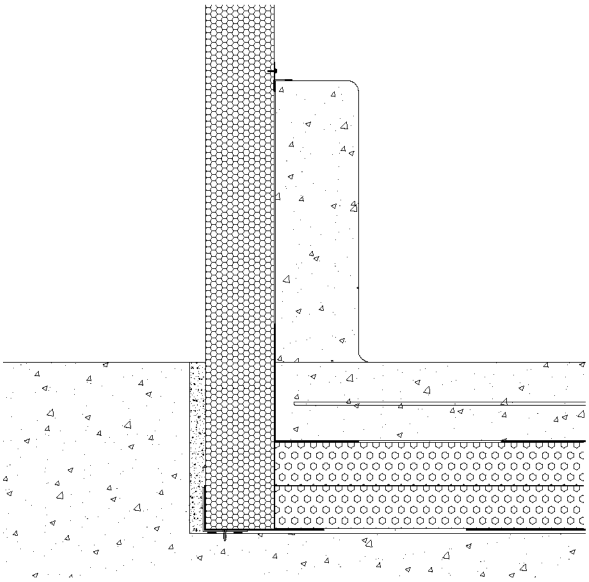
COLD STORE PANELS

The cold stores constructed for the protection of products in a healthy manner at temperatures reaching to -30 °C may cause high energy consumption to stay at low temperatures. The well insulated roof and wall coatings offer very serious advantages at this point by keeping the energy consumption at minimum. For obtaining the optimum thermal insulation in these applications, the most ideal building materials are the polyurethane-filled sandwich panels.

The vegetables, fruits, milk, ice cream, meat, etc. products can be stored for short-term in relatively smaller cold stores with internal temperature varying between +1 °C to +8 °C according to the cooling requirement. Besides its known perfect thermal insulation, the sandwich panels are the ideal building materials of the cold closed store applications due to their quick assembly and moisture-proof filling even under local weather conditions. The thickness of the sandwich panels used in the cold store wall and ceilings varies from 8 cm to 20 cm. Furthermore, the cold store panels in very large sized buildings are connected to the purline system formed with multi-span system and thus preferred as an external wall coating. In order to fully perform the thermal insulation, the reinforced concrete coating is installed with insulation materials.



Thermal Insulation

The accurate determination of the thickness of the sandwich panel depends on many factors:

- The temperature difference between the internal and external side of the building
- The type of the sandwich panel filling material
- The energy prices
- The building cost
- The design of the cooling system

In order to reduce the excessive temperature impacts of the sun, the cold stores are generally preferred within the buildings. By establishing within the building, the energy consumption and excessive moisture impact can be reduced at certain amounts. It may not be applied in larger buildings, but an additional single layer corrugated sheet coating may improve the external protection. The adequate panel thickness must be provided in order to avoid condensation on the external surface under high external temperatures.

The minimum thermal bridge is formed in the building with the sandwich panel preference. The thermal bridges generally reveal on the connection elements and corner joints. The preference of fittings with good insulation such as stainless steel screw, etc., the thermal insulation performance gets affected in a positive manner. The thermal bridges causing freeze due to moisture transmission to the wall and ceilings may result with serious problems at the long-term.

At cold store applications, sandwich panels formed of polyurethane filling material with low thermal conductivity value offer best performance in terms of thermal insulation. The thickness of the thermal insulation material can be determined by taking the maximum thermal flow value 10 W/m^2 as basis and the calculation method is as following;

$$S = \frac{\lambda * \Delta T}{Q}$$

S = Thickness of insulation material (m)
λ = Core material thermal transmission coefficient (W/mK)
ΔT = Internal and external temperature difference (°C)
Q = Thermal Flow (Recommended value: 10 W/m^2)

Furthermore, the thermal flow dependent to the PUR thickness and temperature difference is given in Table 1 where Assan Panel Cold Store Panel thermal insulation values are listed. Optimum PUR thickness can be determined according to the values where thermal flow is under 10 W/m^2.

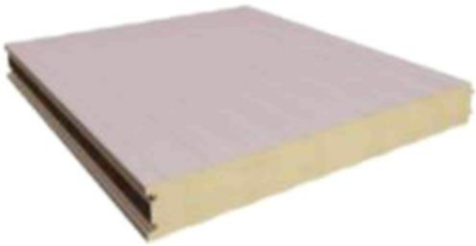


Table 1:

Temperature Difference Between Internal and External Surface (°C)

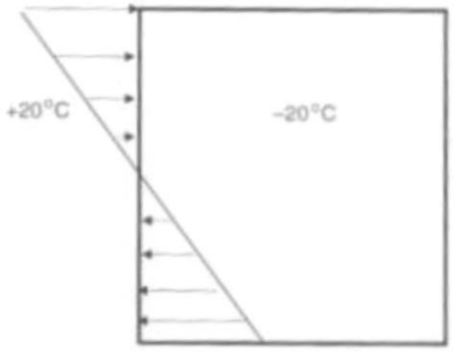
PUR (mm)	U CS panel (W/m^{2}K)	10	15	20	25	30	35	40	45	50	55	60	65	70	80
80	0.247	2.5	3.7	4.9	6.2	7.4	8.6	9.9	<10W/m^2						
100	0.199	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	<10W/m^2					
120	0.167	1.7	2.5	3.3	4.2	5.0	5.8	6.7	7.5	8.3	9.2	<10W/m^2			
150	0.134	1.3	2.0	2.7	3.4	4.0	4.7	5.4	6.0	6.7	7.4	8.1	8.7	9.4	<10W/m^2

Thermal Transmittance As a Function of Temperature Difference (W/m^2)

Airtightness

Due to energy consumption, the cold stores must be airtight. Although sandwich panels are generally airtight, the joint points and fittings must be carefully evaluated during the design phase. Otherwise, freezing may occur. Indeed, the air flow only occurs in pressure differences. The temperature difference between the internal and external side of the building and generally the high buildings cause pressure differences.

Example: The pressure difference, where the internal temperature is -20 °C, the external temperature is +20 °C and the height of the building is 7 meters, will be at 12 Pa level. This pressure difference that is not statically important may cause serious air flow in air-permeable buildings and therefore large amount of moisture transmission.



Moisture Insulation

Contrary to the normal buildings, the vapor pressure occurs inwards from the cold store walls and ceilings. The moisture flow resulting from diffusion must be prevented. The composite material sandwich panels have good permeability capacity due to the metal surfaces, however the joint points and fittings have impact on the moisture permeability like air-permeability. The moisture barriers must particularly hang on well on the hot external surfaces, also must have long life and be resistant against possible moisture movements.

Example: High pressure difference can be formed towards the building with the sudden drop of the temperature from +20 °C to -20 °C after the opening of the cold store components, such as its door. In this case, the panel and moisture barriers may be damaged as a result of the penetration of the moisture.

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