ABSTRACT

The right to health as defined by the United Nations Office of the High Commissioner of Human Rights (OHCHR) includes any service or facility that aids to bridge the gap between health and sickness (OHCHR 25). Whilst still in a phase of infancy, a new field of architecture – therapeutic architecture – has begun seeing its first applications although this is currently limited to a first-world context. There is a need to investigate the potential applications in a developing world context and this is of particular interest to disaster-vulnerable Indonesia. Indonesia is a country plagued with many natural disasters which consistently afflict widespread damage and destruction. These disasters have a significant impact on the growing number of rural, lower-income communities which, as a result of each disaster, are pushed further back into poverty and often even further away from access to adequate healthcare. This situation is made worse by the corruption and poor infrastructure of the country.

This thesis investigates the potential application of therapeutic architecture in a low-income community in central Java. As access to healthcare is identified as intrinsically linked to the region's vulnerability to disaster, this thesis also considers the need for a wider disaster responsive approach. Therapeutic goals already established by existing research are considered through the design of a disaster-ready community health centre. This health centre will serve as hub for the region, providing both eastern- and western-based health care, as well as teaching and meeting spaces. The design proposes a holistic response, which provides access to primary health care while also establishing a therapeutic environment which supports patient healing and well-being.

This thesis conducted an in depth analysis of research on therapeutic architecture and existing precedents, and specific methods were extrapolated through a series of design

iterations. A range of media were employed – for example, digital and analogue modelling, hand drawings, and digital rendering – to iterate multiple outcomes. A couple residing within the local community, as well as a group of healthcare professionals, were approached during the investigative phase to help inform the design process.

This thesis aims to encourage and open the discussion into the application of therapeutic design to a developing world context. The scope of this thesis is limited to a selection of well-researched principles from three main perspectives – namely, evidence-based design, salutogenic design, and phenomenology. It is acknowledged that many factors and perspectives currently exist which could not be covered by this thesis. However, the intention of this thesis is to draw illustrations at a more general level in order to encourage further investigations within this area. While this investigation specifically responds to the unique needs

of Central Java, it is hoped the conclusions not only build upon and challenge the existing body of work, but also open new opportunities for discourse in therapeutic architecture.

HEALING SPACES

INVESTIGATING THE THERAPEUTIC POTENTIALS
OF ARCHITECTURE IN SEMI-RURAL CENTRAL JAVA.

BY

CORINNE YINMING LEE

A 120-point thesis submitted to the Victoria University of Wellington in partial
fulfilment of the requirements for the degree of Master of Architecture (Professional)

Victoria University of Wellington
School of Architecture, 2015

ACKNOWLEDGEMENTS

Thank you, friends and family for 'be-loving' (believing & loving) in me all these years.

Daniele, your belief in me as supervisor and teacher has inspired and helped me discover my love for teaching. I hope we have blessed you in the same measure you have us. For all your love, thank you.

Carinnya, Zaed, Milly and Ash: I will treasure the times we fell to the floor together. For those moments, we will forever be family.

Daniel and Diana, this is a token of our friendship. Without you two, I would not have seen the Light. You reminded me who Love is. This is my piece of art I return to you both.

Mum, Dad, Jen, Brent, Carol, Galvin, Hans, Jo and Baby Sophie: for never giving up on me, even when I very nearly (on many occasions) almost gave up on myself, thank you.

Special thanks to the Soukotta's and the wonderful team of health professionals for investing into this small contribution of architectural research.

ww

And thank You's for those quiet prayers that always covered me as I went about my days.

Cheers!

TABLE OF CONTENTS

II Abstract

VII Acknowledgements

PART ONE - Research Investigations

1 *Chapter 1: Introduction*

- 2 1.1 The Right to Health
- 3 1.2 Architecture and Therapy
- 5 1.3 Disaster-Vulnerable Indonesia
- 5 1.4 Research Aims and Objectives

9 *Chapter 2: Literature*

- 11 2.1 The Current Status of Architecture and Therapeutics
- 12 2.2 The Physiology of Healing
- 12 2.3 A Scientific Perspective – Evidence-Based Design
- 17 2.4 A Psycho-Physiological Response – Salutogenesis
- 18 2.5 A Philosophical Perspective – Phenomenology
- 19 2.6 An Alternative Approach

21 *Chapter 3: Precedents*

- 22 3.1 The Sarah Network
- 24 3.2 The Maggie's Centres
- 26 3.3 The Butaro Hospital Compound
- 28 3.4 Cassia Co-Op Training Centre

33 *Chapter 4: Site Selection*

- 37 4.1 Site 1 - Balai Karangan, Borneo
- 41 4.2 Site 2 - Tawangmangu, Central Java
- 44 4.3 The Selected Site

49 *Chapter 5: Site Analysis*

- 50 5.1 Detailed Site Analysis
- 52 5.2 Programme Review

PART TWO - Design Research

55	<i>Chapter 6: Preliminary Design</i>	
58	6.1	Spatial Planning
58		- Sacred Loci
60		- Participatory Process
67		- Analogue & Digital Iterations
77	6.2	Form Development
77		- Sacred Loci
77		- Analogue & Digital Iterations
88		- Vernacular
92		- Hand-Drawings
101	<i>Chapter 7: Developed Design</i>	
128	<i>Chapter 8: Conclusions & Critical Reflections</i>	
128	8.1	Healthy Living Environments
128		- Natural Light & Protection from Glare
129		- Way-finding
130		- Social Spaces & Nature
131		- Adequate Ventilation
131		- Reduction of Disease Transmission
132	8.2	A Vernacular Response
133	8.3	Pre- Versus Post-Disaster
135	8.4	Methodology
136	8.5	Participation
137	8.6	Conclusion
141	List of References	
146	Sources of Figures	
151	Appendix

1 / INTRODUCTION

Defining healing and the role of architecture in therapy

The Right to Health

The World Health Organisation (WHO) defines health as “the state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity” (“Preamble to Constitution” 100). Many international treaties, including the Constitution of the World Health Organisation consider the ‘right to health’ an inclusive entitlement for all, stating:

the extension to all peoples of the benefits of medical, psychological and related knowledge is essential to the fullest attainment of health, [and] informed

Figure 2 - *The extent of ashcloud on life.*

opinion and active co-operation in the part of the public are of the utmost importance in the improvement of the health of the people. (“Preamble to Constitution” 100)

In addition to the provision of access to primary health care; essential and nutritious food; and adequate sanitation, this definition implies the provision for any “underlying determinants” that may facilitate the goal in achieving the fullest attainment of health (OHCHR 3). These have been defined to include the provision of healthy occupational and environmental conditions, as well as the access to health-related education and information (UN Economic and Social Council 10).

Architecture and Therapy

An emerging field in therapeutic architecture sheds light on the impact of spatial environments on supporting physiological healing, challenging the current role and status of the architectural profession. Many

perspectives – ranging from the scientific to philosophical – currently contribute to the rapidly growing body of research, but it is evidence-based design, salutogenic design, and phenomenology that provide the most insight as to how architecture may be used to influence the healing process. This interest has partially stemmed from implied financial gains that have piqued the interest of the healthcare industry, accelerating growth in research across wealthier countries like Northern America and the United Kingdom (Berry et al. 16). While still in the stages of infancy, many projects have already been designed or built (see Figure 3).

Given the obligation by United Nations state parties to respect, protect, and fulfil any “positive measures [in] reali[zing] the right to health” (WHO and OHCHR 2), as well as an architectural typology that can help to bridge the gap between health and sickness, an investigation of a developing-world application where health is not yet accessible

Figure 3 - *Early architectural outcomes of evidence-based design.*

by all is critical in the goal of equality in access to health care for all.

Disaster-Vulnerable Indonesia

This application is of particular interest to disaster-vulnerable Indonesia. As a country regularly plagued by natural disasters, many communities have lost and will continue to lose homes, livestock, buildings and infrastructure. In the past five years, over 1.5 billion people have been affected by natural disasters in Indonesia, inflicting a total of USD 4 billion worth of damage (Centre for Research on the Epidemiology of Disasters). Despite having the largest economy in Southeast Asia,¹ rampant corruption and poor infrastructure can be attributed for the existing wide socioeconomic gap which has placed over 28 million in poverty (The World Bank).² Effects are compounded by each new disaster, and a growing number of Indonesians are pushed further back as a result. The gap between those who

have access to healthcare and those who do not will arguably continue to widen as communities find themselves in a perpetual state of recovery from each previous disaster.

Research Aims & Objectives

This thesis aims to investigate how alternative therapeutic design solutions may be implemented in a low-income context to improve access to healthcare for a semi-rural village in Central Java. It specifically considers how architectural form and layout may be manipulated to achieve a spatial environment that is supportive of patient healing and well-being. The idea for this thesis came about as a result of my experience working with communities in rural Indonesia and my undergraduate study in health sciences.

As Indonesia's present access to health is recognised as being intrinsically linked to its vulnerability to natural disaster, a wider holistic approach that also responds to the

¹ Indonesia has a Gross Domestic Product (GDP) of USD 868 billion, see World Bank.

² An estimated 46% of the population live on less than USD 2 a day, see Global Finance Magazine.

region's vulnerability to disaster is necessary in the hope of ultimately building resilience at community-level and improving overall standard of living. As such, a disaster-ready community health centre will be used to investigate these aims. The centre will serve as a hub for the region, providing both eastern and western-based medical facilities, as well as offer teaching, meeting and communal spaces. In light of a disaster, the centre will also be designed to be used as a trauma-responsive area.

The proposed design aims to provide an alternative low-cost, low technology solution to existing architectural examples to achieve the therapeutic goals and functional requirements necessary to optimise this unique program. It is expected that this integrated disaster-ready approach to healthcare will not just serve immediate primary needs, but will also establish a sense of community and better prepare residents for disaster-related trauma, increasing

overall resilience, to ultimately ensure sustainable access to health.

This thesis will undertake an in-depth analysis of research on therapeutic architecture and existing precedents before extrapolating selected methods through a series of design iterations. A variety of iterative media is employed – digital and analogue modelling, hand drawings, and digital rendering – to facilitate the realisation of multiple outcomes. People living in the community were consulted and they provided local insight and perspective into the current health care needs of their communities. In addition, a group of healthcare professionals was also approached to partake in a consultant workshop to discuss spatial needs and environmental preferences necessary for an optimal work setting.

This thesis aims to open the discussion of applying therapeutic design in a developing world context. While many factors and

perspectives currently exist, this thesis is limited to well-researched design principles from three main therapeutic perspectives:

- Evidence-based Design;
- Salutogenic Design; and
- Phenomenology.

Due to time restrictions, emphasis is placed on pre-disaster programming, though a general post-disaster plan is also proposed and briefly discussed. While this investigation specifically responds to the unique needs of Central Java, the conclusions not only add to, but also aim to draw upon the existing knowledge of work to challenge and open new opportunities for discourse in therapeutic architecture.

A time-honoured tradition in medicine exists where young doctors are sworn into the local physician board under the Hippocratic Oath. They swear, amongst other things, to ‘first, do no harm’. Perhaps as

professionals to our society, architects have an equal obligation that our contributions first do no harm, and maybe, even help to bridge the gap between health and sickness.

2 / LITERATURE

*Defining healing and the role of
architecture in therapy*

Figure 5 - Spectrum of key architectural perspectives offered on therapy.

Figure 6 - How the body naturally adjusts to changes in environmental stimuli like light (opposite).

The aim of this review chapter is to identify the scope and methodology of the research discussed in this thesis that will contribute to the overall design outcome of the present investigation. It discusses the existing literature surrounding therapeutic architecture to draw upon the insights of three main approaches (see Figure 5) – evidence-based design, salutogenic design, and phenomenology – to serve as a framework for the present design research.

The Physiology of Healing

An understanding of the physiological process of healing is necessary in order to understand the various approaches adopted in this field. In physiological terms, ‘health’ can be achieved by maintaining a neutral internal environment with minimal reactionary flux (Cacioppo and Berntson 73). Regulatory feedback pathways are important in facilitating this balance, a process known as ‘homeostasis’ (see Figure 6).

Homeostasis is a generic system involving a receptor organ (for example, retina cells of the eye) receiving information from a new stimulus (increases in light lux levels) from the external environment, and relaying this information as signals via chemical reactions (neurotransmitters and nerves) to the central nervous system (brain) for processing. Outgoing signals are then relayed to effector organs (in this case, the same receptor organ, retina cells) to ensure

the recalibration of the body's internal environment (reduction of visual sensory input).

As homeostatic pathways respond readily to the external environment, it is considered that this same environment has the potential for shaping, facilitating or impeding a neutral internal environment – or 'health'. It is this homeostatic pathway that serves as the basis for the scientific approach of therapeutic architecture.

A Scientific Perspective – Evidence-Based Design

Evidence-based Design (EBD) is a rational approach to therapeutic architecture that applies scientific observations to design principles. Established by Professor Archie Cochrane as a derivative of evidence-based medicine, this approach can be defined as:

design decisions based on the best available information from credible research and evaluation of existing projects. (Stankos and Schwarz 1)

This approach analyses patient-environment observational studies to determine environmental factors that may

Figure 7 - *The complex inter-relationship between environment and user.*

be supportive of healing. Discussions or findings are subject to a process of peer-review and macro studies to generate a central repository that serves as a basis for informing future architectural design.

Findings of EBD have included links between access to nature and the reduction of pain medication (Ulrich, *View Through a Window May Influence Recovery on Surgery* 420); the use of effective ventilation systems with reduced infection transmission (Jiang et al. 1293; Boswell and Fox); the incorporation of sound-absorbing floor coverings with the improvement of sleep quality (Philbin and Gray 455) and the preference for controlled sunlight access for better pain and sleep management (Walch et al. 156; Bahammam 6). A wider analysis of findings identified a complex inter-relationship between patient healing, staff productivity, and environmental conditions (see Figure 7). These findings are affirmed by a macro-study by Ulrich et al. (61) and reveal

potential opportunities for architecture to serve in the therapeutic process. However, some have argued that this approach renders the art in architecture lost and reduces the profession to a strict set of “sterile guidelines” (Hamilton and Watkins 14). While earlier outcomes of the field within parts of North America and the United Kingdom have arguably tended to produce such outcomes, more recent examples – particularly from the Scandinavian region – demonstrate a more successful outlook on achieving a more balanced approach (see Figure 8).

In the area of health care, the EBD approach has piqued the interest of providers who are perhaps motivated by the benefits of architecture to promoting health and revenue (Berry et al. 16). Projects that adopt the EBD approach tend to have high implementation costs which may be associated with raw materials; space or labour intensity; or high technology demands, thus limiting the influence of this

Figure 8 - Contemporary EBD and salutogenic-influenced healthcare design.

Figure 9 - Key of common EBD features.

approach to wealthier communities only (see Figure 9-10). This thesis attempts to identify low-cost alternatives as a solution for low-income applications.

Figure 10 - *The impact of individual EBD features and possible reasons for high cost implementations.*

A Psycho-Physiological Response: Salutogenic Design

The approach of salutogenic design is similar to EBD in the way it proposes that the right environment can promote the success of an individual's health outcome. Originally coined by medical sociologist Aaron Antonovsky, this approach establishes the correlation between stress and the availability of well-being factors to impact on the success of an individual's health outcome (Dilani 33). Salutogenesis aims to strengthen an individual's 'sense of coherence' by increasing comprehensibility (resources necessary to provide knowledge); manageability (resources necessary to keep going); and meaning (resources that enrich and provide for better quality of life) which in turn promotes healthfulness and a positive health outcome (Golembiewski 63) (see Figure 11). Similar to EBD, salutary factors such as the presence of social support, effective way-finding, access to

nature and use of daylight are attributed to promoting health (qtd. in Dilani 37). This psycho-physiological approach is supported by the neuro-scientific links established by translational researcher Jan Golembiewski (63-65) who argues the need for a new healthcare typology that unlike the traditional institutional setting, is not "devoid of mental meaning" (Pallasmaa 119). The Maggie's Cancer Support network of centres is an example of spaces that intentionally reflect a non-institutional environment to be supportive of emotionally-vulnerable patients (see chapter 2).

Figure 11 - *How sense of coherence affects health.*

However, unlike EBD, the scope of salutogenesis includes the therapeutic approach of a design enriched in meaning, thus allowing individuals the opportunity to engage with concerns beyond themselves (e.g. community, nature, and the cosmos) (Golembiewski 67). It is perhaps this that better incorporates the scope of architecture without reducing it to a strict set of rules some argue that EBD does. While the salutogenic approach may be relatively less rigorous, the overlaps found with EBD (in its general scope, goals and outcomes) serves to reinforce and substantiate the credibility of both – particularly since these were derived separately. However, much like built examples of EBD, the applications in this approach are limited to developed world contexts. It is possible that applications have been made in developing communities, but the lack of record and review have meant restricted access and discussion of such knowledge.

A Philosophical Approach – Phenomenology

Phenomenology, a branch of philosophy, is another field that has lent itself to the area of therapeutic architecture. Defined broadly as the “study of structure of experience or consciousness” (Stanford Encyclopaedia of Philosophy), contemporary architectural phenomenology suggests the opportunity of designing for the spatial experience. This approach posits an environment can engage the body’s innate sensory needs and invoke emotive qualities, thereby conveying subliminal ‘truths’ – such as calm, stillness and rest – to the semi-conscious. Phenomenologist Juhani Pallasmaa attributes the pathology of everyday architecture to “the negligence of the body and the sense” (19), arguing that the lack of a multi-sensorial spatial experience leads to “a [de]strengthened [sense] of self” (28).

Some phenomenologists argue that because this approach responds to the five senses, a universal definition (and therefore a

universal response) exists (Seamon 122). However, the disability of these senses – a criteria in considering therapeutic architecture – has not been considered. Would an aged or physically traumatised individual experience the space in the same way as an healthy, fully functional individual? Furthermore, as this process involves the perception of the individual to his or her environment, it must be argued that an individual's unique cultural background and personal experience has the potential to influence this process. Many examples of affective architecture exists, including works such as those by Peter Zumthor and Kengo Kuma (see Figures 1 and 4). However, the limited scope and definition of phenomenology make defining clear design outcomes difficult, and applying this process to a low-income context is problematic.

An Alternative Approach

It is important to acknowledge that beyond the three approaches outlined above, many

other perspectives also exist to inform architecture's position on therapy. However, some remain restricted to merely theoretical insights, and due to the limitations of the present investigation, only contributions with significant published works will be used. In addition, as this investigation is concerned with designs suitable for a lower-income poverty, it would be considered irresponsible to use methods that are not well-established. Where insights are deemed to be of value but lack adequate research, alternative approaches are developed through more established methods. For example, a phenomenological sensorial space may be designed through a more definitive evidence-based approach in such a way that the architecture is designed to optimise sensory input necessary for maintaining a neutral spatial environment, supportive of healing. Meaningful environments could also be designed through a less abstract, vernacular lens as opposed to an emotive atmospheric approach.

3 / PRECEDENTS

*Reviewing relevant case studies and
architectural precedents.*

The following case studies have been selected for their insights into therapeutic architecture that have been made accessible for the wider community. While some of the examples may not have been specifically motivated to create spaces of therapy, a retrospective analysis of the design helps to identify key features that have contributed to the success of each space. The focus was not placed on identifying individual therapeutic architectural elements alone, but also on the architectural methods of expressing cultural and traditional themes, and the wider programmatic approach to therapy.

THE SARAH NETWORK OF HOSPITALS

Architect: João Filgueiras Lima (Lelé)

Location: Brazil (Rio de Janeiro, Brasilia

(original), St. Louis, Salvador, Belo

Horizonte, Fortress, North Lake, Macapa,

Bethlehem

The Sarah Network of Rehabilitation Hospitals is a network of nine public hospitals in Brazil which were designed by local architect João Filgueiras Lima (Lelé) in partnership with the Brazilian Federal Government. These hospitals were introduced as a new model of publicly accessible healthcare specifically designed to be supportive of patient rehabilitation. Lelé incorporated features such as internal gardens and solariums which are passively ventilated and shaded, yet generously illuminated with natural light; and social areas that encourage communal interaction to create spaces that are spatially, as well as programmatically therapeutic. Although pre-fabricated elements produced in an onsite factory were used, each building form is uniquely reminiscent of the fluid motion found in local Brazilian architecture

style and avoids the appearance of a mass-produced outcome.

Strengths: The Sarah Network of Hospitals exemplifies how therapeutic concepts may be successfully integrated into a design without compromising architectural form. At such a large scale, the iconic simple fluid form found across all hospitals enable a clear definition of a vernacular symbol to provide a sense of cultural resonance and meaning for users of the space. Each hospital design also specifically responds to unique site conditions, to passively manipulate internal environments to be supportive of rehabilitation.

Weaknesses: While this case study offers evidence for a publicly-accessible therapeutic architecture, this was largely dependent on the funding and provision of infrastructure (e.g. onsite factory) by external parties. It is unclear if the hospitals would have been as successful without such collaboration.

Figure 12 - Well-shaded, naturally illuminated therapy space (left).

Figure 13 - Therapeutic design implemented in general common spaces (right).

Figure 14 - Lelé's iconic curvature (bottom).

THE MAGGIE'S CENTRES

Architect: Charles Jencks, Zaha Hadid, Frank Gehry, Richard Rogers, Kisho Kurokawa, Richard Murphy, Page/ Park Architects, Rogers Stirk Harbour + Partners, Sir Richard MacCormac, Ted Cullinan, Piers Gough, Ronald Lu & Partners

Location: various locations across United Kingdom; Hong Kong

The Maggie's Centres are a series of home-styled cancer support centres that aim to provide an emotionally supportive environment for individuals affected by cancer. Founder and landscape architect Charles Jencks, collaborated with several iconic architects to establish thirteen centres across Britain (and one in Hong Kong). Each centre features expansive gardens, sculptures and artwork which attempt to address the failures of the traditional institutional setting, or what Jencks describes as “impersonal factories for manufacturing health” (Jencks 25). One key design guideline is the philosophy of ‘kitchenism’ where small kitchenettes are located near the entrance of each centre. These serve to create an informal environment over ‘a cup of tea’

for first time visitors (who are usually still emotionally vulnerable) to inquire about support available.

Strengths: While ‘healing’ is expressed in the form of rehabilitation, the Maggie's Centres successfully demonstrate how a humanized, non-institutional approach to healthcare architecture can in itself serve as a form of therapy. Furthermore, Jencks proves his recognition of architecture's effect on behaviour and mood, particularly for ‘the more deprived and undernourished’ (13) to ensure that these spaces, although architecturally designed, are freely accessible by anyone.

Weakness: The brightly-coloured interior fit-out and furnishing make up a large part of the centres’ ‘non-institutional’ response. These styles are reflective of a certain aesthetic that may not be appreciated equally by all. In addition, these styles – as with fashion, design, and even architecture trends – are reflective of a certain era, and are a time-limiting factor. Hence, it is necessary to consider that style, when used for its therapeutic value, may have a varying and limited lifespan of effect (see Figures 16 and 17).

Figure 15 - Floor plan of Maggie's London, indicating the philosophy of 'kitchenism' (left).

Figure 16 - Maggie's Dundee designed by Frank Gehry in 2003 (right).

Figure 17 - Maggie's Aberdeen designed by Snohetta in 2013 (bottom).

THE BUTARO HOSPITAL COMPOUND

Architect: MASS Design Group

Location: Burera, Rwanda

The Butaro Hospital, Cancer Centre and Doctors' Housing comprise Burera's first functioning healthcare facility. Prior to this, the impoverished region of 340,000 did not have direct access to healthcare or any trained physicians. MASS Design Group was contracted to design the facility that sought to restore dignity and health amongst the locals. The open construction process provided employment, education and empowered locals in what has become the heart of the Burera community. Local materials such as compressed stabilising

earth blocks and volcanic rock which are deemed as waste were used to create an aesthetic that is relevant and relatable to the community. Onsite accommodation also attracts doctors from surrounding regions to contribute towards a sustainable means of healthcare.

Strengths: The Butaro case study identified community participation as an essential element to successful community integration. Although it demanded a higher level of collaboration between the architect, community and other external funding parties, it is evidence of an approach that empowers and dignifies the community (both in the process and result of the collaboration), to ultimately increase an overall sense of ownership and stewardship. This is particularly important when the

architecture acknowledges the role which community has to play in successfully achieving programmatic goals.

The architectural outcome of this project show how the use of local materials and methods may be expressed in a simple, contemporary response to create environments that both allow a strengthened sense of identity, as well as fulfil its programmatic requirements as a healthcare setting.

The approach of providing onsite housing to attract foreign doctors, is evidence of an integrated architectural solution that has both considered and addressed that a multi-faceted issue exists behind Burera's inadequate access to healthcare. This response acknowledges the need for a sustainable architectural intervention to have a genuine understanding of the underlying problem.

Even though external parties such as the Rwandan Ministry of Health, Partners in Health, and MASS Design Group were involved in the process, the project is a strong example of how community participation in the form of design input and a local labour force, as well as the incorporation of locally sourced materials into the architecture, has made therapeutic architecture accessible for rural Burera.

Figure 18 - Holistic programmatic approach to healthcare (left).

Figure 19 - Vernacular reflected in the use of local volcanic rock (top).

Figure 20 - 'Healing Hill', a simple on-site housing facility for staff (bottom).

CASSIA CO- OP TRAINING CENTRE

Architect: TYIN Tegnestue

Location: Sumatra, Indonesia

The Cassia Co-op was built to promote trade of local villagers in Sumatra, Indonesia. It serves as a communal hub which offers flexible learning and meetings spaces and aims to set the standard for a 'socially well-functioning enterprise'. The design used a material palette that was sensitive to the site, using discarded cinnamon bark – a by-product of the local farms – handcrafted brick, and local timbers to create an aesthetic relevant to the local people. As the training centre is sited in an earthquake-prone region and the project was expected to take 3 months, it was necessary to utilise building methods that are simple and cost-effective, but which also mitigate the effects of potential tremours. This was achieved by using materials of different frequencies that were physically separated in order for each component to move independently and thus resist earthquake forces.

Strengths: Although designed at a small scale, this vernacular responsive design successfully demonstrates how a culturally-sensitive, low-cost approach can be implemented to produce a simple yet contemporary hybrid-type architecture.

This is also an example of an approach appropriate for the region of Indonesia where different elements are physically separated for the fluid, independent movement and can withstand a degree of seismic stress.

Given the scale of the project, as long as a local labour work force was employed and external design costs were kept at a minimum, it identifies that governmental aid and external funding is not necessary for a low-cost build, though architectural services were sponsored.

Weaknesses: Because of the small project scale, it is not possible to foresee if the low-cost solutions would be similarly successful if applied to a project at a larger scale.

Figure 21 - Simple timber roof construction (left).
Figure 22 - Separation of roof and wall structure (right).
Figure 23 - Permeability to exterior environment (bottom).

4 / SITE SELECTION

The site selection process.

Figure 24 - Clouds of volcanic ash spewed from Mount Sinabung's eruption (previous).

Figure 25 - Mount Sinabung spews a hot column of gas (left).

Two sites of interest were considered for the investigation of therapeutic architecture. The first is an impoverished rural village in Borneo that on initial investigations, seemed to fulfil the criteria for investigating the research question. However, further analysis of the wider Indonesian archipelago revealed that present realities to inadequate healthcare access are linked not just to poverty, but to the nation's vulnerability to natural disasters. A second site – a semi-rural village located at the intersection between two of Central Java's major volcanoes – revealed a more appropriate context for investigating the research inquiry as it met both criteria of lack of access to health care and vulnerability to earthquake disasters.

Both sites are located in Indonesia where natural disasters wreak havoc on communities regularly (see Figure 26). Amongst other disasters such as flooding and droughts, its notable position along the notorious Pacific Ring of Fire has meant a concerning vulnerability to earthquake-related disasters that result in volcanic

eruptions, suffocating ash clouds, and landslides (see Figure 24, 25, 27 and 30). These occurrences devastate communities and burden the already limited primary healthcare resources (WHO, "Country Cooperation Strategy" 12). In addition, corruption and poor infrastructure have meant slow and often incomplete post-disaster coping strategies which leave communities increasingly vulnerable to the next inevitable disaster (Chetwynd, Chetwynd and Spector 11).

These impoverished communities are not only deprived of proper access to primary health care, but the level of disaster vulnerability highlights the urgent need for intervention both prior to and following a disaster. As such, a disaster-ready medical intervention would best provide the means to investigate the application of a therapeutic architecture supportive of healing.

The following section briefly profiles both sites, and identifies the importance for the architectural outcome to be responsive of a reality.

Figure 26 - Natural disasters inflicted on Indonesia between 2012 - 2013 (red - volcanic disaster, green - earthquake, brown - landslide, light blue - flash flooding, dark blue - whirlwind, and orange - earthquake)

SITE 1: BALAI KARANGAN, BORNEO

The village of Balai Karangan in West Kalimantan on the island of Borneo is home to over 2.5 million indigenous Dayaks. The greater region of Kalimantan boasts oases of palm trees, rivers, mangrove swamps, and together with one of the oldest and last remaining rainforests, continues to support the subsistent livelihood of local tribes. However, the increase in commercial deforestation has exponentially diminished this primary resource that generations of locals have depended on for their livelihood and, in turn, state of health (Dewi, Belcher and Puntodewo 1419). While a causal link cannot be established, there is an unprecedented level of poor health – illnesses such as malaria, respiratory diseases, rheumatic fever, and chikunguya are common (World Vision Canada 1) – which remains unimproved due to the lack of medical and general infrastructure for this impoverished region.

This site demonstrates the effects of inadequate access to primary healthcare that could be addressed through a low-cost therapeutic architectural intervention. However, further analysis suggests that the area is generally less vulnerable to disasters. Borneo is surrounded by larger landmasses, and is some distance from any major fault lines thus affording it a naturally sheltered site with low earthquake, volcano and tsunami risk (see Figure 28). While the removal of naturally mitigating tree foliage and deep anchoring roots have resulted in an increase in flash floods – particularly during the monsoon periods – a large flat topography allows any flooding to quickly dissipate and poses a relatively low level of concern.

Figure 28 - Borneo surrounded by land masses affords its a naturally sheltered site (above).

Figure 29 - Current rural conditions for Balai Karangan (3 images on right).

Figure 30 - Suffocating ash cloud can travel across continents, affecting many people.

Figure 31 - String of active volcanoes along Java's east-west spine (right).

SITE 2: TAWANGMANGU, CENTRAL JAVA

Tawangmangu is a semi-rural area found close to the central-eastern border of Java (see Figure 32 and 34). Its elevated height at the base of dormant Mount Lawu affords the area with a mineral-rich landscape, abundant in lush greenery and a cool microclimate (see Figure 33). Because of this, the area is a popular retreat for many locals in the surrounding regions. This village of approximately 8,600 people relies heavily on this local tourism industry, though the economy is also supplemented by an active agricultural export (Badan Pusat Statistik 95-98, 106-107). While the level of poverty is not considered low relative to Balai Karangan (site 1), access to primary health care by communities within this region remains inadequate in spite of its high vulnerability to disaster (Badan Pusat Statistik 81).

west spine of volcanoes that dominates the island's topography (see Figure 31). This characteristic feature has devastated and continues to threaten many communities on the world's most populous island and many of these communities are still recovering from recent disasters. These effects are further compounded and have become urgent as the population increases.

Tawangmangu is located centrally between two highly active volcanoes – Mount Merapi 85 kilometres west, and Mount Kelud 130 kilometres east – and allows the site to serve as a refuge point in the event of a disaster (see Figure 34). Mount Merapi, literally translated in Javanese as 'Fire Mountain', is Indonesia's most active volcano. One of its most deadly eruptions occurred in 2010 when over 350 lives were claimed and over 365,000 people were evacuated (ACT Alliance 4). While Mount Kelud has claimed fewer lives – a total of 7 – its recent eruption in February

Figure 32 - Java, part of the archipelago, rides along the Pacific Ring of Fire (above).

Figure 33 - The lush green mountainous landscape make Tawangmangu an ideal retreat (3 images on right).

THE SELECTED SITE

2014 displaced over 200,000 people and blew ash cloud up to 240 kilometres away (IFRC 2). Although no area can definitively escape the unpredictable cover of airborne ash cloud, the site offers a safe distance from other immediate dangers associated with pyroclastic lava flows, poisonous gases, glowing rocks and cinder rain. At present, only small scale health centres, polyclinics and maternity houses service the healthcare needs of Tawangmangu, with only one fully equipped hospital supporting the wider population of Karanganyar (46,000 people) located an hour's drive away (Badan Pusat Statistik 81).

While Tawangmangu may be considered to be less impoverished compared to the village of Balai Karangan (site 1), the community's present lack of adequate access to primary medical care combined with its vulnerability to disaster poses a more urgent call for intervention. Addressing the issues of this site also lends insight into how this architectural intervention might be implemented in many other Indonesian cities which suffer a similar fate. Tawangmangu's idyllic lush setting between two major volcanoes also offers a strategic opportunity to investigate how therapeutic architecture might be implemented to respond to the needs of a disaster-vulnerable community.

Figure 34 - Tawangmangu centrally located relative to active Mount Merapi and Mount Kelud (above).

Figure 35 - Aerial view of Tawangmangu and surrounding regions (next page).

Surakarta
City

Mt. Lawu

5 / SITE ANALYSIS

An in-depth investigation into the site of interest.

Detailed Site Analysis

The Tawangmangu area in Central Java is one of 17 sub-districts that make up the Karanganyar regency. As Tawangmangu sits at the foot of dormant Mount Lawu (see Figure 36), it is afforded a more comfortable microclimate compared to most other Indonesian cities.³ The area is well known by the local Javanese as a place of retreat due to its lush greenery⁴ and rich archaeological history.⁵ This reputation as a retreat naturally identifies and justifies the site as a setting for the proposed holistic health program.

The site of interest lies on a 60 by 95 metre

plot of land found within the Kalisoro village of Tawangmangu (see Figure 37), approximately 1200 metres above sea level. Apart from a few perimeter buildings, the vacant site sits elevated on the upper outskirts of the village. This topography serves as a form of a pedestal for the site, making it visually identifiable from the surrounding areas and an ideal way to locate a community hub and disaster-refuge point.

The site is fed by a main arterial road – Jalan Lawu – that runs through the village in an east-west direction (see Figure 37). In the event of a disaster, this road gives the site

³ Temperatures in Tawangmangu range between 22 – 31 degrees Celsius, whereas mean temperature for Surakarta is 29.5 degrees Celsius. See Satwiko et al.

⁴ Volcanic Andosol-type soils found on Mount Lawu are fertile with high water and nutrient holding qualities. See Prianto et al.

⁵ Locals believe that the gods descended on Mount Lawu to establish the first Javanese kingdom. See Pemberton.

Figure 36 - Physical model showing site relative to Mount Lawu (top).

Figure 37 - Larger scale of site showing existing buildings and vehicular access (bottom).

bi-directional access from disasters either originating from western Mount Merapi, or eastern Mount Kelud. Smaller secondary roads through the northern forest connect and provide access from smaller north-western and north-eastern villages (see Figure 37).

At present, there are 2 hospitals that support the Karaganyar region, of which only one is fully equipped. Within Tawangmangu itself, while there are smaller-scale health centres (4), general practice clinics (3), and maternity houses (1), the closest hospital is located an hour's drive away. This means limited access to full medical facilities for the region of over 46,000 people, and in the event of a natural disaster, the situation is worsened by an inefficient bottleneck effect to the central Surakarta city hospital. By introducing a larger health centre in Tawangmangu, demands on Surakarta's central emergency healthcare resources will be reduced, and primary healthcare will

also be made more accessible to the smaller regions.

Proposed Programme

A disaster-ready community health centre will be designed to address the unique healthcare needs of Tawangmangu, and will be used as a tool to investigate how this response can be enhanced through a therapeutic architectural design. As the existing limited access to healthcare is made more difficult by the village's vulnerability to disaster, it is vital that the proposed architectural design also responds to the disaster needs of the area.

The centre will administer both eastern and western-based medicine, and also serve as central village hub offering communal spaces; meeting and learning areas; a teaching kitchen and café space. Additionally, the centre will be designed to create areas that may be flexibly adapted into tabula rasa-type space, ready to respond to a post-disaster

trauma (see preliminary design). As disaster size and consequently spatial requirements cannot be pre-determined, an open-planned layout for the main spaces was deemed most suitable. This will allow a large central area to be flexibly used and easily adapted to become a general ward. It is hoped that such a holistic program will not only make primary healthcare more accessible, but will also serve to educate and equip the community with health-related skills necessary for both pre- and post-disaster living.

6 / PRELIMINARY DESIGN PROCESS

*The iterative process of establishing spatial
relationships and architectural form.*

The traditional approach of replicating a precedent methodology did not suit the present aims of investigating alternative therapeutic solutions. Thus, rather than directly applying evidence-based and salutogenic design features to the proposed design, a post-analysis was undertaken on these features to identify key therapeutic goals which contribute to a therapeutic environment. These were then extrapolated to identify sources of high expense and identify alternative application to these pre-established outcomes (see Figure 9).

Through this investigation, the thesis aims to challenge the existing developed-world status of therapeutic architecture and prove the possibilities of a more equitable architectural service accessible by all; it does not plan to re-invent the wheel, but asks what other roads this wheel can travel on.

The following iterative design experiments aim to explore how therapeutic goals and functional requirements for a disaster-ready

community health centre in Tawangmangu might be contextually achieved through two ways: spatial planning and form. A variety of media was employed for the design development phase, including both analogue and digital modes of modelling, hand-drawings and digital rendering methods. A couple belonging to the community was approached to provide insight on the culture and livelihoods of the local people. Additionally, a group of New Zealand-based medical professionals were engaged in a workshop to further inform the design iteration process. It was anticipated that this iterative process would reveal design opportunities that would contribute to the final therapeutic architectural outcome.

The *therapeutic goals* of interest include:

- access to sunlight and protection from glare;
- effective way-finding;
- access to social spaces;
- access to nature;
- adequate ventilation;
- reduction of disease transmission; and
- sense of meaning via a culturally-enriched architecture.

Functional requirements include:

- flexibility of space use for pre- and post-disaster functions,
- enhanced spatial relationships for optimal work function.

SPATIAL PLANNING

The first stage of the design process utilised spatial planning as a means to investigate therapeutic goals and functional requirements. This was undertaken through a phenomenological and participatory approach and employed analogue and digital modelling means to investigate these objectives.

Sacred Loci

First, the notion of meaning through culture and symbolism was investigated through

an extrapolative exercise. As the area of interest has a rich history of spirituality and mysticism in the community, it was important that the architecture acknowledges this. A cluster of sacred sites, northeastern Mount Lawu, the southwestern coastline of Parangtritis and eastern Dlepih,⁶ together with northern subsidiary foci – mythical Krendhawahana forest and Mount Merapi – form a ‘cosmological circuitry’ (see Figure 39) many have historically, and to this day, continue to revere (Pemberton 370).

Through this mapping process, these sites

⁶ Mount Lawu is strongly associated with supernatural forces found within the mountain, Parangtritis with the oceanic realm of Queen Ratu Kidul, and Dlepih as the water source of Solo River. See Pemberton.

were identified and three major axes and a resulting triangular form were obtained. These axes were placed onsite to investigate if a post-modern approach to cultural representation – similar to the likes of Zaha Hadid – could be projected onto the design process, and therefore derive a plausible design outcome. The proceeding iterative process resulted in a series of building orientations and configurations (see Figure 40) that was concluded to place premature restrictions on the design and limit further subsequent development. In addition, the outcome was found to be overly abstractive and poorly defined to achieve what Albena Yaneva concluded in her book *Mapping Controversies of Architecture* as the “impasse of representation”, where the design outcome “appears to have an independent constant form ... separated from a distinct meaning” (20). However, the value of a meaningful architecture proved too important to dismiss and further investigations would later identify achieving this through a more direct, vernacular lens.

Figure 39 - Sacred loci symbolically projected onto the wider site (previous page).

Figure 40 - Sacred loci symbolically projected onto the wider site (right).

- ① *North-South Axis - connecting northern Mt. Merapi and southern Dlepih*
- ② *East-Southwest Axis - connecting Mt. Lawu and Parangtritis*
- ③ *Southwest-South Axis - connecting Parangtritis and Dlepih*

Community Engagement

An elderly couple from the community who live and work directly across from the site of interest in Tawangmangu were approached (see Appendix A1 for Ethical Approval). As information on this rural village was difficult to obtain, they provided insight into the culture, traditions and livelihoods of the local people, and how eruptions of nearby volcanoes affect them. Due to resource limitations, the couple was only able to inform the data collection phase, and was unable to contribute further into the other phases of design.

Consultant Workshop

Next, a more pragmatic participatory approach was undertaken by engaging a group of 7 medical professionals to inform part of the design process (see Appendix A2 for Ethical Approval). This process specifically investigated the spatial and environmental needs of each department proposed for the final outcome and served as a basis to which a design could respond. A range of medical professionals – radiologist, anaesthetist, pharmacist, general practitioner, registered nurse, and maxillofacial clinical dental technician – representing each medical space were invited to take part in a participatory workshop (see Figure 41). They were given

Figure 41 - Health professional workshop.

a questionnaire and invited to discuss and contribute spatial layout and environmental preferences they felt would contribute to an optimal work environment (see Figures 42-47). This identified key spatial relationships – within and between departments – as well as environmental preferences to inform both spatial planning and form design processes.

It was found that while some departments had stronger, more specific preferences in spatial layouts, others did not. For example, within the pharmacy (see Figure 47), it was indicated that a general space with defined zones for various functions (storage, dispensing, compounding medicines) was adequate for optimal workflow. While the provision for a separate counter and counselling space was indicated, no specific inter- or intra-room layout would impact on workflow. In contrast, as the radiology department served part of the medical diagnostic process, greater emphasis was needed on a layout that allows for quick and flexible access to all procedural rooms (see Figure 44). It was also determined that locating the radiology department in close

proximity to the emergency department is essential.

In addition to establishing key spatial relationships, the questionnaire also identified environmental preferences specific to each department. It is noted that participants across all departments indicated spatial quality either had, or somewhat had, an impact on the efficiency and quality of personal performance (see Appendix). It was also identified that all but the radiology department preferred more natural environments (access to natural illumination, ventilation, nature, and a basal level of sound). This difference in preference could be attributed to the controlled environmental requirements (dark rooms to view x-rays) necessary to carry out radiological procedures.

Understanding key spatial relationships was important as it influenced the design and location of certain spaces, and highlighted the question of whether adjacencies and close proximities to particular spaces enhance work flow. Optimum spatial relationships promote overall efficiency and

allow for quicker diagnosis and induction of treatments. This directly improves the overall rate of healing (amongst other things). In addition, identifying environmental preferences also established a criterion for which a comfortable environment could be designed through spatial planning, form and materiality. For example, rooms preferring access to natural greenery could be located at the perimeter of a building, feature visually unobstructed forms, and comprise materials that complementarily frame these views. However, it is noted that the participants of this participatory process were New Zealand-based medical professionals and results were reflective of experiences within the local healthcare setting; as such these results had to be extrapolated to suit the present context.

Figure 43 - Sketch of an ideal layout for a surgical department as drawn by an anaesthetist.

Figure 44 - Sketch of an ideal layout for a radiology department as drawn by a radiologist (top).

Figure 45 - Sketch of an ideal layout for a clinical laboratory as drawn by a maxillofacial clinical dental technician (bottom).

Figure 46 - Sketch of an ideal layout for a doctor's polyclinic as drawn by a general practitioner (top).

Figure 47 - Sketch of an ideal layout for a pharmacy as drawn by a pharmacist (bottom).

Analogue and Digital Iterations

The results of the participatory phase defined parameters for the proceeding analogue and digital iterations which explored other aspects of spatial planning. The iterative process investigated in detail the spatial arrangements that first, enhanced essential space relationships and environmental preferences; and second, considered how features such as green spaces, sterile demarcation, scale, axis mundi and axial separation of program may be implemented to achieve therapeutic goals.

Enhancing Essential Space Relationships & Environmental Preferences

Initial spatial iterations focused on privileging access and support to optimize the function of high-sterile zones (surgery, ward, and treatment rooms) (see Figures 48 and 49). Clustering medium-sterile zones (clinics, pharmacy, laboratory and x-ray), would mean an enhanced, overlapping, and

centrally-defined function. Green spaces located near the periphery would also enable a dual segregating and recreational support function to the high-functioning core. Access – either multi or single aspect – was also identified to have an impact on internal spatial relationships and interactions.

However, if this layout was delineated (see Figure 50), the overall program could be laterally spread out thus allowing programmes to function more independently of each other. Lower sterile zones and physical expanses as a means of intermediary space separating zones were explored. It was found that independent clusters of programmes would allow for better infection and crowd control, and enable unique environmental and spatial preferences to be addressed more specifically.

Figure 48 - Cluster spatial approach prioritising high-functioning areas like surgery, treatment and exam rooms (top).

Figure 49 - Using supporting function areas between high-functioning areas to 'break up' and spread out activity (bottom).

Figure 50 - Delineating the cluster and placing spatial arrangements in context to site's bi-directional access; identifying opportunities for sterile demarcation (top).

Figure 51 - Pulling apart the single entity and introducing physical expanse as a sterile demarcation (bottom).

Figure 52 - Pulling the program further apart allowing independent function of smaller clusters of activity, resulting in a multiple pavilion -type building approach.

Sterile Demarcation

The implementation of clusters allowed for a sterile demarcation to physically separate higher sterile zones (surgery) from lower sterile ones (pharmacy). This means that staff-related activity involving the handling of bodily fluids could be confined from the general patient or visitor spaces. This is particularly important as both pre- and post-disaster programmes would continue serving a mixed-use function. When placed in the context of the site, this identified the opportunity for a series of pavilions separated by green and social spaces to be incorporated into the design (see Figures 51 and 52). A dual primary access layout enhancing the site's existing road network allowed the compound to receive traffic from both disasters found in both directions.

Scale & Axis Mundi

As the research shifted to concern a cluster of buildings (see Figure 52), it became

important to investigate how pavilion scale and a central axis mundi might affect way-finding or the “purposeful circulation of people and their ability to mentally situate themselves [within the] setting” (Passini 320) (see Figure 53).

It was determined that a variation on pavilion size with a larger centrally located reference point would offer the best way-finding opportunities. As a visitor onsite, the different sizes would offer visual variation and introduce a sense of hierarchy around the largest, most active central point. This would in turn serve to naturally orientate around a physical landmark and increase overall way-finding experience (Anjali 12). Similarly, when approaching the compound offsite, the natural elevation of the large pavilion would help to identify and reinforce the visual reference as a community hub. Effective way-finding and visual identification is particularly important in the event of a disaster where comprehensibility

Figure 53 - Quick exercise testing permutations of pavilion size and effects on access, way-finding, and interaction between spaces.

and overall sense of coherence is low.

Axial Separation

By introducing an axial criterion, both eastern- and western-based health care facilities could be separated and allow visitors a more logical way-finding experience. Rooms and associated areas of the same type would be located in close proximity to each other and be visually identifiable by similar architectural indicators – such as the use of material and built form (see next section on form) – to enhance the area's imageability (Lynch 9). This would visually reinforce the directional system to provide a sense of 'comprehensibility', thus increasing the sense of coherence and overall impact on therapeutic experience.

Pavilions, Green Spaces & Social Spaces

The use of pavilions to physically separate programmes provided the opportunity to achieve several therapeutic goals (see Figure 52). First, by breaking up the original mass

of the building, both the overall plan and cross-sectional sizes were reduced, thus allowing for easier ventilation, passive cooling and better penetration of natural light into interior spaces. The reduced number of rooms across the cross-section of the building also meant more spaces could gain direct access to nature (see Figure 54). Second, connecting pathways between pavilions incorporates the natural environment into the therapeutic experience. At minimum, visitors will be prompted to engage with nature at a passive level as they make their way to each pavilion. Third, incorporating social spaces into intermediary zones will serve not only serve as a buffer between formal and informal spaces, but will also allow the opportunity for rest and conversations between visitors.

Pre/Post Disaster Planning

As the functional relationships from the perspective of post-disaster programming

Figure 54 - Drawing exercise testing how a building mass could maximise green and social space.

was deemed to be more critical and directly impacting on overall health outcomes, there was an initial investigative bias towards post-disaster planning (see Figure 55). However, this approach meant that outcomes were subsequently used as a basis for which less formal, post-disaster programs.

Pre-disaster programs were located based on their flexibility of needs, environmental requirements and preferences for any specific spatial separation or adjacencies. For example, as the main pavilion would be used as a general open-planned ward in a disaster, it was essential that the pre-disaster program remains as flexible as possible. A general communal space, open informal meeting and café areas which require minimal use of walls maximises this flexibility whilst visually establishing where non-treatment zones are. The open pavilion also provides an abundance of natural light and fresh air necessary for these social spaces. Healthcare facilities such as clinics,

pharmacy, and x-ray facilities would remain during both pre- and post-disaster to ensure the compound can continue to provide basic primary healthcare.

GENERAL *post*-DISASTER STRATEGY

Figure 55 - Proposed post-disaster program.

FORM DEVELOPMENT

Sacred Loci

The same mapping of sacred sites that was used to identify potential spatial configurations was also used to explore roof form. However, this was found to restrict useable area beneath thus making it an inefficient form. Working in reverse, a suitable floor area resulted in a disproportionately large roof plan disruptive to the pavilion layout (see Figure 57).

Analogue & Digital Modelling

As the triangle shape was later identified to be a strong vernacular shape steeped in much of the Javanese culture (see Figure 68.), it was seen to be of value to pursue this form in a different way. A series of analogue models found that folding a rectangular roof plan allowed for a more efficient floor plan, and for the triangular form to be better perceived through an elevational and perspectival view (see Figure 56). Different scales, directions and angles of slopes, heights, overhangs (see

Figures 62 and 68), materiality (see Figures 62-68), form alternatives (see Figures 59-64), and the interaction of roofs with other pavilions (see Figures 60, 62 and 64) were also explored. These iterations also identified that the triangle form – much like the traditional Javanese roof forms (see section on vernacular below) – also allowed for enhanced passive ventilation and light penetration whilst still sheltering from external elements like excess light glare and rain (see Figures 71 and 72).

Figure 56 - Raising the symbol in elevation and perspective, to investigate a more perceivable and practical roof outcome (left).

Figure 57 - Implications of using this resulting triangular form as a roof (right).

Figure 58 - Folding exercise to physically simulate how spaces beneath and between were affected by configurations of roof form.

Figure 59 - Developing the fold as roof architecture (top).

Figure 60 - Introducing structure beneath the triangular shape (bottom).

Figure 61 - Exercise manipulating planes of each roof face and how this affected the spaces beneath and between adjacent structures.

Figure 62 - Inserting constructional materiality and investigating how this affected flexibility of roof form and on spaces beneath (left).

Figure 63 - Using flexible metal to further test configurations and clusters of form (bottom).

Figure 64 - Using paper to manipulate form, with the application of rendered textures to visualise how the form could be perceived as a whole object (top and bottom), and as a spatial experience (next page).

Figure 65 - Placing another roof on a simple Javanese-type plan in elevation (previous page top).

Figure 66 - A butterfly roof structure imagined as an external pavilion, eaves had to extended more than usual to effectively shelter from the sun and rain (previous page bottom).

Figure 67 - A quick rendering exercise from initial folds, illustrating its use as a sheltered inhabitable space.

Vernacular

Research established that traditional Javanese architecture is strongly influenced by spiritual and religious traditions and this thesis recognises the importance of the design development being grounded back into the context of the local vernacular. However, due to time restrictions, the scope of analysis on the vernacular implications was limited to a pragmatic one and a study on the building form, spatial layout, building material and techniques revealed how the traditional architecture is highly responsive to the local climate.

First, the pitched triangular roof form passively ventilates the interior by optimising the stack effect to enhance air flow (see Figure 71). By increasing the attic volume, accumulated hot air within the building can rise to roof level, and be replaced with cooler, fresher air from the external environment through openings found at roof-height (Satwiko 5-11). A pointed roof also serves

to increase air velocity entering the roof openings; the angles of each face also serve to minimise heat radiation into the interior, while roof overhangs protect from glare and rain (Prianto, Bonneaud and Depecker 86-87).

Second, the traditional spatial layout of the Javanese building maximises passive cooling and ventilation by locating sleeping and living areas on the outer edges whilst maintaining clear unobstructed pathways through the building for enhanced cross-ventilation (see Figure 72). The toilets are separated from the main building to isolate odours and is generally in keeping with traditional architecture to separate toilet facilities from living areas.

Air flow is also encouraged through the building through the use of highly porous materials (bamboo and coconut leaf weaves) and openings located at ceiling height (see Figure 68). As the dominant winds blow in the northeast and southwest direction

Figure 68 - Passive ventilation enhanced by use of breatheable materials (clay tiles, thatch, bamboo leaves); roof form provides shade, shelter from rain and enhance passive ventilation.

(Prianto, Bonneaud and Depecker 86), natural ventilation is further optimised when openings are oriented along this axis. An external yard with vegetation adjacent to the building serves to provide an additional body of fresh air to be blown into the house. (see Figure 72).

Finally, building materials like thatch, bamboo and other local timbers allow an overall lightweight structure that is both flexible and minimally demanding on gravitational loads, thereby contributing to an excellent seismic-resisting structure. The natural light colour of these materials also serve to reflect light and reduce overall radiation within the structure. Unlike most other traditional Indonesian architecture

that is commonly raised on stilts for passive cooling reason, Javanese architecture is usually built on an elevated ground system (see Figures 70 and 71); while no benefits have been proven, this is thought to be linked to the historical importation of Indian temple architecture (Satwiko 5-19).

Figure 69 - Variations in roof forms respond to different regional climates (top).

Figure 70 - Open column and foundation structure is a general design (bottom).

- "Pawon" :**
means clay flooring room
used for traditional kitchen
(with wood fuel)
and warehouse
- "Gedongan" :** main room
- Right "sentong" :**
("sentong" means small inner room
of javanese traditional houses
used for family ceremonies or as
a storage room)
- "Jogosatru" :**
veranda or part of terrace used for
mutual activity located
on front of house
- "Sisir" :** building annex

Figure 71 - Passive ventilative properties of the traditional javanese roof structure (top).

Figure 72 - Traditional spatial planning is oriented to enhance ventilation of cool fresh air through the building (bottom).

Hand-Drawings

The final stage of the design development process explored how the key vernacular elements – roof form, lightweight materiality, and spatial layout – could be cohesively rendered into a pavilion-type design. As it was necessary to distinguish between programs, pavilion design was explored for the ‘western’ pavilions, ‘eastern’ pavilion, and a larger central community pavilion, iterations sought to develop a unique, yet cohesive aesthetic.

Figure 73 - Westen pavilion: Exploring proportions of wall to roof to column structure was explored (top), and extent of elongated eaves tested whilst still maintaining proportion to habitable space beneath (bottom), how roof and wall structure could be perceived as a 'contemporary western' aesthetic whilst still maintaining relevance to the Javanese context (previous page).

Figure 74 - Eastern pavilion: the breaking up of building mass to emphasize smaller scale and intimacy of traditional Javanese architecture. Access to nature, the use of lightweight screens and half walls to reduce mass was also iterated.

Figure 75 - Main pavilion: Initial iteration were to replicate the smaller scale as in Figure 76, but were found not to be visually dominant and distinct enough from the smaller eastern pavilions.

Figure 76 - Main pavilion: a mix of screen and solid type surfaces were explored to enhance building mass.

Figure 77 - Main pavilion: Inversely from preceding exercises, a singular mass that incorporated screens and a more permeable facade was tested.

Figure 78 - Preliminary structural solutions considered base isolating the entire site, smaller than a conventional football stadium for future-proofing and enhancing disaster-response.

PRELIMINARY STRUCTURAL APPROACH

As volcanic disasters are often linked with earthquakes, smaller subsequent tremours are common following an event. These have the potential to compromise the structural integrity of buildings and the safety of anyone nearby. A preliminary structural design was investigated to establish if the proposed design could withstand the impact of any seismic movement. This approach also acknowledges the need for a longer-term vision in providing a sustainable solution to meet the needs of a growing population.

It is proposed that the larger plot of land is to be flattened and seismically isolated from the surrounding area (see Figure 78). As a result of the physical elevation of the plot onto the seismic system – a platform of concrete pads, beams and lead bearings – the entire site can flexibly move as a whole in the event of a tremor (Charleson 222). The physical gap created beneath also allows site works to be located beneath. This is an approach

that medium to longer-term humanitarian responses have begun to incorporate as it ultimately provides seismic protection to the refuge site (Sargiacorno and Ianni 14). This also allows the site to be prepared for a response earlier by establishing site works such as drainage, water supplies and sewage prior to a disaster. While this involves a high initial construction cost, it is argued that this is eventually outweighed by the longer-term costs of seismically isolating future pavilions. As seen in the precedents in chapter two, the success of much community-level therapeutic architecture, involves the collaboration in some way by external parties, ideally parties at a governmental-level. If the Indonesian government – Southeast Asia's largest economic contributor – partners with such a project, the burden of initial structural costs could be alleviated.

7 / DEVELOPED DESIGN

An integrated outcome of alternative design solutions.

The final design was the outcome of a carefully considered process that combined key architectural elements identified in the design development phase as alternative solutions to present-day therapeutic features outlined in chapter two. These fulfill the therapeutic goals and functional requirements necessary for a community health centre in Tawangmangu.

The design seeks to enhance access to primary healthcare for the region by providing a holistic healthcare approach that is complemented by a health-promotive environment. This is addressed in a two-fold response:

- programmatically, the health centre enhances access to primary healthcare for the immediate region of Tawangmangu by offering a holistic program of health services. Both eastern- and western-based

medical services, as well as learning, teaching and meeting spaces will enable a relaxed, community-based approach to achieving healthy living; and

- spatially, the environments are designed to optimise staff productivity, as well as be supportive of general user well-being

all of which ultimately supporting patient healing.

As it was identified that the area's inadequate access to healthcare is also intrinsically linked to its disaster-vulnerability, it is important that the architecture is also designed to be disaster-ready. As such, the final design was planned with opportunities for receiving trauma from potential disasters either from eastern Mount Kelud or western Mount Merapi. It is noted that a comprehensive post-

disaster plan is outside the scope of this thesis. However, the final design outcome included features that lays the foundation for a comprehensive post-disaster response, necessary in illustrating how an integrated approach to healthcare might work.

The final outcome was designed as a series of pavilions which addresses both specific spatial and functional requirements of individual buildings. It was envisioned that the compound would also accommodate for future expansion and the addition of pavilions to meet the needs of a growing population.

Site Plan

- 1 Primary Vehicular Access
- 2 Main Pavilion
- 3 'Eastern' Pavilion
- 4 'Western' Pavilion I
- 5 'Western' Pavilion II
- 6 Living Quarters
- 7 Toilet Block
- 8 Reflexology Garden
- 9 Herb & Vegetable Garden

Figure 79 - Site Plan indicating a pre-disaster program.

Figure 80 - Perspective view of the compound used pre-disaster.

Main Pavilion I

- 1 Cafe/ Communal Space
- 2 Pond
- 3 Garden

The main pavilion will serve as an open-planned general ward, ready to flexibly accommodate a large number of beds.

Figure 81 - Plan (top) and elevation (left) of main pavilion.

Figure 82 - Interior perspective of how the main pavilion might be used as a central social space.

Western Pavilion I

- 1-8 GP Consultation Room
- 9 Covered Walkway
- 10 Pharmacy
- 11 Reception / Office
- 12 Waiting Area

Western pavilion I will retain its function dispensing medication and serving as treatment rooms for disaster needs, and continue to partially function as a day clinic for non-disaster needs.

Figure 84 - Exterior perspective of Western Pavilion I (left) and Western Pavilion II (right).

Western Pavilion II

1	Reception	10	Scrub Room
2	Waiting Area	11	Sterile Storage
3	Start of Sterile Separation	12	Dirty Utility
4	Surgical Waiting	13	Staff Room
5	CT & X-Ray	14	Store
6	X-Ray Control Room	15	Supporting Laboratory
7	X-Ray Store	16	
8	Pre & Post-Operation Room	17	Toilet
9	Operating Theatre	18	Dispensary
		19	Office

Western pavilion II will optimise all its existing functions towards responding to disaster needs.

0

5 M

Eastern Pavilion

- 1-6 Javanese Herb (Jawu) Rooms
- 7-12 Javanese Massage Rooms

13 Pond Access

14 Internal Pond

15 Casual/ Teaching Kitchen

Western pavilion II will accommodate a central communal kitchen, as well turn into an administrative, logistical block.

Toilet Block

- 1 Female Toilets
- 2 Male Toilets
- 3 Standard Toilet
- 4 Traditional Squatting Toilet
- 5 'Mandi' or Water Bath
- 6 Walkway

This repeated toilet block separates activity considered unclean from main living and working spaces.

0

5 M

8

Living Quarters

- 1 Repeated Cluster
- Double Unit (Red)
- Triple Unit (Yellow)

- 2 Living Area
3 Shower / Toilet
4 Shared Garden
5 Double Room
6 Balcony

The living quarters will serve to accommodate external relief staff in a post-disaster event.

Limitations

As previously discussed, the scope of this thesis is limited and does not aim to provide a solution to the application and affordability of health care architecture to developing countries. Instead, it sought to illustrate an example of an integrated response to the issue at hand in order to generate further discussions on the role of therapeutic architecture in lower-income communities. This thesis acknowledged that many complex factors are involved, and was restricted to a small scope deemed most critical and representative of the issues highlighted. The general overview of preliminary solutions presents a holistic illustration that will benefit from further resource-optimisation and ethnographic research.

Healthy Living Environments

An environment of minimal sense interference can be supportive of physical therapy, thereby enhancing and promoting

the overall process of healing. A key objective of the final design was to provide an environment that addressed these issues through passive and programmatic means. The final design also aimed to accomplish the following therapeutic goals: access to sunlight and protection from glare; effective way-finding; access to social spaces and nature; adequate ventilation; and reduction of disease transmission.

Natural Light & Protection from Glare

Access to sunlight offers many therapeutic benefits. Historically used as a tool for navigation, natural light instills a sense of orientation and overall user coherence. Research has also shown that exposure to sunlight, even if accessed visually, can produce serotonin, melatonin and vitamin D responsible for elevated moods, improved sleep and protection against cancers and bone health respectively (Ulrich et al. 24). However, excess sunlight can also be

detrimental; over exposure increases the risk of skin cancer and glare causes visual discomfort and the inability to see thus reducing overall sense of coherence.

The final design incorporated a traditional vernacular response to the local climate by using extended eaves to protect from glare, particularly in south-facing aspects of each pavilion. The use of smaller pavilion sizes – as opposed to single, or larger building masses – also allow for easier penetration of light to all spaces. Where pavilions accommodate a larger program, a split clerestory-type roof was used to enable light access further into the pavilion. The eaves also serve to protect the main structure and habitable area from rain and other weathering elements. Plants in adjacent open green spaces can naturally cool local volumes of air, provide shade, and disrupt excessive reflection that might fall on hard surfaces.

Way-finding

Spatial design that optimises way-finding is important for places like hospitals which are associated with high user activity. This becomes of importance when designing a cluster of hospital buildings and is even more essential when serving a post-disaster scenario where user sense of coherence is lower than normal.

The design incorporated the use of a larger social central pavilion to introduce a visual hierarchy which enables orientation around the largest, most active central point both on and offsite. The site's natural elevation will also serve as a pedestal to facilitate offsite identification and reinforce visual reference as a community hub. This is particularly important in the event of a disaster where comprehensibility and overall sense of coherence is low.

To navigate between pavilions on site, a dichotomy was introduced allowing

eastern- and western-based facilities to be differentiated based on pavilion style. 'Western' pavilions utilised a more western-influenced aesthetic – greater use of walls, internal spaces visually enclosed, and a simple roof form – while 'eastern' pavilions were more reflective of the local aesthetic – woven screens used over walls, interior spaces more open to the external environment, and a more detailed roof form.

Social Spaces & Nature

Research has demonstrated how therapeutic benefits of nature or nature-based art can help lower stress levels and improve pain management to enhance the overall healing process (Ulrich, "View Through a Window" 2). As such, it was important that nature is made physically accessible by all spaces. The proposed design strategically reduced the scale of spatial planning, resulting in a smaller number of rooms in each pavilion and increased overall access to nature.

Providing opportunities for social interactions was another key feature addressed in the design. Research has found the beneficial link between the presence of social support and therapeutic outcome of a patient (Laitinen and Isola 943), and it was important to consider the impact of this at both an individual and collective scale. A generous allocation of social spaces was positioned between formal and informal spaces, serving as program buffers between zones. This introduced a subtle change in space use, identifying the difference in formal (medical treatment rooms), informal (teaching and meeting rooms) and social spaces (conversational areas).

Waiting areas within formal spaces were designed to reflect a more relaxed setting; spaces are more open and furnished with softer materials and textures and placed within a garden setting providing access to both nature and filtered sound. This will not only cater for the strong social and

communal aspect of the Javanese culture, but also benefit the therapeutic experience.

Adequate Ventilation

Adequate ventilation allows for a flow of fresh air to drive out any airborne pathogens found within an enclosed space. This replaces warm, moist, and stagnant air that promotes bacterial and pathogenic growth with fresh air. The final design placed an emphasis on optimizing ventilation through several features. At a more general level, the use of separate pavilions as opposed to a single building mass meant that air can flow more freely and unobstructed throughout the site. The open interstitial spaces also meant bodies of fresh air can flow freely through the pavilions.

Drawing from the traditional Javanese design, pavilions were designed with elevated roofs as well as strategic openings across the plan. This enables hot air to be removed and replaced with cooler, fresher air from the

external environment through a stack effect. Across the plan – and particularly between internal rooms – openings were located at ceiling and ground level. This means that air breeze can flow freely across the plan, without being detected and creating a ‘sensory stimulation overload’ for patients. Where possible, openings were also located strategically across plans to enhance cross-ventilation. The open nature of the central pavilion enables the space – envisioned to accommodate the most activity pre- and post disaster – to be maximally ventilated. Plants located in adjacent pavilions will also help in filtering and cooling thereby, passively increasing the quality of incoming air.

Reduction of Disease Transmission

The most direct and effective way of facilitating the process of healing is by physically removing the source of disease or trauma. Second to that is the reduction of its

transmission or ability to be spread. Amongst other things, the pavilion design established a sterile demarcation between the various programmes. By physically displacing areas of high sterile requirements (and higher concentrations of pathogens) from those of lower ones, cross-contamination between programmes can be limited and confined to independent zones. The use of plants within interstitial green spaces will filter out airborne pathogens.

Vernacular Response

The vernacular approach adopted by this thesis was initially incorporated to fulfil the theoretical guidelines of achieving 'meaning' within the built environment. However, the design research process later revealed this to be a precursor necessary when implementing an architectural intervention, particularly to communities of need. If an architecture is to succeed, it is necessary to consider for whom the architecture is

implemented. In hindsight, this resonates with the idea of critical regionalism that suggests the need to carefully consider both local site conditions (aesthetic, cultures and values) and contemporary solutions in order to avoid a 'placeless' architectural outcome that lacks identity (Kingston 36).

The design is the synthesis of a contemporary response that borrowed ideas from the vernacular to generate a response which specifically addresses a site-unique issue. This approach will enable the user group to identify with and perceive the architecture, thereby enhancing the overall therapeutic response. This contrasts with Maslow's hierarchy of needs of prioritising physical needs over others, to suggest a simultaneous fulfilment of all needs in achieving a more synergistic outcome (Cold 3). The use of locally sourced materials like brick, local teak and bamboo are solutions to the need for low cost construction. Similarly, local building techniques such as breathable

bamboo wall constructions, and passive roof designs mean a proven cost effective and material efficient approach to building. These were incorporated into the construction in a contemporary way to produce a hybrid response. The final design outcome considered the rich vernacular context of Java, as well as contemporary therapeutic architectural solutions, to propose a hybrid response that achieved unique programmatic requirements, ensuring the meaning and identity of the local community was preserved and enhanced user engagement with the built environment.

Extensive investigations into the vernacular context are outside the scope of this thesis. This means assumptions and a limited response to the spatial requirements, traditions and decorum on designing for eastern-based spaces were made. However, the present investigations undertaken on traditional Javanese architecture suggest the opportunities that can be afforded when

designing in response to the site.

Pre- versus Post-Disaster

The integrated programmatic approach acknowledges that inadequate access to healthcare is intrinsically linked to the imminent disaster realities of the region. It was important that the two were viewed holistically as a single albeit complex entity, to investigate the opportunities of an integrated approach; a single program approach would not realise a sustainable solution to Tawangmangu's healthcare needs. A pre-disaster establishment of intervention not only allows the site to be physically prepared (seismically isolated with services integrated), but also allows for early integration into the community, addressing opportunities for preparation, education, and awareness, to ultimately strengthen disaster-resilience at a community level.

Although a comprehensive post-disaster proposal is not included in the final

outcome, the final design includes many design features that specifically address the potential opportunity for the site to be used in a post-disaster scenario. The disaster-ready design is considered in the following ways:

1. The overall site plan is designed with dual primary access, providing vehicular access onto generous receiving area, to optimise mass trauma response from both eastern (Mount Kelud) and western (Mount Merapi) regions. The existing network of roads also connect smaller northern and southern regions to the site.
2. As the site will be structurally isolated from the surrounding area, the compound will be protected from any aftershocks often associated with earthquake-related disasters. This safe zone will serve to both physically protect and provide psychological assurance.

3. The pavilion-approach to the compound enables the generous interstitial spaces to be used for the set-up of any additional external structures (tents, storage, portable MRIs etc.) by any external humanitarian relief.

4. Programmatically, as the main pavilion only features a few free-standing walls, the open space can be flexibly converted into an open-plan general ward area, accommodating beds and triage zones according to the size of disaster. The 'X Ray' pavilion will have retain its original program, although primed to respond to disaster-related trauma. As regular day-to-day injuries may still arise, the 'GP' pavilion will have to retain its function as a day clinic. The 'eastern' pavilion will be converted into an logistical block for administrative and storage purposes as well as accommodating a central kitchen separate from the central pavilion. Finally, the living quarters will be used

to house staff and any external relief workers that may be part of the trauma response.

It is important to note that this thesis does not claim to answer the complex disaster response issues for the community. Instead it proposes an architectural intervention that may be designed secondarily to be responsive to the needs of the site. As researching the appropriate disaster response strategy for Central Java could serve as a thesis topic on its own, the present thesis briefly suggests a strategy that is implemented prior to a disaster. Subsequent research identifying the most appropriate disaster-response strategy is necessary in critically validating this approach.

Methodology

The post-analytical, extrapolative, re-applicative methodology applied in this investigation meant that the outcomes of the research were not results as defined in the

traditional sense, but were instead an overall proposal for alternative solutions to these pre-determined outcomes.

There is perhaps a moral responsibility on the profession to apply stronger, more rigorously researched approaches (as opposed to approaches that may still be largely experimental) in scenarios where communities in need are involved. It would be considered unethical and disrespectful to take advantage of a community's very real issues for the sake of architectural experimentation. Yet, while the hypothetical nature of the present investigation may pose a contradiction, it was deemed necessary to simulate a scenario as close as possible to reality in order to generate more pragmatic discussions.

The premise for utilising such a methodology does not discount other aspects of architecture that have the potential to further re-mould the role of therapeutic architecture applied in a developing context.

However, it is suggested that these aspects of architecture, while still in its infancy, should be investigated in contexts where outcomes have less direct impact on the primary needs of a vulnerable community.

Participation

Given the resources and opportunity to improve on this process, a larger-scale community participation process would have been incorporated into the investigation. By including the community of interest across all stages – initial investigations, design development, and feedback process – the concluding design could be enhanced and would reflect more accurately the needs of the end-user. Second to actually building and allowing opportunities for post-occupancy evaluation, a feedback process of a hypothetical architectural intervention would serve as the closest means for measuring the success of such an investigation. While critical feedback was

provided by experts of the field at each stage of the design process, the feedback was not directly representative of the community.

Conclusion

Therapeutic architecture is thriving in research and practice and this growth is an opportunity to reinvestigate its application in a low-income context. This is particularly crucial as inadequate access to primary healthcare remains a reality for many communities around the world. Therapeutic architecture has the potential to improve access to healthcare and any 'underlying determinants' that might enhance the fullest attainment of the right to health.

This thesis reassessed the existing evidence in the field of architectural therapy and applied this architectural solution to the context of a central Javanese community that has difficulty accessing reliable healthcare. The outcome of this thesis is both a proposal for a built outcome and a discussion on equitable architecture which challenges the field to engage itself more with designing for others.

The first chapter outlined the realities and rights of many low-income communities, specifically profiling the existing condition and needs of a village in Tawangmangu, Central Java. As the community's inadequate access to primary healthcare was found to be intrinsically related to its vulnerability to disaster, a unique two-fold program was devised. It re-evaluated seven more established therapeutic features across various evidence-based, salutogenic, phenomenological approaches, to present a vernacular-informed, low-cost alternative fitting of the healthcare needs of the community.

To ensure the most realistic response to the unique realities of the community, this thesis employed a variety of methods and mediums in its research process. This included a detailed analysis of current therapeutic features and precedents studies; extensive ethnographic observations and site investigations; external participation by

medical professionals; and a rigorous critical design iteration process.

It is noted that the design research phase was limited by time and resource constraints of this thesis, resulting in a design outcome still limited to research purposes only. Given the opportunity, a full participatory process engaging the community of interest would have assisted to identify and directly address any other areas of concern. Incorporation of a design feedback stage and seeking out the opinions of proposed users would have also helped to refine the final design outcome. Instead, design iterations were reviewed by various experts of the field as this thesis progressed and critical feedback challenged the discussion as the design progressed.

The final design, accompanying research and discussions of this thesis present an opportunity for therapeutic architecture to be applied to low-income communities and areas. While it presents a response that specifically addresses the local culture

and value of Tawangmangu, it also serves to illustrate how a similar approach to therapeutic architecture may be applied to other similar lower-income communities. However, for this approach to be well-integrated and its full therapeutic potential realised, there is a crucial need to engage with the local healthcare needs of the community of interest and customise a suitable architectural program that holistically incorporates the local culture and vernacular into the design process. This thesis envisioned to contribute evidence to the profession's ongoing debate that architecture can indeed be a service for the rich and the poor.

BIBLIOGRAPHY
&
LIST OF FIGURES

BIBLIOGRAPHY

ACT Alliance. Indonesia: ACT Preliminary Appeal: Mount Merapi Displaced - IDN102. Geneva: ACT Alliance, 2010. Web. 2 March 2014.

Anjali, Joseph. "The Impact of the Environment on Infections in Healthcare Facilities." 2006.

Badan Pusat Statistik. "Karanganyar Dalam Angka - Karanganyar in Figures." n.d.

Bahammam, A. "Sleep in acute care units." *Sleep and Breathing* 10.1 (2006): 6-15.

Berry, Leonard L, et al. "The Business Case for Better Buildings." *Frontiers of Health Services Management* (2004): 3-24. Print.

Boswell, T. C. and P. C. Fox. "Reduction in MRSA Environmental Contamination with a Portable HEPA-Filtration Unit." *Journal of Hospital Infection* 63.1 (2006): 47-54.

Cacioppo, John T and Gary G Berntson. "The Brain, Homeostasis, and Health: Balancing Demands of the Internal and External Milieu." *The Oxford Handbook of Health Psychology* (2011). Print.

Centre for Research on the Epidemiology of Disasters (CRED). EM-DAT: The International Disaster Database. 2009. Web. 11 April 2014.

Charleson, Andrew. *Seismic Design for Architects*. Taylor and Francis, 2012. Print.

Chetwynd, Eric, Frances Chetwynd and Bertram Spector. "Corruption and Poverty: A Review of Recent Literature." 2003.

Cold, Birgit. *Aesthetics, Well-Being and Health: Essays Within Architecture and Environmental Aesthetics*. Aldershot: Ashgate, 2001. Print.

Dewi, Sonya, Brian Belcher and Atie Puntodewo. "Village Economic Opportunity, Forest Dependence,

- and Rural Livelihoods in East Kalimantan, Indonesia.” *World Development* 33.9 (2005): 1419-1434.
- Dilani, Alan. “Psychosocially Supportive Design: A Salutogenic Approach to the Design of the Physical Environment.” *International Hospital Federation Reference Book 2008/2009* (n.d.): 32-37.
- Global Finance Magazine. Country Data: Indonesia. 2015. Web. 9 June 2014.
- Golembiewski, Jan. “Salutogenic Design: The Neurological Basis of Health-Promoting Environments.” *Design & Health Scientific Review* (2012): 62-69.
- Hamilton, Kirk D and David H Watkins. *Evidence-Based Design for Multiple Building Types*. Hoboken, N.J.: Wiley, 2009.
- International Federation of Red Cross and Red Crescent Societies (IFRC). “Emergency Plan of Action (EPoA) Indonesia: Volcanic Eruption - Mt Kelud.” *Disaster Report*. 2014. Print. 15 March 2014.
- Jencks, Charles. *Can Architecture Affect Your Health?* Rotterdam, Arnhem: ArtEZ Press, 2012.
- Jiang, S. P., et al. “Ventilation of wards and nosocomial outbreak of severe acute respiratory syndrome among healthcare workers.” *Chinese Medical Journal* 116.9 (2003): 1293-1297.
- Kingston, Heath Wm. *Vernacular Architecture and Regional Design: Cultural Process and Environmental Response*. London: Architectural Press, 2009. Print.
- Laitinen, P. and A. Isola. “Promoting Participation of Informal Caregivers in the Hospital Care of the Elderly Patient: Informal Caregiver’s Perceptions.” *Journal of Advanced Nursin* 23.5 (1996): 942-947. Print. 3 September 2014.
- Lynch, Kevin A. *The Image of the City*. Cambridge: MIT Press, 1960.

- Pallasmaa, Juhani. *The Embodied Image: Imagination and Imagery in Architecture*. Chichester: John Wiley & Sons, 2011.
- Passini, Romedi. "Wayfinding Design: Logic, Application and Some Thoughts on Universality." *Design Studies* (1996): 319-331.
- Pemberton, J. *On the Subject of "Java"*. New York: Cornell University Press, 1994.
- Philbin, M. K. and L. Gray. "Changing levels of quiet in an intensive care nursery. ." *Journal of Perinatology* 22.6 (2002): 455-460.
- Prianto, E., et al. "Tropical Humid Architecture in Natural Ventilation Efficient Point of View - A Reference of Traditional Architecture in Indonesia." *International Journal on Architectural Science* 1.2 (2000): 80-95. Print.
- Sargiacorno, M. and L. Ianni. "Accounting and Control of Post-Earthquake Interventions." *Critical Perspectives on Accounting*. Florida: Elsevier, 2011. Web. 19 August 2014.
- Satwiko, Prasasto. *Traditional Javanese Architecture and Thermal Comfort*. Yogyakarta: Universitas Atma Jaya Yogyakarta, 2004. Print.
- Seamon, David. "The Phenomenological Contribution to Environmental Psychology." *Journal of Environmental Psychology* (1982): 119-140.
- Stankos, Mary and Benyamin Schwarz. "Evidence-Based Design in Healthcare: A Theoretical Dilemma." *Interdisciplinary Design and Research e-Journal* 1.1 (2007). Web. 26 March 2014.
- The World Bank. *Indonesia*. 2015. Web. 17 June 2014.
- Ulrich, Roger S. "View Through a Window May Influence Recovery on Surgery." *Science* 224.4647 (1984): 420-421.

Ulrich, Roger S., et al. "A Review of the Literature on Evidence-Based Healthcare Design." *Health Environments Research & Design Journal* 1.3 (2008): 61-125.

UN Economic and Social Council. General Comment No. 14: The Right to the Highest Attainable Standard of Health (Art. 12 of the Covenant). Geneva, 11 August 2000. Web. 10 November 2014.

UN Office of the High Commissioner for Human Rights (OHCHR). Fact Sheet No. 31, The Right to Health. n.p., June 2008. Web. 15 November 2014.

Walch, J. M., et al. "The effect of sunlight on post-operative analgesic medication usage: A prospective study of patients undergoing spinal surgery." *Psychosomatic Medicine* 67 (2005): 156-163.

World Health Organisation (WHO) and UN Office of the High Commissioner for Human Rights (OHCHR). Joint Fact Sheet No. 323, The Right to Health. August 2007. Web. 23 August 2014.

World Health Organisation (WHO). WHO Country Cooperation Strategy 2007-2011: Indonesia. World Health Organisation, n.d.

World Health Organisation. Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference. New York, 19-22 June 1946. Web.

World Vision Canada. Vulnerability and Capacity Assessment in West Kalimantan, Indonesia. n.d.

Yaneva, Albena. *Mapping Controversie in Architecture*. Surrey: Ashgate Publishing Ltd., 2012.

LIST OF FIGURES

All figures not attributed are authors own.

Figure 1 – Kengo Kuma and Associates. 2006. Web. Retrieved 9 March 2014. <www.kkaa.co.jp/works/architecture/ginzan-onsen-fujiya/>

Figure 2 – Bintang, Roni. 2013. Web Retrieved 17 March 2014. <www.theguardian.com/news/gallery/2013/nov/19/10-photo-highlights-today#img-3>

Chapter 1 – Introduction

Figure 3 – From left to right, top to bottom:

Image 1: St. Elizabeth's Hospital, 2015.

Image 2: Parkland Health & Hospital System, 2015.

Image 3: Ann & Robert H. Lurie Children's Hospital of Chicago, 2015.

Image 4: Laguna Honda Hospital & Rehabilitation Center, 2015.

The Centre for health Design. 2015. Web. Retrieved 22 May 2014. <www.healthdesign.org/pebble/facilities>

Chapter 2 – Literature

Figure 4 – Binet, Hélène. 2011. Web. Retrieved 3 March 2014. <www.helenebinet.com/photography/architects/peter-zumthor>

Figure 6 – Crankshaft Publishing. n.d. Web. Retrieved 1 October 2014. <www.what-when-how.com/neuroscience/visual-system-sensory-system-part-4/>

Figure 10 – From top to bottom:

Image 1: Furuto, Alison. 2013. Web. Retrieved 21 June 2014. <www.archdaily.com/?p=342294>

Image 2: C. F. Møller. 2013. Web. Retrieved 22 June 2014. <www.cfmoller.com/p/Koege-University-Hospital-i3047.html>

Image 3: Herzog & de Meuron. Nyt Hospital Nordsjælland, 2014. 21 June 2014. Web. <www.archdaily.com/?p=495113>

Figure 11 – Golembiewski, Jan. “Salutogenic Design: The Neurological Basis of Health-Promoting Environments” Design & Health Scientific Review, 2012, Print.

Chapter 3 – Precedent

Figure 12 – 14 Kon, Nelson. n.d. Web. Retrieved 11 September 2014. <www.nelsonkon.com.br>

Figure 15 – Rogers Stirk Harbour + Partners. Maggie’s Centre London Ground Floor Plan. Can Architecture Affect Your Health? Jencks, Charles. Rotterdam, Arnhem: ArtEZ Press, 2012: 20. Print.

Figure 16 – Carnegie Museum of Art. 2003. Web. Retrieved 16 March 2014. <www.archdaily.com/547453/design-with-empathy-an-exhibit-honoring-maggie-s-architecture-of-cancer-care/540fb70dc07a807b9b0000ad_design-with-empathy-an-exhibit-honoring-maggie-s-architecture-of-cancer-care_maggie_s_dundee__2003__architect-_frank_gehry__ge-jpg/>

Figure 17 – Carnegie Museum of Art. 2013. Web. Retrieved 16 March 2014. <www.archdaily.com/547453/design-with-empathy-an-exhibit-honoring-maggie-s-architecture-of-cancer-care/540fb7adc07a803fb30000a1_design-with-empathy-an-exhibit-honoring-maggie-s-architecture-of-cancer-care_maggie_s_aberdeen__2013__architect-_sn_hetta__pho-jpg/>

Figure 18 – 20 – Baan, Iwan. 2011. Web. Retrieved 6 August 2014. <www.iwan.com/photo_Butaro_Housing_Rwanda_MASS_Group>

Figure 21 – 23 – Aalto, Pasi. 2011. Web. Retrieved 12 August 2014. <www.tyinarchitects.com/works/cassia-coop-training-centre/>

Figure 24 – Mahyuddin, Chaideer. 2014. Web. Retrieved 5 March 2014. <www.nytimes.com/2014/02/02/world/asia/volcanic-eruption-in-indonesia>

Figure 25 – Ifansasti, Ulet. 2013. Web. Retrieved 21 November 2014. <www.theatlantic.com/photo/2013/11/the-eruptions-of-mount-sinabung/100630/>

Figure 27 – Loh, Nicky. 2009. Web. Retrieved 5 March 2014. <www.boston.com/bigpicture/2009/10/2009_sumatra_earthquakes>

Chapter 4 – Site Selection

Figure 29 – From top to bottom:

Image 1 – Kauzar, Nizar. 2010. Web. Retrieved 7 July 2014. <www.panoramio.com/photo/42604254>

Image 2 – Kauzar, Nizar. 2010. Web. Retrieved 7 July 2014. <www.panoramio.com/photo/42604254>

Image 3 – Cahyo, Eko. n.d. Web. Retrieved 9 July 2014. <www.ekyo.blogspot.com>

Figure 30 – Aditya, Sutanta. 2009. Web. Retrieved 5 March 2014. <www.nytimes.com/2014/02/02/world/asia/volcanic-eruption-in-indonesia>

Figure 33 – From top to bottom:

Image 1 – Tunliu, Yehezkiel. 2012. Web. Retrieved 20 July 2014. <www.panoramio.com/photo/71996966>

Image 2 – Yswitopr. 2011. Web. Retrieved 21 July 2014. <www.panoramio.com/photo/61199403>

Image 3 – D, Edwin. 2013 Web. Retrieved 21 July 2014. <www.edwin1303.deviantart.com/art/>

Tawangmangu-2-324461449>

Figure 70 – Sardjono, Agung Budi. 1996. “Tropical-Humid Architecture in Natural Ventilation Efficient Point of View” Prianto, E., Bonneaud, F., Depecker P. and Peneau J-P. International Journal on Architectural Science 1.2 (2000). Print.

Figure 71 – Sastro, Yudi. 2012. Web. Retrieved 17 July 2014. <www.architecturelinked.com/profiles/blogs/joglo-a-remarkable-javanese-traditional-home-architecture>

Figure 72 – Sardjono, Agung Budi. 1996. “Tropical-Humid Architecture in Natural Ventilation Efficient Point of View” Prianto, E., Bonneaud, F., Depecker P. and Peneau J-P. International Journal on Architectural Science 1.2 (2000). Print.

A P P E N D I X

Phone 0-4-463 5676
Fax 0-4-463 5209
Email Allison.kirkman@vuw.ac.nz

MEMORANDUM

TO	Corinne Lee
COPY TO	Daniele Abreu e Lima
FROM	Dr Allison Kirkman, Convener, Human Ethics Committee
DATE	23 December 2014
PAGES	1
SUBJECT	Ethics Approval: 21522 Tawangmangu (Central Java, Indonesia) Site Investigation

Thank you for your application for ethical approval, which has now been considered by the Standing Committee of the Human Ethics Committee.

Your application has been approved from the above date and this approval continues until 16 February 2015. If your data collection is not completed by this date you should apply to the Human Ethics Committee for an extension to this approval.

Best wishes with the research.

Allison Kirkman
Human Ethics Committee

Tawangmangu (Central Java, Indonesia) Site Investigations

Participant Information:

Master of Architecture (Professional) Design Research via Interview

Nature & purpose of Design Research:

The purpose of the present design research is to examine the role of Architecture in a post-disaster healthcare context via a Masters by thesis in Architecture. An interview with a local of the community will be undertaken to better understand the physical and anthropological features of the site. This research has been granted Human Ethics Approval by the Victoria University of Wellington Human Ethics Committee.

As part of the data-collection phase, this investigation will look specifically into physical features relating to the rural site (vegetation, landform and climatic conditions), as well as anthropological characteristics of the local community (population, cultural values and responses to natural disasters and vernacular architecture). Due to the rural nature and poor accessibility of information, factual information regarding the site will also form part of the interview. Given the time and budgetary constraints for this research, the investigation will be undertaken by means of an interview via email correspondence.

Use of Interview Feedback:

All photographs and information from the email correspondence intended for use will be presented to the participant for approval prior to any formal publication.

The interview will be undertaken at a time that best suits the participant via email correspondence. This will involve a series of questions (regarding the site and anthropological features of the site) that the participant will reply in response to.

Participant Anonymity:

Please note participant anonymity cannot be assured. Upon approval by the participant, any relevant material pertaining to the interview may be made available for public viewing. This may include the name, age and occupation of the participant, as well as an accompanying photograph in any publication material. All images and documentation

FACULTY OF ARCHITECTURE & DESIGN Te Wāhanga Waihanga-Hoahoa
139 Vivian Street PO Box 600, Wellington, New Zealand
Phone + 64-4-463 6200 Fax +64-4-463 6204 Web www.victoria.ac.nz/fad

will be accessible only to the lead researcher and be stored via electronic security. Images and information (as provided by the participant) not selected or approved for publication will be destroyed. Should any circumstances require that participant anonymity be granted, this can be attained via contact with lead researcher.

Participants may decide to withdraw from the study at any time. Should you wish to do so please email the lead researcher before **January 22nd 2015**.

Contact:

Should you have any questions or concerns about this study please feel free to contact the lead researcher and/or thesis supervisor(s) at any time.

Corinne Lee – Lead Researcher
leecori@myvuw.ac.nz

Daniele Abreu e Lima – Thesis Supervisor
daniele.abreuelima@vuw.ac.nz
(+64) 4 463 6292

Tawangmangu (Central Java, Indonesia) Site Investigations

Participant Consent Form:

Please indicate that you have read and understand the contents of the participant information sheet, and that you are able and willing to be surveyed for the purpose of design research:

- I have been informed about the information surrounding this interview
- I understand the purpose for this interview
- I am able to choose freely whether or not I am willing to participate
- I understand that the interview will be done via email and all information intended for use will require my approval before its use and publication
- I understand that only the lead researcher will access this information, that this information will be stored via electronic security and all material I have not approved will be destroyed
- I understand that my name, age, occupation and photograph may be used
- I understand that the information made available from this interview may be published
- I understand that should I choose to withdraw from the study, this must be done by

January 22nd 2015

Name:

Signature:

Date:

Thank you for your time and participation in this study.

Kind Regards

Corinne Lee – Lead Researcher

Tawangmangu (Central Java), Site Investigation

Site Investigation: Interview Schedule

Interview questions for a local of Tawangmangu

- As an Indonesian local, between Java and Borneo, which area would benefit more from an emergency health centre?
- How have the earthquake and eruptions of nearby volcanos affected you?
- How far is the closest hospital/ clinic for locals, such as yourself, in Tawangmangu?
- Is this largely accessible by the locals?
- What is the population of Tawangmangu?
- What is the predominant cultural group of Tawangmangu?
- What is the climate of Tawangmangu?
- Do you have any maps, pictures, files or sketches of the current buildings within the area?

Phone 0-4-463 5676
Fax 0-4-463 5209
Email Allison.kirkman@vuw.ac.nz

MEMORANDUM

TO	Corinne Lee
COPY TO	Daniele Abreu e Lima
FROM	Dr Allison Kirkman, Convener, Human Ethics Committee
DATE	15 December 2014
PAGES	1
SUBJECT	Ethics Approval: 21502 Health Professional Spatial and Planning Survey

Thank you for your application for ethical approval, which has now been considered by the Standing Committee of the Human Ethics Committee.

Your application has been approved from the above date and this approval continues until 16 February 2015. If your data collection is not completed by this date you should apply to the Human Ethics Committee for an extension to this approval.

Best wishes with the research.

Allison Kirkman
Human Ethics Committee

General Medical Environment Inquiry

Participant Information:

Master of Architecture (Professional) Design Research via Questionnaire

Nature & purpose of Design Research:

The purpose of the present design research is to examine the role of Architecture in a post-disaster healthcare context via a Masters by thesis in Architecture. This research has been granted Human Ethics Approval by the Victoria University of Wellington Human Ethics Committee.

The proposed inquiry will examine preferred spatial conditions of a generic healthcare setting, with specific focus on: (1) inter- and intra-department layout, and (2) environmental conditions for optimal staff efficiency and comfort. Questionnaires will be tailored to the niche expertise of each participant. The following departments are of interest to this questionnaire:

- Surgery
- Radiology
- GP Clinic
- Dental Clinic
- Medical Laboratory
- Emergency Department
- Pharmacy
- General Ward
- Intensive Care Unit

The aim of the present design research is to design a health centre in semi-rural Central Java, Indonesia that will respond to nearby imminent volcanic disasters. Research via a questionnaire will enquire preferred room layouts and environmental conditions from a medical professional's point of view for achieving optimal post-disaster trauma response. The final design aims to provide an environment that supports staff efficiency and comfort, which ultimately affects patient well-being and healing.

1

Corinne Lee
Architecture MArch (Prof)

Use of Questionnaire and Photographs Feedback:

Information from questionnaires will be used solely by the lead researcher to help in understanding the spatial requirements of a healthcare setting. A floor plan / general furniture and equipment layout of the department, as well as other adjacent departments of interest will be drawn during the inquiry. Photographs of participants answering the survey may be taken as evidence of the data collection phase.

A copy of participant's questionnaire, floor plan and photos will be made available for reviewing upon request prior to the publication of the written thesis. Information from both sources will be used to inform the spatial conditions and building layout in both design presentation(s) and written thesis.

Anonymity & Confidentiality:

To ensure credible contributions of expertise, the name and professional title of participants will be published. However, should participant anonymity be required this can be attained via contact with lead researcher. All participant questionnaires, and drawn plans will be kept confidential. Raw data will be kept under electronic security to ensure confidentiality. All documentation pertaining to the General Medical Environment Inquiry will remain with the lead researcher.

Questionnaires will be undertaken at a time and location that best suits the participant. All participants will receive a summary of their questionnaires for acceptance before publication.

Any participant withdrawal should be done via email before **December 25th 2014**.

Contact:

Should you have any questions or concerns about this study please feel free to contact the lead researcher and/or thesis supervisor(s) at any time.

Corinne Lee – Lead Researcher
leecori@myvuw.ac.nz

Daniele Abreu e Lima – Thesis Supervisor
daniele.abreuelima@vuw.ac.nz
04 463 6292

General Medical Environment Inquiry

Participant Consent Form:

By signing this form, you are indicating that you are able and willing to be surveyed, and give your consent for the purpose of design research. Please indicate that you have read and understood the information regarding this research by checking off each of the following statements:

- ☐ I have been told about the study
- ☐ I know why it is being done
- ☐ I am able to ask questions about the study
- ☐ I am able to choose freely to join or not
- ☐ I know I can pull out of the study at any time
- ☐ I know the information from the survey will be recorded, photographs will be taken during the process, and that the interview will be made into a summary
- ☐ I know any reports will be erased after 1 year
- ☐ I will then be able to see the report and give my ideas
- ☐ My name will be used in the study unless I communicate to the lead researcher otherwise
- ☐ The report may be put into a journal or a book
- ☐ I want to take part in the study

Name:

Signature:

Date:

Thank you for your time and participation in this study.

Kind Regards

Corinne Lee – Lead Researcher

Health Professional Spatial and Planning Survey

LAYOUT DESIGN: GP CLINIC

1. Please sketch in a simple diagram a preferred layout of a *GP Clinic* that would offer an environment for optimum and efficient work outcomes. Please include in as much detail:

- Key areas and spaces,
- Rough location of key equipment,
- Patient / Staff Access (if separate entry is applicable, shown in red below), and
- Relationship between rooms (indicating via arrows, shown in blue below)

E.g.

FACULTY OF ARCHITECTURE & DESIGN Te Wāhanga Waihanga-Hoahoa
139 Vivian Street PO Box 600, Wellington, New Zealand
Phone + 64-4-463 6200 Fax +64-4-463 6204 Web www.victoria.ac.nz/fad

2

Corinne Lee
Master of Architecture, MArch (Prof)

SPATIAL QUALITY DESIGN: GP CLINIC

2. What are your preferences for the features listed below? Please circle one number 1 – 5 for each room.

	Dim				Bright
A. Lighting					
- General lighting level	1	2	3	4	5
- Spot lighting level	1	2	3	4	5
- General lighting type	Natural / Artificial				
	Not at all Preferred				Highly Preferred
B. Ventilation					
- Natural ventilation	1	2	3	4	5
C. Access to Nature					
- Visual access to greenery	1	2	3	4	5
- Presence of artwork	1	2	3	4	5
- Pleasant colour scheme	1	2	3	4	5
D. Sound					
- Complete silence of room	1	2	3	4	5

3. Please list any other *spatial qualities* that may be preferred:

4. Which one of the above is the most important to you?

GENERAL OVERALL OPINIONS ON HEALTHCARE DESIGN

5. Do you think that the *layout* and *spatial quality* of a medical facility has an impact on your efficiency and quality of performance as a **medical professional**?

- ☐ Yes
- ☐ Somewhat
- ☐ Not
- ☐ Don't know/ Not sure

6. Do you think that the *layout* and *spatial quality* of a medical facility has an impact on **patient** healing?

- ☐ Yes
- ☐ Somewhat
- ☐ Not
- ☐ Don't know/ Not sure

PARTICIPANT DETAILS

7. Are you (please tick):

- ☐ Male
- ☐ Female

8. Please state the title of your healthcare position: _____