TABLE OF CONTENTS Aug 2003 - 0 comments

Doubling Up II

The second of a series of articles on double skin façades examines the general principles behind the systems with case studies.

By: Terri Meyer Boake, Andrew Chatham, Kate Harrison and Ken Lum

2003-08-01

The actual benefits derived from the use of the double façade system are debatable from both "green" and economic standpoints. In Europe double skin façades are twice as expensive as regular cladding systems. In the U.S. and Canada they can be four or five times the cost due to engineering costs, the amount of special glass required, and the unfamiliarity of trades with these systems. In Europe, energy costs are much higher and therefore offset the original investment with a faster return. If the design process fully integrates mechanical and architectural concerns from the beginning, these systems often require less mechanical (HVAC) equipment, which can compensate for the cost of the second façade.

The goal of double façade systems is to be environmentally "responsible" and to improve working conditions through access to daylighting, natural ventilation and greater control over the workplace atmosphere. Social costs such as employee satisfaction and productivity become factors in calculating cost because healthy employees produce and accomplish more. German law mandates that every workstation in new commercial buildings be in direct sunlight. The typical distance from the window to the core ensures that all workers are within a maximum distance to a window. The design of office buildings has changed to preclude the typical perimeter ring of closed offices and the interior windowless open office plan. North America seems to lag behind Europe in mandating the same standards for quality of workspace.

Occidental Chemical (Hooker Building) 1980:

The first double skin building to be constructed in North America was the Occidental Chemical Center in Niagara Falls, New York designed by Cannon Design Inc. and completed in 1980. Its skin system was not widely adopted in commercial building types to follow.

Occidental employed a straightforward square plan with a central core and suspended ceilings. A 4-foot (1.2m) perimeter cavity allowed for maintenance of the movable daylight controlling louvers and window washing, as well as ventilation of the cavity by stack effect; in modern terms, a Buffer Façade. The outer skin was double-glazed and the inner face single-glazed. The double façade is used on all four faces of the building, regardless of orientation.

The skin system used by Occidental is sometimes termed "dynamic" owing to its ability to change as a function of the time of year and time of day. The louver system was designed to automatically rotate to control daylight. Solar cells at the back of each bank of the aerofoil louvers, if struck with direct light, would effect rotation to block out the sun. Direct sunlight would be intercepted and directed to the ceiling. The louver would pick up the solar heat gain, which could be exhausted by the stack effect of the cavity if desired (summer conditions). For insulation purposes the louvers would rotate to a closed position and provide additional R-value at night. The louvers are shaped much like an airplane wing rather than being flat. This permitted diffuse reflectance of incoming sunlight is either hit at the top or bottom side of the louver.

The system that controlled the horizontal louvers ceased to function approximately 5 years ago and was not repaired, leaving the louvers in a fixed horizontal position and the tenants uncomfortable. Subsequently, the tenants installed traditional vertical blinds to compensate for the lack of solar control from the non-functioning aerofoil system. The general state of disrepair during the late 1990s resulted in a tenancy drop to 30%. At present, the future of this potentially historic building is dubious.

Telus Headquarters (William Farrell Building), Vancouver, British Columbia by Peter Busby and Associates, 2001

The Telus Building in Vancouver, British Columbia differs from other examples in its use of the second skin to encapsulate an existing 8-storey (formerly brick-faced) concrete masonry building to prevent its destruction, extend its life and create an improved interior work environment. This double skin façade strategy is referred to as twin-face. It provides natural ventilation through operable windows in both the exterior and interior façades. The 900 mm cavity extends unobstructed for the full height of the building with the air space acting as a buffer zone between the busy downtown Vancouver site and the interior office environment.

The new outer skin is comprised of a differentially-glazed curtain wall frame with operable windows set out from the building with steel brackets. Access to the air space for cleaning is via a bosun's chair. The window glass on the curtain wall is fritted at different densities for temperature modulation. This skin acts to reduce ventilation and heating requirements by modulating the internal temperatures. The cavity between the existing building and the new building is essentially a greenhouse. The interstitial space stores heat in the winter and provides shade and diverts heat from the building in the summer. The existing concrete structure acts as a sink for excess heat and provides shading. Air flow through the cavity is controlled by louvers at the base of the cavity and dampers at the top that flush the air as required. The cavity is closed during peak traffic hours or as a response to the outside temperature. Photovoltaic cells are linked to the ventilation fans and dampers on the roof. Each workstation is equipped with individually-controlled diffusers to allow the flow of fresh air through a forced air plenum under the raised floor. Daylight reflectors allow light to penetrate deep into the building. The newly exposed concrete ceilings, a result of gutting the building, were painted white to assist with daylighting and exposed thermal mass.

Used only on the south and west sides of the building, the addition of the double skin to the William Farrell Building resulted in significant environmental savings in accordance with the LEED Environmental Assessment system. Used only on the south and west sides of the building.

Caisse de Dépôts et Placement, Montreal, Quebec by the Consortium: Gauthier, Daoust, Lestage/Faucher, Aubertin, Brodeur, Gauthier, Lemay et associés (2002):

A double skin, referred to in this case as une façade intelligente, was used on the recently completed Caisse de Dépôts et de Placements du Québec in Montreal. The system was chosen for its thermal, visual and acoustical properties. The double skin was used as a hybrid type, integrating alternate bands of double façade/cavity glazing with bands of traditional operable windows. In designing for the severity of the Quebec climate the double-glazing was placed on the outside face and single-glazing on the inside skin in an effort to preclude the build up of condensation within the air cavity. Standard recommendations for Twin-Face systems would provide single-glazing on the outside buffering skin and double-glazing on the interior layer. This approach might work in more temperate climates, but the façade designers were highly concerned about the potential for condensation in the cavity and felt the approach not suitable to a cold climate installation.

by a central system. The inner glass pops open for ease of cleaning. Occupant controlled access to fresh air is via a strip of interior opening hopper windows that provide direct access to natural ventilation.

The façade system is employed on all major street faces, with the exception of the façade system that is used along the 9-storey atrium that runs the full length of the building.

Centre for Cellular and Biomolecular Research, University of Toronto: Benisch, Benisch and Partners with Architects Alliance (2003):

The newest Canadian effort in double façade construction will be the 13-storey Centre for Cellular and Biomolecular Research. Construction started in May 2003 with an estimated budget of $85 million.

The double façade system is to be employed on the south face of the building (façade facing College Street) and on the west façade, above the atrium that adjoins with the Rosebrugh Building. In the preliminary report on the skin, prepared by H.H. Angus, the double façade was being used to maximize daylight and natural ventilation into the perimeter spaces of the building. The outer façade would be single-glazed, with the inner façade double-glazed with argon filled, low-e glass. Reflecting louvers are used in the cavity to both shield excess light/heat as well as bounce sunlight further into the building. The cavity width was enough for the potential placement of plants and access for cleaning.

Unlike the other examples, in the CCBR the environmental condition of the interior spaces is divided into controlled and uncontrolled spaces. Those that are "uncontrolled" include the public corridors and winter gardens as well as those that use the double façade as a buffering element. The "controlled" areas such as the laboratory and other program spaces rely exclusively on traditional HVAC systems.

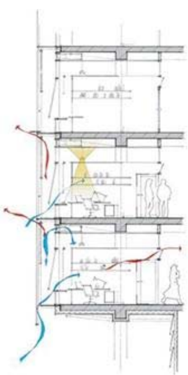
Looking to the Future:

Interestingly, the three recent Canadian double façade examples have chosen to employ differentiated skin systems based on the concept of regional responses that enhance concepts of sustainability by promoting climatic responses such as solar availability, weather patterns, urban design considerations, and other issues that deal with specific regional differences versus technological solutions that operate on universal conventions.

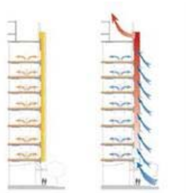
Finite supplies of fossil fuels require that alternate methods of fuelling our buildings must be found.

Terri Meyer Boake is an Associate Professor in the School of Architecture at the University of Waterloo. Kate Harrison is an M.Arch. student at the University of Waterloo and was responsible for significant contributions to the case study on Occidental Chemical Center (Hooker Building), Niagara Falls, NY, by Cannon Design Inc. Andrew Chatham, M.Arch., was responsible for case study research on the Telus Headquarters (William Farrell Building). Ken Lum is an M.Arch. student at the University of Waterloo and was responsible for significant contributions to the case studies of both the Caisse de Dépôts et Placement, Montréal and the Centre for Cellular and Biomolecular Research at the University of Toronto.

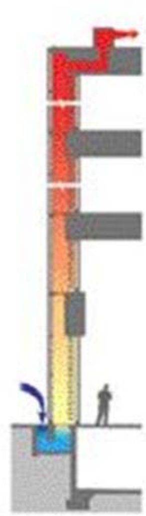
Photos



Larger photo & full caption
File size: 19.2 KB (245px X 476px)
Caption: Section through double façade, CCBR building.



Larger photo & full caption
File size: 7.9 KB (216px X 219px)
Caption: section of cavity wall in the Occidental Chemical build...



Larger photo & full caption
File size: 3.5 KB (78px X 225px)

Related Topics

Concrete
Design-build
Masonry
Mechanical Systems
Offices
Sustainable design/LEED

Monitor These Topics

- Concrete
- Design-build
- Masonry
- Mechanical Systems
- Offices
- Sustainable design/LEED