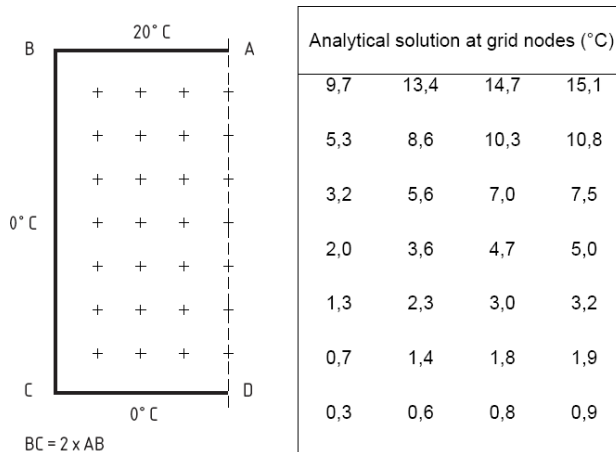


## Introduction

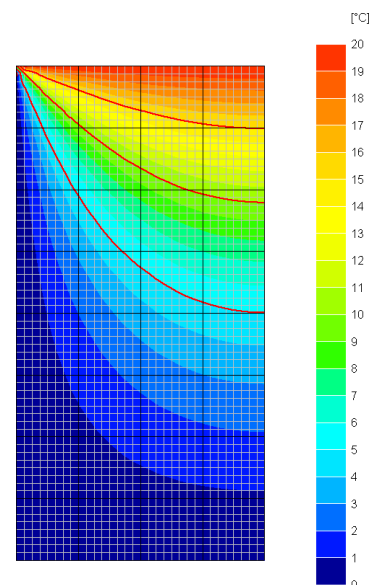
Annex C of the standard ISO 10211<sup>1</sup> contains 4 test reference cases (2 2D and 2 3D). In order to be classified as a three-dimensional steady-state high precision method, TRISCO and SOLIDO shall give results corresponding with those of these 4 cases. The SOLIDO data were obtained by importing the TRISCO data. In the precision range required in the standard, the SOLIDO simulation results are identical to the TRISCO ones.

## Test reference case 1

TRISCO data [validation\\_10211\\_case1.trc](#)  
 SOLIDO data [validation\\_10211\\_case1.sld.sld](#)



**Figure 1. Test reference case 1 as listed in EN ISO 10211:2017**



**Figure 2. Results obtained by TRISCO**

Using the grid as shown in Figure 2 with 4290 nodes the maximum difference between the analytical solution and the simulated one is less than 0.0034 °C. This is lower than the maximum of 0.1 °C required by the standard. The grid temperatures obtained by TRISCO rounded to 1 decimal are identical to the ones listed in the standard.

Table 1 compares the difference between the simulated and the analytical solution as a function of the number of nodes. More details can be found in [validation\\_10211\\_case1.xlsx](#).

<sup>1</sup> ISO 10211:2017 *Thermal bridges in building construction – Heat flows and surface temperatures – Detailed calculations*

Table 1. Simulated and analytical solution of case 1

number of nodes	simulated temperature – real temperature [°C]	
	minimum	maximum
90	-0.234442	0.209684
306	-0.052136	0.046134
1122	-0.013477	0.011988
4290	-0.003398	0.003026
16770	-0.000851	0.000758
66306	-0.000213	0.000189
263682	-0.000057	0.000076
1051650	-0.000015	0.000016

Test reference case 2

TRISCO data [validation\\_10211\\_case2.trc](#)  
 SOLIDO data [validation\\_10211\\_case2\\_sld.sld](#)

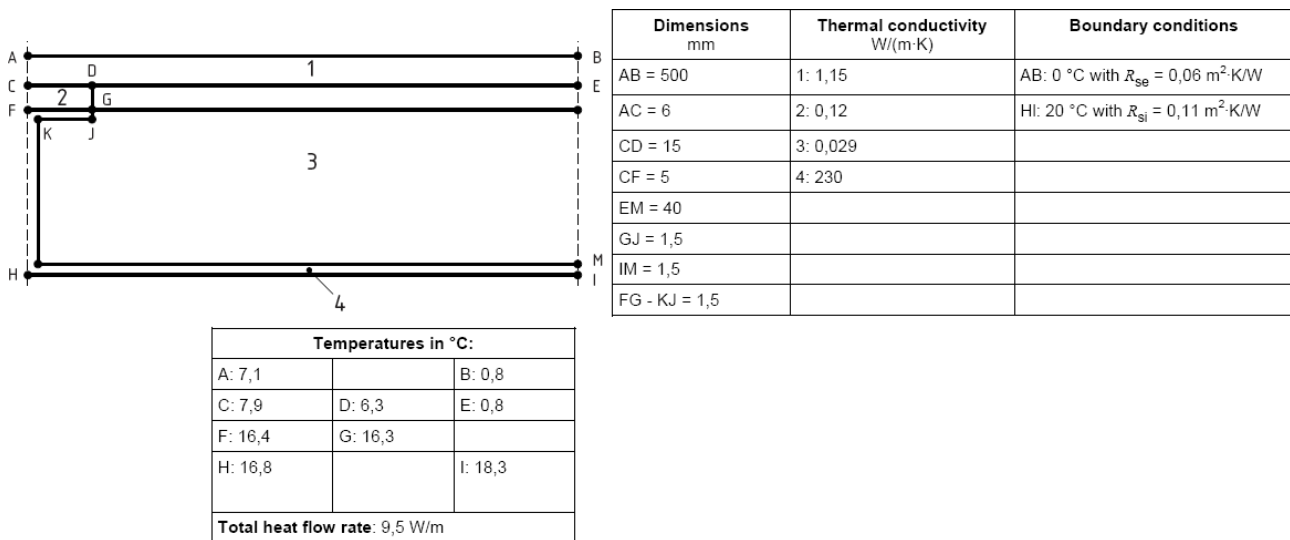


Figure 3. Test reference case 2 as listed in ISO 10211:2017(E)

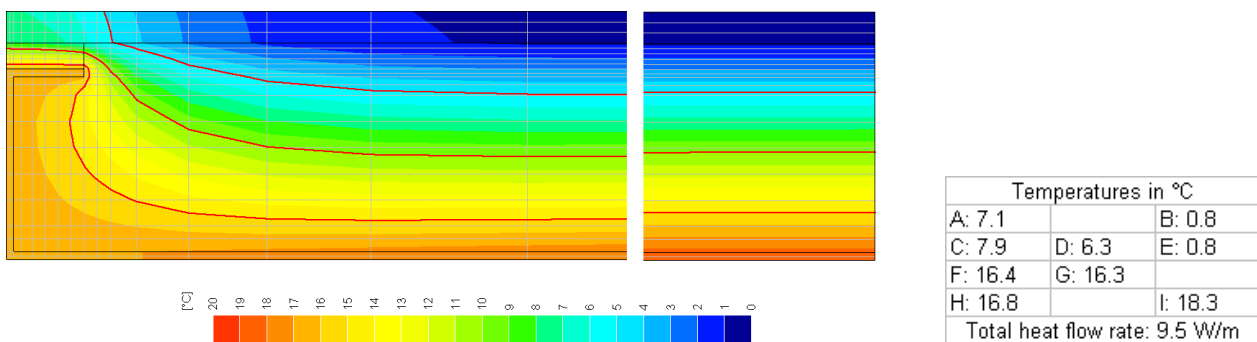


Figure 4. Results obtained by TRISCO

Using a grid with 924 nodes the grid temperatures obtained by TRISCO rounded to 1 decimal are

identical to the ones listed in the standard. The total heat loss rounded to 1 decimal (9.5 W/m) is identical to the one listed in the standard.

### Test reference case 3

TRISCO data [validation\\_10211\\_case3.trc](#)  
 SOLIDO data [validation\\_10211\\_case3\\_sld.sld](#)

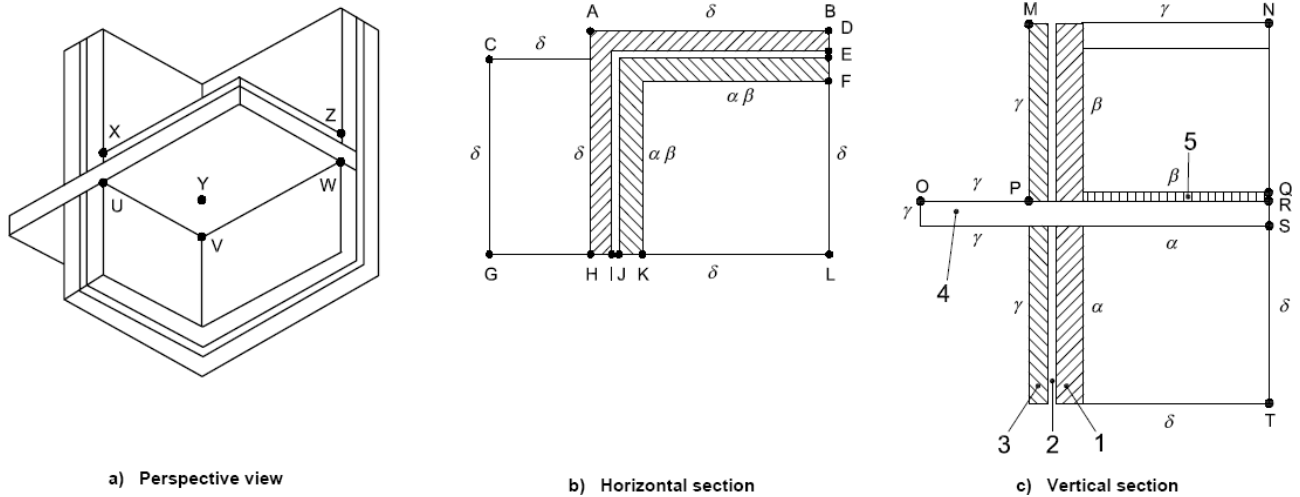


Figure 5. Test reference case 3 as listed in EN ISO 10211:2017

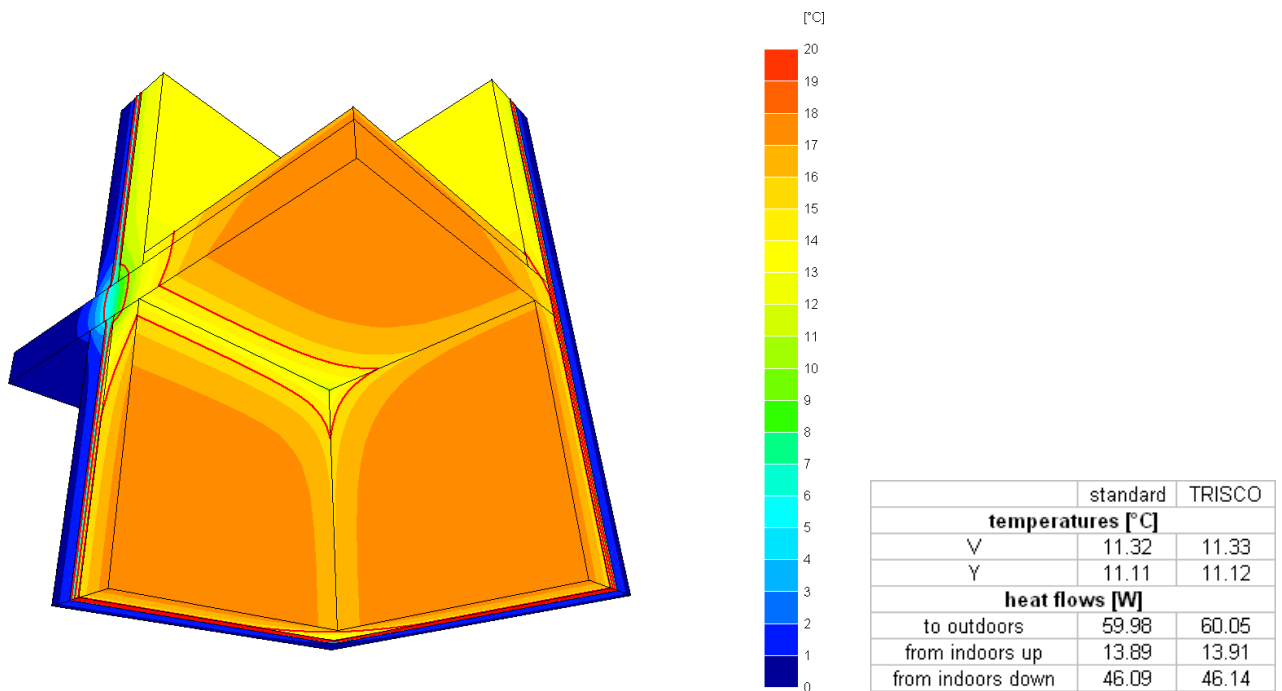


Figure 6. Results obtained by TRISCO compared to the standard results

Figure 6 shows the results obtained by TRISCO using a grid with 130926 nodes. The difference between the simulated and standard temperatures in the points V and Y is less than 0.1 °C. The difference between the simulated and standards heat flows is less than 1%.

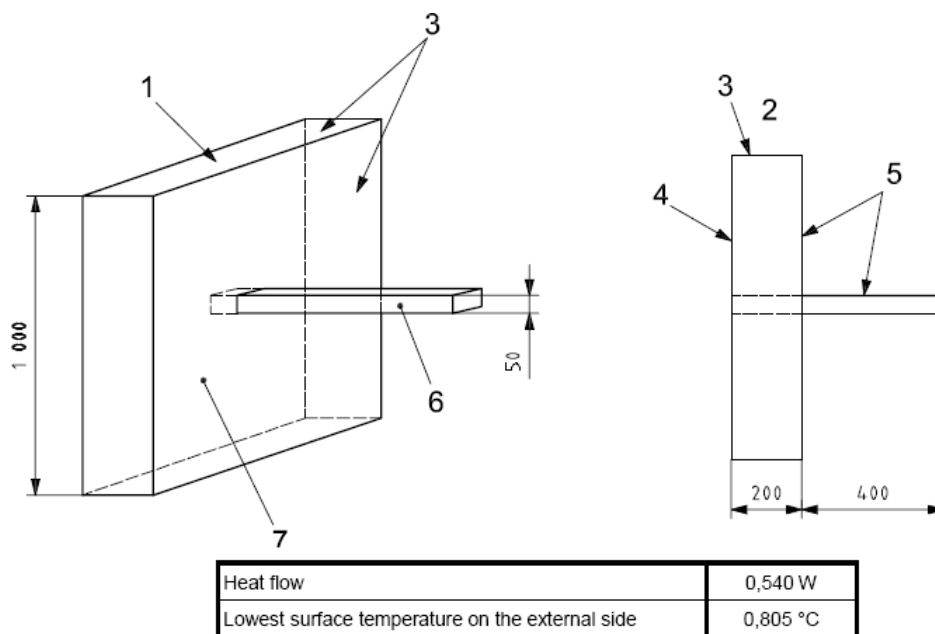


Figure 7. Test reference case 4 as listed in ISO 10211:2017(E)

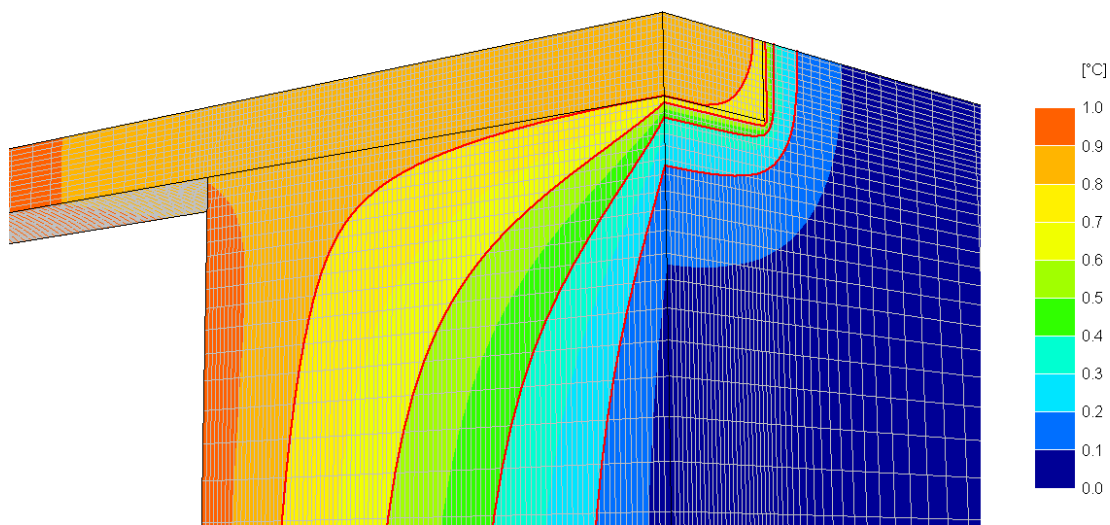


Figure 8. Results obtained by TRISCO (isotherms in part of the object)

Because of symmetry only a quarter of the object was considered in TRISCO. Figure 8 shows the results obtained using a grid with 259784 nodes. The heat flow is 0.1341 W for the quarter object or 0.540 W for the total object, which is exactly the heat flow listed in the standard. The highest temperature on the external surface is 0.802 °C, which is within the range of 0.005 °C of the standard value (0.805 °C).

## Conclusion

According to the standard ISO 10211, TRISCO (and SOLIDO) can be classified as a three-dimensional steady-state high precision method.