FROM VIP TO BUILDING PANEL

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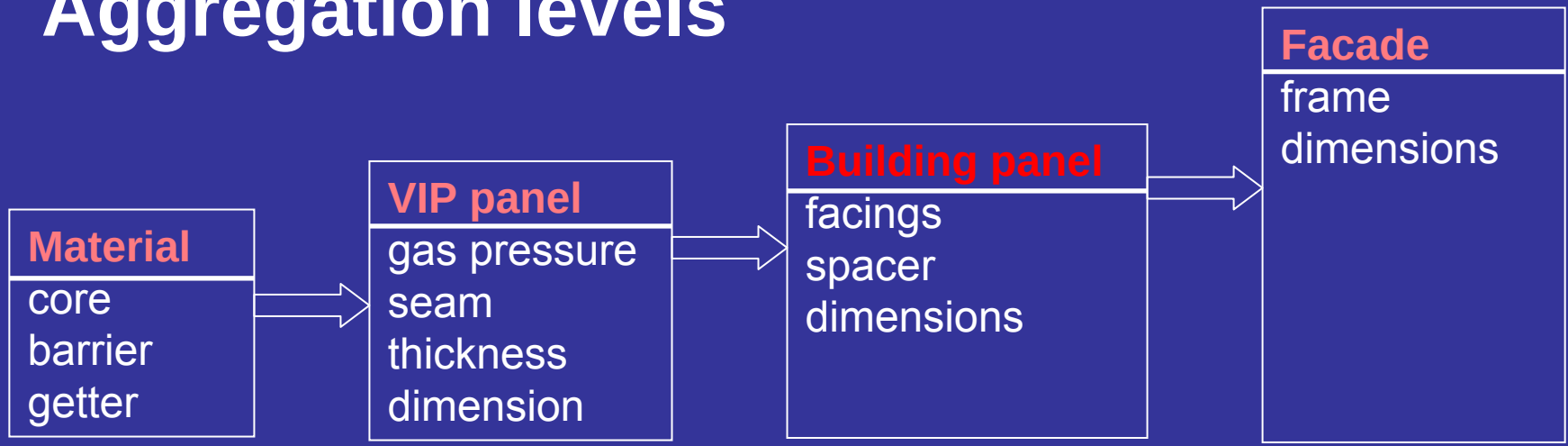
Designing with VIP

Defining requirements

- Thermal
  service life
  effectiveness
- Esthetic
  flatness
- Structural
  windload

Insulation material	λ_{core} in mW/mK
Glass Fibres	35
EPS, PUR	30 - 25
Fumed Silica	20
Modified resol foam	20
VIP	4
Design	8,5 - 10

Aggregation levels



Connecting Spacer	Ū-panel W/m²K	
	1 x 1 m²	1,4 x 1,4 m²
Conventional alu	1,44	1,09
Improved Swiss spacer	0,47	0,39
Barrier film: polymer + laminated alumium Facing: glass / aluminium Center of panel: U = 0,26 W/m²K		

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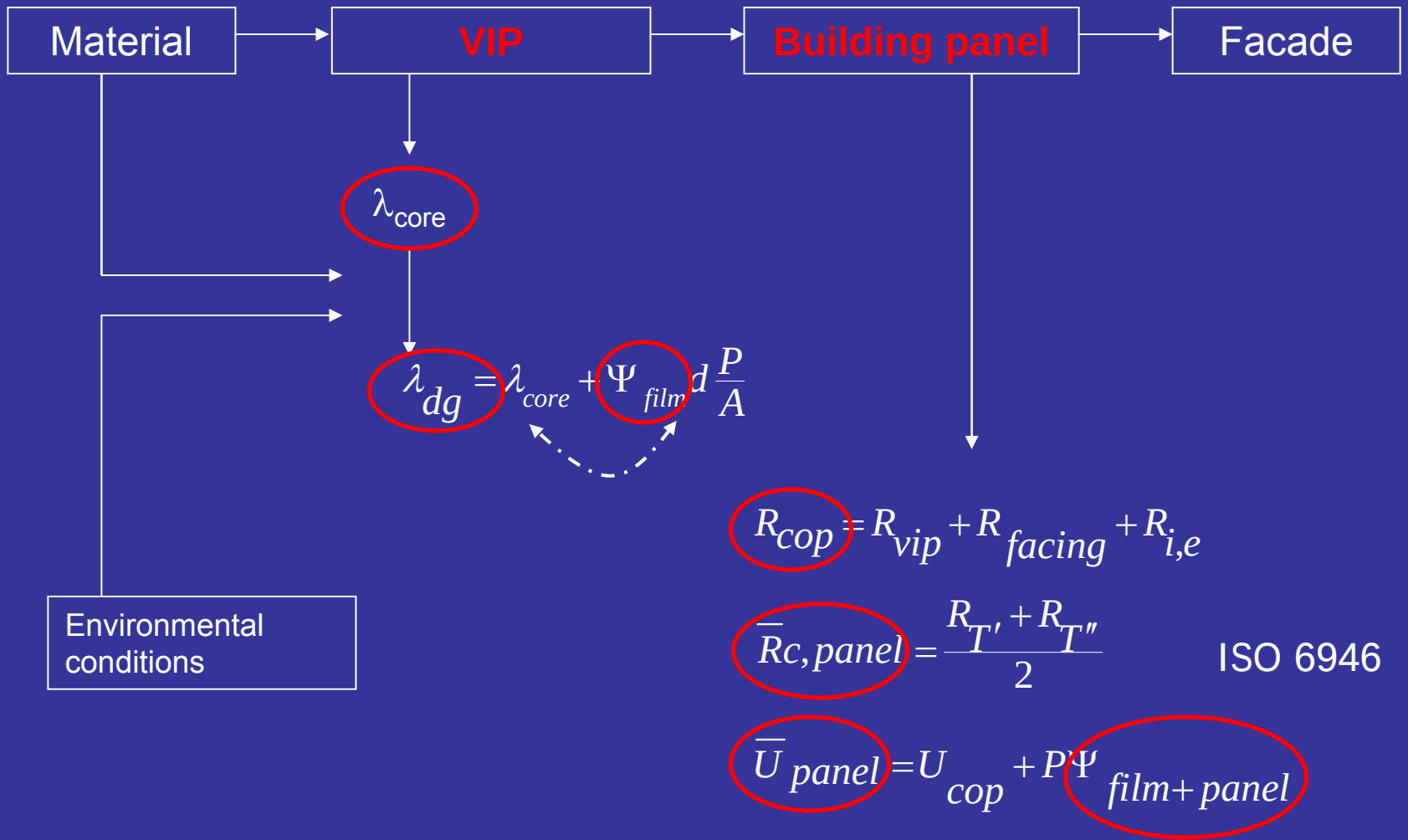
Thermal properties panels



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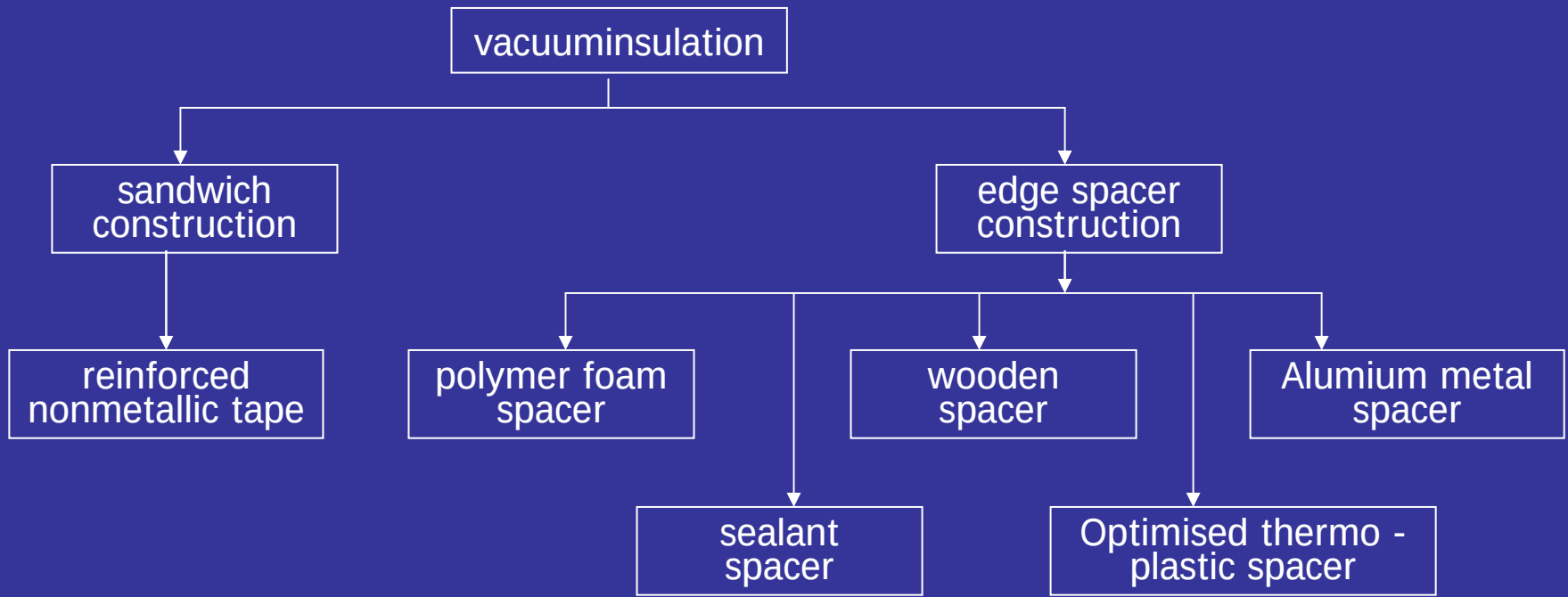
Panel type



$\Psi_{film+panel} - \Psi_{film}$

$\Psi_{film+panel}$

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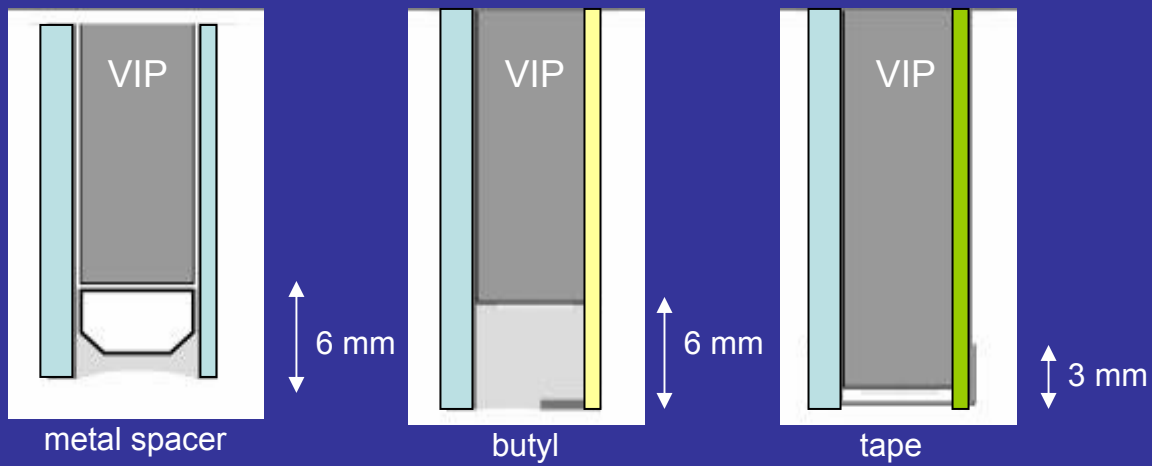
Linair thermal transmittance $\Psi_{film+panel}$



outside facing:	glass 6 mm		
insulation:	vacuum insulation panel 20 mm		
inside facing:	aluminium 1.5 mm	steel 0.75 mm	trespa 3 mm
spacer a	0.320	0.230	
spacer b	0.095	0.084	0.016
spacer c / tape	0.011	0.011	0.011
metallised film barrier			

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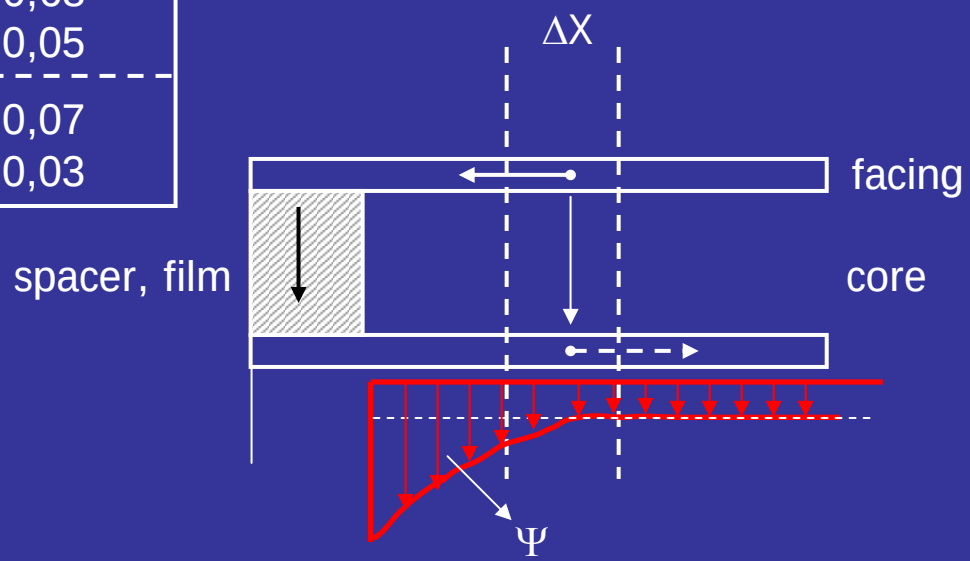
Analytical method $\Psi_{film+panel}$

Provisional results $\Psi_{(film)+panel}$

Panel type	$\Psi_{(film)+panel}$ in W/mK	
	numerical	analytical
2 mm alu / alu spacer	0,71	0,68
3 mm polyester / alu spacer	0,08	0,05
2 mm alu / butyl spacer	0,10	0,07
3 mm polyester / butyl spacer	0,05	0,03



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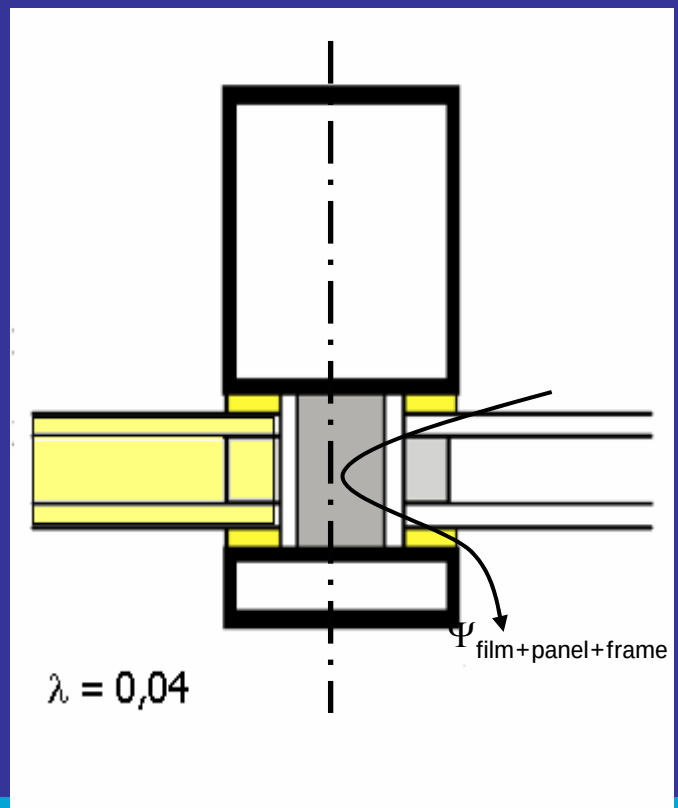
Facade module

Material → VIP → Building panel → **Facade**

$$\overline{U}_{facade} = \frac{A_p U_{cop} + A_f U_f + P\psi_{film+panel+frame}}{A_p + A_f}$$

prEN 13947

Panel type	Conductivity of spacer in W/(m·K)	$\Psi_{(film)+panel^{\wedge}+frame}$ W(mK)
Aluminium / aluminium	0,2 0,4	0,13 – 020 0,23 – 0,29
Aluminium / glass	0,2 0,4	0,14 0,20
Steel / glass	0,2 0,4	0,09 -* 0,14 0,15 -* 0,18
	$\left(\frac{\lambda A}{d}\right)_{spacer}$	



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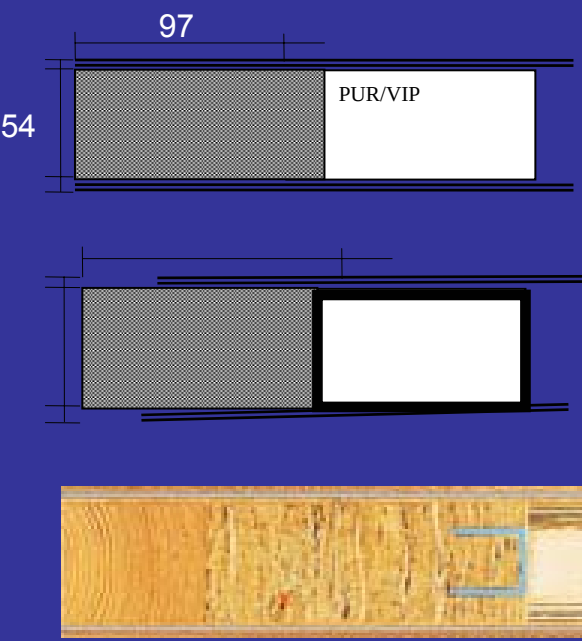
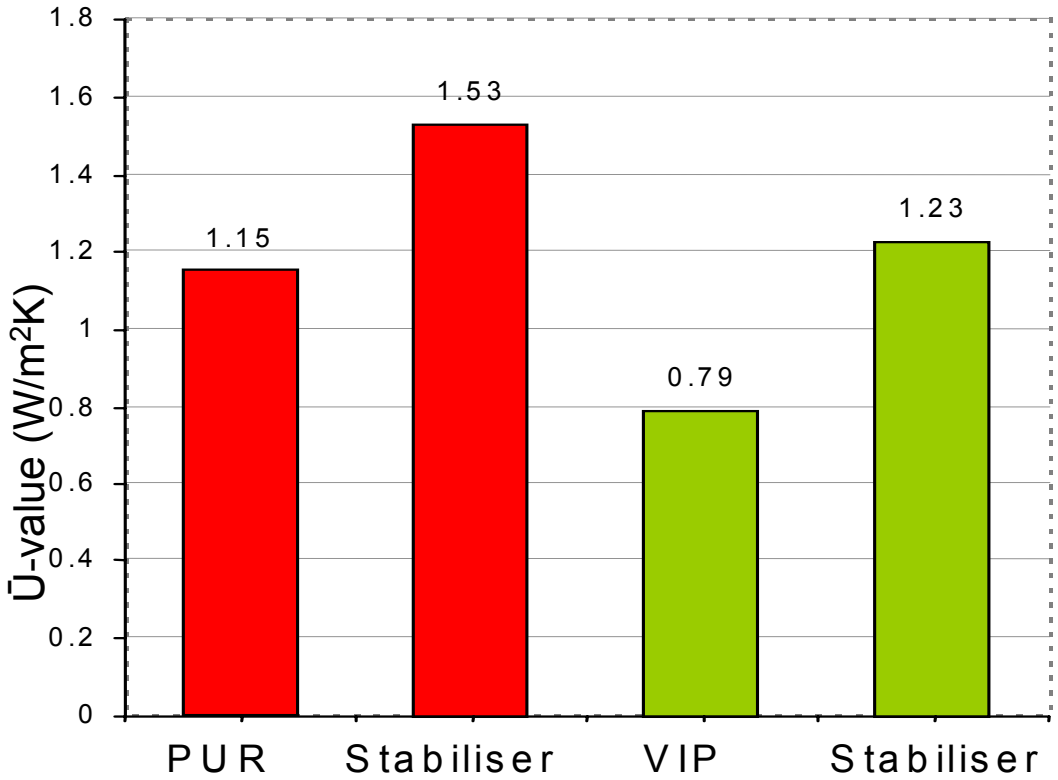
Overview Ψ

Metallized film barrier / d_p = 0,02 m

Ψ_{film}	0,03 (6 μm)	alu film ⟷	0,08 (20 μm)	alu
	0,003	metallized		
		spacer ⟷		
$\Psi_{film+panel}$	0,70	alu facing	0,11	
	0,07	polyester facing	0,03	
$\Psi_{film+panel+frame}$	0,82	alu facing		
	0,22	polyester facing		

Door panel





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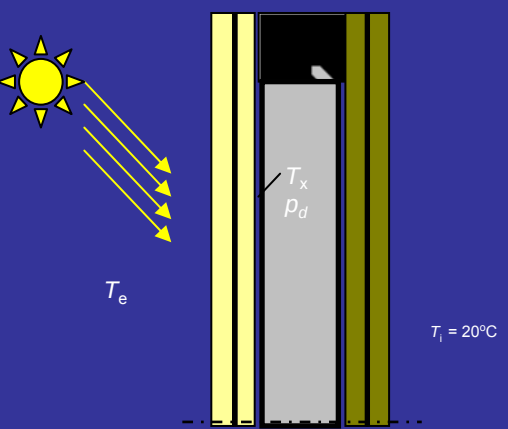
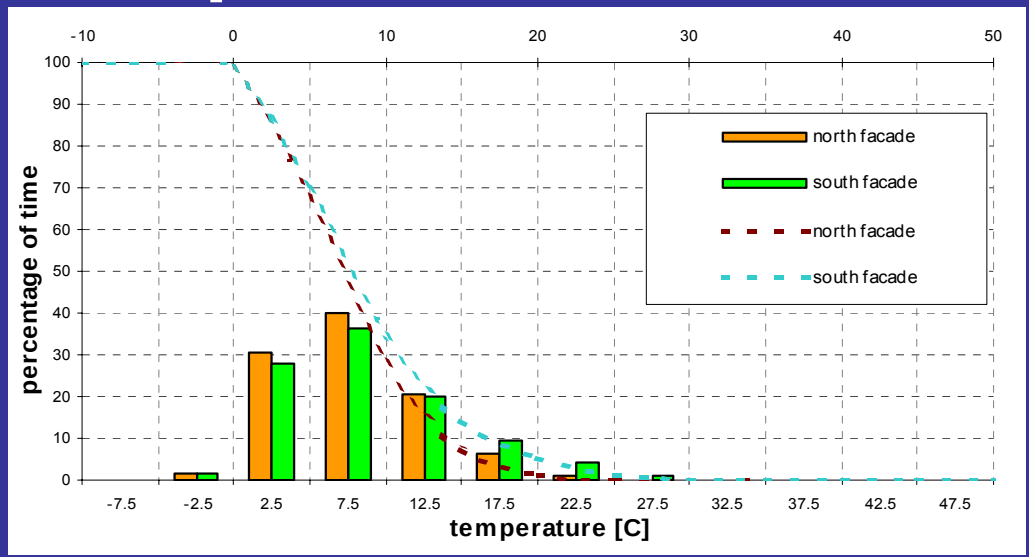
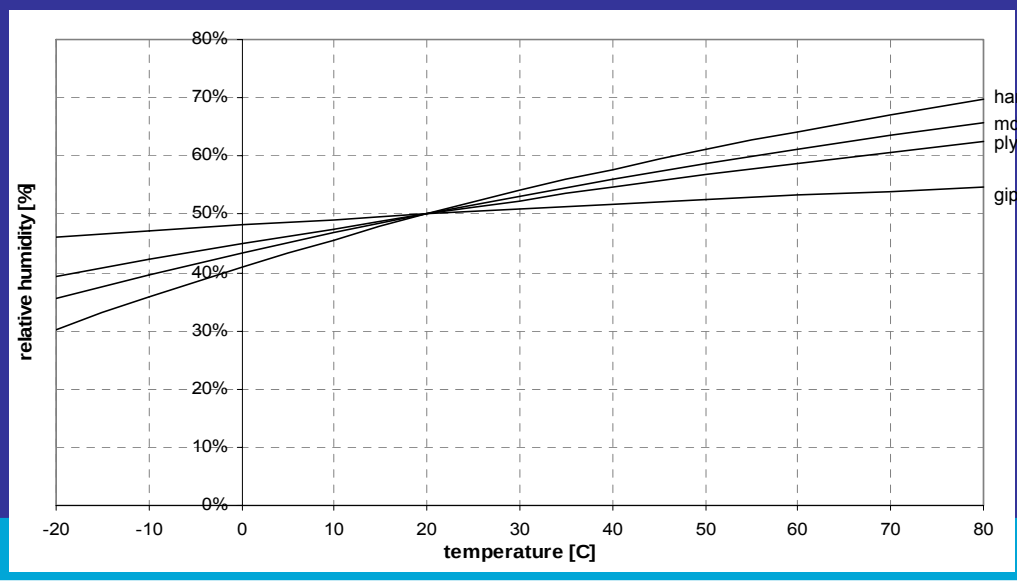
Hygric load door panel







Vapour factor
ref: 21 °C, 50%:

South 0,51
North 0,46

Flexural mechanical properties VIP

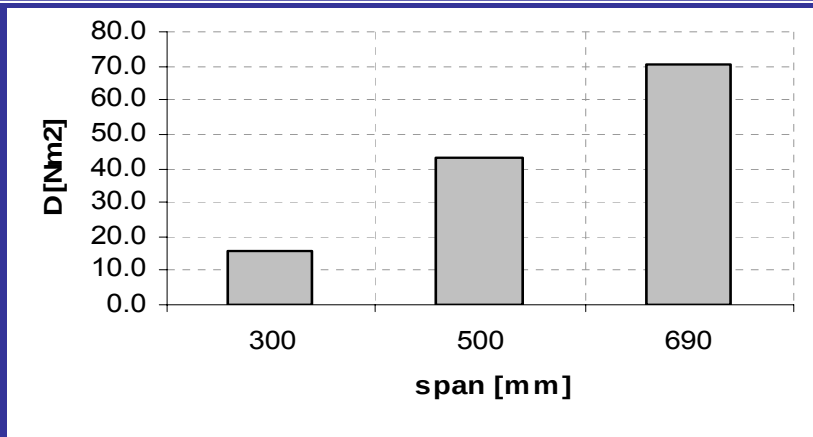
Type	Flexion Modules MPa	Ultimate Flexural Strength kPa	Deformation at fracture / yielding	Source
core material PUR	8,9-2,3 8 - 3	28,7-13,3	0,6-3,2	Quenard and Sallee 2004
VIP				
intact	63,8 ± 8,6	639,8 ±109,9	1,34 ±0,38	
no vacuum	38,6 ± 10,7	611,6 ± 45,3	0,8 ± 0,16	

core: fumed silica
film: metallized

Flexural stiffness sandwich panel

	Measured Flexural stiffness panel Nm^2	Theoretical Flexural stiffness	Ultimate Flexural Strength Panel *MPa*	Deformation at Fracture Panel *%*
Mdf facing VIP, intact	15.4	599	4.3 ± 0.6	12.2 ± 4.5*
Mdf facing VIP, no vacuum	6.7	556	3.9 ± 0.5	12.3 ± 0.6*
Glass facing VIP, intact	30.6	13028	4.1 ± 1.6	1.2 ± 0.3*
Glass facing VIP, no vacuum			4.1 ± 0.5	1.5 ± 0.3*

Core: fumed silica
Film: metallized



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Conclusion

- Unambiguous product specifications are necessary for large scale application
- Sandwich constructions are preferable from thermal and structural point of view
- Knowledge of the structural behaviour of glue layer is necessary
- For an efficient thermal behaviour its is necessary to optimise the use of spacers