

GUIDEBOOK ON HOW TO CALCULATE ROOF U-VALUES FOR LIGHTWEIGHT ROOF (REQUIREMENT UNDER UBBL 38A)

This updated Guidebook is published by Working Committee of RIMM and GBI

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MALAYSIA
PERUNDANGAN
SUBSIDIARI
PERSEKUTUAN

UNIFORM BUILDING BY-LAWS 1984

UNDANG-UNDANG KECIL BANGUNAN SERAGAM 1984

KEMENTERIAN
PERUMAHAN DAN
KERAJAAN TEMPATAN
JABATAN KERAJAAN TEMPATAN

Mandatory R-value and U-value for the entire roof according to UBBL by-law 38A

Roof weight group	Minimum R-value (m ² K/W)	Maximum U-value (W/m ² K)
Lightweight roof (Under 50kg/m ²)	2.5	0.4
Heavyweight roof (Above 50kg/m ²)	1.67	0.6

By-law 38_A Energy efficiency in buildings.

[Amendment 2012]

(1) A new or renovated non-residential building with air conditioned space exceeding 4,000 square metres --

(a) shall be designed to meet the requirements of MS 1525 with regards to the Overall Thermal Transfer Value (OTTV) and the Roof Thermal Transfer Value (RTTV); and

(b) shall be provided with an Energy Management System.

[Amendment 2012]

[Amendment 2021]

(2) The roof for all buildings (residential and non-residential) shall not have a thermal transmittance (U-value) greater than --

(a) 0.4 W/m²K for a light weight roof (below 50 kg/m²); and

(b) 0.6 W/m²K for a heavy weight roof (above 50 kg/m²), unless provided with other shading or cooling means.

[Amendment 2012]

[Amendment 2021]

Table A1: RSI of enclosed air space for ε=0.03

RSI of Enclosed Air Space for Heat Flow Down at Tm=27.5°C, ε=0.03, ΔT=15°C (m²K/W)																											
Enclosed Air Space (m)																											
		0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050	0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.090	0.095	0.100	0.105	0.110	0.115	0.120	0.125	
Angle (°)	0	0.184	0.356	0.514	0.655	0.780	0.892	0.992	1.082	1.164	1.238	1.305	1.366	1.422	1.474	1.521	1.564	1.602	1.637	1.669	1.698	1.724	1.747	1.769	1.788	1.806	
	5	0.184	0.356	0.513	0.650	0.766	0.863	0.944	1.012	1.072	1.124	1.171	1.214	1.252	1.287	1.319	1.348	1.374	1.398	1.420	1.440	1.459	1.476	1.492	1.506	1.520	
	10	0.184	0.356	0.512	0.644	0.752	0.837	0.901	0.950	0.993	1.030	1.062	1.092	1.118	1.142	1.165	1.185	1.203	1.220	1.236	1.251	1.265	1.277	1.290	1.301	1.312	
	15	0.184	0.356	0.511	0.639	0.738	0.811	0.861	0.896	0.925	0.950	0.972	0.992	1.010	1.027	1.042	1.057	1.070	1.082	1.094	1.105	1.116	1.126	1.136	1.145	1.154	
	20	0.184	0.356	0.510	0.633	0.725	0.788	0.825	0.847	0.866	0.882	0.896	0.909	0.921	0.933	0.943	0.954	0.963	0.973	0.981	0.990	0.999	1.007	1.015	1.023	1.030	
	25	0.184	0.356	0.509	0.628	0.712	0.765	0.792	0.804	0.814	0.823	0.831	0.839	0.847	0.854	0.862	0.869	0.876	0.883	0.890	0.897	0.904	0.910	0.917	0.924	0.930	
	30	0.184	0.356	0.508	0.623	0.700	0.744	0.761	0.764	0.767	0.771	0.775	0.779	0.783	0.788	0.793	0.798	0.803	0.808	0.814	0.819	0.825	0.831	0.837	0.842	0.848	
	35	0.184	0.356	0.507	0.618	0.688	0.724	0.732	0.729	0.726	0.725	0.726	0.727	0.727	0.729	0.731	0.734	0.738	0.741	0.746	0.750	0.754	0.759	0.764	0.769	0.774	0.779
	40	0.184	0.356	0.506	0.613	0.677	0.705	0.706	0.696	0.689	0.685	0.685	0.682	0.681	0.681	0.682	0.684	0.686	0.689	0.692	0.695	0.699	0.703	0.707	0.712	0.716	0.721
	45	0.184	0.356	0.505	0.608	0.666	0.687	0.687	0.681	0.666	0.656	0.649	0.644	0.641	0.639	0.639	0.640	0.641	0.643	0.645	0.648	0.651	0.654	0.658	0.662	0.666	0.670
50	0.184	0.356	0.504	0.600	0.646	0.661	0.661	0.654	0.640	0.631	0.624	0.620	0.618	0.617	0.616	0.617	0.619	0.620	0.623	0.626	0.629	0.632	0.636	0.640	0.644	0.648	
55	0.184	0.356	0.503	0.593	0.628	0.637	0.637	0.629	0.616	0.608	0.602	0.598	0.596	0.595	0.595	0.596	0.598	0.600	0.602	0.605	0.608	0.611	0.615	0.619	0.623	0.627	
60	0.184	0.356	0.501	0.585	0.611	0.615	0.615	0.606	0.594	0.586	0.581	0.578	0.576	0.575	0.576	0.577	0.578	0.580	0.583	0.585	0.589	0.592	0.595	0.599	0.603	0.607	
65	0.184	0.356	0.500	0.578	0.595	0.594	0.594	0.584	0.574	0.566	0.561	0.559	0.557	0.557	0.557	0.558	0.560	0.562	0.564	0.567	0.570	0.574	0.577	0.581	0.585	0.588	
70	0.184	0.356	0.499	0.571	0.580	0.574	0.574	0.564	0.554	0.548	0.543	0.541	0.539	0.539	0.540	0.541	0.543	0.545	0.547	0.550	0.553	0.556	0.560	0.563	0.567	0.571	
75	0.184	0.356	0.498	0.564	0.565	0.556	0.556	0.546	0.536	0.530	0.526	0.524	0.523	0.523	0.523	0.525	0.527	0.529	0.531	0.534	0.537	0.540	0.544	0.547	0.551	0.555	
80	0.184	0.356	0.496	0.557	0.551	0.539	0.539	0.528	0.519	0.514	0.510	0.508	0.507	0.507	0.508	0.509	0.511	0.513	0.516	0.519	0.522	0.525	0.528	0.532	0.535	0.539	
85	0.184	0.356	0.495	0.551	0.538	0.523	0.523	0.512	0.503	0.498	0.495	0.493	0.493	0.493	0.494	0.495	0.497	0.499	0.502	0.504	0.507	0.511	0.514	0.517	0.521	0.524	
90	0.184	0.356	0.494	0.544	0.526	0.508	0.508	0.496	0.489	0.484	0.481	0.479	0.479	0.479	0.480	0.481	0.483	0.486	0.488	0.491	0.494	0.497	0.500	0.503	0.507	0.510	

ε is surface emittance. Effective emittance, E is approximated as E=ε in most practical cases. (see Equation 6.2(3) in AS/NZ 4859.2:2018)

Table B: RSI of attic space with reflective or non-reflective surface

Source: AS/NZS 4859.2:2018 Table 14, Heat Flow Down.

Airspace Type	RSI (m²K/W)	
	IR Non-Reflective	IR Reflective
Non-Ventilated	0.28	1.09
Natural Ventilation	0.46	1.36

- 1. Non-reflective surface has an emittance of greater than 0.05. (Source: MS 2095:2014)
- 2. Reflective surface has an emittance of not greater than 0.05. (Source: MS 2095:2014)
- 3. Non-Ventilated refers to no opening, or opening ratio less than 1:600.
- 4. Natural Ventilation requires that the minimum opening ratio shall be 1:600 of the vented space. (Source: US 2015 International Residential Code)

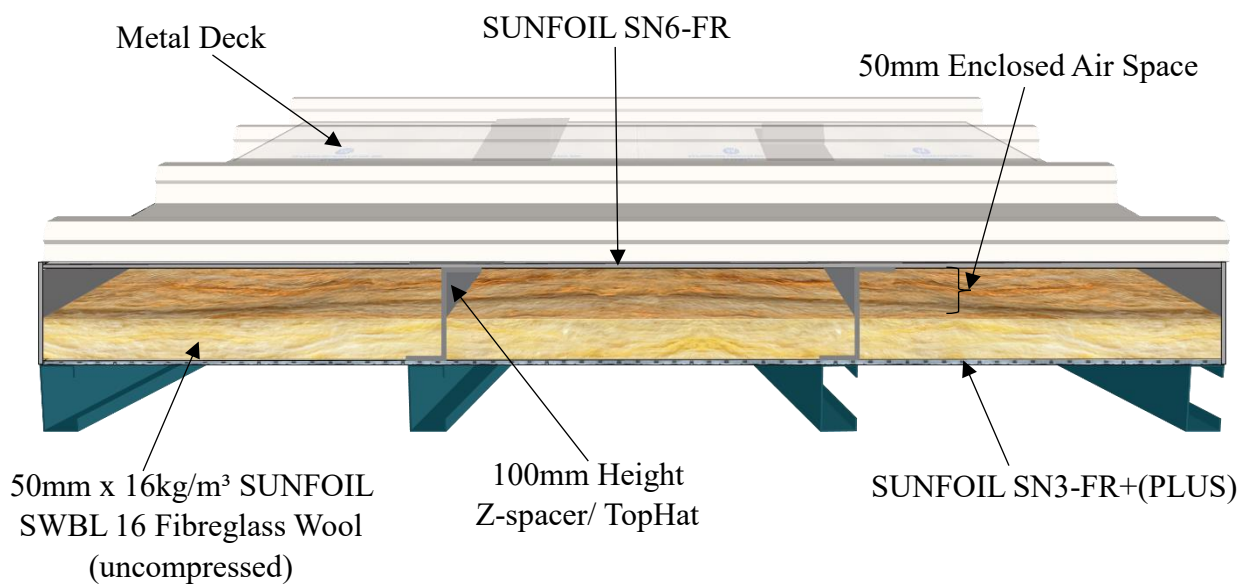
SUN-FOIL®

Premium Brand of  YH LAMINATED PRODUCTS SDN. BHD.

Lightweight Roof Configurations Compliance UBBL by-law 38A @ U-Value ≤ 0.4

1. SUNFOIL Patented Roof Configuration for Factory or Warehouse (Most Cost Effective) -with double layers Aluminium Foil

Patent No: MY-207662-A



1°-5° Pitch Roof

Component	R-value (m²K/W)
1. External Air Film	0.044
2. Metal Deck	0.000
3. SUNFOIL SN6-FR <i>reflective side facing down</i>	0.133
4. 50mm Enclosed Air Space	1.124
5. 50mm x 16kg/m³ SUNFOIL SWBL 16 Fibreglass Wool (uncompressed)	1.350
6. SUNFOIL SN3-FR+(PLUS)	0.133
7. Internal Air Film	0.800
Total	3.584
U-Value = 1/R-Value = 0.279 W/m²K (Compliance with UBBL by-law 38A)	

Based on paper calculation



SPECIFICATION OF ROOFING (EXAMPLE 1)

METAL ROOFING

To supply **YH SUNFOIL 0.42mm BMT Clip Lock System** in Bluescope Zinalume c/w **200mm girth Truecore AZ150 Spacer in 1.0mm BMT** complete with all necessary accessories refer to manufacturer's specification.

INSULATION WOOL

One layer of approved 50mm thick **YH SUNFOIL WOOL SWBL16** (16kg/m3) uncompressed Fibreglass wool insulation **approved with MS 1020**.

INSULATION FOIL

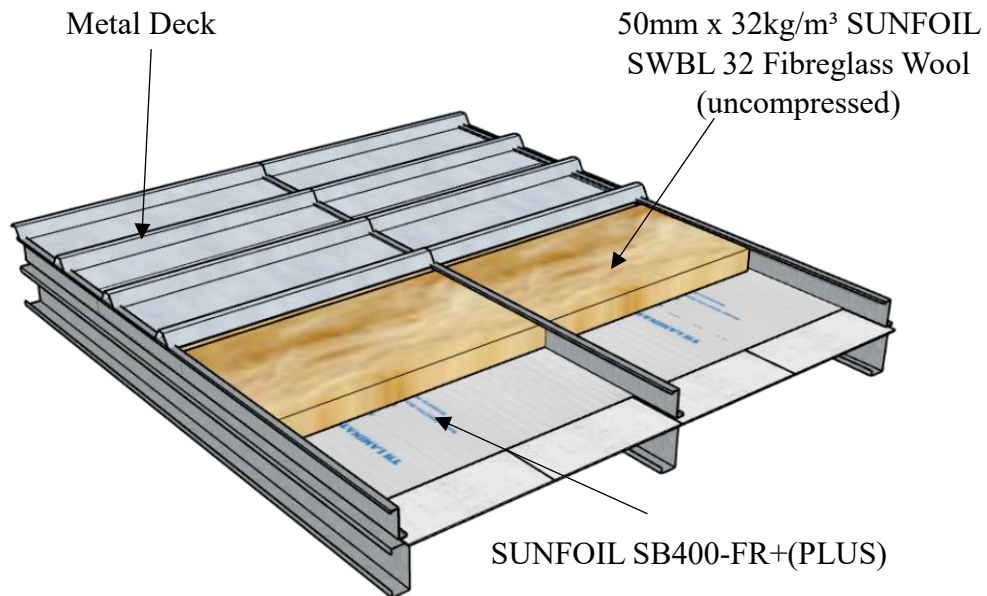
One top layer of approved **YH SUNFOIL SN6-FR** Double-Sided Fire-Retardant Aluminium Foil with "Extra Heavy Duty" in tensile strength and edge tear resistance for both directions **approved with MS 2095** and

One bottom layer of approved **YH SUNFOIL SN3-FR+ Plus** (250g/m2) Double Sided Fire Retardant Pure Aluminium Bubble Foil with 2mm thickness and 6mm bubble diameter reinforced with a layer of 10 x 10 inch woven fabric **approved with Sirim Eco Label** (35-40% energy reduction), **Myhijau Certificate** and **MS 2095**.

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2. Roof Configuration for Factory or Warehouse – Normal components without ceiling



1°-5° Pitch Roof

Component	R-value (m²K/W)
1. External Air Film	0.044
2. Metal Deck	0.000
3. 50mm x 32kg/m³ SUNFOIL SWBL 32 Fibreglass Wool (uncompressed)	1.500
4. SUNFOIL SB400-FR+(PLUS)	0.169
5. Internal Air Film	0.800
Total	2.513
U-Value = 1/R-Value = <u>0.397 W/m²K</u> (Compliance with UBBL by-law 38A)	

Based on paper calculation



SPECIFICATION OF ROOFING (EXAMPLE 2)

METAL ROOFING

To supply **YH SUNFOIL 0.42mm BMT Clip Lock System** in Bluescope Zinalume complete with all necessary accessories refer to manufacturer's specification.

INSULATION WOOL

One Layer of approved 50mm thick **YH SUNFOIL WOOL SWBL 32** (32kg/m³) uncompressed Fibreglass wool insulation **approved with MS 1020**.

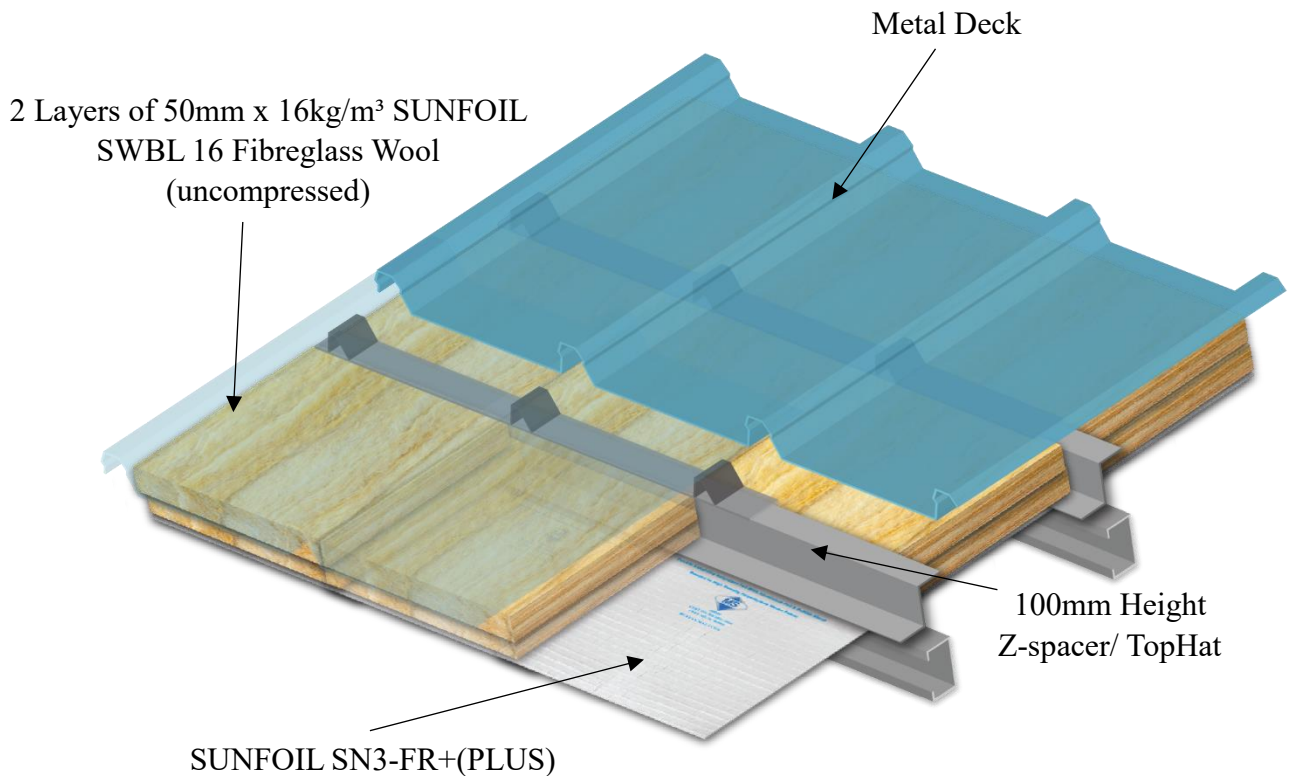
INSULATION FOIL

One layer of approved **YH SUNFOIL SB400-FR+ Plus** (380g/m²) Double Sided Fire Retardant Pure Aluminium Bubble Foil with double sided reflective emittance 0.01, extra heavy strength with 9mm thickness and 25mm bubble diameter reinforced with a layer of 10 x 10 inch woven fabric **approved with Sirim Eco Label** (35-40% energy reduction) **and MS 2095**.

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3. Roof Configuration for Factory or Warehouse - with double layers Insulation Wool



1°-5° Pitch Roof

Component	R-value (m²K/W)
1. External Air Film	0.044
2. Metal Deck	0.000
3. 2 Layers of 50mm x 16kg/m³ SUNFOIL SWBL 16 Fibreglass Wool (uncompressed)	2.700
4. SUNFOIL SN3-FR+(PLUS)	0.133
5. Internal Air Film	0.800
Total	3.677
U-Value = 1/R-Value = 0.271 W/m²K (Compliance with UBBL by-law 38A)	

Based on paper calculation



SPECIFICATION OF ROOFING (EXAMPLE 3)

METAL ROOFING

To supply **YH SUNFOIL 0.42mm BMT Clip Lock System** in Bluescope Zincalume c/w **200mm girth Truecore AZ150 Spacer in 1.0mm BMT** complete with all necessary accessories refer to manufacturer's specification.

INSULATION WOOL

Two Layers of approved 50mm thick **YH SUNFOIL WOOL SWBL 16** (16kg/m3) uncompressed Fibreglass wool insulation **approved with MS 1020**.

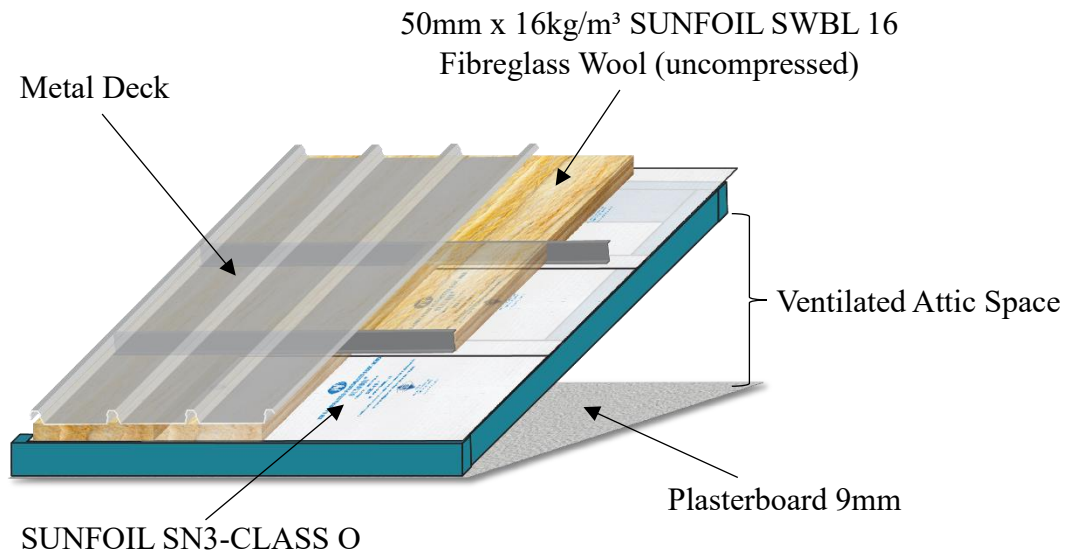
INSULATION FOIL

One layer of approved **YH SUNFOIL SN3-FR+ Plus** (250g/m2) Double Sided Fire Retardant Pure Aluminium Bubble Foil with 2mm thickness and 6mm bubble diameter reinforced with a layer of 10 x 10-inch woven fabric **approved with Sirim Eco Label** (35-40% energy reduction), **Myhijau and MS 2095**.

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4. Roof Configuration for Residentials or Shoplots (with Ceiling)



1°-5° Pitch Roof

Component	R-value (m²K/W)
1. External Air Film	0.044
2. Metal Deck	0.000
3. 50mm x 16kg/m³ SUNFOIL SWBL 16 Fibreglass Wool (uncompressed)	1.350
4. SUNFOIL SN3-CLASS O <i>reflective side facing down</i>	0.000
5. Ventilated Attic Space	1.360
6. Plasterboard 9mm	0.036
7. Internal Air Film	0.160
Total	2.950
U-Value = 1/R-Value = <u>0.338 W/m²K</u> (Compliance with UBBL by-law 38A)	

Based on paper calculation



SPECIFICATION OF ROOFING (EXAMPLE 4)

METAL ROOFING

To supply **YH SUNFOIL 0.42mm BMT Clip Lock System** in Bluescope Zinalume c/w all necessary accessories refer to manufacturer's specification.

INSULATION WOOL

One layer of approved 50mm thick **YH SUNFOIL WOOL SWBL 16** (16kg/m³) uncompressed Fibreglass wool insulation **approved with MS 1020**.

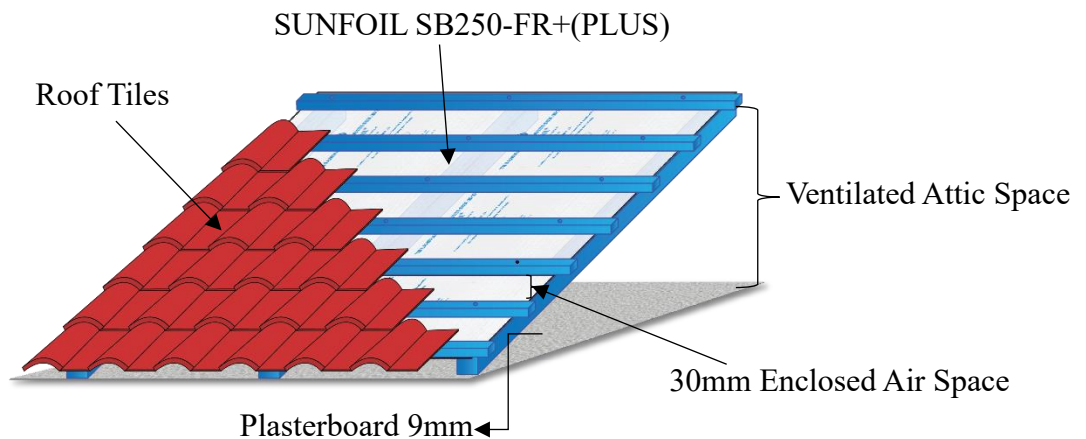
INSULATION FOIL

One Layer of approved **YH SUNFOIL SN3-CLASS 'O'** Double-Sided Fire-Retardant Aluminium Foil with 10 x 10-inch woven fabric **approved with MS 2095**.

SUN-FOIL®

Premium Brand of  YH LAMINATED PRODUCTS SDN. BHD.

5. Roof Configuration for Residential (with Ceiling)



21°-25° Pitch Roof

Component	R-value (m ² K/W)
1. External Air Film	0.044
2. Roof Tile	0.014
3. 30mm Enclosed Air Space	0.765
4. SUNFOIL SB250-FR+(PLUS) <i>double sided reflective</i>	0.133
5. Ventilated Attic Space	1.360
6. Plasterboard 9mm	0.036
7. Internal Air Film	0.160
Total	2.512
U-Value = 1/R-Value = <u>0.398 W/m²K</u> (Compliance with UBBL by-law 38A)	

Based on paper calculation

Different roof pitch will result in different R-Value for enclosed air space, **the higher the roof pitch angle, the lower the R-Value.*



SPECIFICATION OF ROOFING (EXAMPLE 5)

ROOF TILES

To supply **CLAY/ CONCRETE ROOF TILES (ROOF PITCH 21°-25°)** complete with all necessary accessories refer to manufacturer's specification. Roof tiles to Architect selection c/w 30 mm height battens MB30K/42.

INSULATION FOIL

One layer of approved **YH SUNFOIL SB250-FR+ Plus** (300g/m²) Double Sided Fire Retardant Pure Aluminium Bubble Foil with 4mm thickness and 10mm bubble diameter reinforced with a layer of 10 x 10-inch woven fabric **approved with Sirim Eco Label** (35-40% energy reduction) **Myhijau and MS 2095**.