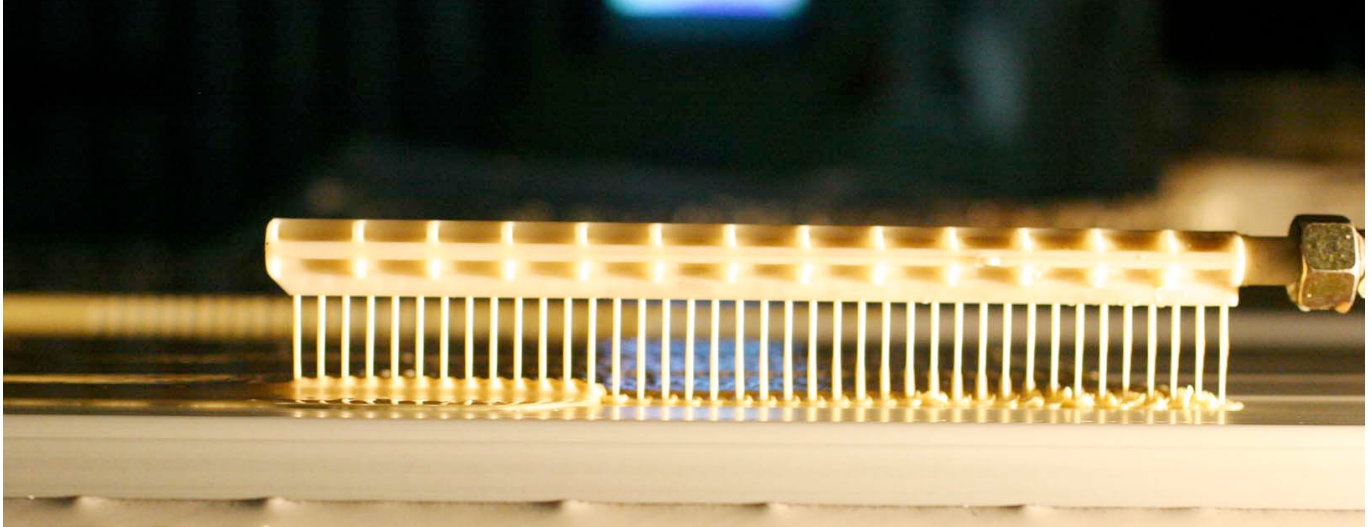


Thermal Insulation Calculation At Sandwich Panels With Polyurethane



Calculation of Heat Loss on Walls

The thicknesses of the polyurethane foams in Sandwich Panels may vary according to the thermal insulation capacity, bearing capacity, conditions of the region and the utilization purpose of the building. The standard production is available at polyurethane thicknesses varying between 30 to 80 mm. While the polyurethane thickness is determined according to the thermal insulation capacity, the Thermal Transmittance Coefficient and Condensation values must also be taken into consideration.

Since the sandwich panels are the composite materials formed with polyurethane filling material between two metals, the contribution of the external metal surfaces having thermal conductivity in the thermal insulation is little if any. Therefore, the insulation values of the polyurethane, which is the filling material, are very important for the calculation of the thermal insulation.

Turkey has been divided into 4 regions in terms of Thermal Transmittance Coefficient "U" according to TS - 825, and it is required from all building components to be used in the buildings, to have maximum "U" values given in the **Table-1**. By taking $\lambda = 0.022 \text{ W/mK}$ polyurethane design value into consideration, the "U" values of all ASSAN PANEL products have been determined as can be seen in **Table-2**.

The thickness of polyurethane can be determined via **Table-1** and **Table-2**.

Table-1

	U WALL (W/m ² K)	U CEILING (W/m ² K)	U GROUND (W/m ² K)	U WINDOW (W/m ² K)
1. Region	0,80	0,50	0,80	2,80
2. Region	0,60	0,40	0,60	2,80
3. Region	0,50	0,30	0,45	2,80
4. Region	0,40	0,25	0,40	2,80

*U values recommended according to the regions (TS 825)

Perspiration on Walls and Controlling the Perspiration

Besides the data provided above, the utilization purpose of the building, the indoor-outdoor temperatures and the indoor humidity rate data are also effective on the calculation of the polyurethane thickness. In a comfortable area, it is required to have maximum 3 °C temperature difference between the indoor temperature and external inner surface. Within this respect, the most effective polyurethane thickness can be determined for the project by making the necessary calculations by means of providing the following information in order to avoid the condensation of the water steam within the building after contacting with the inner surface of the panel as well as to avoid perspiration-dripping.

The polyurethane thickness necessary to avoid the condensation can be determined with the formula given below;

$$S = \frac{\lambda (T_i - T_d)}{\alpha_i (T_i - T_y)}$$

S = Thickness of the insulation material (m)

λ = Polyurethane thermal transmission coefficient 0.022 (W/mK)

α_i = Internal surface thermal convection coefficient (ave. 5)

α_d = External surface thermal convection coefficient (ave. 20)

T_i = Indoor temperature (°C)

T_d = Outdoor temperature (°C) (See: **Table-4**)

T_y = Condensation temperature limit. Tc is calculated through superposing the humidity rate given in the following **Table-3** and the environmental temperature

Table-3

Humidity rate %

	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
10	-6,0	-4,2	-2,6	-1,2	0,1	1,4	2,6	3,7	4,8	5,8	6,7	7,6	8,4	9,2
11	-5,2	-3,4	-1,8	-0,4	1,0	2,3	3,5	4,7	5,8	6,7	7,7	8,6	9,4	10,2
12	-4,5	-2,6	-1,0	0,4	1,9	3,2	4,5	5,7	6,7	7,7	8,7	9,6	10,4	11,2
13	-3,7	-1,9	-0,1	1,3	2,8	4,2	5,5	6,6	7,7	8,7	9,6	10,5	11,4	12,2
14	-2,9	-1,0	0,6	2,3	3,7	5,1	6,4	7,5	8,6	9,6	10,6	11,5	12,4	13,2
15	-2,2	-0,3	1,5	3,2	4,7	6,1	7,3	8,5	9,6	10,6	11,6	12,5	13,4	14,2
16	-1,4	0,5	2,4	4,1	5,6	7,0	8,2	9,4	10,5	11,6	12,6	13,5	14,4	15,2
17	-0,6	1,4	3,3	5,0	6,5	7,9	9,2	10,4	11,5	12,5	13,5	14,5	15,3	16,2
18	0,2	2,3	4,2	5,9	7,4	8,8	10,1	11,3	12,5	13,5	14,5	15,4	16,3	17,2
19	1,0	3,2	5,1	6,8	8,3	9,8	11,1	12,3	13,4	14,5	15,5	16,4	17,3	18,2
20	1,9	4,1	6,0	7,7	9,3	10,7	12,0	13,2	14,4	15,4	16,4	17,4	18,3	19,2
21	2,8	5,0	6,9	8,6	10,2	11,6	12,9	14,2	15,3	16,4	17,4	18,4	19,3	20,2
22	3,6	5,9	7,8	9,5	11,1	12,5	13,9	15,1	16,3	17,4	18,4	19,4	20,3	21,2
23	4,5	6,7	8,7	10,4	12,0	13,5	14,8	16,1	17,2	18,3	19,4	20,3	21,3	22,2
24	5,4	7,6	9,6	11,3	12,9	14,4	15,8	17,0	18,2	19,3	20,3	21,3	22,3	23,1
25	6,2	8,5	10,5	12,2	13,9	15,3	16,7	18,0	19,1	20,3	21,3	22,3	23,2	24,1
26	7,1	9,4	11,4	13,2	14,8	16,3	17,6	18,9	20,1	21,2	22,3	23,3	24,2	25,1
27	8,0	10,2	12,2	14,1	15,7	17,2	18,6	19,9	21,1	22,2	23,3	24,3	25,2	26,1
28	8,8	11,1	13,1	15,0	16,6	18,1	19,5	20,8	22,0	23,2	24,2	25,2	26,2	27,1
29	9,7	12,0	14,0	15,9	17,5	19,0	20,4	21,7	23,0	24,1	25,2	26,2	27,2	28,1
30	10,5	12,9	14,9	16,8	18,4	20,0	21,4	22,7	23,9	25,1	26,2	27,2	28,2	29,1

The thermal insulation must not be considered only for protection from cold. The thermal insulation is very important in hot regions. The insulated wall will not let the heat in at the hot regions and will enable the areas to be cool during summer. Otherwise, the hot wall will continuously spread heat to indoor and cause the area to be blistered. Even when there is cooling installation at the hot regions, heat insulation must still be performed.

*TS 825

Table-4

LOWEST ANNUAL TEMPERATURE VALUES AT THE CITIES AND REGIONS					
CITY	°C	Region No	CITY	°C	Region No
Adana	-8,4	I	Kocaeli	-18	II
Adıyaman	-9,6	III	Konya	-28,2	II
Afyon	-27,2	III	Kütahya	-28,1	III
Ağrı	-46,6	IV	Malatya	-25,1	III
Amasya	-20,4	III	Manisa	-17,5	I
Ankara	-24,9	II	K. Maraş	-9	III
Antalya	-4,6	I	Mardin	-14	II
Artvin	-16,1	IV	Muğla	-12,6	I
Aydın	-11	I	Muş	-34,4	III
Balıkesir	-21,8	I	Nevşehir	-23,6	II
Bilecik	-16	III	Niğde	-27	II
Bingöl	-23,2	IV	Ordu	-7,2	III
Bitlis	-21,3	IV	Rize	-7	IV
Bolu	-34	III	Sakarya	-14,5	III
Burdur	-16,7	II	Samsun	-7	III
Bursa	-25,7	II	Siirt	-19,3	II
Çanakkale	-11,5	I	Sinop	-8,4	III
Çankırı	-25	III	Sivas	-34,6	III
Çorum	-25,6	II	Tekirdağ	-13,5	II
Denizli	-11,4	II	Tokat	-23,4	III
Diyarbakır	-24,2	II	Trabzon	-7,4	IV
Edirne	-22,2	III	Tunceli	-30,3	IV
Elazığ	-22,6	III	Ş. Urfa	-12,4	I
Erzincan	-32,5	III	Uşak	-24	II
Erzurum	-35	IV	Van	-28,7	IV
Eskişehir	-26,3	II	Yozgat	-24,4	III
Gaziantep	-17,5	III	Zonguldak	-8	III
Giresun	-9,8	IV	Aksaray	-22,4	II
Gümüşhane	-25,7	III	Bayburt	-22,5	III
Hakkari	-22	IV	Karaman	-26,8	II
Hatay	-14,6	I	Kırıkkale	-31,3	II
Isparta	-21	II	Batman	-30,3	II
İçel	-6,6	I	Şırnak	-39,8	IV
İstanbul	-16,1	II	Bartın	-14,5	III
İzmir	-8,2	I	Ardahan	-11	IV
Kars	-39,6	IV	Iğdır	-18,6	IV
Kastamonu	-26,9	III	Yalova	-26,4	II
Kayseri	-32,5	II	Karabük	-12	III
Kırklareli	-15,8	II	Kilis	-15,1	II
Kırşehir	-28	II	Osmaniye	-8,4	III

Assan Panel reserves the right to make changes in this file that has been issued for informative purposes.

Reference: 1. Assan Panel Studies 2. TSE 825/April 1999 3. Ode Teknik Yayınlar- 1999 4. TSE EN 14509/08.01.2009 5. Lightweight Sandwich Construction, J.M. Davies 6. Sandwich Panel Construction, Rolf Koschade 7. İzoder Yayınla