

ESRU

Technical Report



CEN Standard 13791: ESP-r Test Results

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Standard EN ISO 13791:2004

Models

The models are embedded in ESP-r, and can be run by selecting “validation” in the Project Manager. There are four groups of tests in the Standard:

Section 7.2.2 Heat conduction through opaque elements

Section 7.2.3 Internal long-wave radiation heat exchanges

Section 7.2.4 Evaluation of short-wave radiation heat transfer (calculation of shaded area of a window due to external obstructions)

Section 7.3 Whole calculation method

Simulations

All results can be obtained from the Project Manager and can be displayed on the screen or output to a file.

Results

Heat Conduction through Opaque Elements:

Results obtained with ESP-r Version 11.4, released November 2007.

Table 6: Internal air temperature (deg C)

Test		Time				
		2h	6h	12h	24h	120h
1	Ref	20.04	21.26	23.48	26.37	30.00
	ESP-r	20.04	21.29	23.46	26.36	29.96
2	Ref	25.09	29.63	30.00	30.00	30.00
	ESP-r	24.64	29.49	29.98	30.00	30.00
3	Ref	20.00	20.26	21.67	24.90	29.95
	ESP-r	19.99	20.24	21.63	24.85	29.94
4	Ref	20.00	20.06	20.25	20.63	23.17
	ESP-r	19.99	20.05	20.24	20.62	23.16

All temperatures are well within the tolerance of +/- 0.5degC

Internal long-wave radiation heat exchanges

Results obtained with ESP-r Version 11.4, released November 2007.

Table 9: Internal air temperature in deg C

	Test 1	Test 2	Test 3	Test 4
Ref	34.4	30.4	38.5	25.5
ESP-r	34.4	30.4	38.6	25.7

All temperatures are well within the tolerance of +/- 0.5degC

Sunlit area of a window due to external obstructions

Results obtained with ESP-r Version 11.4, released November 2007.

Table 11 Value of sunlit factor for various test cases

Hour		Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
07:00	Ref	0.00	0.00	0.00	0.00	1.00	0.00
	ESP-r	0.00	0.00	0.00	0.00	1.00	0.00
08:00	Ref	0.53	0.47	0.00	1.00	0.89	0.00
	ESP-r	0.51	0.49	0.00	1.00	0.90	0.00
09:00	Ref	0.24	0.76	0.00	1.00	0.71	0.07
	ESP-r	0.23	0.77	0.00	1.00	0.70	0.10
10:00	Ref	0.21	0.97	0.18	1.00	0.39	0.72
	ESP-r	0.21	0.97	0.18	1.00	0.40	0.70
11:00	Ref	0.30	1.00	0.30	0.90	0.00	1.00
	ESP-r	0.30	1.00	0.30	0.85	0.03	1.00
12:00	Ref	0.33	1.00	0.33	0.84	0.00	1.00
	ESP-r	0.35	1.00	0.35	0.80	0.03	1.00

Note: ESP-r calculates shading at each hour, not half hour. Also the outputs from ESP-r are shading fraction and have been converted to sunlit factor (1-shading factor) in above table.

All results are within the specified tolerance of +/- 0.05.

Whole Calculation Method

Results have been obtained with ESP-r Version 11.4, released November 2007.

Table 21: Operative temperature for Geometry A

Test	Ventilation	Max temp (degC)		Av temp(deg C)		Min temp (deg C)	
		Ref	ESP-r	Ref	ESP-r	Ref	ESP-r
A1	a)	38.7	39.0	35.9	35.7	33.6	33.5
	b)	34.1	33.9	29.4	29.2	25.5	25.5
	c)	33.5	33.5	29.0	29.1	25.4	25.4
A2	a)	37.6	37.9	35.9	35.9	34.4	34.5
	b)	32.2	32.2	29.5	29.3	26.5	26.5
	c)	32.4	32.4	29.1	29.2	26.4	26.5
A3	a)	40.8	41.2	38.7	38.8	37.1	37.2
	b)	35.4	35.7	31.6	31.7	28.0	28.2
	c)	33.8	33.9	30.3	30.5	27.4	27.6

Table 22: Operative temperature for Geometry B

Test	Ventilation	Max temp (degC)		Av temp(deg C)		Min temp (deg C)	
		Ref	ESP-r	Ref	ESP-r	Ref	ESP-r
B1	a)	35.9	35.8	30.7	30.2	27.2	26.7
	b)	29.9	29.5	22.1	21.7	16.4	16.5
	c)	28.1	28.2	21.5	21.6	16.2	16.4
B2	a)	33.7	34.0	30.8	30.7	28.5	28.6
	b)	26.7	26.7	22.2	22	17.9	18
	c)	26.4	26.6	21.7	21.8	17.7	18
B3	a)	36.0	36.5	32.7	32.8	30.3	30.4
	b)	29.6	30	24.2	24.2	19.2	19.5
	c)	27.7	28.1	22.7	23	18.6	19

Note that the reference temperatures for B1a and B1b are the corrected values taken from the tabulated results of Table K.1.2 in the Standard rather than the ones quoted in Table 22 (see CIBSE TM33, page 4).

Notes:

1. ESP-r uses the given horizontal radiation to calculate the vertical solar radiation, rather than use the given values for the west facade. In tests this can make a difference of a few tenths of a degree Centigrade.
2. The tests specify that the internal short-wave absorptances are 0.6, but that no solar radiation leaves the zone. This is physically unrealistic. In the model used in these tests the internal surface absorptances are assumed to be 1, so that all solar is absorbed in the test room.
3. The test results are sensitive (to a few tenths deg C) to several simulation parameters, e.g. start-up period, number of timesteps per hour, averaging period of the timesteps. With different parameters than those chosen for the tests, it can mean a few of the individual results lie just outside the specified tolerances.

All results are within the specified tolerance of +/- 0.5 degC.

Conclusion

ESP-r passes all the tests within the 13791 Standard within the specified tolerances.