

Energy efficient glazed office buildings with double skin facades in Europe

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Intelligent Energy  Europe

Austria, Germany, Greece, Portugal, France, Sweden, Belgium

Why glazed office buildings?

The architects like to create

- Airy, transparent and light buildings with a view to the inside and to the outside
- Buildings with increased access to daylight
- Openness and impression of the future
- Image creating

Enabled thanks to

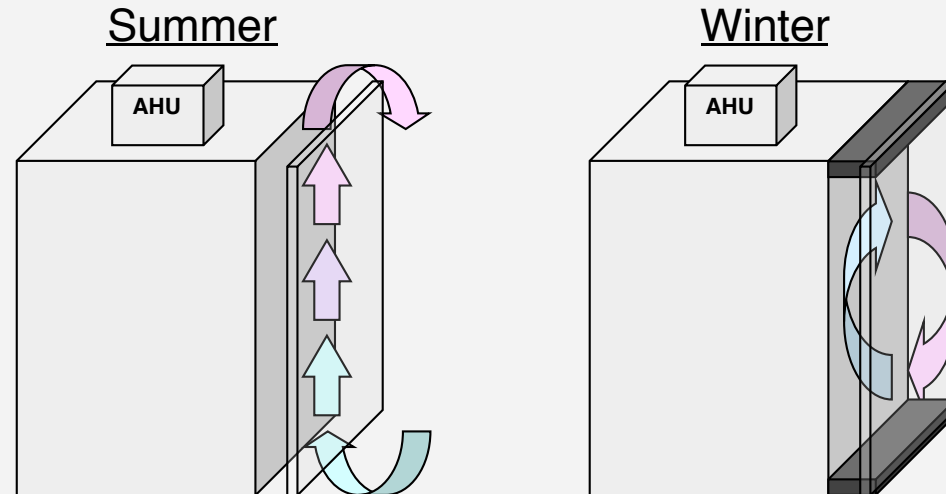
- Development of facade construction technology
- Improved physical properties

Mode 1: Typical Double Skin Façade

Naturally ventilated

Summer: heat extraction through the ventilated cavity

Winter: the closed cavity functions as a thermal buffer zone

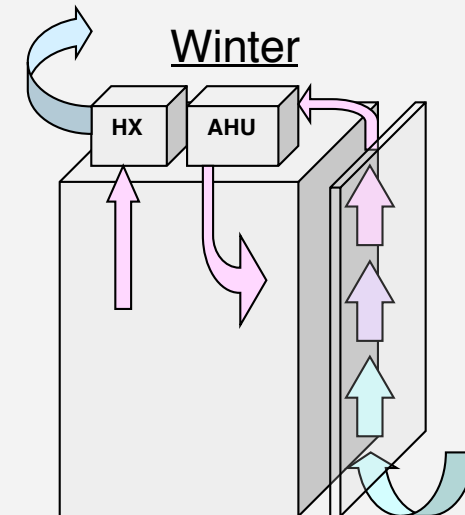
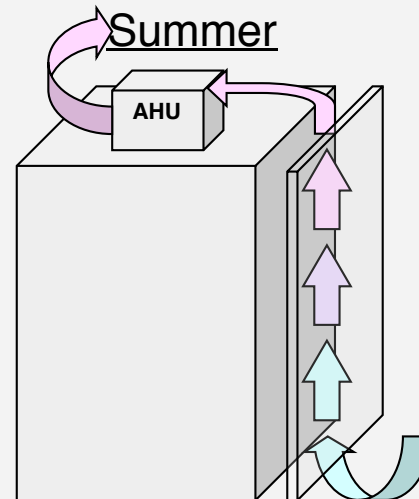


Mode 1: Typical Double Skin Façade

Mechanically ventilated

Summer: heat extraction through the ventilated cavity

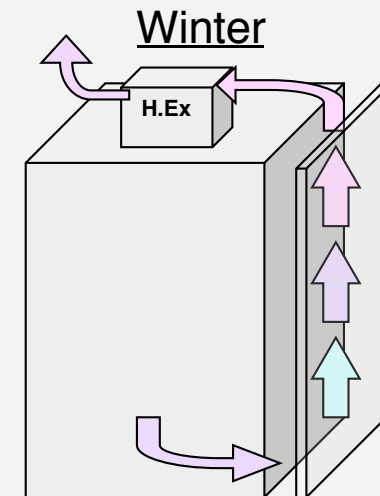
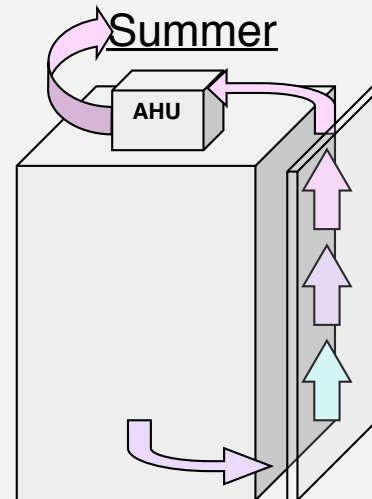
Winter: the air is preheated in the cavity and through the AHU supplied in the building



Mode 2: Airflow window

Mechanically ventilated

Summer and Winter
the cavity functions
as a thermal barrier



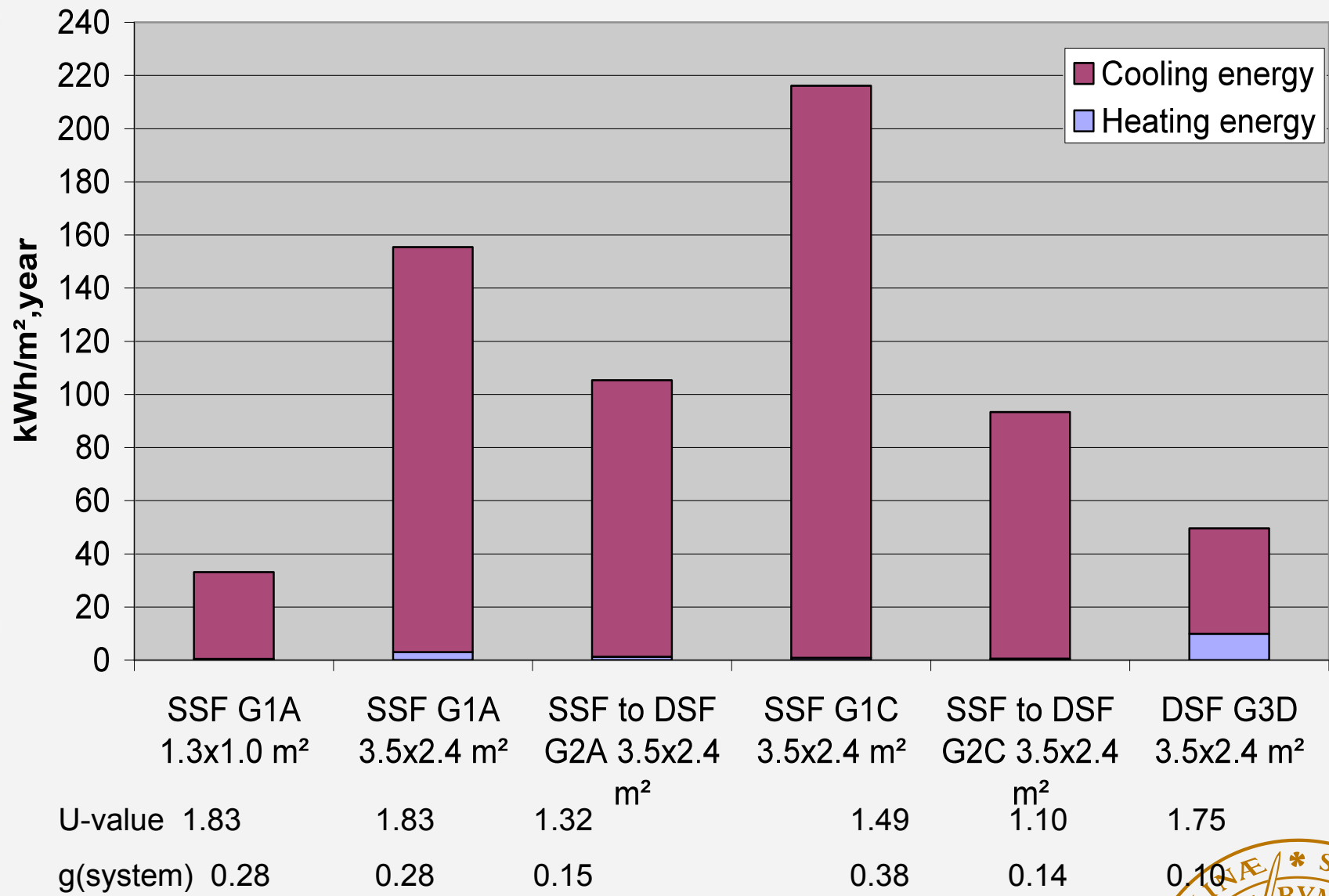
Potential advantages with double skin facades

- Individual window airing almost independent of wind and climate conditions, mainly during sunny winter days and intermediate seasons (spring and fall)
- Reduced heating demand thanks to preheating of outdoor air in the cavity, compared with single skin facades
- Night cooling of the building – when opening of inner windows is possible
- Improved burglary protection thanks to the double skins
- Better sound attenuation towards outside
- Efficient outer (intermediate) solar shading, as it can be used on windy days also
- Wind load on the façade can be reduced

Potential disadvantages with double skin facades

- Less efficient for cross airing and insufficient heat removal from office rooms at calm weather, if mainly natural ventilation
- Risk of high temperatures in office rooms when window airing during warm summer/spring/fall days
- High investment costs
- High operation and maintenance costs
- Reduced office floor area
- Risk of sound transmission via the facade between offices with open windows
- Cleaning can cause additional costs
- Energy savings potential often overestimated

Calculated yearly energy use for heating and cooling for a south facing cell office in Lisbon

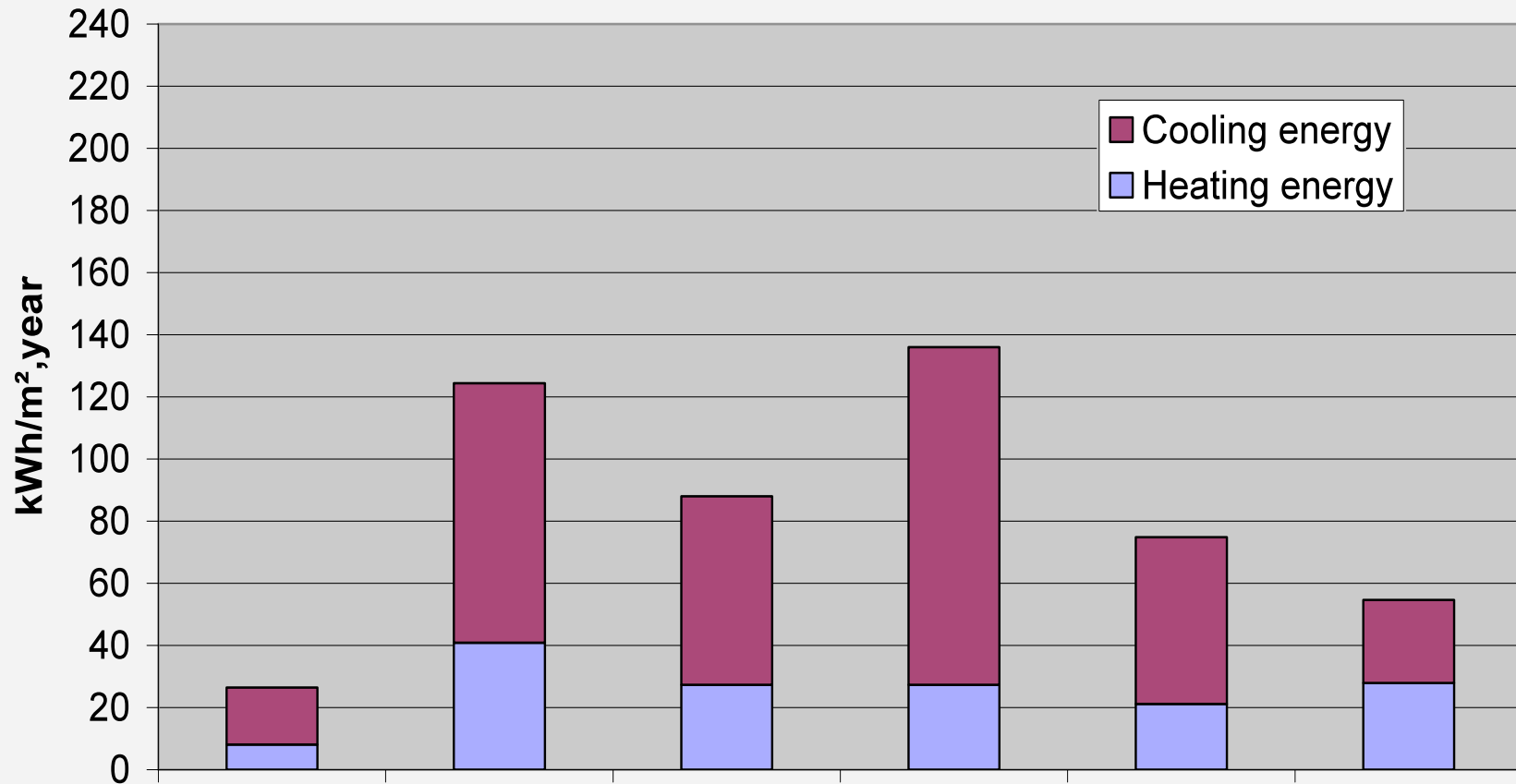


SSF = single skin façade, DSF = double skin façade mode 1 naturally ventilated. SSF to DSF = retrofit of a SSF to a DSF.

ECEEE Summer study 2009



Calculated yearly energy use for heating and cooling for a south facing cell office in Paris

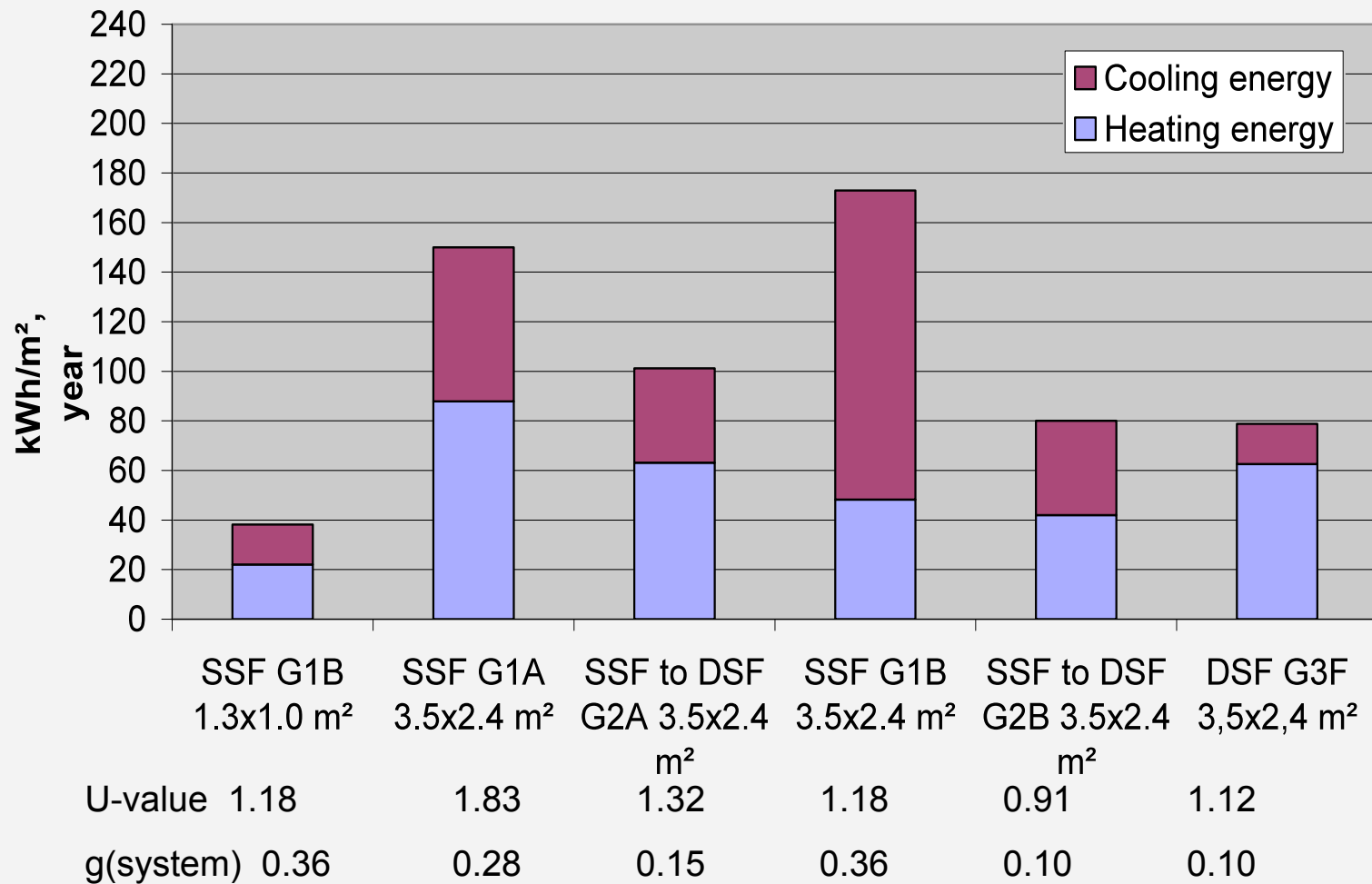


	SSF G1B 1.3x1.0 m ²	SSF G1A 3.5x2.4 m ²	SSF to DSF G2A 3.5x2.4 m ²	SSF G1C 3.5x2.4 m ²	SSF to DSF G2C 3.5x2.4 m ²	DSF G3F 3,5x2,4 m ²
U-value	1.18	1.83	1.32	1.49	1.10	1.12
g(system)	0.36	0.28	0.15	0.38	0.14	0.10

SSF = single skin façade and DSF = double skin façade mode 1 naturally ventilated. SSF to DSF = retrofit of a SSF to a DSF.



Calculated yearly energy use for heating and cooling for a south facing cell office in Stockholm



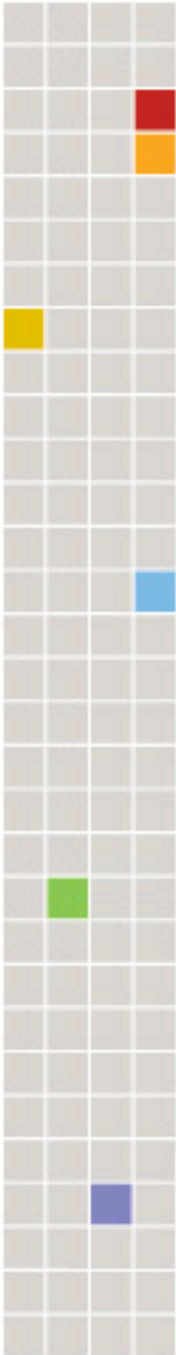
SSF = single skin façade and DSF = double skin façade. SSF to DSF means retrofit of a single skin façade to a double skin facade.

Calculated $g(\text{system}) \times \text{Area}(\text{glazing})$ for a south facing cell office in Lisbon, Paris and Stockholm.

gxA	Lisbon	Paris	Stockholm
SSF G1A 1.3x1.0 m ²	0,3		
SSF G1B 1.3x1.0 m ²		0,4	0,4
SSF G1A 3.5x2.4 m ²	1,8	1,8	1,8
SSF G1B 3.5x2.4 m ²			2,7
SSF G1C 3.5x2.4 m ²		2,7	
SSF to DSF G2A 3.5x2.4 m ²	1,2	1,1	0,9
SSF to DSF G2B 3.5x2.4 m ²			0,7
SSF to DSF G2C 3.5x2.4 m ²	1,1	1,0	
DSF G3D 3.5x2.4 m ²	0,8		
DSF G3F 3,5x2,4 m ²		0,8	0,6

Calculated U(façade) x Area(façade), W/K, for a south facing cell office in Lisbon, Paris och Stockholm.

UA(facade)	Lisbon	Paris	Stockholm
SSF G1A 1.3x1.0 m ²	4,6		
SSF G1B 1.3x1.0 m ²		3,9	3,9
SSF G1A 3.5x2.4 m ²	14,2	14,2	14,2
SSF G1B 3.5x2.4 m ²			9,6
SSF G1C 3.5x2.4 m ²		11,8	
SSF to DSF G2A 3.5x2.4 m ²	10,6	10,6	10,6
SSF to DSF G2B 3.5x2.4 m ²			7,7
SSF to DSF G2C 3.5x2.4 m ²	9,0	9,0	
DSF G3D 3.5x2.4 m ²	13,6		
DSF G3F 3,5x2,4 m ²		9,2	9,2



EC











Guaranteeing energy efficiency and indoor climate for a glazed office building

- Energy use and environmental performance specifications drafted in the brief and then refined
- Energy and environmental coordination from the brief phase until first year of operation
- Energy simulations started in the brief and then refined
- Good cooperation to ensure a well performing system, between architects, all engineers, energy and climate specialists, the client and contractors
- LCC analysis
- Separate performance specifications for the glazed facade

General conclusions on glazed office buildings

- Glass architecture must limit energy losses by innovative solutions
- A double skin façade can improve thermal comfort and energy use of glazed building
- Many buildings with double skin facades perform poorly, high energy use and poor indoor climate
- Best thermal comfort and energy use for a well insulated building with traditionally sized windows
- Modest glazing area, low U- and g-values

General conclusions on glazed office buildings

- Advanced thermal simulations using validated tools required
- Less tolerance for design and construction errors
- Require more careful planning
- The optimal glazed facade construction varies with climate

- The future of glazed office buildings?
- The future development of double skin facades?