Planning and design strategies for sustainable urban development

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ABSTRACT: In order to create high impact low-carbon architecture it is necessary to address issues at the urban scale. This paper reviews methods adopted in the UK, Hong Kong and America and develops a series of themes that should be incorporated in modern city development strategies to produce green and sustainable outcomes. These are concerned with: planning policies and building regulations; neighborhood and site planning; and building design. Underlying themes which must be incorporated are connected to: building façade, systems design and operation; energy demand and supply; transportation systems; water supply and use; and wastes/pollution issues. To achieve success a number of support mechanisms are needed including strategic and infrastructure development, implementation of assessment frameworks, and the distribution of information and knowledge to stakeholders. The themes are compared to recent developments in the city of Kunming and proposals for future applications are explored.

1. INRODUCTION

Cities contribute an estimated 70% of the world's energy-related greenhouse gases (GHG). With the rapid urbanization in China, huge stresses have been added onto all forms of public services provision, such as systems for energy, water use, transport and waste. In the 12th Five-Year Plan for 2011–2015, many Chinese cities are already committed to a high carbon-emission growth path. The World Bank estimated that about half of the world's new building constructions have taken place in China in the years leading up to 2015 (Baeumler et al. 2012). In response to the emerging focus on environmentally sustainable growth, many cities are already developing eco-city and low-carbon city initiatives. At the beginning of 1990s, gradual development of the real estate market efficiently and effectively boosted China's economy, and also led to rapid development of the housing industry. Under the influence of the commodity economy, Chinese housing became a commercial product that encouraged cutting-edge technology and design theory with an emphasis on market competition. A number of housing projects which were designed with "green" concepts have appeared. Constructing green house or low-carbon dwellings has become a popular trend in much housing design practice, and estate developments with green styled names have been developed.

In order to create impactful low-carbon architecture it is necessary to address issues at urban scale. This paper reviews methods adopted in the UK (BREEAM, BREEAM for community), Hong Kong (HK- BEAM), and America (LEED, LEED-ND), and develops a series of themes that should be incorporated in modern city development strategies to produce more green and sustainable outcomes. Based on the analysis of different sustainable design assessment methods, a case study of recent a development in Kunming city has been used to explore the issues and make a number of suggestions for future development.

2. REVIEWS: BREEAM, HK-BEAM, LEED, ASGB

Green building assessment systems have been developed in various countries with different emphases. Based on the different development situations, the contents of each evaluation systems are vary.

The first prominent green building assessment system was published in 1990 by BRE (Building Research Establishment) in the UK. BREEAM (Building Research Establishment Environment Assessment Method) became the leading and most widely used environmental assessment method for buildings and communities. Inspired by BREEAM, different versions of green building assessment

methods have been launched by research organizations in different countries. HK-BEAM was introduced to Hong Kong in 1996 and is an environmental performance-based assessment scheme purpose designed for high-rise buildings. The certification scheme is completely voluntary and is owned by the HK-BEAM Society, a non-profit making organization consisting of industry professionals (Chu 2004). The United States Green Building Council's (USGBC's) (established in 1993) Leadership in Energy and Environmental Design (LEED) is a program that provides third-party certification for green buildings. The first version of LEED was published in 1998 (Floyd & Bilka 2012). There are many other assessment systems currently available, such as GB-Tool (Canada), Australian Building Greenhouse Rating Scheme and NABERS, Green Star, SAP, Home Energy Rating System (HERS) programs, NatHERS and FirstRate, Eco-Quantum, Green Guide to Specification, ENVEST and Ecopoints, BEES (Pitts 2004). The details of different of BREEAM, HK-BEAM, LEED and ASGB ("*Assessment Standards of Green Building"*) are listed in the Table 2.1.

The following sections of the paper focus on the individual methodologies; the purpose of this analysis in the overall project was to enable identification of key and recurring factors and features that could be applied in the setting of the City of Kunming. This then helps set a background against which future development trends might be evaluated. Further information on design and detail is still required, though sometimes this is not easy to obtain

2.1 BREEAM

Different versions of each assessment systems and methods have been updated for a number of times, and also included more assessment items. BREEAM consists of a series of rating systems for a range of building types. Buildings are rated and certified on a scale of 'Pass', 'Good', 'Very Good', 'Excellent'. In 2008, the BRE added a fifth category of 'Outstanding'. There are several purposes of the rating system: firstly, it is to provide guidance to reduce the effect of buildings on the global and local environmental whilst also creating comfortable and healthy indoor environments; secondly, it is to enable developers of buildings who have addressed environmental issues to gain credit for this through the rating of proposals and the award of a certificate (Pitts 2004).

2.2 LEED

The LEED rating systems address a wide variety of buildings types, including separate rating systems for new construction and existing buildings. Those include operations and maintenance, commercial buildings, core and shell, schools, retail (new and commercial interiors), healthcare, homes, neighborhoods developments. Buildings are rated at levels of 'Certified', 'Silver', 'Gold', and 'Platinum'. A points based system is then used to encourage the implementation of other green and sustainable best practices, and has led to healthier, productive buildings, reduced stress on the environment by encouraging energy and resource-efficient buildings, and savings from increased building value, higher lease rates and decreased utility costs (Floyd & Bilka 2012).

Table 2.1 General comparison of green building assessment methods

Assessment System	Object	Categories
BREEAM 1990 UK	New construction, Existing buildings Include: Communities, Courts, Data-centres, Education, Healthcare, Industrial, Entertainment and leisure, Office, Other buildings and mixed use developments.	Management, Energy, Transport, Water, Materials, Waste, Land Use and Ecology, Pollution, Health and Well Being.
LEED 1998 US	New construction, existing buildings including: operations and maintenance, commercial interiors, core and shell, schools, retail (including new and commercial interiors), healthcare, homes, and neighborhood development.	Sustainable sites, Water efficiency, Energy and atmosphere, Materials and resources, Indoor environmental quality, Innovation design, Regional priority.
HK-BEAM 1996 Hong Kong	"New" and "Existing" building types including: offices, residential, mall, hotel, school, hospital, institutional and mixed complexes centrally air-conditioned, naturally ventilated or mixed mode.	Site, Materials, Resource, Water resource, Indoor environmental quality, Innovation design.
ESGB Assessment Standard for Green building 2006 China (China, 2015)	New construction, extended buildings (residential building, public building)	Land saving and outdoor environment, Energy saving and energy utilization, Water saving and water resources utilization, Material saving and material resources utilization, Indoor environmental quality, Construction management, Operation management.

2.3 HK-BEAM

The Building Environmental Assessment Method (HK-BEAM) scheme used in Hong Kong was established in 1996, largely based on the UK Building Research Establishment's BREEAM. There was a significant upgrade to the previous BEAM documents in 2004. Next in response to raised concerns of occupant health in buildings especially after the outbreak of SARS in 2003, the latest HK-BEAM standards have evolved to address hygiene, health and other environmental issues in a more holistic manner (Chu 2004). In 2009, in consideration of the critical state of global environmental issues, BEAM was further enhanced to meet higher expectations of the public and community. A rating is issued to a project according to the score achieved after Provisional Assessment (PA) or Final Assessment (FA). Potential outcomes are: 'Platinum', 'Gold', 'Silver', 'Bronze', and 'Unclassified'. As with other schemes, a number of benefits can be achieved by adopting HK-BEAM, such as cost-savings through the more efficient use of energy and resources; increasing occupant satisfaction from healthy and productive accommodation, enhancing corporate profile and marketability to potential building users; providing a tool to improve purchaser choice and information; integrating local and international best practice into new designs; providing increased protection against environmental liability; and establishing a clear direction for continuous improvement and optimized performance (Society 2004).

2.4 ASGB (<绿色建筑评价标准>)

In China green building has been defined in the "*Assessment standard for green building*" (GB50378) as: "constructions that fully considered the requirements of environment protection issues during the process of design, constructing, and the utilization of building materials". It also requires assessment combining architecture with farming and agriculture, energy, environmental protection, aesthetics, and high-technology construction. It also asks for the design of buildings that not only satisfying functional demands, but which also provide healthy and environmental friendly spaces for living and working. (在全寿命期内，最大限度地节约资源（节能、节地、节水、节材）、保护环境、减少污染,为人们提供健康、适用和高效的使用空间,与自然和谐共生的建筑)" (China 2015). Considering the basic needs of Chinese development, it contains sections related to the following: land preservation and outdoor environment; energy saving and energy utilization; water saving and water resources utilization; materials saving and material resources utilization; indoor environmental quality; construction management; and operation management. Under each theme, there are 'Prerequisite items'; 'General items'; and 'Optimized items'. Prerequisite items are those which must be achieved as a necessity for green building. General items are those which are difficult to achieve and generally require high levels of attainment for each target. Optimized items denote those which are more difficult to implement in the project and with higher requirements for each target. The latest version of the "*Evaluation standard for green building*" (published in 2014) has changed 'General items' into 'Scoring Items' and removed 'Optimized items', which means higher standards have to be achieved as part of the process in order to get higher scores.

2.5 BREEAM FOR COMMUNITIES, LEED-ND

Both BREEAM and LEED have developed assessment methods for community and neighborhood scales, explained as follows.

BREEAM for Communities has been developed to enable planners and development teams to address sustainability from an early stage. It is an independent, third party assessment and certification standard based on the established BREEAM methodology. It is a framework for considering the issues and opportunities that affect sustainability at the earliest stage of the design process for a development. The scheme addresses key environmental, social and economic sustainability objectives that have an impact on large-scale development projects. BREEAM for communities awards credits in six categories:

- Governance (GO): "Promotes community involvement in decisions affecting the design, construction, operation and long-term stewardship of the development." (BRE 2012)
- Social and economic wellbeing (SE): "Considers societal and economic factors affecting health and wellbeing such as inclusive design, cohesion, adequate housing and access to employment." (Ibid.)
- Resources and energy (RE): "Addresses the sustainable use of natural resources and the reduction of carbon emissions." (Ibid.)
- Land use and ecology (LE): "Encourages sustainable land use and ecological enhancement." (Ibid.)
- Transport and movement (TM): "Addresses the design and provision of transport and movement infrastructure to encourage the use of sustainable modes of transport." (Ibid.)

- Innovation (Inn): “Recognizes and promotes the adoption of innovative solutions within the overall rating where these are likely to result in environmental, social and/or economic benefit in a way which is not recognized elsewhere in the scheme.” (Ibid.)

To avoid negative impacts and design problems during community development, there are three design steps that are promoted for the assessment of sustainability at the master-planning level. Master-planning should be an iterative process that involves: developing plans, consulting stakeholders and then revising plans. BREEAM for communities links assessment with the master-planning process to ensure that issues are addressed at an appropriate point in the early design stages.

LEED-ND (LEED for Neighborhood Development) was released in 2010 in the US. It aims to integrate the principles of smart growth, urbanism and green building into a national system for neighborhood design. The LEED-ND system is collaboration between the United States Green Building Council, the Congress for New Urbanism and the Natural Resources Defense Council. LEED-ND appears to be the most comprehensive of all the LEED green rating programs. It has been design to put emphasis on site selection, design, and construction elements that bring buildings and infrastructure together into a neighborhood. This approach also promotes the relationship between the neighborhood, its landscape, and its local and regional context. It has different focuses from those in BREEAM for Communities that involves more evaluation at the master-planning level. LEED-ND has three environmental categories: smart location and linkage, neighborhood pattern and design, and green infrastructure and buildings. These are discussed below

- Smart location and Linkage: “Focuses on site selection that minimized the adverse environmental effects of development across several categories, including transportation, air quality and preservation of environmentally-sensitive lands or ecosystems. Urban sprawl and associated low density, segregated housing and commercial uses are discouraged. Preference is given to locations close to existing town and city centres, sites with good transit access, infill sites, previously developed sites and sites adjacent to existing developments. Selection of sites that are within or adjacent to existing development can minimize habitat fragmentation and also help to preserve areas for recreation. Remediation and reclamation of contaminated brownfield sites make them safer and can contribute to social and economic revitalization of depressed neighborhoods.” (Floyd & Bilka 2012)
- Neighborhood Pattern and Design: “Emphasizes the creation of compact, walkable, mixed-used neighborhoods with convenient pedestrian connections to nearby communities. Compact communities provide opportunities to reduce driving and resultant emissions, conserve economic resources, and help reduce the spread of low density development across a region's landscape. Public spaces, such as parks and plazas, can encourage social interaction and active recreation while helping control storm-water runoff and reducing heat island effects. Community gardens promote social interaction and physical activities while increasing access to fresh, locally grown produce. Communities with diverse housing types permit residents to live closer to their workplaces and allow families to remain in a given neighborhood as their circumstances changes.” (Ibid.)
- Green Infrastructure and Buildings: “Focuses on measures that can reduce the environmental consequences of the construction and operation of buildings and infrastructure. Including certified green buildings in project is one way to reduce negative environmental effects. Sustainable building practices reduce waste and use energy, water and materials more efficiently than conventional building practices. Site ecology damage can be minimized during construction by confining construction activities to limited areas and restriction the development footprint.” (Ibid.)

In the following section, Expo Eco-town in Kunming is used as a case study to investigate sustainable development in practice in a Chinese city.

3 EXPO ECO-TOWN IN KUNMING CITY

As mankind enters the 21st Century, the focus on sustainable development now holds the world's attention and has been widely practiced in different fields. The building sector has been identified as that with the highest energy consumption at a time when China has a rapidly and continuously growing real-estate industry. ‘Green and low-carbon housing’ has been recognized as one of the phrases which suggests the most advanced design concepts for residential products are being exploited in design practice.

Expo Eco-town is presented here as an example of residential development that takes sustainability as a key design issue along with appropriate design practice. Beginning in 2000, the Natural Resources

Defense Council (NRDC) and U.S. Department of Energy worked closely with China's MoST (Ministry of Science and Technology) to develop large scale demonstration projects for green building in China. One of these projects is in the southern city of Kunming, Yunnan by the UK-based designers INTEGER.

3.1 MASTER-PLANNING

Situated in southwest of China, Kunming is a historical city with great potential for development. It is located on the northern side of the Dian Lake, which is in the central part of Yunnan province, and it is surrounded by hills on three sides and by water on the fourth side. Kunming is famous for its gentle climate which is not very hot in summer and not too cold in winter. Annual average temperature of Kunming is around 15.1°C, and reputed as 'spring city' and 'flower metropolis'. Kunming is a tourist city that bears little relationship to the cycle of the seasons. However, there are many challenges that the city has had to face during rapid urban development. Its geomorphic types are varied: up to 85% of the is classified as a mountainous region; 13% urban flatlands; and 2% natural water systems (Kunming 2012). Limited by natural resources and environment, sustainable land use has to be addressed: for example, in future development, mountains and hills (as the dominant terrain of the city) need to be considered as development choices. Furthermore, urbanization of Kunming city is less well supported than in other Chinese cities due to a relative lack of industrial development. This is one of the reasons leading to the overload of urban functions in the central city. Moreover, urban water environment is one of the important considerations of sustainable urban development. Water-intake, water supply, water drainage, and water resources renewal, are major challenges to meet the present needs without compromising the future. It is the water environment in Kunming that determines the scale of the possible urban economic development and sustains the population (Kunming 2012).

By considering the natural environment and sustainable development, new approaches have been explored in Kunming. Expo Eco-town has been one of the examples of adopting sustainable design concepts that match with local conditions.

The Expo Eco-town is located on the east of Kunming city. Hills are the dominant terrain, which makes the area distinctive with natural landscape features different to the built-up city centre. The site covers a total area of 255.7 ha. The planned area for the project was distributed across three surrounding areas (fig. 1).

The total construction area of Expo Eco-town is about 460,000m^2, combining eight independent districts. Plot ratios of construction in phase one development were set between 0.3-0.4. The whole project of Expo Eco-town includes the eight neighborhood units, (with housing on hilly areas), sports centre, golf course, commercial centre, exhibition hall of Expo INTEGER (UK-based company), and space for Government funded projects, such as International Conference Centre and the State Guest House. The first phase development of Expo Eco-town has been fully completed; other parts of the site are still under construction.

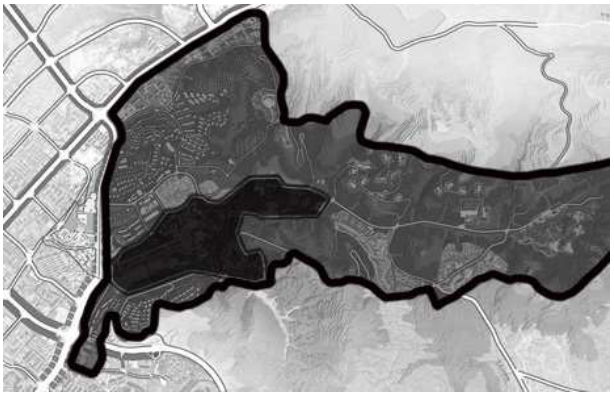

Figure 1: Planned development area of Expo Eco-town and boundary of World Expo site (Jiang 2014).

The identification of the project boundaries in figure 1 is based on the authors' access to project materials and on site visits

Seven research teams from different disciplines were involved in the primary studies for the project. The research fields included: geographic environment, architecture and urban planning, housing market demand, community management, evaluation of the geological environment, and analysis of policy and profit; all encompassing a wide range of research on local conditions (Eco-town 2007).

Meanwhile, on the basis of previous research, "*Key point of healthy residential construction technology*" (<健康住宅建设技术要点>, 2004), "*Key points and technical guidance of green ecological residential district construction*" (<绿色生态住宅小区建设要点与技术导则（试行）>, 2001), and LEED (USGBC's Leadership in Energy and Environmental Design) Rating System have been used as main design references to guide the design and construction of the project. Coopera-

tion between SWA (Design Institute of Landscape Architecture, Planning and Urban Design) and UK-based green building design agency INTEGER enabled comprehensive planning of Expo Eco-town to be developed.

3.2 CONCEPT DEVELOPMENT

After discussions among stakeholders and researchers, several design concepts were generated and one chosen to be finalized as a design proposal for Expo Eco-town. The design proposal covered five areas of planning for the residential area which could provide more sustainable lifestyles for residents. For the whole residential area, Expo Eco-town was considered as an open area that could establish good connections among neighborhoods and with people from other residential areas around it. For neighborhoods within the Expo Eco-town, living facilities were an important issue and were well-considered in different areas. Living resources, information resources, and energy supply have been designed to provide for a good quality of life for residents. Waste recycling, sewage treatment, and air cleaning systems have been introduced into the residential area along with Medical facilities. Earthquake resistant design has also been used to ensure a safe living environment. Further, Expo Eco-town has been designed as an integrated community which generated various urban functions to include tourism facilities, a research centre, educational facilities, a conference centre, a sports centre, eco-homes, and other municipal facilities. To enhance the natural environment in Expo Eco-town, the design proposal put emphasis on the combined consideration of the local climate and landscape in order to provide a good living environment for residents and also meet the needs of other species that inhabit there. For instance, the natural water system, the natural mountain landscape, and the forest on site, have each been well protected to avoid destroying the natural habitat for other species.

"Long-lived residential dwelling" is a slogan that delivers the message to residents that the dwellings have been designed using local natural resources for and for sustainability. To achieve this aim, building materials with less embodied energy have been promoted in the project, and ways of recycling and reusing the available resources also have been well considered based on local conditions. Furthermore, solar energy as the main renewable energy source in Kunming has been well-developed in this project.

A concept of "self-renewal" has also been set to improve and renew facilities in time to make sure of longer term use. To provide alternative ways for residents to travel, a transport system was designed to encourage residents to use public transport, walk or cycling; and to regulate the use of private vehicles. An efficient management system can ensure the whole community is running well. The design proposal for Expo Eco-town requested an optimized management system which could respond to demands from residents in good time. The management system is still committed to maintain a normal order for residents to create a community with a strong sense of belonging. Furthermore, community regulations set up a number of rules for residents (for example: residents cannot cut trees or other plants, hunt or kill animals, discharge sewage or waste, and so on). Green education has also been considered, for example, how to strengthen residents' environmental consciousness, how to encourage residents to use green building materials, and how to deliver a basic understandings of recycling waste.

The whole design proposal covers different study fields of constructing in a sustainable residential area. Starting from the planning theme through the detailed living facilities that were implemented at the end, Expo Eco-town was seen as a cutting-edge approach that explored ways to create a vibrant residential area with more consideration for sustainability. The design proposal generated different methodologies which could enhance the level of sustainability in residential area; however methods which could implement intangible concepts in a more tangible way were not well- considered at the planning stage. Therefore, after residents have moved into the community, a number of original design concepts have lost their meaning. This is design understanding gap which needs to be filled and requires further in-depth and empirical research on understanding the links.

3.3 ENERGY-EFFICIENT DESIGN AND TEHNOLOGY

As a pioneer project of the "Green residential area" approach in Kunming, a number of intelligent, green and energy-efficient building technologies have been explored and implemented. One of the principal features of this project is the site plan strategy. In order to ensure there will be less damages cased by construction on site, the building land-coverage proportion has been controlled within 10%. This means there will be more greenland sustained on the site and the natural water system has been preserved to some extent. Furthermore, there are five drainage channels for collecting rainwater for recycling and utilization. Moreover, water seepage paving stones have been used for outdoor walking paths which can sustain the rainwater

within the site and provide more water for irrigation. After being filtered and collected, rainwater can be used for plants or stored in a reservoir. Figure 2 shows the location of reclaimed wastewater treatment systems of Expo Eco-town (phase 1) and is based on site visits by the author and information from the Design Institute.

Figure 2 Distribution of reclaimed wastewater treatment system in Expo Eco-town in first phaase of development, (using data from Kunming 2005)

Figure 3 Redesign the natrual water system on site (Jiang 2007)

Figure 4 Permeable pavement design in Expo Eco-town (Jiang 2007)

Each residential dwelling, including those buildings on hillsides, is orientated to face south to gain as much as natural light and heat as possible. Traditional means of ventilation in dwellings have been used in order to reduce the extra energy consumption for mechanical cooling and ventilation systems. Water-saving faucets, showerheads and toilet tanks have been used. Furthermore, domestic sewage can be recycled through residential wastewater treatment systems which have been installed in each house. Kunming is rich in solar energy resources, and in Expo Eco-town, solar panels are mounted on the south-facing roofs to heat water for everyday use. All the residential dwellings have Low-E glass windows installed with the purposes of reducing energy use and CO2 emissions.

Figure 5 Solar energy ground lights and solar heat-collecting panel on the roof (Jiang 2007)

3.4 DISCUSSION

From master-planing to detailed housing design, Expo Eco-town as a pioneer project in Kunming has explored and has practiced cutting-edge designs and technologies. New approaches and technologies brought together development of sustainable residential designs, yet also led to higher cost at the initial construction stage. The design concepts and green products have verified the development of sustainable design in residential dwellings, but the impacts on residents in and around Expo Eco-town in the long-term still needs further research. For instance, design concepts and management strategies identified Eco-town as a project to demonstrate sustainable design to the general public. It has also been considered as an area that aims to establish good connections amongst neighbourhoods and also with other residential areas around it. But as an expensive high-end development, it has already been isolated due to residents ability to afford to live there; by contrast, residential districts around the Expo Eco-town have accumulated residents from different social groups. The management strategy for the Expo Eco-town is to ensure the living environment to be more safe, quiet and comfortable. As a result "good connections" with other residential areas is hard to achieve. Furthermore, as a demonstration project with educational functions, easy access for other residents of the city to visit the community is important in order to disseminate

knowledge and to share the well preserved natural environment. But the gated community makes it difficult for others to visit the place. Overall, Expo Eco-town has demonstrated possible ways for residential districts to be designed and used more sustainably in Kunming. But more detailed research and observation are needed to improve intangible design concepts, which means not only the designer conceives what the residential district will be like, but also the end users also know what the residential district should be like.

3.5 CHALLENGES AND SUCCESSES

Arising from the post-development phase of Expo 99' Kunming, Expo Eco-town is a new attempt for residential development in Kunming. It is different from other residential projects implemented in Kunming; the project received a lot of attention and support from government. The project has put great effort into integrating design resources and establishing connections among different disciplines. The new approaches to urban development, adopting hilly and mountainous areas in Kunming, have been implemented with the manner of sustainability. In 2000 a research team to consider post-development of Expo 99' Kunming was established and for several years examined natural resources and development strategies for land around Expo 99'. The cross-over research among different disciplines provided detailed information on site, and has also done much to support decision-making during the later design processes.

But there are also challenges associated with this project. As the first demo-project for green residential development implemented in Kunming, providing the environmental-friendly living space is not the only target. More significantly, this project should have provided opportunities to spread knowledge and information that could improve consciousness of sustainability in residents' daily life. For example, Expo eco-town has well connected inner residential neighbourhood, but the whole project basically exists as a huge "gated" residential district. Good design concept and green lifestyle cannot therefore be shared easily amongst the wider group of city residents. Significantly, a high profile demo project such as this should not be developed for an isolated community.

3.6 CONCLUSION AND SUGGESTIONS

According to the reviews of assessment methods set up in the UK (BREEAM, BREEAM for community),Hong Kong (HK-BEAM), and America (LEED, LEED-ND), there are a series of themes that should be incorporated in modern city development strategies to produce green and sustainable outcomes. A numbers of common principles from all the assessment systems introduced in this study are suitable for referencing in creating impactful low-carbon architecture and also to address issues at urban scale. In addition, good practices for sustainable urban design in China can be summarized based on the analysis of the Expo Eco-town case study as follows:

1. Include design teams from different disciplines and users groups in the master-planning process to ensure that issues are addressed in early design stages.
2. The post-construction stage of the project is equally important to ensure that measures of sustainable design are implemented in the occupation stage and the good connection between neighborhoods are maintained and managed.
3. Good design concepts and practices of sustainable projects need to be disseminated to the general public in various ways and easy access to those projects needs to be provided for visitors.

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