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SWEDISH STANDARDS INSTITUTE

Belysningsstolpar –
Del 3-3: Konstruktion och verifiering – Verifiering genom beräkning

Lighting columns –
Part 3-3: Design and verification – Verification by calculation

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Europastandarden EN 40-3-3:2013 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN 40-3-3:2013.

Denna standard ersätter SS-EN 40-3-3, utgåva 1.

The European Standard EN 40-3-3:2013 has the status of a Swedish Standard. This document contains the official version of EN 40-3-3:2013.

This standard supersedes the Swedish Standard SS-EN 40-3-3, edition 1.

Upplysningar om sakinnehållet i standarden lämnas av SIS, Swedish Standards Institute, telefon 08-555 520 00. Standarder kan beställas hos SIS Förlag AB som även lämnar allmänna upplysningar om svensk och utländsk standard.

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Denna standard är framtagen av kommittén för Vägutrustning, SIS/TK 248.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 40-3-3

February 2013

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Supersedes EN 40-3-3:2003

English Version

Lighting columns - Part 3-3: Design and verification - Verification by calculation

Candélabres d'éclairage public - Partie 3-3: Conception et vérification - Vérification par calcul

Lichtmaste - Teil 3-3: Bemessung und Nachweis - Rechnerischer Nachweis

This European Standard was approved by CEN on 25 November 2012.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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Foreword

This document (EN 40-3-3:2013) 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of an identical text or by endorsement, at the latest by August 2013, and conflicting national standards shall be withdrawn at the latest by August 2013.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 40-3-3:2003.

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.

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies the requirements for the verification of the design of lighting columns by calculation. 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.

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 standard. Fibre reinforced polymer composite lighting columns are covered in this standard in conjunction with EN 40-7.

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).

The calculations used in this European Standard are based on limit state principles, where the effects of factored loads are compared with the relevant resistance of the structure. Two limit states are considered:

a) the ultimate limit state, which corresponds to the load-carrying capacity of the lighting column;

b) the serviceability limit state, which relates to the deflection of the lighting column in service.

NOTE In following this approach, simplifications appropriate to lighting columns have been adopted. These are:

1) the calculations are applicable to circular and regular octagonal cross-sections;

2) the number of separate partial safety factors have been reduced to a minimum;

3) serviceability partial safety factors have a value equal to unity.

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

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

EN 40-7:2002, *Lighting columns — Part 7: Requirements for fibre reinforced polymer composite lighting columns*

EN 1993-1-1, *Eurocode 3: Design of steel structures — Part 1-1: General rules and rules for buildings*

EN 1999-1-1, *Eurocode 9: Design of aluminium structures — Part 1-1: General rules — General rules and rules for buildings*

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	Clear length of door opening
a_r	Length of the door cut out in the column wall for type 5 reinforcement
A_e	Effective cross-sectional area of door reinforcement.
A_s	Cross-sectional area of door reinforcement
b	Clear width of the door opening
b_r	Width of the door cut out in the column wall for type 5 reinforcement
B_x	Factor defined in 5.6.2.3.2
B_y	Factor defined in 5.6.2.3.2
C	Length of halves of straight edge of door opening
d_w	Width of door reinforcement
e	Specified elongation
E	Modulus of elasticity
f_y	Characteristic yield strength
F	Factor defined in 5.6.2.2
g	Factor defined in 5.6.2.2
G	Shear Modulus
h	Nominal height
J	Mean dimension of flat side of octagonal cross section
J_o	Mean dimension of flat side at edge of door opening.
l	Length of Type 5 reinforcing. (Fig. 6e)
L	Effective length of door opening
m_{ox}	Distance from centroid of door reinforcement measured normal to the x-x axis.
m_{oy}	Distance from centroid of door reinforcement measured normal to the y-y axis.
m_x	Distance from centre of column wall at the door opening measured normal to the x-x axis.
m_y	Distance from centre of column wall at the door opening measured normal to the y-y axis.
M_p	Combined bending moment for closed regular cross-sections.
M_{up}	Bending moment of resistance for closed regular cross sections.
M_{ux}	Bending moment of resistance about x-x axis.
M_{uy}	Bending moment of resistance about y-y axis.
M_x	Bending moment about x-x axis.
M_y	Bending moment about y-y axis.
N	Corner radius of door opening.
P	Factor defined in 5.6.2.3.2
R	Mean radius of cross-section.
R_w	Mean radius of cross-section of type 5 reinforcement
S	Length of end connection of door reinforcement.
t	Nominal wall thickness
t_0	Lesser of t and t_w.
t_w	Nominal thickness of reinforcement at the side of the door opening.
T_p	Torsion moment
T_u	Torsion moment of resistance

v	Radius of gyration of door reinforcement
w	Bracket projection
Z_p	Plastic modulus of closed regular cross-section
Z_{pn}	Plastic modulus of unreinforced door opening cross-section about n-n axis.
Z_{py}	Plastic modulus of unreinforced door opening cross-section about y-y axis.
Z_{pnr}	Plastic modulus of reinforced door opening cross-section about n-n axis.
Z_{pyr}	Plastic modulus of reinforced door opening cross-section about y-y axis.
γ_f	Partial load factor.
γ_m	Partial material factor.
θ	Half angle of the clear door opening.
θ_r	Half angle of the door cut out in the column for type 5 reinforcement
π	Constant = 3,1416
ε	Factor defined in 5.6.2.1
ϕ_1 / ϕ_2	Factors defined in 5.6.2.1
ϕ_3 / ϕ_5	Factors defined in 5.6.2.2
ϕ_6 / ϕ_7	Factors defined in 5.6.2.3.2

5 Structural strength requirements (ultimate limit state)

5.1 Application of calculations

The adequacy of the strength of the lighting column shall be calculated for the following cross sections:

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

b) the lower edge of the door opening. If the positions of the door and the 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 of each opening shall be verified (see Figure 1);

c) in addition to b) for tapered lighting columns the top of the door opening. If two or more door openings are provided, the strength of each opening shall be verified (see Figure 1);

d) the point at which the bracket begins if the column and the bracket consist of 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 at a change in material thickness;

f) anti-rotation device between the columns and the 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.

5.2 Characteristic loads

The characteristic loads for strength requirements shall be calculated in accordance with EN 40-3-1.

5.3 Characteristic strength of materials

5.3.1 Metal lighting columns

The characteristic yield strength $f_{y,}$ in N/mm^2, of steel and aluminium alloys shall be calculated in accordance with EN 1993-1-1 and EN 1999-1-1 respectively.

The increase in yield strength due to any process (such as cold working) shall not be used for members which are subject to another process (such as heat treatment or welding) which may result in softening.

5.3.2 Concrete lighting columns

The characteristic strength shall be determined in accordance with EN 40-4.

5.3.3 Fibre reinforced polymer composite lighting columns

The characteristic strength shall be determined in accordance with EN 40-7.

5.4 Design loads

The characteristic loads specified in 5.2 shall be multiplied by the appropriate partial load factors, γ_f shown in Table 1 to give the design load to be used for the ultimate limit state calculation.

Table 1 — Partial load factors γ_f

	Wind load	Dead load
Class A	1,4	1,2
Class B	1,2	1,2
Serviceability Limit State	1,0	1,0

NOTE Refer to National Guidance or National Annex for selection of the correct class.

5.5 Calculation of moments

5.5.1 Bending moments

The bending moments, M_x and M_y, in Nm, about the orthogonal axes *x-x* and *y-y*, respectively, shall be calculated for each position specified in 5.1 using the design loads specified in 5.4.

For cross-sections with openings the *x-x* and *y-y* axes shall be taken as shown in Figures 5b and 6.

NOTE For regular octagonal cross-sections the axes can be positioned through the centre of the flat side or through a corner.

For closed regular cross-sections, the bending moments M_x and M_y may be combined to give a single moment, $M_{p,}$ in Nm, that gives the most adverse action on the column cross-section being considered and shall be calculated from the formula:

$$M_p = \sqrt{M_x^2 + M_y^2} \qquad (1)$$