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Doubling Up

The first of a series of articles on double skin façades examines the general principles underlying the systems.

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Double skin façade systems are increasingly employed in high profile buildings, and are being touted as an exemplary "green" building strategy. This new technology is more often found in Europe and the Pacific Rim, and far less in North American buildings. For the majority of architects, double skin technology remains elusive. From perspectives of both knowledge and budget, double skin systems are often beyond the scope of most commercially-driven North American high-rise projects. Is North American commercial architecture missing out on potential energy and environmental savings?**Environmental Principles**

The double skin façade is based on the notion of exterior walls that respond dynamically to varying ambient conditions, and that can incorporate a range of integrated sun shading, natural ventilation, and thermal insulation devices or strategies.

The double skin façade is normally comprised of a pair of glass "skins" separated by an air corridor. The air space between the layers of glass acts as a buffer against temperature extremes, winds, and sound. Sun shading devices are often located between the two skins. All elements can be arranged in various permutations and combinations of both solid and diaphanous membranes.

The double skin system is normally used to improve the environmental performance of the building skin. This includes reducing energy costs as well as improving occupant comfort. Strategies include natural ventilation, daylighting/shading and passive solar gain.

Natural ventilation is a key feature of the twin-face system. The passive use of air currents rather than mechanical means of air conditioning reduces energy consumption and in turn reduces CO2 output in the operational phase of the building. The outer layer of the double skin creates a stratum of air that is not affected by high velocity wind. This buffer zone, a key component to the double skin façade, is typically the region used for natural ventilation, allowing access to outside air without disruption by the high velocity winds prevalent at higher altitudes of multi-storey buildings.

Daylighting reduces the need for electric lighting. In addition to energy-saving benefits, access to daylight has been proven to improve worker comfort and performance. The double skin façade, with its extensive glazing coverage, provides ample access to daylight. Where uncontrolled daylighting--particularly on west façades--can result in excessive overheating and glare, the cavity of the double façade is used to extract heat and incorporate shading devices.

Control of solar heat gain with double skin façades is obtained through the use of spectrally selective glazing, coupled with shading devices in the air cavity--typically horizontal blinds--as well as the ability of the cavity itself to absorb some incoming solar radiation. Horizontal blind shading devices can either be fixed elements or operable units that are controlled by the occupant or by sensors within the building. On multi-storey buildings, unprotected external devices are expensive due to installation costs and safety concerns. They are typically fixed and usually not effective for all sun conditions, especially low sun angles in early morning or late afternoon. Double skin façades offer protection from the elements for operable shading devices.

The Air Space

Appropriate design of the air space is crucial to the double façade. Variations allow for improved airflow, sound control and other benefits. The actual size of the air space (non-leasable area), not the expense of the additional glass layer, can be the economic factor that deters commercial implementation of these systems.

The air cavity can be continuous vertically (undivided) across the entire façade to draw air upward using natural physics principles (hot air rises), divided by floor--best for fire protection, heat and sound transmission--or be divided vertically into bays to optimize stack effect.

Undivided façades benefit from stack effect. On warm days hot air collects at the top of the air space. Openings at the top of the cavity siphon out warm air and cooler replacement air is drawn in from the outside. However, without openings at the top of the cavity, offices on the top floors can suffer from overheating due to the accumulation of hot air in the cavity adjacent to their space.

Divided air spaces can reduce overheating on upper floors as well as noise, fire and smoke transmission. Floor-by-floor divisions contribute to the ease of construction of a repeating unit, resulting in economic savings. These corridor façades have fresh air and exhaust intakes on every floor allowing for maximum natural ventilation. Shaft façades (divided into vertical bays across the wall) draw air across the building face through openings, allowing better natural ventilation. However, shaft façades can be problematic for fire protection, sound transmission and the mixing of fresh and foul air.

The design of the air space also impacts cleaning. Continuous cavity applications use either a bosun's chair or platform, similar to a window-washing rig, to access the interior of the space for cleaning. Any louvers that are located within the cavity must be movable to facilitate access. Some air spaces incorporate open grates at each floor level. These permit air flow through the space but provide a platform upon which to stand when cleaning the cavity floor by floor. In a divided air space, the interior windows, whether operable for ventilation or not, will function as access panels for cleaning crews to enter the space for maintenance. Where the air space must be accessed for cleaning, the interior clear dimension is usually in the 600 to 900 mm range. Where the dimensions are small, cleaning is done from within the office space and requires that interior window panels open fully to provide adequate access for cleaning.

One of the chief concerns with cold climate implementation of the double façade system is the potential for buildup of condensation in the air space. It is essential for high volume airflow of warmed air through the cavity to prevent any condensation that may occur.

Different Types of Double Skins In contemporary practice, four primary types of double skin façade system can be identified, each chosen for its unique environmental offerings.

overall double skin. Shading devices can be included in the cavity. One example of this type is the Occidental Chemical/Hooker Building in Niagara Falls, New York, by Cannon Associates. This building allows fresh air intake at the base of the cavity and exhausts air at the top.

Extract air systems are comprised of a second single layer of glazing placed on the interior of a main façade of double glazing. The air space between the two layers of glazing becomes part of the HVAC system. The heated "used" air between the glazing layers is extracted through the cavity using fans, thereby tempering the inner layer of glazing while the outer layer of insulating glass minimizes heat transmission loss. Fresh air is supplied mechanically and precludes natural ventilation. These systems tend not to reduce energy requirements as fresh air changes must be supplied mechanically, and occupants are prevented from adjusting the temperature of their individual spaces. Shading devices are often mounted in the cavity. The space between the layers of glass ranges from 150 mm to 900 mm and is a function of the space needed to provide access for cleaning and of the dimension of the shading devices. This system is used where natural ventilation is not possible--for example, in locations with high noise, wind or fumes.

Twin face systems are currently the most popular. They consist of a conventional curtain wall or thermal mass wall system inside a single glazed building skin. This outer glazing may be of safety or laminated glass or insulating glass. Shading devices are normally included. These systems may be distinguished from both buffer and extract air systems by their inclusion of openings in the skin to allow for natural ventilation. The single glazed outer skin is used primarily for protection of shading devices in the air cavity from weather. Windows on the interior façade can be opened, while ventilation openings in the outer skin moderate temperature extremes within the façade. The use of windows can allow for nighttime cooling of the interior thereby reducing cooling loads of the building's HVAC system. For sound control, the openings in the outer skin can be staggered or placed remotely from the windows on the interior façade. The William Farrell Building in Vancouver by Busby + Associates Architects, and the proposed Centre for Cellular and Biomolecular Research (CCBR) at the University of Toronto by Behnisch, Behnisch & Partner and Architects Alliance, typify the twin face type.

Hybrid systems combine various aspects of the three primary systems and are used to classify systems that do not fit into a precise category. Such buildings have a higher incidence of non-glazed components and may use a layer of screens or non-glazed materials on either the inside or outside of the primary environmental barrier. They may also, like the recently completed Caisse du Dépôt et Placement (CDP) in Montreal by Gauthier, Daoust Lestage Inc./Faucher Aubertin Brodeur Gauthier/Lemay et associés, combine a number of façade systems.

The North American case studies mentioned in this article will be examined in more detail next month.

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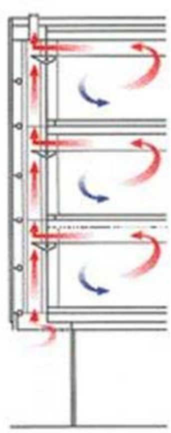
Photos

Larger photo & full caption
File size: 12.2 KB (160px X 241px)
Caption: The William Farrell building uses a twin-face system

Larger photo & full caption
File size: 11.3 KB (159px X 232px)
Caption: The double skin at CDP Capital is a hybrid system



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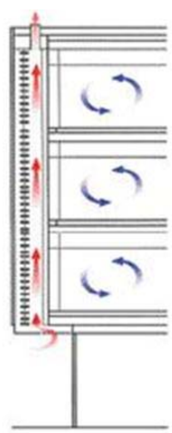
File size: 6.1 KB (102px X 246px)
Caption: The extract air system



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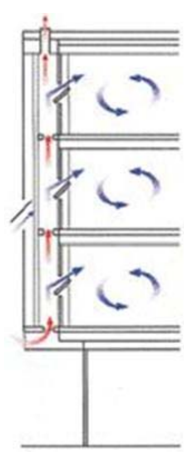
File size: 5.7 KB (104px X 246px)
Caption: The buffer system



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Caption: The twin face system

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