THE UNIVERSITY OF AUCKLAND

NATIONAL INSTITUTE OF CREATIVE ARTS AND INDUSTRIES®

NZSSES Forum

The Future of Buildings

Bad Science and Brand Image

Trends in the Facade Design of NZ Commercial buildings

Hugh Byrd

Brief History of Facade Engineering (Europe and US)

Date	Event	Design of facade	Code compliance
Pre mid-1970s	Pre oil crisis	Architect	Architect
Late 1970s to 1990s	Response to first oil crisis	Architect	Architect + engineer
2000s	Peak oil and climate change	Architect and engineer	Engineer

Facade engineering has been a response to Code compliance concerning energy

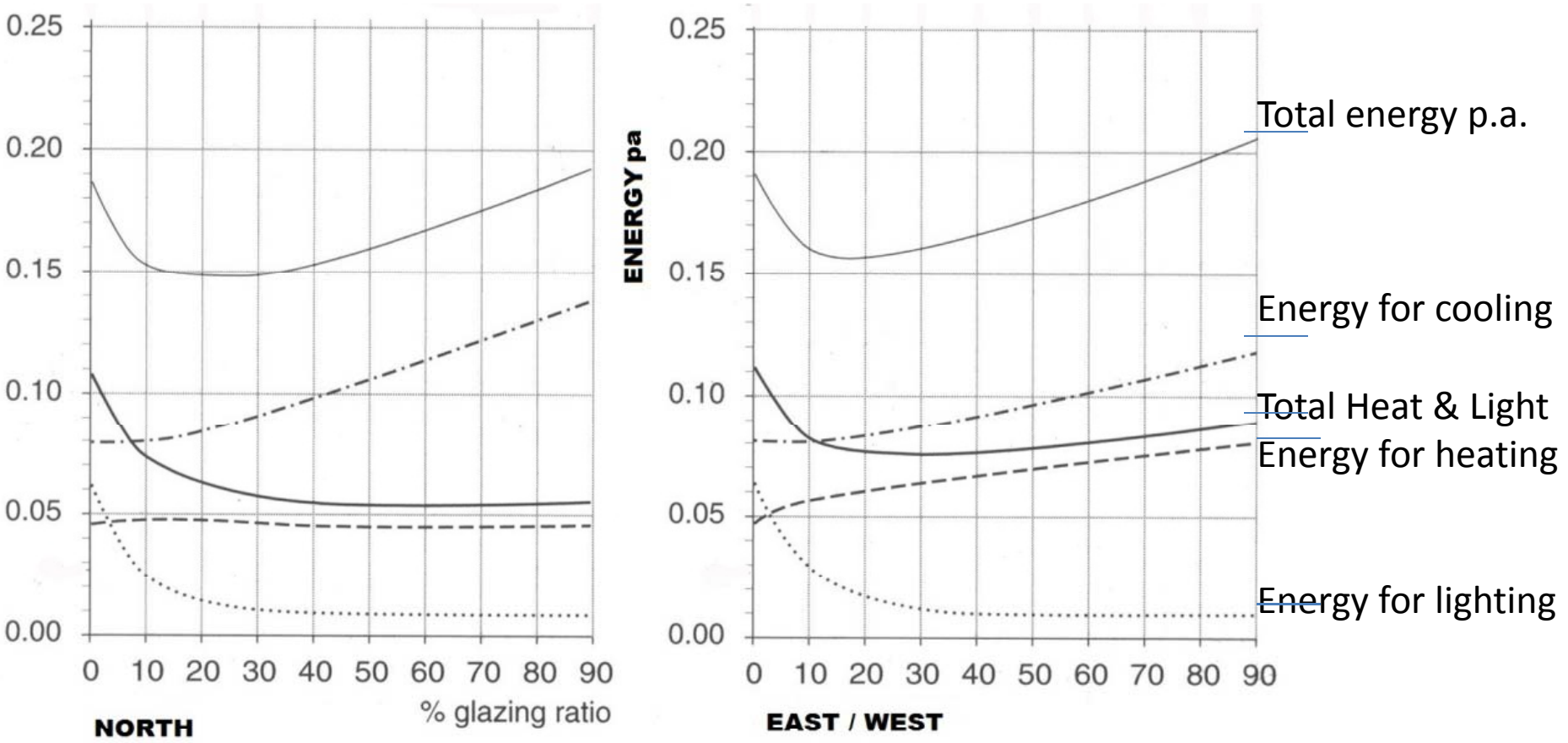
Facade Engineering focused on energy use.

A facade should be designed to balance:

- overheating/cooling in hot weather,
- daylight
- heating demand in cold weather.

Thermal modelling and monitoring buildings has identified the proportion of glass in a facade as the single most important index for a building's energy performance.

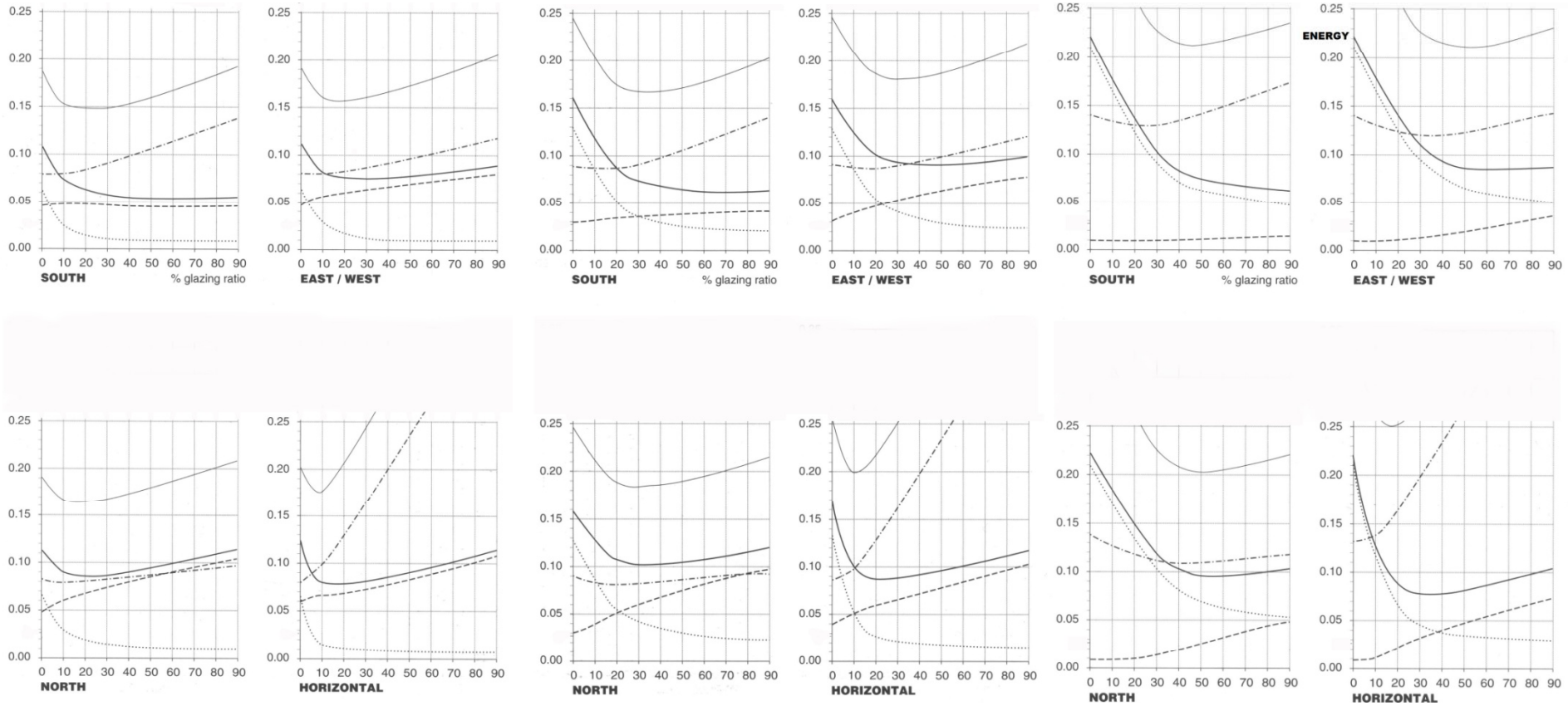
Proportion of Glazing Related to Energy Use in Temperate Climates



Rule of thumb for glazing above 50%:
Approximately 10% energy increase for every additional10% in percentage glazing

Baker, N., Steemers, K. (1994) The LT Method v 2.0, The Martin Centre for Architectural & Urban Studies, Cambridge. University

LT Method for Temperate Climates



150 lux 15 W

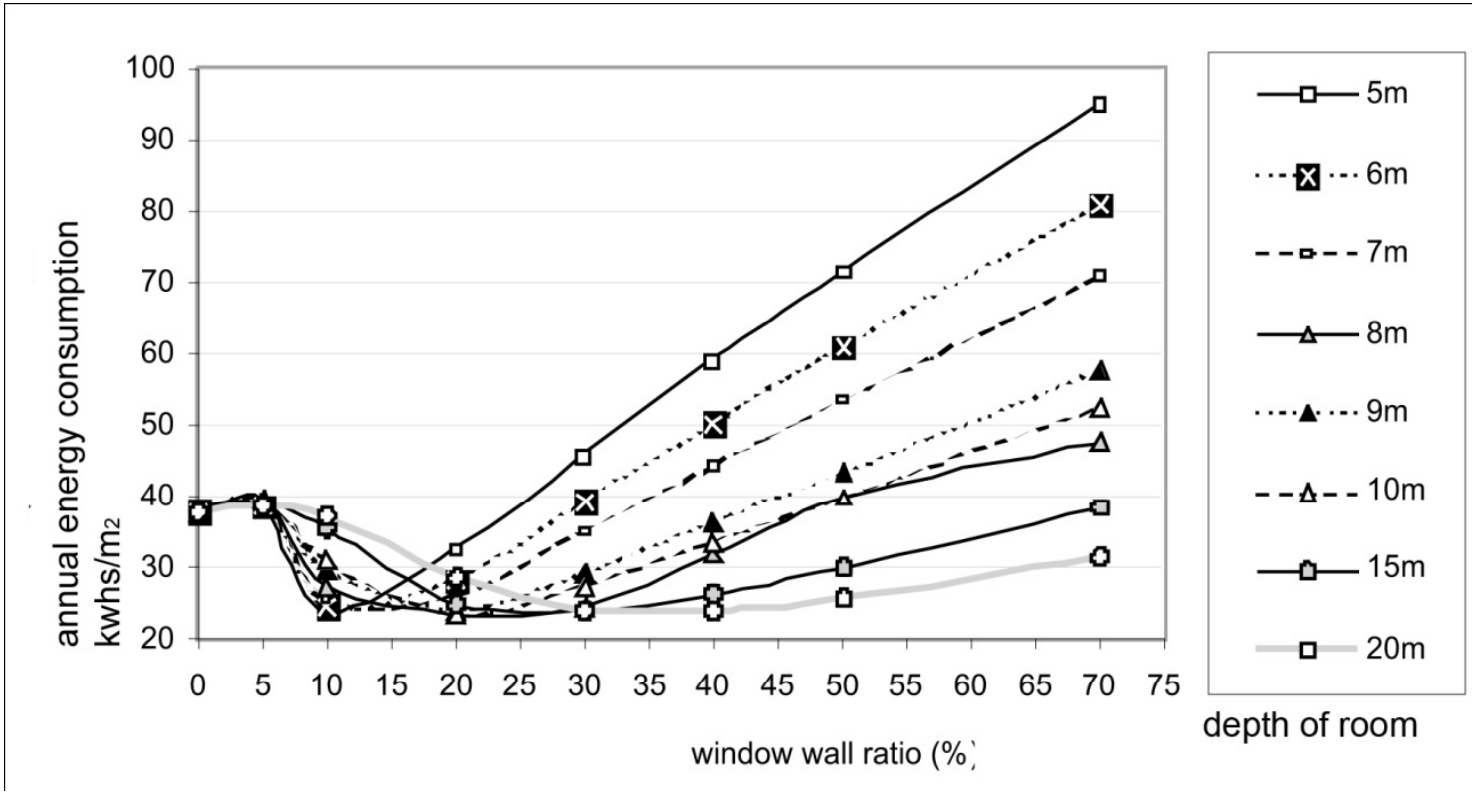
300 lux 15 W

500 lux 30 W

Assumptions: temperate climate, overcast sky, well insulated building

Baker, N., Steemers, K. (1994) The LT Method v 2.0, The Martin Centre for Architectural & Urban Studies, Cambridge. University

LTV Method for Sub-tropical Climates

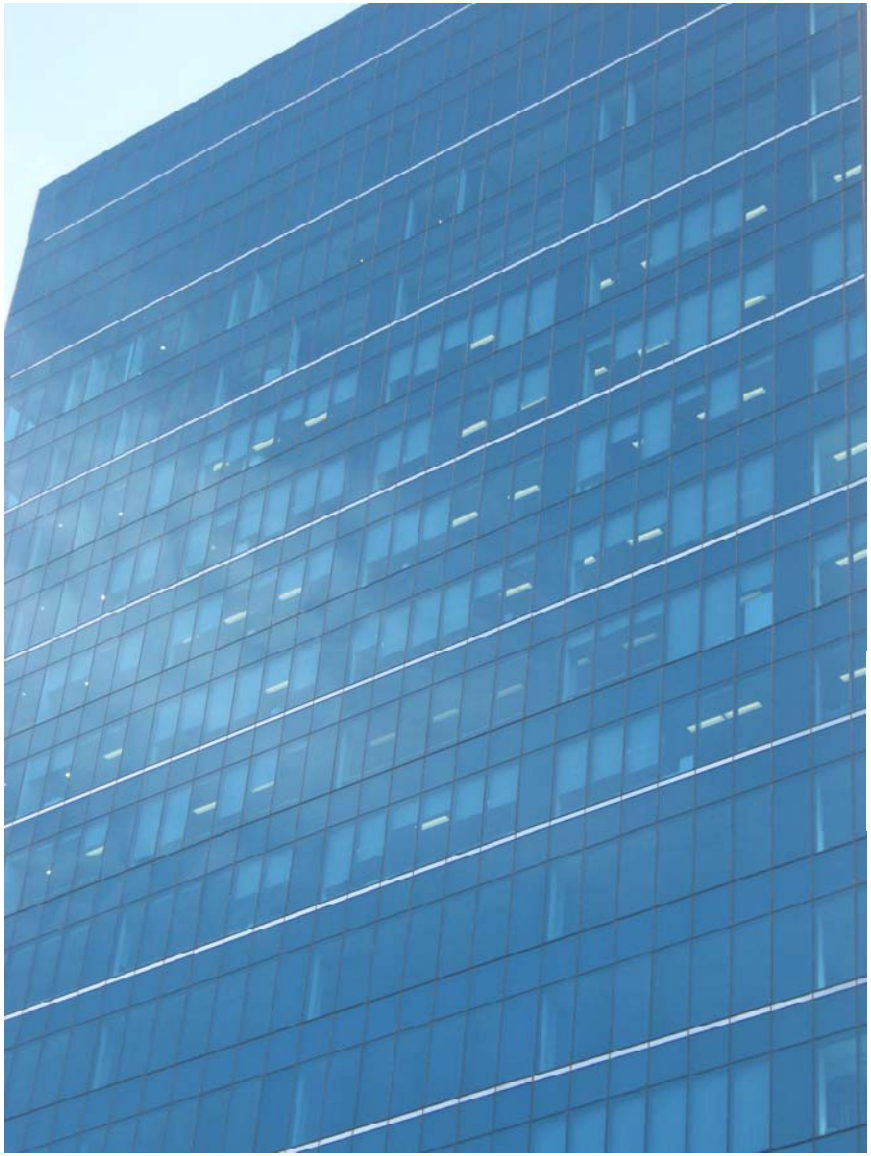


Optimum area of glazing in sub-tropical climates is less than temperate climates

Hyde, R.A., Pedrini, A. (2002) 'LTV Design Tool', *Proceedings of the Experts Meeting, Department of Building,* NUS Singapore.

Proportion of glazing

Difference between theory and practice



Brand Image vs. Energy Use

"Less is more"

A bad joke for energy conservation

Highly glazed buildings become a brand image for commercial institutions

Mies van de Rohe (1919), Glass Skyscraper Project.

Problem for Architects:

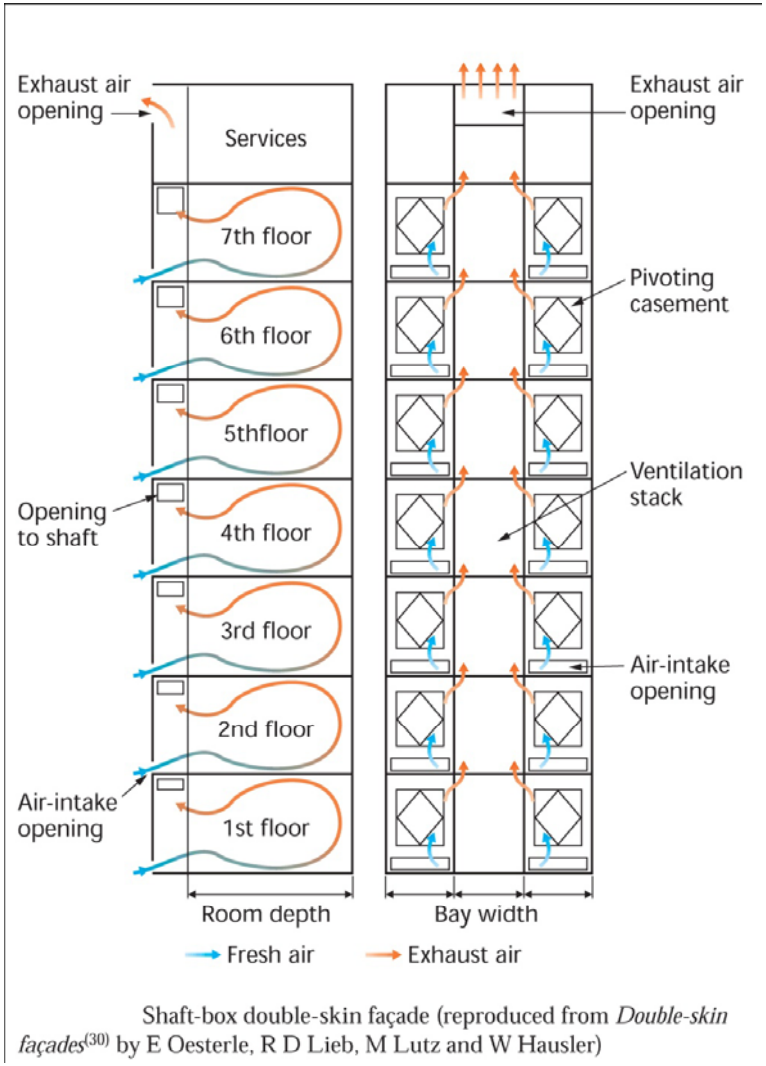
How do you retain a highly glazed facade and comply with Codes?

“The double-skin façade is an architectural phenomenon driven by the aesthetic desire for an all-glass façade.....”

Lawrence Berkeley National Laboratory, University of California.
http://gaia.lbl.gov/hpbf/techno_n.htm

Two Basic Types of Double Skin Facades

1. The shaftbox; induces natural ventilation into the building



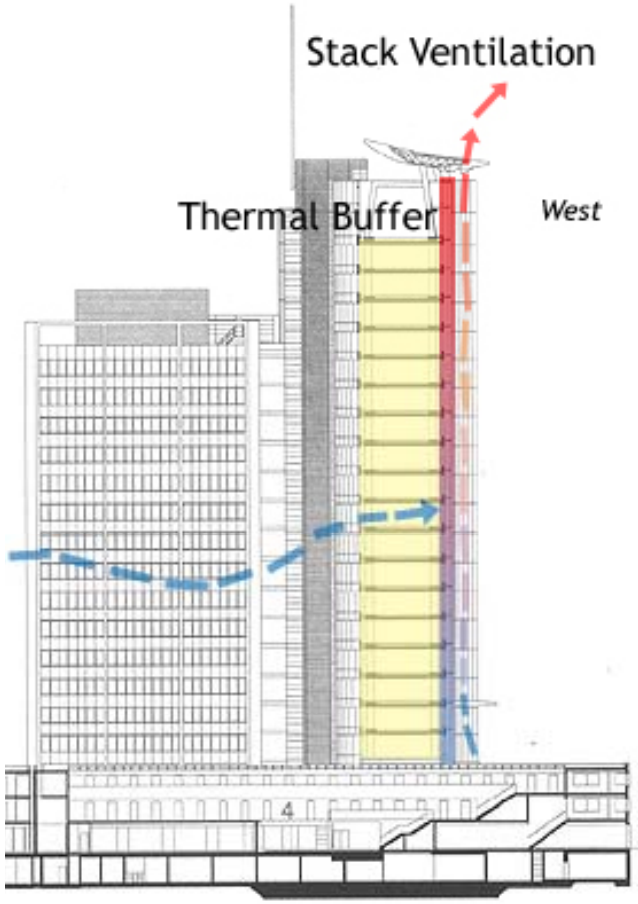
Shaft-box double-skin façade (reproduced from *Double-skin façades*[30] by E Oesterle, R D Lieb, M Lutz and W Hausler)

Le Corbusier (1929)
Tsentrosoyuz building, Moscow

Two Basic Types of Double Skin Facades

2. The vertical corridor; a chimney in front of a sealed building

http://www.google.co.nz/imgres?imgurl=http://www.ebossnow.co.nz/wp-content/uploads/2010/09/Copy-of-DSF-Cavity-Photo.jpg&imgrefurl=http://www.ebossnow.co.nz/2010/apl/complex-window-facade-withstands-christchurch-earthquake.html&usg=__WIauMJyh6HX7596DFSf6vdv3mT8=&h=600&w=800&sz=97&hl=en&start=39&zoom=1&tbnid=4L9VsTbr4cJjJM:&tbnh=149&tbnw=201&ei=hy90TbWeKIG2sAP8pJjaCw&prev=/images%3Fq%3Ddouble%2Bskin%2Bfacades%26um%3D1%26hl%3Den%26sa%3DN%26rlz%3D1T4GGIE_enNZ367NZ368%26biw%3D1899%26bih%3D805%26tbs%3Disch:10%2C142&um=1&itbs=1&biw=1899&bih=805&iact=rc&dur=406&oei=PC90TZXjDYb0swPt28HNCw&page=2&ndsp=41&ved=1t:429,r:7,s:39&tx=95&ty=107



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Double Skin Facades

Lawrence Berkeley National Laboratory, University of California.

“It has been extremely difficult to find any objective data on the performance of actual buildings implementing some of these solutions, particularly double-skin façades and adaptive façades. Subjective claims abound in the architectural literature.”

http://gaia.lbl.gov/hpbf/techno_n.htm

Double Skin Facades

Buro Happold, UK and New York

"Double Facades must be assessed specifically on their individual merit considering climate, orientation, detailing, construction cost and energy price. "

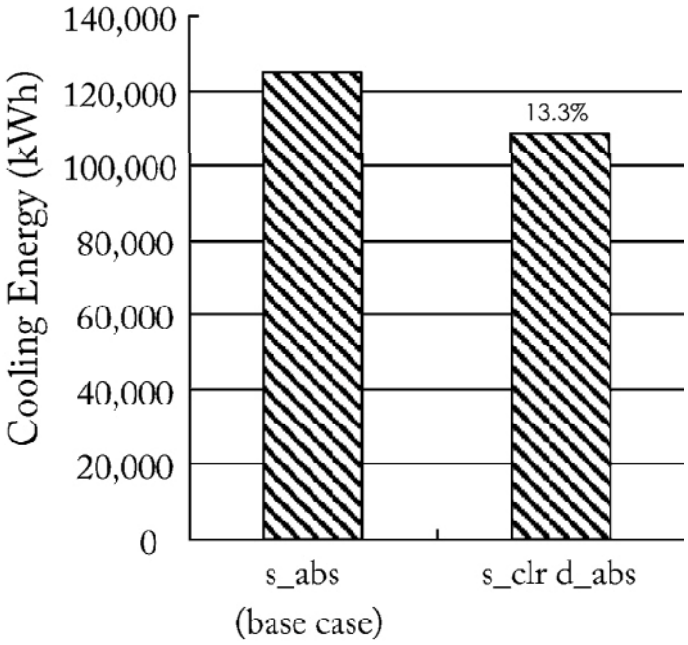
Table 2 – Comparison of payback periods for double facades in different locations

	London	Las Vegas	Winnipeg	New York	Miami	Rome	Munich
Façade area	1,040m^2	1,040m^2	1,040m^2	1,040m^2	1,040m^2	1,040m^2	1,040m^2
Add. façade cost	£700/m^2	£500/m^2	£500/m^2	£800/m^2	£600/m^2	£650/m^2	£600/m^2
Add. capital investment	£728k	£520k	£520k	£832k	£624k	£676k	£624k
Energy cost saving	£1.01/m^2	£1.31/m^2	£0.83/m^2	£2.57/m^2	£1.17/m^2	£2.18/m^2	£1.88/m^2
Floor area	3,000m^2	3,000m^2	3,000m^2	3,000m^2	3,000m^2	3,000m^2	3,000m^2
Annual cost saving	£3,030	£3,930	£2,490	£7,710	£3,510	£6,540	£5,640
Payback period	**240 Yrs**	**132 Yrs**	**208 Yrs**	**108 Yrs**	**177 Yrs**	**103 Yrs**	**111 Yrs**

Stribling, D. & Stigge, B. (2003) A critical review of the energy savings and cost payback issues of double facades. CIBSE/ASHRAE Conference, https://www.cibse.org/pdfs/8cstribling.pdf

Double Skin Facades

Building Energy and Environmental Technology Research Unit, City University of Hong Kong



"However, the long payback period of 81 years makes the double skin façade system economically infeasible."

Chan, A., Chow, T., Fong, K., Lin, Z. (2009) Investigation on energy performance of double skin façade in Hong Kong. Energy and Buildings 41 (2009) 1135–1142

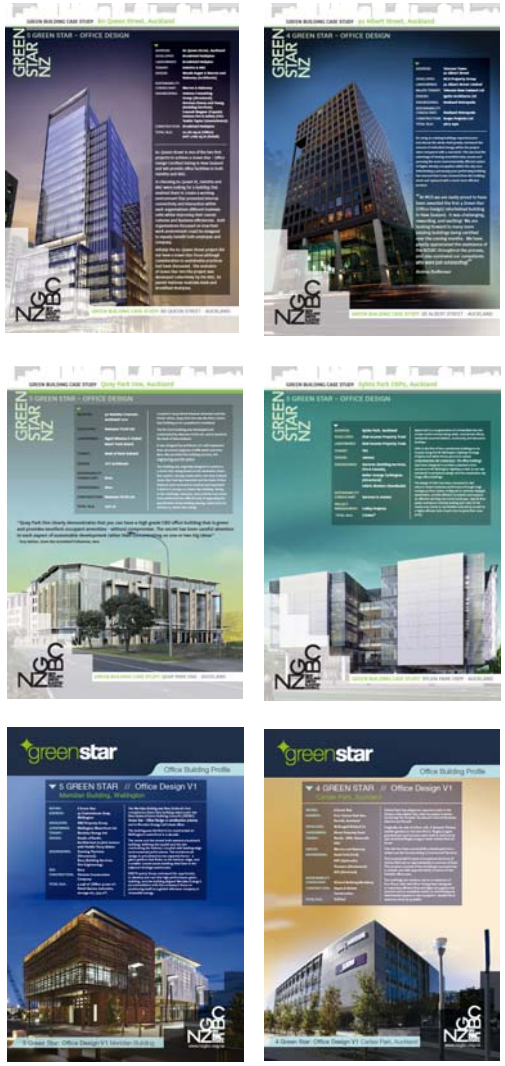
Double Skin Facades

US Department of Energy

"In sum, it appears that a building with an effectively designed DSF may realize moderate energy savings, albeit at high incremental cost and with extensive design effort. It is likely that other technologies and design approaches can achieve the desired positive attributes of DSFs in a more cost-effective manner."

Roth, K., Lawrence, T. & Broderick, J. (2007) Double Skin Facades. ASHRAE Journal, Oct 2007, pp 70-73

‘Green’ rated building designs in NZ



- Air conditioned, ‘green’ office buildings average score for ‘energy’ is only 50% of the available.
- The majority are sealed buildings that are fully air-conditioned and have 80% glazing or more.
- These buildings are dependent on a constant and uninterrupted supply of electricity in order to remain habitable and productive.

NZGBC (2010) web site content http://www.nzgbc.org.nz/main/greenstar/elaboration/casestudies. Accessed June 30 2010

NZGBC Office Design Case Studies

- 25% weighting for ‘energy’ in rating tool

- Only 2/3rds of these points are for building envelope performance

- Case studies of air conditioned offices on NZBBC web site average 50% of total energy score

- Therefore the typical NZ green building values energy in the design of its envelope as :
  25% of %66% of 50% = **8%**

The Future of Buildings

The problems with many NZ commercial buildings:

1. The facades are over-glazed

2. The buildings are high energy consumers

3. Double-skin-facades are unproven

Conclusion

- There are no ‘green’ rated buildings in New Zealand. There are only ‘green’ designs.

- Unless we monitor actual building performance, we risk repeating mistakes of the past.

- The future of buildings should not be in the hands of ‘brand image’ but be guided by robust research into their actual performance.