

Introduction

Annex D of the standard EN ISO 11855-2:2015 “Building environment design – Design, dimensioning, installation and control of embedded radiant heating and cooling systems – Part 2: Determination of the design heating and cooling capacity (ISO 11855-2:2015) contains a test example that must be used to verify a steady state numerical calculation program. The program BISCO is used to simulate the test example.

Validation example data

BISCO data [pipe_in_floor.bsc](#)

- Room temperature below and above the structure = 26 °C
- Water temperature is the mean = 18 °C
- turbulent flow (resistance between heating medium and inner pipe is assumed =0)
- Thermal resistance at upper boundary air layer = 1/7 = 0,1429 m²K/W
- Thermal resistance at lower boundary air layer = 1/11 = 0,0909 m²K/W
- Pipe distance = 150 mm
- Pipe outside diameter = 20 mm,
- Pipe wall thickness = 2,3 mm
- Pipes simulated as circles
- Screed below pipe = 10 mm
- Screed above pipe = 30 mm

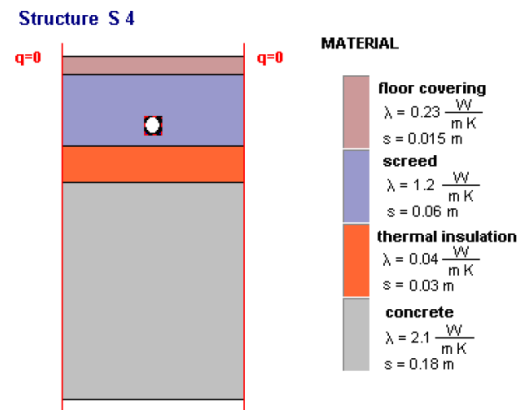
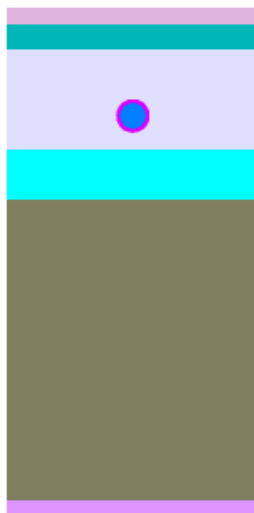


Figure 1. Test example data as listed in EN ISO 11855-2:2015, Annex D








Col.	Type	Rule	Name	Pat.	λ [W/mK]	ε [-]	θ [°C]	h [W/m ² K]
5	MATERIAL		thermal insulation		0.040			
21	MATERIAL		floor covering		0.230			
38	MATERIAL		PE-X pipe		0.350			
129	MATERIAL		screed		1.200			
144	MATERIAL		concrete		2.100			
150	BC_SIMPL	NIHIL	room below				26.0	11.00
182	BC_SIMPL	NIHIL	room above				26.0	7.00

Figure 2. Test data as defined in BISCO.

Figure 1 shows the example data as defined in the standard. Figure 2 shows the data as defined in BISCO. Because of missing data in the standard, the following assumption is made: the thermal conductivity of the pipe = 0.35 W/mK (PE-X from table E.1 in EN ISO 11855- in 2:2015)

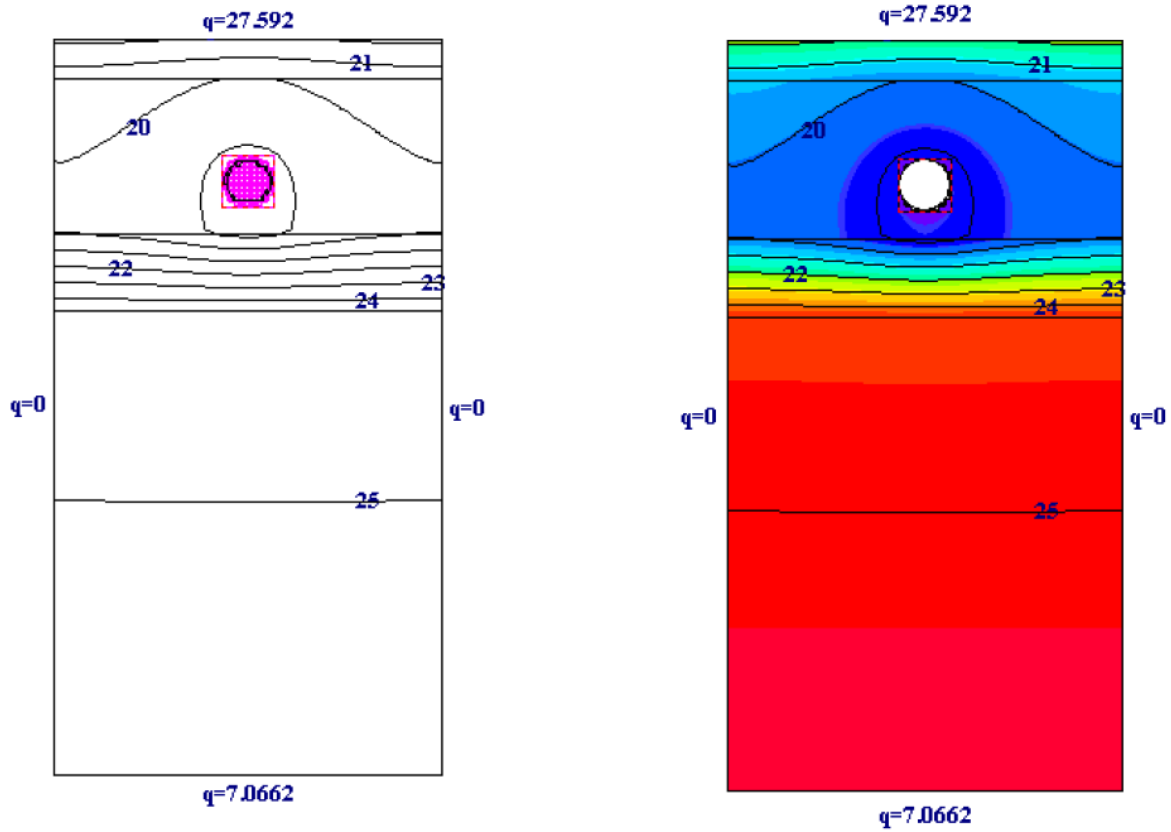
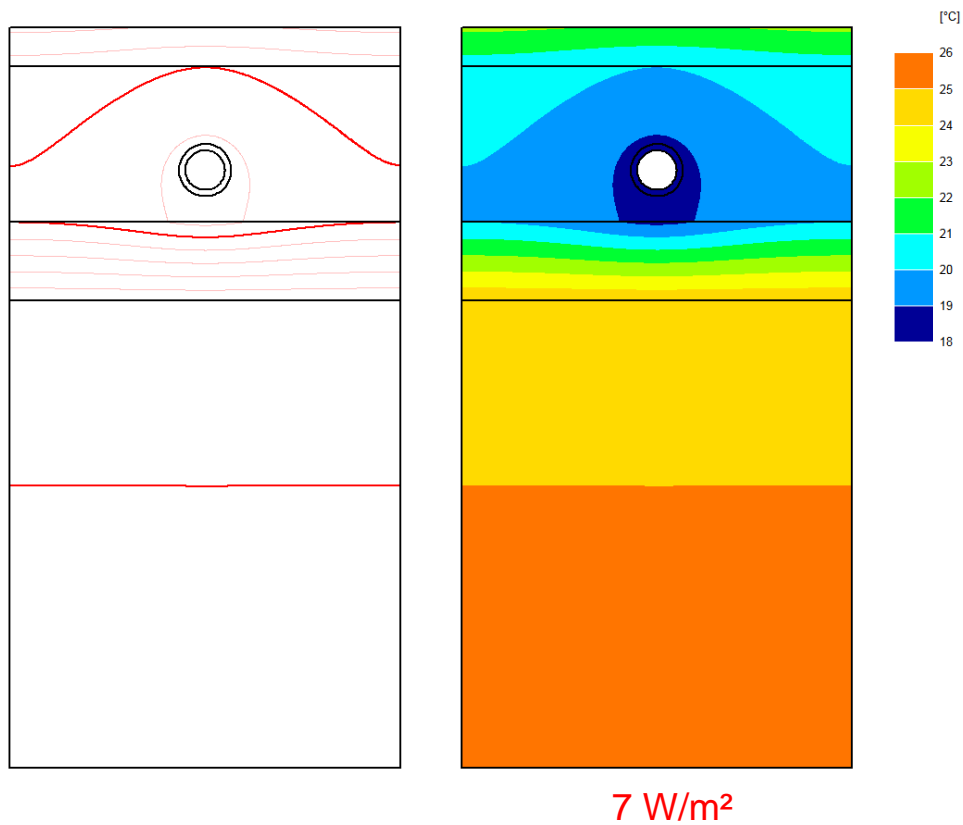


Figure 3. Isotherms according to the standard

27.4 W/m²



7 W/m²

Figure 4. Isotherms obtained by BISCO (line increments 1°C and 5 °C)

The BISCO results were obtained using a triangulation with 197557 nodes. The isotherms obtained (Figure 4) correspond well with the ones from the standard (Figure 3). Table 1 lists the standard temperatures in some points and the BISCO temperatures in 4 points. The difference is much less than the difference of 0.3 °C required by the standard. The difference between the heat loss densities at the lower and upper (standard in Figure 3 and BISCO in Figure 4) is about 1%, lower than the 3 % required by the standard.

y [m]	T(x = 0 m) [°C]	T(x = 0.0375 m) [°C]	T(x = 0.075 m) [°C]
0,285	22,201 22.228	22,064	21,893 21.938
0,246	20,086	19,788	19,11
0,205	20,728	20,414	19,765
0,164	24,809	24,806	24,802
0,123	24,944	24,943	24,943
0,082	25,082	25,081	25,081
0,041	25,219	25,219	25,219
0	25,357 25.361	25,357	25,357 25.361

Table 1. Temperatures from the standard and from BISCO (in red).

Bibliography

EN ISO 11855-2:2015 "Building environment design – Design, dimensioning, installation and control of embedded radiant heating and cooling systems – Part 2: Determination of the design heating and cooling capacity (ISO 11855-2:2015)