PLANNING AND DESIGN FOR SUSTAINABILITY – A CASE STUDY OF LAM TIN ESTATE OF HONG KONG

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ABSTRACT

The Hong Kong Housing Authority (HKHA) has been providing affordable and sustainable public housing for people in need since 1953. With rapid growth of population in the 1980s, the old Mark series blocks with inferior living conditions had to be redeveloped. HKHA implemented the comprehensive redevelopment programme in Lam Tin since 1990s and Lam Tin Estate was the final phase which took up its name as suggested by the community.

This paper presents Lam Tin Estate as a case study to illustrate the sustainable design approach in the dense urban environment, including the study of micro-climate in assisting planning and design for comfort living for our tenants; the extensive use of grid-connected photovoltaic (PV) panels for the economical use of renewable energy and implementation of roof greening and vertical greening to reduce heat island effect. Last but not the least, the engagement of the stakeholders including proactive community building through workshops and enhancing quality management through partnering with stakeholders.

This is a demonstration project in building a sustainable community and manifestation of our core values of 4C's, namely Caring, Customer focused, Creative and Committed. It took a great journey for HKHA's project team to work with the stakeholders and it turned out to be a rewarding experience with high user satisfaction, as reflected in the high satisfaction rate in the customer survey conducted after occupation. The experience we gained in Lam Tin Estate made us believe that by proactively engaging the community in the development process and employing green technologies in the design will bring forth fruitful outcome for a harmonious and sustainable living environment mostly valued by the project team and the users.

Keywords: *sustainability, caring, community engagement, greening, sustainable design approach*

1. INTRODUCTION

Hong Kong Housing Authority's (HKHA) primary role is to provide subsidized public housing to low income families who cannot afford private rental accommodation. The public housing programme has evolved to meet public expectations, from an emergency housing programme in the 1950's, to the more sophisticated public housing services that we provide today, covering planning, design, construction, management and maintenance aspects. The improvements we made are a direct response to public demand as society has prospered and public aspirations have changed.

One of our key missions is to provide affordable quality housing with a healthy living environment, thereby improving the quality of life in Hong Kong. This, we believe, allows our tenants to contribute more effectively to the community and the local economy, and allows the HKHA to contribute to the overall sustainability of Hong Kong. Lam Tin Estate is a demonstration project in building a sustainable community and manifestation of our core values of 4C's, namely Caring, Customer focused, Creative and Committed. It took a great journey for HKHA's project team to work with the stakeholders and it turned out to be a rewarding experience with high user satisfaction, as reflected in the high satisfaction rate over 96.6% in the customer survey conducted after occupation.

1.1 OVERVIEW OF PROJECT REQUIREMENTS

The following factors press the need for redevelopment:

- Under-utilization of land development potential
- Substandard habitable space (average area per person is 5 - 7.5 sq.m.)
- Substandard provision for safety, hygiene, ventilation and lighting etc.
- Poor Sanitation
- Poor natural ventilation and lighting
- Substandard building services provision for basic comfort

Figure 1 Old Lam Tin Estate (left) New Lam Tin Estate (right)

Lam Tin estate is the last phase of the Lam Tin area redevelopment which was completed in June 2009. The new estate occupies an area of 2.7 hectares and has four non-standard 40-storey residential buildings providing 3,036 units. Green living is the main theme of the estate design, featured with the largest grid-connected photovoltaic (PV) system in public housing in Hong Kong. We made use of micro-climate studies in estate design and conducted extensive community engagement throughout the redevelopment process.

Project particulars:

- Four 40-storey non-standard rental blocks
- 38 domestic floors with elevated garden deck
- 3,036 rental flats
- Design population was 8,568
- LGV carport (22 spaces which were late additions in response to community request)
- Estate management office
- Footbridge, lift tower and covered walkway linking to completed estate of earlier phases
- External works

1.2 SUSTAINABLE DESIGN APPROACH

In planning and design for the development, we adopted Sustainable Design Approach by integrating environmental, social and economic factors through:

1. Enhancing energy efficiency through application of micro-climate studies.
2. Reducing resources consumption by using renewable energy.
3. Reducing urban heat island effect through maximizing greening.
4. Enabling continuous improvement through Stakeholders Engagement.

In the following sections, we will layout the facts and results to illustrate the achievements made possible through various means in Sustainable Design Approach.

2. ENHANCING ENERGY EFFICIENCY THROUGH MICRO-CLIMATE STUDIES

Micro-climate studies involve the application of latest proven scientific technologies, including computational fluid dynamics simulations, wind tunnel tests and daylight simulations tools, etc. The innovation application of those established technologies enable designers to compare different options and help to fine-tune architectural layout and details based on qualitative and objective analyses. This project was one of the first batches of public rental housing projects where comprehensive microclimate studies were applied during planning and design stages.

2.1 THE DESIGN ENHANCEMENT THROUGH APPLICATION OF MICROCLIMATE STUDIES

- **Capture Wind Environment and Natural Ventilation**
  - Wind corridor enhances the wind environment of the site with average pedestrian wind speed of 1 m/s;
  - A deck garden linking all domestic blocks and ventilation bays at first floor enhances wind circulation through domestic blocks by over 50%; and
  - Cross ventilation at ground floor entrance lobby and lift lobby of typical domestic floors enhances building permeability for natural ventilation and daylight by at least 15%.
- **Optimise Daylight and Sun-shading**
  - Maximization of window area at typical floor lobby and corridor enhances daylight penetration by 10%; and
  - Entrance plaza design corresponds to sun-shading pattern to enhance thermal comfort when external activities are conducted.
- **Induce Thermal Comfort**
  - Environmental façade design and over 30% greening ratio mitigate solar heat gain in domestic flats.

2.2 ENVIRONMENTAL FAÇADE

- We adopted Environmental Façade Design in the domestic block based on Life Cycle Costing considerations. Optimum horizontal shading fins of varying overhanging width up to 575 mm were designed to mitigate solar heat gain.

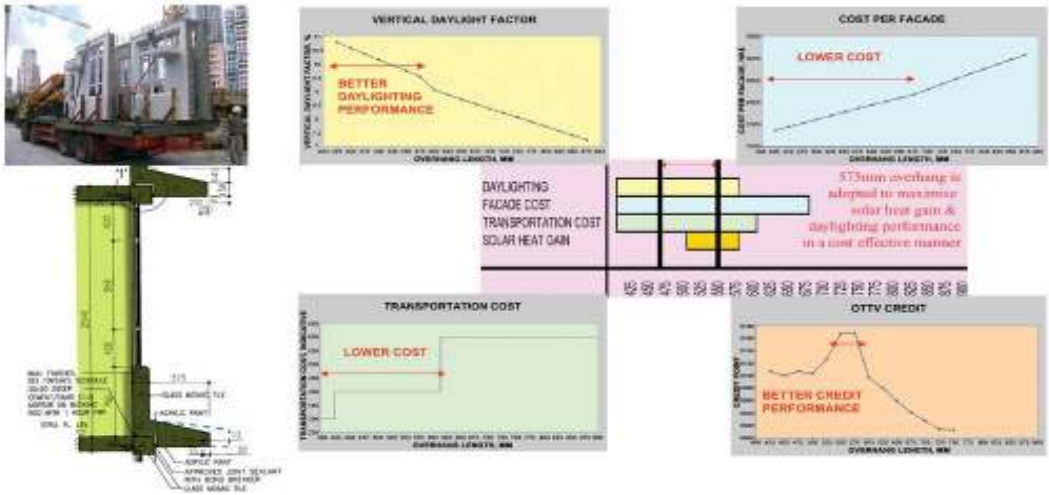

Figure 2: Micro-climate studies and Life-cycle costing studies facilitate the designers to determine the locations and size of solar shading device in a holistic design approach.

3. REDUCING ENERGY CONSUMPTION THROUGH USING RENEWABLE ENERGY

3.1 PHOTOVOLTAIC PANEL (PV) AS A TESTING TRIAL

Seeking to improve energy saving, new technologies were tried out to capture more energy in this project. A total of approximately 248m^2 mono-crystalline silicon PV modules at the total capacity of 33kW were installed on the upper roofs of three domestic blocks and part of the covered walkway. The installation was integrated in the architectural and structural design:

- The PV system is connected directly to the power distribution network of the buildings as a power source secondary to the conventional electrical power supplied by the power company. The grid-connected design obviates the need of power storage batteries, thus resulting in lower installation and maintenance cost. The panels were installed at upper roofs of domestic towers to capture the maximum natural light;
- Three transparent PV panels were installed at roof of covered walkway located at main pedestrian thoroughfare for educational purpose with LCD display monitor indicating the on time power generation of the system;
- Annual saving in electricity (approximately 43,000 kWh) by using the photovoltaic system to generate electricity for the public areas;
- Annual energy saving (approximately 652,174 kWh of electricity) for artificial lighting at common area is 13%; and
- Annual saving in energy consumption equals to a reduction of 2,800 tonnes of carbon emission per year.

Figure 3 PV panels installed on the upper roof for the maximum solar absorption (left), PV panels installed over the pedestrian level to enhance awareness on the use of solar energy to the building users. (right)

3.2 GREEN LIVING EDUCATION

A publicity display system was located at the thoroughfare and was specifically designed and incorporated with the PV system to promote the environmental awareness of tenants and people passing-by. Two LCD monitors were installed at the open venue and the upper lobby of lift tower respectively for display of the real time PV data for information of the public.

We also installed interactive games at exhibition corner of the deck garden based on intelligent technology, for playing by tenants of all ages to arouse their awareness for green living habitat.

4.0 REDUCING URBAN HEAT ISLAND EFFECT THROUGH GREENING MAXIMIZATION

4.1 MAXIMIZED GREENING

The main cause of the heat island is modification of the land surface by urban development which uses materials that retain excessive heat. To reduce urban heat island effect, we tried to reduce the concrete hard surface and increased the greening area as far as possible. Other than the planting at grade, we experimented different means to increase the greening area, such as roof greening over the covered walkway, hydroseeding on surrounding slopes, vertical greening on the west facing walls, preserving the trees on site, etc. The overall greening ratio of 26.3% is achieved.

4.2 ACTION SEEDLING

Other than the greening effort on hardware design and provision, we also engaged the tenants, contractors and local community in the "Action Seedling" greening activity to create a sustainable environment and foster sense of belonging and social responsibility. With the collaborated efforts of the contractor, we distributed seedling plants to nearby primary school children in late 2008 and prior to the contract completion, for them to nurture the plants, which were then transplanted back to the planters of the new estates in 2009.

Figure 4: Action seedling event held on 8 November 2008 (left) and 28 November 2009 (right)

4.3 COMMUNITY FARM

The continuous engagement of the tenants on the greening education is carried through to the Community Farm. The Estate Management Advisory Committee (EMAC) and residents made good use of the Community Farm designed at one corner of the site. Gardening training was provided with good response from residents. The Community Farm not only offers a venue for tenants' enhanced communication and participation, it also promotes human relationship and sense of belonging.

Figure 5 : Community Farm location (left), View inside the community farm (right)

5. ENABLING CONTINUOUS IMPROVEMENT THROUGH STAKEHOLDERS ENAGEMENT

5.1 COMMUNITY SPIRIT

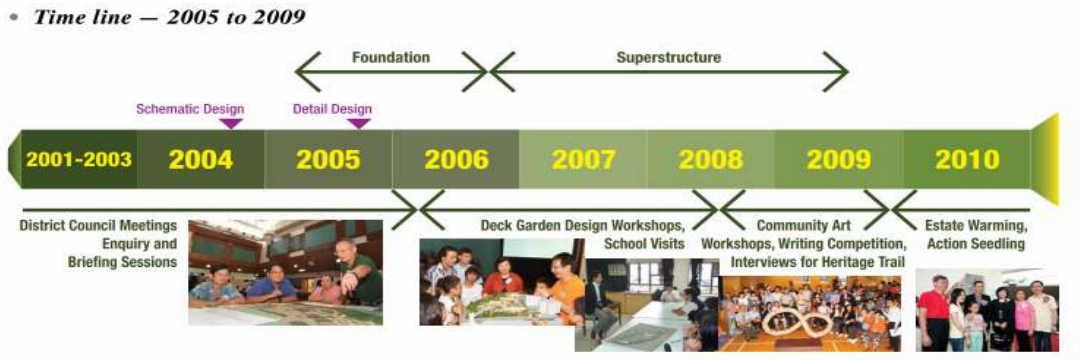

Figure 6: Time line of the community engagement process

In 2008, we organized a total of four community design workshops jointly with Kwun Tong District Council, Lam Tin Area Committee, local schools and non-government organizations (NGO) to work out the design of the deck garden linking all domestic blocks. Through the community- engagement activities, project team worked directly with the stakeholders to create a distinct and sustainable master layout and design as follows:

- Provision of elevated deck garden for heritage and green living educational elements with leisure sitting-out area and physical exercise area;
- Provision of light goods vehicles (LGV) parking block to minimize the noise nuisance;
- Provision of tensile cover in the estate plaza for shelter and performance stage;
- Provision of more sitting benches in the ground-floor lobby and external areas;
- Colour scheme and naming of the domestic blocks giving a character to the development in the locality.

5.2 PARTNERING SPIRIT

The Housing Authority has been an active leader in promoting Partnering in Hong Kong Construction Industry. We adopted the Partnering approach to engage our stakeholders, including planners and designers, building, maintenance and property services experts, tenants, users and workers, as well as the community at large for sustainable housing development. We make constant improvement to our system and measure against established targets to ensure that our expertise meets our needs and our services meet the tenants' aspirations.

5.3 PROJECT SPECIFIC PARTNERING

An Initial Partnering workshop was held on 30 November 2006 when the contract was commenced to align the project and construction teams. A Close-out Partnering Meeting was held on 8 December 2009 to review the performance of the partnering arrangement throughout the contract. About two years after occupation, Post completion Review Workshop cum Joint Site Visit was held on 24 May 2011, participated by project team, contractor's representatives and housing manager to gauge feedback and review the handover and maintenance services and overall customer satisfaction. This also serves as a knowledge sharing platform amongst various stakeholders with an aim for continuous service improvement.

6. CONCLUSION

6.1 HIGH SATISFACTION RATE

About one year after occupation, we engaged consultant to carry out comprehensive resident survey through questionnaires and home visits in order to gauge customer's feedback and satisfaction level. A total of 344 interviews were conducted, out of the total 2,938 households residing in the estate. The survey result shows that 96.6% of the households are satisfied with the estate as a whole, and no household felt unsatisfied.

6.2 A SUSTAINABLE COMMUNITY FOR ALL

This is a demonstration project showing the building of a sustainable community and manifestation of our core values of 4C's, namely Caring, Customer focused, Creative and Committed. It took a great journey for HKHA's project team to work with the stakeholders and it turned out to be a rewarding experience with high user satisfaction as reflected in the high satisfaction rate in the customer survey conducted after occupation.

Figure 7: Heritage Trail showcases the history of the old Lam Tin Estate (left), Public Engagement through community art making (right)

Public housing in Hong Kong has made an enormous contribution towards the well-being of the local community for the past 60 years. The experience we gained in Lam Tin Estate made us believe that by striving for sustainable planning, design, construction and management through adoption of suitable technologies and proactively engaging the community, listening to their needs and involving them in the development process help to bring a win-win situation for all parties and thus build up a sustainable living environment.

Figure 8: Community artwork " Infinity" symbolizes the use of Renewable Energy (left), PV panel installation on the roof of the domestic blocks (right)