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EXPLORING THE CAPABILITY OF HONG KONG BEAM PLUS FOR CARBON FOOTPRINT EVALUATION: PERCEPTIONS OF INDUSTRY LEADERS

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ABSTRACT

Buildings in Hong Kong and perhaps elsewhere take up a significant portion of greenhouse gases (GHG) emissions. Having committed by the HKSAR Government to reduce the carbon intensity of Hong Kong by 50-60% by 2020 compared with 2005, the building sector has an undeniable role to play. Despite that building environmental assessment (BEA) tools are increasingly used to evaluate the environmental impacts of building facilities in the local industry, their effectiveness in the carbon reduction were still unknown. This study therefore aims to reveal the local practices and industry practitioners' perceptions on reducing buildings' carbon footprint in general, and to explore the capability of the BEA tool adopted in Hong Kong, namely Building Environmental Assessment Method (BEAM Plus), for carbon footprint evaluation in particular. An interview survey was carried out with twelve local industry experts to achieve the research aims. The results of interview survey indicated that the awareness and concern of building carbon footprint were still very limited in Hong Kong. This might due to the insufficient endeavor from various stockholders especially the government and private developers in promoting and adopting low carbon strategies for buildings. Besides, there was a predominant view among the interviewees that the BEAM Plus is not adequately comprehensive to assess the buildings' carbon footprint. Adopting a holistic framework for assessing the carbon footprint throughout the entire building lifecycle is thus desirable.

Key words: Green Building, Building Environmental Assessment, Carbon Footprint, BEAM Plus.

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Introduction

Climate change is one of the greatest challenges facing nations, governments, business and citizens and will influence the way we live and work in future decades [1]. The release of carbon dioxide (CO_2) and other greenhouse gases through human activities such as the burning of fossil fuels, chemical processes and other sources of anthropogenic greenhouse gases will have an effect on future global climate [2]. According to the UK Carbon Trust [3], carbon footprint, also named as carbon profile, measures "the total GHG emissions caused directly and indirectly by a person, organisation, event or product measured in tonnes of carbon dioxide equivalent (tCO_2e)". The GHG emissions, as covered in the Kyoto Protocol [4] to the United Nations Framework Convention on Climate Change (UNFCC), include six types of gas, namely CO_2, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

In the Copenhagen Climate Change Conference 2009, the Chinese government made commitment that China would cut GHG emissions per unit of GDP by 40-45% by 2020 from the 2005 level. As the Special Administration Region of China, the Hong Kong government has also committed to reduce the carbon intensity by 50-60% [5]. A number of studies indicate that modern buildings are energy intensive throughout the building life cycle, particularly the construction and operation phases, thereby taking up a significant portion of global GHG emissions [6, 7, 8]. Taking US as an example, the commercial and residential buildings generate almost 30 percent of the nation's total carbon emission [7]. For subtropical cities like Hong Kong, buildings can contribute to almost 60% of final energy consumption [8]. Being able to assess the carbon emissions of a building is therefore imperative so as to introduce corrective actions for carbon reduction. Building environmental assessment (BEA) offers a platform to serve this purpose. However, the usage and limitations of BEA tools in carbon footprint evaluation have rarely been explored.

The aim of this study was therefore to reveal the local practices and industry practitioners' perceptions on reducing buildings' carbon footprint in general, and to explore the capability of the BEA tool adopted in Hong Kong, namely BEAM Plus, for carbon footprint evaluation in particular. Recommendations are made to enhance the BEAM Plus and low carbon policies so as to achieve the reduction target.

Low Carbon Initiatives for Buildings in Hong Kong

BEAM Plus

BEAM Plus is a voluntary initiative to measure, improve and label the environmental performance of buildings. Established by Hong Kong BEAM Society, this BEA tool mostly follows the standards specified in the BREEAM [9]. Developed since 1996,

BEAM Plus has certified around 240 landmark properties in Hong Kong, Beijing, Shanghai and Shenzhen, comprising over 10.5 million m2 of spaces and 56,000 residential units [9].

BEAM Plus is not solely a tool assessing the building carbon emissions. Instead it is an assessment method covering several aspects of environmental impacts including energy efficiency, water use, resources, indoor environment, pollutant and so on [9]. In 2009, the climate change and global warming became international critical issues. In response to the critical global environmental issues, BEAM Plus has been evolved to meet the higher expectation from the public and communities. There are two environmental indicators in BEAM Plus evaluating the GHG emissions, and they makes up less than 20% of the total scores [10]. However, its evaluation on GHG emissions emphasizes on the operational stage but not the entire building life cycle [10].

Building Energy Codes (BEC)

To promote and ensure energy efficiency in buildings, EMSD developed a set of Building Energy Codes (BEC) for different building service functions. As a further step, the Performance Based BEC (PB-BEC) has been developed and implemented in 2003 aiming to provide an alternative means of the BEC compliance based on the computation of the total building energy consumption. The assessment is carried out by comparing the energy consumption of the assessed building design, with that of a corresponding reference building, a generic building design of the same size and shape as the design building that fully complies with all the requirements prescribed in PB-BEC [11]. If an assessed building tends to complied with the PB-BEC it must fulfil the requirement that its energy total consumption is not greater than that of the reference building. This approach informs the building owners and developers the energy performances of their buildings at early design stage.

The Buildings Energy Efficiency Ordinance (Cap. 610) will come into full operation on 21 September 2012. Since then the BEC will be mandatory for all new constructed buildings in Hong Kong as a minimum energy efficiency requirement. It is anticipated that this initiative could effectively reduce the carbon emission level from buildings.

Mandatory Energy Efficiency Labelling Scheme (MEELS)

Hong Kong government has implemented the MEELS since 9 November 2009 to facilitate the public in choosing energy efficient appliances and raise public awareness on energy saving. The MEELS is one of the most successful "green" initiatives in Hong Kong. Under the MEELS, energy labels are required to be display on five types of electrical appliance products before being supplied in Hong Kong, and they include room air conditioners, refrigerating appliances, compact fluorescent lamps, washing machines, and dehumidifiers. Over two years, hundreds of brands of prescribed

products have been certified, graded, and labeled under the scheme. It is demonstrated that, under the scheme, the grade 1 refrigerating appliances save 49% energy than that of grade 5 [12].

Zero Carbon Building (ZCB)

The Construction Industry Council (CIC) Hong Kong, in collaboration with the Hong Kong Government, is developing the first ZCB in Hong Kong which is a signature project to showcase state-of-the-art eco-building design and technologies to the construction industry internationally and locally as well as to raise community awareness of sustainable living. Expected to be completed by mid 2012, the project includes a ZCB with a footprint of approximately 1,400 m2 and a landscaped area for public use. The target energy efficiency would be 38% more efficient than the conventional design. Use of renewable energy from photovoltaic panels and biofuels may offset its energy consumption during the same period.

Methodology

A series of interview survey was carried out with experts in the building sector of Hong Kong to achieve the following objectives:

1) To determine the current status of awareness and concern on building carbon footprint and low-carbon policies in Hong Kong;
2) To examine the current situation and limitations of adopting BEA tools/schemes in Hong Kong;
3) To explore the need of GHG emissions assessment for buildings.

Since the information requested were reflecting the perspectives from as many as different parties related to the building carbon footprint, a wide spectrum of industry stakeholders were invited to conduct the interviews. Target interviewees included representatives from the managerial level of government departments, developers, contractors, architects / consultants, suppliers, pressure groups (NGOs & NPOs), and professional institutions. 25 invitations were sent out and 12 of them (48%) replied and completed the interview between May and August 2010. These included 3 (25%) from government departments, 2 (16.7%) from developers, 2 (16.7%) from contractors, 1 (8.3%) from architectural consultant, 3 (25%) from pressure groups, and 1 (8.3%) professional. All of the 12 interviewees had over 10 years working experience in the industry and had intimate knowledge of sustainable construction and as well as the building carbon footprint. Thus, the information being provided formed a solid basis of the study.

Face-to-face interviews were conducted in a semi-structured manner, i.e. a set of questions were prepared in advance, but the interviewees were allowed to bring new questions. The semi-structured interview was designed last for 45 minutes and each

interviewee was interviewed individually. Their prospective and opinions were audibly recorded throughout the interview. Interview reports were compiled and subsequently validated by interviewees. Useful information was then selected from the finalized reports according to the objectives above.

Interview results

Current status of awareness and concern on building carbon footprint and low-carbon policies in Hong Kong

Reduction of buildings' GHG emissions was basically not one of the top priority issues at present. Most of the interviewees (11 out of 12) assured that the awareness and concern on carbon footprint of buildings were low in the Hong Kong building and construction industry. This might due to the fact that reducing the GHG emissions of buildings was a relatively new subject of the local practice. Five interviewees pointed out that the developers, consultants and contractors in Hong Kong did not concern much about their social and environmental responsibility but mainly on profit. Even pursuing environmental awards is only because of acquiring the financial benefits and reputation behind. Eight (67%) interviewees pointed out that clearly there is a lack of available incentives for the industry to adopt low carbon measures. However, two interviewees deemed that there was increasing concern of building carbon footprint in Hong Kong. Recently, the Hong Kong government and pressure groups started to encourage the building stakeholders to reduce the GHG emissions of buildings especially through air conditioning system. A number of architects and consulting firms in Hong Kong started to conduct carbon auditing for new buildings.

Regarding building carbon footprint reduction measures and policies, two interviewees from NGOs were convinced that Hong Kong was still quite a long way behind other developed countries such as UK, US, German and Singapore.

Current situation and limitations of adopting BEA tools/schemes in Hong Kong

More and more clients in Hong Kong are adopting the BEA tools to evaluate the environmental performance of buildings they develop. Although Leadership in Energy and Environmental Design (LEED) became more and more popular in Hong Kong, two-third of the interviewees commented that BEAM Plus was still the most commonly used BEA tools. Two interviewees pointed out that the selection of BEA tools largely depended on the levels of recognition of the BEA schemes among the developers. Another expert pointed out that the need of a BEA certification depended on the buyers and tenants of buildings.

Most of the interviewees doubted that the BEA results were informative to report a building's environmental friendliness. Especially for the public housing in Hong Kong, BEAM Plus were hardly informative and helpful to reduce the carbon

footprint, as elaborated by one of the interviewee from Hong Kong Housing Authority (HA). HA dose not use low or zero carbon materials but used less construction materials. For example, it eliminates some of the cement pasting in the construction of some public houses. Take the floor finishing as another example. The end users of the houses may prefer different type of floor finish: wood, marble, plastics and so forth. When the HA hand over the houses to the users, it dose not complete the floor finish but leave the users to complete it. In such case, the amount of waste is reduced if the users would like to replace the original floor decoration. The HA try to save materials in every possible way meanwhile maintain the high quality of the buildings; however the BEAM Plus dose not count these merit in the assessment.

Six (50%) interviewees held the view that the assessment of GHG emissions should focus on all building life cycle stages. However five (42%) interviewees considered that despite lifecycle GHG assessment was a good initiative in Hong Kong; the carbon auditing should first focus on the operation stage, especially the energy use on air conditioning. It might be not worthwhile being entangled with measuring the embodied carbon of materials due to its complexity. Moreover, as a pre-requisite, a commonly recognized method of calculating and benchmarking the carbon footprint of building materials should first be in place. However, such carbon auditing and benchmarking mechanisms did not exist in Hong Kong at present.

The need for GHG emissions assessment for buildings

Two-third of the interviewees assured that the BEAM Plus was not sufficient to audit and benchmark the buildings' life cycle GHG emissions. The BEAM Plus was too general to assess and reduce GHG emissions in Hong Kong. It assesses the sustainability of the entire life cycle of a building, including materials, energy, water, waste, effect on the surrounding environment, indoor environment etc., but not specified for the analysis of GHG emissions. It is designed to benchmark the energy efficiency and associated GHG emission during the operational stage but not the entire building life cycle. Hence, Hong Kong lacked a comprehensive tool to audit the carbon footprint of a building and a baseline for benchmarking. All of the interviewees agreed that benchmarking was essential but it must be done against significant and representative samples. The baseline and benchmarks should be renewed and upgraded to fulfill the continuous development of society and technology.

Discussions

Mandatory Energy Efficiency Labelling Scheme (MEELS) for electrical appliances has been successfully implemented in Hong Kong since late 2009. This may due to the fact that the using energy efficient appliances could directly reduce the energy bill for end users. In contrast, the current awareness and concern of carbon footprint of buildings were still low in the Hong Kong as perceived by the local industry

practitioners, probably because low carbon footprint building might not bring straight benefits to the building stakeholders. Besides, compared to other developed countries, the awareness of building carbon footprint from the public is not enough in Hong Kong. Whether the stakeholders concern the buildings' carbon footprint largely depends on the government's requirements.

Many of the consulted experts agreed to focus on GHG emissions reduction in the operation stage. However, if sustainable design is adopted at the early stage, it would be effective in reducing the GHG emissions throughout the entire building life cycle i.e. "from cradle to grave". For instance, the building elements that consume the most significant amount of materials and emit most GHG are structure and envelope. If the sustainable design is adopted for the structure and envelope, e.g. using reinforce concrete structure rather than structural steel one, carbon footprint would be improved in the initial stage.

The existing BEA tools are rapidly increasing in numbers and tend to be more mature and comprehensive. But many interviewees doubted if these tools could essentially improve the building carbon footprint, which is a critical issue on the environmental aspect. It is true that the primary function of BEA systems is to assess the performance of the resource use, ecological loadings, health and comfort in individual buildings [13]. Ensuring that the BEA methods are simple, practical, and inexpensive in both use and maintenance was deemed paramount. However the carbon footprint assessment is a process consists of data collecting, data processing, accounting, modelling, categorizing and benchmarking. This requires a much more complicated assessment process i.e. LCA for buildings. In recent years, a number of building carbon footprint auditing tools has been developed e.g. EcoQuantum (Netherlands), ENVEST (UK), ATHENA (Canada), Carbon Footprint (UK), Carbon Fund (USA), and so on. Most carbon auditing tools calculate the carbon footprint by converting the amount of electricity, oil, gas or coal used into GHG emissions [14]. However, the databases these tools adopted are highly localized, which imposes restrictions on them to be used extensively worldwide. That is the reason that if a developer in Hong Kong intends to carry out carbon footprint assessment, local adjustments have to be made on the database.

Conclusions and recommendations

With the increasing concern on global and local GHG emission mitigation, the building sector is required to disclose the buildings carbon footprint, and to minimize their GHG emissions. In recent year various low carbon initiatives have been developed in Hong Kong targeting in reducing the GHG emissions of buildings. However, majority if them are focusing on improving the performance of operational emissions. Among them only the CIC's ZCB performs a LCA on building carbon footprint.

Interview survey was carried out among the local industry experts to reveal the current situation of building carbon footprint assessment in Hong Kong. Unfortunately, it is found that this field is still at its infant stage in Hong Kong. The voluntary BEAM Plus is the most dominantly used BEA scheme in Hong Kong. However, it focuses on improving the performance of operational emissions. Majority of the interviewee believed that BEAM Plus is not adequately comprehensive to assess the building carbon footprint, thus not sufficient to minimize the building carbon footprint. At present there is neither a standardized carbon footprint auditing tool nor an assessment framework being applied for buildings in Hong Kong. Hence, there is a need is to establish a comprehensive carbon assessment framework to standardize the building carbon footprint assessment with a localized life cycle inventory (LCI), a unified energy / GHG emissions auditing method, and a local benchmarking system.

This study forms a basis to develop the above mentioned framework which maximises the opportunity of building GHG emissions reductions.

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