



# Calculation of U-value

for OH Sandwich Panels

Carried out for:

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Aarhus, 18 April 2017

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As agreed, the Danish Technological Institute, Building Technology has performed calculations of the U-value for vertical (90°) OH sandwich Panels. The panels are used in doors and windows.

## Basis

- Table from OH showing all the different panels to be calculated.
- Stated design values for the thermal conductivity of the materials used in the panels (if available values from EN 10077-2 are used).
- Plan drawing of raised and fielded panel edge (see Appendix 1). The U-value is calculated on a 1m x 1m panel as required from OH.
- The calculation has been carried out in accordance with EN ISO 10077-2.

## Calculations

Design values for the thermal conductivity:

Material	Thermal conductivity $\lambda_p$ ( W/mK)
Extruded Polystyren (iso) $\leq 60$ mm	0.034
Extruded Polystyren (iso) $> 60$ mm	0.036
HDF	0.13
Chenchen	0.13
Mahogany	0.13
Pine	0.13
Oak	0.18
Aluminium	160
Compact laminate	0.25

$$U_{\text{panel}} = 1 / ( R_{\text{se}} + d_{\text{pe}}/\lambda_{\text{pe}} + d_{\text{iso}}/\lambda_{\text{iso}} + d_{\text{pi}}/\lambda_{\text{pi}} + R_{\text{si}})$$

For raised and fielded panels a linear thermal transmittance is calculated from THERM calculations (see example in Appendix 1) and the Up value is then calculated using the formula

$$A_p = A' = 1\text{m} \times 1\text{m} \text{ (thermal transmission area)}$$

$$U_{\text{panel}} = \frac{U_{p,\text{flush}} \times A_p + \Psi \times \ell_{\Psi}}{A'}$$

## **Results**

The results of the calculations can be found in the attached tables in Appendix 1.

Aarhus, 18 April 2017  
Danish Technological Institute, Building Technology



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<b>Calculation of U-value for Sandwich Panels</b>		<b>System:</b> OH
		<b>Type:</b> softwood
		<b>Profile:</b> Edge, R&F
Manufacturer: OH		
Type: softwood		
Source file:		
<b>Description:</b>		
Pine $\lambda$ = 0,13    W/m K XPS $\lambda$ = 0,034   W/m K		
<b>Results:</b>		
Dimension: (dxb)	70.0mm x 310.0mm	
U-value	$U_f = 0,6445 \text{ W/m}^2\text{K}$	
<b>Remarks:</b>		
Calculated in accordance with EN ISO 10077-2, 2nd edition. Temperatures of the cross section are shown at 0 °C outside and 20 °C inside .		
Danish Technological Institute, Sustainable Building and Construction, Kongsvang Allé 29, DK-8000 Aarhus C		Date: 2013-08-28
Dir. Tel.: +45 7220 1147		Calculated by: Bent Lund Nielsen

<b>Calculation of U-value for Sandwich Panels</b>		<b>System:</b> OH
		<b>Type:</b> softwood
		<b>Profile:</b> Panel
Manufacturer: OH		
Type: softwood		
Source file:		
<b>Description:</b>		
Pine $\lambda$ = 0,13    W/m K XPS $\lambda$ = 0,034   W/m K		
<b>Results:</b>		
Dimension: (dxb)	70.0mm x 310.0mm	
U-value	$U_f = 0,6340 \text{ W/m}^2\text{K}$	
<b>Remarks:</b>		
Calculated in accordance with EN ISO 10077-2, 2nd edition. Temperatures of the cross section are shown at 0 °C outside and 20 °C inside .		
Danish Technological Institute, Sustainable Building and Construction, Kongsvang Allé 29, DK-8000 Aarhus C		Date: 2013-08-28
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**U-value - OH Sandwich Panels W/m<sup>2</sup>K**

Surface	Flush panels							
	HDF	Chen Chen	Mahogany	Pine	Oak	Aluminium	Aluminium Aluminium	Compact Laminate
Facing specification	2 x 4 mm HDF board	2 x 5 mm ChenChen veneer	2 x 5 mm Mahogany veneer	2 x 4 mm Pine veneer	2 x 5 mm Oak veneer	Outside: 1.5 mm Aluminium Inside: 4 mm HDF	Outside: 1.5 mm Aluminium Inside: 1.5 mm Aluminium	2 x 4 mm Compact laminate
Insulation	XPS	XPS	XPS	XPS	XPS	XPS	XPS	XPS
Thickness total (mm)								
20	1,71	1,85	1,85	1,71	1,92	1,59	1,49	1,80
21	1,63	1,75	1,75	1,63	1,82	1,52	1,43	1,71
22	1,55	1,67	1,67	1,55	1,73	1,46	1,37	1,63
23	1,49	1,59	1,59	1,49	1,64	1,40	1,32	1,55
24	1,42	1,52	1,52	1,42	1,57	1,34	1,27	1,49
25	1,37	1,45	1,45	1,37	1,50	1,29	1,22	1,42
26	1,31	1,39	1,39	1,31	1,44	1,24	1,18	1,37
27	1,27	1,34	1,34	1,27	1,38	1,20	1,14	1,31
28	1,22	1,29	1,29	1,22	1,32	1,16	1,10	1,27
29	1,18	1,24	1,24	1,18	1,27	1,12	1,07	1,22
30	1,14	1,20	1,20	1,14	1,23	1,09	1,04	1,18
31	1,10	1,16	1,16	1,10	1,19	1,05	1,01	1,14
32	1,07	1,12	1,12	1,07	1,15	1,02	0,98	1,10
33	1,03	1,08	1,08	1,03	1,11	0,99	0,95	1,07
34	1,00	1,05	1,05	1,00	1,07	0,96	0,92	1,03
35	0,97	1,02	1,02	0,97	1,04	0,94	0,90	1,00
36	0,95	0,99	0,99	0,95	1,01	0,91	0,88	0,98
37	0,92	0,96	0,96	0,92	0,98	0,89	0,85	0,95
38	0,90	0,93	0,93	0,90	0,95	0,86	0,83	0,92
39	0,87	0,91	0,91	0,87	0,93	0,84	0,81	0,90
40	0,85	0,89	0,89	0,85	0,90	0,82	0,79	0,87
41	0,83	0,86	0,86	0,83	0,88	0,80	0,78	0,85
42	0,81	0,84	0,84	0,81	0,86	0,78	0,76	0,83
43	0,79	0,82	0,82	0,79	0,84	0,77	0,74	0,81
44	0,77	0,80	0,80	0,77	0,82	0,75	0,73	0,79
45	0,76	0,78	0,78	0,76	0,80	0,73	0,71	0,78
46	0,74	0,77	0,77	0,74	0,78	0,72	0,70	0,76
47	0,73	0,75	0,75	0,73	0,76	0,70	0,68	0,74
48	0,71	0,73	0,73	0,71	0,74	0,69	0,67	0,73
49	0,70	0,72	0,72	0,70	0,73	0,68	0,66	0,71

**U-value - OH Sandwich Panels W/m<sup>2</sup>K**

Surface	Flush panels							
	HDF	Chen Chen	Mahogany	Pine	Oak	Aluminium	Aluminium Aluminium	Compact Laminate
Facing specification	2 x 4 mm HDF board	2 x 5 mm ChenChen veneer	2 x 5 mm Mahogany veneer	2 x 4 mm Pine veneer	2 x 5 mm Oak veneer	Outside: 1.5 mm Aluminium Inside: 4 mm HDF	Outside: 1.5 mm Aluminium Inside: 1.5 mm Aluminium	2 x 4 mm Compact laminate
Insulation	XPS	XPS	XPS	XPS	XPS	XPS	XPS	XPS
Thickness total (mm)								
<b>50</b>	<b>0,68</b>	<b>0,70</b>	<b>0,70</b>	<b>0,68</b>	<b>0,71</b>	<b>0,66</b>	<b>0,64</b>	<b>0,70</b>
51	0,67	0,69	0,69	0,67	0,70	0,65	0,63	0,68
52	0,66	0,67	0,67	0,66	0,68	0,64	0,62	0,67
53	0,64	0,66	0,66	0,64	0,67	0,63	0,61	0,66
54	0,63	0,65	0,65	0,63	0,66	0,61	0,60	0,64
55	0,62	0,64	0,64	0,62	0,65	0,60	0,59	0,63
56	0,61	0,63	0,63	0,61	0,63	0,59	0,58	0,62
57	0,60	0,61	0,61	0,60	0,62	0,58	0,57	0,61
58	0,59	0,60	0,60	0,59	0,61	0,57	0,56	0,60
59	0,58	0,59	0,59	0,58	0,60	0,56	0,55	0,59
<b>60</b>	<b>0,57</b>	<b>0,58</b>	<b>0,58</b>	<b>0,57</b>	<b>0,59</b>	<b>0,55</b>	<b>0,54</b>	<b>0,58</b>
65	0,52	0,54	0,54	0,52	0,54	0,51	0,53	0,53
<b>70</b>	<b>0,51</b>	<b>0,50</b>	<b>0,50</b>	<b>0,51</b>	<b>0,50</b>	<b>0,50</b>	<b>0,49</b>	<b>0,52</b>
75	0,48	0,49	0,49	0,48	0,49	0,47	0,46	0,48
<b>80</b>	<b>0,45</b>	<b>0,46</b>	<b>0,46</b>	<b>0,45</b>	<b>0,46</b>	<b>0,44</b>	<b>0,43</b>	<b>0,45</b>
85	0,42	0,43	0,43	0,42	0,43	0,42	0,41	0,43
<b>90</b>	<b>0,40</b>	<b>0,40</b>	<b>0,40</b>	<b>0,40</b>	<b>0,41</b>	<b>0,39</b>	<b>0,39</b>	<b>0,40</b>
95	0,38	0,38	0,38	0,38	0,39	0,37	0,37	0,38
<b>100</b>	<b>0,36</b>	<b>0,36</b>	<b>0,36</b>	<b>0,36</b>	<b>0,37</b>	<b>0,35</b>	<b>0,35</b>	<b>0,36</b>

**U-value - OH Sandwich Panels  $W/m^2K$**

Surface	Raised & Fielded Panels				
	MDF	Mahogany	Pine	Oak	MDF
Facing specification	2 x 15 mm MDF board	2 x 15 mm Mahogany timber	2 x 15 mm Pine timber	2 x 15 mm Oak timber	2 x 12 mm MDF board
Insulation	XPS	XPS	XPS	XPS	XPS
Thickness total (mm)					
40	1,51	1,51	1,51	1,64	1,28
41	1,44	1,44	1,44	1,57	1,23
42	1,38	1,38	1,38	1,50	1,19
43	1,33	1,33	1,33	1,44	1,15
44	1,28	1,28	1,28	1,38	1,11
45	1,23	1,23	1,23	1,32	1,07
46	1,19	1,19	1,19	1,27	1,04
47	1,15	1,15	1,15	1,23	1,01
48	1,11	1,11	1,11	1,19	0,98
49	1,08	1,08	1,08	1,15	0,95
50	1,04	1,04	1,04	1,11	0,93
51	1,01	1,01	1,01	1,07	0,90
52	0,98	0,98	0,98	1,04	0,88
53	0,96	0,96	0,96	1,01	0,86
54	0,93	0,93	0,93	0,98	0,83
55	0,91	0,91	0,91	0,95	0,81
56	0,88	0,88	0,88	0,93	0,80
57	0,86	0,86	0,86	0,90	0,78
58	0,84	0,84	0,84	0,88	0,76
59	0,82	0,82	0,82	0,86	0,74
60	0,80	0,80	0,80	0,84	0,73
65	0,71	0,71	0,71	0,74	0,66
70	0,65	0,65	0,65	0,67	0,60
75	0,59	0,59	0,59	0,61	0,55
80	0,54	0,54	0,54	0,56	0,51
85	0,50	0,50	0,50	0,52	0,50
90	0,47	0,47	0,47	0,48	0,46
95	0,46	0,46	0,46	0,47	0,44
100	0,43	0,43	0,43	0,44	0,41