Road lighting

Part 6. Code of practice for lighting for bridges and elevated roads

BSI STANDARDS

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Electrical Illumination Standards Policy Committee (LGL/-) to Technical Committee LGL/23, upon which the following bodies were represented:

Automobile Association
British Lighting Association for the Preparation of Standards (Britlaps)
British Precast Concrete Federation Ltd.
Chartered Institution of Building Services Engineers
Council for the Protection of Rural England
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Institution of Civil Engineering Surveyors
Institution of Civil Engineers
Institution of Electrical Engineers
Institution of Lighting Engineers
Institution of Mechanical Engineers
Lighting Industry Federation Ltd.
Royal Fine Art Commission
Scottish Office (Building Directorate)

This British Standard, having been prepared under the direction of the Electrical Illumination Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on
15 August 1992

First published December 1967
Second edition May 1990
Third edition August 1992

The following BSI references relate to the work on this standard:
Committee reference LGL/23
Draft announced in *BSI News* March 1992

ISBN 0 580 20925 3

Amendments issued since publication

Amd. No.	Date	Text affected

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of the Electrical Illumination Standards Policy Committee and is a new edition of BS 5489 : Part 6 : 1990 which is withdrawn.

The 1990 edition drew attention to problems in and considerations that should be given to, the design of lighting installations for bridges and elevated roads. The recommendations made in other Parts of BS 5489 should apply, as appropriate, to bridges and elevated roads but deviations may be necessary to meet special conditions imposed by structural design or traffic. It is essential that individual cases are considered on their merits and for this reason it is not possible in this code to suggest optimum solutions or to make detailed recommendations.

The 1990 edition did accommodate modern aesthetic values and technical capabilities.

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 technical and aesthetic considerations of designing lighting installations for road bridges, footbridges and elevated roads.

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 6100 : Subsection 2.4.1, BS 5225 : Part 1 and BS 5489 : Part 1 apply, together with the following.

2.1 elevated road

A road which is:

(a) supported on a structure usually having a series of piers for spanning other roads, structures or valleys; or

(b) built on an embankment.

2.2 footbridge

A bridge over an obstacle to pedestrians provided for the passage of pedestrians only.

2.3 lower viewpoint

Any location off the bridge or elevated road from where a side view of the bridge can be seen in full or oblique elevation.

2.4 road bridge

A structure carrying the road under consideration over another road, railway, river, etc.

2.5 upper viewpoint

Any location on the bridge or elevated road where a view along the structure can be seen.

3 General lighting

3.1 Lighting considerations

The recommendations given in BS 5489 : Parts 1, 2, 3, 5, 8 and 9 should be applied. However, where there is a lack of useful background, presence of a disabling glare, or other visual confusion, the effectiveness of silhouette vision is likely to be reduced and greater dependence on direct vision may be necessary. This can be achieved by increasing the lighting levels and modifying the mounting height and/or spacing arrangement. To reduce the effect of glare, it is likely that lighting systems with threshold increment (TI) values not exceeding 15 % will be needed.

There is a risk to traffic both on and off the structure as a result of possible collision with columns. It is essential that due consideration is given to the siting of columns, their method of fixing and their protection with safety fences or parapets.

Whilst considerations of safety and maintenance should have priority, the lighting equipment may be conspicuous and, therefore, special attention should be given to civil engineering restrictions and aesthetic considerations by day and by night, both from the viewpoints of the bridge/road itself and from the surrounding neighbourhood. It may be necessary to consider alternative systems of lighting such as high-mast lighting, floodlighting, catenary lighting, unidirectional lighting or low-level lighting.

3.2 Maintenance considerations

Large traffic flows may restrict access for the maintenance of lighting equipment. Maintenance access may only be possible in light traffic conditions for reasons of safety and to minimize disruption to traffic.

Consideration should be given to minimizing maintenance costs by selection of more reliable components and by a safe and economical arrangement of installation design for maintenance.

4 Lighting for bridges

4.1 General

Bridges present aesthetic and lighting problems which differ from those met elsewhere. However, the lighting recommendations defined in BS 5489 : Parts 1, 2, 3, and 8 should be applied. It may be desirable to provide a higher level of lighting in those cases where the consequences of an accident may be more serious.

NOTE. If a model of a proposed bridge is available this may be used, perhaps with a suitable periscope, to gain an impression of a lighting installation from all viewpoints.

4.2 Technical problems

4.2.1 *Bridge characteristics*

The design of lighting for a bridge may be influenced by the character and structure of the bridge and the surrounding environment.

Where bridges carry the road system without significant change of gradient or direction it is likely that the lighting system on the bridge approaches can be continued across the bridge.

However, bridges lacking in significant surrounding landscape features or background, or those arched to create central crests, may create conditions of glare with reduced luminous foreground or confusing forward scene, each of which reduce the forward view of the driver.

Drivers approaching the crest of a bridge may experience glare from lights on and beyond the crest and have a reducing length of visible lit road before them. Beyond the crest, their forward view may be confused by the presence of road, vehicle and building lights occurring in the near and/or distant fields of view.

4.2.2 *Bridges spanning railways and navigable waters*

Further technical problems may arise from features spanned by, or in the vicinity of, the bridge. Railways and navigable waterways, for example, may impose restrictions on the distribution and colour of light. BS 5489 : Part 8 emphasizes the need for consultation with the appropriate authorities at the design stage. Luminaires for bridges may have special requirements not called for in normal lighting and not necessarily covered by the requirements of BS 4533 and they may have to be designed to suit the individual bridge.

4.3 Structural considerations

Difficulties are sometimes encountered in obtaining fixings for columns on existing bridges and the desired positions may be partially or completely obstructed by services or features, or the structure may not be strong enough. However, the mechanical loads imposed on the bridge by road lighting equipment are usually small, even when heavy wind loadings have to be taken into consideration.

The strength and natural frequency of the assembly of column, bracket and luminaires should be checked to make sure that detrimental oscillations will not occur.

On new bridges, the positions for lighting columns and the location of power supply cables should be decided at a sufficiently early stage in the design to ensure the provision of suitable space, fixings and protection for them. Structural and other considerations often lead to the siting of columns at the back of the footway, on or outside the parapet.

NOTE. Consideration should also be given for the provision of any necessary air and/or water navigation lights.

4.4 Visual appearance of bridge lighting installations

4.4.1 *Viewpoints*

Advice on the daytime and night-time appearance of roadlighting installations is given in BS 5489 : Part 1. Some special problems, however, arise where bridges are concerned. These vary so much in individual cases that only broad guidelines can be suggested.

In most cases there are two viewpoints to be considered and these are the upper and lower viewpoints.

4.4.2 *Upper viewpoint*

Columns and luminaires on bridges will often be silhouetted against the sky and so be more conspicuous than those at the approaches; consequently equipment acceptable for the approaches may not be suitable for the bridge. This is particularly so where the bridge has a strong character of its own or forms the gateway to a town.

Where the bridge has major structural elements above deck level, the lighting equipment should be carefully related to those elements. The columns and luminaires should either be combined with the structure or be so placed as not to conflict unduly with the structural forms. A column seen against a structure is often less obtrusive than one seen against the sky. In its detailed design the equipment should be sympathetic to the structure. An exception is the very large bridge where lighting columns will be no more than minor intrusions in a scene dominated by the structure.

Where the main structure of the bridge is wholly below deck level, the bridge parapet will be the main consideration. The detailed lighting design should be sympathetic to that of the parapet and, where there are important structural elements in the parapet, their spacing should be taken into account when siting the columns. On some bridges, however, particularly older ones, there may be a heavy masonry parapet, perhaps originally designed to carry lighting equipment. Where the bridge is not too wide and the spacing as determined in accordance with BS 5489 : Parts 2 and 3 is feasible, it may be best to site the new equipment on the parapet, but here it is important that the mounting height should be in proportion to the dimensions of the bridge. If this arrangement is impracticable it may be best to keep the columns well clear of the parapet and it may be visually preferable to site the columns on a central reserve.

Where a combination of side and centrally mounted luminaires is necessary it is better to achieve overall consistency in the design of the equipment, coordinating it with the structure and parapets if possible, rather than closely relating the side mounted equipment to the structure and having different equipment on the central reserve.

4.4.3 *Lower viewpoint*

The lower viewpoint is the more important in most cases and often more difficult to consider. The installation will be seen in relation to both substructure and superstructure above parapet level and the height and spacing of columns should be properly related to the design of the bridge. It is better, for example, to have a column either wholly clear in silhouette or wholly hidden rather than apparently cut in half by the upper flange of a girder or a suspension cable.

In very large bridges, the scale of the superstructure above the parapet level permits greater freedom in the design of the lighting installation. In smaller bridges it may be possible, for example with bow-string girders, to make the lighting equipment inconspicuous in daytime as seen from the side of the bridge. In other cases it

may be practicable to attach the luminaires to the superstructure above parapet level. Where there is no superstructure above parapet level, the installation will become a more prominent feature in the side view. In the case of very long bridges, the columns will dominate less and primary considerations may well be spacing and arrangements rather than height or detailed design. If there is a strong rhythm in the structure, for example a series of heavy arches, the spacing should be related to this rhythm.

The arrangement of luminaires on the bridge should also be considered, having regard to its appearance in oblique view where such viewpoints are important. Staggered arrangements of columns can produce an irregular appearance when seen obliquely. The appearance of opposite arrangements is preferred particularly as this may make possible a lower mounting height. A central arrangement appears as a regularly spaced array of columns from any viewpoint and needs fewer columns than an opposite arrangement.

It is preferable to mount columns over piers and abutments, where their height may be more aesthetically acceptable. With long spans it may be necessary to have additional columns between the piers, but all luminaires should be at the same mounting height. On very short bridges it may be possible, and indeed desirable, not to have columns on the bridge proper, even if this means a greater mounting height for the luminaires at either end.

4.5 Bridges of special, historical or architectural interest

When bridges have historical interest, other special architectural qualities or are scheduled as ancient monuments, the necessary consent should be obtained from the appropriate authorities.

In the case of ancient monuments, consideration may have to be given to having no equipment on the bridge. If the bridge is too long to be lit from the ends only, even with a substantial increase in mounting height, a special design may be called for. Where lighting complying with BS 5489 : Parts 2 and 3 is accepted, very careful consideration should be given to the detailed design. For the medieval type of bridge with embrasures above the cutwaters, relatively short columns in some of the embrasures may prove the most acceptable answer, perhaps with post-top mounting if, as is often the case, the carriageway is narrow. Specially designed columns and luminaires may be desirable.

For the classical type of bridge with bold semicircular or elliptical arches and open masonry balustrades, somewhat similar considerations apply, but the lighter character of the structure and the greater refinement of its detail make it more difficult in some ways to relate a new lighting installation satisfactorily to the design of the parapet and the bridge generally. If there are solid dies between the runs of balusters, columns can sometimes be mounted on the parapet but a special design will almost certainly be required. Stock designs are seldom good enough for bridges of historical importance.

If the bridge is wide enough a better solution may be to erect the columns in a central reserve; but although this may improve the effect from the lower viewpoint it may worsen it from the upper viewpoint, for example, where the bridge forms a monumental approach to a formally laid out town. In any case, even on central reserves specially designed equipment may be required.

4.6 Lighting for footbridges

The lighting on a footbridge should comply with BS 5489 : Part 3. Special care should be given to the illumination of stairs and ramps. Where a footbridge is in a lighted area or over a lighted road the illumination on the bridge should be integrated with the surrounding area. Where the footbridge crosses a lit road the lighting of the road may suffice for the bridge and its ramps, especially if the parapets are not solid. Where the bridge crosses an unlit road, any lighting on the bridge should be designed to minimize its visible intrusion on the road below. In all cases the lighting equipment should be kept as inconspicuous as possible in the daytime and should be considered both in its design and its siting in relation to the bridge structure. In new bridges it should be incorporated as an integral part of the design and not added as an afterthought. Provision should also be made for the inconspicuous placing of supply cables and switchgear. Special precautions against damage or theft may be necessary.

5 Lighting for elevated roads

5.1 General

The lighting requirements defined in BS 5489 : Parts 1, 2, 3 and 8 should be applied. Elevated roads differ from bridges in that they are usually longer, they are often sinuous and they often have parallel roads alongside them at lower levels. They also often have slip roads which join the two levels and they usually carry very heavy traffic and have little room for maintenance. Maintenance may be very difficult, since the closing of lanes for a maintenance vehicle may not be acceptable and this may be a ruling factor in the lighting design.

5.2 Configurations with special needs

5.2.1 *Configurations*

Elevated roads differ so much that each requires individual consideration. Special lighting needs can be defined for the following configurations:

(a) those without parallel ground-level roads;

(b) those with parallel ground-level roads;

(c) those on an embankment with parallel ground-level roads;

(d) those on a viaduct with parallel ground-level roads.

Each of the above configurations is considered in turn.

5.2.2 *Elevated road without parallel ground-level roads*

If the elevated road is on a viaduct it is desirable to relate the lighting installation structurally and visually to the design and strength of the supporting structure.

There may be limited space available on the outside of the carriageway and therefore special arrangements may be required for column mounting in the structure design.

5.2.3 *Elevated road with parallel ground-level roads*

The existence of parallel roads on two levels creates problems namely:

(a) light from the upper installation reaching the lower road possibly over only a part of its surface;

(b) drivers being able to view the two levels of lighting simultaneously.

The design decision may be to light the two roads independently or to light them wholly or partly by a combined installation (see **5.2.4** and **5.2.5**).

5.2.4 *Elevated road on embankment with parallel ground-level roads*

When the elevated road is on an embankment with a slope, the bank results in the lower road having vertical and horizontal separation from the upper road. The roads may be lit by the following arrangements:

(a) *Each road lit individually.* This solution may generate a large number of units, related maintenance problems and conflicting arrays of lights.

(b) *Masts mounted between the roads.* If the overall width of the road is suitable both roads may be lit by units mounted on masts which are high compared with the difference in level of the roads and located between the roads. This arrangement has the advantage of reducing the number of lighting points, avoiding glare and simplifying maintenance.

(c) *Masts mounted on the outside of the lower road.* Where there are steep embankments or retaining walls it may be possible to mount the masts on the outside of the lower road. The same advantages and cost implications as in item (b) above apply.

(d) *Luminaires mounted on upper road columns.* The same luminaires may suffice or separate luminaires may be mounted on the same columns at an appropriate height. Care should be taken with this arrangement to ensure that the lower roads are adequately lit in all conditions.

5.2.5 *Elevated road on viaduct with adjacent roads*

The possibilities within this configuration are as follows:

(a) *Parallel ground-level roads close to and/or partly beneath.* When the elevated road is on a viaduct the level roads may be close to it or partly beneath it. If the upper road is lit by luminaires at its sides their lights may reach only a part of the lower carriageway and they may cause an undesirable continuous shadow. This may be offset by lighting units mounted on the underside of the viaduct. The mounting height available for such lighting is usually restricted and there are often problems with other shadows cast by beams or piers, or by luminaires mounted on the far side intended to light the other lower road.

(b) *Parallel ground-level roads close to or crossing the elevated road.* It may be possible to light both the lower and upper roads from luminaires mounted on the outer sides of the lower roads provided that a mounting height can be found such that the upper road is lit to the required level without shadows being cast by the viaduct on the inner sides of the lower roads. This solution avoids all maintenance on the elevated road and may provide better results on bends than other arrangements quoted. It may require a special light distribution designed to control the light beyond the confines of the road. If the elevated road is insufficiently lit by the outer luminaires on the lower road, then luminaires mounted on the elevated road will be necessary.

5.3 Lighting for slip roads

Slip roads should be lit in compliance with BS 5489 : Parts 1, 2, 3, 5 and 8.

Where slip roads connect two levels particular attention should be given to the following:

(a) the view of the rising slip road from both the upper and lower levels;

(b) the clear definition of routes and turn off points;

(c) the clear revealing of merging traffic;

(d) the avoidance of confusing arrays of luminaires;

(e) the merging of installations which may be of different types;

(f) the clear definition of carriageway markings and protective barriers;

(g) the requirements for luminaires with special light distribution properties.

6 Maintenance and operation

Maintenance should be carried out as given in BS 5489 : Parts 1, 2 and 3.

Where specialized mechanical, hydraulic and electrical equipment is used, it is recommended the equipment be inspected and maintained regularly in accordance with use, legislation and manufacturer's recommendations and depending upon local conditions.

Publications referred to

BS 4533	Luminaires
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 5 Code of practice for lighting for grade-separated junctions Part 8 Code of practice for lighting for roads near aerodromes, railways, docks and navigable waterways Part 9 Code of practice for lighting for urban centres and public amenity areas
BS 6100	Glossary of building and civil engineering terms Subsection 2.4.1 Highway engineering

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ISBN 0 580 20925 3

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