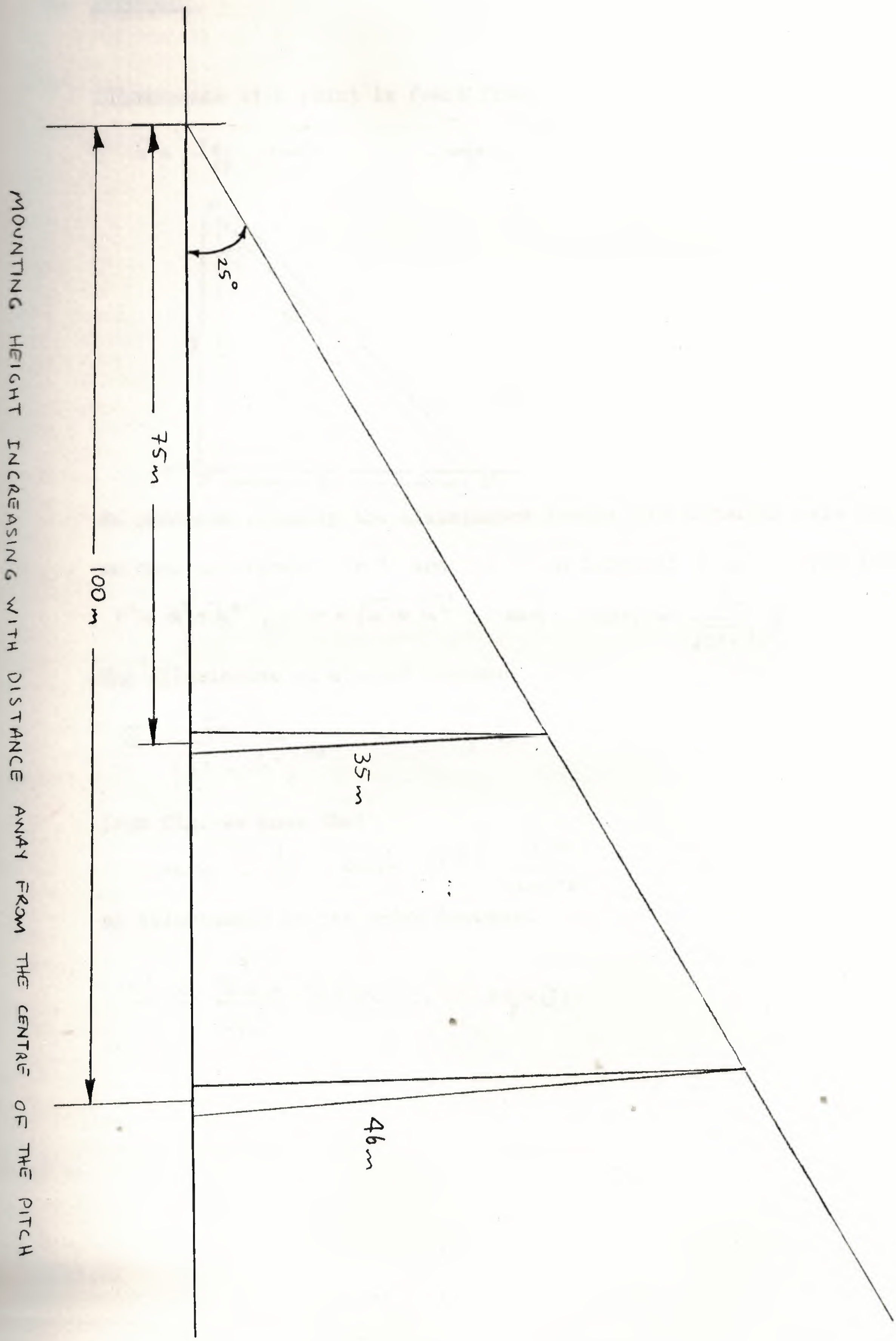
Units were taken in mm.



FOUR-CORNER ARRANGEMENT OF STADIUM LIGHTING SHOWING THE POSITION OF THE COLUMNS



VIEWING DISTANCE FROM FARTHEST SPECTATOR TO PITCH CENTER

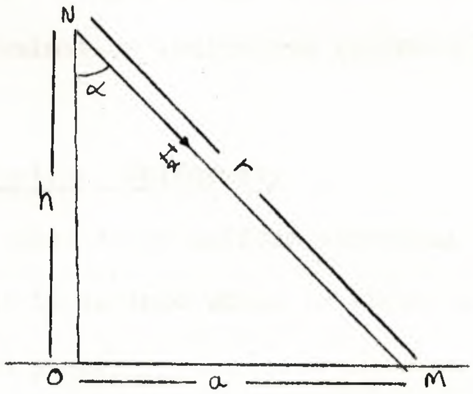

MOUNTING HEIGHT INCREASING WITH DISTANCE AWAY FROM THE CENTRE OF THE PITCH
100m
75m
25°
35m
46m

14.1

3. FORMULAS

Illuminance at a point is found from

$$E = \frac{I_{\alpha}}{r^2} \cos\alpha \quad \ldots\ldots \text{eqn } (1)$$



In practice , mostly the illuminance levels in horizantal axis are calculated, we have to express " r " and " d " in terms of " a " ; from above fig.

$$r^2 = a^2 + h^2 \ , \quad r = \sqrt{a^2+h^2} \quad \text{and} \quad \cos\alpha = \frac{h}{\sqrt{a^2+h^2}}$$

The illuminance at a point becomes.

$$E = \frac{I_\alpha h}{\left[a^2 + h^2\right]^{3/2}} \quad \ldots\ldots \text{eqn } (2)$$

from fig. we know that

$$\cos\alpha = \frac{h}{r} \quad \text{and} \quad r^2 = \frac{h^2}{\cos^2\alpha}$$

so illuminance at the point becomes.

$$E = \frac{I_{\alpha,A}}{h^2} \cos^3\alpha \quad \ldots\ldots \text{eqn } (3)$$

Formula at eg. 3. consists of direct illumination at calculations of Outdoor - Illumination. at calculations of Outdoor Illumination. The basic characteristic of Outdoor Illumination calculations is formed by not calculating co-efficient reflection of which belongs to surface limiting the atmosphere. So, the whole outdoor illumination lumineires reflects light to semi-low atmosphere.

Illumination Uniformity

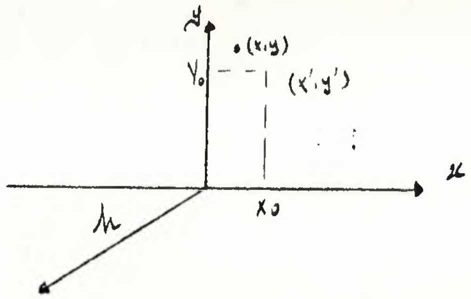
It is asked to be uniform according to place and time, Two uniformity co-efficient is defined which is shown by δ_1, δ_2 in order to express its uniformity according to place.

$$\delta_1 = E\ \min / E_{AV} \qquad \text{(asked to be at least } 0.3 \text{)}$$

$$\delta_2 = E\ \min / E\ \max$$

The basic formula used in stadium illuminations is Eq 3 defined.

To find $I\alpha$, A and $\cos^3\gamma$ at the formula, we use the formulas mentioned below.



$$\alpha = \cos^{-1} \frac{1}{\sqrt{1+x_0'^2+y_0'^2}} \left(\frac{1+y_0'^2}{\sqrt{1+y_0'^2+x'^2}} + \frac{x_0' x'}{\sqrt{1+y_0'^2+x'^2}} \right)$$

$$A = \cos^{-1} \frac{1}{\sqrt{1+x_0'^2+y_0'^2}} \left(\frac{1+x_0'^2}{\sqrt{1+x_0'^2+y'^2}} + \frac{y_0' y'}{\sqrt{1+x_0'^2+y'^2}} \right)$$

$$\cos^3\gamma = \frac{1}{\left[1+x'^2+y'^2\right]^{3/2}}$$

$$x' = \frac{x}{h}, \quad y' = \frac{y}{h}, \quad x_0' = \frac{x_0}{h}, \quad y_0' = \frac{y_0}{h}$$

x_o : it is the x- co-ordinate on the surface which the projector axis intercept the plane that will illuminate.

y_o : it is the y- co-ordinate on the surface of the point at which the projector axis intercept the plane wthat will illuminate.

x,y : the co-ordinate of the point at which we want to calculate illuminance.

γ : It is the angle between the direction at which we want to calculate the illuminance and tha normal to the surface that will illuminate.

The formula used in illumination in order to find the number of floodlights to be used, can be defined like this.

$$\eta = \frac{\text{Area} \times E_{av}}{\text{lumen of floodlight}}$$

4. CONCEPTS

a) Colour Rendering

The effect of a light source on the colour apperance under a reference light source.

b) Diffused Lighting

Lighting in which the light on the working plane or on an object is not predominantly incident from any particular direction.

c) Glare

A condition of vision in which there is discomfort and/or a reduction in the ability to see significant objects, due to an unsuitable distribution or range of brightness, or to extreme contrasts simultaneous or successive in the field of view.

d) Maintenance factor

A factor used in illumination calculation to allow for the reduction of light output from a source of fiting because of dust and foreign matter being deposited on it.

e) Objective Brightness

This is the lumnious 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 candles per unit area.

PART C

CALCULATIONS OF STADIUM ILLUMINATION

I. Computer program & data for illumination.

2. Calculation of horizontal illumination (table 1)

3. Calculation of vertical illumination (table 2)

4. Table: classification of the recommended vertical illumination in some countries.

```fortran
      open(3,file='pr4.dat',status='new')
      write(*,*)'give the values of x0,y0,h'
      read(*,*)x0,y0,h
      WRITE(*,10)
      WRITE(3,10)
10    format(5x,'x',5x,'y',9x,'a',10x,'A',6x,'cos3&'/)
      do 1 i=1,71,5
      m=i-1
      do 2 j=1,101,5
      n=j-1
      x10=x0/h
      x1=n/h
      y10=y0/h
      y1=m/h
      b=(1/sqrt(1+x10**2+y10**2))
      c=((1+y10**2+x10*x1)/sqrt(1+y10**2+x1**2))
      a=acos(b*c)*180/3.142
      d=(1/sqrt(1+x10**2+y10**2))
      e=((1+x10**2+y10*y1)/sqrt(1+x10**2+y1**2))
      f=acos(e*d)*180/3.142
      t=1/(1+x1**2+y1**2)**1.5
      write(*,100)n,m,a,f,t
      write(3,100)n,m,a,f,t
100   format(4x,i3,3x,i2,6x,f6.3,5x,f6.3,5x,f5.3)
2     continue
1     continue
      stop
      end
```

* 25	17.5	0°	0°	0.566	107163.	54	1618 17

x	y	a(α)	A	cos3&	I (cd)	number of floodlights	E (Lux)
0	0	27.371	18.773	1.000	53651.61291	54	1430.7096
5	0	21.459	18.773	.982	56322	54	1474.8854
10	0	15.671	18.773	.930	59850	54	1484.2799
15	0	10.115	18.773	.854	65475.00001	54	1491.0839
20	0	4.873	18.773	.763	75600	54	1538.2079
25	0	.000	18.773	.668	77034.6818	54	1372.2444
30	0	4.479	18.773	.576	75600	54	1161.216
35	0	8.563	18.773	.492	68512.5	54	898.884
40	0	12.264	18.773	.418	63196.87	54	704.434
45	0	15.608	18.773	.354	59850	54	564.9839
50	0	18.624	18.773	.299	58050.00001	54	462.8519
55	0	21.344	18.773	.254	56322	54	381.4876
60	0	23.798	18.773	.216	54600	54	314.496
65	0	26.017	18.773	.184	52920	54	259.6607
70	0	28.026	18.773	.158	52737.0167	54	222.1989
75	0	29.850	18.773	.136	51679.6875	54	187.4249
80	0	31.509	18.773	.118	49827.2727	54	156.7898
85	0	33.023	18.773	.102	47250	54	128.52
90	0	34.409	18.773	.089	47250	54	112.1399
95	0	35.680	18.773	.078	46249.4117	54	96.1987
100	0	36.848	18.773	.069	44248.23	54	81.4167
0	5	27.371	13.226	.982	58767.18	54	1538.91
5	5	21.459	13.226	.964	64968.75	54	1670.25
10	5	15.671	13.226	.914	69693.75	54	1698.66
15	5	10.115	13.226	.840	75600	54	1693.44
20	5	4.873	13.226	.751	81912	54	1641.37
25	5	.000	13.226	.659	86121.77	54	1512.61
30	5	4.479	13.226	.569	83490.75	54	1266.83
35	5	8.563	13.226	.486	77178.15	54	1000.65

				cos 3θ	I (cd)	flood light	E (lux)
40	5	12.264	13.226	.413	72765	54	801.38
45	5	15.608	13.226	.350	69693.75	54	650.47
50	5	18.624	13.226	.297	68040	54	538.87
55	5	21.344	13.226	.252	64968.75	54	436.67
60	5	23.798	13.226	.215	62310.93	54	362.25
65	5	26.017	13.226	.183	59653.12	54	291.10
70	5	28.026	13.226	.157	57309.67	54	239.93
75	5	29.850	13.226	.136	53651.61	54	194.57
80	5	31.509	13.226	.117	52737.09	54	164.53
85	5	33.023	13.226	.102	49140	54	133.66
90	5	34.409	13.226	.089	48195	54	114.38
95	5	35.680	13.226	.078	47250	54	98.28
100	5	36.848	13.226	.069	45123.75	54	83.02
0	10	27.371	7.781	.930	61425	54	1523.34
5	10	21.459	7.781	.914	69734.48	54	1699.66
10	10	15.671	7.781	.868	75600	54	1750.49
15	10	10.115	7.781	.800	82175.62	54	1753.07
20	10	4.873	7.781	.718	91381.5	54	1749.65
25	10	.000	7.781	.632	95139	54	1603.40
30	10	4.479	7.781	.548	91381.5	54	1335.38
35	10	8.563	7.781	.470	82206	54	1067.91
40	10	12.264	7.781	.401	79387.56	54	848.91
45	10	15.608	7.781	.341	75600	54	687.45
50	10	18.624	7.781	.290	74685.48	54	577.56
55	10	21.344	7.781	.247	70537.50	54	464.60
60	10	23.798	7.781	.210	67200	54	376.31
65	10	26.017	7.781	.180	63000	54	302.4
70	10	28.026	7.781	.155	60334.61	54	249.38
75	10	29.850	7.781	.134	57456	54	205.30
80	10	31.509	7.781	.116	54054	54	167.20
85	10	33.023	7.781	.101	50652	54	136.42
90	10	34.409	7.781	.088	48384	54	113.54
95	10	35.680	7.781	.077	47250	54	97.01
100	10	36.848	7.781	.068	44820	54	81.27
0	15	27.371	2.530	.854	63273.91	54	1440.95
5	15	21.459	2.530	.840	75600	54	1693.44
10	15	15.671	2.530	.800	83954.91	54	1791.03
15	15	10.115	2.530	.740	90903.27	54	1793.82
20	15	4.873	2.530	.668	98980	54	1763.16
25	15	.000	2.530	.591	105660	54	1665.20
30	15	4.479	2.530	.515	99879.23	54	1371.67
35	15	8.563	2.530	.445	97811	54	1160.69
40	15	12.264	2.530	.381	88596.51	54	900.14
45	15	15.608	2.530	.326	83954.91	54	729.84
50	15	18.624	2.530	.278	80109	54	593.87
55	15	21.344	2.530	.238	75600	54	479.80
60	15	23.798	2.530	.204	70669.56	54	384.44
65	15	26.017	2.530	.175	65739.13	54	306.78
70	15	28.026	2.530	.151	62041.30	54	249.81
75	15	29.850	2.530	.130	58343.47	54	202.25
80	15	31.509	2.530	.113	54645.65	54	164.66
85	15	33.023	2.530	.099	50947.82	54	134.50
90	15	34.409	2.530	.087	49140	54	114
95	15	35.680	2.530	.076	47250	54	95.75
100	15	36.848	2.530	.067	47250	54	84.41
0	20	27.371	2.456	.763	63273.91	54	1287.41
5	20	21.459	2.456	.751	75600	54	1514.01
10	20	15.671	2.456	.718	83954.91	54	1607.45
15	20	10.115	2.456	.668	90903.27	54	1619.29
20	20	4.873	2.456	.607	98980	54	1602.15
25	20	.000	2.456	.541	105660	54	1524.32
30	20	4.479	2.456	.475	99879.23	54	1265.13
35	20	8.563	2.456	.413	97811	54	1077.22
40	20	12.264	2.456	.357	88596.52	54	843.43
45	20	15.608	2.456	.307	83954.91	54	687.31

50	20	18.624	2.456	.264	80109	54	563.96
55	20	21.344	2.456	.226	75600	54	445.61
60	20	23.798	2.456	.195	70669.56	54	367.48
65	20	26.017	2.456	.168	65739.13	54	294.75
70	20	28.026	2.456	.145	62041.30	54	239.89
75	20	29.850	2.456	.126	58343.47	54	196.03
80	20	31.509	2.456	.110	54645.65	54	160.29
85	20	33.023	2.456	.096	50947.82	54	130.42
90	20	34.409	2.456	.084	49140	54	110.67
95	20	35.680	2.456	.074	47250	54	93.23
100	20	36.848	2.456	.066	47250	54	83.16
0	25	27.371	7.127	.668	63126	54	1124.48
5	25	21.459	7.127	.659	73575	54	1292.95
10	25	15.671	7.127	.632	77854.50	54	1312.10
15	25	10.115	7.127	.591	84437.64	54	1330.73
20	25	4.873	7.127	.541	92959.65	54	1341.09
25	25	.000	7.127	.486	99272.25	54	1286.65
30	25	4.479	7.127	.431	92959.65	54	1068.41
35	25	8.563	7.127	.378	87950.73	54	886.54
40	25	12.264	7.127	.329	81669.80	54	716.51
45	25	15.608	7.127	.285	77854.50	54	591.69
50	25	18.624	7.127	.247	75600	54	497.95
55	25	21.344	7.127	.213	73575	54	417.90
60	25	23.798	7.127	.184	69057.69	54	338.84
65	25	26.017	7.127	.160	65394	54	279.01
70	25	28.026	7.127	.139	61992	54	229.78
75	25	29.850	7.127	.121	57881.25	54	186.76
80	25	31.509	7.127	.106	53156.25	54	150.25
85	25	33.023	7.127	.093	49612.5	54	123.03
90	25	34.409	7.127	.082	47250	54	103.31
95	25	35.680	7.127	.072	47250	54	90.72
100	25	36.848	7.127	.064	44820	54	76.49
0	30	27.371	11.455	.576	58767.18	54	902.66
5	30	21.459	11.455	.569	64968.75	54	985.79
10	30	15.671	11.455	.548	69693.75	54	1018.45
15	30	10.115	11.455	.515	75600	54	1038.23
20	30	4.873	11.455	.475	81912	54	1037.55
25	30	.000	11.455	.431	86121.77	54	989.82
30	30	4.479	11.455	.385	83490.75	54	857.17
35	30	8.563	11.455	.341	77178.15	54	701.80
40	30	12.264	11.455	.299	72765	54	580.17
45	30	15.608	11.455	.262	69693.75	54	486.92
50	30	18.624	11.455	.228	68040	54	413.68
55	30	21.344	11.455	.199	64968.75	54	344.76
60	30	23.798	11.455	.173	62310.93	54	287.46
65	30	26.017	11.455	.151	59653.12	54	240.20
70	30	28.026	11.455	.132	57309.67	54	201.73
75	30	29.850	11.455	.115	53651.61	54	164.53
80	30	31.509	11.455	.101	52737.09	54	142.03
85	30	33.023	11.455	.089	49140	54	116.62
90	30	34.409	11.455	.079	48195	54	101.53
95	30	35.680	11.455	.070	47250	54	88.19
100	30	36.848	11.455	.062	45123.75	54	74.60
0	35	27.371	15.434	.492	56109.37	54	736.15
5	35	21.459	15.434	.486	60936.20	54	789.73
10	35	15.671	15.434	.470	65677.5	54	823.15
15	35	10.115	15.434	.445	70284.37	54	834.04
20	35	4.873	15.434	.413	78756.3	54	867.36
25	35	.000	15.434	.378	81612	54	822.64
30	35	4.479	15.434	.341	78756.3	54	716.15
35	35	8.563	15.434	.304	75600	54	612.86
40	35	12.264	15.434	.270	67261.76	54	484.28
45	35	15.608	15.434	.238	65677.5	54	416.83
50	35	18.624	15.434	.209	62606.25	54	348.92
55	35	21.344	15.434	.183	60936.20	54	297.36
60	35	23.798	15.434	.161	60053.12	54	257.82

X	Y		A	cos 3θ	I(cd)	floodlight	E(Lux)
65	35	26.017	15.434	.141	57559.09	54	216.42
70	35	28.026	15.434	.124	55840.90	54	184.64
75	35	29.850	15.434	.109	52565.62	54	152.79
80	35	31.509	15.434	.096	50793.75	54	130.03
85	35	33.023	15.434	.085	49021.87	54	111.11
90	35	34.409	15.434	.075	47280.	54	94.5
95	35	35.680	15.434	.067	47280	54	84.41
100	35	36.848	15.434	.060	45248.82	54	72.33
0	40	27.371	19.070	.418	53651.61	54	598.03
5	40	21.459	19.070	.413	56322	54	620.29
10	40	15.671	19.070	.401	59850	54	639.99
15	40	10.115	19.070	.381	65475	54	665.22
20	40	4.873	19.070	.357	75600	54	719.71
25	40	.000	19.070	.329	77034.68	54	675.85
30	40	4.479	19.070	.299	75600	54	602.78
35	40	8.563	19.070	.270	68512.5	54	439.29
40	40	12.264	19.070	.241	63196.87	54	406.14
45	40	15.608	19.070	.215	59850.	54	343.13
50	40	18.624	19.070	.190	58050	54	294.11
55	40	21.344	19.070	.168	56322	54	252.32
60	40	23.798	19.070	.148	54600	54	215.48
65	40	26.017	19.070	.131	52920	54	184.86
70	40	28.026	19.070	.116	52737.09	54	163.13
75	40	29.850	19.070	.102	51679.68	54	140.56
80	40	31.509	19.070	.091	49827.27	54	120.91
85	40	33.023	19.070	.081	47250	54	102.06
90	40	34.409	19.070	.072	47250	54	90.72
95	40	35.680	19.070	.064	46249.41	54	78.93
100	40	36.848	19.070	.057	44248.23	54	67.25
0	45	27.371	22.380	.354	47250	54	446.04
5	45	21.459	22.380	.350	47250	54	440.99
10	45	15.671	22.380	.341	50793.75	54	461.88
15	45	10.115	22.380	.326	54337.5	54	472.37
20	45	4.873	22.380	.307	63000	54	515.75
25	45	.000	22.380	.285	67500	54	513
30	45	4.479	22.380	.262	63000	54	440.15
35	45	8.563	22.380	.238	58590	54	371.85
40	45	12.264	22.380	.215	53325	54	305.72
45	45	15.608	22.380	.192	50793.75	54	260.06
50	45	18.624	22.380	.172	48917.64	54	224.36
55	45	21.344	22.380	.153	47250	54	192.78
60	45	23.798	22.380	.136	47250	54	171.35
65	45	26.017	22.380	.121	47280	54	152.45
70	45	28.026	22.380	.108	47280	54	136.08
75	45	29.850	22.380	.096	47280	54	120.96
80	45	31.509	22.380	.085	47250	54	107.09
85	45	33.023	22.380	.076	45248.82	54	91.70
90	45	34.409	22.380	.068	44248.23	54	80.23
95	45	35.680	22.380	.061	44248.23	54	71.97
100	45	36.848	22.380	.055	41246.47	54	60.49
0	50	27.371	25.387	.299	47250	54	376.73
5	50	21.459	25.387	.297	47250	54	374.22
10	50	15.671	25.387	.290	50793.75	54	392.80
15	50	10.115	25.387	.278	54337.5	54	402.82
20	50	4.873	25.387	.264	63000	54	443.51
25	50	.000	25.387	.247	67500	54	444.59
30	50	4.479	25.387	.228	63000	54	383.03
35	50	8.563	25.387	.209	58590	54	326.54
40	50	12.264	25.387	.190	53325	54	270.17
45	50	15.608	25.387	.172	50793.75	54	232.97
50	50	18.624	25.387	.155	48917.64	54	202.19
55	50	21.344	25.387	.139	47250	54	175.13
60	50	23.798	25.387	.124	47250	54	156.23
65	50	26.017	25.387	.111	47250	54	139.86

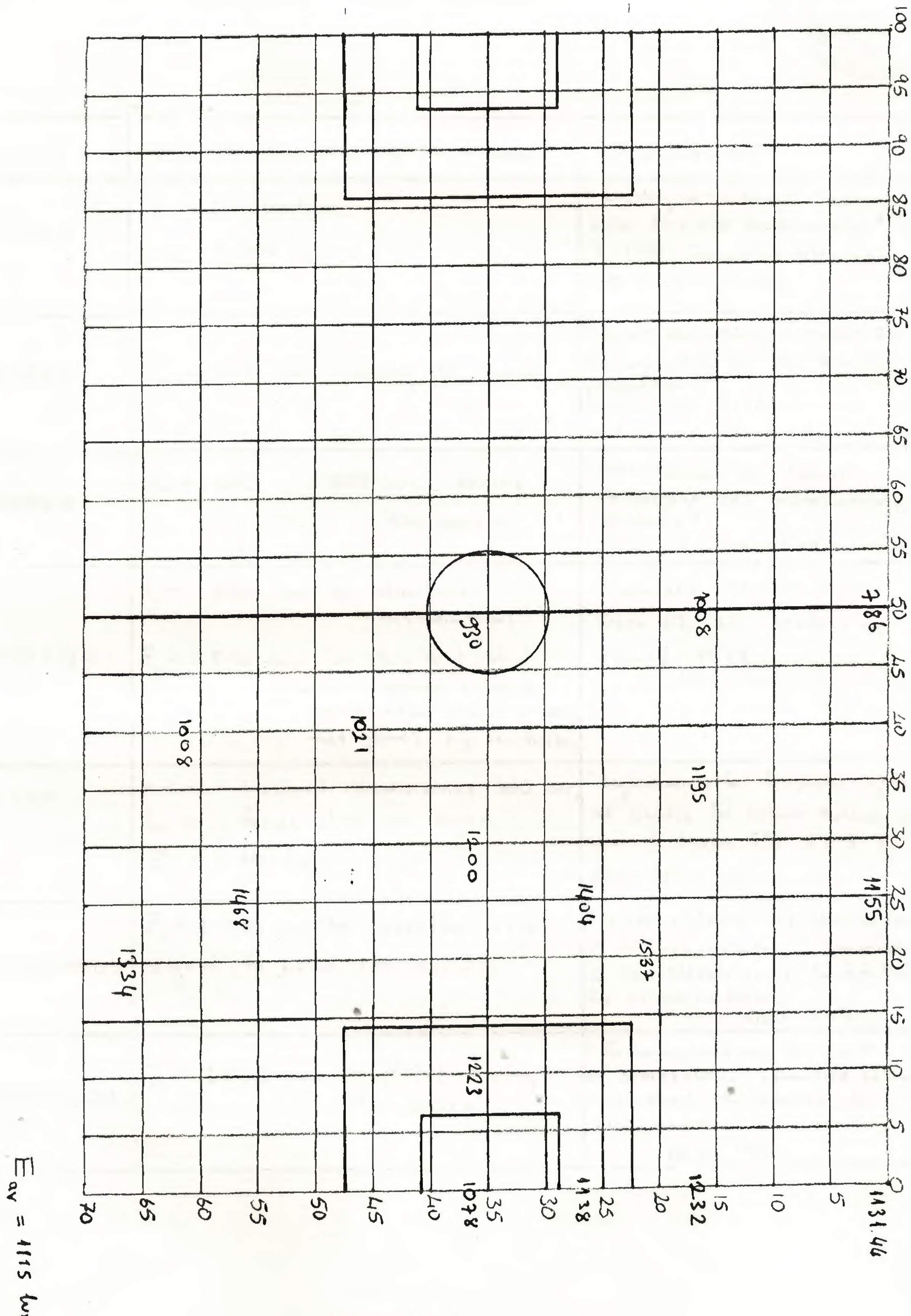
70	50	28.026	25.387	.100	47250	54	125.99
75	50	29.850	25.387	.089	47250	54	112.13
80	50	31.509	25.387	.080	47250	54	100.79
85	50	33.023	25.387	.072	45248.82	54	86.87
90	50	34.409	25.387	.064	44248.23	54	75.51
95	50	35.680	25.387	.058	44248.23	54	68.43
100	50	36.848	25.387	.052	41246.47	54	57.19
0	55	27.371	28.115	.254	40950	54	277.36
5	55	21.459	28.115	.252	42714	54	287.03
10	55	15.671	28.115	.247	43848	54	288.81
15	55	10.115	28.115	.238	43324.61	54	274.96
20	55	4.873	28.115	.226	44415	54	267.67
25	55	.000	28.115	.213	43848	54	249.05
30	55	4.479	28.115	.199	44415	54	235.69
35	55	8.563	28.115	.183	43470	54	212.13
40	55	12.264	28.115	.168	43247.64	54	193.74
45	55	15.608	28.115	.153	43848	54	178.89
50	55	18.624	28.115	.139	43957.74	54	162.93
55	55	21.344	28.115	.126	42714	54	143.51
60	55	23.798	28.115	.113	42557.58	54	128.24
65	55	26.017	28.115	.102	41782.5	54	113.69
70	55	28.026	28.115	.092	40320	54	98.91
75	55	29.850	28.115	.083	39399.23	54	87.20
80	55	31.509	28.115	.074	38745	54	76.45
85	55	33.023	28.115	.067	37327.5	54	66.69
90	55	34.409	28.115	.060	36896.08	54	59.03
95	55	35.680	28.115	.055	36896.08	54	54.11
100	55	36.848	28.115	.049	35100	54	45.86
0	60	27.371	30.592	.216	40950	54	235.87
5	60	21.459	30.592	.215	42714	54	244.89
10	60	15.671	30.592	.210	43848	54	245.54
15	60	10.115	30.592	.204	43324.61	54	235.68
20	60	4.873	30.592	.195	44415	54	230.95
25	60	.000	30.592	.184	43848	54	215.14
30	60	4.479	30.592	.173	44415	54	204.90
35	60	8.563	30.592	.161	43470	54	186.63
40	60	12.264	30.592	.148	43247.64	54	170.68
45	60	15.608	30.592	.136	43848	54	159.02
50	60	18.624	30.592	.124	43957.74	54	145.35
55	60	21.344	30.592	.113	42714	54	128.71
60	60	23.798	30.592	.103	42557.58	54	116.89
65	60	26.017	30.592	.093	41782.5	54	103.62
70	60	28.026	30.592	.084	40320	54	90.31
75	60	29.850	30.592	.076	39399.23	54	79.84
80	60	31.509	30.592	.069	38745	54	71.29
85	60	33.023	30.592	.063	37327.5	54	62.71
90	60	34.409	30.592	.057	36896.08	54	56.08
95	60	35.680	30.592	.051	36896.08	54	50.17
100	60	36.848	30.592	.047	35100	54	43.99
0	65	27.371	32.842	.184	37611	54	184.54
5	65	21.459	32.842	.183	39568.06	54	193.09
10	65	15.671	32.842	.180	38297.36	54	183.82
15	65	10.115	32.842	.175	33642	54	156.99
20	65	4.873	32.842	.168	30240	54	135.47
25	65	.000	32.842	.160	30240	54	129.02
30	65	4.479	32.842	.151	30240	54	121.76
35	65	8.563	32.842	.141	30240	54	113.70
40	65	12.264	32.842	.131	35473.84	54	123.92
45	65	15.608	32.842	.121	38297.36	54	123.57
50	65	18.624	32.842	.111	39399.23	54	116.62
55	65	21.344	32.842	.102	39568.06	54	107.62
60	65	23.798	32.842	.093	38745	54	96.08
65	65	26.017	32.842	.085	37611	54	85.25
70	65	28.026	32.842	.077	37044	54	76.06
75	65	29.850	32.842	.070	35518.96	54	66.30

80	65	31.509	32.842	.064	35100	54	59.90
85	65	33.023	32.842	.058	34020	54	52.61
90	65	34.409	32.842	.053	32856.92	54	46.43
95	65	35.680	32.842	.048	32202.69	54	41.21
100	65	36.848	32.842	.044	31600.8	54	37.07
0	70	27.371	34.889	.158	35910	54	151.30
5	70	21.459	34.889	.157	39568.06	54	165.65
10	70	15.671	34.889	.155	38297.36	54	158.29
15	70	10.115	34.889	.151	33642	54	135.46
20	70	4.873	34.889	.145	30240	54	116.92
25	70	.000	34.889	.139	30240	54	112.08
30	70	4.479	34.889	.132	30240	54	106.44
35	70	8.563	34.889	.124	30240	54	99.99
40	70	12.264	34.889	.116	35473.84	54	109.73
45	70	15.608	34.889	.108	38297.36	54	110.29
50	70	18.624	34.889	.100	39399.23	54	105.06
55	70	21.344	34.889	.092	39568.06	54	97.07
60	70	23.798	34.889	.084	38745	54	86.78
65	70	26.017	34.889	.077	37611	54	77.22
70	70	28.026	34.889	.071	37044	54	70.13
75	70	29.850	34.889	.065	35518.96	54	61.56
80	70	31.509	34.889	.059	35100	54	55.22
85	70	33.023	34.889	.054	34020	54	48.98
90	70	34.409	34.889	.049	32856.92	54	42.93
95	70	35.680	34.889	.045	32202.69	54	38.64
100	70	36.848	34.889	.041	30870	54	33.75

2)

- ATATURK STADIUM /LEFKOSA
- FLOODLIGHT TYPE : HNF 002
- FLOODLIGHT FOR COLOUR T.V, PLAYING FIELD
- MOUNTING HEIGHT :45.0 meter
- LAMP TYPE : HPI-T 2000 w METAL HALIDE LAMP
- LUMINOUS FLUX : 189,000 LUMEN
- CALCULATION OF HORIZONTAL ILLUMINANCE (LUX)
  AVERAGE ILLUMINANCE E_{Ave} : 155156/88 =1763.4
  MAXIMUM ILLUMINANCE E_{Max} : 2306.74
  MAXIMUM ILLUMINANCE E_{min} : 1135.82
  UNIFORMITY I : E_{min}/ E_{Ave} : 0.64
  UNIFORMITY 2 : E_{min} / E_{max} : 0.49

95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0	
1775	1779	1804	1867	1733	1559	1335	1215	1153	1185	1153	1215	1335	1559	1733	1867	1804	1797	1775	1697	0
2002	2043	2036	2001	1902	1758	1430	1383	1318	1310	1318	1383	1430	1758	1902	2001	2036	2043	2002	1843	5
2091	2165	2187	2219	2103	1879	1660	1512	1439	1445	1439	1512	1660	1879	2103	2219	2187	2165	2091	1884	10
2130	2252	2269	2271	2203	1956	1793	1606	1532	1513	1532	1606	1793	1956	2203	2271	2269	2252	2130	1848	15
2049	2185	2239	2306	2277	2014	1838	1637	1541	1532	1541	1637	1838	2014	2277	2306	2239	2185	2049	1804	20
1896	1957	2017	2114	2107	1874	1689	1532	1462	1444	1462	1532	1689	1874	2107	2114	2017	1957	1896	1707	25
1773	1850	1927	2020	1971	1825	1566	1489	1427	1415	1427	1489	1566	1825	1971	2020	1927	1850	1773	1642	30
1748	1835	1890	1984	1350	1801	1658	1448	1428	1395	1428	1448	1658	1801	1350	1984	1890	1835	1748	1637	35
1773	1850	1927	2020	1971	1825	1566	1489	1427	1415	1427	1489	1566	1825	1971	2020	1927	1850	1773	1642	40
1896	1957	2017	2114	2107	1874	1689	1532	1462	1444	1462	1532	1689	1874	2107	2114	2017	1957	1896	1707	45
2049	2185	2239	2306	2277	2014	1838	1637	1541	1542	1541	1637	1838	2014	2277	2306	2239	2185	2049	1804	50
2130	2252	2269	2271	2203	1952	1793	1606	1532	1513	1532	1606	1793	1956	2203	2271	2269	2252	2130	1848	55
2091	2165	2187	2219	2103	1879	1660	1512	1439	1445	1439	1512	1660	1879	2103	2219	2187	2165	2091	1884	60
2002	2043	2036	2001	1902	1758	1430	1383	1318	1310	1318	1383	1430	1758	1902	2001	2036	2043	2002	1843	65
																				70



E_{av} = 1115 lux
E (lux)
786
1008
930
1021
1008
1195
1200
1155
1404
1468
1537
1334
1223
1131.46
1232
1138
1078

TABLE 2

4) TABLE 3: CLASSIFICATION OF THE RECOMMENDED VERTICAL ILLUMINANCE IN SOME COUNTRIES

COUNTRY	RECOMMENDED VERTICAL ILLUMINANCE	PUBLICATION
CANADA	$\bar{E}_V$ = 1.250 Lux $E_{V_{min}}$ = 900 Lux	"Lighting for football stadiums for color television broadcastings", CTP 7, 1971, Canadian telecasting practices committe
CANADA	$\bar{E}_V$ = 1.250 Lux, facing the camera	"Report on lighting of Indoor Ice-hockey events for color television production" report no. 7:24:86 revision no. 4, iss. 4. Jan. 72
FRANCE	E_V = 1.000..... 1.400 Lux, facing the camera	"Recommandations relatives a l'eclairage des installations sportives" AFE, Edition 1974
GERMANY	$\bar{E}_V$ = 1.000 Lux for standard installations $\bar{E}_V$ = 1.500 Lux for very large stadia with shooting distance greater than 150 m or very fast games e.g. ice-hockey	Standard recommendation DIN 67 526, section 2 issued 1973
GREAT BRITAIN	minimum incident illuminance 800 Lux, for long focus close-up lenses $\bar{E}_V$ = 1.400 Lux	"Requirements for Television lighting at Stadia for colour Outside Broadcasts", issue III 27.8.71 BBC Television
NETHERLANDS	$\bar{E}_V$ = 1.500 Lux for aperture f:4 signal-to noise ratio 40 dB	"Recommendations for the lighting of football-grounds" Committee of the Netherlands Institution for Illumination Nov. 1971
NETHERLANDS	$\bar{E}_V$ = 1.000 Lux on planes facing the camera	"Recommendations for the lighting of sports-halls" Committee of the Netherlands Institution for Illumination Dez. 1971

Feeder Circuit

I. Explanation

a) The Way of Feeding

The electrical power for stadium illumination is going to be provided by normal link and from generator when it is cut off.

b) LINK

It is going to be fed by II kv. underground cable of city link, oil circuit breaker at power unit and step_down transformer. The power of step-down transformer is usually 500K.V.A . Voltages of step-down transformer, for link part is II k.v input and output is 4I5/240 v.

c) GENERATOR

A diesel generator with same power as step-down transformer (500 kva) is been thought, in order to feed the whole system urgently from generator. It is also thought that, the diesel generator must get switched on automatically while producing electrical power, in order to prevent loss of time.

d) LINK OUTPUT (Link o/p)

It will be connected to the generator board and feed the system. The busbars, according to the situation, will be fed with 650 amp magnetic and thermal protection breaker.

The above system will be fed with 300 amps. for I.and 3. masts, 300 amps. for 2.and 4. masts by underground cables through thermal and magnetic protection breaker$\{3x150+70\}mm^2$ cu and also by underground cables of which the output is $10x2.5\ mm^2$ cu from power and control unit with control board. The way of feeding for 2. and 4. masts is the same as I. and 3.

Power unit of masts will be fed by I50 amps. magnetic and thermal breakers and she will feed 3, I0 amps. conductors. Conductors will have thermal protection. The conductor output will feed the busbar system of which I8 floodlight in the I. group are connected.

Every projector will be fed by IOamps. fuse via her busbar group. From the R-S and T lines, 6 of each group which will make I8 projectors in total will be fed.

Conductors will be controlled through undergroud cables IOx 25 mm^2 cu from control board.

2) CALCULATION

The necessary fuse calculation of each projector

$$P = VI \cos \varphi$$

$$P = 2000 \text{ w}$$

$\cos\varphi$ for HNF 002 $\cos \varphi = 0.9$

$$P = VI \cos \varphi$$

$$2000 = (240)(I)(0.9)$$

$$\Rightarrow I = 9.25 \text{ Amps.}$$

According to this result, the best appropriate value is determined as 10 amps. by using Regulation.

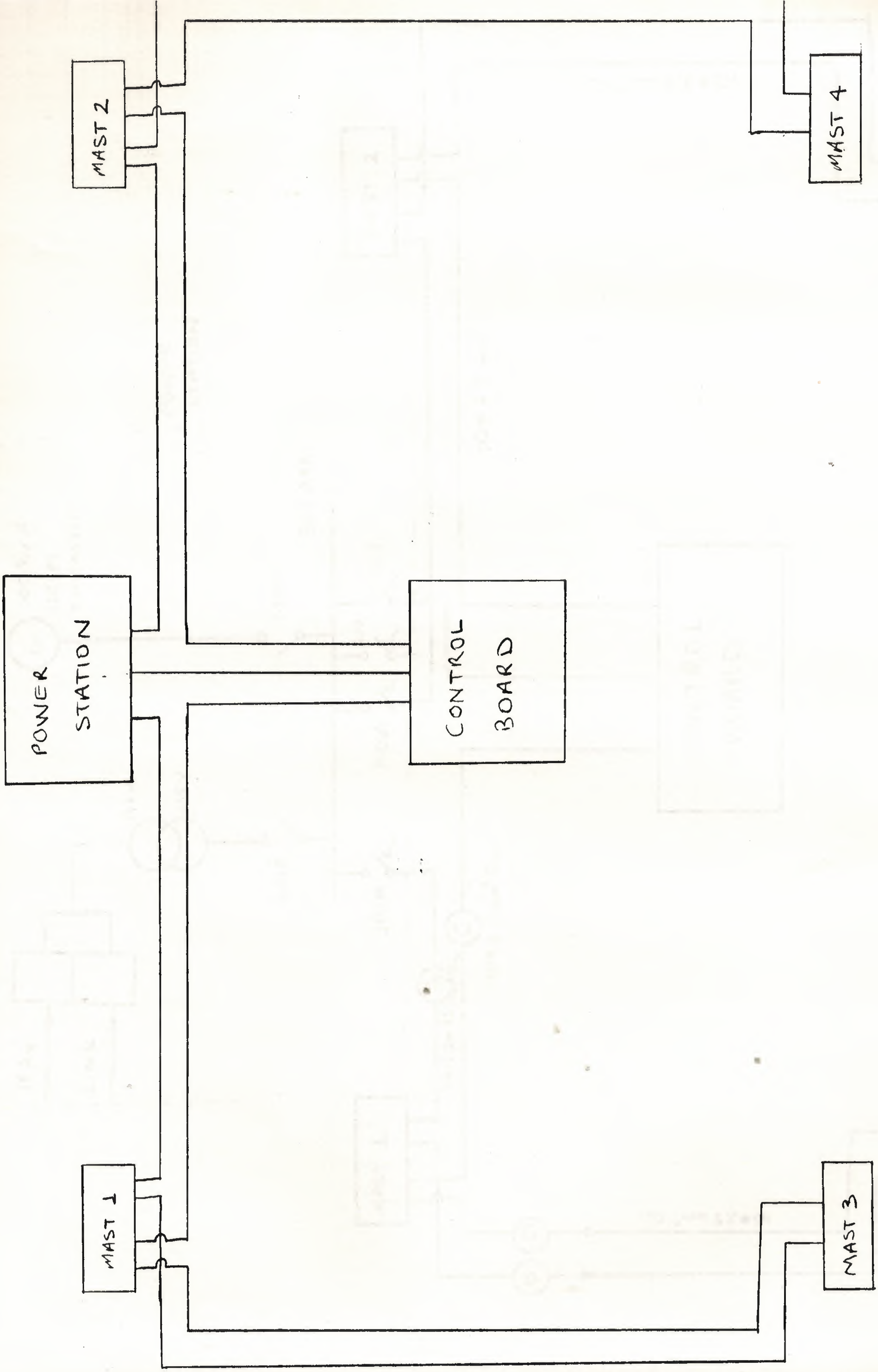
We use the below power formula in order to find the line current.

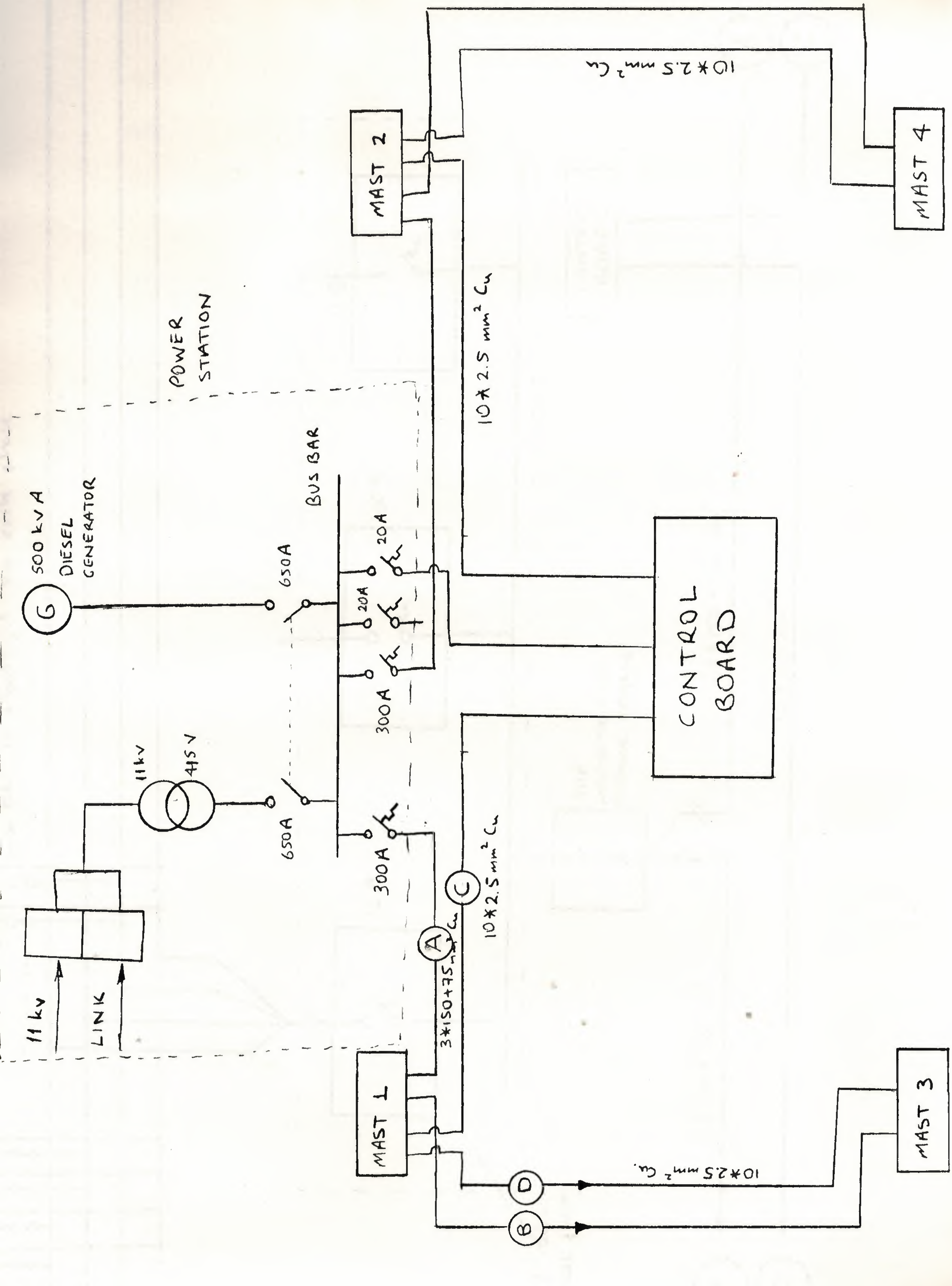
$$P = \sqrt{3}\, V_l\, I_l\, \cos\varphi$$

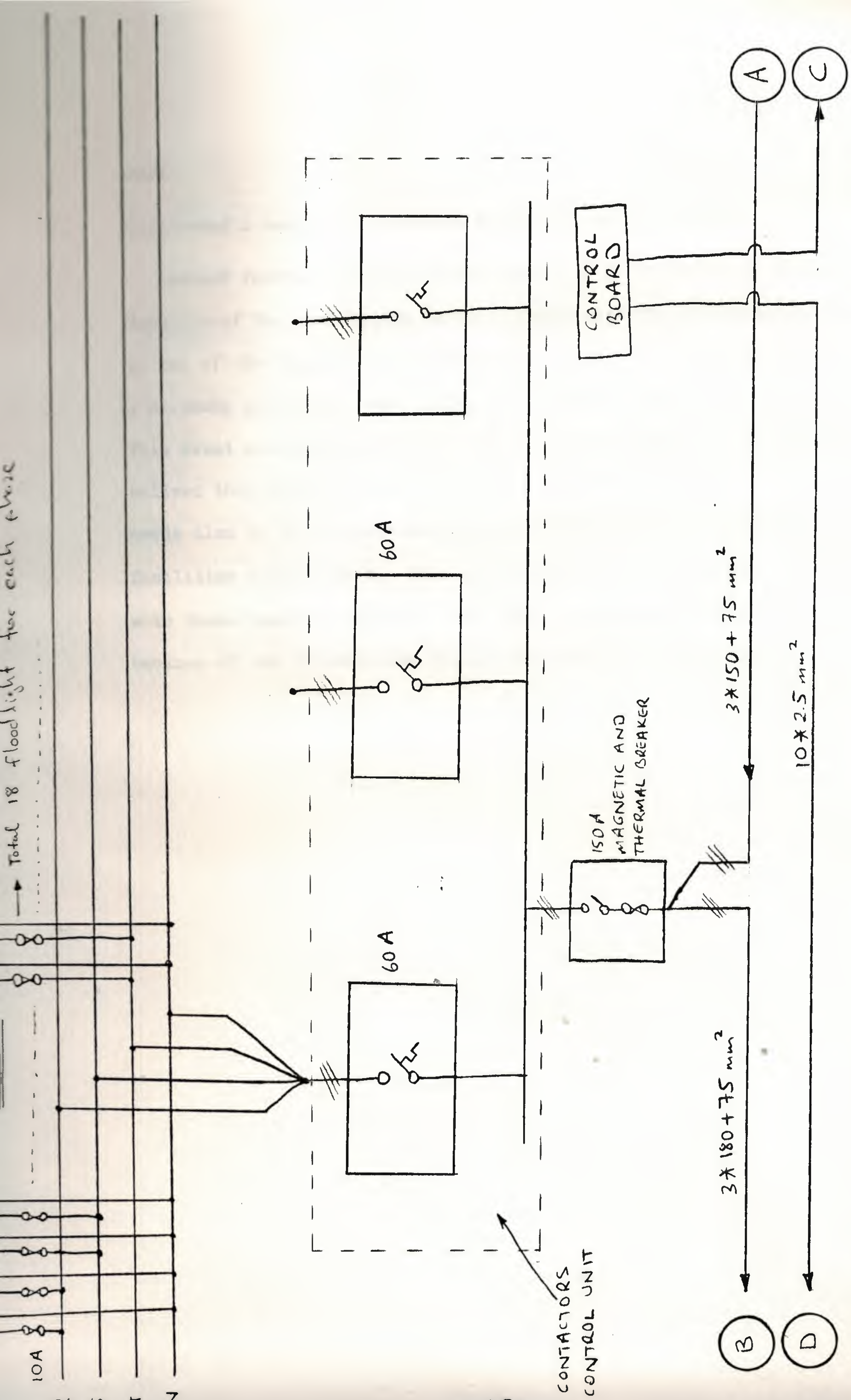
$$18 \times 2000 = \sqrt{3}\ 415\ I_L\ (0.9)$$

$$\Rightarrow I_l = 55.64 \text{ Amps.}$$

According to this result, the best possible value is determined as 60 Amps. by using the Regulation.


MAST 2
MAST 4
POWER STATION
CONTROL BOARD
MAST 1
MAST 3


POWER STATION
500 kVA DIESEL GENERATOR
G
BUS BAR
650A
650A
20A
20A
300A
300A
11kV
415V
11 kV
LINK
CONTROL BOARD
MAST 1
MAST 2
MAST 3
MAST 4
A
B
C
D
3*150+75 mm² Cu
10*2.5 mm² Cu
10*2.5 mm² Cu
10*2.5 mm² Cu
10*2.5 mm² Cu


Total 18 floodlight for each phase
10A
R
S
T
N
60 A
60 A
CONTROL BOARD
150 A MAGNETIC AND THERMAL BREAKER
3*150 + 75 mm²
3*180 + 75 mm²
10*2.5 mm²
CONTACTORS CONTROL UNIT
A
B
C
D

PART E

COST

1. Cost-Benefit Analysis of Ataturk Football Stadium Project

Ataturk football Stadium became the pearl of our country, Turkish Republic of Northern Cyprus having 30,000 capacity of spectators which is one of the biggest in the Middle East. This stadium was opened with a ceromony which two teams (F.B and Sariyer) had played in 1989. This event was attracted from a lot of Turkish Cypriots and they all belived that this Stadium was really a need of our country. Ataturk Stadium needs also to be illuminated for night affairs when different types of facilities will be held. This , of course brings high cost when compared with these benefits above as there will be increase in the cost of the project because of the illumination facilities needed for the project.

2. Cost of The Equipments and Installation Used in the Illumination of the Project.

	Price (T.L)
a) Cost of one step up-down transformar	80,000,000
b) Cost of four masts	20,000,000
c) Cost of 216 floodlights	216,000,000
d) Cost of 800 meter cable	15,000,000
e) Cost of one dizel generator (500 KVA)	70,000,000
f) Cost of contactor, fuse and other materials	60,000,000
Total 1:	461,000,000
g) Cost of drawing (20 % total 1)	92,200,000
h) Cost of installation (80 % of Total 1)	368,800,000
Total Cost:	922,000,000 TL.
Total Cost:	347,924 $

APPENDIX

I. THE PLAN OF THE STADIUM

2. THE PLAN OF FEEDER CIRCUIT

3. ISO-CANDELA CURVE OF HNF 002 FLOODLIGHTS

(*) HNF 002

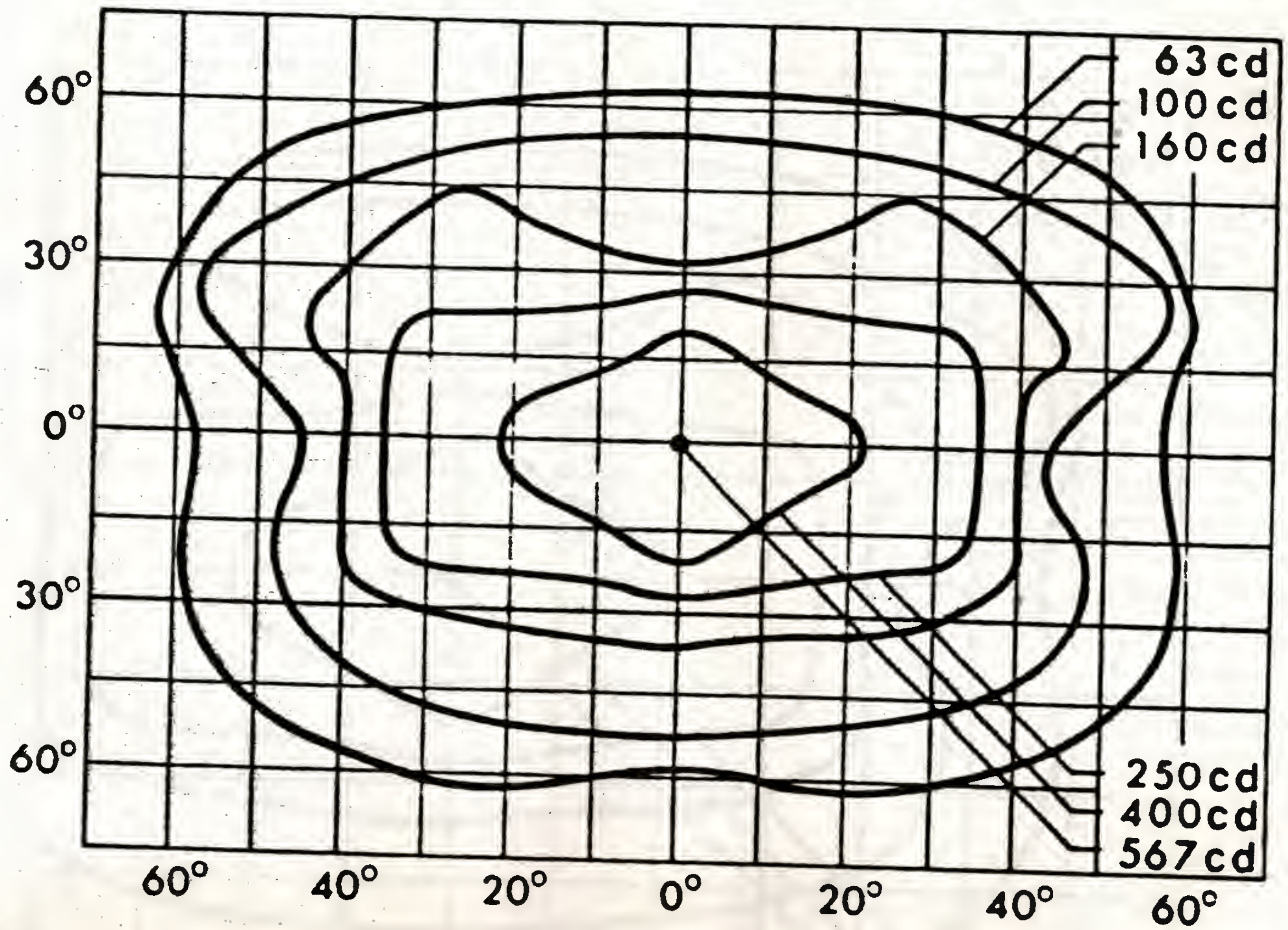
(*) WIDE BEAM

(*) LUMINOUS FLUX

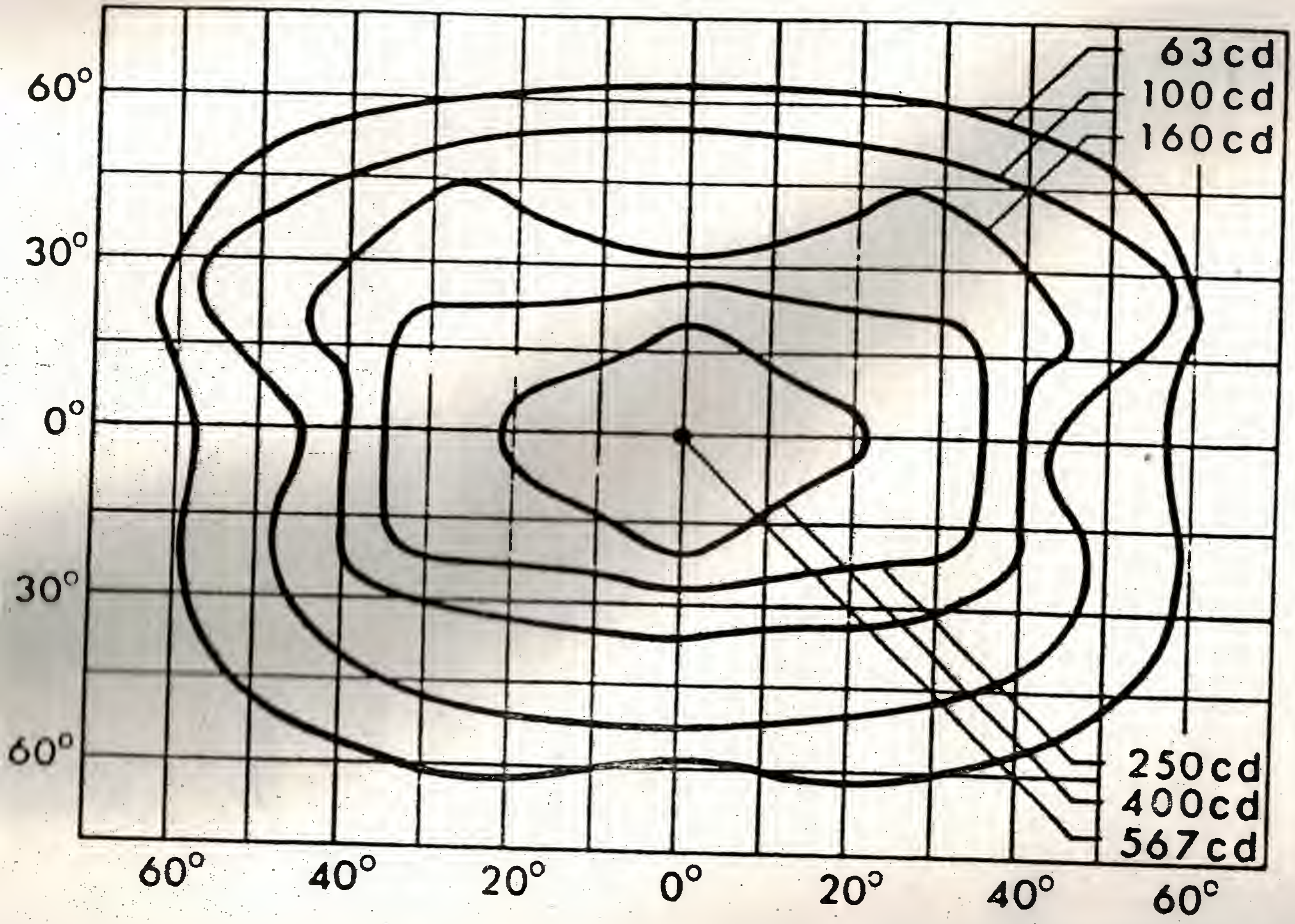
189,000 lumen

(*) TYPE :

HPI-T 2000 W



(*)



⊛ HNF 002

⊛ WIDE BEAM

⊛ LUMINOUS FLUX
189,000 lumen

⊛ TYPE : HPI-T
2000 W

REFERENCES

I. DOCUMENTS and CATALOGUES - PHILIPS

2. AYDINLATMA TEKNİĞİ - Prof. MUZAFFER ÖZKAYA

3. DOCUMENTS and CATALOGUES - SIEMENS

4. LAMPS and LIGHTING - EDWARD ARNOLD