

# **State-of-the-art in Facade Engineering**

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## Advanced Facade Engineering and Technology 2006

### State-of-the-art in Facade Engineering

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## Cable Net Glass Wall System



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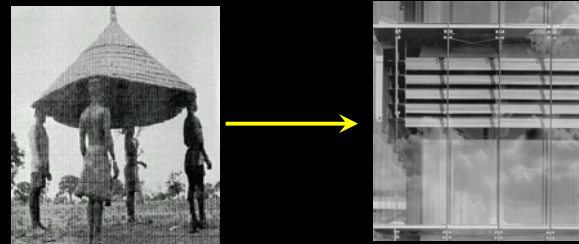
## Blast Resistant Facade



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## Is Double Skin Facade the way forward?

### Evolution.....



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## Why Double Skin Façades (DSF)?

### Common reasons

- Architectural Trend – Clear glazing
- Utilize natural daylight
- Increase energy efficiency of buildings – Low energy building
- Occupants in comfortable environments, increase productivity
- Increase value of the building when it carries a Green label

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## Common DSF types

Double Skin Facade is a generic name but

EACH BUILDING IS DIFFERENT:-

Orientation, Building Services System, Climate, Performance expectation.

Which type to use?

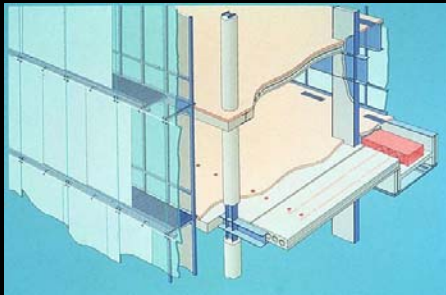
In broad terms –

**Passive Systems and Active Systems**

Common key feature is sunshading devices

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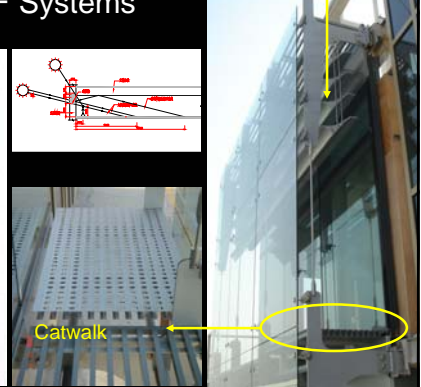
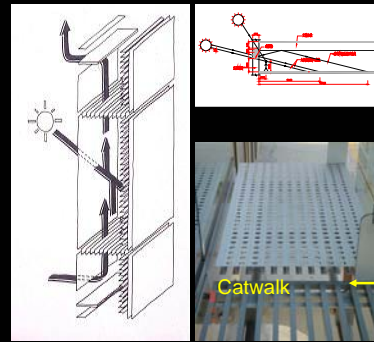
### Passive System - Naturally Ventilated DSF



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### Passive DSF Systems

Light Redirection Device

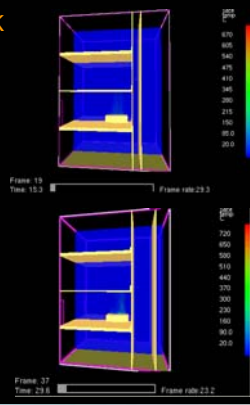


Catwalk

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### Passive systems not ideal in HK

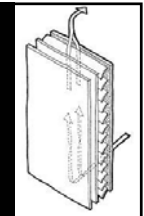
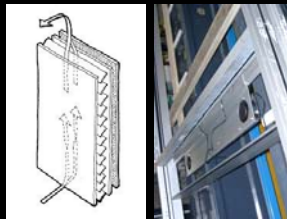
- Take up GFA (may not be able to obtain exemption)
- Pollution – frequent cleaning
- May not meet fire regulations
- More suited for cold climate
- Ventilation easily short circuited by external wind
- Both layers subject to wind load
- Long payback period – over 20 years



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### Active DSF Systems

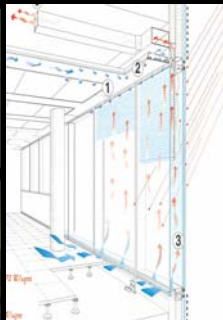
Forced ventilation by mechanical means



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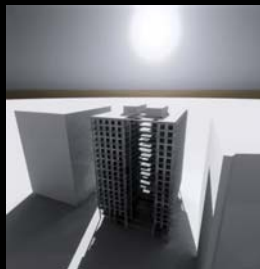
### What we aim to achieve:

- Allow daylight but control glare
- Create thermal comfort zone around building perimeter
- Save energy and running cost



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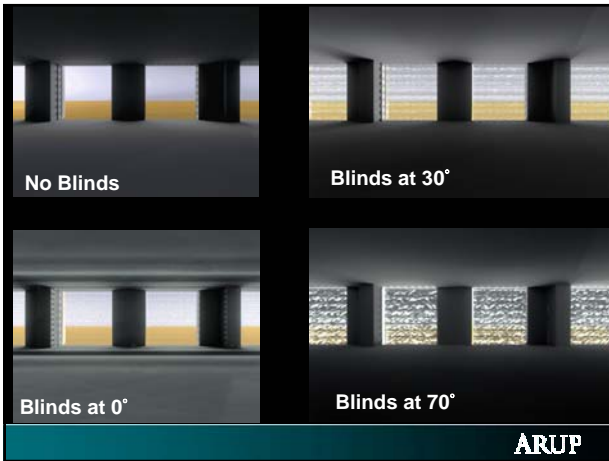
### Design considerations – Daylighting and Glare Control



West Elevation Summer Sun



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**Otherwise.....**

If designed correctly:

- Enjoy natural daylight
- Save in electricity for lighting
- Save in cooling load against heat generated by artificial lighting

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### Daylight and Glare Control

- Control amount of diffused daylight
- Artificial lights controlled by light sensors (via BMS)
- Centralised mechanical blind controlled by BMS
- Unified exterior appearance
- Saving of electricity for artificial lights (significant amount)

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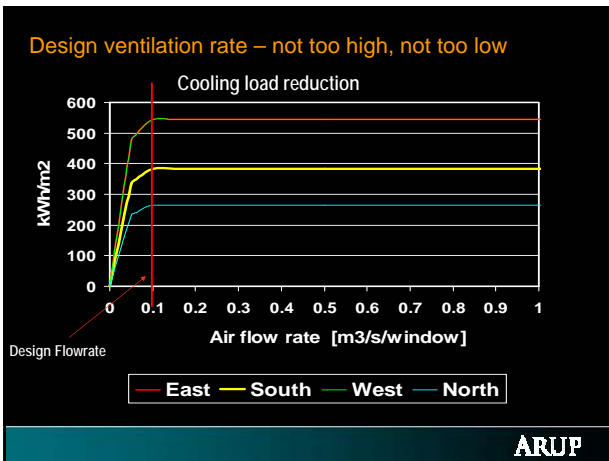
### Design considerations – Thermal Comfort

Outlet temperature = 33°C

Inlet temperature = 24°C

Utilising pre-conditioned air – no extra cost

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Ventilated

Outer pane temp = 50°C

Inner pane temp = 25°C

DGU

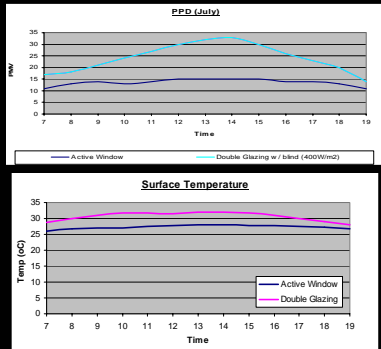
Outer pane temp = 50°C

Inner pane temp = 35°C

PPD Level

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### Thermal Comfort



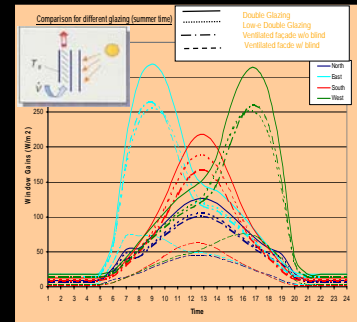
PPD Level

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### Design considerations – Energy Saving

Potential savings on:

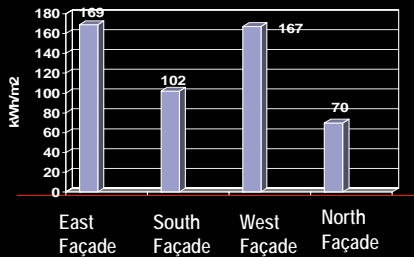
- Cooling Energy
- Heating Energy
- Lighting Energy



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### Energy saving

Summer – Annual Cooling Energy Saving  
(Winter – Annual Heating Energy Saving)

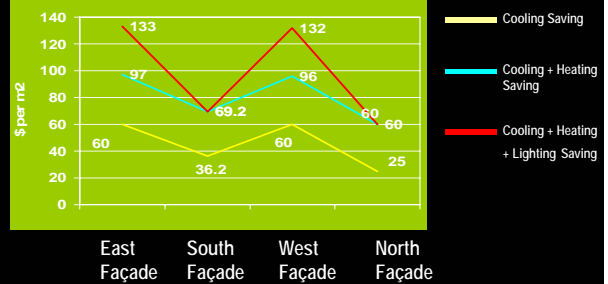


Ventilated façade  
Baseline: DGU

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### Economic Analysis

Energy Cost Saving (\$ per year)



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### So what about \$\$\$ - more or less?

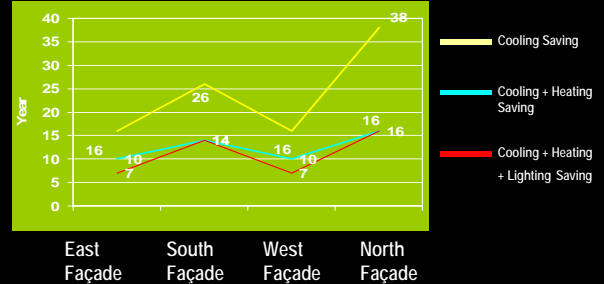
- Increase in capital cost (material, fabrication, transportation, installation....)
  - Glass (and accessories)
  - Extrusions (bigger, heavier, more)
  - Mechanical blinds & control systems
  - Mechanical extraction (fans, ducting etc)
- Increase in maintenance cost
  - Cleaning
  - Maintenance cost
- Cost saving
  - Lower fuel bills (less running cost)
  - Smaller plant (cheaper), more rentable areas
- Increase in building value



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### On average – increase capital cost by 50% - 100% !

Payback (years) Typical 10-15 years in HK



(Excluding maintenance cost & increase in building value)  
(Assume current energy price, no way of telling future price)

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### Other considerations

- Open plan office required to maximise benefits
- Partially blocked views, tenant may not want to be living behind blinds, it is only human to want to be in "control", but the benefits can diminish soon as manual override is allowed
- Maintenance could be problematic, the perimeter band next to glass have to be accessible
- Difficult to incorporate operable vents
- Additional weight on structure, more structural cost (albeit minor effects)
- Developer may not be concerned about running cost (e.g. cooling and lighting energy) as tenants will pay
- "Green" facade is being promoted but consider the embodied energy
  - Aluminium – 221 MJ/kg
  - Steel – 45 MJ/kg
  - Concrete – 1 MJ/kg
  - Glass – 1 MJ/kg

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### Conclusions

- Active system is considered to be a viable DSF system in HK – reasonable payback period, appropriate performance
- The system needs to be designed holistically with the building services and interior planning
- We are living in a commercially driven world, developer will look to maximise return of investment, hence DSF will not be an attractive option, especially when tenants are paying for energy cost
- Building professionals can promote Green facades but need the push from government (e.g. Germany) to make it a success

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