

F2 CASTA/Horticultural Glass

Checking, optimising and designing horticultural glass

The new component Horticultural Glass enables you to test and optimise the glass dimensions for all locations of the roof and in the outer walls of Venlo greenhouses and Wide span greenhouses in accordance with the calculation rules of European Greenhouse Construction Standard EN 13031-1. The loads may be determined for the European countries in the new European Greenhouse Construction Standard file of CASTA/Kassenbouw: EuroNed, EuroFrance, EuroBRD and EuroUK (depending on your licence). You can select 'standard float glass', toughened glass or hammered glass for each window.

Check: Current standard glass dimensions meet the requirements.

Where it concerns the glass dimensions for the existing 'standard' greenhouses, virtually no (negative) consequences are to be reported for the application of the new calculation method. The largest glass dimensions that are currently applied on the roof still meet the requirements. In some cases, larger glass dimensions are possible. CASTA/Kassenbouw allows you to check whether the desired glass dimensions meet the requirements for all roof locations of both Wide span greenhouses and Venlo greenhouses. As usual in CASTA/Kassenbouw, you can demonstrate this in a simple manner using the output.



Optimisation: Larger glass dimensions in the outer walls, clear boundaries

When examining the component Horticultural Glass in greater detail, you will discover that there are more options than just testing specified glass dimensions. Using the new calculation method, you will be able to dimension your design with respect to the glass dimensions, glass thickness, glass types and installation method.

The maximum glass width of hammered or patterned glass in the outer walls, for instance, is limited in NEN3859, 2nd edition. The European Greenhouse Construction Standard EN 13031-1 allows for a broader area of application – a glass

width of 800 mm for hammered glass is possible if the 'average' thickness of the glass is sufficient. Furthermore, it is possible to calculate that standard float-glass wall windows with a glass width of 800 mm can be mounted double-sided in the vertical glazing bars. In this case, the requirements for the stacking profiles to be applied are less stringent.

The new component Horticultural Glass specifies clear boundaries for the maximum glass dimensions on the roof. This means that limitations in glass dimensions no longer need to be prescribed, as occurred in publications on a regular basis. For instance, it can be calculated that a glass width of 1.750 m for a roof width of 4.0 m and a glass width of 1.125 m for a roof width of 4.8 m in the centre

areas of Venlo greenhouses just meet the requirements (with the exception of any 2nd roofs along the side wall). The dimensions of the centre areas are determined mainly by the snow load, which means that the column height here is not really essential. However, the wind load determines the dimensions for the glass at the edges of the greenhouse, and the maximum glass dimensions here *are*

determined by the column height, which determines the wind pressure to an important extent. It should also be noted that the increased wind suction on the roof along the side wall starts from the third roof half. This means that slimmer glass dimensions may have to be applied in the second roof by comparison with the centre areas.

Experienced users of CASTA/Kassenbouw will certainly use the optimisation option immediately. It allows users to determine at which width the glass is just sufficiently strong. We need not mention that the profiles and connections of the roof must be sufficiently strong to allow for the optimised glass dimensions.

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 2. Zij tracht dit te bereiken door het doen ontwikkelen van nieuwe kennis en inzichten op het gebied van constructie methoden van tuinbouwkassen door het sluiten van overeenkomsten voor de uitvoering van onderzoek met de Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek TNO.
 3. De stichting heeft geen winstoogmerk

Design: Playing with (toughened) glass, glass of the future.

Over the past few years, more and more attention has been devoted to the advantages of applying toughened glass on greenhouses with respect to the safety of construction companies and users. Among other things, the Labour Inspectorate is working on a study on the application of toughened glass (a proposed requirement as of 1 October 2001 is involved). A number of export countries (e.g. USA and Canada) have already been using toughened glass on greenhouse roofs for some time now. The Greenhouse of the Future at the Floriade in 2002 will also be constructed with toughened, coated glass. The coating on the glass increases its light transmission. The construction of the Floriade greenhouse demonstrates that larger glass dimensions in the centre areas and edges of the roof are possible when toughened glass is used. Toughened glass is already being applied on (edge) locations of greenhouse roofs in some cases. The component Horticultural Glass allows you to determine the optimal glass covering for the roof by varying the glass type at different locations of the roof.

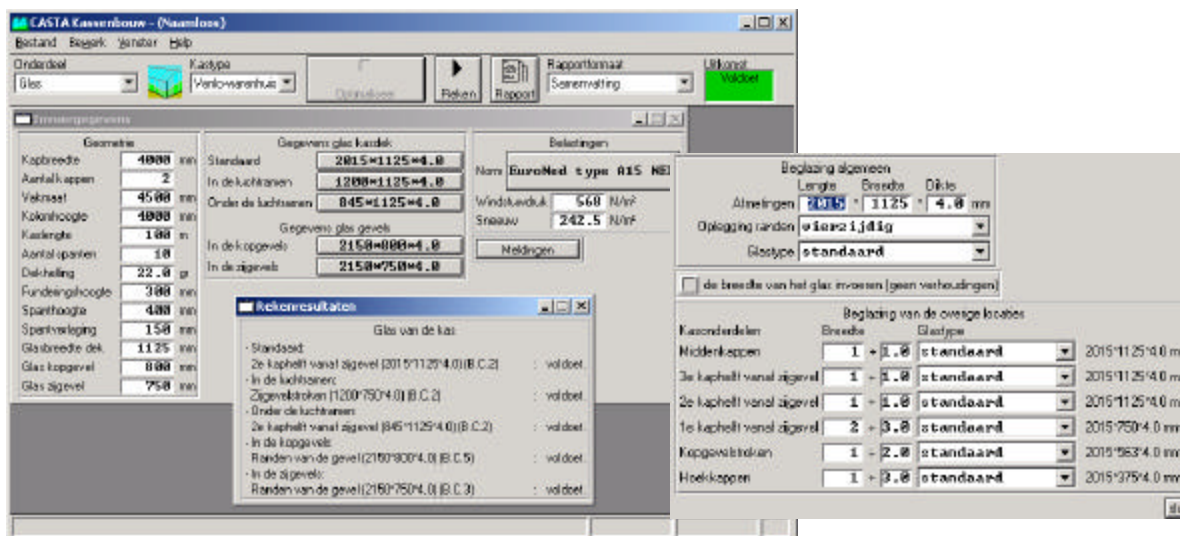
Advice: How much play does the glass have and where should (smaller) sheets be used?

The European Greenhouse Construction Standard sets new requirements for the allowable displacement of the substructure as a result of temperature changes and wind loads. The allowable displacement has been made dependent, among

other things, on the glass dimensions and the available play in the rebate. This dimension is required to allow for the fixation of the sheets in the outer walls and the roof. In the component Horticultural Glass in CASTA/Kassenbouw, these requirements were translated to a recommendation with regard to the minimum play of the roof and wall glass for the glass dimensions that were entered and the gutter that is applied (coated or uncoated steel or aluminium). Furthermore, the output specifies exactly how many 'half sheets' are required in the outer wall from the corners to be allowed to construct the given greenhouse length and width without dilatation. A number of recommendations in *Recommendations for the quality and safety of horticultural glass* were thus further elaborated where it concerns calculation requirements (see the appendix *Recommendations for the quality and safety of horticultural glass*).

Deposit for MathCad application 'Glass'

The MathCad application 'Glass' developed by TNO allows a group of system suppliers united in the WSL to execute glass calculations in accordance with NEN3859, 2nd edition, since 1997. After the introduction of the European Greenhouse Construction Standard, this calculation method will be replaced by the component Horticultural Glass in CASTA/Kassenbouw 2.20. Since the MathCad application served as a model for the development of the component Horticultural Glass in CASTA/Kassenbouw 2.20, a special discount is offered to the companies that invested in the MathCad application 'Glass'.



The new module 'Horticultural Glass', which allows users to test all glass sheets in the greenhouse

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F3 Extension of the Four Energy Indicators

Now including continuous ventilation windows and the determination of the U value for the entire greenhouse

The expansion of the module Four Energy Indicators mainly covers the two components 'Ventilation opening' and 'U value'. The calculation of the ventilation opening was expanded to include calculations for continuous ventilation windows in Venlo and Wide span greenhouses. The component U value was expanded with a calculation of the weighted average U value of the greenhouse housing, taking into account the U value of the foundation, the outer walls, and the greenhouse dimensions. These extensions were demonstrated during the Workshop *Energy-integrated Design of Greenhouses*, which was organised at TNO Building and Construction Research on 7 December 2000.

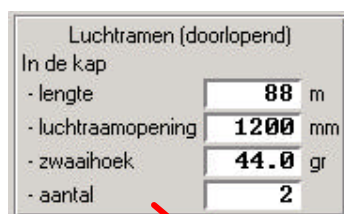
Continuous ventilation windows in the component 'Ventilation opening'

The current component 'Ventilation opening' in CASTA/Kassenbouw 2.10 calculates the ventilation opening of standard ventilation windows in Venlo greenhouses. On the request of many users, the component 'Ventilation opening' was further expanded to include a calculation method for determining the ventilation opening for continuous



It is now possible to calculate the ventilation openings for continuous ventilation windows

single- or double-sided ventilation windows in Venlo and Wide span greenhouses. The new calculation method was developed on the basis of the same theory in the **European Greenhouse**



Entering continuous ventilation windows

Construction Standard EN13031-1. With this expansion, you can rapidly and effectively compare the ventilation opening percentage of various ventilation window and greenhouse types.

U value calculation for the entire greenhouse

The addition of the calculation of the U value for the entire greenhouse constitutes an important, practice-based extension of the component 'U value'. This extension allows you to examine the

CASTA Kassenbouw Uwaarde van de randfunderatie

Gevraagd wordt om de U-waarde van de toegepaste randfunderatie. Deze waarde is verkrijgbaar bij de leverancier van de randfundering. De U-waarde geeft aan hoeveel energie er door een vierkante meter kasgevel verdwijnt bij een temperatuurverschil van 1 Kelvin. Hoe groter de U-waarde des te meer energie stroomt er naar buiten. Hoe lager de U-waarde van de fundering, des te energie efficiënter is de fundering.

De U-waarde van de totale kas wordt bepaald door een gewogen gemiddelde te nemen van de U-waarden van de fundering, gevel en het kasdek. Indien alternatieve omhulingsmaterialen zoals een geïsoleerde randfundering wordt toegepast kan de U-waarde van de fundatie, en in geringere mate van de totale kas verbeterd worden.

Enkele richtwaarden voor de gevelfunderatie:

- Standaard: 3,86 (gestort beton)
- Geïsoleerd: 2,62 (Zeus Iso cassette voet)

The U value of the foundation can be specified separately

interaction between the U value of the wall foundation, the U value of the outer walls, and the U value of the roof of a greenhouse. The new version also allows you to assess the effects of a number of insulating measures. The greenhouse U value as calculated by CASTA/Kassenbouw can also be used as input for programmes that calculate the heat requirements of the greenhouse as well as for energy balance calculations. This integrated U value for the greenhouse in its entirety is an important indicator

CASTA/Kassenbouw calculates the U value of the outer wall, the roof and the entire greenhouse (for Energy equilibrium calculations)



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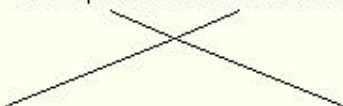
for the energy efficiency of the greenhouse.

Both these extensions were implemented within the framework of the project *Energy-integrated Design of Greenhouses II*. Companies that already acquired the module 'Four Energy Indicators' of CASTA/Kassenbouw 2.10 will be offered these extensions at a small additional rate. When

determining the contribution per participant, we have also taken into account the companies that have a licence for both 'Venlo greenhouses' and 'Wide span greenhouses'. Participants in CASTA/Kassenbouw that have not yet acquired the module 'Four Energy Indicators' will be able to purchase the improved version at an attractive price.


CASTA Kassenbouw Doorlopend luchtraam; aantal

Er wordt gevraagd om het aantal doorlopende luchtramen per kap. Het doorlopende luchtraam kan enkel of dubbelzijdig toegepast worden.



Dubbeltzijdig doorlopende lucht



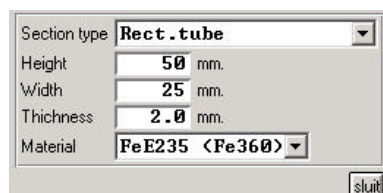
Enkelzijdig doorlopende lucht

The continuous ventilation windows can be both single and double

F4 English version of CASTA/Kassenbouw

Opt for your language of preference at no additional cost

The screen drivers for CASTA/Kassenbouw are now also available in English. After the introduction of the European Greenhouse Construction Standard, interest in CASTA/Kassenbouw from abroad is expected to

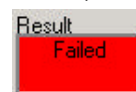


Section type: Rect. tube
Height: 50 mm.
Width: 25 mm.
Thickness: 2.0 mm.
Material: FeE235 <Fe360>

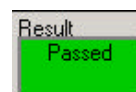
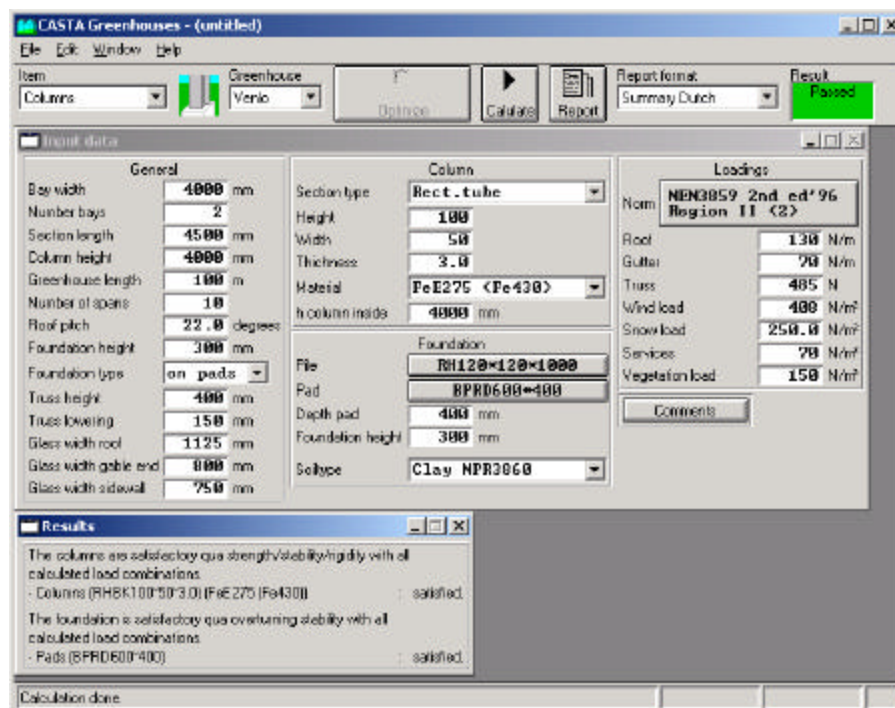
grow. There are already a number of foreign countries that have acquired the Dutch

version of CASTA/Kassenbouw despite the language barrier. Moreover, the existing user group of CASTA/Kassenbouw increasingly operates on an international scale. Thanks to the introduction of the English-language version, the international acceptance and recognition of CASTA/Kassenbouw as the calculation programme for greenhouses is strengthened. Which is also an important criterion of the board for accepting potential foreign companies.

The English version is of course interesting to the current foreign participants in the CASTA/Kassenbouw programme, but it can also be useful for Dutch users of CASTA/Kassenbouw. The 'input' of the greenhouse may, for instance, be executed by an 'international' representative, who can enter the data directly into the English version of CASTA/Kassenbouw with the English-speaking customer. Thus, it is possible for the company to commence preparing the work immediately.



The English or Dutch version of CASTA/Kassenbouw 2.20 is available at no additional cost. If you would like to receive both language versions, an additional contribution is required.

CASTA Greenhouses - (untitled)

File Edit Window Help

Item: Columns Greenhouse: Venlo Options: Calculate Report Report format: Summary Dutch Result: Passed

Input data

General

Bay width: 4000 mm
Number bays: 2
Section length: 4500 mm
Column height: 4000 mm
Greenhouse length: 1000 mm
Number of spans: 10
Roof pitch: 22.0 degrees
Foundation height: 300 mm
Foundation type: on pads
Truss height: 400 mm
Truss lowering: 150 mm
Glass width roof: 1125 mm
Glass width gable end: 800 mm
Glass width sidewall: 750 mm

Column

Section type: Rect. tube
Height: 100 mm
Width: 50 mm
Thickness: 2.0 mm
Material: FeE275 <Fe430>
h column inside: 4000 mm

Foundation

File: B1120*120*1000
Pad: BPRD600*400
Depth pad: 400 mm
Foundation height: 300 mm
Soil type: Clay NPR3060

Loadings

Norm: NEN3059 2nd ed '96 Region II (2)

Roof: 130 N/m
Gutter: 70 N/m
Truss: 405 N
Wind load: 400 N/m²
Snow load: 250.0 N/m²
Services: 70 N/m²
Vegetation load: 150 N/m²

Results

The columns are satisfactory qua strength/stability/rigidity with all calculated load combinations.

- Columns (BHBK100*50*3.0) (FeE275 (Fe430)) : satisfied.

The foundation is satisfactory qua overturning stability with all calculated load combinations.

- Pads (BPRD600*400) : satisfied.

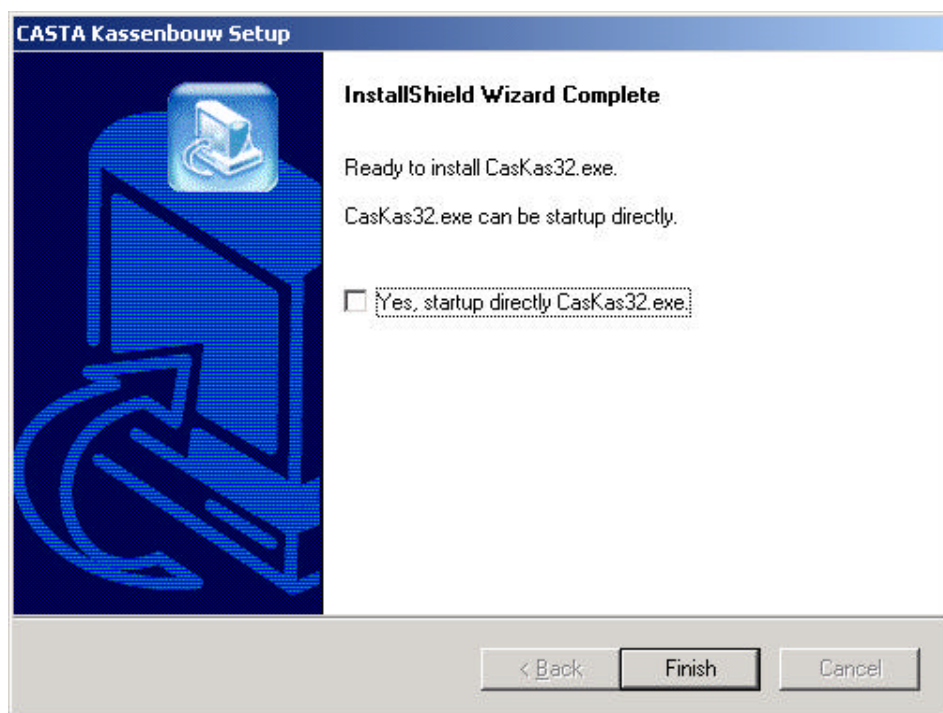
Calculation done

English screen drivers

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Opting for English-language installation



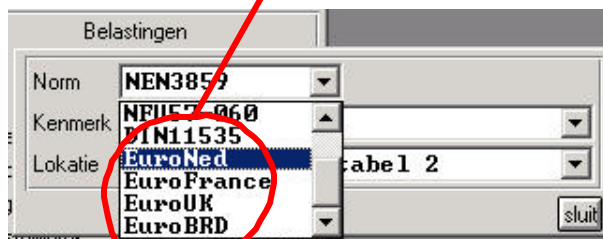
English installation procedure

F1 European Greenhouse Construction Standard EN 13031-1

CASTA/Kassenbouw suitable for the Netherlands, UK, France and Germany (EuroNed, EuroUK, EuroFrance and EuroBRD)

On 23 March last, the word came from Brussels: the first European Greenhouse Construction Standard EN 13031-1 was approved by CEN. In principle, European Greenhouse Construction Standard EN 13031-1 will take effect from 1 January 2002 in all member states of the CEN. As chance would have it, this is also the date on which the Euro will become the instrument of payment in these countries. Officially, the NEN 3859 standard, 2nd edition, must be officially withdrawn, although it is likely that a transition period of one year will prevail in actual practice. One thing is certain, however, European Greenhouse Construction Standard EN 13031-1 will soon be a reality.

The European Greenhouse Construction Standard roughly comprises a general part (comparable to NEN3859 2nd edition) and a country-specific part, which consists mainly of country-specific loads and load combinations. The European Greenhouse Construction Standard has been implemented in CASTA/Kassenbouw 2.20 for those countries that were already part of CASTA/Kassenbouw 2.10: the Netherlands (EuroNed), France (EuroFrance), Germany (EuroBRD), and the United Kingdom

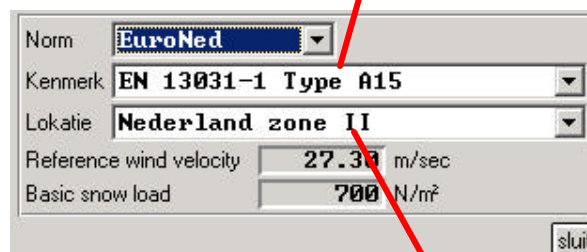


(EuroUK). The wind and snow loads on greenhouses, especially, are specified per country. Attention was devoted specifically to this aspect during the development of CASTA/Kassenbouw 2.20 to enable the user to determine the correct loads for the country-specific regions rapidly and

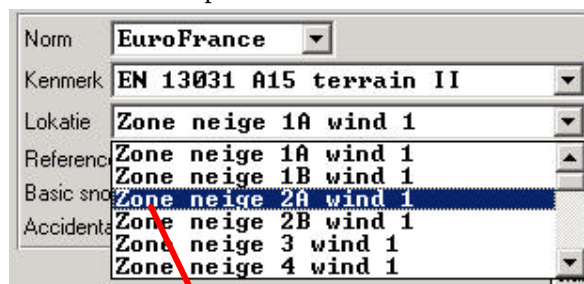
efficiently. When running the programme it is explained in detail how the loads were determined.

In the input data for the European Greenhouse Construction Data, the user can also specify

Selecting the service life of the greenhouse (A15 means 15 years)



the designed service life of the greenhouse that is to be calculated. The alternatives are greenhouse types A15 and A10. Normal horticultural greenhouses must be calculated in accordance with type A15. Greenhouse type A10 can be used for greenhouses with plastic housings. When determining the loads for greenhouse type A10, an insulating housing with a less favourable melting reduction – for a heated greenhouse – of the snow load ($C_t=0.6$ instead of $C_t=0.5$) was assumed. Please note that for unheated greenhouses, no melting reduction of the snow load is possible.



Up-to-date regional layout of France

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The extension of CASTA/Kassenbouw with the European Greenhouse Standard allows you to dimension greenhouse structures in accordance with the European Greenhouse Standard in a timely fashion, ensuring that you will be well prepared when it takes effect in 2002 and that you will be able to benefit from the advantages of the European Greenhouse Construction Standard before that time.

Lighter and longer greenhouses are possible, on the condition that...

Although the European Greenhouse Construction Standard EN 13031-1 closely resembles the Dutch Greenhouse Construction Standard NEN 3859 where it concerns the technical requirements, there are a number of important differences. With normal greenhouse dimensions, most of the substructure components and the foundation can be somewhat lighter if the wind load determines the dimensioning. Another important difference with NEN 3859 is that the much talked-about (and maligned) absolute maximum greenhouse length of 200 m and width of 270 m have been relinquished. The European Greenhouse Construction Standard EN 13031-1 allows for larger greenhouse dimensions without applying bothersome and

expensive dilatations. The precise allowed length of a greenhouse is made dependent in part on the available play of the roof glass. Further information of this subject is provided in the output of CASTA/Kassenbouw. With the current 'state of technology' for many modern greenhouse roofs, the maximum greenhouse length will be maintained at approximately 200 m. For excessive greenhouse dimensions, we recommend that you consult your system supplier to make sure that the roof is suitable for the desired greenhouse dimensions.

Transition period

It will of course be considered whether a reasonable transition period for the European Greenhouse Construction Standard in the Netherlands can be agreed upon in consultation with the Board of the STOREKA foundation (probably 1 year). As usual, more detailed information on this subject will be provided on the distribution of CASTA/Kassenbouw 2.20. For the time being, however, the existing standard options will be maintained so that you may continue to execute calculations in accordance with the existing standards.

2 GEGEVENS OVER DE TOEGEPASTE NORM

2.1 Windbelasting:

- Reference wind velocity: $V_{ref,50} = 27.3 \text{ m/s}$
- Shape parameter: $K_1 = 0.294$; $\alpha = 0.5$
- Return period: $ref_period = 15$
- Reference wind velocity:

$$V_{ref} = V_{ref,50} \times \left(\frac{1 - K_1 \cdot \ln(-\ln(1 - 1 / ref_period))}{1 - K_1 \cdot \ln(-\ln(1 - 1 / 0.05))} \right)^{0.5} = 25.166 \text{ m/s}$$

- Terrain category $q_s = 0.200 \text{ m}$, $z_{min} =$
- Reference height: z
- Roughness coefficient
- Topography coefficient
- Turbulence intensit
- Exposure coefficient
- Reference wind pres
- Reference mean wind velocity pressure: $q_{ref} = q_s \cdot |z_s| \cdot q = 5$

The output clearly specifies the calculation method that was used

Input screens for EuroUK and EuroBRD. The regional data is pre-programmed. The help texts contain the new European regional maps

Norm: EuroUK
Kenmerk: EN 13031 A15 terrain I
Lokatie: United Kingdom
Reference wind velocity: 20 m/sec
Basic snow load S_k : 300 N/m²
Altitude sea level A_s : 0 m

Norm: EuroBRD
Kenmerk: EN 13031 A15 regular heated
Lokatie: National Zone I (0.6 snow)
Reference wind velocity: 24.30 m/sec
Basic snow load: 678 N/m²
Altitude sea level A_s : 0 m

sluit

F6 Extranet CASTA/Kassenbouw

Discover the potential of the Extranet at no extra cost

The Extranet CASTA/Kassenbouw 2.20 was developed especially for the communication with the user group. It consists of a direct Internet connection with a computer installed at TNO Building and Construction Research. The name 'Extranet' is a derivative of the Intranet computer network, which is intended exclusively for the internal communication within a company. The Extranet is a computer network that allows for communication between external companies, in this case the user group of CASTA/Kassenbouw. A pilot version of the Extranet CASTA/Kassenbouw will be online at the same time as the introduction of version 2.20. In consultation with the Board and Advisory Committee of the STOREKA foundation, it was decided to run a pilot with a group of volunteer users of CASTA/Kassenbouw in order to gather experience with the new medium. We are therefore happy to invite you to participate in the pilot Extranet CASTA/Kassenbouw this year, which will allow you to benefit from the advantages offered by the Extranet while at the same time having the opportunity to contribute to this valuable expansion of CASTA/Kassenbouw.

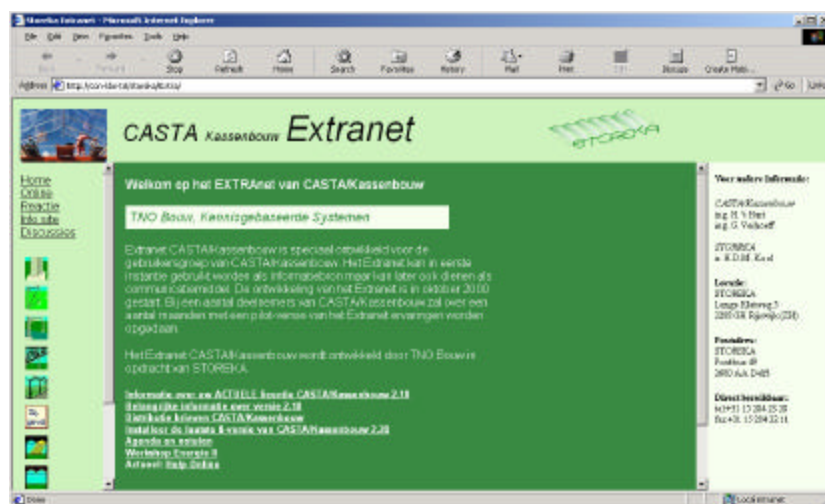
Access to the Extranet CASTA/Kassenbouw

A first condition to use the Extranet CASTA/Kassenbouw is a connection to the Internet

between your computer and the telephone network, the cable or your own network. Full access to the Extranet is included with CASTA/Kassenbouw 2.20. A unique secure logon procedure ensures that the Extranet CASTA/Kassenbouw is accessible exclusively to STOREKA members with a licence for the Extranet CASTA/Kassenbouw. The logon procedure is unique in that it uses your personal licence code and your personal hardware key. The entire procedure proceeds unnoticed by the user of CASTA/Kassenbouw, ensuring a fast and secure connection to the Extranet.

What does the Extranet CASTA/Kassenbouw have to offer?

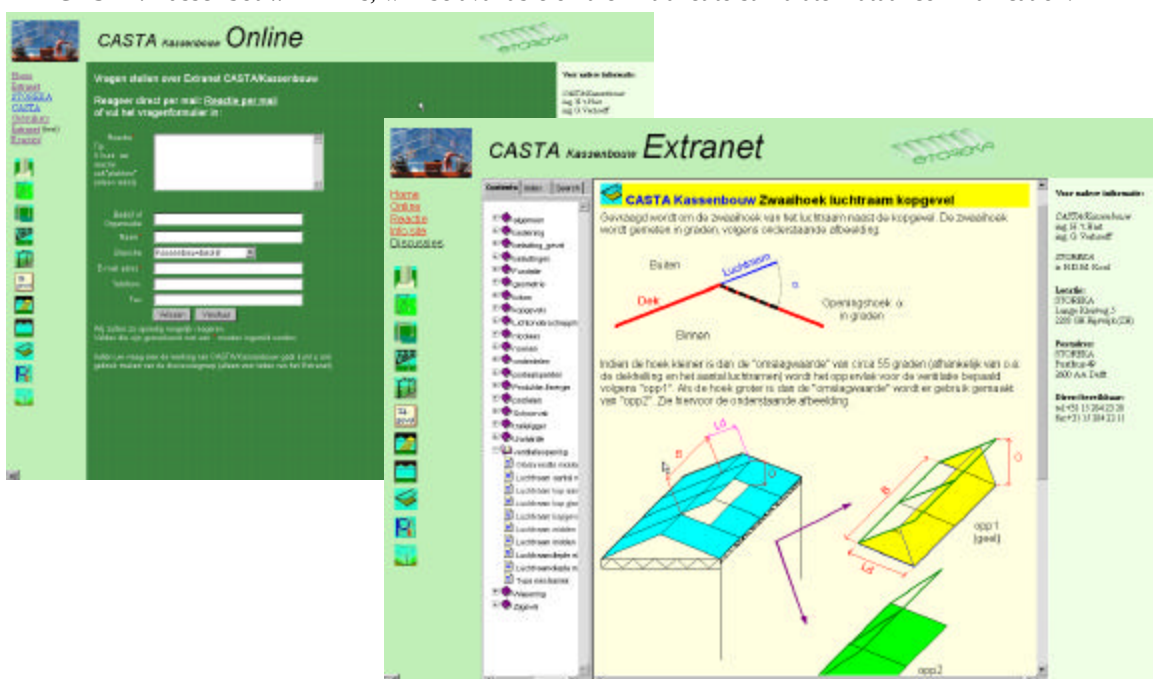
Initially, the pilot version of the Extranet CASTA/Kassenbouw will serve mainly as a source of information for the user group of CASTA/Kassenbouw. However, the idea is that the user group will also participate actively in the Extranet. On the back of this leaflet, you will find an overview of the possibilities that the pilot version of the Extranet CASTA/Kassenbouw offers you. The further elaboration and structure of the Extranet will be examined once the pilot project is concluded.



The Extranet CASTA/Kassenbouw

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3. De stichting heeft geen winstoogmerk

- **CASTA/Kassenbouw up-to-date** The Extranet allows you to load new versions of CASTA/Kassenbouw, which makes it possible to respond rapidly to changes and developments in the market. It will also be easier to realise interim updates, even for relatively small modifications.
- **Help texts** The help texts of CASTA/Kassenbouw can also be found on the Extranet. The Extranet version of the help texts will always be up-to-date. Thus, the user can decide to download the latest versions of the help texts from the Extranet.
- **Questions** The Extranet CASTA/Kassenbouw allows users to submit their (general) questions concerning CASTA/Kassenbouw. All questions and answers (if any) will be saved and made available to all users of the Extranet CASTA/Kassenbouw. It is possible that your question has already been submitted and that you will find the answer directly on the Extranet. You can also answer questions here.
- **Survey** The Extranet will feature a specific rubric where you can report comments on the operation of CASTA/Kassenbouw as well as any wishes you may have for extensions in CASTA/Kassenbouw. The survey will result in a list of priorities, allowing for direct insight into wishes and requirements in the field of any programme-technical modifications.
- **Source of information** You will be able to find information on various subjects on the Extranet, such as:
 - Publications, articles and news
 - Details of the licence of the logged-on user
 - New versions
 - Documentation of STOREKA (e.g. distribution letters)
 - Comments on the greenhouse construction standards
- **Source of information** Op het Extranet is informatie te vinden over diverse onderwerpen, waaronder:
 - Publicaties, artikelen en nieuwsfeiten
 - Gegevens over de licentie van de ingelogde gebruiker
 - Nieuwe versies
 - Documenten van STOREKA (b.v. distributie-brieven)
 - Commentaar op de Kassenbouwnormen
- **User list** A user list for CASTA/Kassenbouw, including e-mail addresses and Internet links, will be available on the Extranet to stimulate mutual communication.



Some of the features of the Extranet of CASTA/Kassenbouw

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F5 Extension ‘optimisation per subject’

Optimising profiles while the calculation is not (yet) perfected

The possibility to optimise the profiles and other greenhouse data in CASTA/Kassenbouw, such as the wall thickness of a column or the loads on installations, has been available since the introduction of the first version of CASTA/Kassenbouw. In practice, it was found that this method is often used to optimise profile dimensions and dimension greenhouses as efficiently as possible. The many reactions after the introduction of the first Windows version of

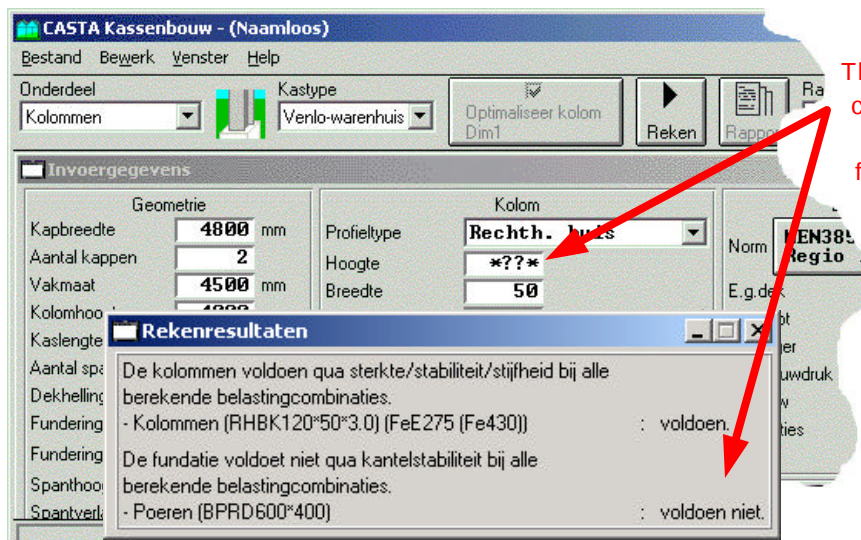
fact that the option is popular. The current release of CASTA/Kassenbouw, version 2.10, features the full optimisation component. The extension ‘optimise per subject’ now allows you to optimise a profile separately whilst the complete calculation may not yet be perfected. This makes it easier to execute optimisation calculations immediately after entering the data of a greenhouse structure for the first time.



CASTA/Kassenbouw 2.00 – in which this option was temporarily unavailable – confirmed the

‘Optimisation per subject’ can be selected in the programme settings

The option ‘Optimisation per subject’ in CASTA/Kassenbouw 2.20 can be purchased as a separate component, so it is still possible to optimise in accordance with the current method. The option was used to the full satisfaction of the participants during the Workshop. Users that are not yet able to execute optimisations for the components ‘lattice girders’ and ‘front and side walls’ can acquire this option at the same time as the option ‘Optimisation per subject’.



The column height can be optimised even if the foundation is not satisfactory

CASTA Kassenbouw - (Naamloos)

Bestand Bewerk Venster Help

Onderdeel: **Tralieliggers** Kastype: **Venlo-warenhuis** Optimaliseer Bovenrand Dim1 Reken Rapport

Rapportformaat: **Samenvatting** Uitkomst: **Invoer correct**

Invoergegevens

Geometrie		Tralieligger		Belastingen	
Kapbreedte	4800 mm	Bovenrand	Profieltype: Rechth. buis	NEN3859 2edruk'96 Regio II (2)	
Aantal kappen	2	Onderrand	Hoogte: *??* mm.		
Vakmaat	4500 mm	Diagonalen per kap	Breedte: 25 mm.		
Kolomhoogte	4000 mm	- druk	Dikte: 2.0 mm.		
Kaslengte	100 m	- trek	Materiaal: FeE235 <Fe360>		
Aantal spanten	10	- plaatsing 1e diag.			
Dekhellings	22.0 gr	- verbinding	Ongezet		
Funderingshoogte	300 mm	Gootstrip	ST50*5.0		
Spanthoogte	400 mm	Veldstrip			
Spantverlaging	150 mm	Eindplaat			
Glasbreedte dek	1125 mm	- schotjes			
Glas kopgevel	800 mm	Bouten bovenrand			
Glas zijgevel	750 mm	Bouten onderrand			

Rekenresultaten

De tralieliggers voldoet niet qua sterkte/stabiliteit/stijfheid bij de berekende belastingcombinaties.

- Bovenrand (RHBK50*25*2.0) (FeE235 (Fe360))	: voldoet niet.
- Onderrand (C50*25*8.5*2.5) (FeE235 (Fe360))	: voldoet niet.
- Drukdiagonalen (RD14.0) (FeE235 (Fe360))	: voldoen niet.
- Trekdiagonalen (RD12.0) (FeE235 (Fe360))	: voldoen.
- Gootvertikaal (ST50*5.0) (FeE235 (Fe360))	: voldoet.
- Gootdiagonalen (RD14.0) (FeE235 (Fe360))	: voldoen.
- Bouten onderrand (M12-8.8)	: voldoen.
- Bouten bovenrand (M12-8.8)	: voldoen niet.
- Eindplaten met schotjes (ST50*12.0) (FeE235 (Fe360)) (zonder onderleggingen)	: voldoet niet.
- Stijfheid	: voldoet niet.

Optimising the upper edge of the lattice girder while a number of components are not yet satisfactory