BRITISH STANDARD

BS 5489 :
Part 5 : 1992

Road lighting

Part 5. Code of practice for lighting for grade-separated junctions

Eclairage routier
Partie 5. Code de bonne pratique pour l'éclairage des embranchements dénivelés

Straßenbeleuchtung
Teil 5. Leitfaden zur Beleuchtung von Straßenkreuzungsbauwerken

BSI
STANDARDS

Committees responsible for this British Standard

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British Precast Concrete Federation Ltd.
Chartered Institution of Building Services Engineers
Council for the Protection of Rural England
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Institution of Electrical Engineers
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Contents

Foreword

This Part of BS 5489 has been prepared under the direction of the Electrical Illumination Standards Policy Committee and is a new edition of BS 5489 : Part 5 : 1989 which is withdrawn.

The 1989 edition reviewed the special problems of lighting grade-separated junctions and enhancements were made to the process of selecting the most appropriate type of installation. Recommendations related to the use of lighting by systems given in BS 5489 : Parts 2 and 3 and to high-mast techniques and reflected the need to provide good levels of illumination.

This edition incorporates editorial improvements but it does not reflect a full review or revision of the standard, which will be undertaken in due course.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Code of practice

1 Scope

This Part of BS 5489 gives recommendations for the lighting of grade-separated junctions and provides guidance on the factors which may influence a choice between, or a combination of, lighting systems in accordance with BS 5489 : Part 2, or high-mast lighting. Guidance on the lighting of roundabouts, bridges, elevated roads, underpasses and subsidiary roads which may be associated with grade-separated junctions is given in BS 5489 : Parts 3, 4, 6, 7 and 10.

NOTE. The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this Part of BS 5489, the definitions given in BS 5489 : Part 1, BS 6100 : Subsection 2.4.1 and BS 5225 : Part 1 apply, together with the following.

2.1 grade-separated junction

A road junction at which at least one road passes over another.

2.2 high-mast lighting

A system of lighting for large areas in which masts giving a mounting height of 18 m, or more, carry clusters of high-output luminaires.

3 Need for lighting

There are three main characteristics of grade-separated junctions where the provision of lighting should be considered:

(a) where some or all of the approach roads concerned are lit;

(b) where the junction design involves abrupt changes of horizontal or vertical curvature;

(c) where the junction is so complicated that lighting is essential for safety and night-time visibility.

4 General principles

4.1 Extent of lighting

Consideration should be given to the number of roads present and their relative dispositions. This may indicate the need for either lighting of individual roads or an integrated lighting system covering large areas.

4.2 Recommended values

Recommendations on values of luminance and uniformity ratios and limits of threshold increment (TI) are given in BS 5489 : Parts 2, 4, 6 and 7.

4.3 Deviations from luminance-based assessment

A luminance-based design should be applied as in BS 5489 : Part 2, where it can be calculated. Assessment of this design should be based on a limited number of prescribed observer positions. Other areas, such as sharp bends, junctions and changes in gradient, should be designed on an illuminance basis. Values of average illuminance in these other areas should be not less than those calculated or measured on the adjacent roads. The ratio of minimum illuminance to average illuminance should be not less than 0.5 for main carriageways and not less than 0.4 for slip roads, over any 60 m length of road.

4.4 Route merge points

At some grade-separated junctions, the roads associated with the junction may be widely spread. Lighting should be provided to cover all points where these roads merge with each other so that drivers are able to determine their intended route as clearly as possible. The luminance or illuminance of these merge areas should be not less than those values of lighting for the approach roads.

4.5 Route guidance

Whilst lighting can show the various routes available, it does not usually provide the information necessary to assist in the choice of route. Such information should normally be furnished by traffic signs. The road lighting and signing requirements should be considered jointly so that a coordinated layout is achieved without impairing daytime sight lines.

5 Aesthetic considerations

The important points to be considered in the design of lighting for grade-separated junctions are:

(a) the daytime appearance of road lighting schemes as described in BS 5489 : Part 1;

(b) that the column, bracket projections, luminaire, and, for high-mast lighting, the mast, headframe and luminaire assembly, should be of good integrated design;

(c) that the scheme as a whole should be compatible with its setting by day and night. At the approaches to a junction, it is desirable to avoid the appearance of a confusing array of columns or luminaires. Also, it is desirable in the design of complex layouts that involve both horizontal and vertical curves and changes of radius, to avoid using equipment with complex outlines. Where bracket projections are used, simple straight designs with a uniform uplift are to be preferred to avoid the tangled-web effect of curved bracket projections of varying projections and alignment.

6 Lighting by systems designed in accordance with the recommendations in BS 5489 : Parts 2, 3 and 4

6.1 General

Where a site involves a single grade-separated junction (e.g. of two-level, four-ways with a roundabout layout above or below the major road), and particularly in rural areas, it is normally preferable to light the junction using the methods defined in Parts 2, 3 and 4 of this standard. Figure 1 illustrates a typical full lighting system designed to the requirements of Parts 2 and 4 of this standard. If only the minor road is to have lighting, a partial lighting system may have to be designed to avoid throwing light onto the carriageway of the major road (see figure 2).

6.2 Design characteristics

6.2.1 *General*

The factors governing the application of road lighting to grade-separated junctions are in general those applicable to the use of methods in other road situations as set out in Parts 2, 3 and 4 of this standard. Design of layouts should, however, avoid a confusion of light sources at the different levels and angles of approach.

6.2.2 *Light distribution*

The degree of glare is affected by the nature of the background, variations in gradient and the number, positions and orientation of luminaires in the field of view. Because of the above factors, low threshold increment (LTI) distributions may be appropriate.

6.2.3 *Design considerations*

Priority should be given to the needs of any major road within the junction. In many cases, this will be a dual carriageway road and can most easily be defined throughout by lighting from columns mounted in the central reserve. If centrally mounted safety fences are being provided as safety measures, these, as a secondary function, can give protection to the columns. If safety fences are not being provided, the need for local protection and suitable siting of the columns should be considered (see also **7.2.5**).

6.2.4 *Slip roads*

Slip roads usually join the main carriageway by tapering acceleration or deceleration lanes. Where the main carriageway is lit, single-sided lighting, which can usually be of a lesser mounting height and with lower output luminaires, should commence from a point on a taper along the length of each slip road to give delineation of the slip roads and to reinforce the lighting in the areas where the road widens.

6.2.5 *Glare*

For junctions where a roundabout or other road layout is above or below the major road, care should be exercised to avoid undue glare from light sources on the lower carriageway which might affect the users of the upper road. Correct siting of columns and the use of columns of reduced height in the immediate vicinity of the upper road coupled with luminaires of LTI classification afford a means of controlling the problem. Further guidance on the lighting of roundabouts is given in Part 4 of this standard.

6.2.6 *Engineering considerations*

6.2.6.1 *Site works*

Consideration should be given to the lighting at an early stage in the design of the junction so that fixings for columns and cable ducting may be allowed for and incorporated in the structures. It is equally important that longitudinal and transverse ducting and draw-in chambers are provided for any future lighting.

6.2.6.2 *Structural constraints*

Much of the lighting in complex grade-separated junctions may be on viaducts and bridges and guidance on structural considerations and daytime appearance, etc. is contained in BS 5489 : Part 6. It may be difficult to relate lighting columns to structural elements, such as supports, and the initial spacings arrived at by lighting design calculations may have to be modified to suit constructional features, e.g. the spacing and width of transverse beam sections of the structure.

6.2.7 *Light sources*

The choice of light source is governed by functional, economic and aesthetic considerations. For some complex junctions, there may be advantages in lighting the section of local road within the junction with the same type of light source as that used on its contiguous sections to assist in its demarcation. For example, a local road system crossing an urban motorway and the contiguous sections of the local roads may be lighted by a different type of light source from that of the motorway.

7 Lighting by high-mast techniques

7.1 General

The principal use of high-mast lighting is to light a number of roads rather than a single road. Where junctions involve a complex system of roads at different levels, high-mast lighting can provide good uniformity and improve the scene by reducing the amount of street furniture with a consequential improvement in daylight appearance. The mast can support fixed geometry or variable geometry luminaires or floodlights and usually incorporates a means of lowering the luminaires to ground level for maintenance. Figure 3 illustrates lighting by high-mast techniques.

7.2 Design characteristics

7.2.1 *General*

It should be noted that:

(a) less use is made of preferential reflection from the surfaces of the road and the levels of road surface luminance may be lower than those achieved by other types of installation giving the same levels of illuminance;

NOTE. This should be considered when designing in accordance with BS 5489 : Part 2.

(b) it is desirable to site masts in accordance with Parts 2 and 4 of this standard to ensure, so far as is possible, that the luminaire to light each section of road is beyond that section of road as seen by the observer for whom the lighting is intended.

7.2.2 *Light distribution*

Individual luminaires may provide a symmetric or an asymmetric light distribution. They may be so grouped as to produce an overall light distribution tailored to match the area to be lit from each mast. Figure 4 illustrates typical high-mast light distributions and figure 5 shows how individual luminaires may be combined to produce complex light distribution patterns. They should provide a distribution with negligible light at the horizontal and at angles just below the horizontal. Present experience suggests that the beam elevation should lie in the region of 65° from the downward vertical but higher angles may prove to be acceptable.

7.2.3 *Design considerations*

Some of the aspects that should be taken into account are as follows.

(a) Since the area illuminated by a single high mast may be large, each mast should preferably carry more than one lamp or luminaire and the overall light distribution of the luminaires should be so arranged that no large section of any carriageway would be left in darkness in the event of failure of a single lamp. This permits variations in the number of luminaires or lamps used on each mast to meet the design requirements of the scheme.

(b) Inevitably there will be light on adjacent areas. This may well help to define the visual scene by lighting the surround of the road system or it may provide lighting which would otherwise require separate consideration.

(c) The height of the mast should be influenced by the size and shape of the area to be lit and by the difference in road levels of the project. The minimum effective mounting height, i.e. actual height of luminaires above the carriageway which they are intended to light, should preferably be not less than 18 m. The effective mounting height has to be used in any calculations.

(d) In grade-separated junctions, shadows will occur where one road passes over another. The size and density of the shadow will depend upon the siting of the masts. It should be possible, at the planning stage, to decide whether such a shadow will present a traffic hazard. If this occurs, some form of supplementary lighting at a lower level should be provided. Some shadows may be acceptable.

NOTE. See BS 5489 : Part 7.

7.2.4 *Light sources*

The choice of light sources is governed by functional, economic and aesthetic considerations, but because high-mast lighting illuminates the whole visual scene including the background and surrounding of the road itself, a source giving good colour appearance and good colour rendition will have advantages in defining the scene.

7.2.5 *Engineering considerations*

The planned position of the mast and mast foundations will depend upon both the ground and overhead conditions and the layout of the complete scheme. Neither the mast nor its headframe in the lowered position should present a traffic hazard. The area around the base of the mast and where the luminaires are serviced, should be a level hardstanding such that the operator has full facilities to carry out maintenance in safety. On sites where a mast has to be placed in what may be considered a vulnerable position, i.e. where it could be struck by a vehicle leaving the carriageway, a protective safety fence should be provided.

7.2.6 *Lightning protection*

The need for lightning protection should be evaluated in accordance with BS 6651.

Where a structure is a continuous metal frame, it requires no air termination or down conductor. It is sufficient to ensure that the conducting path is electrically and mechnically continuous and that the recommendations of BS 6651 in respect of the connection to the general mass of the earth are met.

The resistance to earth of the earth termination network and of each earth electrode should be tested in accordance with CP 1013.

8 Maintenance

In addition to the guidance given in BS 5489 : Parts 1 and 2, high-mast installations require further maintenance because of the mechanical equipment involved. Luminaires should be given regular attention to maintain a performance compatible with that recommended for use with contiguous systems.

It is recommended that high-mast installations should be inspected and maintained regularly in accordance with use, legislation and manufacturers' recommendations and depending upon local conditions such as air pollution. During these inspections, particular attention should be given to winches, compensating pulleys, wire ropes, bolts, baseplates, hinged arrangements and associated hydraulic equipment and, where fitted, electrical contact units.

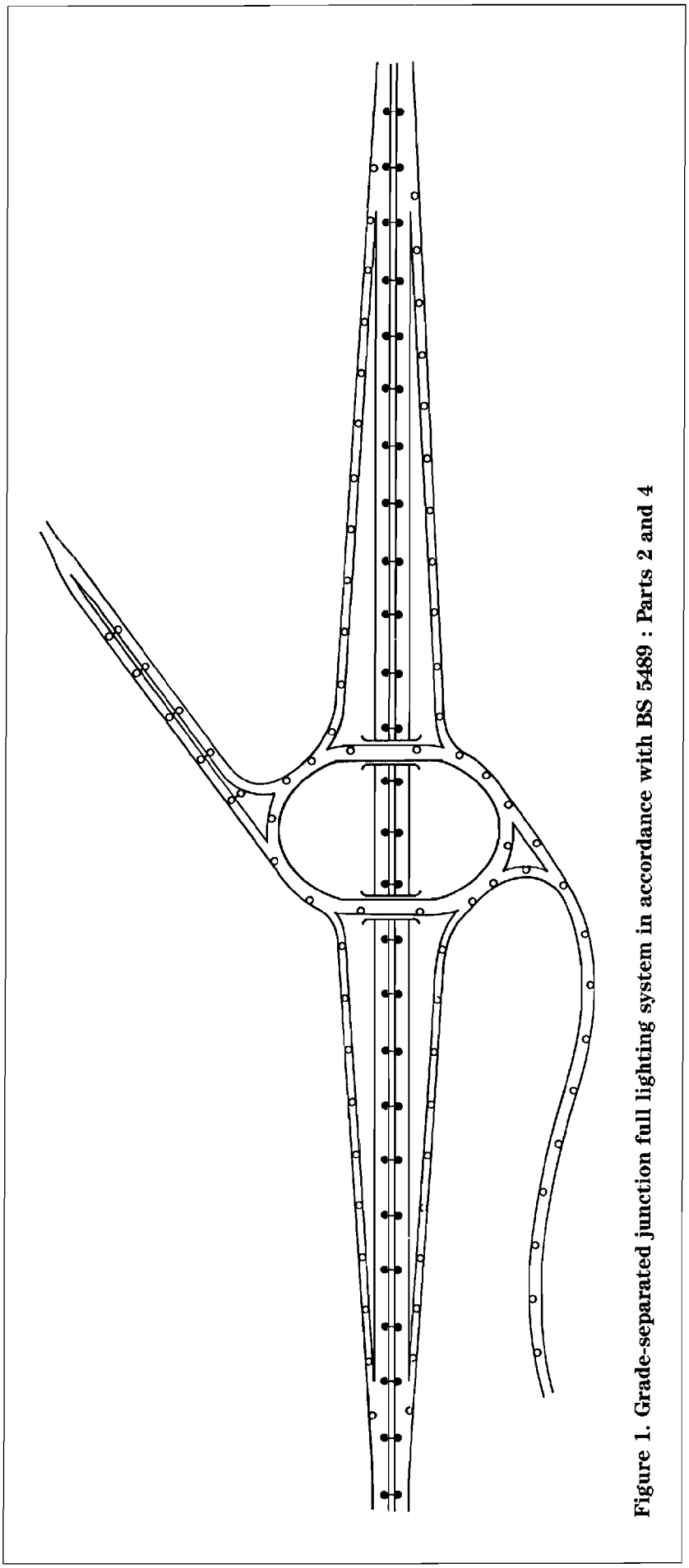


Figure 1. Grade-separated junction full lighting system in accordance with BS 5489 : Parts 2 and 4

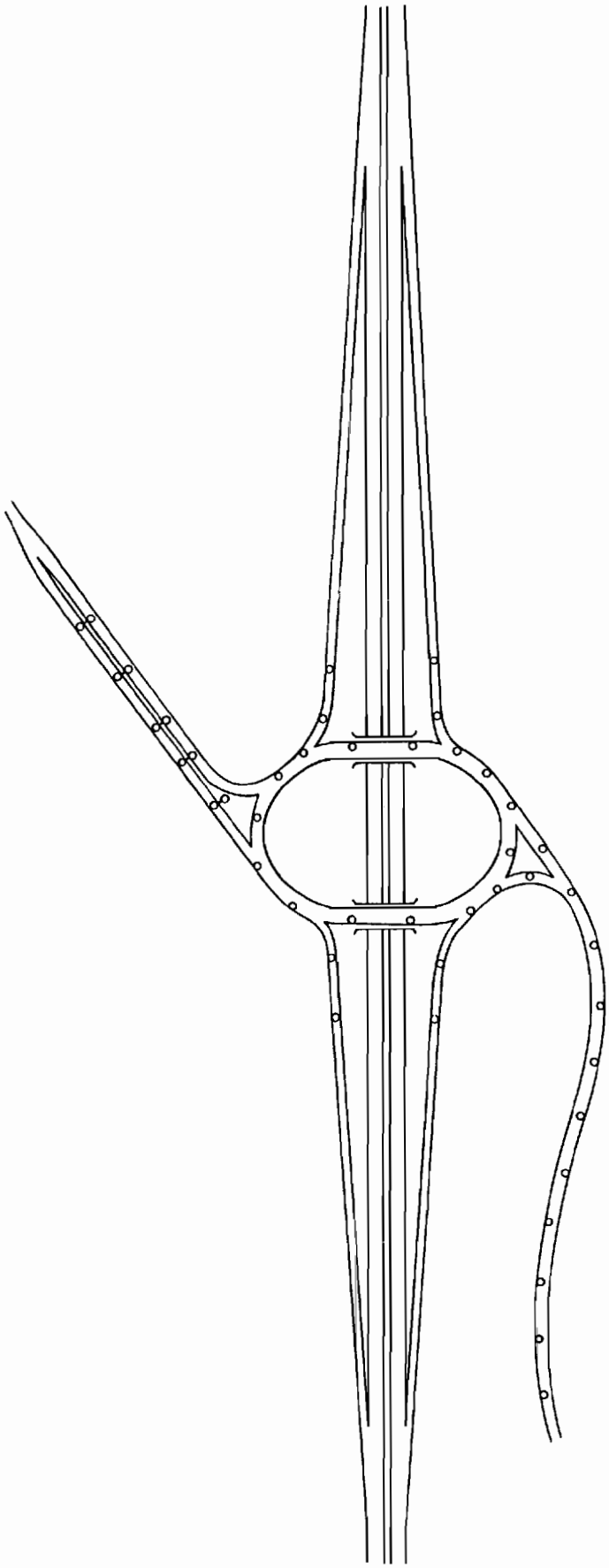
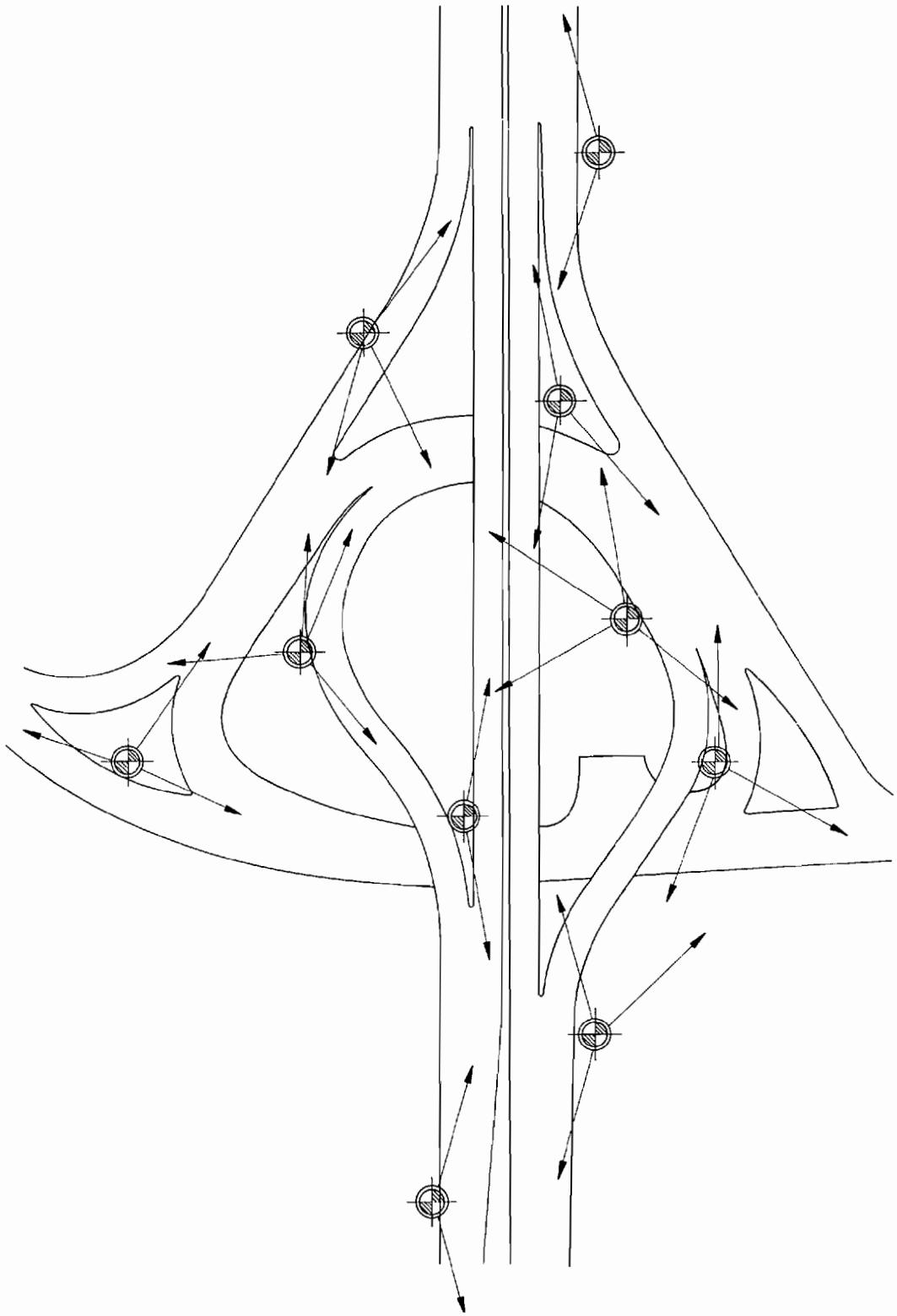


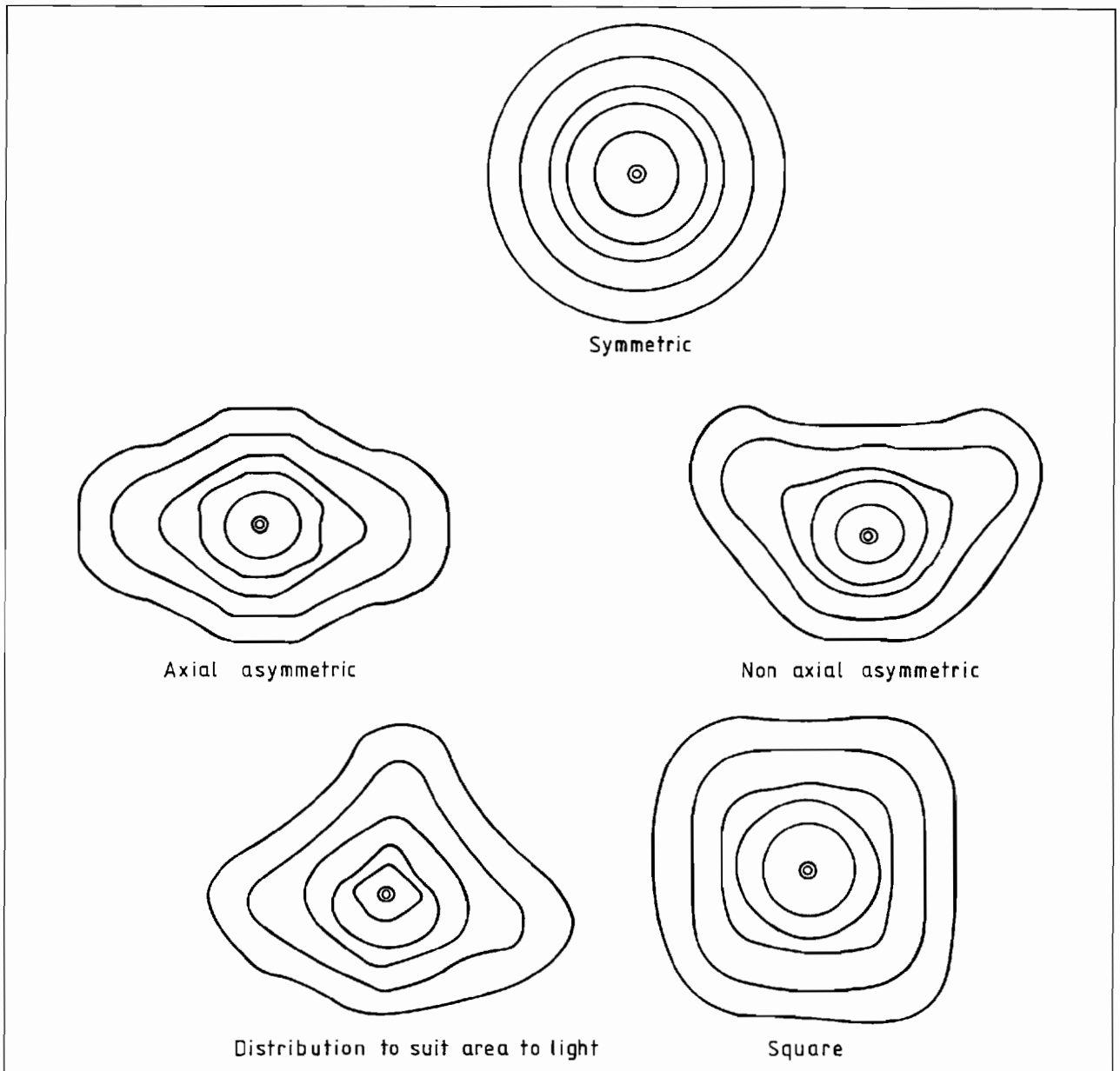
Figure 2. Grade-separated junction partial lighting system in accordance with BS 5489 : Parts 2 and 4



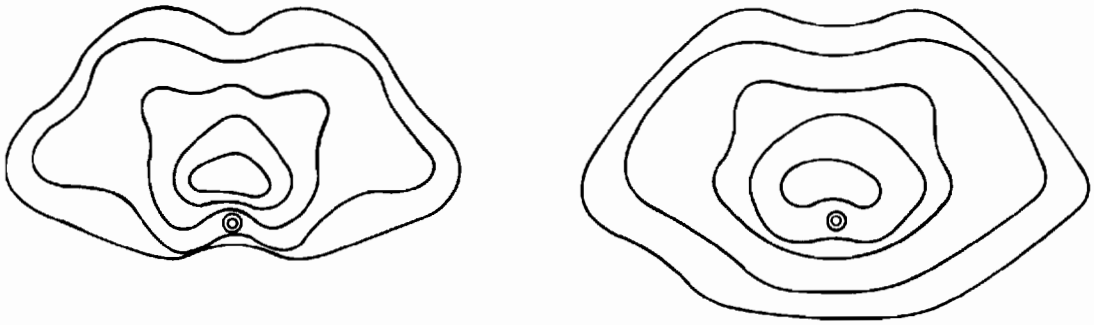
NOTE 1. The roads are shown diagrammatically, not to scale.

NOTE 2. Arrows indicate the direction of the main beams from the array of luminaires on each mast. The number of arrows does not correspond with the number of individual luminaires.

Figure 3. Typical high-mast lighting techniques for a grade-separated junction



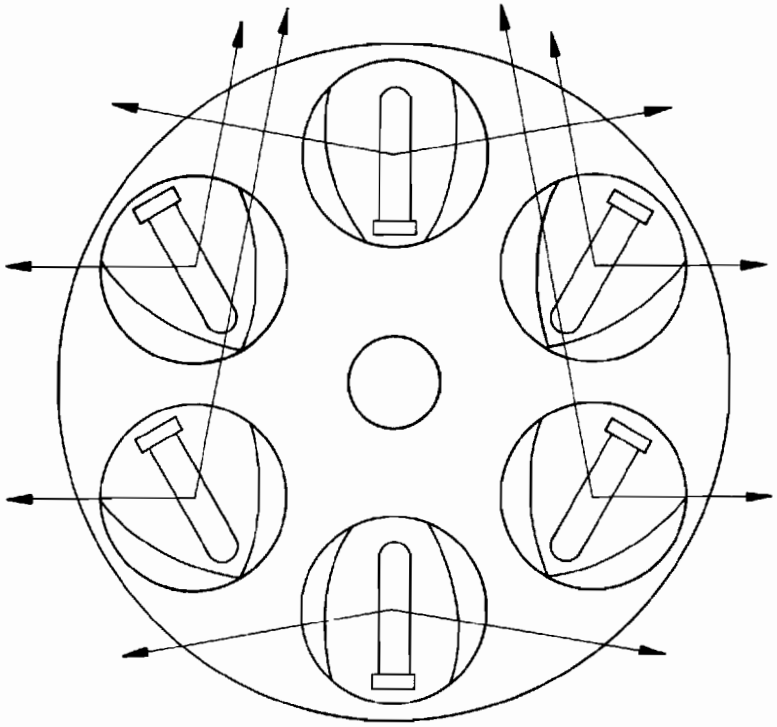
(a) Variable geometry luminaire arrangements



(b) Floodlight distribution

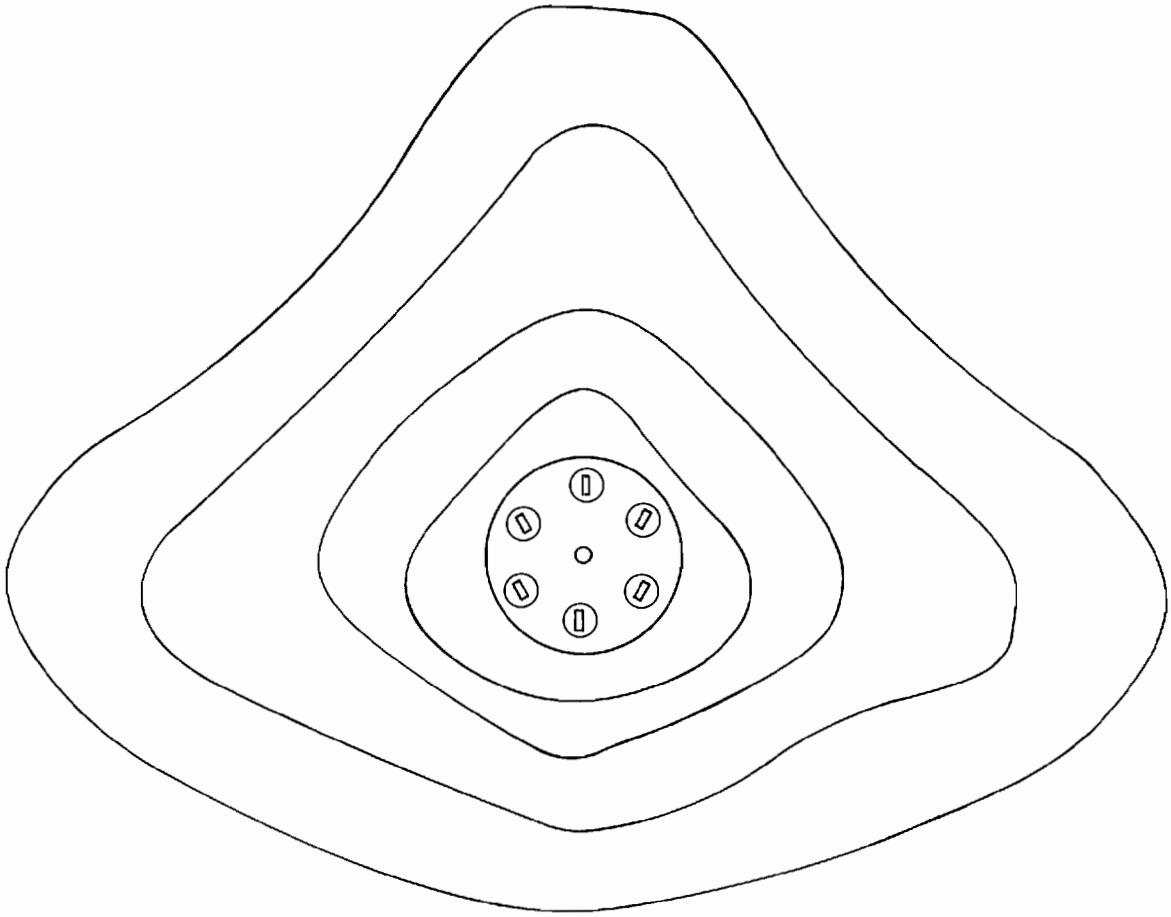
(c) Mixture of variable geometry luminaires and floodlights

Figure 4. High-mast light distribution showing isolux contours



(a) Headframe installation of luminaires

Figure 5. Isolux contours from a combination of luminaires to produce a high-mast light distribution



(b) Isolux contours at ground level

Figure 5. Isolux contours from a combination of luminaires to produce a high-mast light distribution (*concluded*)

Publication(s) referred to

BS 5225	Photometric data for luminaires Part 1 Photometric measurements
BS 5489	Road lighting Part 1 Guide to the general principles Part 2 Code of practice for lighting for traffic routes Part 3 Code of practice for lighting for subsidiary roads and associated pedestrian areas Part 4 Code of practice for lighting for single-level road junctions including roundabouts Part 6 Code of practice for lighting for bridges and elevated roads Part 7 Code of practice for lighting of tunnels and underpasses Part 10 Code of practice for lighting for motorways
BS 6100	Glossary of building and civil engineering terms Subsection 2.4.1 Highway engineering
BS 6651	Code of practice for protection of structures against lightning
CP 1013	Earthing

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