Chapter 7
Future Perspectives

Logic will get you from A to B. Imagination will take you anywhere.

Albert Einstein.

Abstract This chapter concludes the overall content of this book. The key challenges regarding possible innovations in the building sector are presented from the perspective of the development in materials science, design concepts, as well as tools and services for improved façade management.

The main purpose of a building envelope is to protect occupants from the weather and provide a basic shelter. Nowadays, building façades perform many more functions than in the past, offering security, privacy, comfort, as well as benefits such as aesthetic pleasure and improved well-being. A building façade reflects civic and cultural identity; therefore, we want our homes to be unique and individualized. In fact, façade design can make buildings become iconic and be remembered for centuries. On the other hand, we want to perceive façades as honest and sincere.

The key challenge in designing building façades is meeting the occupant needs while reducing building energy consumption, according to requirements of global policies (OECD/IEA 2013; EPBD 2018). The modern architecture focuses on every stage of the building process. It starts with the design and planning phase, includes construction and building performance, as well as the disposal of building materials. The way building façades are designed is changing. Besides waterproofing, insulation, and aesthetic functions, façade planning includes energy efficiency, which adds another layer of complexity to the design process. Forthcoming developments regarding building façades are related to the innovation of materials, alternative design, and facilities enabling essential functioning and operation.

Building envelopes should guarantee functional and aesthetic performance. Technological development is constantly bringing to the market materials enriched by new technologies that can reduce the environmental impact, while improving health and safety. New materials (both cladding and insulation) and construction methods (prefabrication and modular system) enable a fast and accurate construction process. Bio-based products have the advantage of a significantly lower

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embodied carbon manufacturing profile than steel or concrete, with the added benefit of carbon sequestration. Mass timber in tall building applications is under investigation as an alternative to steel and reinforced concrete structural systems, with feasible options already at a height of 40 stories and above (Larasatie et al. 2018). Using bio-based building materials in the building sector moves the traditional building concept towards the green architecture. In fact, green buildings have become one of the most important and progressive trends in the building industry during the last 20 years (Jadhav 2016). In this perspective, environmentally friendly materials originating from plants or animals (e.g., wood, bamboo, cork, hemp, flax, straw, sheep wool, seaweed, mushrooms hyphae) are in great interest of architects.

Sustainable construction principles require the use of local materials and products. An example might be the Living Building Challenge certification programme and sustainable design framework that require a certain percentage of building materials to be originated from within a certain distance to the construction site (Brown 2016). Due to their versatile character, bio-based materials enable creating buildings adapted to any local context. Different natural materials usually look good together even if having different form or patterns (Kotradyová and Teischinger 2014). Thus, biomaterials give an impression of being suitable for any context. Examples of a rustic and modern architecture being in synergy with the environment are presented in Fig. 7.1.

As static structures, traditional buildings remain the same for decades, interacting with their occupants and the environment in limited ways. Sustainable design aims to create buildings that respond to the environment and react to climate changes. In addition, it focuses on living conditions, resulting in regenerative, restorative, and adaptive buildings. Restorative architecture is the next stage of green architecture. Here, a building gives more to the environment during its lifetime than it takes away during the construction. Instead of focusing narrowly on the building design, such buildings tend to integrate with the natural environment while being environmentally friendly. When optimizing orientation, shape, and layout of buildings, we should consider both, needs of society and relationship with the environment. Humans are inherently drawn to nature; however, urban

Fig. 7.1 Wooden buildings designed in rustic and modern style well fitted in mountain landscape Photograph courtesy of Paolo Grossi (left) and Accsys (right)

Fig. 7.2 Different approaches for connection with nature. Duna Building (Bergen School of Architecture, Slovak University of Technology in Bratislava), photograph courtesy of Veronika Kotradyová (left) and Romanian Pavilon at the World Expo 2000, arch. Doru O. Comsa, 2000 (right)

environments are disrupting this relationship. Biophilic design encourages this affinity by creating natural environments for living, working, and learning. By consciously including natural materials in interior or architectural design, we are unconsciously reconnecting to nature (Fig. 7.2).

According to the World Health Organisation, stress-related illnesses (e.g., mental health disorders and cardiovascular disease) will be the largest causes by 2020 (Vigo et al. 2016). Using wood as an exposed material in buildings where humans can interact with it is known to create positive psychophysiological effects for building users. Incorporating nature into the built environment, either directly (e.g., potted plants) or indirectly (e.g., tree-like columns), can reduce physiological and psychological indicators of stress, while increasing productivity, creativity, and self-reported levels of well-being (Mcsweeney et al. 2015). Research in this area provides an evidence base of positive health impacts of wood use in the built environment (Burnard and Kutnar 2015). One emerging area in this research field is Restorative Environmental and Ergonomic Design (REED), a building design paradigm that can provide guidance for wood use in buildings to improve human health (Burnard et al. 2016). Integrating nature into the built environment, by enabling views of nature, by using natural materials (especially local materials), and by reflecting local ecology in building design and use, is thought to improve building users' perception of the natural environment and therefore motivate them to care for it (Derr and Kellert 2013). REED is integrating frameworks for improving occupant and user health, increasing safety, and improving building management. This represents a shift in building design (and neighbourhood/community design) from minimizing environmental harm towards creating positive impacts for the natural environment, building users, and society in general.

Bio-based building materials fit very well with the general concept of minimizing the amount of waste based on the "reduce–reuse–recycle" paradigm. Reused engineered solid wood products are a highly valuable source of construction materials following cascade use principles. Moreover, such architecture design directs public attention towards the benefits of a low-waste, circular economy. Material reuse and recover are linked not only to the recyclability of individual products but also to the construction techniques that enable fast disassembly (Casini 2016). Sustainability in this perspective is achieved by using smarter materials, optimizing design and layout, and reducing long-term maintenance costs and recovery of materials at the end of their service life. Therefore, durability, sustainability, and low-maintenance will continue to be factors that influence the selection of exterior materials.

Innovation in architectural design requires applying new design strategies and new project delivery methods. Progress in information technology, sensors, and computation transforms design processes and procedures, delivery methods, as well as fabrication and construction methods (Aksamija 2016). Computational performance-based design, building information modelling (BIM), simulations, virtual construction, and digital fabrication are transforming contemporary architecture practice. Building information modelling (BIM) is a design procedure that includes the administration/management of the digital representation of physical objects composing the planned building (structure, sub-structure, installations, and systems). The general idea resembles the concept of the “Internet of Things”, where every physical object has its virtual representation, with the difference that BIM is used to design and plan buildings. BIM files enable storing and exchanging the information, and—what is the most important feature—the networking on the project. BIM systems are utilized by individual designers, organizations, and government offices. In the context of material ageing, BIM is a very powerful tool that makes it possible to examine potential changes in material properties and appearance and plan future maintenance. Ongoing research aims to expand BIM specifications to include object performance data, environmental impact data, and health impact data, among other expansions. Consequently, new functionalities, such as 4D (construction sequencing), 5D (costs), 6D (sustainability), and 7D (facility management), provide new complementary extensions of the BIM utilities.

Progress in material science and new concepts in the building design phase create a vast amount of multidisciplinary technological knowledge regarding building façades. The development of new technologies and concepts should be supported with multi-scale characterization methods at a component level. This should be followed by whole-life evaluation methods at the building level and building/user integration. The most promising concepts should be identified and disseminated between the different stakeholders in the façade industry and the academia. Finally, lifelong training programmes for future generation of architects and designers should be implemented in order to bring new design concepts into existence.

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