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Contextualizing green building rating systems: Case study of Hong Kong

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ABSTRACT

The paper reports on a research study undertaken on the differentiation of green building certification systems at an international, national and local level. Through a cross comparison, authors are able to explain the differences by the contextualism theory which could be traced back to the fundamental divergence on lifestyles, preferences, urban morphology besides climatic variations. The discussion is derived from a study of three green rating systems representing international, national and local systems with reference to intentions, mechanisms and benchmarks to facilitate objective assessments. For the case of Hong Kong, local challenges are identified and compared with counterparts at a national level. Two residential projects having certified by the ‘modified, localized’ national system is selected for a case study for synopsis with a view to explain the cause and effect of transferability versus non-transferability of assessment credits and protocols. Introducing and applying national and international systems to a local context can detect flaws in local design practices that may be ignored in the local rating system.

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Introduction

Countries and cities have started to launch and implement green building schemes and policies that centered upon a building rating or assessment system, a tool that rates the performance of a building according to a specified set of criteria that usually covers site, water, material, energy and indoor environment quality and other attributes of sustainable design. Aiming to identify priorities for sustainable design, to frame environmental information, and to create a body of information about the impacts of buildings on the environment, the green building assessment systems are a type of indicators revealing key characteristics of important subsystems and elements of concern. As shown in Fig. 1, the green building rating systems usually cover from global environmental impacts to indoor impacts (Burnett, 2007). In recent years, these systems are expanding to assess neighborhoods, communities and cities (Sharifi & Murayama, 2013). Understanding the green building rating systems is of great importance for urban planning and design (Retzlaff, 2008). Buildings are an important part of the sustainable development and their environmental, economic and social impacts on cities are obvious. Although the environmental concern in urban planning is being given increasing attention, it remains secondary to economic and social priorities. Green building assessment systems rank environmental performance relative to typical practices, design codes, planning and engineering standards. Thus these rating systems can provide evidence for planning or policy system to judge the sustainability of buildings and to reduce the chance of arbitrary decisions (Yudelson, 2008).

The Building Research Establishment Environmental Assessment Method (BREEAM) — developed in the United Kingdom in 1990 — was the first to address a broad range of environmental issues in a single tool. Since then, there had been a rapid increase in the number of methods throughout the world and a corresponding increase in research on building assessment systems. Some renown assessment methods or tools are U.S. Leadership in Energy and Environmental Design (LEED), Hong Kong Building Environmental Assessment Method Plus (BEAM Plus, formally known as HK- BEAM), Japan Comprehensive Assessment System for Built Environment Efficiency (CASBEE), and China Green Building Label (GBL). The existence of the wide variety of building assessment systems provides evidence that no single system has emerged as the green building industry standard in the world (Cole, 2006). Benefits may come from the existence of so many different
systems; for instance, multiple systems in practice in the same country can act as a driver for innovation. However, they might also confuse the market by sending mixed messages, and they require design professionals to be familiarized with multiple assessment methods. Furthermore, duplication and overlap among various systems and a lack of transparency and implicit assumptions can make choosing among the various systems difficult and costly (Cole, 2006).

On the one hand, building rating systems need a standard set of criteria so that the same system can be used multiple times to be able to evaluate buildings and to have consistent results; on the other hand, much criticism has been levied against the standardized criteria and their requirements for lack of addressing local or regional issues, goals and contexts. Early adaptation of building assessment systems to local and regional conditions was addressed in 1998 at the Green Building Challenge Conference (Cole, 1999). Several considerations for adaptation were proposed, for example, assessing building energy consumptions relative to standard local codes and usage and rewarding higher levels of performance on water or materials in specific regions where these resources are lacking or unavailable. A tendency of re-developing green building rating systems was seeking more opportunities for locally developed weighting especially in those developing countries where advanced building assessment tools were absent. For example, a hypothesis-based study has been conducted using LEED as a reference, to measure green performance of Qatari buildings in accordance to the current needs of Qatar and its future plan (Ibrahim, 2012). BREEAM, LEED and CASBEE were considered as a starting point for the development of an effective environmental assessment method intended for the establishment of environmental assessment method suited to Saudi Arabia (Alyami & Rezgui, 2012).

International or national building assessment systems can provide a starting point for localities interested in developing more contextual systems, can enhance compatibility of sustainable building products, and can set targets for green buildings and demonstrate what may be possible if barriers to green building are removed (Todd, Crawley, Geissler, & Lindsey, 2001). They also provide access to third-party reviewers so localities do not need to review and certify the green achievements. Adaptation of international and national building assessment systems to local contexts, therefore, is a cost-effective way for cities or regions to implement green building programs if they do not have developed a system, or to underpin current green building policies if the market is accommodating for co-existence of different systems.

Objective

Adaptation of building assessment systems to local contexts is a key area of impact that researchers can achieve in green building development. While some systems have developed methods to adapt to local climatic and environmental conditions, they still have not tackled the problem of adapting to social, economic, and technological conditions. This article aims to help move forward the discussion of how to provide more context considerations in these building assessment systems through using a national green building rating system (GBL) in Hong Kong context to underpin co-existence of different green building labels.

With the rapid globalization, there is a trend to standardize these rating systems and to make them interchangeable for a larger scale of green building market. Research is needed to identify potential barriers and possible solutions to support this green building revolution. Many countries and cities have not developed their own systems. Introducing a relevant one is cost-effective. The article is a demonstration of how to tailor national or international building rating or assessment systems to local contexts. Another important motivation for this article is that green building rating systems are usually based on local standards and practices, and that they are likely to be ignorant of global or national sustainable design practices. Introducing and applying national or international rating systems can expose underlying limitations of local practices and push green building design forward.

The main body of this article is arranged as follows: first of all, three main different green labels are selected and compared based on intentions and capacities of defining sustainability: LEED as an international label, GBL as a national label, and BEAM Plus as a local label; second, local challenges in Hong Kong are discussed for planning and designing green buildings; third, GBL is selected as a base for demonstrating revision and adaptation to Hong Kong context; fourth, two residential projects are certified by the revised and localized GBL to verify its suitability and effectiveness; finally, implications for contextualizing green building rating systems are discussed.

Comparison

Green building rating systems are usually run by tertiary institutes who certify that the building meets the criteria. The systems typically work by awarding points for identified criteria. Many systems require a minimum amount of points or credits for each category with prerequisite or control credits, general or regular
credits as well as optimal or premium credits. Different levels of benchmark are based on the number of points that a building or development accrues (Gou, Lau, & Prasad, 2013).

For Hong Kong, the main green building rating system is BEAM Plus (formally known as HK-BEAM). From 1996 to 2012, nearly 200 projects are registered or certified by BEAM (www.beamsociety.org.hk). However, the market is quite free and open for any international or national green labels. From 2008 to 2012, LEED certified 17 projects and trained nearly 590 LEED Accredited Professional or Green Associate in Hong Kong (http://www.usgbc.org/LEED/). From 2011 to 2013, China GBL certified 6 projects and trained 101 green managers in Hong Kong (www.cngb.org.cn). Meanwhile, other green labels such as Singapore Green Mark and UK BREEAM have certified some projects in Hong Kong. In this article, LEED, GBL, BEAM Plus are compared to respectively represent international, national and local labels for Hong Kong. The three systems all have controlling or prerequisite credits that should be first completed before a building is to be evaluated, general or regular credits that are optional for classifying green buildings into different levels, as well as premium or optimum credits for additional credits.

Table 1 compares scoring and ranking systems for the most recent versions of the three labels. A shown in Fig. 2, these systems share a similar coverage mentioned in Fig. 1. However, these categories are weighed differently according to their priorities and these credits are technically different. LEED highlights public transport and low emitting vehicles, and energy and water reductions. In U.S., 28.1% of total carbon emissions come from the transportation (USGBC, 2009). Huge private car ownership and low density highlight the significance of public transport to designing a green building. However, this is less significant in Hong Kong (Hui and Yu, 2013) where over 90% of the daily journeys are on public transport, making it the highest rate in the world (Lam, 2003). While in Hong Kong, public health and ventilation attract more attention since SARS (Severe acute respiratory syndrome) (Wong et al., 2009). Correspondingly, BEAM Plus underscores an efficient and healthy building for users. In China, green building development is deeply related to national policies such as the “eleventh five-year plan” which advocated a society of “saving”. Thereby, “saving” is the key word of the China green building label: saving land, energy, material and water. In sum, the three systems share similar categories that embody universal consensus on a green building. However, under each category, they have different credits to reflect regionalities and intentions.

For the category of “Site”, three basic aspects define a sustainable site: the first is sustainable site planning that refers to site selection, habitat protection, connectivity to basic services and public transits, encouraging bicycles and low emitting vehicles, etc.; the second is sustainable landscape design requiring native or adaptive plantation, and sufficient greenery and open spaces for reducing urban heat island and increasing rainwater precipitation; the third is outdoor environmental quality referring to controlling noise and lighting pollution, improving outdoor thermal comfort, and reducing energy load for indoors. The three systems have different quantitative requirements for these aspects. For example, in the aspect of connectivity to basic services, LEED requires 10 services within 805 m; GBL requires 8 within 500 m; BEAM Plus requires 10 within 500 m. The difference is due to different basic population distribution and density conditions in these areas.

For the category of “Water”, they have similarities on how to save water in buildings. But they have different quantitative water reduction rates. For example, LEED requires 20% water reduction; GBL and BEAM Plus require 10%. LEED has a more stringent threshold for the water reduction rate. Efficient landscaping by using adaptive plants or rainwater for irrigation is a significant part for water saving strategies in these tools. The three tools identify different quantitative methods for calculation of water consumptions. For example, LEED sets 6 L per flush for toilets; while the default values in GBL and BEAM Plus are 6.6 L per flush and 7.5 L per flush, respectively. The variance reflects different industry practices in these areas.
For the category of “Energy”, the three systems have two basic aspects: building energy efficiency and renewable energy use. However, the three systems base energy efficiency on different standards. For example, LEED uses ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) standards; GBL uses national standards for different climates in China (such as Hot-summer and Cold-winter, Hot-summer and Warm-winter, and Severe Cold and Cold); BEAM Plus uses ASHRAE standards as well as a local standards such as Performance-based Building Energy Code from EMSD (Electrical and Mechanical Services Department). These standards or codes similarly use a baseline to compare proposed design. However, their baselines are quite different, and the credit scales are varying amongst the three rating systems. Through an energy modeling comparison of two office buildings in Shanghai, it is found that the yearly energy saving of the proposed design was approximately 27% from GBL system and 21% from LEED (Pan, Yin, & Huang, 2008). Another comparison study of energy performance requirements across LEED, BREEAM, BEAM Plus, GBL, etc. confirmed that LEED was more stringent in terms of default parameters in comparison with the other systems (Lee, 2012). However, no matter how sophisticated these energy performance ratings, they may be unlikely to reveal actual performance in use (Gou, Prasad, & Lau, 2014). Therefore, the results should be carefully explained.

The category of “Material” aims at reducing, reusing and recycling building materials from a life cycle perspective. LEED and BEAM Plus encourage using rapidly renewable materials such as bamboo and certified wood or timber exploited and produced in a sustainable manner; while GBL does not have such credits. On the other side, many credits such as endurable and high-performance structure adopted by GBL are rarely mentioned in other two systems due to the fact that these technologies are popularly used in building practice in U.S. and Hong Kong. These dissimilarities show the different levels of building product standards and construction technologies between developing and developed areas.

The category of “Indoor Environment Quality (IEQ)” encourages a healthy working and living environment by natural ventilation, low emitting materials, natural light, etc. However, the three systems use different standards to calculate and measure the performance of each aspect. LEED and BEAM Plus use ASHRAE standards while GBL uses national standards. The IEQ variables such as temperature, air speed settings, etc. are varying amongst these systems and these differences reflect different design practices and office cultures (Lee & Burnett, 2008).

**Hong Kong context**

Hong Kong is a special administrative region (SAR) of the People's Republic of China (PRC). It is situated on China's south coast and, enclosed by the Pearl River Delta and South China Sea. With a landmass of 1104 km² and a population of seven million people, Hong Kong is one of the most densely populated areas in the world (Census and Statistics Department, 2007). There are three significant challenges for Hong Kong to develop a green project.

The first challenge is high dense urban morphology. Hong Kong is one of the most densely populated areas in the world. As much of Hong Kong’s terrain is hilly to mountainous with steep slopes, less than 25% of the territory’s landmass is developed, and about 40% of the remaining land area is reserved as country parks and nature reserves (Lau, Gridharan, & Ganesan, 2005). The ultra high density results in limited space for greenery and renewable energy development, and limited access to sunlight and daylight (Gou & Lau, 2012). Excess exposure to noise is another environmental issue in Hong Kong (Lau, 2002).

The second is intensive use of air-conditioning and artificial lighting. Studies repeatedly showed low indoor air temperature settings (Chung, 1993, Chung & Tong, 1990; Hogg, 2005; Hong Kong Government, 2008) and high lighting power density (Lee & Yik, 2002) in Hong Kong. The humid and hot climate plus urban heat island causes intensive dependence on air-conditioning from April to October (Lau & Yang, 2011). What’s worse is that there is no thermal performance requirement for residential building envelopes (Lam, 2000).

The third is lack of concern for water saving. Eighty percent of the territory's fresh water comes from Guangdong’s East River. Low water price causes unawareness of water saving (Wong, Zhang, & Chen, 2010). Hong Kong people use more water per capita than all other major cities in the world, according to the International Statistics for Water Services by the International Water Association Specialist Group on Statistics and Economics. Looming water shortages and the need to manage our water resources are worldwide concerns. Although the annual rainfall in Hong Kong is about 2200 mm, the geology of Hong Kong that is dominated by hard granite base makes development of groundwater impossible. Besides, the mountainous territory of Hong Kong results in extremely difficult collection and storage of rainwater (Woo, Wong, Heng, & Che, 2012).

The natural and man-made situations significantly handicap green building design and construction. Analogously, every city has its unique natural and man-made contexts and situations that to different extents challenge green building development. However, current green building labels or systems are developed in a top-down manner addressing specific national or regional values, which inevitably ignore local context.

**Revision and contextualization**

Most of green building rating systems are developed by a panel of experts and stakeholders. This also applies to this revision. The revision was conducted by a scientific panel consisted of experts from China Green Building Council who official assessed the GBL as well as local professionals who proposed a set of suggestions and comments. The experts were selected based on their expertise on each categories (site, water, energy, material and indoor environment quality) and the local professionals were selected from local architectural and engineering consultancy companies. Totally, 12 experts and stakeholders were involved in this revision. The revision stringently followed the structure and principles of the GBL. The total number of credits remained the same and the objective was consistent with the base assessment tool.

At the beginning, strategies and questions were put forward for discussions (Table 2). The aim of this discussion was to find out how to address these challenges in the checklist and credit-endorsing system. Delphi methodology was used to instruct this discussion. The Delphi method is a consensus-building tool to promote and encourage involvement from all stakeholders during the evaluation framing process (Dalkey & Helmer, 1963). A Delphi study aims to engage a large number of experts and stakeholders in a process of coming to agreement without necessitating their leaving their usual domain. The Delphi method was frequently used in making environmental assessment frameworks or selecting indicators. There were three rounds of discussion. In the first round, different opinions and suggestions on the questions were collected. These opinions and suggestions were categorized into several key solutions for the revision. The most frequently mentioned solutions for the raised questions referred to adjusting credit types (prerequisite, general, and optimum credits), combining local and national standards, and raising or lowering the thresholds to different extents. In the second round, the panel members voted for their
preferred solutions in more quantitative ways and explained the reasons. In the third round, the solutions with the highest votes were sent out for final agreements. The discussion lasted for one week.

Table 3 summarizes some important revisions and adaptations based on the Delphi focused-group discussion. Most revisions is fine-tuning of the GBL requirements using counterparts in the BEAM Plus as a reference. For example, in the credit for outdoor wind speed, GBL mainly concerns the upper limit of the wind speed (5 m/s) for pedestrian comfort; while BEAM Plus is concerned with the lower limit of the wind speed (1.5 m/s) for ventilation. The revision combines them to form a wind speed range (1.5 m/s–5 m/s) for a comfortable zone which takes into account both the need for ventilation in high-dense environments as well as the control of wind amplification that refers to the high wind speed at pedestrian level caused by high-rises.

### Certified projects

The revised rating system mainly applied to the design stage for a star-rated green design label. Two public residential design schemes were selected for the verification. There are three major

![Table 3](image)

| Categories                  | Strategies | Questions |
|-----------------------------|------------|-----------|
| **Outdoor Environment**     | Lowering the requirement for greenery ratio, sunlight access, urban heat island and outdoor noise environments | How much should be lowered to retain the threshold for a green building while applicable in Hong Kong? |
| **Energy Saving and Utilization** | Considering local design practice | How to take into account local design practice? |
| **Water Saving and Utilization** | Lowering the requirement for renewable energy uses | How much should be lowered to retain the threshold for a green building while applicable in Hong Kong? |
| **Indoor Environmental Quality** | Encouraging water saving | How much water saving should be raised to encourage water saving while applicable in Hong Kong? |

![Table 2](image)

| Categories                  | Strategies | Questions |
|-----------------------------|------------|-----------|
| **Land Saving and Outdoor Environment** | Lowering the requirement for greenery ratio, sunlight access, urban heat island and outdoor noise environments | How much should be lowered to retain the threshold for a green building while applicable in Hong Kong? |
| **Energy Saving and Utilization** | Considering local design practice | How to take into account local design practice? |
| **Water Saving and Utilization** | Lowering the requirement for renewable energy uses | How much should be lowered to retain the threshold for a green building while applicable in Hong Kong? |
| **Indoor Environmental Quality** | Encouraging water saving | How much water saving should be raised to encourage water saving while applicable in Hong Kong? |
Table 4: Key Performance Indicators for the two residential developments.

| Indicator             | Unit | Case 1  | Case 2  |
|-----------------------|------|---------|---------|
| Building footprint    | M²   | 34,700  | 43,000  |
| Gross Floor Area (GFA)| M²   | 232,000 | 26,000  |
| Population            | People | 13,020  | 11,000  |
| Percentage of underground floor | % | 22.78 | 0.00   |
| Percentage of pervious area | % | 29.50 | 35.60  |
| Percentage of non-traditional water use | % | 40.93 | 41.72  |
| Percentage of recyclable materials | % | 7.74  | 0.088   |
| Percentage of reusable materials | % | 0.00  | 31.24   |
| Greenery ratio        | %    | 29.52   | 31.24   |
| Percentage of renewable energy use | % | 2.23  | 2.4     |

reasons for selecting the two public housing developments: first, public housing accounted for 60% of the new housing production in Hong Kong (Hong Kong Government, 2013); second, green design has been always addressed in the public housing development for saving energy cost and other resources (Fung et al., 2011); third, the selected two projects are green demonstration projects in the public housing sector in recent years. Table 4 illustrates key indicators for the two residential developments.

The certification process has two steps. In the first step, the project stakeholders consisting of the architects, engineers, developers, and other consultants conducted a preliminary self-certification to find out how to revisit their design schemes to pursue maximum scores. After carefully revisiting the design scheme and preparing supporting documents, a workshop was held by China Green Building Council to go through the design schemes credit by credit. Finally, the credits and their supporting documents (Table 5) were approved by the Council. Both of the two projects were awarded the three-star design label, the highest level in GBL. However, as shown in Table 5, neither of the two projects satisfied the credit for sunlight and daylight access, the credit for

Table 5: Credits for the two residential projects.

| Categories                 | Credits             | Types          | Assessments                                                                 | Case 1 | Case 2 |
|----------------------------|---------------------|----------------|-----------------------------------------------------------------------------|--------|--------|
| Land Saving and Outdoor Environment | Site Ecology  | Control | Approved Planning Brief, Environmental Monitoring Report, etc. | Yes    | Yes    |
|                            | Site Safety        | Control | Environmental Assessment Report, Site Photos, Outline Zoning Plan, etc. | Yes    | Yes    |
|                            | Land Use per capita| Control | Approved Planning Brief, Calculation on Population Density, etc. | Yes    | Yes    |
|                            | Local Plants       | Control | Landscape Plan, Plant Species, Soil Plan, Green Coverage Calculation, etc. | Yes    | Yes    |
|                            | Greenery Ratio     | Control | De-odouring System Plan, Layout of Activated Carbon/Chemical Filters, etc. | Yes    | Yes    |
|                            | Public Services Access | General | Approved Planning Brief, Master Layout Plan, etc. | Yes    | Yes    |
|                            | Sunlight and Daylight Access | General | Master Layout Plan, Sunlight and Daylight Analysis Report, etc. | No     | No     |
|                            | Noise Control      | General | Acoustic Consultancy Report, etc. | Yes    | Yes    |
|                            | Outdoor Comfort    | General | Microclimate Consultancy Report, Air Ventilation Assessment Report, etc. | Yes    | Yes    |
|                            | Biodiversity       | General | Landscape Layout Plan, Plant Species, etc. | Yes    | Yes    |
|                            | Public Transit Access | General | Approved Planning Brief, Master Layout Plan, etc. | Yes    | Yes    |
|                            | Pervious Paving    | General | Green Coverage Calculation, Pervious Paving Catalog, etc. | No     | No     |
|                            | Brownfield Redevelopment | Premium | Environmental Monitoring Report, Environmental Assessment Report, etc. | No     | Yes    |
| Energy Saving and Utilization | Urban Heat Island Control | Premium | Microclimate Consultancy Report, Air Ventilation Assessment Report, etc. | Yes    | Yes    |
|                            | Thermal Performance | General | Thermal Performance Report, etc. | No     | No     |
|                            | Passive Design     | General | Simulation Report for Natural Ventilation, Daylighting, etc. | Yes    | Yes    |
|                            | Equipment Efficiency| General | Energy Certificates for Lift, Lighting, Air-conditioning, etc. | Yes    | Yes    |
|                            | Lighting Efficiency | General | Lighting Control Plan, Energy Certificates for Lighting, etc. | Yes    | Yes    |
|                            | Renewable Energy   | General | Photovoltaic Panel Specification, Layout, Simulation, etc. | No     | No     |
|                            | Air-conditioning Consumption | Premium | Energy Simulation Report, etc. | Yes    | Yes    |
|                            | Energy Saving and Efficiency Control | General | Photovoltaic Panel Specification, Layout, Simulation, etc. | No     | No     |
| Water Saving and Utilization | Water Management Planning | Control | Rainwater Plan, Water Efficiency of Taps, Flushing Water System, etc. | Yes    | Yes    |
|                            | Water Leakage Control | Control | Plumbing and Drainage Plan, etc. | Yes    | Yes    |
|                            | Water Efficiency   | Control | Water Saving Calculation, Water Efficiency of Taps | Yes    | Yes    |
|                            | Non-traditional Water Safety | Control | Rainwater Plan, Plumbing Design and Layout, Rainwater Filtration System etc. | Yes    | Yes    |
|                            | Rainwater Management Plan | General | Rainwater Plan, Rainwater Collection System Design and Calculation, etc. | Yes    | Yes    |
|                            | No-traditional Water Use | General | Rainwater Plan, Rainwater Collection System Design and Calculation, etc. | Yes    | Yes    |
|                            | Irrigation Efficiency | General | Irrigation System, Water Efficient Irrigation Calculation, Root Zone Irrigation System, etc. | Yes    | Yes    |
|                            | Rainwater Storage  | General | Rainwater Plan, Rainwater Collection System Design and Calculation, etc. | Yes    | Yes    |
|                            | No-traditional Water Ratio | General | Rainwater Plan, Rainwater Collection System Design and Calculation, etc. | Yes    | Yes    |
|                            | Enhanced No-traditional Water Ratio | Premium | Seawater Flushing System Design and Calculation, etc. | Yes    | Yes    |
| Material Saving and Utilization | Minimum Decoration | Control | Architectural Drawings, Shading Devices, Façade Specifications, etc. | Yes    | Yes    |
|                            | Premixed Concrete  | General | Concrete Mix Design, Raw Material Supplies Plan, etc. | Yes    | Yes    |
|                            | High Performance Structure | General | Building Structure Design, Material Specifications, etc. | Yes    | No     |
|                            | Material Recycle   | General | Structural Material Calculation Report, etc. | No     | No     |
|                            | Integration of Building and Interior Design | General | Architectural Drawings, Interior Drawings, etc. | Yes    | Yes    |
| Indoor Environment Quality | Low Impact Structure | Control | Prefabrication Design, Raw Material Supplies Plan, etc. | Yes    | Yes    |
|                            | Noise Insulation   | Control | Acoustic Analysis Report, etc. | Yes    | Yes    |
|                            | Natural Ventilation | Control | Natural Ventilation Simulation Report, etc. | Yes    | Yes    |
|                            | Daylighting        | General | Daylighting Simulation Report, etc. | Yes    | Yes    |
|                            | Visual Privacy     | General | Visual Assessment Report, etc. | Yes    | Yes    |
|                            | Thermal Comfort    | General | Indoor Surface Temperature Analysis Report, etc. | Yes    | Yes    |
|                            | Air-conditioning Control | General | Air-conditioning Installation Specifications, etc. | Yes    | Yes    |
|                            | Adjustable Shading | General | Architectural Drawings for Windows Design and Façade Design, etc. | No     | No     |
|                            | Bedroom Sunlight Access | Premium | Solar Access Mode | Yes    | Yes    |

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renewable energy, or the credit for building envelope thermal performance.

The certification uncovered that the sunlight access was unachievable in Hong Kong. According to the national standard GB 50180, there must be at least 3 h of sunlight in the lower floors of a building in Big Chill Day when the daily average temperature is the lowest according to Lunar Calendar. In the two projects, only higher floors could access sunlight. The 3-h sunlight could hardly be met for the lower floors in the high-rise environment. Deficiency of thermal performance of the building envelope showed another cultural difference. Thermal performance of the building envelope is an essential design factor for energy saving in residential buildings. Thermal performance mainly refers to window-wall ratio, heat-transfer coefficient, sunlight shield coefficient etc. Neither of the two projects met the standard. Because there is no energy efficiency requirement for residential buildings in Hong Kong, thermal performance is largely ignored in local residential design practices.

The certification process also uncovered some credits that were easily achieved without efforts. For land saving in residential developments, one prerequisite requires that the maximum of land usage for high-rises should be 15 m² per capita. The land use per capita for Case1 was 2.67 m² and it was 3.93 m² for Case2, much lower than the cap in GBL. The requirement is too loose for high dense cities where land per capita is quite low. For community connectivity, GBL proposes that there should be 8 public service facilities like education, medical care and hygiene, banking, post service and so on within 500 m of the residential development. Case1 had 21 services and Case2 had 26 services within their 500-meter radius. Encouraging non-traditional water use is an important strategy to save potable water use. For Case1, the percentage of non-traditional water use was more than 42%, much higher than the optimal requirement 5%. This is because seawater as a kind of non-traditional water is popularly used in flushing in Hong Kong. According to Water Supplies Department, seawater is used to flush toilets in 79% households in Hong Kong. Obviously, these green features are commonplace in Hong Kong. What’s the significance of awarding these green features? If the rating system aims to push the building sector for more sustainable, how to further raise the thresholds for these credits?

Conclusion

Through revising the national green building rating system GBL in terms of Hong Kong context and certifying two green-oriented residential projects for verification of the revision, three strategies could be learned to revise national or international assessment tools to address local challenges: the first is combining local and international standards; the second is prioritizing credits to address local challenges; the third is raising or lowering requirements according to local or regional conditions.

This article identifies and confirms natural and man-made challenges in high-dense urban environments for applying alternative green building rating systems. The application of a national system into a local context does lead to some interesting conclusions. For example, the thermal performance of residential buildings in Hong Kong can hardly meet the national code. Thermal performance of a building’s envelope has a key role in reducing energy load and sustaining indoor thermal comfort, which is largely ignored in the local building codes and green building rating system. Applying national and international green building rating systems can disclose the deficiency of local design practices and design codes.

Because there is no scientific evidence to support the revision, the revision was based on consensus of panel discussions. In other words, there is a lack of transparency in the process of revision, which is also the common limitation for today’s green building rating systems. With more and more buildings certified, it is expected that the next generation rating system should be developed based on a pool of scientific evidence generated from certified buildings to reduce subjectivity.

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