KINGDOM OF SAUDI ARABIA

SAUDI STANDARDS, METROLOGY AND QUALITY ORGANIZATION

SASO

SAUDI STANDARD
DRAFT No. 28793/2014

Thermal Transmittance Values for Residential Buildings

SAUDI STANDARDS, METROLOGY AND QUALITY ORGANIZATION

Thermal Transmittance Values for Residential Buildings

1. SCOPE

1.1 This standard outlines the requirements of thermal transmittance values in residential buildings that aim to improve the energy efficiency in these buildings.

1.2 This standard excludes buildings that are already built, unless these buildings are in the process of being modified, having parts added to, or being renovated. This standard also excludes buildings or structures, or their parts, that are not subject to cooling or heating control.

1.3 This standard does not include requirements for pipe insulation, duct insulation or other products with insulating characteristics, such as floorings.

2. COMPLEMENTARY REFERENCE

2.1 SASO-ASTM C-578:2014 " Specification for Rigid, Cellular Polystyrene Thermal Insulation "

2.2 GSO-ISO-8873-1:2009 " Rigid cellular plastics -- Spray-applied polyurethane foam for thermal insulation -- Part 1: Material specifications "

2.3 GSO-ISO-8873-2-2009 " Rigid cellular plastics -- Spray-applied polyurethane foam for thermal insulation -- Part 2: Application "

2.4 SASO-GSO- BS- 4841-1:2010 " Rigid polyisocyanurate (PIR) and polyurethane (PUR) products for building end-use applications - Part 1 : Specification for laminated insulation boards with autoadhesively or separately bonded facings "

2.5 SASO-GSO- BS- 4841-2:2010 " Rigid polyisocyanurate (PIR) and polyurethane (PUR) products for building end-use applications - Part 2 : Specification for laminated boards with auto adhesively bonded facings for use as thermal insulation for internal wall linings and ceilings "

2.6 SASO-GSO- BS- 4841-3:2010 "Rigid polyisocyanurate (PIR) and polyurethane (PUR) products for building end-use applications - Part 3 : Specification for laminated boards (roofboards) with auto-adhesively or separately bonded facings for use as roofboard thermal insulation under built up bituminous roofing membranes "

2.7 SASO-GSO- BS- 4841-4:2010 "Rigid polyurethane (PUR) and polyisocyanurate (PIR) products for building end-use applications - Part 4 : Specification for laminated insulation boards (roofboards) with auto-adhesively or separately bonded facings for use as roofboard thermal insulation under non-bituminous single-ply roofing membranes "

2.8 SASO-GSO- BS- 4841-5:2010 "Rigid polyisocyanurate (PIR) and polyurethane (PUR) products for building end-use applications- part 5: Specification for laminated boards (roofboards) with auto-adhesively or separately bonded facings for use as thermal insulation boards "

2.9 SASO-GSO- BS- 4841-6:2010 "Rigid polyisocyanurate (PIR) and polyurethane (PUR) products for building end-use applications - Part 6 : Specification for laminated boards with auto-adhesively or separately bonded facings for use as thermal insulation for floors "

2.10 SASO-GSO- EN- 13162:2012 " Thermal insulation products for buildings - Factory made mineral wool (MW) products – Specification "

2.11 SASO- EN- 13167:2012 " Thermal insulation products for buildings - Factory made cellular glass (CG) products – Specification "

2.12 SASO-ASTM C- 549:2007 "Standard Specification for Perlite Loose Fill Insulation"

2.13 SASO-ASTM C-516:2007 "Standard Specification for Vermiculite Loose Fill Thermal Insulation "

3. DEFINITIONS

3.1 Thermal insulation

Thermal insulation is an overall system used to insulate the envelope of buildings by using material (natural or synthetic) having characteristics that help in reducing the thermal transmittance of roofs, floors, walls, windows and glass doors. This aims to limit the transfer of heat from the exterior of the buildings internally during the summer time, and the transfer of heat from inside the buildings externally during the winter time.

3.2 Thermal transmittance

Is the rate of heat transfer measured in Watts per a meter square of structure, divided by the difference of surface temperature across the two sides of the structure measured in degrees Kelvin. The unit of thermal transmittance is U and is given in W/m2•K.

3.3 Thermal resistance

The reciprocal of thermal conductance . The unit is R and is given in m2•K/W.

3.4 Solar heat gain coefficient

The ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation, and has a value between 0 and 1. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then transferred through radiation, conduction, or convection into the space. The lower the solar heat gain coefficient is for a window, the lower is the solar heat that it transmits.

3.5 Thermal Conductivity

Rate of steady state heat flow across a unit area of a material, having one meter of thickness, induced by the unit difference of temperature between the two surfaces of the material. It is denoted by K and is given by the unit Watt/meter.kelvin (W/m.K)

3.6 Thermal Conductance

Rate of steady state heat flow through a unit area of a material or construction, induced by a unit temperature difference between the body surfaces . The unit is C and given by W/m2•K.

3.7 Low-rise buildings / residential

Are housing units that are specified for residential use and that do not exceed three floors in height (such as single residential villas, or two adjacent villas, or single villas constituted of two floors or suites, each of which is independent with all living amenities).

3.8 Climatic zone

Climatic zones are areas that have been specified according to the daily ambient temperature and rainfall levels in that particular area, and are used to determine the applicable specifications and requirements of thermal transmittance values for buildings in these zones.

4. Symbols and abbreviations

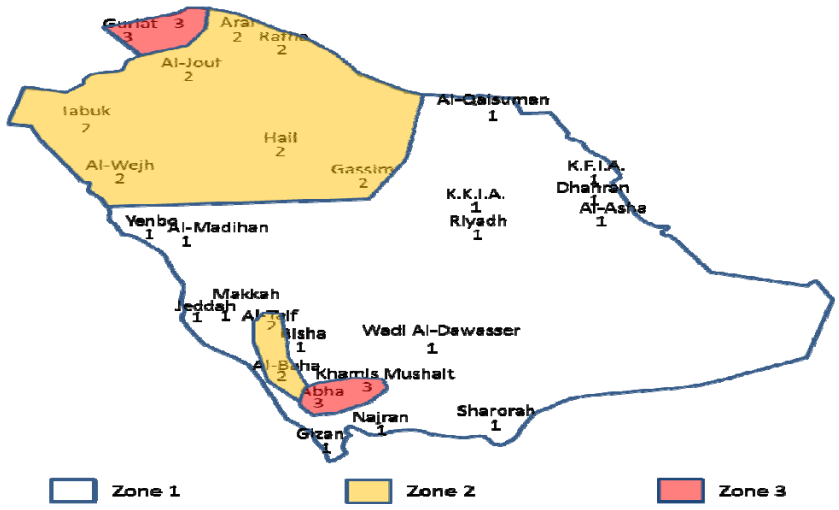
U	Thermal transmittance
R	Thermal resistance
K	Thermal Conductivity
C	Thermal Conductance
SHGC	Solar heat gain coefficient

5. CLASSIFICATION

Buildings are classified according to their height to low rise / residential buildings or high rise / commercial buildings, and are categorized under three climatic zones depending on their geographical location as shown in Figure 1 below:

- Zone 1 that includes: Riyadh , Makkah (excluding Al Taif), Al Sharkiyya, Al Madina, Najran, Gizan, Bisha
- Zone 2 that includes: Gassim, Hail, Tabuk, Al Jouf, the Northern border area (excluding Tarif and Guriat), Assir (excluding Abha, Khamis, Moshet, and Bisha), Al Taif, Al Baha
- Zone 3 that includes: Abha, Khamis Moshet, Guriat, and Tarif

Figure 1 - Saudi Arabia Climate Zones



6. REQUIREMENTS

6.1 Material

The insulation material used in buildings shall conform to the SASO standards referenced in clause 2 above.

6.2 Thermal transmittance (U-Values)

6.2.1 Low-rise / Residential buildings (not built by/for governmental entities)

Thermal transmittance values for low rise / residential buildings (not built by/for governmental entities) should not exceed the requirements listed in **Table 1** below.

Note: The values listed in Table 1 are applicable to these buildings only until January 1, 2017. Beyond January 1, 2017, the values listed in Table 2 shall be applicable to all low rise / residential buildings, even if they are not built by/for governmental entities.

6.2.2 Low-rise / Residential buildings (built by/for governmental entities)

Thermal transmittance values for low rise / residential buildings (built by/for governmental entities) should not exceed the requirements listed in **Table 2** below:

Table 1 – The thermal transmittance (U-Values) for low-rise / residential buildings

Opaque Elements	Zone 1	Zone 2	Zone 3
Roofs	0.31	0.37	0.42
Walls	0.53	0.61	0.7
Opaque Doors –All Assemblies	2.84	2,84	2,84
Vertical Glazing , 25% of wall			
All Assemblies	2.67 SHGC - 0.25	2.67 SHGC - 0.25	2.67 SHGC - 0.25
Skylight with Curb , Glass , % of Roof			
0% -3% All Types	4.26 SHGC- 0.35	4.26 SHGC- 0.35	4.26 SHGC- 0.35

Table 2 – The thermal transmittance (U-Values) for low-rise / residential buildings

Opaque Elements	Zone 1	Zone 2	Zone 3
Roofs	0.20	0.24	0.27
Walls	0.34	0.4	0.45
Opaque Doors –All Assemblies	2.84	2.84	2.84
Vertical Glazing , 25% of wall			
All Assemblies	2.67 SHGC- 0.25	2.67 SHGC- 0.25	2.67 SHGC- 0.25
Skylight with Curb , Glass , % of Roof			
0% -3% All Types	4.26 SHGC- 0.35	4.26 SHGC- 0.35	4.26 SHGC- 0.35

6. 3 Calculating Thermal Values

6.3.1 Calculating the Thermal Transmittance Values for Multi-Level Elements

The thermal transmittance value for a multi-level element as shown in Figure 2 below, is calculated as the inverse of the sum of the resistance of each level of this element, including the resistance of the internal surface, and resistance of the external surface, and is given by the following equation:

$$\text{Thermal transmittance (U)} = \frac{1}{R_{Si} + R_{So} + R_C + \sum R_i} \quad (1)$$

Where,

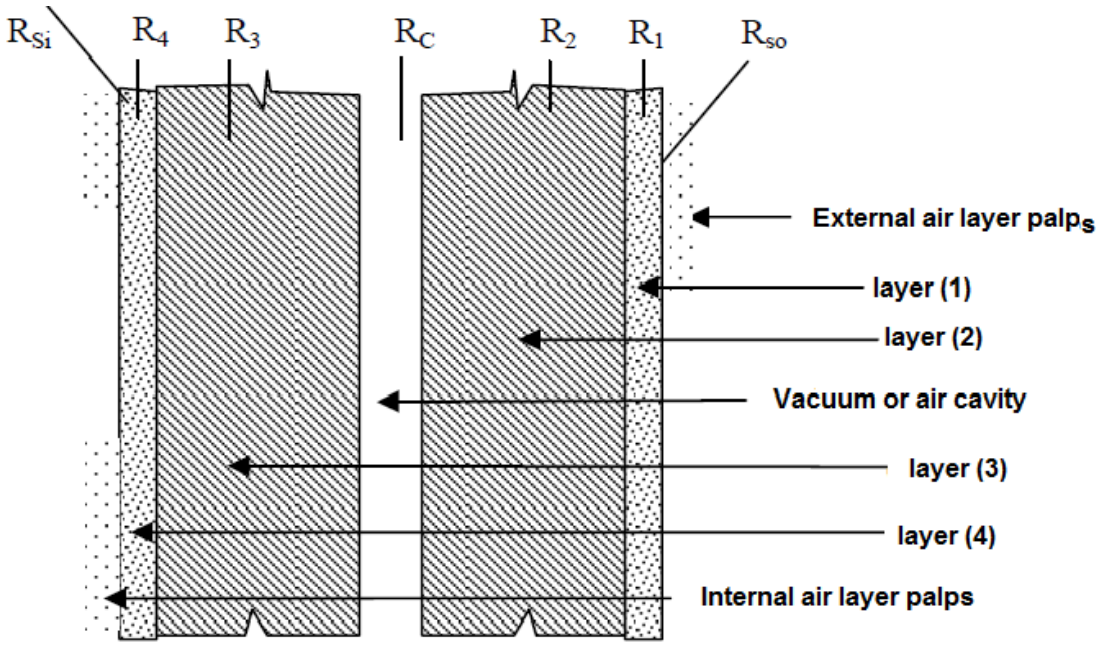
R_{Si} : thermal resistance of the internal surface

R_{SO} : thermal resistance of external surface

R_C : thermal resistance of the cavity

ΣR_i : Sum of the resistances of the multi-levels

Figure 2: Cross section of a multi-level wall



6.3.2 Calculating the Thermal Transmittance for Heterogeneous Elements:

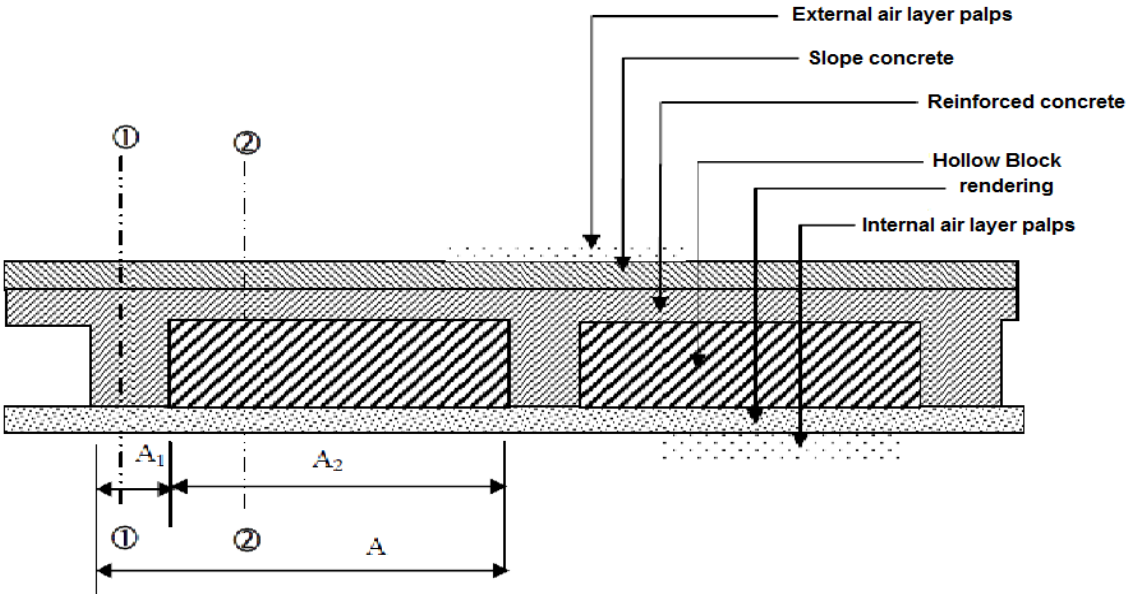
The thermal transmittance value for elements of a heterogeneous construct, as shown in Figure 3 below, is calculated by partitioning the element into several homogenous areas, where each area has its own different thermal transmittance value. The thermal transmittance value is calculated separately for each of those areas according to equation 1 above. The overall thermal transmittance value of the element is then calculated as follows:

Overall Transmittance Value (U) = $\frac{\sum U_i \ A_i}{A}$ (2)

Where,

U: is the overall thermal transmittance value in W/m^2K
A: Overall surface area of the element in m^2
Ui: Thermal transmittance value of a specific area of the element in W/m^2K
Ai: Surface Area of the specific area of the element in m^2

Figure 3: Cross Section of a Heterogeneous Element



6.3.3 Calculating the Thermal Resistance (R) of Material:

The thermal resistance value for any homogenous part of an element is calculated according to the following equation:

$$R = \frac{d}{K} \quad (3)$$

Where,

d: is the material thickness in meters

K: is the thermal conductivity of the material in W/m.K

6.4 Installation requirements

6.4.1 The insulation materials shall be free from any damages during the building process or when it is being installed. Any defected or broken boards shall be removed and not used.

6.4.2 The surfaces of the used insulation materials shall be free from dust scrapings, grease, or any impurities that may affect their use or performance.

6.4.3 Points of contact with the building that could form a passage for heat transfer from the outside to the inside, shall be also insulated, such as the points of contact between concrete bridges and external walls and columns.

6.4.4 The design and installation of pipes used for electrical, water, telephone, and sewage services shall be carried out in a way to avoid damage to the insulation material, thereby reducing the effectiveness and performance of the insulation system

6.4.5 Fasteners used to support the insulation material for walls, shall be resistant to rust.

7. STORAGE

The insulation material shall be stored in closed, dry places in a manner that prevents damage or puncturing.

8. TRANSPORTATION

The insulation material boards shall be transported in a manner that protects them from weather effects, so that they may reach their destination free from cracking or

breaking, and free from exposure to grease or any other impurities that may reduce their efficiency.

9. ACCEPTANCE AND REJECTION CRITERIA

The thermal transmittance values for the building shall meet the requirements listed in this Saudi Standard.

References:

1- SASO 1335/1998 "Regulations of thermal insulation in building "

2- ASHRAE 90.2 /2013 " Energy-Efficient Design of Low-Rise Residential Buildings in Saudi Arabia "