Journal of Cleaner Production 182 (2018) 187–197

Contents lists available at ScienceDirect

Journal of Cleaner Production

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

Well-being, health and urban coherence-advancing vertical greening approach toward resilience: A design practice consideration

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ARTICLE INFO

Article history:
Received 9 August 2017
Received in revised form
31 October 2017
Accepted 23 December 2017

Keywords:
Vertical greening
Well-being
Design practice
Resilience
Urban coherence

ABSTRACT

The approach for urban coherence requires a rigorous and comprehensive understanding of available adaptive practice toward resilience and sustainability in the urban centers. We ascertain that this calls for swift restorative actions to amend the ecology damages with the incorporation of 'greening' elements as available methods of environmentally sensitive, innovative practices in bridging the fields of ecology, horticulture, architecture and environmental tools to the natural restoration of the urban damages, hence the purpose of this study.

The theoretical frameworks, including sustainability, resilience, adaptive practice, may be helpful when considering urban resilience. We suggest that all of the considerations should cooperate through the practical implementation. Given this, design consideration to vertical greening for urban sustainability may be categorized as those: (1) the enhancement with vertical greening in urban setting, whether in the interior or exterior environment, can aid in the regenerative role toward the restoration of the urban ecological landscape; (2) the recent progress on smart building technology further enhanced the management for comfort, biodiversity and well-being benefits of vertical greening; (3) ideas and practices permutations of the systemic design possibilities for vertical greening contribute to the resilience of the urban core; (4) the outcome focuses on the design thinking process into the practice of vertical greening aimed for sustainable conscious architecture, advantageous on their potential for human's well-being and health, at the same time, being feasible for amelioration of our urban microclimate condition, opportunity and threats; together, they contribute toward the sustainability for the future of urbanity.

1. Introduction

Sustainability is a process, not an outcome (Childers et al., 2014), and includes a normative, socially firm set of implemented targets. On the advent of a new 'urban millennium', it is estimated that by 2050, two-thirds of the world population will be living in the urban area (UN, 2015), mostly in isolation from Nature. The global urbanization process had blazed thru the urban systems expanding the boundary of densely packed population settlements and urban infrastructures. Moreover, the fourth assessment report on the Intergovernmental Panel reported that climate change has caused the global average temperature during 1995–2006 to increase, and heavy rainfall events have become much frequent. Further, the 2015 UN Global Report on Human Settlements, by the United Nations Centre for Human Settlements (UN Habitat) called for the focus on the planning of socially inclusive, resilient, economically prosperous and energy-efficient cities (UN, 2015). Thus, the stature of Architecture needs to incorporate innovative ideas and experimentation that explore purposeful design through the incorporation and redefinition on traditional paradigm into sustainable urbanism and consider the urban-rural gradients, urban mass and energy budgets supporting the "ecology of cities" to integrate the social and natural practices (Revell and Anda, 2014; Pickett et al., 2016) toward the resilient sustainable urbanity.

Due to the high cost of imported energy cost and heavy dependence on mechanical cooling practice in Taiwan, the heat island condition in the urban centers has deteriorated the urban microclimate environ, causing discomfort to the urban lifestyle (Hsu et al., 2011; Liao et al., 2015; Peng, 2013; Sun, 2015); the recent

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https://doi.org/10.1016/j.jclepro.2017.12.207
0959-6526/

of power shortages scare aggravated the island's social and economic status even further. Sustainable development requires the consideration of the whole host of interconnected elements such as resilience and adaptive practice. Taking into consideration the need to reduce energy and water consumption with the use of environmentally friendly materials (Johnston and Newton, 2004), the proposal for a feasible strategy is the practice of passive design with green renovation or design solutions (Lin and Ling, 2013). The consideration and practice measures contribute to the urban coherence and ensure the future resilience capacity (Ling et al., 2017).

As the complexity of the urban environment evolves, design patterns need to include vegetation and other measures to improve the urban micro climate and comfort conditions (Yahia et al., 2017). We argue that the placement and functionality of walls and vertical greens should be considered since they are the connecting elements that directly link the interior to the exterior of buildings, defining the form of the cities thru the expression of the settlements and shape the urban morphology. Walls further their decisive commander defined thru the building boundary and interior spaces as the effective barrier for settlement to keep out intruders. Their role as an intermediary media in engaging communication with the urbanscape, in a way, permit the initiative to the rehabilitation of the urban green scape. Vertical greening can not only be applied to beautify city landscape but also to promote the development of sustainable environment (Ahern et al., 2014; Steiner, 2014; Abkar et al., 2011; Maas et al., 2006). Thus, the concept of bringing greenery closest to residents, and at the same time, strive for a sustainable ecology should be present in the design thinking of architecture per say.

This study aims at exploring the consideration of vertical greening in architecture as an active contributor to sustainable ecology. The practice should go beyond the obligatory legal statutes and begin to consider urban resilience as an important variable in the process of design. The first part discusses the experimental project with wall thermal improvement and regenerative drivers for vertical green followed by its role as active contributor for the urban sustainability; finally, we concentrate on the discussion and conclusion of possible partake of vertical green in the regenerative role of urbanity resilience in the wake of climate change risks in the urban centers.

2. Material and methods

The design of building then should take active consideration of the urban island heat effect prior to the finalization of the building on sites. This paper presents an exploratory research on the local design consideration for the vertical green approach. We begin with an experimental project on the field, the first stage is to examine for thermal consideration of wall system prior to any vertical green; the second stage will be to determine the effect of various vertical green impact on the urban microclimate. This section begins a discussion of the study area and further review of the literature to determine the direction for the design consideration of vertical greening approach to urban resilience and sustainability.

2.1. Study area

Taiwan is characterized with a subtropical climate. The industrialization promoted the rapid increase in energy use in Taiwan. Most urban buildings in Taiwan are equipped with an air conditioning unit or system, since most residents prefer to use air conditioning as way of cooling the interior; the heat then, is removed to the exterior. On a daily basis the air conditioning load accounts for around 40% of the energy consumed in a typical building, while lighting accounts for another 35%. The cooling load is the main cause for summer peak power demand. Approximately 70% of Taiwan's population lives in cities and the dependency on electricity has up-scaled in recent years (Fig. 1). The dependency on mechanical cooling compounded with inadequate thermal insulation construction methods have caused a tremendous rise to the urban heat island phenomenon and in the health and well-being concern to the inhabitants. . Majority of residential buildings are built of reinforced concrete or masonry construction, characterized for their heat conducting ability with low thermal resistance. Due to the building ageing process, 97% of the buildings are considered as built-up, and their existence generally does not meet the ecological needs (Peng, 2013; Peng and Lin, 2015). With the expansion of the urban scale, the urban heat island effect has become increasingly significant (Liao et al., 2015). The production and increase of urban heat waves affect the health, mortality and air pollution (Vaezizadeh et al., 2016). To reduce the heat impact and increase cooling insulation, most of the cities rely on greening project through landscape engineering (Lee and Chuang, 2017), therefore, passive and resilient practices toward mitigating urban heat should be explored.

Though site greening strategy has been adopted as one of the nine indicators of green building measure, the buildings in Taiwan rarely accommodate such measure due to the lack of space and increases in construction cost. The indicators are related with the greening increase, biodiversity and site water design. With the current standstill in the local traditional design and construction practice, research indicated that green walls are capable of reducing wall surface temperature effectively b y 10–14° C and indoor temperature by 2.0–2.4° C (Lin and Huang, 2013). Issues of vertical greening could be applied to rehabilitate the current urban condition.

Several studies categorized the building type by construction date or building typology (Lin and Ling, 2013; Peng, 2013; Peng and Lin, 2015); however, when dealing with vertical greening, we argue that it should follow the vertical wall construction method. This study characterized the typology as follows: (1) traditional wood, masonry or clay construction, characterized by buildings built at least 30–40 years; (2) buildings above 5 stories, with concrete construction and tiled on the exterior surface, which accounts for at least 60 percent of the buildings in urban centers; (3) High rise above 6-7 stories, steel-reinforced concrete with either tile or stone cladding on the exterior of wall system. The government has allocated funding for façade renovation or “wall facelift” for older buildings. This could be combined with the practice of green wall as part of the government incentives. In lieu of climate change and the

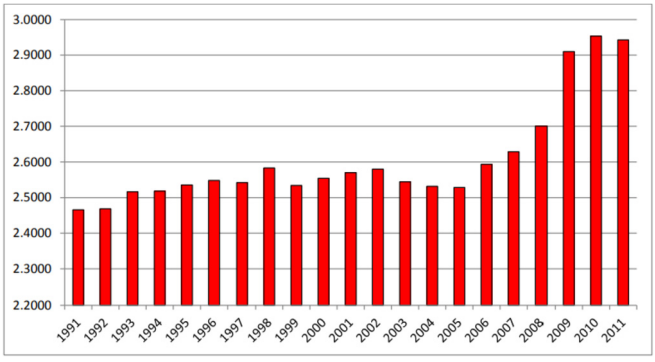

Fig. 1. Historical electricity prices by year in Taiwan, R.O.C. Unit: N.T.$/KWh (Taiwan Power Company, 2012).