BS EN 40-3-2:2013

BSI Standards Publication

Lighting columns

Part 3-2: Design and verification — Verification by testing

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee B/509/50, Street lighting columns.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Foreword

This document (EN 40-3-2:2013) has been prepared by Technical Committee CEN/TC 50 “Lighting columns and spigots”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2013, and conflicting national standards shall be withdrawn at the latest by August 2013.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 40-3-2:2000.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

There are seven parts to the series of standards EN 40 - *Lighting columns*, as follows:

- *Part 1: Definitions and terms;*
- *Part 2 : General requirements and dimensions;*
- *Part 3: Design and verification:*
  - *Part 3-1: Specification for characteristic loads*;
  - *Part 3-2: Verification by testing*;
  - *Part 3-3: Verification by calculation*;
- *Part 4: Requirements for reinforced and prestressed concrete lighting columns,*
- *Part 5: Requirements for steel lighting columns;*
- *Part 6: Requirements for aluminium lighting columns;*
- *Part 7: Requirements for fibre reinforced polymer composite lighting columns.*

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1 Scope

This European Standard specifies the requirements for the verification of the design of steel, aluminium, concrete and fibre reinforced polymer composite lighting columns by testing. It gives type tests and so does not cover testing for quality control purposes. It applies to lighting columns of nominal height (including any bracket) not exceeding 20 m. Special structural designs to permit the attachment of signs, overhead wires, etc. are not covered by this European Standard.

This European Standard includes a simplified method for testing steel and aluminium lighting columns. Refer to EN 40-4 for concrete lighting columns and to EN 40-7 for fibre reinforced polymer composite lighting columns.

NOTE For a more detailed test procedure, refer to Annex D of EN 1990:2002.

The requirements for lighting columns made from materials other than concrete, steel, aluminium or fibre reinforced polymer composite (for example wood, plastic and cast iron) are not specifically covered in this European Standard.

This European Standard includes performance requirements for horizontal loads due to wind. Passive safety and the behaviour of a lighting column under the impact of a vehicle are not addressed. Such lighting columns will have additional requirements (see EN 12767).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 40-1:1991, *Lighting columns — Part 1: Definitions and terms*

EN 40-3-1:2013, *Lighting columns — Part 3-1: Design and verification —Specification for characteristic loads*

EN 40-3-3:2013, *Lighting columns — Part 3-3: Design and verification — Verification by calculation*

EN 40-4, *Lighting columns — Part 4: Requirements for reinforced and prestressed concrete lighting columns*

EN 40-7, *Lighting columns — Part 7: Requirements for fibre reinforced polymer composite lighting columns*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 40-1:1991 apply.

4 Symbols

The following symbols are used in this European Standard.

The definitions are abbreviated, the full definitions being given in the text.

a	Overall door opening length
b	Overall door opening width
c	Dimension from ground level to bottom of door opening
f_y	Characteristic strength of material for design
f_{yT}	Actual strength of test sample material as tested

h	Nominal height of column
w	Bracket projection
I	Design value of second moment of area
I_T	Actual second moment of area of test sample as measured
γ_f	Partial safety factor for loads from EN 40-3-3:2013, Table1
γ_t	Test factor given in 6.4 as equal to γ_f
γ_u	Minimum ultimate load factor given in 6.4

5 Test loads

The serviceability and structural test loads for the verification test are the characteristic dead and wind loads specified in EN 40-3-1:2013, Clauses 5 and 6.

6 Acceptance criteria

6.1 General

If the following serviceability and structural requirements (see 6.2 and 6.3) are satisfied, the lighting column shall be deemed to have successfully passed the test and the design for that type of lighting column shall be verified.

6.2 Serviceability requirements

Serviceability requirements are as follows:

a) The vertical deflection of the luminaire connection caused by the vertical forces corresponding to the test load shall not exceed the value of 0,025 w (see EN 40-3-3:2013, 6.5.1).

b) The temporary horizontal deflection of the luminaire connection caused during the load test by the incremental load due to the horizontal forces corresponding to the test load shall not exceed the value given in EN 40-3-3:2013, Table 4.

6.3 Structural requirements

Structural requirements are as follows:

a) For steel and aluminium lighting columns the residual deflection after removal of the test load shall be no greater than 10 % of the deflection caused by the test load.

b) For concrete lighting columns the residual deflection after removal of the test load shall be no greater than 20 % of the deflection caused by the test load.

c) For fibre reinforced polymer composite lighting columns the residual deflection after removal of the test load shall be no greater than 5 % of the deflection caused by the test load.

6.4 Minimum ultimate requirement

The minimum ultimate load achieved shall be not less than the test load multiplied by the factor γ_u and shall be the greatest value obtained for the cross-sections listed in 6.5. The factor γ_u shall be obtained from the following formula:

$$\gamma_{\mathrm{u}} = \gamma_t \frac{f_{yT}}{f_y} \cdot \frac{I_T}{I} \quad (1)$$

where

f_y is the characteristic strength of the material

f_{yT} is the actual strength of material in the lighting column

I is the specified inertia

I_T is the inertia of the test lighting column

γ_t is the test factor, equal to γ_f partial safety factor for wind loads given in EN 40-3-3:2013, 5.4 and Table 1.

The ratios shall not be included if less than 1.

Where more than one material, or batch of material, is used in construction of the test lighting column, the highest ratio shall be adopted.

For metal lighting columns f_{yT} shall be taken as either the yield stress or if a yield phenomenon is not present, the 0,2 % proof stress non proportional extension shall be used.

For concrete lighting columns f_{yT} shall be as defined in EN 40-4 and shall be determined from test pieces cast at the same time and from the same batch as the test lighting column.

For fibre reinforced polymer composite lighting columns f_{yT} shall be as defined in EN 40-7 and shall be determined from appropriate testing of a significant batch of columns.

6.5 Critical cross-sections

The adequacy of the strength of the lighting column under test shall be checked at the following cross sections:

a) the point at which the lighting column is fixed (normally at ground level);

b) the lower edge of the door opening. If the positions of the door and brackets can be changed relative to each other and are not specified, the lower edge of the door opening should be calculated about its weakest axis. If two or more door openings are provided, the strength at each opening shall be verified;

c) in addition to b) for tapered columns the top of the door opening. If two or more door openings are provided the strength at each opening shall be verified;

d) the point at which the bracket begins if the lighting column and bracket are in one piece, or the point at which the bracket is attached if the bracket is detachable and check the junction between the bracket arm and the column;

e) transition from one diameter to another or change in material thickness;

f) anti-rotation device between the column and bracket arm, if such a device is present and intended to transfer torsional forces between the bracket arm and the column;

g) any other critical position.

6.6 Ultimate failure test (optional)

After completion of the minimum ultimate load test in 6.4 the lighting column may, at the discretion of the manufacturer, be taken to ultimate failure. Where this is done, the result shall be recorded.

7 Preparation for test

The lighting column tested shall be representative of the production batch being assessed.

The lighting column shall be tested in either a horizontal or vertical position. When tested in the horizontal position, the dead loads resulting from testing in this position shall be taken into account, or be compensated for by appropriate supports.

During the test, the lighting column shall be rigidly secured over its planting depth. The upper support point shall coincide with the intended ground level. Lighting columns with flange plates shall be bolted to a rigid plate using bolts of the same size as specified for use in final erection of the lighting column.

The position of the door relative to the direction of the horizontal loading shall be in the most onerous position allowed in design and the position shall be stated. Where a bracket is used, the position of the bracket projection relative to the position of the door shall be stated.

NOTE Before carrying out the tests described in Clause 8, the lighting column can be loaded once and then unloaded, provided that the applied load does not exceed 50 % of the test load calculated in accordance with EN 40-3-1:2013.

8 Application of forces

8.1 General

The forces shall be applied by dead weights or by means of devices such as load cells having an accuracy of at least $\pm$ 2 %.

8.2 Serviceability requirements

8.2.1 Vertical deflection

For lighting columns with brackets the vertical forces corresponding to the masses of the luminaire and that part of the bracket deviating from the vertical shall be applied first.

The vertical deflection of the luminaire connection caused by the vertical forces shall be measured and entered in the test report. The vertical forces shall remain applied during all subsequent testing.

8.2.2 Horizontal deflection

Horizontal forces shall be applied to act so that the moments caused at the critical sections in the column (see 6.5) are at least equal to the moments resulting from the test loads. At all other points the moments shall be not less than 95 % of the moments resulting from the test loads.

The horizontal forces shall be applied in stages by means of at least four approximately equal incremental loads up to the test load. At the test load, the horizontal deflection of the luminaire connection shall be measured and entered in the test report.

8.3 Structural requirements

After unloading from the horizontal deflection test, the residual linear horizontal deflection shall be measured and recorded.

8.4 Minimum ultimate load test

On completion of the test in 8.3, the horizontal forces shall be gradually and proportionally increased up to the minimum ultimate load as determined from 6.4 of this standard.

At this minimum ultimate load condition, the horizontal and vertical deflections shall be measured and recorded.

8.5 Ultimate failure test (optional)

When this test is carried out, the loads shall be applied in increments until failure occurs. The loading at ultimate failure shall be recorded.

9 Test report

A test report shall describe the method of testing in detail and contain at least the information listed in Annex A.

10 Type test certificate

A type test certificate shall contain at least the information listed in Annex B.

11 Permissible modifications to type tested columns

Where alterations to requirements produce loads which differ from the test loads, e.g. as a result of a change in the specified wind load or luminaire area, new bending and torsional moments shall be calculated as specified in EN 40-3-1:2013 for the new test load. If the moments thus calculated show that the bending and torsional moments do not at any point exceed the moments produced by the test, the type test shall be deemed to verify the modifications.

12 Fatigue requirements

Fatigue requirements are not covered in this standard. However, if specified, the possibility of fatigue effects may be considered for lighting columns above 9 m in height. If fatigue testing is specified, then the requirements and methods of test shall be provided.

NOTE 1 Due to the inherent rigidity of concrete lighting columns, it is not normally necessary to consider fatigue for concrete lighting columns.

NOTE 2 For fibre reinforced polymer composite lighting columns, unless statistically significant published fatigue test reports are available, appropriate testing is carried out.

Annex A
(normative)

Lighting columns: Report on type testing as specified in EN 40-3-2:2013

A test report shall be provided for all lighting columns verified by testing. This should contain, as a minimum, the information given in this annex.

An example showing the typical layout of such a report is given below.

Column type_____ Production No_____ Production Date_____

Nominal height *h* _____m Bracket projection *w* _____m

Luminaire: Weight _____kg. Windage_____m^2 Length_____m

Overall door opening length, a_____mm Overall door opening width, b _____mm

Dimension from ground level to bottom of door opening, c_____mm

γ_u = (As defined in 6.4)

Relationship between positions of door opening and bracket(s) on tested column.

Table A.1 Forces required to simulate the tests loads

Application point of the forces	Direction	Forces	
		Test load N	Minimum ultimate load N
Luminaire connection	vertical		
Luminaire connection	horizontal		
Brackets.....m			
Distance from the	vertical		
longitudinal axis	horizontal		
of the column shaft			
Bracket connection	horizontal		
.... m above ground level	horizontal		
.... m above ground level	horizontal		
.... m above ground level	horizontal		
NOTE The dimensions of the tested column are given in a special drawing attached to this test report.			

Table A.2 Test moments and resulting deflections

a) Vertical forces

The vertical deflection of the luminaire connection caused by the vertical forces is _____m.

b) Horizontal forces

1	2	3	4	5	6	7	8	9	10
Type of test	Type of moment	Moment at the bracket connection Nm	Moment at .....m above ground level Nm	Moment at ....m above ground level Nm	Moment at lower edge of the door opening Nm	Moment at upper edge of the door opening Nm	Moment at ground level Nm	Deflection under load m	Permanent deflection after removal of load m
Test loads	Required BM								
	Required TM								
	Actual BM								
	Actual TM								
Minimum ultimate loads	Actual BM								
	Actual TM								

NOTE

Column 2. BM = bending moment: TM = torsional moment

Columns 4 and 5 apply for points with significant changes in section

Annex B
(normative)

Lighting columns: Certificate for the type test specified in EN 40-3-2:2013

A type test certificate shall be produced for all lighting columns verified by testing. This should contain, as a minimum, the information given in this Annex.

An example showing the typical layout of such a certificate is given below.

Column type_____ Production No_____ Production Date_____

Nominal height *h* _____m Bracket projection *w* _____m

Luminaire: Weight _____kg. Windage_____m^2 Length_____m

Overall door opening length, a_____mm Overall door opening width, b _____mm

Dimension from ground level to bottom of door opening, c_____mm

γ_u = (As defined in 6.4)

Style of bracket:

one, two or several arms.

Relationship between positions of door opening and bracket(s) on tested column.

The dimensions of the tested column are given in a special drawing attached to this certificate.

Results of the type test

- Vertical deflection of the luminaire connection at the test load _____m
- Horizontal deflection of luminaire connection at the test load _____m
- Residual horizontal deflection of the luminaire connection after removal of the test load _____m
- Ratio of residual deflection to deflection at test load_____%
- horizontal deflection at minimum ultimate load _____ m

Certification

It is certified that the above specified lighting column has been tested in accordance with EN 40-3-2:2013 and that the results of the test lie within the limits specified in Clause 6. The structural design of this type of column is therefore deemed as verified.

Issued on behalf of:

Signature:

Date:

Bibliography

[1] EN 40-2:2004, *Lighting columns — Part 2: General requirements and dimensions*

[2] EN 40-5:2002, *Lighting columns — Part 5: Requirements for steel lighting columns*

[3] EN 40-6:2002, *Lighting columns — Part 6: Requirements for aluminium lighting columns*

[4] EN 1990:2002, *Eurocode — Basis of structural design*

[5] EN 1991-1-1, *Eurocode 1. Actions on structures. General actions. Densities, self-weight, imposed loads for buildings*

[6] EN 1991-1-4, *Eurocode 1: Actions on structures — Part 1-4: General actions — Wind action*

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