

Hospital Design in Tropical Malaysia Towards a Green Agenda

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“Sustainability” is a broad concept and a requirement in building designs that tend to be abused by trends and over commercialisation. In the area of hospital design, new is usually associated with being modern, and therefore green. In the quest to distinguish the “tree” from “the forest” with regard to the hundreds of existing hospitals, ranging from colonial to early independence up to the new hospital designs, a yardstick to measure those that are actually “green” and “sustainable” needs to be set. This study intends to provide a qualitative definition and recommended criteria for green hospital designs in the context of the tropical climate of Malaysia and its people. A qualitative approach using case studies of hospital designs from the pre-colonial period to the present day was used. The study includes aspects of the physical architecture that significantly affect health, i.e. the building configuration, form, spatial quality, materials used and culture. Findings indicate that the degree to which green factors are implemented in the different designs varies; intuitive and regulatory approaches to green considerations in the design were seen. The constraints where compromises must be made as a priority include site conditions, costs, construction time, planning time, expertise, experience and procurement methods. The significance of the findings will contribute to the qualitative criteria of the green requirement in health-care buildings, especially for the tropical climate of Malaysia.

Keywords: *tropical, hospital, design, green*

INTRODUCTION

The term sustainability may give rise to a variety of understandings and perspectives, depending on the context in which it is used. Sustainability in architecture goes beyond the physical elements of walls, floors and façades; it has spiritual significance and its meaning derives from the continuity of the architecture of the place to the overall built heritage.

The main priority of sustainability for healthcare buildings and design is its ability to function, support operations, and efficiently serve the users, i.e. the patients, staff, relatives, visitors and equipment, around the clock. Healthcare buildings have to be designed for hygiene and infection control, and ease of circulation; they must have adequate space and ventilation, and the capacity to function; and they must be safe and

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comfortable and provide a supportive healing environment.

In tropical countries like Malaysia, the natural location of hospitals has been idyllic locations such as the sea or hill-sides, with windows that can be opened, high ceilings and wide *verandahs* all around (Figure 1).



Figure 1. The single-storey colonial hospital architecture of a tropical hospital in a garden. Source: Balik Pulau Hospital, Penang website.

These types of facilities still exist in most parts of the country. Although some have been replaced others are being reused and are undergoing constant renovations, expansions and refurbishments to meet the current medical needs and demands. Hence the original design intentions of the tropical hospital situated amidst the greenery and fresh air were either ignored due to the pressing priority of functional adjacent spaces and circulation, or mismanaged during renovation work.

Each new wave of the structural planning of urban sites brings proposals for new land uses due to the commercial viability of the land for resorts, residential apartments or any other facility that would bring more economic resources to the city or town as part of its sustainability agenda. Hospitals, with their conflicting roles of centrality and isolation,

bringing multi-faceted supplies and disposal in huge quantities, layers of building services, ranges of technologies and energy consumption, contribute to the environmental issue. Hospitals are the second highest energy consumers on a per square foot basis after the food service industry.

Designing new healthcare facilities is not an easy task. Professional architects and health facility planners who plan and design hospitals, a daunting task in itself, need to add the green and sustainable facility to the matrix.

In light of these “movements” across the globe, Malaysia had formulated its own green index under the Malaysian Green Building Index (GBI) for residential, non-residential and industrial buildings to date. As Malaysia is located in the tropics, the GBI is formulated to consider the environmental and developmental context, and the cultural and social needs, specifically for the tropical climate. However, as the GBI for hospital buildings has yet to be formulated, the Malaysian healthcare service provider opted to adapt the foreign standards of LEED, BREAM, or, nearer to home, the Singapore Green Mark, into the building contract brief of requirements.

All hospital designs are subject to the Uniform Building Bylaws (UBBL) 1984. For health and safety purposes the UBBL incorporated the minimum requirements of passive design considerations for users. The design of private hospitals in Malaysia is also governed by the Private Healthcare and Services Act 1998 in addition to the UBBL. The UBBL, however, do not provide mandatory requirements on energy consumption or intangible sustainable issues relating to culture or the clinical process

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dures required in the holistic make up of a healthcare environment. Specialised buildings such as hospitals have specific design requirements put forward by knowledgeable clients or their advisors.

The objectives of this paper are to:

- ascertain the meaning of “green” and “sustainability” in the design of hospital architecture in the tropical climate of Malaysia in view of its architectural sustainability and clinical functionality;
- provide direction for qualitative design guidelines as a rule of thumb in recognising good and practical green hospital designs, in view of the green agenda for hospitals in the tropics.

For the purpose of this paper the scope of the study involves:

- identifying available “green” and “sustainability” standards or criteria for hospital building design in the tropical climate of Malaysia;
- examining the physical and non-physical or humanistic development of selected hospital designs through case studies of hospitals built in Malaysia from the colonial period to the present.

The qualitative method adopted for the study involved data collection executed within a limited time frame. The process involved obtaining both primary and secondary data: primary data from observation, field visits to selected hospital facilities, random interviews with professionals (architects, engineers and green specialists) and clients, as well as personal experiences in the planning and design of hospitals; and secondary data from the content analysis of available literature covering the study of old

and new photographs and previous field study notes.

The findings and analyses of the “green” and “sustainability” aspects of these hospitals were based on selected site location, building layout and configuration, built form, internal planning strategy or spatial quality, materials used and construction, as well as culture. The tangible and intangible green elements assessed included each facility’s general orientation on site; each building structure’s access to natural ventilation, views and daylight; layout or planning designating specific areas of the building for controlled conditions; internal space planning strategies for infection control; natural ventilation; access to views, daylight and family members inside and outside the clinical area; adequate human circulation and orientation; and respect for the local culture and context.

This paper intends to contribute aspects of qualitative considerations in the green planning and design of hospitals for the tropical climate of Malaysia.

ISSUES AND DISCUSSION

This paper discusses exemplar hospital architecture as a universal attribute focusing on the implication of it being located in the tropics. The issue was brought to the forefront with claims that new hospitals are designed with green and sustainable considerations, whereas past hospitals were not. The hypothesis is that these remarks were made without an understanding that the concept of green and sustainability for a hospital goes beyond the passive and active design attributes reflected in the performances of the physical structure and touches on those that embrace the clinical functionality and humane aspects of a healing environment.

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Hospital Architecture in the Tropics

Each community, depending on where it is located, has different terms for its built facilities, built forms and ways of addressing the sick in accordance with its culture, belief systems and traditions. Asian cultures have not left much evidence behind with regard to hospitals or healthcare buildings, especially in the tropics, that can be studied or emulated. Built structures or shelters to house the sick, such as hospitals in their present-day form, hail from the Western and Middle Eastern evolution of houses of charity, churches, palaces and secular buildings for the sick or Bimaristan, as well as from the training of medical and health professions. Building typologies for hospitals in the tropics are relatively new. Even in the tropics, the early “pavilion plan” hospital design inadvertently came from the same source, i.e. 18th century France (Cook, 2002), so the design of hospital buildings is almost universal worldwide. So how can hospitals built in the tropics differ in order to be sustainable and effective?

Physically, as a shelter for the sick, Kleczkowski (1983) stated that the planning and design of hospitals should consider the local climate and the region's typical approach to architecture, i.e. by providing simple low rise buildings connected by corridors as shown in Figures 2 and 3; utilising local building materials and construction methods; designing to respect local customs and habits: ensuring affordable costs; guaranteeing reliability in terms of operation and maintenance; as well as serving the functions and users of the facility.

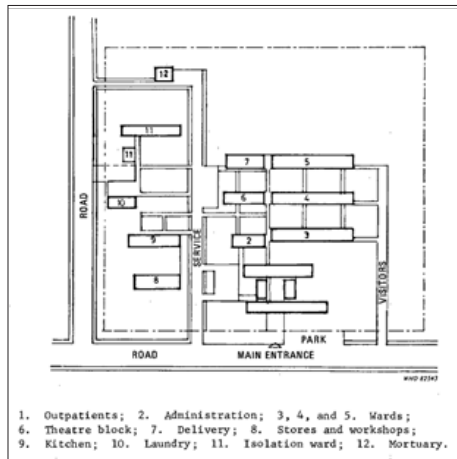


Figure 2. Typical hospital layout in tropical developing countries. Source: Kleczkowski, 1983.

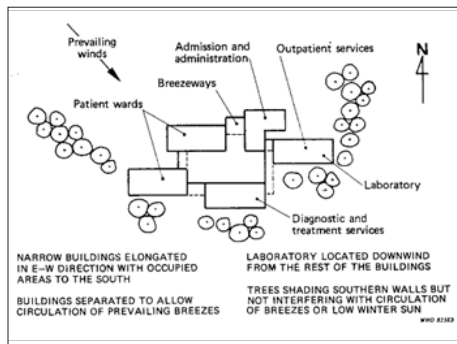


Figure 3. Typical hospital layout for countries with a hot humid climate. Source: Kleczkowski, 1983.

WHO, following on from the study edited by Kleczkowski (1985), described the different implementation of “standard designs” and “type plans” through case studies of selected healthcare facilities in various countries by looking at their income levels. The study of acceptable internal micro-climates in the physical planning of hospitals in the selected countries, i.e. Venezuela, Cuba, Senegal, Sudan, Zambia and Algeria, all located within the tropics, showed that the design of most of the facilities allowed for artificial ventilation at es-

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sential areas with the majority orienting their buildings to capture the prevailing winds. However, most facilities in these countries, except for Cuba, had difficulty in maintaining acceptable levels of artificial ventilation or air conditioning in sensitive areas for several reasons, which included inadequate maintenance and locations within small courtyards that were too small and thus had less air circulation. The study also reveals the importance of site selection as a priority, in compliance with the prevailing local socio-cultural preferences in the making of the design.

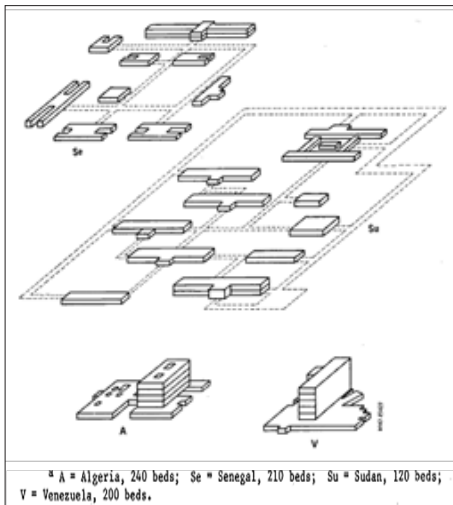


Figure 4. Comparative evaluation of design efficiency – horizontal and vertical. Source: Kleczkowski, 1991.

The discussion on construction methods and the use of building materials in hot-humid countries highlighted the following issues:

- durability and strength of the building materials used in extreme weather conditions of heat, rain and flooding;
- workmanship due to unskilled labour;

- maintenance culture and skills aside from the passive design discussed earlier;
- availability of constant supplies of water, electricity;
- waste treatment.

Findings by Ziqi Wu (2011) showed that improving the performance of thermal comfort through design sophistication, as found in recently completed hospital buildings, did not necessarily achieve the desired outcomes with respect to simple hospital designs.

In summary, the utilitarian architecture of past hospital designs addressed both functional aspects as well as climatic considerations so as to ensure less maintenance. Today, hospitals are generally designed independently by different architects for different service providers with different philosophies. Hence, present-day hospital designs are not uniform. Old hospitals may not be sustainable or comply with the new requirements of healthcare buildings, but whether the new hospital buildings are sustainable or green, as claimed, has yet to be evaluated.

Hospital Design: Towards a Green Agenda

The hospital represents a building typology with ever conflicting attributes in one cauldron; for those with a green agenda, issues of “architectural sustainability versus clinical functionality” arise.

Definition of Sustainability in the Hospital Context: Architectural Functionality
Sustainability, as defined by Verderber (2010), involves more than the ecological or economic context. It is

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a holistic approach that incorporates supply-demand tensions, priorities over limited resources such as clean air and water, a livable climate, a healthy standard of living, the community, spiritual and psychological health, meaningful work, intellectual openness, individual and social empowerment, a sense of heritage and history, cultural diversity, art, music, and everyday life.

Yeang (2012) informed designers not to mistake green design as simply focusing on eco-engineering systems and the use of rating systems, although these are an important part of the process and serve as a generic checklist for green design. In the context of designing a hospital, Yeang's principle emphasizes the importance of understanding the very nature of the building as an artificial element; its function, operation, outcomes and impact on the environment will undoubtedly provide insight in the selection of the appropriate site, and into its current and future growth, inter and intra spaces, shapes and configurations.

Both Verderber and Yeang's viewpoints concur with the Islamic perspective of the environment in balance with manmade edifices, be they hospitals or other constructions. The concept of mankind as a stakeholder of development, as a vicegerent on Earth, implies a duty of care in managing the limited resources so as not to waste them but turn them to the benefit of mankind and the environment in a holistic sense, as an act of submission to the Creator for sustainability.

Clinical Functionality: Healthcare Requirements for Hospitals

The clinical functionality of a hospital is based on an environment that places "pathogenic" criteria as a priority. Hospitals include various functions that require different working environments for people, equipment, and pathogens. While there are areas that require low energy and environmental control such as general wards, waiting areas, cafeterias and corridors, due to their location within a bigger envelop these areas are also subjected to environmental control.

The Humanistic Function of a Hospital

Pellitteri and Belvedere (n.d.) introduced aspects that are rarely brought up in hospital design and that relate to the role of hospitals within the city and the community. This role includes recovering values that differ from those of quantity and function characteristic of modern hospitals in the first half of the twentieth century.

The process of humanization involves a holistic vision of people, design environments and spatial distributions that fulfils the needs of the patient (a sense of acceptance and familiarity, respect for privacy, space and sensory comfort, ease of orientation) and at the same time minimizes stress factors. A humanization project can be implemented through the distribution and composition of spaces, the shape of the exterior volume of the building, views to the outside, green areas (gardens) and worship spaces, furnishings, materials, finishes, colours, signage, lighting (both natural and artificial), and elements of visual reference (e.g. art installations).

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In the quest for architectural sustainability and clinical functionality, despite the constant dilemma facing hospital planners and designers of how to effectively balance the physical requirements, innovative approaches and outcomes should be constant factors.

MALAYSIAN HOSPITALS: TOWARDS A GREEN AGENDA

Malaysia is located within the tropical equatorial zone, with latitude and longitude at 2° 30' N and 112° 30' E respectively (refer to Figures 7 and 8).

Malaysian general climatic data, retrieved from Malaysian Meteorological Department (MMD) 2012, as cited in Norita Johar's (2012) thesis. See Table 1 for temperature and Table 2 for wind direction.

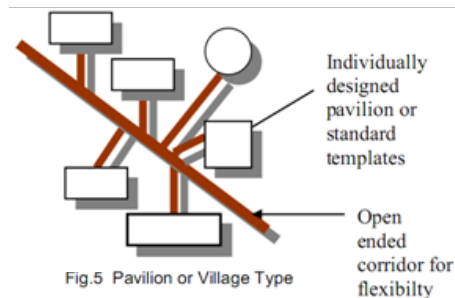


Figure 5. Pavilion building form. Source: Norwina Mohd Nawawi & Srazali Aripin (2004).

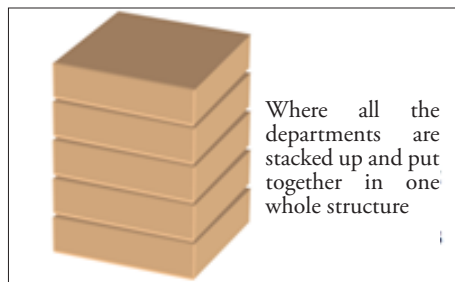


Figure 6. Compact or Stacked Building Form. Source: Norwina Mohd Nawawi & Srazali Aripin (2004).

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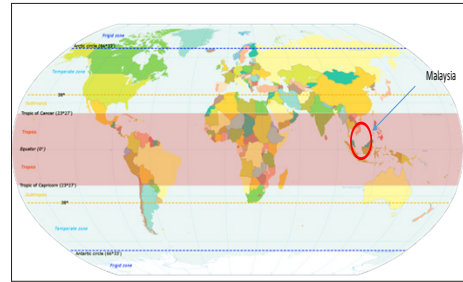


Figure 7. Location of Malaysia in the tropics. Source: Worldmap indicating tropics and sub-tropics. Retrieved August 12, 2013 from <http://en.wikipedia.org>.



Figure 8. Map of Malaysia in the tropics. Source: Malaysia latitude and longitude map. Retrieved August 12, 2013 from <http://www.mapsofworld.com>.

Climatic Data	
Average Minimum Temperature	24°C or 74°F
Average Maximum Temperature	33°C or 90°F
Average Low Humidity	74%
Average High Humidity	89%
Average Wind Speed	7.7 m/s

Table 1. Malaysian general climatic data. Source: MMD 2012, as cited in Norita Johar's (2013) unpublished thesis.

Factors	Descriptions
Wind direction	Northeast & Southwest
Outdoor wind speed	As measured
Building orientation	Facing wind direction
Building	Shape, depth, size, volume
Openings	Size, location

Table 2. Factors affecting natural ventilation. Source: (NIBS (2011), Ghiaus et al. (2005), Allard & Santamouris (1998), Jiang et al., (2003), as cited in Norita Johar's (2013) unpublished thesis

As regards the disease patterns of the tropics, Malaysia in particular, being hot and humid, is also a haven for vector borne diseases carried, among others, by mosquitoes that cause malaria and dengue fever.

Hence, when focusing on a green agenda, Malaysian researchers, while busy defining and refining the parameters for a green hospital, should also note the conflicting implications the recommendations would make in combating some of the diseases.

The Malaysian authorities, with respect to the nation's green agenda, worked on many aspects of implementation through regulations, best practices and contractual obligations.

The brief and fragmented research on different hospital buildings has provided an idea of what the preferred environmental conditions of hospital design should physically and conceptually "look" like for similar conditions. The guidelines, however, do not spell out the climatic conditions.

Hence detailed studies are required, not only for each hospital building forming part of an entire complex but for each locality in Malaysia. For this brief study, case studies were selected to represent specific periods in which hospitals were built to give insights into what lay behind the decisions of the architects as designers of the time, and the respect and consideration given to the various factors in play at that time and place, for the design of truly complex buildings in the tropics that still exist today.

CASE STUDIES OF SELECTED MALAYSIAN HOSPITAL DESIGNS THROUGH THE AGES

Selected hospitals that represent the periods identified as: Colonial / Pre-independence; Post-Colonial / Independence 1960s and 1970s; Towards Nation Building & Health for All 1980s-1990s; and Towards a Developed Nation 2000s to present, were analysed using a qualitative method based on the criteria listed below:

1. Site location (orientation/organization/topography);
2. Building configuration and layout (compact or sprawling layout, building shape – deep or thin);
3. Built form, materials used and construction details (low rise, high rise);
4. Internal planning strategy (clinical, humanistic);
5. Cultural and humanistic values.

ANALYSES AND FINDINGS

Summary of Analyses

Healthcare facilities including hospitals are not a traditional building typology in old Malaya or present-day Malaysia. Traditionally all illnesses were treated at home. These facilities were brought by colonial masters as early as the 15th century, first from Portugal, then Holland, and most recently Britain, through its East India Company and North Borneo Company. The British deployed similar designs from India and Africa in Malaysia.

The Colonial period witnessed pavilions and climate-friendly building typologies as illustrated in Figure 9, brought over by the British from other parts of the colony with a similar climate and adjusted on site by British soldiers.

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Table of Hospital Accommodation.											
The date of the construction of the native artillery and European hospital is not known. The native infantry hospital was erected in 1860. Total number of wards, 5. Total regulation number of beds, 46.											
Wards. No.	Regulation Number of Sick in each Ward.	Dimensions of Wards.				Cubic Feet per Bed.	Superficial Area in Feet per Bed.	Height of Patient's Bed above the Floor.	Windows.		
		Length.	Breadth.	Height.	Cubic Contents.				Number.	Height.	Width.
Native Infantry Hos- pital, 3 - -	14	Ft. 80	Ft. 18	Ft. 19	49,590	1,771	93	2 6	{ 27 12	2 6 7 0	5 0 5 0 vents. 3 6
	7	39	15	19							
	7	39	15	18							
European Artillery, 1	10	38	19	10	7,220	722	72½	2 6	5	5 0	3 6
Golindauze, 1 -	8	27	18	10	4,860	607½	27	2 6	4	5 0	3 6

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Table 3. Statistical table of hospital accommodation in Pinang (Penang). Source: *The Commissioners, The Report of the RCSSAI, Vol. 2.*

Table 3 demonstrates the standards exercised throughout the British Empire. Upon independence in 1957, with a view to nation building and meeting the WHO's "Health For All" agenda by 2000, Malaysia embarked on a hospital building programme to replace old hospitals as well as construct new ones at new hospitals sites with "standard" and "type" plans.

In the late '80s and '90s, with the advent of Information and Communication Technology (ICT), mechanical means of transporting goods and information, medical discoveries and changes in medical practices meant that the adjacency of functional departments was no longer critical and they could be placed elsewhere. Similarly passive design requirements, with the advent of medical breakthroughs, considered the welfare of patients in relation to the importance of natural daylight and views in care settings.

The series of hospital designs produced in the year 2000 witnessed the sprouting of more one-off designs for even smaller hospitals, including healthcare centres. With more rural areas becoming

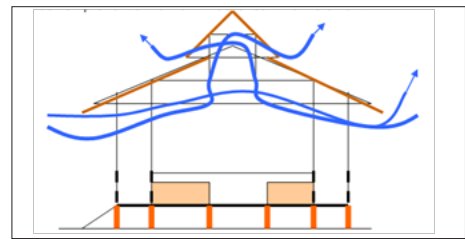


Figure 9. Typical cross section of a single-storey Colonial hospital ward pavilion. Source: Norwina Mohd Nawawi and Suzali Ariffin, 2004.

ing urban due to extensive development and the opening up of new areas, architectural structures at district level which were once simple had evolved into more sophisticated structures using more mechanical means. As care was the priority, the introduction of outreach facilities, such as haemodialysis and intensive care units, which require indoor controlled environments, on the doorstep of the people, added to the energy requirement of former low-energy hospitals.

With urban centres becoming heat islands, it became imperative to sustain human comfort in almost all public facilities by using air conditioning systems. Culture had it that air-conditioned spaces in clinics and hospitals

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were a mark of progress as it signified comfort for both patients and their accompanying relatives. Hence air conditioning was introduced in all waiting areas of hospitals and clinics. Hospitals built during this period, due to their location within cities and the clashing of requirements within the hospital departments themselves, caused many problems among which were condensation issues. This led to the growth of mould in many hospitals. The government had to address the problem technologically on site for already existing problems and provide guidelines for new ones including the need for design simulation for new projects.

Today, the towards a developed nation approach requires new project briefs to incorporate green requirements. All public hospitals are expected to adhere to these requirements with a certain weightage being given to design evaluation. In the public sector, clinical functionality takes priority in design decisions over everything else after the bottom line has been set. However, implementation and monitoring remain difficult due to the priority of needs when the project commences, the lack of experienced human resources to monitor and make deci-

sions and most of all the will to make it happen on the part of builders under certain procurement methods. Hospitals designed in this period tried their best to avoid deep plans and flat roofs, and to provide wider corridors and patient areas with access to natural daylight, and more space for respite. Being in a tropical climate, the Ministry of Health Malaysia calls for “mosquito free” hospitals. Water and lush plants brought into gardens create a humid environment and thus a haven for mosquitoes. So do designs with water features to a certain degree.

Recently, more private sector healthcare providers answered Malaysia’s call for the integration of services and health tourism by complementing the public sector healthcare provisions. The latest project, “healing hands”, was introduced as a concept by Nightingale Associates in association with the Malaysian firm M&R Architects. The project promises a green agenda with state-of-the-art technology, materials and the concept of care enveloped in finger-like forms. The project won an international design competition held by leading private healthcare provider KPJ Healthcare Berhad.



Figure 10. The Healing Hand Hospital, Kumpulan Perubatan Johor. Source: Nick Varey on Aug 3, 2011 from *Habitable*, Johor Bahru Hospital, Malaysia – Nightingale Associates.

Summary of Findings

A review of the colonial period up to the present day shows that the demand on physical facilities, the environment and medical development have evolved tremendously over time. The idea that a “new” hospital building should be a better building is relative. Location, the level of care, population, site size, planning decisions, project priority and moment in time are among other criteria that define whether a hospital is green and sustainable.

Each hospital analysed has its reasons for being built the way it is which depend on the site orientation or site conditions, despite the north and south facing norms for the Malaysian climate conditions. In the design of the modular block for Colonial and post-independence hospitals, due to the functional requirements of certain buildings that require daylight, ventilation and views, the orientation positioning is compromised according to the best option at the time. The situation is similar for new developments especially in cities, as the sites are islands with minimal space for achieving the best orientation with respect to the evening sun. While newer hospitals have to opt for compact designs, older hospitals can sprawl having the luxury of a site and location either on a hill or at the coast. Similar findings concerning the layout and built form, aside from the standard plan or nucleus hospital, pointed to the site as one of the main factors that shapes its layout.

Older facilities provide simple and effective solutions for protection against the rain, heat and glare through passive and intuitive designs. Newer facilities, due to conflicting requirements, require more technological solutions. With patient and human-centred care in newer hospitals, the duplication of certain service areas for both patient and staff convenience is evident and expected.

The materials used are always the most robust at the time of construction in order to combat the wear and tear of a hospital, infection control containment, and noise abatement, and the colours are symbolic of a place of care; they range from cement render, to tiles and terrazzo. Humanistic values are demonstrated through the culture of use and the indirect provision of a healing environment achieved through orientation, respite spaces, relative waiting areas, staff rest areas and the simple provision of spaces for prayers and meditation, with views, daylight and access to the gardens and therapy spaces.

CONCLUSIONS

The initial purpose of this study was to define “green” and the concept of “sustainability” in the design of tropical climate hospitals for Malaysia with the objective of contributing qualitative attributes for the formulation of the Malaysian Green Building Index for hospital buildings. The study defines sustainability for a hospital, which differs from the general physi-

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cal definition due to clinical requirements and the nature of conflicting spatial requirements with humans as the central users and the healing environment as the supportive aim.

According to Verderber (2010), Yeang (2012), ZiQu Wu (2011), Srazali Aripin (2007), Pellitteri and Belvedere (n.d.) and Burpe (2008), sustainability that embraces the green requirements in healthcare facilities should also embrace the notion of creating a supportive environment (i.e. healing environment) that is physically healthy and psychologically appropriate. The physical aspects should be cleverly designed to achieve the balance and principles of economic, social and ecological sustainability without compromising the functionality of the hospital building (Burnet, 2004). Thus achieving sustainable hospital design through appropriate physical aspects is not an impossible task. The growing research evidence compiled by local researchers and the case studies of Malaysian public hospitals presented above unequivocally suggest that the physical aspects play a significant role in the creation of a healing environment. It is important to note that in the context of hospital buildings, measurable patient health outcomes in a healing environment are the indirect result of the appropriate design of physical aspects. The effort to reduce dependency on artificial lighting would directly contribute to the energy consumption of hospital buildings, subsequently assisting sustainability.

Unlike temperate countries, professionals engaged in healthcare projects

and services in Malaysia should be inspired by the availability of the natural environment in the Malaysian climate without sacrificing clinical functionality and design visions. We must accept the fact that the design of a hospital to create a supportive and healing environment as well as a physically healthy and psychologically appropriate one is a multidisciplinary effort that can contribute to a sustainable design. The step towards one-off design for public hospitals in Malaysia through an improved procurement system is a commendable starting point as each location requires a customized design to overcome contextual issues. However, constraints on the physical aspects to meet environmental requirements should be explicitly stated in the design briefs for any hospital development and for the designer to comply with. These requirements must be validated by healthcare designers and approved by the healthcare providers.

In conclusion, the findings of researchers and from the case studies of existing hospitals found that the respective periods provide peculiar and interesting physical solutions derived from the construction details through to the implementation of standards and UBBL. Humanistic requirements derive from the scale, proximity and care requirement and are intuitively woven into the design. These findings could be significantly integrated in a document to reinforce the project briefs provided by the healthcare provider (Ministry of Health Malaysia) as well as the general green guidelines for hospitals in Malaysia for a healthy population.

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REFERENCES

- Burnet, L. (2004). Healing Environment, *Contract* Vol. 46, Issue 9; Career and Technical Education.
- Burpee, H. (2008). *History of Healthcare Architecture, Integrated Design Lab Puget Sound, 1*.
- Cook, G. C. (2002). Henry Currey FRIBA(1820-1900): Leading Victorian hospital architect, and early exponent of the "pavilion principle". *Postgraduate Medical Journal*, 78.
- Kleczkowski, B. M. and Pibouleau, R. (ed.) (1983). *Approaches to planning and design of health care facilities in developing areas. Vol. 4*. WHO.
- Kleczkowski, B. M., Montoya-Aguilar, C., and Nilsson, N.O. (ed.) (1985). *Approaches to planning and design of health care facilities in developing areas. Vol. 5*. WHO. WHO OFFSET 91.
- Ministry of Health Malaysia (2012). *Guidelines on Prevention and Management of Tuberculosis for Health Care Workers*. Ministry of Health Malaysia. Occupational Health Unit, Disease Control Division.
- Hanita, N., Majid A. et al. (2011). Climate Responsive Strategies versus the Cultural and Religious Dimensions in the Architecture of Malay Traditional Houses. In Nawawi, M. N, (ed.). *Malay Vernacular Architecture-traditional and contemporary expressions*. Kuala Lumpur, IIUM Press.
- Hanita, N., Majid A. and Hussaini, I. U. (2011). Islam and the Concept of Sustainable Development. In *The Islamic Quarterly, in the Fourth Quarter* 1432/2011, Vol. 55, No. 4, The Islamic Cultural Centre and London Central Mosque.
- Norita Johar (2012). *The Feasibility of Open Wards For Airborne Infectious Isolation Use During Seasonal Pandemic Crisis: A Case Study of Sungai Buloh Hospital*. A thesis presented to the Kulliyah of Architecture and Environmental Design of International Islamic University Malaysia in partial fulfilment of the requirements for the Degree of Master of Science (unpublished).
- Nawawi, N. M., and Aripin, S. (2004). Comparative Study on Passive Design Considerations on Selected Hospital Designs in Malaysia. Paper presented at a Seminar on *Passive Design Consideration in the Built Environment* from November 22-23, 2004 in KAED, IIUM, Malaysia.
- Nawawi, N. M., Hanita, N., Majid, A., Rahim, Z.A., Sopian, A.R., and Denan, Z. (2013). *Configuring The Nature of Colonial Hospital Architecture in Peninsular Malaysia - Serie 1: Special Studies on The Tuberculosis Ward and Hospital Administration Building Typologies of Kota Bharu Hospital*. Unpublished study report.
- Pellitteri, G., and Belvedere, F. (n.d.) *Characteristics of the Hospital Buildings: Changes, Processes and Quality*. University of Palermo.

version for review of the authors

Aripin, S. (2007). Healing Architecture: Daylight in Hospital Design, *Proceeding of Conference on Sustainable Building South East Asia*, November 5-7, 2007, Malaysia.

Aripin, S. (2012). The Role of Daylighting in the Green Built Environment. *Proceeding of the International Conference on Green in Built Environment (ICGBE) 2012: 'Green' Built Environment: Redefined*, Kuliyah of Architecture and Environmental Design, International Islamic University Malaysia.

Verderber, S. (2010). *Innovations in Hospital Architecture*. London: Routledge.

Yeang, K. (2006). *Ecodesign, a manual*

for ecological design. London: Wiley-Academy.

Yeang, K. (2012). Green Design and Planning. Keynote paper for Session 3: *International Conference on Green in Built Environment (ICGBE) 2012: 'Green' Built Environment: Redefined*, Kuliyah of Architecture and Environmental Design, International Islamic University Malaysia.

Ziqi Wu. (2011). *Evaluation of a Sustainable Hospital Design Based on Its Social and Environmental Outcomes*. A thesis presented to the Faculty of the Graduate School of Cornell University in partial fulfilment of the requirements for the Degree of Master of Science.