Agrément Certificate 2018/584

innovative construction product assessments

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Validity

Users of any Agrément certificate should check its status: All currently valid certificates are listed on the website. In addition, check whether the certificate is Active or Inactive.

The certificate holder is in possession of a confirmation certificate attesting to his/her status.

SANS 10400-XA: Energy usage in buildings

Quick guide

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Subject:

DESIGNBUILDER (VERSION 5) BUILDING ENERGY ANALYSIS SOFTWARE

Certificate holder:

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Use

The certificate covers *DesignBuilder* (Version 5) Building Energy Analysis Software when used for the assessment of the energy requirement of buildings as required in Regulation XA3 of Part XA: *Energy usage in buildings* of the **National Building Regulations**.

This certificate and Agrément South Africa's assessment apply only to the *DesignBuilder* (Version 5)Building Energy Analysis Software as described in this certificate, and where the terms and conditions of certification are complied with.

General description

DesignBuilder Energy Analysis Software is a user-friendly interface for the US Department of Energy software, *EnergyPlus*. *EnergyPlus* has been developed from both of the *BLAST* (Building Loads Analysis and System Thermodynamics) and the *DOE-2* programmes of the 1970's and 1980's.

DesignBuilder Energy Analysis Software may be used for the rational design air-conditioned buildings or naturally ventilated buildings of all occupancies in terms of the requirements of Regulation XA3 b) and c) of Part XA: *Energy usage in buildings* of the National Building Regulations.

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- features of the software explicitly required to enable modelling in terms of Agrément South Africa's assessment protocol
- ability to be able to edit and add to existing material property database
- ability to be able to add pre-determined or directly modelled energy loads resulting from vertical transport, where provided, and for the supply of hot water
- ability to be able to determine energy consumption of buildings in terms of SANS 10400 Part XA for South African climate zones
- training and technical support
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- general description
- air –conditioned and naturally ventilated buildings
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PREAMBLE

This certificate is issued by Agrément South Africa in terms of the Agrément South Act No. 11 of 2015.

Protocol for the Certification of Energy Simulation Software

This certificate:

- has been granted after a technical assessment of the performance of *DesignBuilder* (Version 5) Building Energy Analysis Software in terms of **Agrément South Africa's assessment protocol** for the uses covered by the certificate, and Agrément Certificate 2012/413: Designbuilder 4.0 – Building Energy Analysis Software (Reviewed July 2015)
- is independent of any patent rights that may or may not subsist in the subject of the certificate and
- does not relieve the user from complying with any of the requirements imposed by the building authority concerned pertaining to the National Building Regulations.

Agrément South Africa considers that the accuracy of energy assessments carried out by competent persons using *DesignBuilder* (Version 5) Building Energy Analysis Software will be satisfactory. However, Agrément South Africa does not on behalf of itself, or the government, or any of its employees or agents guarantee such accuracy.

No action for damages, or any other claim whatsoever, lies against Agrément South Africa, its members, the government or any of its employees should the said software fail to comply with the standards set out in this certificate.

Building authorities or users of the software, who are in any doubt about the continued validity of this certificate should contact Agrément South Africa.

The validity of this certificate is reviewed every three years. The certificate shall remain valid as long as Agrément South Africa is satisfied that:

- the certificate holder complies with the general and specific conditions of certification
- no serious anomalies have become apparent in the results obtained using the software and
- any changes in legislation, regulations, relevant standards or Agrément assessment protocol have not invalidated the technical assessment that formed the basis of certification.

Agrément South Africa reserves the right to withdraw the certificate at any time, should reasonable cause exist.

Notices affecting the validity of this certificate will be published in the *Government Gazette*.

PART 1: CONDITIONS OF CERTIFICATION

Licensee - any person or company appointed by the certificate holder and registered with Agrément South Africa to make the software available, offer technical support and training.

This certificate covers only *DesignBuilder* (Version 5) Building Energy Analysis Software:

- as long as technical support and training are available from the certificate holder or licensees appointed by the certificate holder and registered as such with Agrément South Africa, and
- provided that the conditions of certification are complied with.

Any change to an aspect of the software could result in other aspects of the software no longer complying with Agrément South Africa's performance criteria. For these reasons, no changes, other than changes and/or additions to the user interface, or additions of features not affecting the main methods of computations, may be made to the *DesignBuilder* (Version 5) Building Energy Analysis Software as described in this certificate unless such changes are approved in writing by Agrément South Africa before they are implemented.

DesignBuilder 5
Building Energy Analysis Software
Tested and approved fit-for-modelling or calculation purposes
CERTIFICATE 2018/584
AGRÉMENT SOUTH AFRICA
innovative construction product assessments

General conditions

Marking

Where possible and appropriate software packaging, marketing brochures, user manuals and other material must be marked with Agrément South Africa's identification logo and certificate number, as illustrated opposite.

Validity

The validity of this certificate is subject to a satisfactory review by Agrément South Africa every three years.

Quality monitoring

The certificate holder is required to participate in Agrément South Africa's post-certification quality management scheme, which requires:

- that the certificate holder shall continue to implement and manage the quality system approved by Agrément South Africa in the assessment of the *DesignBuilder* (Version 5) Building Energy Analysis Software
- the certificate holder to notify Agrément South Africa within 30 days of any change of company address and
- the cooperation of the certificate holder in facilitating post-certification quality monitoring by Agrément South Africa or its authorised agents.

Reappraisal:

- must be requested by the certificate holder prior to introducing new versions of the software into the market and

- will be required by Agrément South Africa if there are changes to regulations or Agrément South Africa's criteria.

This certificate may be withdrawn if the certificate holder or a registered licensee fails to comply with the above-mentioned requirements.

On behalf of the Board of Agrément South Africa:

Chairperson
18 October 2018

PART 2: ASSESSMENT

Scope of assessment

This assessment is based on:

- an assessment of the software in accordance with Agrément South Africa's assessment protocol and
- an assessment of *DesignBuilder* Software Limited's quality management system.

Assessment

In the opinion of Agrément South Africa, the *DesignBuilder* (Version 5) Building Energy Analysis Software is suitable for the uses as specified on page 1 of this certificate.

Agrément South Africa's comments on the various aspects of the assessment are set out in Table 1.

Table 1: Assessment

Aspect of assessment	Opinion of Agrément South Africa	Explanatory notes
Accuracy of the predictions made using DesignBuilder 3.1 **ANSI/ASHRAE standard 140:** *"Standard method of test for the evaluation of building energy analysis computer programs"*	Satisfactory	Tested in accordance with the **ANSI/ASHRAE standard 140.** It was deemed necessary to perform only test cases 600, 630, 910, 920, and 600FF to confirm the integrity of the *DesignBuilder* interface and *EnergyPlus*. *EnergyPlus* has already been assessed in the USA and conforms to **ASHRAE 140.**
Features of the software explicitly required to enable modelling in terms of Agrément South Africa's assessment protocol	All features required in terms of the protocol are present	Refer to protocol
Ability to be able to edit and add to existing material property database	Satisfactory	Refer to protocol
Ability to be able to add energy loads resulting from vertical transport, where provided, and for the supply of hot water	Vertical transport loads cannot be modelled nor can pre-determined data be added, however, water heating loads, determined in accordance with the requirements of **SANS 10252-1**, can be modelled	Vertical transport loads must be allowed for as a separate item to the output of the software. **SANS 10252-1:** *Water supply and drainage for buildings*
Ability to be able to determine energy consumption of buildings in terms of SANS 10400 Part XA for South African climate zones **SANS 10400**: *The application of the National Building Regulations*	Satisfactory	Climate files for the six zones in South Africa can be used to assess building performance in terms of **SANS 10400**

Table 1 (Continued): Assessment

Aspect of assessment	Opinion of Agrément South Africa	Explanatory notes
Training and technical support	Satisfactory	Training and technical support are readily available from the certificate holder
Quality management	Satisfactory When properly implemented, the quality system will ensure that acceptable standards are maintained	The quality system complies with Agrément South Africa's requirements. The quality system assessed is based on **SANS/ISO: 9001**

PART 3: TECHNICAL DESCRIPTION

General description

DesignBuilder was developed as a user-friendly interface for the United States Department of Energy (DOE) building energy analysis software, *EnergyPlus*. *EnergyPlus* is the simulation engine on which DesignBuilder is based.

EnergyPlus has its roots in both the *BLAST* and *DOE-2* programs. *BLAST* (Building Loads Analysis and System Thermodynamics) and *DOE-2* were both developed and released in the late 1970's and early 1980's as energy and load simulation tools. *EnergyPlus* is an energy analysis and thermal load simulation program. Based on a user's description of a building from the perspective of the building's physical make-up, associated mechanical systems, etc., *EnergyPlus* will calculate the heating and cooling loads necessary to maintain thermal control setpoints and specified conditions throughout the building. It will calculate and report the energy use associated with the HVAC system and all plant equipment as well as many other simulation details that are necessary to ensure that the simulation is representative of the actual building.

DesignBuilder features an OpenGL (Open Graphics Library), which allows building models to be assembled by positioning, stretching and cutting "blocks" in 3-D space. Realistic 3-D elements provide visual feedback of actual element thickness and room areas and volumes. There are no limitations on geometric form or surface shape. Users can draw their own 3-D building models or import 3-D models from any BIM (Building Information Modelling) software supporting the gbXML (Green Building XML schema) standard.

Data templates allow users to load common building constructions, activities, HVAC & lighting systems into their design by selecting from drop-down lists. They can also add their own templates when working on similar types of buildings. This combined with data inheritance, allows global changes to be made at building, block or zone level. The level of detail in each building model can be controlled, allowing the tool to be used effectively at any stage of the design or evaluation process.

Air-conditioned and naturally ventilated buildings

DesignBuilder may be used to model large commercial, industrial as well as small domestic buildings. Buildings may be air-conditioned or naturally ventilated.

Methods of assessment used in the software

Below is list of most of the features of the *DesignBuilder*:

- integrated, simultaneous solution where the building response and the primary and secondary systems are tightly coupled
- sub-hourly, user-definable time steps for the interaction between the thermal zones and the environment and, where applicable, HVAC systems
- aSCII text based weather, input, and output files that include hourly or sub-hourly environmental conditions, and standard and user definable reports, respectively
- heat balance based solution technique for building thermal loads that allows for simultaneous calculation of radiant and convective effects at both in the interior and exterior surface during each time step
- transient heat conduction through building elements such as walls, roofs, floors, etc. using conduction transfer functions
- improved ground heat transfer modelling through links to three-dimensional finite difference ground models and simplified analytical techniques
- combined heat and mass transfer model that accounts for moisture adsorption/desorption either as a layer-by-layer integration into the conduction transfer functions or as an effective moisture penetration depth model (EMPD)
- thermal comfort models based on activity, inside dry bulb, humidity, etc.
- anisotropic sky model for improved calculation of diffuse solar on tilted surfaces, electrochromic glazings, layer-by-layer heat balances that allow proper assignment of solar energy absorbed by window panes, and a performance library for numerous commercially available windows
- daylighting controls including interior illuminance calculations, glare simulation and control, luminaire controls, and the effect of reduced artificial lighting on heating and cooling
- loop based configurable HVAC systems (conventional and radiant) that allow users to model typical systems and slightly modified systems without recompiling the program source code
- atmospheric pollution calculations that predict C021 SOx, NOx, CO, particulate matter, and hydrocarbon production for both on site and remote energy conversion
- links to other popular simulation environments/components such as WINDOWS, DElight and SPARK to allow more detailed analysis of building components.

The *EnergyPlus* program is a collection of many program modules that work together to calculate the energy required for heating and cooling a building using a variety of systems and energy sources. It does this by simulating the building and associated energy systems when they are exposed to different environmental and operating conditions.

The core of the simulation is a model of the building that is based on fundamental heat balance principles. The model is described in great detail in the US Department of Energy: *EnergyPlus Engineering Reference – The reference to EnergyPlus Calculations*, 2017.

New Features of DesignBuilder V5

Compliance and Certification

- UK DSM compliance and certification tool Level 5 Building Regulations and EPC reports for England, Wales and Scotland.
- Major additions to the LEED module including: o Fully automated baseline building generation with improvements in support for complex surface and window shapes.
    - o Support for LEED 2009 and v4.
    - o Online submission documentation preparation system for LEED 2009.
    - o Increased automation of baseline HVAC systems, including auto-assignment of AHUs and single-zone systems.
    - o Energy and cost comparisons between proposed and baseline building displayed.

Simulation

- Improved links with the JESS cloud simulation service.
- SageGlass electrochromic dynamic glazing with a wide range of control options.
- Thermochromic glazing.

Daylighting

- Climate-based daylighting assessment based on Spatial Daylight Autonomy (sDA), Annual Sun Exposure (ASE) and UDI via the Daysim simulation engine.
- Zone margin daylight options for more accurate BREEAM daylighting reports.
- Specular reflection of daylight now allows modelling of light shelves etc.
- New "Perez all weather" options for defining sky illuminance distribution.
- Diffusing glazing can now be modelled in Radiance and Daysim.
- More flexible and accurate modelling of working planes.

Outputs

- New graphical output of annual, monthly, daily or hourly simulation results rendered onto the 3-D model using false colours.
- Generate movies of the new graphical data plots to show time-varying outputs over the model
- Thermal comfort reports for CIBSE TM52 and TM59.

Modeller

- Import 2-D elevation drawings to help with drawing facades.
- gbXML export capability allows DesignBuilder models to be opened in other simulation tools.
- Stretch and rotate tools allow existing openings to be easily modified at both building and surface levels.

- Selective ghosting of blocks allows "buried" blocks to be accessed for geometric editing.
- Show the current block/zone in the context of the rest of the building.
- Direct input options for absolute internal/lighting gains and number of occupants without reference to floor area.
- Improved filters for fast data loading from templates.

Databases

- Update to International Glazing Database (IGDB v52).

Visualisation

- Various improvements and fixes to ensure that the rendered view accurately represents the data used in the simulation.
- Faster performance with less delay when moving to the Visualisation screen.

HVAC

- Several new components and options have been added for Detailed HVAC including: Radiant surfaces with option for reversible heating/cooling in same surface; Absorption chillers; Reformulated EIR chillers; Indirect absorption chillers; Zone water to air heat pump; Chilled water storage, VAV Outdoor air terminal unit; Dedicated outdoor air sizing options for HVAC zones and zone groups.
- New options for mechanical ventilation modelling in heating and cooling sizing calculations.

Natural Ventilation

- Options to model 2 new adaptive comfort natural ventilation control modes: CEN 15251 Adaptive and ASHRAE 55 Adaptive.

Cost Modelling

- Construction cost calculations and reports using NRM1 or UNIFORMAT II standards.
- HVAC systems can be costed based on heating/cooling capacity as well as by floor area.
- Additional capital cost KPIs for use in design optimisation studies

Thermal properties of materials utilised in the software

The software includes a data base of generic material properties sourced from:

- energy Plus & *DesignBuilder* Library (sourced from CIBSE, ASHRAE, the International Glazing database)
- reputable supplier data sheets
- Agrément South Africa (sourced originally from CSIR publications)

These material properties may be selected by the user or, if necessary, edited. Additional materials and properties may also be added to this data base.

Climate file format and compatibility of the reference climate files covering the six climate zones in South Africa

Climate files are ASCII text based weather, input and output files that include hourly or sub-hourly environmental conditions, and standard and user defined reports, respectively. As such the reference climate files for the six climatic zones as defined in **SANS 10400:XA** may be used as input.

Technical support and training

Technical support and training is available from the certificate holder. *DesignBuilder* also maintain a register of consultants worldwide who can offer assistance with all aspects of the software and related issues.