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English Version

Solar energy systems for roofs - Requirements for structural connections to solar panels

Systèmes d'énergie solaire pour les toits : Exigences relatives aux raccordements des panneaux solaires à la charpente

Solare Energiesysteme für Dächer: Anforderungen an konstruktive Verbindungen zu Sonnenkollektoren

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| Contents | Page |
|---|-------------|
| European foreword..... | 7 |
| Introduction | 8 |
| 1 Scope..... | 9 |
| 2 Normative references..... | 9 |
| 3 Terms and definitions | 10 |
| 4 Symbols..... | 10 |
| 5 Configuration of solar panel installation..... | 10 |
| 6 Design responsibility..... | 10 |
| 7 Thermal solar collectors and PV solar panels | 10 |
| 8 Principles of limit state structural design..... | 11 |
| 8.1 General..... | 11 |
| 8.2 Design situations..... | 11 |
| 8.3 Ultimate limit state..... | 11 |
| 8.4 Serviceability limit state..... | 11 |
| 9 Determination of actions..... | 11 |
| 9.1 Permanent actions (G) | 11 |
| 9.2 Variable actions (Q)..... | 11 |
| 9.2.1 General..... | 11 |
| 9.2.2 Imposed loads | 12 |
| 9.2.3 Snow loads..... | 12 |
| 9.2.4 Wind loads..... | 12 |
| 9.2.5 Critical load combinations..... | 13 |
| 9.2.6 Load combination factor ψ | 13 |
| 9.2.7 Partial safety factors for actions..... | 13 |
| 9.2.8 Consequence of structural failure..... | 13 |
| 10 Structural resistance of connections..... | 14 |
| 10.1 Configuration and type of connectors | 14 |
| 10.2 Design by calculation..... | 14 |
| 10.3 Design assisted by testing..... | 14 |
| 11 Design for accidental action..... | 15 |
| 12 Design for seismic action..... | 15 |
| Annex A (informative) Examples of connection design..... | 17 |
| A.1 Fixing hook for PV solar panels mounted above tiled roof..... | 17 |
| A.1.1 Description of the system..... | 17 |
| A.1.2 Climate zone..... | 17 |
| A.1.3 Loads..... | 17 |
| A.1.3.1 Dead loads..... | 17 |

| | |
|---|----|
| A.1.3.2 Imposed load | 18 |
| A.1.3.3 Wind and snow loads..... | 18 |
| A.1.3.4 Calculation of the wind load acting on the panels..... | 18 |
| A.1.3.5 Snow loads..... | 19 |
| A.1.3.6 Summary of loads acting on a single panel, in directions normal to the roof and down the roof..... | 19 |
| A.1.4 Factored load combinations for the ultimate limit state..... | 20 |
| A.1.5 Factored load combinations for the serviceability limit state..... | 21 |
| A.1.6 Structural resistance (by test)..... | 22 |
| A.1.6.1 General..... | 22 |
| A.1.6.2 Characteristic Resistance..... | 23 |
| A.1.6.3 Safety factors and design resistance | 24 |
| A.1.6.3.1 General | 24 |
| A.1.6.3.2 Ultimate Limit State for characteristic resistance by test..... | 24 |
| A.1.6.3.3 Serviceability Limit State for resistance by test | 24 |
| A.1.6.3.4 Design structural resistance values:..... | 24 |
| A.1.7 Design verification – derivation of the number of hooks required | 25 |
| A.2 Thermal solar collector on flat roof stabilized with dead weight | 27 |
| A.2.1 Description of the system..... | 27 |
| A.2.2 Climate zone..... | 27 |
| A.2.3 Loads..... | 27 |
| A.2.3.1 Dead loads | 27 |
| A.2.3.2 Wind load at roof height Z..... | 27 |
| A.2.4 Ultimate load case for uplift and sliding..... | 28 |
| A.2.5 Serviceability limit state..... | 28 |
| A.2.6 Ultimate resistance to uplift and sliding | 28 |
| A.2.7 Design downward load on roof (concrete blocks + collector + downward wind + snow, excluding self weight of roof structure Concrete blocks: $14 \times 0,35 \times 1,35 = 6,62 \text{ kN}$ ($\gamma_G = 1,35$) | 29 |
| A.2.8 Verify the design load and compression strength of the aluminium member BD | 30 |
| A.2.8.1 Critical load case: Snow + downward wind | 30 |
| A.2.8.1.1 Snow: In accordance with EN 1991-1-3: | 30 |
| A.2.8.1.2 Wind: Downward pressure coefficient $c_{p,net} = +1,2$ | 30 |
| A.2.8.1.3 Factored snow, wind and dead loads..... | 30 |
| A.2.8.2 Compression strength of member BD | 33 |
| A.2.9 Summary of design verification for compression member BD | 34 |
| A.3 Connections for an in-roof solar PV system..... | 35 |

| | | |
|--|--|-----------|
| A.3.1 | Description of the system..... | 35 |
| A.3.2 | Climate zone..... | 35 |
| A.3.3 | Loads..... | 35 |
| A.3.3.1 | Dead load..... | 35 |
| A.3.3.2 | Imposed loads | 35 |
| A.3.3.3 | Wind loads..... | 35 |
| A.3.3.3.1 | General | 35 |
| A.3.3.3.2 | External pressure coefficient | 35 |
| A.3.3.4 | Snow loads | 36 |
| A.3.3.5 | Thermal loads..... | 36 |
| A.3.4 | Vector load components..... | 37 |
| A.3.5 | Ultimate limit state load combinations..... | 37 |
| A.3.5.1 | Ultimate limit state criteria..... | 37 |
| A.3.5.2 | Load cases | 37 |
| A.3.5.3 | Vectorial load..... | 38 |
| A.3.6 | Serviceability limit state load combinations..... | 39 |
| A.3.6.1 | Serviceability limit state criteria..... | 39 |
| A.3.7 | Structural resistance of connections..... | 39 |
| A.3.7.1 | Lower side of module..... | 39 |
| A.3.7.1.1 | General | 39 |
| A.3.7.1.2 | Axial load | 39 |
| A.3.7.1.3 | Shear Load | 40 |
| A.3.7.2 | Upper edge of module..... | 41 |
| A.3.8 | Design verification (resistance \geq loads) | 42 |
| A.3.8.1 | Lower edge of module | 42 |
| A.3.8.2 | Upper interlocking profile..... | 43 |
| A.4 | Earthquake resistant design of solar PV panel connections | 43 |
| A.4.1 | Description of the system..... | 43 |
| A.4.2 | Seismic zone | 43 |
| A.4.3 | Calculation of the seismic load acting on the panels | 43 |
| A.4.4 | Seismic load and other loads acting on a single panel..... | 45 |
| A.4.5 | Load Combination..... | 45 |
| Annex B (normative) Supplementary information on wind actions | | 47 |
| B.1 | General..... | 47 |
| B.2 | Terms and definitions (NEN 7250:2014/A1:2015 3.0) | 47 |
| B.2.1 | back panel (NEN 7250:2014/A1:2015 3.1)..... | 47 |

| | | |
|-----------|---|----|
| B.2.2 | building construction (NEN 7250:2014/A1:2015 3.2) | 47 |
| B.2.3 | eave height (NEN 7250:2014/A1:2015 3.3) | 47 |
| B.2.4 | photovoltaic element (NEN 7250:2014/A1:2015 3.4) | 47 |
| B.2.5 | combined element (NEN 7250:2014/A1:2015 3.5) | 47 |
| B.2.6 | closed substructure (NEN 7250:2014/A1:2015 3.6) | 47 |
| B.2.7 | façade (NEN 7250:2014/A1:2015 3.7) | 47 |
| B.2.8 | sloping roof (NEN 7250:2014/A1:2015 3.8) | 48 |
| B.2.9 | high side (NEN 7250:2014/A1:2015 3.9) | 48 |
| B.2.10 | mounting method (NEN 7250:2014/A1:2015 3.10) | 48 |
| B.2.11 | mounting method 1 (NEN 7250:2014/A1:2015 3.11) | 48 |
| B.2.12 | mounting method 2 (NEN 7250:2014/A1:2015 3.12) | 49 |
| B.2.13 | mounting method 3 (NEN 7250:2014/A1:2015 3.13) | 50 |
| B.2.14 | mounting method 4 (NEN 7250:2014/A1:2015 3.14) | 51 |
| B.2.15 | mounting method 5 (NEN 7250:2014/A1:2015 3.15) | 52 |
| B.2.16 | low side (NEN 7250:2014/A1:2015 3.16) | 53 |
| B.2.17 | substructure (NEN 7250:2014/A1:2015 3.17) | 53 |
| B.2.18 | open substructure (NEN 7250:2014/A1:2015 3.18) | 53 |
| B.2.19 | flat roof (NEN 7250:2014/A1:2015 3.19) | 53 |
| B.2.20 | thermal element (NEN 7250:2014/A1:2015 3.20) | 53 |
| B.2.21 | external dividing construction (NEN 7250:2014/A1:2015 3.21) | 54 |
| B.2.22 | solar element (NEN 7250:2014/A1:2015 3.22) | 54 |
| B.2.23 | solar energy system (NEN 7250:2014/A1:2015 3.23) | 54 |
| B.3 | Requirements for the construction (NEN 7250:2014/A1:2015 6) | 54 |
| B.3.1 | General (NEN 7250:2014/A1:2015 6.1) | 54 |
| B.3.2 | Wind load (NEN 7250:2014/A1:2015 6.2) | 54 |
| B.3.2.1 | General (NEN 7250:2014/A1:2015 6.2.1) | 54 |
| B.3.2.2 | Net pressure coefficient for mounting method 1 (NEN 7250:2014/A1:2015 6.2.2) | 55 |
| B.3.2.2.1 | External pressure coefficient c_{pe} , mounting method 1 (NEN 7250:2014/A1:2015 6.2.2.1) | 55 |
| B.3.2.2.2 | Internal pressure coefficient, c_{pi} , mounting method 1 (NEN 7250:2014/A1:2015 6.2.2.2) | 55 |
| B.3.2.2.3 | Pressure equalization factor c_{eq} mounting method 1, sloping roof (NEN 6.2.2.3) | 55 |
| B.3.2.2.4 | Pressure equalization factor c_{eq} , mounting method 1, wall (NEN 7250:2014/A1:2015 6.2.2.4) | 57 |
| B.3.2.3 | Net pressure coefficients for mounting method 2 (NEN 7250:2014/A1:2015 6.2.3) | 59 |
| B.3.2.3.1 | Net Pressure Coefficient, $c_{p,net}$, pitched roof, parallel (NEN 7250:2014/A1:2015 6.2.3.1) | 59 |

| | | |
|-----------|--|----|
| B.3.2.3.2 | Net Pressure Coefficient, $c_{p, net}$, pitched roof, not-parallel (NEN 7250:2014/A1:2015 6.2.3.2) | 60 |
| B.3.2.3.3 | Net Pressure Coefficient, $c_{p, net}$, of Mounting method 2, façade (NEN 7250:2014/A1:2015 6.2.3.3) | 61 |
| B.3.2.3.4 | Net Pressure coefficient $c_{p, net}$, for mounting method 2, flat roof (NEN 7250:2014/A1:2015 6.2.3.4) | 61 |
| B.3.2.4 | Net pressure coefficient $c_{p, net}$, for mounting method 3 (NEN 7250:2014/A1:2015 6.2.4) | 62 |
| B.3.2.4.1 | General (NEN 7250:2014/A1:2015 6.2.4.1) | 62 |
| B.3.2.4.2 | Open support structure (NEN 7250:2014/A1:2015 6.2.4.2) | 62 |
| B.3.2.4.3 | Closed under construction (NEN 7250:2014/A1:2015 6.2.4.3) | 65 |
| B.3.2.4.4 | Load Zones (NEN 7250:2014/A1:2015 6.2.4.4) | 66 |
| B.3.2.4.5 | Roof areas (NEN 7250:2014/A1:2015 6.2.4.5) | 67 |
| B.3.2.5 | Net pressure coefficient mounting methods 4 and 5 (NEN 7250:2014/A1:2015 6.2.5) | 69 |
| B.3.3 | Determination of the design value for wind load resistance of solar energy systems according to assembly method 1 and 2 by testing (research prototype) (NEN 7250:2014/A1:2015 11.2) | 69 |
| B.3.3.1 | General (NEN 7250:2014/A1:2015 11.2.1) | 69 |
| B.3.3.2 | Principle (NEN 7250:2014/A1:2015 11.2.2) | 70 |
| B.3.3.3 | Sampling (NEN 7250:2014/A1:2015 11.2.3) | 70 |
| B.3.3.4 | Test Conditions (NEN 7250:2014/A1:2015 11.2.4) | 70 |
| B.3.3.5 | Specimen (NEN 7250:2014/A1:2015 11.2.5) | 70 |
| B.3.3.5.1 | Test Samples (NEN 7250:2014/A1:2015 11.2.5.1) | 70 |
| B.3.3.5.2 | Dimensions of the test specimen (NEN 7250:2014/A1:2015 11.2.5.2) | 70 |
| B.3.3.5.3 | Number of tests (NEN 7250:2014/A1:2015 11.2.5.3) | 70 |
| B.3.3.5.4 | Composition of the test piece (NEN 7250:2014/A1:2015 11.2.5.4) | 70 |
| B.3.3.5.5 | Equipment and apparatus (NEN 7250:2014/A1:2015 11.2.6) | 70 |
| B.3.3.5.6 | Test Procedure and evaluation (NEN 7250:2014/A1:2015 11.2.7) | 70 |
| | Bibliography | 73 |

European foreword

This document (CEN/TR 16999:2019) has been prepared by Technical Committee CEN/TC 128 “Roof covering products for discontinuous laying and products for wall cladding”, the secretariat of which is held by NBN in co-operation with CEN/TC250 “Structural Eurocodes”, CEN/TC254 “Flexible sheets for waterproofing”; CEN/TC312 “Thermal solar systems and components” and CLC/TC82 “Solar photovoltaic energy systems”.

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Introduction

The following is a summary of the requirements for structural design of the structural connection between solar energy panels and the roof structure as detailed in this Technical Report.

- a) Type of solar panel: Thermal or photovoltaic solar panels which comply with the mechanical resistance requirements of EN 12975-1 (solar thermal collectors) or EN 61215 (solar PV panels).
- b) Determining of the loads and load combinations: self-weight of the solar panels and relevant imposed snow and wind actions in accordance with EN 1991-1-1, EN 1991-1-3 and EN 1991-1-4. Referring to French Standard NF P78-116 and Dutch Standard NEN 7250 for additional data on snow and wind loads on solar panels.
- c) Determining the design loads for the solar panels: multiplication of each of the loads by their respective partial factor γ_G or γ_Q for the ultimate limit state, and separately for the serviceability limit state in accordance with EN 1990.
- d) Identifying combinations of most unfavourable design loads which act together at the same time, for the ultimate and serviceability limit states. Modifying the loads by applying a load combination factor ψ to one of the two variable loads which act at the same time.
- e) Determining of the structural resistance of the connections between the solar panels and the roof structure in accordance with calculation methods of one or more of the following European Standards:
EN 1992 series to EN 1996 series, and EN 1999 series for the ultimate and serviceability limit states:
 - 1) For the serviceability limit state, determining of the resistance at the specified maximum deformation limiting the function of the connection;or
 - 2) determine the resistance by serviceability and ultimate load tests.
- f) Verifying the design by confirming that the factored structural resistance is not less than the critical combinations of factored actions for both limit states.

Four examples of design calculations for different solar panel connections are given in Annex A.

1 Scope

This document provides guidance on the principles and requirements of structural design for the safety and serviceability of the structural connection between solar energy panels (thermal or photovoltaic) and the structure of flat or pitched roofs.

This document does not include requirements for:

- weather tightness of the roof, solar panels and connections;
- electrical, thermal or mechanical characteristics of the solar panels;
- precautions against fire of the installation.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1990:2002, *Eurocode - Basis of structural design*¹⁾

EN 1991-1-1, *Eurocode 1: Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings*

EN 1991-1-3:2003, *Eurocode 1 - Actions on structures - Part 1-3: General actions - Snow loads*

EN 1991-1-4:2005, *Eurocode 1: Actions on structures - Part 1-4: General actions - Wind actions*

EN 1992 (all parts), *Eurocode 2 - Design of concrete structures*

EN 1993 (all parts), *Eurocode 3 - Design of steel structures*

EN 1994 (all parts), *Eurocode 4 - Design of composite steel and concrete structures*

EN 1995 (all parts), *Eurocode 5 - Design of timber structures*

EN 1996 (all parts), *Eurocode 6 - Design of masonry structures*

EN 1998-1:2004, *Eurocode 8: Design of structures for earthquake resistance - Part 1: General rules, seismic actions and rules for buildings*²⁾

EN 1998 (all parts), *Eurocode 8: Design of structures for earthquake resistance*

EN 1999 (all parts), *Eurocode 9: Design of aluminium structures*

EN 1999-1-1:2007, *Eurocode 9: Design of aluminium structures - Part 1-1: General structural rules*³⁾

1) This document is impacted by the amendment EN 1990:2002/A1:2005.

2) This document is impacted by the amendment EN 1998-1:2004/A1:2013.

3) This document is impacted by the amendments EN 1999-1-1:2007/A1:2009 and EN 1999-1-1:2007/A2:2013.