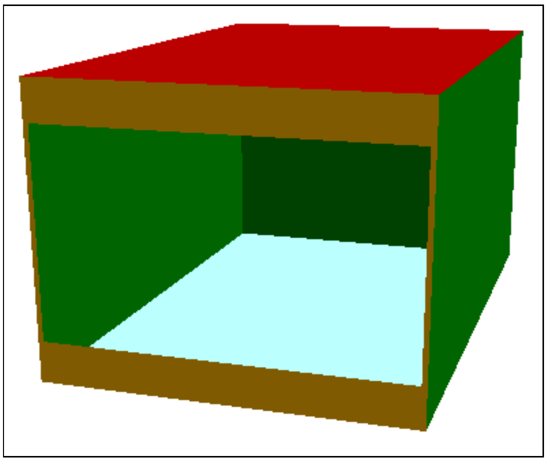
EDSL Tas 9.5.2 Compliance with BS EN 15265:2007

Twelve test cases were modelled (of which eight, tests 5 – 12, are considered for compliance with the standard). In each case a whole year simulation was carried out. For each case the total heating and cooling loads for the year were compared to the target values from the standard.

Input Data

Room Geometry



Geometry as seen in the Tas 3D modeller. The window faces west.

Element	Surface area (m^2)
External Wall	3.08
Glazing	7.00
Partition wall (left)	15.40
Partition wall (right)	15.40
Partition wall (back)	10.08
Floor	19.80
Ceiling	19.80

The volume of the room was 55.44m^3. The latitude of the building was 49°N.

Construction Details

Opaque constructions were set up in accordance with table 4 of the standard. Details are given below in screenshots from Tas.

Type no. 1 (external wall)

Layer	M-Code	Width (mm)	Conductivity (W/m·°C)	Density (kg/m³)	Specific Heat (J/kg·°C)
Inner	Ext Wall Internal Plastering	15.0	0.7	1400.0	850.0
2	Ext Wall Masonry	175.0	0.79	1600.0	850.0
3	Ext Wall Insulation	60.0	0.04	30.0	850.0
4	Ext Wall Outer Layer	115.0	0.99	1800.0	850.0

Type no.2 (internal wall)

Layer	M-Code	Width (mm)	Conductivity (W/m·°C)	Density (kg/m³)	Specific Heat (J/kg·°C)
Inner	Int Wall Gypsum Plaster	12.0	0.21	900.0	850.0
2	Int Wall Mineral Wool	100.0	0.04	30.0	850.0
3	Int Wall Gypsum Plaster	12.0	0.21	900.0	850.0

Type no. 3 (ceiling / floor)

Layer	M-Code	Width (mm)	Conductivity (W/m·°C)	Density (kg/m³)	Specific Heat (J/kg·°C)
Inner	Type 3 Concrete	180.0	2.1	2400.0	850.0
2	Type 3 Insulation	40.0	0.04	50.0	850.0
3	Type 3 Concrete Floor	60.0	1.4	2000.0	850.0
4	Type 3 Covering	4.0	0.23	1500.0	1500.0

Note: order of layers is underside to topside.

Type no. 4 (ceiling / floor)

Layer	M-Code	Width (mm)	Conductivity (W/m·°C)	Density (kg/m³)	Specific Heat (J/kg·°C)
Inner	Type 4 Acoustic Board	20.0	0.06	400.0	840.0
2	Type 4 Mineral Wool	100.0	0.04	50.0	850.0
3	Type 4 Concrete	180.0	2.1	2400.0	850.0
4	Type 4 Insulation	40.0	0.04	50.0	850.0
5	Type 4 Concrete Floor	60.0	1.4	2000.0	850.0
6	Type 4 Covering	4.0	0.23	1500.0	1500.0

Note: order of layers is underside to topside.

Type no. 5 (roof)

Layer	M-Code	Width (mm)	Conductivity (W/m·°C)	Density (kg/m³)	Specific Heat (J/kg·°C)
Inner	Roof Concrete	200.0	2.1	2400.0	850.0
2	Roof Insulation	80.0	0.04	50.0	850.0
3	Roof External Layer	4.0	0.23	1500.0	1300.0

The glazing construction was set up in accordance with table 3 of the standard.

Component	Solar transmittance	Solar reflectance	Solar absorptance
Inner Pane	0.84	0.08	0.08
Outer Pane	0.84	0.08	0.08
Shade	0.2	0.5	0.3

The solar parameters were considered to be independent of the solar angle. The direct transmission of the glazing was reduced by 10% from the values shown above, to account for the angular dependence of the solar transmission properties.

Weather and Time

The weather data from Annex A of the standard was used.

Weather data was given in solar time. Schedules are given in legal time, which is two hours ahead of solar time in summer (hour 1,996 to 7,032) and one hour ahead of solar time in winter. This means that a schedule in legal time of 08:00 – 18:00 is equivalent in solar time to 06:00 – 16:00 in summer and 07:00 – 17:00 in winter.

The first day of the year is a Monday.

System

Each test case used 100% convective heating and cooling, controlled to room dry bulb temperature limits of 20°C and 26°C with no dead bands. The heating and cooling had unlimited capacity.

The schedule of system operation varied between the test cases.

Other inputs

- **Heat transfer coefficients**
  - Section 6.3 of the standard specifies 23 W/(m^2K) for the external surface heat transfer coefficient (convective plus long wave).
    In the Tas model the external surface emissivities were set to zero and the wind speed was set to a constant 4.75 m/s, to give a total external heat transfer coefficient of 23 W/(m^2K) (4 + 4*windspeed).
  - Section 6.3 of the standard specifies 2.5 W/(m^2K) for the internal surface convective heat transfer coefficient and 5.5 W/(m^2K) for the internal long-wave radiative heat transfer coefficient.
    In the Tas model the convective heat transfer coefficient of all internal surfaces is set to 2.5 W/(m^2K). Tas calculates long wave radiation exchange based on emissivities, these values were set to get as close as possible to the required 5.5 W/(m^2K).
  - Section 8.2 of the standard specifies the following thermal resistances for the glazing:
    - 0.0435 m^2K/W for the external surface of the blind (or outer pane, whichever is the outermost layer of the glazing system) – this is equivalent to the 23 W/(m^2K) heat transfer coefficient set on all external surfaces in the Tas model (see above).
    - 0.080 m^2K/W for the air gap between the blind and the outer pane – in the Tas model a convection coefficient of 12.5 W/(m^2K) was applied in the air gap with the surface emissivities set to zero.
    - 0.173 m^2K/W for the air gap between the outer and inner panes – in the Tas model a convection coefficient of 5.78 W/(m^2K) was applied in the air gap with the surface emissivities set to zero.
    - 0.125 m^2K/W for the internal surface of the inner pane – this is equivalent to the total 8 W/(m^2K) heat transfer coefficient set on all internal surfaces in the Tas model (see above).
- **Solar distribution**
  The distribution of the solar radiation on the internal surfaces of the room is time-independent. This was achieved by splitting the solar gain evenly over each of the internal opaque surfaces (weighted by surface area) on every hour.
- **Solar-to-air factor**
  10% of the solar heat entering the room through the window was added directly into the internal air.
- **Solar loss factor**
  No solar radiation which entered the room was reflected back outside.
- **External Surface Solar Absorptances**
  The external wall had an external solar absorptance of 0.6. The roof had an external solar absorptance of 0.9
- **Additional heat transfer due to building element thickness**
  Heat transfer through external walls and roofs was increased by 5% to account for additional edge losses, as only the internal dimensions of the geometry were given.

- **Ground solar reflectance**
  A ground solar reflectance of zero was assumed.
- **Glazing U-value**
  The U-values calculated in Tas for the two glazing systems (shaded and unshaded) were adjusted to meet the values given in the standard.
- **Infiltration**
  No infiltration was allowed for in any of the test cases.

<u>Test Case Setup</u>

Test	Glazing	Ceiling	Floor	Gains	System Schedule
1	Shaded	Adiabatic 4	Adiabatic 4	20 W/m^2	Continuous
2	Shaded	Adiabatic 3	Adiabatic 3	20 W/m^2	Continuous
3	Shaded	Adiabatic 4	Adiabatic 4	None	Continuous
4	Unshaded	Adiabatic 4	Adiabatic 4	20 W/m^2	Continuous
5	Shaded	Adiabatic 4	Adiabatic 4	20 W/m^2	Weekdays 08:00-18:00
6	Shaded	Adiabatic 3	Adiabatic 3	20 W/m^2	Weekdays 08:00-18:00
7	Shaded	Adiabatic 4	Adiabatic 4	None	Weekdays 08:00-18:00
8	Unshaded	Adiabatic 4	Adiabatic 4	20 W/m^2	Weekdays 08:00-18:00
9	Shaded	Roof 5	Adiabatic 4	20 W/m^2	Weekdays 08:00-18:00
10	Shaded	Roof 4	Adiabatic 3	20 W/m^2	Weekdays 08:00-18:00
11	Shaded	Roof 5	Adiabatic 4	None	Weekdays 08:00-18:00
12	Unshaded	Roof 5	Adiabatic 4	20 W/m^2	Weekdays 08:00-18:00

Internal gains, when present, were 100% convective, and from 08:00 to 18:00 on weekdays.

All test models had 1 ACH of ventilation at outside air temperature from 08:00 to 18:00 on weekdays.

Results

Below: Target annual heating and cooling loads (in kWh) and results from Tas.

Qhref: Target heating load
Qcref: Target cooling load
Qtotref: Sum of heating and cooling loads
Qh: Heating load from Tas simulation
Qc: Cooling load from Tas simulation
rQh: The absolute value of (Qh – Qhref)/Qtotref
rQc: The absolute value of (Qc – Qcref)/Qtotref

For level A compliance, both rQh and rQc must be equal to or less than 0.05.

	Targets			Tas Results				
	Qhref	Qcref	Qtotref	Qh	Qc	rQh	rQc	Compliance
Test 1	748.0	233.8	981.8	721.37	221.99	0.0271	0.0120	Level A
Test 2	722.7	200.5	923.2	694.26	186.12	0.0308	0.0156	Level A
Test 3	1368.5	43.0	1411.6	1345.32	48.58	0.0164	0.0040	Level A
Test 4	567.4	1530.9	2098.3	535.91	1560.03	0.0150	0.0139	Level A
Test 5	463.1	201.7	664.8	440.58	172.62	0.0339	0.0437	Level A
Test 6	509.8	185.1	694.9	482.86	164.09	0.0388	0.0302	Level A
Test 7	1067.4	19.5	1086.9	1057.86	7.18	0.0088	0.0113	Level A
Test 8	313.2	1133.2	1446.4	289.01	1065.60	0.0167	0.0467	Level A
Test 9	747.1	158.3	905.4	718.96	147.92	0.0311	0.0115	Level A
Test 10	574.2	192.4	766.6	559.77	167.64	0.0188	0.0323	Level A
Test 11	1395.1	14.1	1409.3	1365.78	6.33	0.0208	0.0055	Level A
Test 12	533.5	928.3	1461.8	484.87	872.74	0.0333	0.0380	Level A

Monthly Heating and Cooling

Monthly heating loads, kWh

Heating	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Test 11	Test 12
Jan	173.71	173.18	263.97	165.80	121.07	135.47	211.89	104.38	187.91	146.63	278.99	166.18
Feb	115.35	113.65	191.99	77.13	74.88	82.60	152.44	37.90	121.22	91.85	200.37	73.18
Mar	54.61	45.55	122.11	9.67	31.66	29.27	100.12	2.75	52.00	40.13	127.88	6.26
Apr	48.14	43.88	120.08	3.44	23.26	23.84	97.25	0.08	43.40	34.93	124.32	0.16
May	7.08	3.81	45.04	0.00	2.11	1.07	39.41	0.00	4.47	3.72	44.97	0.00
Jun	0.00	0.00	9.83	0.00	0.00	0.00	6.49	0.00	0.00	0.00	4.84	0.00
Jul	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug	0.00	0.00	4.82	0.00	0.00	0.00	2.87	0.00	0.00	0.00	1.64	0.00
Sep	0.40	0.00	23.65	0.00	0.00	0.00	17.04	0.00	0.00	0.15	16.66	0.00
Oct	38.02	32.61	113.15	14.93	11.81	12.21	86.67	1.94	25.87	22.21	112.66	3.75
Nov	126.25	124.46	210.99	114.19	79.49	89.85	164.33	60.66	129.78	100.88	215.96	102.68
Dec	157.81	157.12	239.70	150.75	96.29	108.54	179.35	81.30	154.30	119.27	237.49	132.66

Monthly cooling loads, kWh

Cooling	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Test 11	Test 12
Jan	0.00	0.00	0.00	5.88	0.00	0.00	0.00	3.54	0.00	0.00	0.00	0.00
Feb	0.00	0.00	0.00	16.43	0.00	0.00	0.00	5.93	0.00	0.00	0.00	0.06
Mar	7.65	1.62	1.89	170.07	3.00	0.52	0.00	99.09	0.00	2.60	0.00	61.61
Apr	0.84	0.00	0.15	77.95	0.00	0.00	0.00	41.83	0.00	0.00	0.00	12.40
May	8.78	3.66	1.40	167.14	4.06	2.76	0.00	109.00	0.71	4.60	0.00	81.55
Jun	42.77	35.78	7.45	273.67	31.27	29.95	0.02	183.03	23.05	30.85	0.00	167.78
Jul	91.81	88.08	27.23	380.85	73.56	76.85	4.92	267.50	75.89	73.88	5.44	268.43
Aug	54.02	46.33	9.39	251.42	47.69	43.84	2.12	196.75	40.48	44.60	0.89	180.36
Sep	14.73	10.62	1.00	137.06	12.30	10.13	0.12	101.02	7.79	10.74	0.00	83.06
Oct	1.24	0.03	0.07	57.70	0.73	0.03	0.00	41.52	0.00	0.38	0.00	13.17
Nov	0.15	0.00	0.00	17.47	0.00	0.00	0.00	14.54	0.00	0.00	0.00	4.33
Dec	0.00	0.00	0.00	4.39	0.00	0.00	0.00	1.84	0.00	0.00	0.00	0.00