Engineering 2 (2016) 63–68

Contents lists available at ScienceDirect

Engineering

journal homepage: www.elsevier.com/locate/eng

Research
Architecture—Perspective

A New Look at Building Facades as Infrastructure

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ARTICLE INFO

Article history:
Received 21 February 2016
Revised 1 March 2016
Accepted 9 March 2016
Available online 31 March 2016

Keywords:
Building facade infrastructure
Public pedestrian comfort
Building facades for public Health

ABSTRACT

Like the hard surfaces of streets and sidewalks in an urban environment, the vertical and horizontal surface area on the outside of urban buildings contributes to the constant heating of large cities around the world. However, little is done to design this surface to benefit the public sphere. Instead, the facade of a building performs either as a component that focuses only on the quality of comfort for interior occupants, while ignoring effects on the exterior of the building, or as an identifiable aesthetic for the building's owners. This essay proposes the rethinking of the building facade as a steward of outdoor pedestrian welfare, and the conception of public health as an added function of the building envelope—a concept that may fall into the jurisdiction of public works. If the huge total surface area of a city's buildings is thought of as part of the city's infrastructure, then its public contribution may not only make outdoor areas comfortable, clean, and enjoyable, but also help to alleviate the bigger problem of rising temperatures in cities.

1. Introduction: Not just a pretty face

The fundamental physiology of animals, including humans, operates with only one goal in mind—to sustain itself. The main purpose of the body's liminal surface is to moderate the outside environment in order to ensure the efficient operation of what is on the inside. Trees and plants, on the other hand, more selflessly contribute to the earth's climate. Serving the animal kingdom, these life-giving organisms provide many things for others to survive by means such as photosynthesis (synthesizing carbon dioxide and generating oxygen). This altruistic relationship can inform ways in which the built environment maybe developed in a more public-spirited manner. With so many hard surfaces being built in urban areas, more consideration should be put into the potential of these surfaces to actively contribute to the urban climate. Although some designers are already engineering facades to collect energy, respond to the changing environment, and protect the occupants from intolerable situations, the purpose of most urban building facades is to be a "pretty face" to the public eye. However, that same liminal surface can be designed and engineered to do much more, thereby contributing to the common good. Surfaces on the outside of buildings can filter air, clean water, regulate temperature, generate breeze, and contribute to public health. When considered in such a way, the outside of a building may be better categorized as part of a hybridized area of public works, private development, or even public art—or what some may consider to be infrastructure.

2. Background: Self-centric building capsules

The unequivocal warming of the earth's climate is mainly due to an increase in greenhouse gases produced by humans. The crisis caused by burning and depleting our limited supplies of fossil fuels has provoked a critical and wide spread need to generate new sources of renewable energy, as well as viable solutions for zero-energy living. It is sobering to review current statistics that delineate energy consumption in the US; buildings account for roughly 47.6% of all energy usage[†] (Fig. 1), markedly more than

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[†] Source ©2013 2030, Inc./Architecture2030. Data Source: US Energy Information Administration (2012). Available from: http://architecture2030.org/buildings_problem_why/.

http://dx.doi.org/10.1016/J.ENG.2016.01.008
2095-8099/

the usages for industry and transportation. From large-scale infrastructural projects to small-scale houses, heating and cooling consume gargantuan amounts of resources; a situation made clear by the fact that energy usage comprises the single largest expense for commercial office buildings. In many urban areas around the world where there are large areas of exposed urban surfaces, this crisis is exacerbated by the well-documented "heat-island effect." The city's sidewalks, streets, and hard surfaces emit the heat it has absorbed during the day, preventing the city from cooling down at night. The compounding rising temperatures in cities cause residents to turn up the air conditioning, which in turn generates more heat that is sent into the atmosphere and contributes to the vicious cycle of rising urban temperatures. In addition to the need to diminish the use of heating, ventilating, and air-conditioning (HVAC) systems and bring down energy consumption in buildings, urban pedestrian areas are becoming unbearable and must somehow be included in the energy equation.

Prior to the 1900s, buildings were constructed with thick walls and small windows, providing an undeniable separation between interior and exterior. Humanity's natural inclination to commune with nature was superseded by the benefits provided by dense load-bearing walls, which provided natural insulation. The interiors were cool during the summer and warm in the winter with very little heat loss through the small openings. However, with the introduction of plate glass and rolled steel in the 1930s, architects began to design houses with floor-to-ceiling glass exterior walls, introducing the idea that "form follows function"—that is, exposing all building components and spatial functions on the building's facade, in an effort to seek honesty and transparency in design. Along with the undeniable visual, physical, and aesthetic benefits came some less-than-salutary side effects: tremendous heat gain from the penetrating sun, unstable interior temperatures from a lack of insulation, and an irreversible reliance on artificial cooling/heating. As commercial buildings grew taller with the evolution of structural steel and elevator technologies, HVAC systems likewise became more complex, requiring increasing amounts of energy and dispersing tremendous amounts of heat into the atmosphere; and building envelopes were designed to hermetically seal and insulate the interior cavity for excessive levels of comfort. For safety and HVAC efficiency, windows in new commercial structures were made inoperable, making these buildings uninhabitable during power outages and exposing our absurd reliance on energy-consuming mechanical systems and capsule-like building envelopes.

Today, at this critical juncture, the building envelope must be

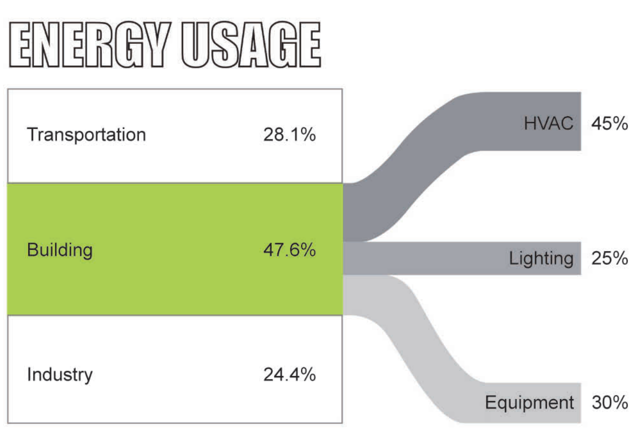

Fig. 1. Because 47.6% of all energy is used by buildings, any reduction or contribution back would make a large dent in overall energy savings. (Image courtesy of DOSU Studio Architecture.)

reconsidered. Architects must conceptualize the building skin as a true mediator between the interior and exterior environments: first, as a potentially responsive system for the purposes of zero-energy human occupation; and second, as a responsible and active participant in its adjacent spaces. Instead of metaphorically turning its back on the urban environment, the outside surface of a building can improve pedestrian thermal comfort, acoustics, reflectivity, air quality, and wind-driven rain to make outdoor areas more comfortable and useful. In addition, because our environment is changing hourly, daily, seasonally, and annually, we need to design building envelopes that are dynamic, responsive, and intelligent.

Rather than simply mimic biologic skins, which selfishly perform as liminal surfaces for the biologic mass within, designers can use technology to progress beyond this concept and make multi-functioning building skins, in which there is virtually no "outside surface," and in which the outside surface can function completely differently than the inside (i.e., with form not following function). Because the surface area of building facades covers huge amounts of square footage—sometimes more than those of streets and sidewalks—building facades are both the culprits and the potential saviors of urban rut. In other words, even though they have contributed to the problem of the heat-island effect in the past, building facades can be repurposed to offset these and other problems in the future. Given the newer technology now available and a greater interest in urban climate, buildings' outer surfaces can filter pollution, promote air circulation, and generate clean water—at most, contributing to the common good of society at large, and at least, making outdoor pedestrian spaces healthier, more comfortable, and markedly more useful. Because the outer surface of a building literally touches the urban environment along its entire perimeter, that same surface has a responsibility to take on a more active role in that arena, in addition to its already self-centered purpose of encapsulating the building.

3. Split personality: Outside surface belongs to the city, inside to the building

High-rise facades have not witnessed a major innovation since Ludwig Mies van der Rohe unleashed the glass-box curtain-wall over 80 years ago. The time is ripe to advance major change, reduce the use of energy, and assume a major role in controlling the urban climate by making the outside surfaces of buildings contribute to urban welfare, public health, and pedestrian comfort. The two sides of a building facade should each perform for the side it faces—one for the inside and the other for the outside. Once this concept takes hold, the perception of what architecture should be or do will change dramatically, and we might witness something like the explosive growth in popularity of the cellular telephone. Telephone technology was stagnant for 100 years before cellular telephones emerged. In a short amount of time, fueled by the invention of digital transmission, the use of mobile devices grew astonishingly fast, leading to a boom in the development of smart devices, positioning systems, and digital applications. It is hard to remember what life was like before cell phones. The same explosive growth can happen with respect to building envelopes.

Building envelope and facade design, currently a hot topic in Europe, will inevitably be influenced by the use of smart and low-energy systems. Thomas Auer of Transsolar KlimaEngineering, the climate engineer for the Manitoba Hydro Headquarters project, has extensive experience and interest in the design of the building envelope. He believes that, on a material level and in addition to self-ventilation, the skin of a building can perform much like a dehumidifier, drawing moisture out the air and even gener-