SLOVENSKI STANDARD
oSIST prEN 13031-2:2024

01-januar-2024

Rastlinjaki: Projektiranje in gradnja - 2. del: Rastlinjaki v vrtnih centrih

Greenhouses: Design and construction - Part 2: Greenhouses in garden centres open to the public

Gewächshäuser - Bemessung und Konstruktion - Teil 2: Verkaufsgewächshäuser

Serres - Calcul et construction - Partie 2: Serres dans les jardineries ouvertes au public

Ta slovenski standard je istoveten z: **prEN 13031-2**

ICS:

65.040.30	Rastlinjaki in druge naprave	Greenhouses and other installations

oSIST prEN 13031-2:2024	**en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 13031-2

October 2023

ICS 65.040.30

English Version

Greenhouses: Design and construction - Part 2: Greenhouses in garden centres open to the public

Gewächshäuser - Bemessung und Konstruktion - Teil 2: Verkaufsgewächshäuser

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (prEN 13031-2:2023) has been prepared by Technical Committee CEN/TC 284 “Greenhouses”, the secretariat of which is held by NEN.

This document is currently submitted to the CEN Enquiry.

Part 2 (EN 13031-2) is related to greenhouses open to the public used for the exhibition, presentation and / or retail of plants.

This Euronorm recognizes the responsibility of each Eurocode Member State and safeguards their right to determined values related to regulatory safety matters at national level through the use of National Annexes.

Introduction

This document relates specifically to greenhouses open to the public, used for the exhibition, presentation and / or sale of plants, such as greenhouses in garden centers or expositions in botanical gardens. Part 1 of this document is related to commercial production greenhouses used for the professional production of plants with limited access for authorized personnel only.

The structural design of greenhouses open to the public is carried out using EN 1990 and the relevant parts of EN 1991 to EN 1999 (Eurocodes 1 to 9) and any further parts, which may follow (e.g. for glass), regarding the general principles and basic requirements for actions, structural resistance and stability, serviceability, durability and robustness. National Application Documents (NAD) are considered for each of the parts.

This document gives additional non-contradictory rules and complementary information for snow actions on the transparent claddings of greenhouses, where special methods are used, to remove snow and optimize the transmission of solar radiation, which would otherwise not permit the climate for a successful growth of plants.

The snow load on the roof can be controlled by removing snow, for example by melting snow with a system for controlled heating. Controlled snow load is the difference between the initial snow load expected when heavy snowfall starts, and the snow load removed by a device whose performance is guaranteed even during heavy snowfall, see ISO 4355. With this document the values for controlled snow loads can be calculated, taking into account the thermal coefficient C_t for roof claddings with high thermal transmittance.

For wind loads on greenhouses with multi-span roofs EN 1991-1-4 gives conservative values for pressure coefficients. In supplement to calculations according EN 1991-1-4, wind tunnel tests and proven and/or properly validated numerical methods may be used to obtain load and response information.

This document can be applied either to the greenhouse or only to the transparent cladding system.

As long as a structural Eurocode part on glass is not available, it is recommended to specify the glazing and the relevant design regulations in the National Annex to this part of the standard. For flat glass panels uniformly loaded perpendicular to their surface, simply supported along the edges and with nominal thickness not less than 4 mm EN 13031-1 can be used.

National choices are allowed in EN 13031-2 through the following clauses:

— Introduction NOTE: for the glazing and design method for the structural safety of glass panels (as long as the Eurocode Glass or other regulations (NAD) are not available)

— 5.1 (2) for the estimation of thermal coefficients $C_t < 1$

— 5.2 (3) for minimum air temperature under the roof for controlled heating

— 5.2 (5) for safety measures for controlled heating

— 5.4 (2) for appropriate snow load distributions for sliding snow on slippery surfaces

National choice is allowed in EN 13031-2 on the use of the informative annexes:

— Annex A for the minimum roof snow load and the calculation of C_t using the formulae and appropriate limitations

— Annex B for the estimation of $C_{t,0}$ or C_t based on heat flux, melt rates and snowfall rates

When no national choice is given, the default choice given in this document can be used. The National Annex can contain, directly or by reference, further non-contradictory complementary information, in line with the verbal forms “shall”, “should”, “may” and “can”, as they are used in the Eurocode.

1 Scope

This document specifies principles and requirements for the estimation of controlled snow loads on the transparent cladding of greenhouses open to the public.

Fire resistance-related aspects are not covered in this document.

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.

ISO 4355, *Bases for design of structures — Determination of snow loads on roofs*

EN 673, *Glass in building - Determination of thermal transmittance (U value) - Calculation method*

EN 674, *Glass in building - Determination of thermal transmittance (U value) - Guarded hot plate method*

EN 675, *Glass in building - Determination of thermal transmittance (U value) - Heat flow meter method*

EN ISO 6946, *Building components and building elements - Thermal resistance and thermal transmittance - Calculation methods (ISO 6946)*

EN ISO 10077-1, *Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 1: General (ISO 10077-1)*

EN ISO 10077-2, *Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 2: Numerical method for frames (ISO 10077-2)*

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

EN 1990, *Eurocode - Basis of structural and geotechnical design*

EN 1991 (all parts), *Eurocode 1: Actions on structures*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1990, EN 1991 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp/

— IEC Electropedia: available at https://www.electropedia.org/

3.1
greenhouse
building structure that optimizes solar radiation transmission used for plants requiring regulated climatic conditions

3.2
greenhouse open to the public
greenhouse (3.1) used for the professional presentation and / or sale of plants, such as garden centers or expositions in botanical gardens, where people can have access to certain areas (traffic areas)

3.3
commercial production greenhouse
greenhouse (3.1) for professional production and / or protection of plants, where human occupancy is restricted to authorized personnel, concerning low levels in number and duration

Note 1 to entry: Other persons shall be accompanied by authorized personnel.

3.4
transparent cladding
cladding, that allows transmission of solar radiation, required for the growth of plants

Note 1 to entry: Transparent cladding makes snow accumulation visible (impaired solar radiation); immediate measures can be taken for removal of the snow.

3.5
controlled snow load
difference between the initial snow load expected during a heavy snowfall and the snow load removed by a device whose performance is guaranteed even during heavy snowfall

3.6
controlled heating
heating operation with devices that are intended and capable of melting and / or removing an amount of snow, to limit the roof snow load as fast as required

Note 1 to entry: Requirements for greenhouse heating and safety (back up) are given in 5.2 and can be further specified in the National Annex, dependent on the local snow climate, experience, and state of the art for technical equipment.

4 Symbols and abbreviations

Abbreviations:

NAD National Application Documents, e.g. National Annex to Eurocode, also National Code or Standard or National Regulation of an Authority

SWE Snow Water Equivalent

Symbols:

NOTE The following symbols used in this document are based on EN 1990 and EN 1991.

Latin upper-case letters:

C_e exposure coefficient

$C_{e,c}$ special exposure coefficient for controlled snow loads

C_t thermal coefficient

$C_{t,0}$ basic value of the thermal coefficient (without roof angle influence f(α))

L_f latent heat of fusion of water (for ice, snow) in kJ/kg at melt temperature $\theta_{s,m}$ = 0,01 °C

$L_{f,c}$ corrected latent heat of fusion in kJ/kg including the warming of snow

Q_o energy flux density (rate) in W/m^2 from the warm roof below to the melt layer

$Q_{s,e}$ energy flux density (rate) in W/m^2 from the air outside via the snow to the melt layer

R_T thermal resistance of a component in m^2K/W

R_{si} internal surface resistance (surface to internal air) in m^2K/W

$R_{si,sw}$ internal surface resistance for heat flow sideways in m^2K/W

$R_{si,up}$ internal surface resistance for heat flow upwards in m^2K/W

R_{se} external surface resistance (surface to external air) in m^2K/W

$R_{\lambda,j}$ thermal resistance of the material layer j in m^2K/W

R_f thermal resistance of the frame, e.g. gladding bars and gutter, in m^2K/W

$R_{g,k}$ thermal resistance of the gas space k in m^2K/W

$R_{ts,m}$ thermal resistance of the (thermal) screen m in m^2K/W

U overall heat transmittance in $W/(m^2K)$

U_o special heat transmittance in $W/(m^2K)$ for snowmelt conditions for the heat flux from the internal air to the external roof surface excluding the external heat transfer into the air

$U_{s,e}$ special heat transmittance in $W/(m^2K)$ for snowmelt conditions through the roof snow layer into the external air

Latin lower-case letters:

c_{pi} specific heat capacity of snow in $kJ/(kg \cdot K)$

d_s depth of the snow layer

$f(a)$ *r*oof angle function for the thermal coefficient C_t

$f(\theta_i)$ influence of the heating (internal air temperature) on the thermal coefficient C_t

$f(U_o)$ influence of the thermal transmittance of the cladding on the thermal coefficient C_t

$f(s_k)$ influence of the snowfall rate (related to snow load) on the thermal coefficient C_t

$h_{s,k}$ heat transfer coefficient of the gas space k

$h_{c,i}$ heat transfer coefficient for convection

$m_r(\Delta t_i)$ melt rate in kg/m^2 within a certain time interval Δt_i

s_k characteristic snow load on the ground in kN/m^2

s_c controlled snow load in kN/m^2

$s_{c,k}$ characteristic value of the controlled snow load in kN/m^2

$s_r(\Delta t_i)$ snowfall rate in kg/m^2 within a certain time interval Δt_i

$\min s_{1,t}$ minimum roof snow load in kN/m^2 (threshold value for models)

v_m mean wind speed (over 10 min) in m/s