Design Thesis Manual (Part 2/4) – Sustainability Science
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INTRODUCTION
In this second part of a four-part series about the Design Thesis Manual, the focus is on Sustainability Science, an increasingly popular framework for the final year Design Thesis projects at University of Malaya’s School of Architecture (UM School). This immediately begs the question, why is Sustainability Science gaining momentum in architectural design studies? But before we answer the question, let’s take a look at the definitions of Sustainability Science.

i. Sustainability Science is an emerging discipline that was officially established in 2001 as an academic discipline².
ii. The cultivation, integration, and application of knowledge about Earth systems gained especially from the holistic and historical sciences (such as geology, ecology, climatology, oceanography) coordinated with knowledge about human interrelationships gained from the social sciences and humanities, in order to evaluate, mitigate, and minimize the consequences, regionally and worldwide, of human impacts on planetary systems and on societies across the globe and into the future – that is, in order that humans can be knowledgeable Earth stewards.³

From the second definition it is apparent that the built environment, that is the environment where most architects are operating in, is also where the Sustainability Science framework will be of immense relevance. At the same time, such framework provides the opportunity to conduct interdisciplinary research as well as permitting inter-varsity collaboration, when the researchers/designers consult experts from other universities. This is common sense for Architecture as it fits naturally in the Sustainability Science framework due to its multi-faceted nature (applied science, technology and art)⁴.

Therefore, Sustainability Science in Architectural Design focuses on aspects of sustainable design in general, sometimes referred to as ecological design, bio-climatic design, green architecture and many other terms to describe architectural design products and processes engaged with green issues and concerns.

By using Sustainability Science as the research framework, architects take the role of enablers and facilitators to the design process rather than the architect as simply a form-maker. Form takes a back seat in the ‘Sustainability Science in Architectural Design’ approach, often coinciding with the choice of the utility-type of building. There is less reliance on high maintenance services and equipment in such architectural types, as flexibility of use and the ease of maintenance become two priorities in design⁵. Hence the approach will always be focused on functionality.

Many of our students at UM School took up this challenge in the last three years. Examples of utility-type of buildings as design thesis projects include affordable housing, marine hotel, an adaptive re-use of an existing structure converted to an urban market with rooftop agriculture, up-cycling gallery showcasing art products made from recyclable materials, a shopping mall and a budget airport terminal, both using passive energy systems. The next several paragraphs will describe two design thesis projects that exemplify Sustainability Science in Architectural Design:

- Education of primary school children on the awareness of sustainability issues by Kong Seng Yeap entitled ‘Eco-literacy School at the Forest Research Institute Malaysia (FRIM)’⁶;
- Sustainability issues of a traditional urban village by Siti Yusrime Yusoff entitled ‘Micro-agriculture of Kampung Baru’.

PROJECT 1: ECO LITERACY SCHOOL AT FRIM
This is an example of a Design Thesis that has a lot of potential for experimentation via:

1. Design Thesis becoming a research thesis (masters or PhD); and/or
2. Design Thesis becoming a real life project.

In fact, the Eco-literacy school’s design thesis conceptual framework is currently being further developed by Kong Seng Yeap, who is the designer, in his doctoral thesis by building a Recycling Centre for a primary school in 2011. The project is a tool for investigation by bringing together the disciplines of environmental sciences and social sciences (specifically education and behavioural studies) into architecture.

For his Design Thesis project⁷, Kong consulted experts from other fields including a construction waste expert, an ecologist and an education specialist from local universities to provide much needed input and insight into the research/design problem.

From the beginning, Kong was aware about environmental sustainability as his interest in green issues stemmed from his concerns about nature being divorced from the urban environment, as he stated, “We talked about protecting all the flora and fauna but how do you make people protect something they don’t even know or have not seen before?” Thus, he focused on the education of the child and decided to design a primary school. He further added that his interest in green architecture started in the first year and he avidly read Dr Ken
Yeang’s writings on ideas on sustainability influencing the design thesis project and subsequently exploring it further in his doctoral thesis.

Kong stated that he started the design thesis process by reading environmental books and developed the basis of his design from there. The designer proposed that architecture can be knowledge resource like a ‘3D text book’ and when regular schools adopt clear ecological principles, for example re-using water for toilets and using passive energy systems.

And for the PhD thesis, Kong has carried out ground research at the Green school in Bali and found that that the students there experienced hands-on active learning although they followed the normal curriculum. Kong thinks that active learning at the Green school encourages the use of all senses compared to regular schools’ limited learning experience. The main challenge lies in designing a school that teaches Science and is a text book for knowledge in itself. In the Green school, Kong observed that, “The children talk a lot about creativity and imagination, because the children saw creativity and imagination through the building”.

PROGRAMME AND CONTEXT
Kong’s definition of an Eco-literacy school is “understanding the way things are organized to sustain the web of life, using the school grounds as a teaching resource, with a view to raise awareness about the natural environment, its complexity and its vulnerability.” This means that the Eco-literacy school design placed importance on engaging humans’ multiple senses in the learning process. This is in contrast to the formal Environmental Education (EE) for children in Malaysia, which is often conducted in a featureless classroom, thereby ignoring the interaction with the natural-physical environment. Hence, the design thesis and the subsequent PhD study focus on the issue of how sensory design can turn school environment into an instrument of pedagogy to enhance EE learning.

CONCEPT, IDEAS AND PROCESS
The primary school students understanding about the ‘web of life’ will be experienced while still using the normal curriculum, but will be exposed to...
The ecological learning processes created by the new design. The proposed school works with nature instead of against it. A symbiotic relationship is established between the man-made structure (proposed school) and nature (existing forest) defining the concept of ‘ecological design through sensory learning’.

One of the ideas is by using existing construction waste to rebuild the new school. FRIM was undergoing a relocation exercise on housing for its staff members and families, thus the strategy that the designer has adopted is to recycle the materials from the demolished quarters. Kong estimated that almost 70-80% of the building materials will be recycled and used, such as:

- Second hand windows and doors;
- Second hand bricks;
- Crushed concrete, brick and stone; and
- Re-used timber and lumber.

Kong also explored the idea of rainwater harvesting, firstly, to reduce the amount of rainwater that reaches the forest floor near the buildings. Secondly, the rainwater will be collected and used to recharge the ground water, ensuring the survival of various flora and fauna in the existing forest. The forest also provides a rich source of dried leaves to be composted as mulch to enrich the soil for the roof top plantings. Students will be planting and birds and insects that feed the plants contribute to create more pollination agents for the trees. Additionally, the school will have a raised floor construction to minimize the disturbance to the forest floor ecosystem.

Then Kong toyed with the idea of how the building becomes a 3D textbook. The building is based on a modular kit of parts, where the wall cassettes ‘teach’ by being flexible in its use to store bottles, aluminium cans, plastics, cardboards are made as part of the furniture and screens, reclaimed doors and windows utilized again and the roof as a garden for insulation and utilization.

PROJECT 2: MICRO-AGRICULTURE OF KAMPUNG BARU

Located within a fast-growing city of Kuala Lumpur, Kampung Baru has struggled to keep up with massive urban development while preserving its traditional heritage. The Malay enclave, conceived by the British in 1902 created a Malay ethnic habitat closer to Kuala Lumpur’s centre retaining the villagers’ lifestyle with continued agricultural activities. Siti Yusrime Yusoff’s design thesis provided an alternative vision to the conundrum of Kampung Baru as the Government’s vision is to transform the urban village into a modernized land use filled with high-rise buildings and commercial development similar to the surrounding area. The Government’s vision is viewed to create an unbalanced development where the community does not gain any benefit and at the same time will lose the unique qualities of this urban village with its historically rich architecture of wooden Malay houses and the sense of place created by the daily bustle of activities that exists in a typical village.

The idea of heritage conservation is very much embedded in the aim of this design thesis. Although the problem existed since Kampung Baru is by law not to be resided and developed for other ethnic groups, the issue is always about the physical development but recently through a new bill, there is a possibility of this development happening on a massive scale. Thus the designer, Siti Yusrime who lives with her family in Kampung Baru felt compelled to propose this alternate vision of Micro-Agriculture in Kampung Baru.
PROGRAMME AND CONTEXT

Siti Yusrime proposed that the community practices agriculture in the city and observed that, “There is a lot of herb gardens in between the houses, where I have taken the idea of the herb garden to explore the possibilities of introducing urban agriculture into Kampung Baru”. The designer set out a master plan proposing ‘green linkages’ from the urban village centre to existing green areas and pockets of gardens. By using the backyard and vacant lot, there is an opportunity to cut down on the capital cost and create potential large areas of communal farming. The Kampung Baru centre will be the hub to educate, experience and consume the agricultural products by the community and the public. The designer envisioned that such a concept could be replicated elsewhere and would be a green model that would be propagated in Kampung Baru and other parts of Kuala Lumpur.

Siti Yusrime’s project is not about urban design in the traditional sense and far from form-making. It is purely about content, context and functionality. The design is derived from an economic sense to argue for sustaining the community. The project was ambitious and yet, if one chooses Kampung Baru as a topic, the issue of heritage conservation and the need to review at the master planning level is vital and cannot be overlooked.

CONCEPT, IDEAS AND PROCESS

The proposal micro-agriculture includes a nexus of economic activities brought about by the ‘herbal farm’ idea. The hypothesis of sustaining the heritage buildings and way of life to create a sense of place is transmitted to the concept of a self-sustaining community able to generate its own income. Not all residents would agree but the idea was to use existing plots of land and back yard and even creating urban farm building towers that could generate enough food for the community and even provide additional income. The offshoot economical activities will generate further income such as heritage and food tourism.

Interestingly, Siti Yusrime was first inspired by her observation of chilli (pepper) farming in Kampung Baru, where chillies are the main ingredient for many Malay dishes besides pandan leaves, turmeric leaves and lemon grass, which are the vegetables cultivated on the urban farm towers. Traditional Malay homegardens are also filled with fruit trees such as the rambutan and green mango trees and children love to play in these gardens. In the evenings people would sit and chat leisurely. Increasingly these green pockets are diminishing as the residents would build extensions to build accommodations for rental. The sense of space and place reduced and this would affect the significant character of Kampung Baru.

The designer being a resident of Kampung Baru, idealized and strived for a project that is close to her heart’s concerns. The design thesis also challenged her to deal with difficulties such as servicing the urban farm towers located at the central communal area near the light rail transport station and low cost high rise flats. The designer managed to organize the existing programme and added new relevant ones, additionally providing a much more flexible design by including spaces for gathering activities multi-purpose, in an activity flow, with the surau (muslim prayer hall) next to an open space next to the food eateries area.

Siti Yusrime designed a modular concept purposefully for easier maintenance called a modular farming unit. This modular unit in the urban farm towers provides access to local food sources and promotes self sufficiency on a community scale providing solution to growing food in urban areas. Exploring the principle of sustainable design, she stated that, “With the use of a mirror-like device placed below the floors, I am able to let in more daylight inside the modular unit”. She then thought of how this modular unit will be introduce to the community through training workshops, where it can be apply in the existing green area such as backyard and vacant lot as well.

There were many technical issues to be solved to sustain the farms, so she considered designing spaces for worm farming and how to bring in water to the building to nourish the plants and she had to do calculations and designed for that problem. She wished she had more time to provide an overall view of how things will work from the centre to the backyards.

CONCLUSIONS

Both projects being illustrated in this commentary actually attempt to show us the vast and diverse scopes of study under Sustainability Science. It must be emphasized here that any student/designer who attempts to work within the Sustainability Science framework will have to be familiar or well-versed in ecology as well as the three principles of Sustainable Development (environmental sustainability, social equity and economic prosperity). If the traditional architectural training approach dwells on form-making, or even embraces conventional designs with devices such as rainwater harvesting or solar panel on the roof or mixing passive energy systems with mechanical ones, in order to (perhaps) obtain Green Building certification. Serious Sustainable designs, in contrast, must strive to conceptually make use of the ecological aspects from the very beginning of the design process by placing importance on content, not just on environmental science aspects but also, social equity and functional aspects plus economic sustainability.

The clue to where to start and where to end lies in the Detailed Design stage, where investigations probed earlier with research continued to details and how it would work informs the ideas. The final year school project although it does not get built or will ever get built, will not entirely be based on what was drawn unless the Designer could entirely influence and control the process right until its built, thus its prioritized in terms of (as suggested by Kevin Mark Low, 2010):

1. The nature of its immediate use;
2. The degree of its exposure to heat, cold and/or moisture;
3. The ease of its function and continued maintenance; and
4. The nature of its finish and appearance.

Thus the functional approach is suggested to be the basis of an ecological design imbued with Sustainability Science that makes it complete when content is prioritized rather than form and that is why Sustainability Science becomes an attractive framework to new design approaches. Of course, we would underline Steve Jobs message to the architects when he said, “People don’t know what they want until you show it to them”.

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5 Recently, the Eco-literacy School has been awarded a grant from the Government of Malaysia, because it is seen to be fulfilling the agenda for exploratory and interdisciplinary research. This proves that the design thesis is an excellent vehicle for exploring original work in the field of architectural design, thus compelling the architectural fraternity and building industry to rethink the traditional and vocational origins of schools of architecture in Malaysia.