

ROAD LIGHTING COLUMNS AND BRACKETS

Contents

<i>Clause</i>	<i>Title</i>	<i>Page</i>
1301	General	172
1302	Design of Lighting Columns, Brackets, Foundations, Anchorages and Attachment Systems	172
1303	Data Sheets	174
1304	Identification and Location Markings	174
1305	Installation of Foundations, Anchorages and Attachment Systems	174
1306	Site Tests on Anchorages in Drilled Holes	175
1307	Materials and Surface Finishes	175
1308	Handling, Transport and Erection	176
1309	Amendments and Additions to BS 5649 : Part 2 : 1978	176
1310	Amendments and Additions to BS 5649 : Part 3 : 1982	177
1311	Amendments and Additions to BS 5649 : Part 5 : 1982	179
1312	Attachments to Lighting Columns	180
1313	Laminated Glass Fibre Reinforced Plastic (GFRP) Columns	180
1314	Brackets for Laminated GFRP Lighting Columns	181
1315	Specification for design loads to BS 5649 : Part 6 : 1982	181

Road Lighting Columns and Brackets

1301 General

- 1 This Series shall apply to the design, supply and installation of lighting columns and brackets for traffic route lighting within the following dimensional limitations:
 - (i) For steel, aluminium and concrete columns:
 - (a) post top columns not exceeding 20 m nominal height;
 - (b) columns with brackets not exceeding 18 m nominal height;
 - (c) bracket projections not exceeding 0.25 x nominal height or 3 m whichever is the lesser.
 - (ii) For glass fibre reinforced plastic columns (GFRP):
 - (a) columns not exceeding 10 m nominal height;
 - (b) bracket projections not exceeding 1.5 m.
- 2 The designer and manufacturer of lighting columns and brackets proposed by the Contractor shall demonstrate, to the satisfaction of the Engineer, adequate quality procedures and controls.

The Contractor shall where required provide designs for foundations for planted columns as described in Appendix 13/1.

The Contractor shall where required provide designs for:

 - (i) anchorages and attachment systems for columns with flange plates to foundation or bridge deck;
 - (ii) foundations for columns with flange plates; as described in Appendix 13/1.
- 3 Lighting columns and brackets shall be supplied and installed in compliance with IS EN 40-1 and BS 5649 : Parts 2, 3, 5, 6, 7, 8 and 9 together with the amendments and additions stated in Clauses 1309, 1310 and 1311 and all the other requirements of this Series.
- 4 Brackets shall include wall mounted brackets and fixtures.
- 5 Temporary lighting on Contractor's and Engineer's temporary diversions for traffic, and crossovers, shall comply with this Series.

- 6 Where lighting columns are to be in the vicinity of overhead power lines the Contractor shall ensure that the installation is carried out in accordance with The National Rules for Electrical Installations and the particulars of Part 7 of that document, that the appropriate Electricity Authorities, or the proprietors of the overhead power lines are notified and give written agreement to the specific clearances to be provided and that warning notices as described in Appendix 13/1 are permanently fixed to the columns affected prior to erection.

1302 Design of Lighting Columns, Brackets, Foundations, Anchorages and Attachment Systems

- 1 Lighting columns, brackets, the foundations of both planted columns and columns with flange plates, and the anchorages and attachment systems for columns with flange plates shall be designed to comply with the requirements of the UK Department of Transport Standard BD 26/94 (UK DOT Standard, BD 26/94), Design of Lighting Columns, as follows:

"Introduction":

Sub-Clause 1.1 (omit second sentence);
Sub-Clause 1.3;
Scope sub-Clause 1.4.

Chapter 3, "Use of British Standards and Standards Issued by the Overseeing Organisations":

Sub-Clause 3.4 to sub-Clause 3.9 inclusive.

Chapter 4, "Glass Fibre Reinforced Plastic (GFRP) Lighting Columns":

All Clauses.

Chapter 5, "Doors in Lighting Columns":

All Clauses.

Chapter 6, "Wall Mounted Brackets":

All Clauses.

Chapter 7, "Attachments to Lighting Columns":

All Clauses, except that reference to Appendix 13/2 in sub-Clause 7.5 refers to Appendix 13/2, Specification for Road Works.

Chapter 8, "Foundations":

All Clauses.

Chapter 9, "References".

- 2** Lighting columns and column systems shall be certified as complying with these specifications in accordance with the design and check certificate shown in Appendix 13/4 and as follows:

- (i) The design certificate for lighting columns (for planting or with flange plates), brackets, anchorage and attachment systems shall be completed by the manufacturer and the check certificate by an independent Checking Consultant accepted by the Engineer and the manufacturer.

The design and check certification shall specify the range of combinations of column heights and length of brackets (taking account of orientation of bracket relative to door opening and orientation of sign) together with the weights and windage areas of lanterns for which the column has been designed and confirm that the design has been accurately transferred to the working drawings.

- (ii) Where lighting column designs are verified by testing as permitted in BS 5649: Part 8, a combination of calculations and testing shall be carried out as follows:

- (a) Fatigue life shall be verified by calculation;
- (b) Testing shall be in accordance with BS 5649: Part 8 with the following modifications and instructions:

Add to the end of the last sentence of Clause 4: "and UK DOT Standard BD 26/94".

In Clause 5 substitute: "the site value for k" in place of "a k factor of 1". Add a new paragraph "The effect of the required 0.3 m² sign shall be allowed for by applying a load equal to the calculated wind load of the sign oriented in accordance with Chapter 7, UK DOT Standard BD 26/94".

Modify Clause 7(b) to read: "The temporary horizontal deflection of the lantern connection caused during the load test by the incremental load due to the horizontal forces corresponding to the value of k appropriate to the site, shall not exceed 0.06 (h+w). (See BS 5649: Part 2 as modified by UK, DOT Standard, BD 26/94 Clauses incorporated into the Specification for Road Works)".

When applying Clause 7(e) the value of γ_t from Annex A shall be that of the country of origin of the column material.

Delete the following text from the 4th line of Clause 8: "for k = 1.0 and".

- (c) The Checking Consultant shall witness the test and countersign the Annex C report unless the test is carried out by a testing laboratory acceptable to the Engineer.

- (iii) Any modification to a certificated design shall be subject to recertification by the manufacturer and the Checking Consultant.

- 3** Where the design of anchorages and attachment systems is provided by the Contractor the design may be required to be certified by a Checking Consultant accepted by the Engineer and the Contractor.

- 4** Where the design of foundations for columns with flange plates is provided by the Contractor the design may be required to be certified by a Checking Consultant accepted by the Engineer and the Contractor.

- 5** The Contractor shall submit to the Engineer evidence of certification in respect of the above as follows:

- (i) For sub-Clause 2: A copy of the design and check certificate as in Appendix 13/4 and the Annex C report (if appropriate) inclusive of the information required under sub-Clause 2 and signed by the manufacturer and Checking Consultant;
- (ii) For sub-Clause 3: A copy of the design and check certificate signed by the Checking Consultant in compliance with the requirements described in Appendix 13/1;
- (iii) For sub-Clause 4: A copy of the design and check certificate signed by the Checking Consultant in compliance with the requirements described in Appendix 13/1.

Aesthetic Approval

- 6** The design of lighting columns and lanterns including those with bracket arms shall be submitted to the Engineer for aesthetic approval.

Foundations for Planted Columns

- 7 The Contractor shall where required submit designs appropriate to the soil types encountered on Site, as identified in Appendix 13/1, to the Engineer for his acceptance.

1303 Data Sheets

- 1 The Contractor shall complete the details in Appendix 13/2 Sheet 1 and Sheet 2 in accordance with the Instructions given in Appendix 13/3. He shall provide the Engineer with triplicate copies of the completed Data Sheets for each type of column and bracket not later than the date stated in Appendix 13/1.
- 2 The columns and brackets shall not be erected until the Engineer has notified his acceptance of the completed Data Sheet in writing to the Contractor.

1304 Identification and Location Markings

- 1 All lighting columns and brackets shall carry a unique identification mark which indicates the name of the manufacturer, year of production, and other information, to enable details of the column and bracket to be determined by a unique design code reference number relating to the appropriate Column and Bracket Data Sheet. The unique reference number shall not be used for any other design of column or bracket.
- 2 The column identification mark shall be permanent, legible and clearly visible and be:
 - (i) on a permanent fixed label; or
 - (ii) hard stamped; or
 - (iii) formed in the material of the column on an external face only.

It shall be located either within the base compartment or, except in the case of hard stamping, immediately above or below the door. It shall not be located on the door.

All hard stamping shall be made only in a secondary member of the column and shall be done in a manner which will not induce any stresses in the material of the main member of the column.

- 3 The bracket identification mark shall be permanent and legible and be:
 - (i) hard stamped; or
 - (ii) formed in the material of the bracket on an external face only.

The mark shall be located either on the lantern spigot or on the underside of the bracket adjacent to the column shaft.

- 4 Alternatively the bracket identification mark shall be hard stamped or formed in a detachable label supplied fixed to the bracket. This label shall be moved from its temporary position and fixed on erection to a suitably provided hole next to the label on the column.
- 5 In addition, location marks for inspection and maintenance purposes shall be applied to each column as described in Appendix 13/1.

1305 Installation of Foundations, Anchorages and Attachment Systems

Planted Columns

- 1 A layer of concrete mix ST4 75 mm thick, complying with Clause 2602 shall be placed and compacted in the bottom of the excavation up to the base of the column. Alternative materials may be described in Appendix 13/1.
- 2 The cable entry slot shall be temporarily plugged as necessary in order to prevent any ingress of concrete or filling material during the concreting and backfilling operations.
- 3 The hole into which the column is placed shall be backfilled as follows:
 - (i) in the case of metal and glass fibre reinforced plastic columns with concrete or other material subject to the approval of the Engineer;
 - (ii) in the case of concrete columns with concrete or earth fill complying with sub-Clause 5 of this Clause or other material subject to the approval of the Engineer.
- 4 Concrete backfill shall be mix ST5 complying with Clause 2602, well compacted by vibration over the full planting depth of the column. A duct equal in size to the width of the cable entry hole, shall be formed through the concrete filling using an approved preformed lining tube capable of retaining its cross-sectional shape during compaction.

- 5 Earth backfill shall be Class 8 material complying with Clause 601, Table 6/1 unless otherwise described in Appendix 13/1. The material shall be placed in 150 mm thick layers and shall be well rammed and compacted in order to provide full lateral support to the planting depth of the column. If the backfilling is disturbed for any reason it shall be reinstated in compliance with this Clause. A duct equal in size to the width of the cable entry hole, shall be made through the backfill material using an approved preformed lining tube capable of retaining its cross-sectional shape during compaction.

Columns With Flange Plates

- 6 Concrete in the foundations shall comply with the 1700 Series.
- 7 The bedding mortar between the underside of the column flange plate and the top of the concrete base shall comply with Clause 2601.
- 8 A cable duct, 75 mm diameter (unless otherwise specified), shall be provided through the foundation or bridge component as described in Appendix 13/1.
- 9 Steel anchorages and attachment systems shall be used and the anchorage shall include an internally threaded component to receive the attachment system, ie. holding down bolt or stud.
- 10 Where anchorages in drilled holes are to be used, the Contractor shall, unless otherwise described in Appendix 13/1, submit to the Engineer at least 4 weeks before installation well attested and documented evidence that the proposed anchorage is:
- (i) capable of complying with the test requirements specified in Clause 1306; and
 - (ii) capable of resisting pulsating loading.
- Anchorage in drilled holes of an expanding type shall not be used.
- 11 For anchorages in drilled holes the hole location shall be checked to ensure that the hole will be clear of reinforcement before drilling is carried out.
- 12 Before installation of anchorages in drilled holes, the hole shall be sound, clean and dry and the tolerance of the hole shall be within the values given by the anchorage manufacturer.
- 13 The threads of steel anchorages shall be lined with grease having a high resistance to creep and being suitable for hot or cold smearing. The grease shall provide protection to the

threads for a minimum of either 18 months under cover or 6 months exposed on Site.

- 14 Attachment systems shall be tightened to the appropriate torque and have the minimum thread engagement calculated in accordance with the requirements of BS 6779 : Part 1 : 1992 : sub-clause 12.4.
- 15 All voids in anchorages, attachment systems and flange plates shall be filled with a non-setting passive filler to prevent the collection of water.

1306 Site Tests on Anchorages in Drilled Holes

- 1 The Contractor shall have Site tests carried out on anchorages in drilled holes by a testing laboratory accredited by ILAB. For the purpose of this sub-Clause the phrase "Type of fixings" as defined in sub-clause 1.2 of BS 5080 : Part 1 : 1993 shall include "anchorages". Where anchorages are tested they shall be loaded incrementally in tension in accordance with BS 5080 : Part 1 : 1993 except that they shall be capable of resisting a test load equal to 10 per cent above the nominal tensile load to be resisted by the anchorage in lieu of testing to failure. The nominal tensile load shall be determined in accordance with the criteria given in Clause 1302.1, Chapter 8, sub-clause 8.4. Incremental loads shall be held for not less than half a minute and the test load for not less than five minutes. Readings shall be taken immediately after applying load and at the end of the time intervals stated above.
- 2 The total movement of the anchorage shall not exceed 1.0 mm during the test. Any evidence of slip during loading up to the test load, as demonstrated by a significant change in the slope of the load/extension curve, shall constitute failure.
- 3 The Contractor shall test the anchorages selected by the Engineer and the testing frequency shall be in accordance with Appendix 1/5.

1307 Materials and Surface Finishes

- 1 All steel fixings including doors, door hinges, chains and locks shall be stainless steel to BS 1449 : Part 2, BS 970 : Part 1 or BS 6105 as appropriate or steel to IS EN 10025, BS 4360 or BS 5649 : Part 3 : 1982 galvanized in compliance with sub-Clause 3 of this Clause.

- 2 Where different metals are in contact, consideration shall be given to the necessary measures to avoid galvanic corrosion.
- 3 The surface preparation and protection of steel lighting columns, brackets and wall mountings shall comply with Appendix 19/3 and the relevant Clauses in the 1900 Series.
- 4 In addition to galvanizing the column root shall be coated internally and externally with bitumen to BS 3416 Type 1 to a height of 300mm above ground.
- 5 The exterior and interior surfaces of the intended planted depth of an aluminium alloy column shaft and a length of 300 mm above the ground level shall be coated with a non-porous electrically insulating bitumen with a minimum layer thickness of 250 microns. The coating shall only be applied after degreasing and after an approved preliminary treatment in order to ensure adhesion.
- 6 The underside of an aluminium alloy flange plate shall be treated before erection with bituminous paint complying with BS 3416.
- 7 The finish to concrete lighting columns and brackets shall be Class F3 in compliance with Clause 1708.

1308 Handling, Transport and Erection

- 1 Lighting columns and brackets shall be handled, transported and stored in such a way as to avoid any structural damage or damage to the surface protection system. Any damage shall be made good to the satisfaction of the Engineer.
- 2 Lighting columns and brackets shall be stored clear of the ground in such a way that contact with cement, groundwater, soil or ash or other deleterious material is prevented and that water does not accumulate on any surfaces or inside sections. Suitable packings shall be placed between the columns to allow a free passage of air and dispersion of water.
- 3 All rivets, bolts, nuts, washers, screws, small plates and small articles generally shall be suitably packed and identified. All such items shall be stored under cover.
- 4 Columns shall be installed in accordance with the manufacturer's recommendations and to the approval of the Engineer. The door shall face the direction described in Appendix 13/1.

- 5 Wall mounted lighting brackets and fixtures shall be fixed as described in Appendix 13/1.

1309 Amendments and Additions to BS 5649 : Part 2 : 1978 (AMD 3136 1979)

Page 4 – Clause 3

Delete Note "Lantern fixing angle 5° or 15°" and Insert Note "Lantern fixing angle in the range 0° to 20°".

In the table insert additional bracket projections w of "0.5 m, 1.0 m, 1.5 m and 2.5 m".

Page 5 – Clause 4

Delete cable entry slot width dimension "50 mm" and

Insert cable entry slot width dimension "X".

Insert additional note as follows:

"5) Cable entry slot width dimension "X" shall be either 75 mm or 50 mm as described in Appendix 13/1."

a to be annotated "a⁵", b to be annotated "b⁵".

add footnote 5: "Dimensions of door cut out should allow for the fitting of door reinforcement and the Standard Door as referenced in Clause 1311 and NRA Road Construction Detail listed in Appendix 13.5".

Page 7 – Clause 6

Delete existing Tables and replace by the following:

h m	s ¹⁾ min	a	d ₁ ¹⁾ min	d ₂ min
≤ 5	8	200	M12	13
≤ 12	10	300	M16	17
≤ 20	15	300 400	M24	26

Delete '1' from Figure 7 and 'c' from Figure 8.

Insert additional notes as follows:

"2 Unless otherwise described in Appendix 13/1 circumferential slotted holes shall be used instead of round holes in the flange plates in order to allow ± 5° of rotational adjustment.

3 Where slotted holes are required in the flange plate to allow for rotational adjustment of the column then the flange plate sizes shall be increased to give a suitable edge distance.

4 The distance from the edge of the hole or slot to the edge of the plate shall be not less than d^2 .

5 Washers complying with BS 4320 shall be used between the holding down fastener and the flange plate."

Page 8 – Clause 7

Delete existing table for post top lanterns and replace by the following :

d_1^{30}	l_1
60.3	70 100
76.1	76 100
101.6	250
108.0	250

Delete existing table for side entry lanterns and replace by the following :

d_2^{30}	l_2
33.7	80
42.4	110 400
48.3	110
60.3	110 250 400

Page 9 – Clause 8

8.1 Straightness.

Delete

$$"x \leq 0.003 l; l = h + e"$$

and

$$"\Delta x \leq 0.003 \Delta l; \Delta l \geq 1 \text{ m}."$$

Insert

$$"x \leq 0.002 l; l = h + e"$$

and

$$"\Delta x \leq 0.002 \Delta l; \Delta l \geq 1 \text{ m}."$$

8.7 Column cross-section

Insert additional sub-Clause as follows:

"8.7.1.3 Material thickness tolerance (+ unspecified, – 5%)".

8.7.2.2 Deviation in shape

Delete content of entire sub-clause and insert the following:

"Cross-section dimensional tolerances $\pm 5\%$ with a maximum of $\pm 10 \text{ mm}."$

1310 Amendments and Additions to BS 5649 : Part 3 : 1982

Page 2 – Clause 7

Delete sub-clause 7.1 and insert the following:

"7.1 Steel and Aluminium Lighting Columns

7.1.1 General. Arc welding of carbon manganese steels shall comply with BS 5135. Arc welding of stainless steels shall comply with BS 4677. Arc welding of aluminium alloys shall comply with BS 3019 or BS 3571 as appropriate. Processes other than arc welding shall be to the approval of the Engineer.

7.1.2 Procedures. Written welding procedures shall be used with testing to IS EN 288 : Part 3 for Steel and Part 4 for aluminium alloys and shall apply to all production and repair procedures. These shall be subject to reapproval after a period of seven years. When applying IS EN 288 : Part 3 the welding consumables and procedures used for steel shall be such that the mechanical properties of deposited weld metal will not be less than the respective minimum specified values of the parent metal being welded. Testing shall be by a laboratory appropriately accredited by ILAB. Approval shall be by an Inspecting Authority acceptable to the Engineer using appropriately qualified Welding Engineers, Welding Quality Engineers or equivalent.

7.1.3 Welder Qualification. All welders shall be approved to IS EN 287: Part 1 for steel and Part 2 for aluminium alloys. The tests shall include in addition an application test representative of the main structural joints on which the welder is to be approved to work. The main structural joints shall include, where relevant, the flange plate joint, the base compartment to shaft joint, the door reinforcement, any intermediate column joint, the column to bracket joint and the column seam weld. Welders shall be subject to

reapproval after two years. Testing shall be by a laboratory appropriately accredited by ILAB. Approval shall be by an Inspecting Authority acceptable to the Engineer using appropriately qualified Welding Engineers, Welding Quality Engineers or Welding Inspectors or equivalent.

7.1.4 Inspection and Non-Destructive Testing

7.1.4.1 Inspection Personnel. The manufacturer shall provide suitable personnel to carry out inspection of production welds as required in 7.1.4.2 to 7.1.4.4. Personnel conducting visual inspection shall have a recognised certificate of competence appropriate to the type of welding being inspected. Personnel conducting non-destructive testing (NDT) shall be certified according to a recognised certification scheme appropriate to the equipment used and the weld groups inspected. Evidence of training and qualification shall be retained and made available for examination when required. The results of all weld inspections shall be recorded.

7.1.4.2 Visual Inspection. All welds shall be subject to visual inspection in accordance with BS 5289 prior to any NDT and galvanizing. Weld surfaces shall be free of slag residues and sharp edges. All surfaces shall be free of traces of weld spatter, arc strikes and contaminants. The throat dimensions of butt welds and the leg length and apparent throat dimensions of fillet welds, as measured by a welding gauge and taking into account lack of fit, shall not be less than those specified, except that local shortfalls up to 0.5 mm may be accepted provided the average over any 50 mm length is not less than the specified dimension. The toe angle shall not be less than 110°. The surface of all welds shall be free from cracks, lack of fusion including overlap, and slag. Isolated discontinuous porosity may be accepted provided it is not detrimental to the galvanizing process. Undercut shall not result in a section loss of more than 5% over any 50 mm length of joint, nor shall its depth exceed 0.5 mm or 10% of the thickness, whichever is the less.

7.1.4.3 Magnetic Particle Inspection (MPI) and Liquid Penetrant Inspection. MPI shall be applied in accordance with BS 6072 to joints in steel lighting columns selected in accordance with 7.1.4.5, where any of the material thickness exceeds 20 mm. Liquid penetrant inspection in accordance with BS 6443 shall be applied to transverse welds in aluminium columns selected in accordance with 7.1.4.5. Notwithstanding the requirements of 7.1.4.5, one of the above methods shall be applied as

appropriate where on visual inspection the presence of cracking or lack of fusion may be suspected. To aid inspection the profile of the weld may be dressed by burr grinding provided that the specified throat size and leg length is still maintained. The surface of the weld shall be free of cracks, lack of fusion and slag.

7.1.4.4 Ultrasonic Testing. All butt joints selected in accordance with 7.1.4.5 shall be ultrasonically tested in accordance with BS 3923 where the column shaft is 8 mm thick or greater. For aluminium the principles in BS 3923 shall be applied. The weld shall be free of cracks. The height of buried slag, lack of fusion or lack of penetration shall not exceed 3 mm. Within 6 mm of the outer surface, their individual length shall not exceed 5 mm. The resulting net throat area loss over any 50 mm length of weld shall not exceed 5%.

7.1.4.5 Frequency of Testing. Joints for MPI, liquid penetrant inspection or ultrasonic testing shall be selected as follows:

10% of lighting columns of each type shall be inspected. The sample shall include all variations in joint geometry, material thickness and weld size covered by the basic type, that are within the scope of 7.1.4.3 and 7.1.4.4. If non-conformances are found the scope of MPI, liquid penetrant inspection and ultrasonic testing shall be doubled. If further non-conformances are found, the whole batch shall be tested.

7.1.4.6 Reporting. Inspection records for production welds shall be retained by the manufacturer for seven years and those covering the production periods relating to the lighting columns supplied shall be made available for examination.

7.1.5 Destructive Testing. Copies of certified reports of destructive tests on lighting columns supplied under earlier roads contracts shall be provided at the request of the Engineer.

The Contractor shall supply sample joints cut from complete lighting columns for destructive testing as selected by the Engineer. The sample joints shall be cut from the column, bracket and welded anchorage where relevant. The basis of selection shall be as follows:

- a) For orders of 1 to 150 lighting columns – one complete lighting column for each type, unless destructive testing has been carried out within the last six months on a lighting column of that type where the lighting column that was tested was selected by the Engineer to another contract complying with this Specification.

- b) For orders of 151 to 300 lighting columns – One complete lighting column for each type.
- c) For orders exceeding 300 lighting columns – Two complete lighting columns for each type.
- d) For lighting columns in excess of 12 m nominal height destructive testing may be waived where all of the following applies: A report is provided by an appropriately qualified Welding Inspection Consultant indicating that the welding designs, techniques, procedures and testing used by the manufacturer for the production of the columns are satisfactory; the Welding Inspection Consultant is commissioned by the Engineer to the contract or to another contract complying with this Specification; the Welding Inspection Consultant is afforded the same facilities as due to the Engineer and inspection takes place during the manufacturing process.

Notwithstanding destructive testing carried out in accordance with sub-Clauses (a),(b) and (c) or waived in accordance with (d) the Engineer may select and test one complete lighting column of each type at time of delivery to site in accordance with Clause 1310 and NG 1310.

Acceptance criteria shall be as specified in 7.1.4, except that in 7.1.4.2 the throat and leg dimension shall apply to the true rather than the apparent dimension.

In the event that there is a non-conformance arising from a serious deviation in materials, preparation, assembly, or welding procedure, the batch concerned shall be rejected and further production of the columns affected stopped until such time as the fault has been corrected. A minor non-conformance shall only be accepted on the basis that further sampling and testing shows that fault is not repetitive and in the view of the Engineer will not in that instance impair structural integrity.

If the problem can be traced to a particular manufacturing period, operator, piece of equipment or batch of materials and if proper traceability to individual batches of components can be assured, only those batches affected may be subject to rejection.

The destructive test reports shall be retained by the manufacturer and recorded in a register for a period of two years. The destructive test specimens shall be retained for a period of 12 months. These shall be made available for examination on future contracts with the National Roads Authority.

7.1.6 Remedial Work. Welds which do not comply with the Specification may be repaired to an approved procedure, as described in 7.1.2."

Page 2 – Clause 7

Delete sub-clause 7.2 in its entirety.

1311 Amendments and Additions to BS 5649 : Part 5 : 1982

Page 3

3.2, after paragraph 2

Insert additional paragraphs as follows:

"The door fastening arrangement shall be such that it can be opened by releasing two threaded locking fasteners of sufficient length to allow visual sighting of screw engagement. Each fastener shall be fitted with a corrosion resistant metal retaining washer. The fasteners shall be of stainless steel to BS 6105 or BS 970 : Part 1 with the principal dimensions given in NRA Road Construction Detail 1 listed in Appendix 13/5.

When the door is secured the fastener head shall be completely recessed into the door in a circular recess as indicated in NRA RCD 1 above except that in the case of the Standard Door as shown in NRA Road Construction Detail 2 listed in Appendix 13/5, the tolerance on the internal diameter of the recess is 18mm to 21 mm. The locking fastener shall be suitable for opening with the standard key detailed in NRA RCD 1 above or equivalent key.

For steel road lighting columns 12 metre or less in nominal height the following shall apply unless otherwise specified in Appendix 13/1:

- (i) The door opening shall be reinforced with a welded-in steel frame in accordance with type 1 of Figure 5 of BS 5649 Part 7. A 5mm wide steel strip is to be fitted within the frame and recessed 10mm from the front of the frame. The door shall be fitted to bear against this strip;
- (ii) The Standard Door shall be in accordance with NRA RCD 2 above for road lighting columns 8 metres to 12 metres in nominal height."

3.3, after paragraph 1

Insert additional paragraph as follows:

"Hardwood baseboards shall be protected with three coats of intumescent varnish."

3.4, after paragraph 2

Insert additional paragraph as follows:

"Where a cable entry slot width of 75 mm is provided, the minimum size of cableway from the cable entry slot to the base compartment shall be 75 mm"

After Page 3

Insert NRA Road Construction Details 1 and 2 as listed in Appendix 13/5.

1312 Attachments to Lighting Columns

- 1 Attachments to lighting columns shall be by means of circumferential clamps of stainless steel complying with AISI Grade 201 or other approved material which shall not damage the column or its protective coating.

1313 Laminated Glass Fibre Reinforced Plastic (GFRP) Columns

Manufacture of GFRP Laminates

- 1 The columns shall be produced either by hand lay-up or mechanical moulding technique. The mechanical manufacture shall be carried out either by filament winding, centrifugal casting, compression moulding, resin injection or any other method approved by the Engineer.
- 2 An exterior resin rich layer of at least 0.25 mm thickness shall be provided to ensure adequate protection of the reinforcing fibres against adverse effects of the weather and possible chemical attack.
- 3 Columns containing bubbles, cracks, holes, pits or other voids each greater than 7 mm² in area shall be rejected.
- 4 The dimension and tolerances shall be those given in BS 5649 : Part 2 : 1978 for seamless metal columns. The outer surface shall have a smooth uniform taper along its total length.

Materials for GFRP Laminates

- 5 The fibre reinforced plastic shall be in the form of laminate made of thermosetting resin, fibre reinforcement (mainly glass fibre), catalyst system and filler.

- 6 The resins used shall conform to the appropriate British Standards. Polyester resins shall be based on isophthalic acid and conform to BS 3532, Type B.
- 7 Any fillers and pigments incorporated in the resin shall form part of the total resin system and shall have the approval of the Engineer.
- 8 Fibre reinforcement shall unless otherwise agreed with the Engineer conform to the appropriate British Standards. Where glass fibre is used as the base for mat or chopped fibre it shall conform to BS 3691 and shall be treated with an appropriate finish compatible with the resin system used.
- 9 All accelerators, catalysts and hardeners shall be used in accordance with the resin manufacturer's instructions.

Testing of GFRP Laminates

- 10 The properties of the laminates shall be verified by testing as described in sub-Clauses 13 to 18 of this Clause. Any material failing any of the tests listed shall be rejected. Such tests shall, unless otherwise described in Appendix 13/1, be carried out on samples representing the batch of columns to be supplied under the Contract.
- 11 Two types of samples shall be provided for the tests:
 - (i) Samples from a specially prepared flat laminate for type tests or where changes in raw materials or manufacturing techniques are proposed. These shall comprise tests for colour fastness, electric strength, water absorption and impact strength.
 - (ii) Samples cut from complete columns to be used for quality control purposes, to be carried out at a frequency of one in each two hundred production columns. Each column for tests will be selected on a random basis and will be examined by visual inspection and for loss on ignition.
- 12 A flat laminate sample 300 mm \pm 10 mm square by 3 mm + 0.5 mm/- 0.0 mm thick shall be prepared by hand lay-up method using the same curing conditions resin and reinforcement systems as used for production columns. The total glass fibre content shall not exceed 40% by weight.
- 13 The colour fastness test shall be conducted in accordance with BS 2782 : Part 5 : Method 550A, as agreed with the Engineer, and the

results assessed by Method 552A. Material with a colour change assessed greater than moderate will not be accepted.

- 14 The electric strength test shall be carried out in accordance with BS 2782 : Part 2 : Method 221. The electric strength shall be not less than 10 kV/mm.
- 15 The water absorption test shall be carried out in accordance with BS 2782 : Part 4 : Method 430A. The absorption of water shall be not greater than 50 milligrammes.
- 16 The impact strength test shall be carried out in accordance with BS 2782 : Part 3 : Method 359. The impact resistance shall be at least 30 kJ/m².
- 17 The loss on ignition tests shall be carried out in accordance with BS 2782 : Part 10 : Method 1002. The loss on ignition on samples taken at random throughout the length of a column shall not exceed 60% after subtracting the amount allowed for non combustible fillers. The percentage of glass fibre remaining following ignition shall be at least 40% by weight.
- 18 Samples cut randomly throughout the length of a column shall be visually inspected to confirm that there are no delaminations or voids greater than specified in sub-Clause 3 of this Clause and that the laminate is fully densified and includes the required number of laminations.

1314 Brackets for Laminated GFRP Lighting Columns

General

- 1 Brackets shall consist of a galvanized steel tube assembly with an external self-skinning rigid polyurethane foam moulding.

Materials

- 2 The steel tube assembly shall comply with BS 5649 and the requirements of this Series.
- 3 The rigid polyurethane foam shall be moulded in accordance with the manufacturer's instructions to give a bulk density within the range of 500 ±50 kg/m³, when in the form of a test sheet in accordance with sub-Clause 5 of this Clause. The surface shall be free from obvious defects such as voiding, pitting or cracking. It shall have a surface hardness of at least D/30/1 when measured in accordance with BS 2782 : Part 3 : Method 365B.

- 4 The polyurethane moulding shall be primed with a two part polyurethane primer and finished with a two part polyurethane top coating all in accordance with the manufacturer's instructions.

Testing of Polyurethane Foam

- 5 Properties of foam shall be verified by testing using specimens cut from moulded test sheets of 10 mm nominal thickness using the same material as in the manufacture of the bracket arms.
- 6 The apparent bulk density of a specimen shall be determined and be within the range of 500 ± 50 kg/m³. The method of testing shall be in accordance with the polyurethane foam manufacturer's instructions.
- 7 The impact strength of a specimen shall be determined in accordance with BS 2782 : Part 3 : Method 359 and shall be at least 6.0 kJ/m².
- 8 The flexural stress at a deflection of 10 mm carried out on a specimen shall be in the range of 24 to 30 MPa. The method of testing shall be in accordance with the polyurethane foam manufacturer's instructions.
- 9 The tests specified in sub-Clauses 6, 7 and 8 of this Clause shall each be carried out on two specimens and, unless otherwise stated in Appendix 13/1, the results shall be representative of the batch of columns to be supplied.
- 10 Evidence of quality control including results of tests similar to those required in sub-Clauses 6, 7 and 8 of this Clause shall be made available when required by the Engineer.
- 11 Tests specified in sub-Clauses 6, 7 and 8 of this Clause shall be carried out when changes in raw materials or manufacturing techniques are proposed. For quality control purposes testing shall be carried out in accordance with sub-Clause 3 of this Clause on each production batch of brackets which are to be fitted to columns.

1315 Specification for Design Loads to BS 5649: Part 6 : 1982

The value of the k factor to be used in this Specification shall be 3 unless:

- (i) The Engineer evaluates a k value of 2.5 or less for the Site in accordance with the relevant reference in BS 5649: Part

6:1982 i.e. CP3: Chapter V: Part 2, when a value of 2.5 shall be used;

- (ii) The lighting column is to be located as typified in the last paragraph of Appendix B of this Standard. In these cases a value of k shall be evaluated in accordance with CP3: Chapter V: Part 2 and a k value in excess of 3 referenced in Appendix 13/1 if appropriate.