EN 15265/ ISO 13790 Standard (2008) - Tests for the calculation of energy use for space heating and cooling

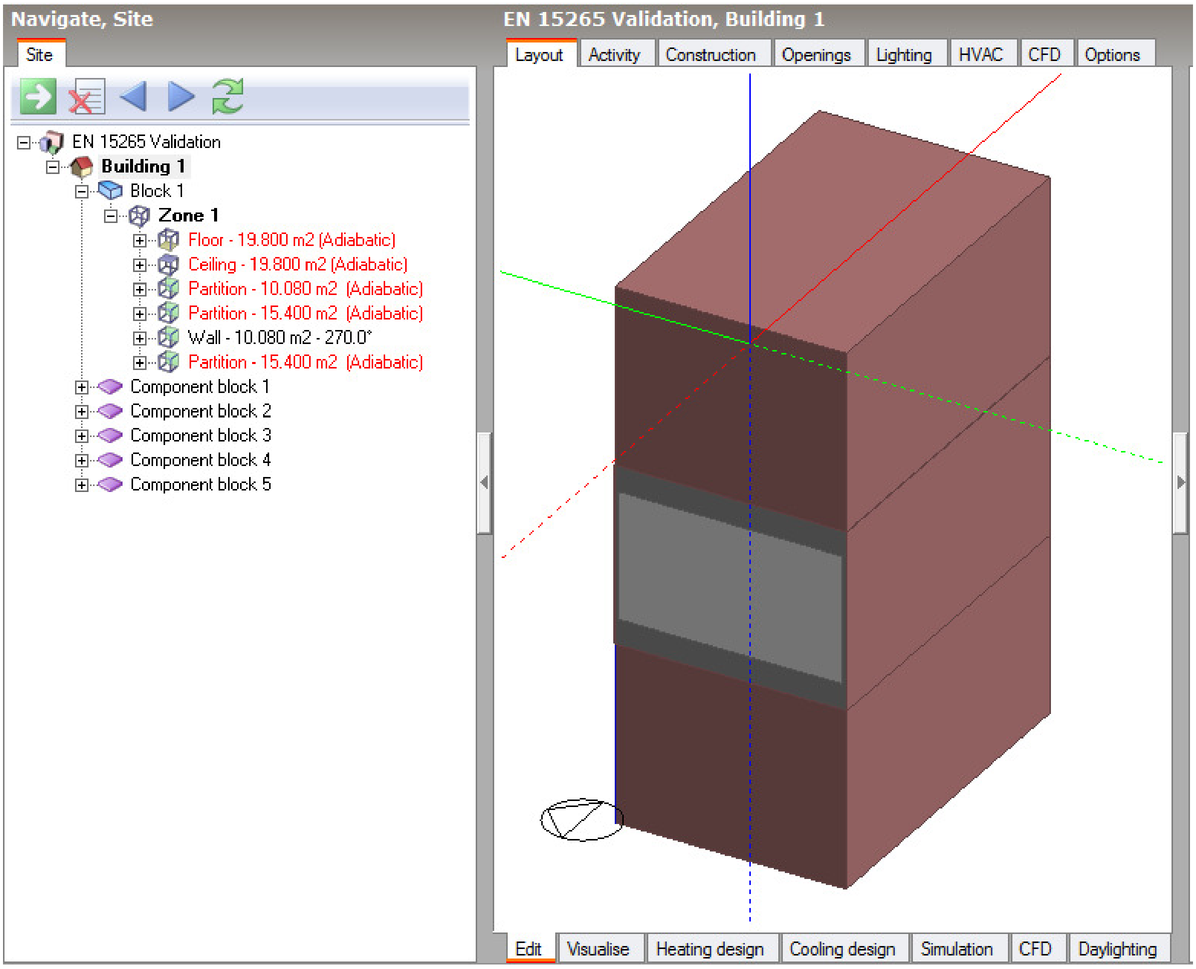
DesignBuilder Version 4.5 (incorporating EnergyPlus version 8.3.0) – May 2015

1. Purpose

This standard[1] is checked in accordance with European Standard EN 15265[2].

2. Input Data (All input data shall be listed and justified)

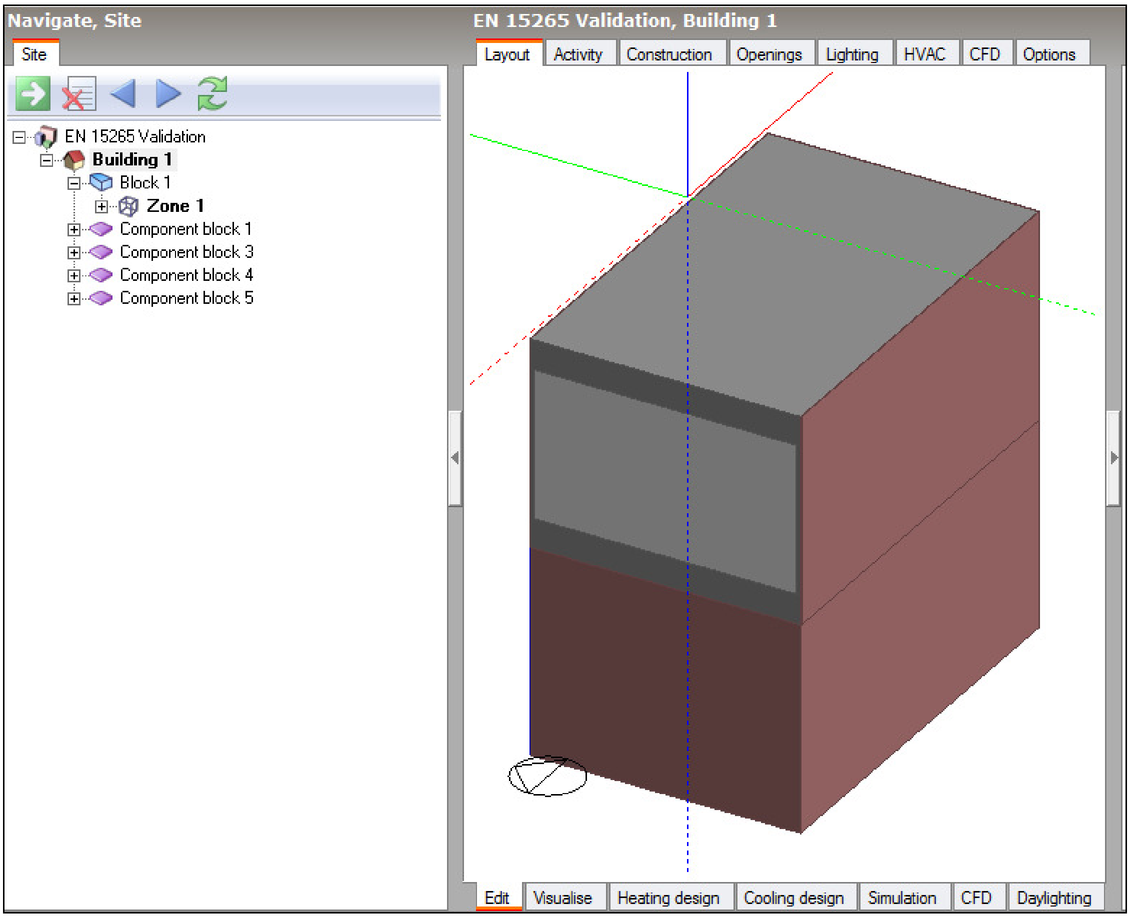
2.1. Geometry



A base geometry was created for use in all the tests. This used three extruded blocks with a height of 2.8m placed on top of each other. The middle block was a building block with wall thickness 0.01m.
All blocks had external dimensions of 5.52m (north and south walls) by 3.62m (west and east walls). This produced a block of internal dimensions 5.5m x 3.6m x 2.8m.

The lower and upper blocks were adiabatic component blocks. Adiabatic component blocks were placed on each of north, south and east walls, these had a nominal thickness of 0.01m.
A window was placed in the west wall with sill height 0.4m, width 3.5m and height 2.0m. This geometry was used for Tests 5 to 8.

For Tests 9 to 12 the upper adiabatic block was removed.



2.2. Constructions

The following constructions were defined at Building Level:

External Walls: Type 1
Internal partitions: Type 2
Internal floor: Type 4f
Flat roof: Type 5

In some of the tests the internal floor was replaced with Type 3f and the flat roof with Type 4c .
New materials were created as component layers for these constructions, these are listed below.

Material Name	Conductivity [W.m^{-1}.K^{-1}]	Specific Heat [J.kg^{-1}.K^{-1}]	Density [kg.m^{-3}]	Thermal Absorptance (emissivity)	Solar/Visible Absorptance
EN 15265 acoustic board	0.06	840	400	0.9	0.6
EN 15265 cement floor	1.40	850	2000	0.9	0.6
EN 15265 concrete	2.10	850	2400	0.9	0.6
EN 15265 gypsum plaster	0.21	850	900	0.9	0.6
EN 15265 insulating layer	0.04	850	30	0.9	0.6
EN 15265 internal plastering	0.70	850	1400	0.9	0.6
EN 15265 masonry	0.79	850	1600	0.9	0.6
EN 15265 mineral wool-insulating	0.04	850	50	0.9	0.6
EN 15265 mineral wool (low density)	0.04	850	30	0.9	0.6
EN 15265 outer layer	0.99	850	1800	0.9	0.6
EN 15265 plastic covering	0.23	1500	1500	0.9	0.6
EN 15265 rain protection	0.23	1300	1500	0.9	0.9

The constructions were defined as follows:

Type 1		
Outside surface convective heat transfer	Coefficient [$W.m^{-2}.K^{-1}$]	17.5
EN 15265 outer layer	Thickness [m]	0.115
EN 15265 insulating layer	Thickness [m]	0.060
EN 15265 masonry	Thickness [m]	0.175
EN 15265 internal plastering	Thickness [m]	0.015
Inside surface convective heat transfer	Coefficient [$W.m^{-2}.K^{-1}$]	2.5

Type 2		
Outside surface convective heat transfer	Coefficient [$W.m^{-2}.K^{-1}$]	2.5
EN 15265 gypsum plaster	Thickness [m]	0.012
EN 15265 mineral wool (low density)	Thickness [m]	0.100
EN 15265 gypsum plaster	Thickness [m]	0.012
Inside surface convective heat transfer	Coefficient [$W.m^{-2}.K^{-1}$]	2.5

Type 3f		
Outside surface convective heat transfer	Coefficient [$W.m^{-2}.K^{-1}$]	2.5
EN 15265 concrete	Thickness [m]	0.180
EN 15265 mineral wool-insulating	Thickness [m]	0.040
EN 15265 cement floor	Thickness [m]	0.060
EN 15265 plastic covering	Thickness [m]	0.004
Inside surface convective heat transfer	Coefficient [$W.m^{-2}.K^{-1}$]	2.5

Type 4f		
Outside surface convective heat transfer	Coefficient [$W.m^{-2}.K^{-1}$]	2.5
EN 15265 acoustic board	Thickness [m]	0.020
EN 15265 mineral wool-insulating	Thickness [m]	0.100
EN 15265 concrete	Thickness [m]	0.180
EN 15265 mineral wool-insulating	Thickness [m]	0.040
EN 15265 cement floor	Thickness [m]	0.060
EN 15265 plastic covering	Thickness [m]	0.004
Inside surface convective heat transfer	Coefficient [$W.m^{-2}.K^{-1}$]	2.5

Type 4c (Exterior roof)		
Outside surface convective heat transfer	Coefficient [$W.m^{-2}.K^{-1}$]	17.5
EN 15265 plastic covering	Thickness [m]	0.004
EN 15265 cement floor	Thickness [m]	0.060
EN 15265 mineral wool-insulating	Thickness [m]	0.040
EN 15265 concrete	Thickness [m]	0.180
EN 15265 mineral wool-insulating	Thickness [m]	0.100
EN 15265 acoustic board	Thickness [m]	0.020
Inside surface convective heat transfer	Coefficient [$W.m^{-2}.K^{-1}$]	2.5

Type 5		
Outside surface convective heat transfer	Coefficient [$W.m^{-2}.K^{-1}$]	17.5
EN 15265 rain protection	Thickness [m]	0.004
EN 15265 mineral wool-insulating	Thickness [m]	0.080
EN 15265 concrete	Thickness [m]	0.200
Inside surface convective heat transfer	Coefficient [$W.m^{-2}.K^{-1}$]	2.5

Note: DesignBuilder automatically uses the internal floor construction to define the ceiling and therefore the ceiling construction Type 3c defined in EN 15265 is not used. The Type 4c construction is used in Test 10 for the external roof as required by EN 15265.

2.3. Infiltration

Infiltration was deselected.

2.4. Openings

Two Glazing Types were defined for the tests: EN 15265 DP and EN 15265 Shaded DP. The latter being used in the base test 5. Two glass specifications were created for the layers (one for pane and one for shade) and two gas types were defined to achieve the correct gas space resistances:

Glass Name	Thick-ness [mm]	Conduct-ivity [W.m^{-1}.K^{-1}]	Solar Transmitt-ance	Inside /Outside Reflectance	IR Transmittance	Inside /Outside Emiss-ivity
EN 15265 Shade	0.1	0.9	0.20	0.50	0.00	0.90
EN 15265 Pane	6.0	1.0	0.84	0.08	0.00	0.90

Note that U value was determined by DesignBuilder according to its inbuilt glazing EN 673[3] U value calculation. Neither window type was defined as having a reveal or frame.

Glazing Name	Layers	U value (EN 673)	g value
EN 15265 DP	EN 15265 Pane Air 13.6mm EN 15265 Pane	2.930	0.764
EN 15265 Shaded DP	EN 15265 Shade Air 3 mm EN 15265 Pane Air 13.6mm EN 15265 Pane	2.372	0.206

2.5. Activity

Occupancy was set to zero by both setting the occupancy density to zero and schedule to *Off*. Heating Setpoint was set to 20.0 (with setback of 0.0) and Cooling Setpoint set to 26.0 (with setback of 40.0). The only internal gains were defined as Office Equipment. These were 20.0W/m^2 using the general schedule '*8:00 – 18:00 Mon – Fri*'.

2.6. HVAC

The zone was defined as heated by a 100% convective system and cooled. The building was mechanically ventilated at a rate of 1ac/hr. Air distribution was set as *mixed*. Both HVAC systems operated according to the same schedule (*08:00 – 18:00 Mon – Fri*) as was used for the internal gains.

2.7. Site

Weather data was extracted from EN 15265 and converted to EnergyPlus weather format. The following data was assigned as specified in that document:
Dry Bulb Temperature, Direct Normal radiation, Diffuse Horizontal radiation.
Global Solar Radiation was calculated according to an EnergyPlus internal formula and annual Global West Solar Radiation was checked from output and matched specification to a tolerance of 2.5%.

The following assumptions were made:

- 50% external Relative Humidity
- Air Pressure 99.323kPa
- wind speed 2.5m/s
- wind direction: random
- Latitude 48.8oN
- Longitude 2
- Surface Solar Reflection 0.2

3. Test Cases

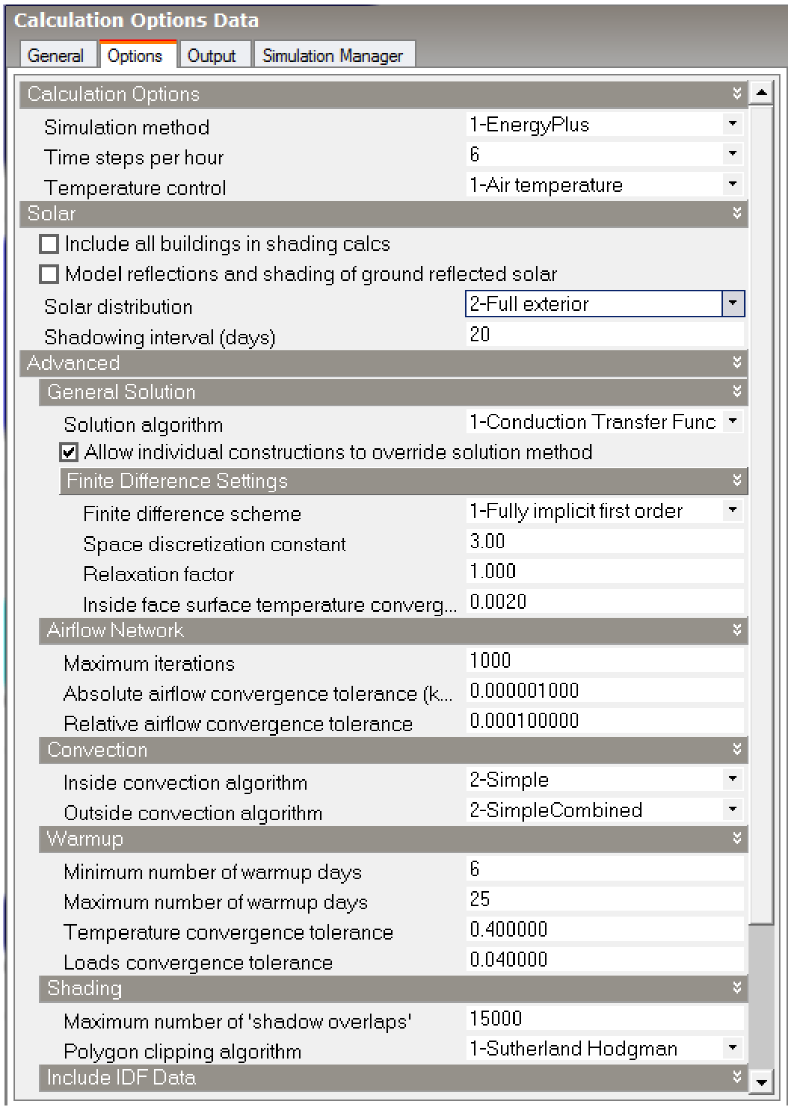
The Base Test Case (5) has already been defined. Test Cases 6 – 9 are defined below according to the changes made to Case 5. Test Cases 10 – 12 are defined according to changes made to Case 9.

Test	Change from Test 5
6	Internal Floor 3f
7	Internal Gain schedule set to Off
8	Glazing : DP
9	Top Adiabatic block removed

Test	Change from Test 9
10	Internal Floor 3f + Roof Type 4c
11	Internal Gain schedule set to Off
12	Glazing : DP

4. Simulation

A full annual simulation was conducted. The simulation options are shown in the following figure. Note that the Inside Convection Algorithm chosen was ***Simple*** ie directly used the input heat transfer coefficients. The Outside Convection Algorithm: ***SimpleCombined*** was used as the declared heat transfer coefficients represented the combination of convective and radiative coefficients.



5. Results

The following Table shows the reference results as they appear in EN 15265. These are the values against which the DesignBuilder results were compared using the accuracy criteria (A, B, C) which are described in this document.

Test	$Q_{H, ref}$	$Q_{C, ref}$	$Q_{tot, ref}$
5	463.1	201.7	664.8
6	509.8	185.1	694.9
7	1067.4	19.5	1086.9
8	313.2	1133.2	1446.4
9	747.1	158.3	905.4
10	574.2	192.4	766.6
11	1395.1	14.1	1409.2
12	533.5	928.3	1461.8

The second table shows the actual Annual Heating (**Q_H**) and Cooling (**Q_C**) delivered in each test and the accuracy criteria (A, B, C).

Test	$Q_{H, test}$	$Q_{C, test}$	$Q_{tot, test}$	r_{QH}	r_{QC}	Level
5	484.4	207.0	691.4	3.2%	0.8%	**A**
6	534.3	186.4	720.7	3.5%	0.2%	**A**
7	1075.5	22.7	1098.2	0.7%	0.3%	**A**
8	363.9	977.7	1341.6	3.5%	10.8%	**C**
9	748.8	206.7	955.4	0.2%	5.3%	**B**
10	616.7	197.7	814.4	5.5%	0.7%	**B**
11	1350.0	29.3	1379.2	3.2%	1.1%	**A**
12	585.9	844.7	1430.6	3.6%	5.7%	**B**

6. Discussion

All tests are within the acceptable range of results.

All heating results lie within the 5% tolerance (Level A) except Test Case 10 which is marginally above this threshold and therefore assigned with a Level B accuracy.

Most of the cooling results are well within the 5% tolerance (Level A) (Test Case 5,6,7,10 and 11) and Test Cases 9 and 12 are slightly above giving them a Level B.

For Test Case 8 the 10.8% accuracy on the cooling results means that for a marginal difference the achieved level is Level C.

7. References

1. EN ISO 13790-2008: Energy Performance of Buildings — Calculation of energy use for space heating and cooling, European Committee for Standardisation, 2008.

2. EN 15265-2007: Thermal Performance of Buildings — Calculation of energy use for space heating and cooling – General criteria and validation procedures, European Committee for Standardisation, 2007.

3. EN 673: Glass in Building - Determination of Thermal Transmittance (U value) - Calculation method, European Committee for Standardisation, 2011.