P e r f o r m a n c e
o f S c a l e

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Performance of Scale

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Submitted in partial fulfilment of the requirements for the
Masters of Architecture [Professional] Degree.

Victoria University of Wellington, School of Architecture.

2013

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[The] scalar relation between body and space considers more than just one's height or size: it also considers how one uses, occupies and experiences space in terms of size, movement and time. If scale is considered as a relationship between the spectator and a work of art, this underlines the origin of such relations in subjective experience.¹

¹ ADLER, G., BRITTAİN-CATLIN, T. & FONTANA-GIUSTI, G. 2013. *Scale: Imagination, Perception and Practice in Architecture*, Taylor & Francis. p126

Abstract

Cities are for people.

As the scale of modern day cities continue to grow with overbearing homogeneity, the human body has become a disengaged entity among the repetitive monolithic forms. This city environment has come to lack the facilitation of personal, social, spatial and economic connections. Architecture can be seen to be the major facilitator in engaging and shaping urban space and subsequently the connection between people and space.

This thesis responds to these static environmental conditions, questioning how ‘shifts in scale’ could influence the performance of space, and resultantly how performative space can create a connection between the body and the city.

The thesis identifies a gap in performance research which considers ‘shifting scales’ as a non-human active agent. Active agents are assessed for their effects on the body (subject) and space (form), becoming critical to successive design evaluation and development. The notion of ‘Performance in Architecture’ is defined and grounded through acknowledging current modes of discourse in architectural theory, establishing the relationships between the interconnected theories of ‘subject performance’ and ‘performance of form’. These two theories explore the performative relationships between the body ‘subject’ and architecture ‘form’, setting up the research structure and subsequent conditions for the production of progressive design iterations.

The framework for the performance design iterations engages two alternate scaled conditions (Act One & Act Two), both of which are explored through parametric based software in conjunction with physical modelling. This parametric based technology enables the comprehension and fabrication of complex forms, allowing the design process to move between the digital world and real world with ease. Engaging with this technology allows the scaled conditions to become specifically responsive to parameters defined by the architect.

Each design iteration ‘shifts in scale’, focusing on a select combination of components, providing feedback on the productive application as to how ‘shifts in scale’ influence the performance of space. The design iterations systematically bring together parameters responding to: Scaled Volume, Intersection, Context, Traversal Movement and Access, Circulation, Speed, and Connection. The resultant design is evaluated for its performative success in allowing the body to shift and move between multiple scaled volumes and floor levels. The production and evaluation of these design iterations grounds the importance of ‘shifts in scale’ as an active agent that generates a connection between the body and city.

The uniqueness of each space provides a set of diverse tenanting opportunities where the design strategy begins to address the expansion and densification of cities, re-enlivening and connecting ‘unused’ ‘left over’ space. The design strategy acts as a catalyst for dealing with complex architectural parameters while maintaining its sensitivity to the human scale.

Acknowledgements

Thank you

Many thanks to my research supervisors. Simon Twose for your open design position and Dr. Jan Smitheram for your supportive feedback throughout the thesis.

A thank you to Chris Welch, Matthew McFetridge and Gordon Yung for your digital software support. Ben Sutherland, thank you for your help assembling and photographing the full scale design iteration and Grant Douglas for your help throughout the thesis.

To my dearest partner Beth Cameron, thank you for your unbelievable capacity to give; time, energy and expertise, your generosity, support and love has made this possible.

Contents

ABSTRACT	5	CASE STUDIES	27
ACKNOWLEDGMENTS	6	SUBJECT PERFORMANCE STUDIES	28
INTRODUCTION	8	PERFORMANCE OF FORM STUDIES	32
PERFORMANCE IN ARCHITECTURE	12	DESIGN PROPOSAL	37
SECTION 1 - A BRIEF BACKGROUND TO PERFORMANCE IN ARCHITECTURE	12	DESIGN ITERATION METHOD	38
SECTION 2 - CURRENT STATE OF PERFORMANCE ARCHITECTURE	14	ACT ONE PROCESS DIAGRAM	42
SECTION 3 - ARCHITECTURES ACTIVE AGENCY THEORY	16	ACT TWO PROCESS DIAGRAM	43
SECTION 4 - THE GAP	18	ACT ONE - SHIFTS IN SCALE	45
SECTION 5 - SUBJECT PERFORMANCE	20	DESIGN ITERATION 1 - INTERSECTION	47
SECTION 6 - PERFORMANCE OF FORM	22	DESIGN ITERATION 2 - SCALED SURFACE	53
SECTION 7 - CONCLUSION OF PERFORMANCE FRAMEWORK	24	DESIGN ITERATION 3 - SCALED VOLUME	63
		DESIGN ITERATION 4 - SCALED COMPONENTS	69
		ACT ONE REFLECTION	76
ACT TWO - PERFORMANCE OF SPACE	79	DESIGN ITERATION 9 - PROGRAMME	135
SITE AND CONTEXT	81	DESIGN ITERATION 10 - STRUCTURE AND SKIN	151
DESIGN ITERATION 5 - SCALED VOLUME, INTERSECTION AND CONTEXT	87	DESIGN ITERATION 11 - PERFORMANCE OF COMPLEX ARCHITECTURE	157
DESIGN ITERATION 6 - VORONOI DIVISIONS	101	ACT TWO REFLECTION	174
DESIGN ITERATION 7 - TRAVERSAL, CIRCULATION AND ACCESS	109		
DESIGN ITERATION 8 - VOLUME INTERSECTION	127		
CONCLUSION	176	BIBLIOGRAPHY	182
LIST OF FIGURES	178	WORKS CITED	184

Introduction

This research aims to develop a strategy to design performative architecture which facilitates a connection between the body and the city. This connection has a direct relationship to the social and economic success of a city. As our cities continue to grow with monolithic force the connection and sensitivity to human scale diminishes. With the advent of Modernism and modernist principles, economic drivers and disregard for context has allowed mass produced buildings to fill the landscape at rapid pace.² This view is reinforced by Michael Benedikt, he explains that;

*“[T]he ever increasing size of buildings and the alienation wrought by the growing difficulty of comprehending scale relationships between parts of buildings, and of one part of the built environment to another” stimulates a disconnected environment.*³

Jan Gehl argues that dominant planning ideologies, market forces and related architectural trends have focused design towards single buildings, not public spaces, shifting the city to be more isolated, introverted and dismissive. This is demonstrated in his most recent publication, the film *‘The Human Scale’*⁴. Gehl expresses that human dimensions have been overlooked rejecting human interaction regardless of a cities global, economic position or stage of development.⁵

This research proposes that ‘shifts in scale’ will influence the performance of space. To achieve this the thesis addresses two research questions. First, how do ‘shifts in scale’ influence the performance of space? Second, how does performance of space create a connection between the body and the city? At this point it is necessary to define the word ‘scale’ as perceived from a body centric perspective, as opposed to the technical drawing convention. ‘Shifts in scale’ can be considered as the shifting between one size to another, occurring in both architectural shifts and body movement perception.

The thesis is design-led where ‘research for design’ endeavours to formulate a strategy to produce performative architecture.⁶ The strategy consists of design iterations, where each follows a controlled method of investigation, contributing to the natural generation of the thesis direction.⁷ The design iterations help build a strategy for dealing with complex architecture which supports a connection between body and the city. These design iterations are broken into two distinctive testing conditions (scaled extremities) which for the purpose of this thesis are labelled as ‘Acts’.

² ASLA. 2013. *Interview with Jan Gehl* [Online]. American Society of Landscape Architects. Available: <http://www.asla.org/ContentDetail.aspx?id=31346> [Accessed 10 October 2013].

³ Michel Benedikt is a teacher and architect ADLER, G., BRITTAIN-CATLIN, T. & FONTANA-GIUSTI, G. 2013. *Scale: Imagination, Perception and Practice in Architecture*, Taylor & Francis. p3

⁴ The Danish architect and professor Jan Gehl has studied human behaviour in cities for the last 40 years, researching and testing solutions to improve public space within the modern city. REAL, F. C. F. 2012. *The Human Scale* [Online]. Available: <http://thehumanscale.dk/the-film/> [Accessed 7th Jan 2014].

⁵ GEHL, J. & ROGERS, R. 2010. *Cities for People*, Island Press. p3

⁶ “Research for design undertaken in a general and not project-specific framework, is aimed at the improvement of an aspect of design or of design in a particular realm”. DOWNTON, P. 2003. *Design Research*, RMIT Pub. p17

⁷ Methods are considered as ‘a way of doing things’. Downton expresses that a method can be developed for design, where “the process is still more or less repeatable but the outcome is expected to vary”. Where a design following a method can be seen as a test of the method. Ibid. p12

Figure | 1 Left: Monolithic towers, a production of modernist planning ideologies dominating the 1960's expressed by Jan Gehl

Figure | 2 Below: Monolithic built form disengaged from the human scale

Figure | 3 Left Below: Life takes place on foot with a variety of built scale (Lucca, Italy Amman) *Cities for People* Jan Gehl p119

Figure | 4 Below Right: The film *‘The Human Scale’* by Jan Gehl

Act one considers the body's connection with space, where the research questions how 'shifts in scale' influences the body's performance. This is tested through the assembly of scaled components coming together into a single object, positioned for public interaction. The outcome is a design which shifts how the body performs, facilitating interpersonal performance and altering people's otherwise everyday trajectories. As the design purposefully had no contextual relevance to the space, it was a pure experiment regarding how 'shifts in scale' influence the body.

The second Act considered how 'shifts in scale' can connect the body and the city addressing the research question. In scaling up the conditions of the first Act to the size of the city, the second Act generated a complex architecture becoming the new testing ground to evaluate a performative architecture. Over ten design iterations were conducted towards the understanding of this incredibly complex interaction between the cities existing context, the everyday performance of people, and architecture in the city. The result is a design which challenges Wellington City's existing Central Business District's (CBD) uniform cityscape, resulting in the creation of a complex building, where 'shifts in scale' act to create diversity and space which performs. The performative architecture connects people with space, while also supporting social and economic performance. These two Act's form the basis of an architectural strategy addressing shifts in architectural scale, which in turn facilitates a connective relationship between the body and the city.

The theoretical framework brings together two theories of performance; 'Subject performance' and 'Performance of Form'. Each performance theory is interconnected while defined separately so as to recognise the research approach towards the generation of alternate strategies for performance design.

The framework for this research is broken into seven sections. Section 1, 2 & 3 introduces the theory of performance in architecture. In Sections 4, 5 & 6 the meeting of two current ways of considering performance are presented where; Section 4 presents the 'gap' in current architectural performance research and theory, where the notion of 'shifting scale' is explored as a performative condition Section 5 considers subject performance (from a body centric perspective), and Section 6 considers the performance of form (towards the navigation of context). Section 7 concludes the prior sections providing an understanding of the symbiotic relationship between the body and form, and subsequently the development of an alternate understanding of performance in architecture.

Act One – Shifts in Scale

Act Two – Performance of Space

Performance in Architecture

Section 1 – A Brief Background to Performance in Architecture

The development of performance has been grounded in the humanities and social sciences. During the 1940's and 1950's the intellectual movement known as the *performative turn* presented a major paradigm shift, and focussed on the theorising of “*performance* as a social and cultural element”.⁸ Generally the notion of performance is directly connected to human behaviour. Key sociologists considered how dramaturgy (theatrical performance) could be applied to culture on mass, where culture as a whole could be considered as performance. One of the most influential socialists Erving Goffman considered ‘performance’ to be the interaction between people (face-to-face) in combination with the environment and audience.⁹

Performance became a means of observing moments of personal engagement within many disciplines, which naturally led to the Architectural world investigating its ability to add performance to modes of research exploration and design representation. With Performance giving rise to a new mode of architectural thinking and designing it led to a flurry of interdisciplinary influences. In August 1967 there was an entire issue in *Progressive Architecture* (PA) discussing Performance Design where by methods were discussed regarding *efficiency, effectiveness* and *optimisation*.¹⁰ Around the same time the (NASA) Apollo Space programme (1961-72) required a complex approach to design which involved “mathematical modelling towards optimisation and efficiency.”¹¹ Also at a similar time the critique of functionalism produced an array of directions for architecture which led to the development of ‘performance of form’.

The increased interest in architects using performance based frameworks to engage in architectural questions was noted in 1988 where Philip Johnston and Mark Wigley curated the MOMA exhibition named ‘De-constructivist Architecture’.¹² This exhibition introduced some of today's most famous architects many of which worked within the context of performance as an extension of scenography. The architects involved in the performance discourse were: Frank Gehry, Rem Koolhaas, the collective Coop Himmelb(l)au, Daniel Libeskind, Zaha Hadid, Peter Eisenman, and Bernard Tschumi.

*What these architects brought to performance was not just the specialized architectural discourse of programme, event, strategy, and movement, but an aggressive challenge to modernist discourses of form versus function, advancing the role of technology in the process of construction, and examining the political relationships inherent in the perception of space.*¹³

8 HENSEL, M. 2013. *Performance-oriented Architecture: Rethinking Architectural Design and the Built Environment*, United Kingdom, John Wiley & Sons Ltd. p17

9 The concept of dramaturgy considers the everyday life as theatrical play where the city could be considered the stage SMITH, G. 2002. *Goffman and social organization: studies of a sociological legacy*, Routledge. p33-34

10 HENSEL, M. 2013. *Performance-oriented Architecture: Rethinking Architectural Design and the Built Environment*, United Kingdom, John Wiley & Sons Ltd. p24

11 Ibid. p23

12 SALTER, C. 2010. *Entangled: Technology and the Transformation of Performance*, MIT Press. p76

13 Ibid. p77

Looking at these architects now you can observe their differing research agendas. Libeskind, Eisenman, Gehry and Hadid express the role technology has in design and construction. Their research can be aligned with the proceeding ‘performance of form’ design approach. Whereas the research from Tschumi, Eisenman and Koolhaas can be associated with ‘subject performance’, where the subject is privileged in the performance discourse around event, programme and movement.¹⁴ Bernard Tschumi expresses the notion of event to be the unplanned nature of architecture, where event and architecture cannot exist without one another. Tschumi states:

*There is no architecture without action, no architecture without events, no architecture without program... architecture is never autonomous, never pure form, and, similarly, ...architecture is not a matter of style and cannot be reduced to a language...*¹⁵

These influential architects have established approaches and processes for design which developed “into coherent ideas about form, [and] ideas that change political, cultural, and social notions.”¹⁶ The advancement of technology has enabled the comprehension and fabrication of complex form to be realised in what many are calling ‘Performative Architecture’.¹⁷ These new technological abilities have led to an explosive exploration of complex forms, which were initially critiqued heavily for their divorce from architecture's functional fundamentals. Critique aside, without the exploration of the likes of Greg Lynn's work with form, the development of architecture could not have conceived the complex overlapping of information that has allowed the development towards architectural performance.

14 Ibid. p76

15 TSCHUMI, B. 1996. *Architecture and Disjunction*, MIT Press. p3

16 GROBMAN, Y. J. & NEUMAN, E. 2011. *Performatism: Form and Performance in Digital Architecture*, ROUTLEDGE CHAPMAN & HALL. p3

17 Ibid. p3

Section 2 - Current State of Performance Architecture

Performance as practice, method, and worldview is becoming one of the major paradigms of the twenty-first century..... suddenly everyone from new media artists to architects, physicists, ethnographers, archaeologists, and interaction designers are speaking of embodiment, situated-ness, presence, and materiality. In short, everything has become performative.¹⁸

Over the last decade “[T]he characterization of architecture as performative has enjoyed a certain success among theorists and practitioners”¹⁹. However, while popular, the term ‘Performance’ in architecture is widely used with little definition.²⁰ This broad view allows an open and non-descript understanding of the term performative “as a means to theorise, make, understand or act in the world.”²¹ Thus generating a multitude of theories relating to performance.

Current performance discourse in architecture is attempting to define the term, as a means to move towards a productive application of performance in architecture. Both Michael Hensel and duo Eran Neuman & Yasha J. Grobman are attempting to formulate definitions of performance. Hensel defines performance as; ‘Performance-orientated architecture’ “...characterised by four domains of ‘active agency’; the human subject, the spatial, material organisation complex, and the environment.”²² Similarly practicing architects Preston Scott Cohen consider characteristics of agency to be responsive to; site, context, ‘human subject’ and laws of physics as integral to the production of performative architecture.²³ Neuman and Grobman discuss architecture performance as ‘Performatism’ pulling together a broad range of theories regarding performance discourse in architecture. Neuman and Grobman focus on how performance will continually support changes in politics, society and culture where architecture responds to these realities.²⁴ These definitions look towards ‘performance’ and methods which support practice towards performative architecture. Within these definitions they similarly consider the ‘human subject’, and ‘spatial and material organisation’ as active agents.

This thesis will focus on developing and supporting the interconnection of two alternate theories; ‘subject performance’ and ‘performance of form’. Neuman describes these theories from differing backgrounds as diverging in the architectural realm.²⁵ The following section will define ‘agency’ (based on the Actor Network Theory) supporting the interaction and connection between ‘subject performance’ and ‘performance of form’. As an agent, the ‘human subject’ supports the theory of ‘Subject Performance’, while the ‘spatial and material organisation’ agent supports the theory of ‘Performance of Form’.

¹⁸ SALTER, C. 2010. *Entangled: Technology and the Transformation of Performance*, MIT Press. pxxi

¹⁹ PICON, A. 2011. Architecture as performative art. In: GROBMAN, Y. J. & NEUMAN, E. (eds.) *Performatism: Form and Performance in Digital Architecture*. ROUTLEDGE CHAPMAN & HALL. p15

²⁰ SPRECHER, A. Ibid. Informationism: information as architectural performance. p21

²¹ SMITHERAM, J. 2011. Spatial Performativity/Spatial Performance. *Architectural Theory Review*, 16, 55-69. p56

²² HENSEL, M. U. 2011. Performance-oriented Architecture and the Spatial and Material Organisation Complex. *FORMakademisk*, 4, 3-23. p3

²³ GROBMAN, Y. J. & NEUMAN, E. 2011. *Performatism: Form and Performance in Digital Architecture*, ROUTLEDGE CHAPMAN & HALL. p73

²⁴ The risk with pigeonholing performance traits into concepts of ‘ism’ is its inability to shift with our fast moving world. Ibid. p3

²⁵ NEUMAN, E. 2011. The collapsing of technological performance and the subject’s performance. In: GROBMAN, Y. J. & NEUMAN, E. (eds.) *Performatism: Form and Performance in Digital Architecture*. ROUTLEDGE CHAPMAN & HALL. p33

Figure | 5 Diagram shows the relationship between of form and the subject body.

Figure | 6 Diagram shows the relationship between environment and form.

Section 3 - Architecture's Active Agency Theory

The concept of agency among philosophy and sociology, refers to “the capacity of a person or entity to act in the world”.²⁶

*Thus, the question to ask about any agent [is] the following: Does it make a difference in the course of some other agent's action or not? Is there some trial that allows someone to detect this difference?*²⁷

Here Bruno Latour states that; anything that modifies the state of another agent can be considered an actor.²⁸ This recognition that not only humans, but also non-human entities can act in the world, leads to the question of non-human agency. Non-human agency considers all materials, objects and entities in the world which; act, move or influence one another as an agent, resultantly including architecture as a performing agency.²⁹ Without this notion of non-human agency, architecture could not be considered a performative entity.³⁰ Architectures capacity to perform facilitates complex interactions between many agents, human and non-human, as expressed by Michael Hensel as being the “intricate process of interaction”, between; the subject (body), the environment, the spatial and the material.³¹ In support of architectures capacity to act Latour expresses that “... visiting construction sites offer[s] an ideal vantage point to witness the connections between humans and non-humans.”³² In this respect, the building requires action from the human agent (subject) to be built and realised, the architecture becomes a non-human active agent in the process of construction. The interconnections between human and non-humans supports how this thesis defines performance in architecture.

26 HENSEL, M. 2013. *Performance-oriented Architecture: Rethinking Architectural Design and the Built Environment*, United Kingdom, John Wiley & Sons Ltd. p18
27 Non-human agency is a principle feature supporting the 'Actor-network theory' discussed by the likes of Bruno Latour. LATOUR, B. 2005. *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford University Press. p71
28 Ibid. p109
29 Ibid.
30 HENSEL, M. 2013. *Performance-oriented Architecture: Rethinking Architectural Design and the Built Environment*, United Kingdom, John Wiley & Sons Ltd. p18
31 GROBMAN, Y. J. & NEUMAN, E. 2011. *Performatism: Form and Performance in Digital Architecture*, ROUTLEDGE CHAPMAN & HALL. p6
32 LATOUR, B. 2005. *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford University Press. p88

Subject (active agent)
The human subject, the individual or body

←
→
'Subject Performance'

Scale (active agent)
Scale made up of spatial and material organisation

Figure | 7 Diagram showing the relationship between scale and the subject (body)

Section 4 – The Gap

The thesis explores a gap in performance research which considers ‘shifts in scale’ as a non-human active agent in architectural design. Shifts in scale can be applied at all scales of design where the application of scaled conditions to any context prompts a performative reaction. Points of overlap occur where the intersecting of two entities come together creating a shift in scale. At these points of intersection the activation of space occurs where it affects the body (subject’s) trajectory and interpretation of space. ‘Subject performance’ considers how the body performs in reaction to ‘shifts in scale’. Through privileging ‘Subject performance’ as an active agent, an alternate design strategy is established facilitating human interaction with the built environment. ‘Performance of form’ navigates active agents of; form, site and context, in combination with constraining realities of the physical world towards the production of a highly performing architecture. The combinations of these theories form the basis for a design strategy which works together to connect the body to the city.

Section 5 - Subject Performance

Generally the notion of performance is directly connected to human behaviour, “[t]his is rooted in the hypothesis that all human practices are performed and are affected by their specific context: the notion of active human agency”.³³ ‘Subject Performance’ focuses on human (subject) interaction with non-human agents over time, resultantly creating a subject identity. The development of identity provides insight into the body’s connection to architecture. Eran Neuman describes ‘subject performance’ as;

*..actions that are performed by individuals, and the way individuals develop a personal identity and become subjects following the performance of a certain action; from this point of view the personal identity of the performer of any action crystallizes as a consequence of having performed the action. According to gender discourses, the very fact of performing the action and repeating it crystallizes the subject’s consciousness about him/herself.*³⁴

Neuman further expresses ‘subject performance’ as “...the appearance of the subject who utilizes the various strata of architecture..” where the action of the subject is prompted by the architecture.³⁵ Architecture is the facilitator of this complex interaction between human and non-human agents where the ever repeating interaction generates a connection. Neil Leach can be seen to support ‘subject performance’ expressing that “[d]esign can provide a form of connectivity, a mediation between individuals and their environment.”³⁶ The design research considers ‘subject performance’ in conjunction with ‘shifts in scale’ as the generator of spatial and material organisation, thus the resulting forms influence the subjects capacity to act.³⁷ Supported by Hensel, architecture’s active agencies (human subject, material and spatial organisation and environment) are fundamental to architecture’s performative capacity.³⁸ Hence, the importance of ‘subject performance’ in the formulation of a design strategy supports the performance of space, creating a connection between the body and its environment.

³³ HENSEL, M. 2013. *Performance-oriented Architecture: Rethinking Architectural Design and the Built Environment*, United Kingdom, John Wiley & Sons Ltd. p17

³⁴ This definition of subject performance is based on Butlers, *Bodies that matter: On the Discursive Limits of “Sex”* NEUMAN, E. 2011. The collapsing of technological performance and the subject’s performance. In: GROBMAN, Y. J. & NEUMAN, E. (eds.) *Performatism: Form and Performance in Digital Architecture*. ROUTLEDGE CHAPMAN & HALL. p33

³⁵ Ibid. p33

³⁶ LEACH, N. 2006. *Camouflage*, Cambridge, MIT Press. p9

³⁷ Neuman notes that Foucault and Althusser’s neo-Marxist theories of power mechanisms and apparatus contributed greatly towards the theorising of non-human agents influencing individual’s actions. NEUMAN, E. 2011. The collapsing of technological performance and the subject’s performance. In: GROBMAN, Y. J. & NEUMAN, E. (eds.) *Performatism: Form and Performance in Digital Architecture*. ROUTLEDGE CHAPMAN & HALL. p36

³⁸ HENSEL, M. U. 2011. Performance-oriented Architecture and the Spatial and Material Organisation Complex. *FORMakademisk*, 4, 3-23. p8

Subject Performance

Figure | 8 Illustration expressing the interconnection between form and subject, being the theory of ‘Subject Performance’

Section 6 - Performance of Form

‘Performance of form’ similarly to ‘subject performance’ has the capacity to act. David Leatherbarrow suggests, performance of form is the method, whereby the building begins to explore the potential for action.³⁹

‘Performance of form’ for the purpose of this thesis is defined by the designs ability to navigate the active agents of; site and context, in combination with constraining realities of the physical world. The aim is to produce an efficient built form responding to these active agents. Efficiency is examined for its relationship between an action (action being the influence of arranging spatial and material form) and the outcome it produces. Efficiency is achieved when the outcome successfully corresponds to the related parameter.⁴⁰ Parameters are defined by the relative information provided by the active agents, for example; sight lines, sunlight, physical boundaries, spatial partitions, privacy, access and circulation etc. All of these parameters provide information, shaping the design response, achieving ‘performance of form’.

Preston Scott Cohen denotes that, built “geometry has the uncanny ability both to be a constraint and to manifest the remarkable combination of other constraints”. When a building assumes a shape which accommodates a set of complex functional constraints, the architecture becomes performative.⁴¹ Supporting this concept, digital parametric tools provide the opportunity to deal with complex interdependent constraints. Parametric software supports the architect’s ability to manage the hierarchy of information, supporting the process of design. These parametric tools are engaged with and iteratively practiced and tested over time to establish the most highly performing and efficient design solution. “A computer is more than anything else a steering device. According to the old rules of cybernetics this simply means two things: direction and flexibility”.⁴² Using parametric software as a tool simply supports the designer’s ability to control the play between form, function and programme. This control of overlapping information allows the ‘performance of form’ to explore ‘shifts in scale’ as an active agent in response to contextual and functional constraints. The use of parametric information in design is part of the architect’s pursuit to unite “the architectural object with its environment”⁴³ achieving ‘performance of form’. ‘Shifts in scale’ can stimulate a performative connection through the information exchange between form and subject.

39 SALTER, C. 2010. *Entangled: Technology and the Transformation of Performance*, MIT Press. p83

40 NEUMAN, E. 2011. The collapsing of technological performance and the subject’s performance. In: GROBMAN, Y. J. & NEUMAN, E. (eds.) *Performatism: Form and Performance in Digital Architecture*. ROUTLEDGE CHAPMAN & HALL. Neuman, 2011) p33

41 GROBMAN, Y. J. & NEUMAN, E. 2011. *Performatism: Form and Performance in Digital Architecture*, ROUTLEDGE CHAPMAN & HALL. p73

42 SPUIYBROEK, L. 2004. *Nox: Machining Architecture*, Thames & Hudson, Limited.

43 SPRECHER, A. 2011. Informationism: information as architectural performance. In: GROBMAN, Y. J. & NEUMAN, E. (eds.) *Performatism: Form and Performance in Digital Architecture*. ROUTLEDGE CHAPMAN & HALL. p27

‘Performance of Form’

Figure | 9 Illustration expresses the interconnection between form and context

Section 7 - Conclusion of Performance Framework

The endeavour now is to establish a debate in which experimentation, technology and progress do not exclude the actuality of emotions, traditions and identity.⁴⁴

To bring conclusion to the previous sections, a performance framework is defined, supporting the thesis strategy towards the generation of a performative architecture. As discussed previously, the framework uses the notion of 'agency' to bring together two alternate theories, 'Subject Performance' and 'Performance of Form'. These theories together support the notion that 'shifts in scale' influence the performance of space which subsequently influences the connection between body and city. In this respect both 'subject performance' and 'performance of form' are considered to be, interdependent conditions. 'Subject performance' looks from a body centric perspective where it considers the subject (body) to be influenced by non-human agents such as spatial composition. Whereas the formal spatial and material design composition of 'shifts in scale' is considered to be 'performance of form'. Subsequently 'performance of form' looks to 'human agents' ('subject performance') as a contributing parameter in guiding the formulation of design decisions. These two theories present a critical understanding into the significance spatial composition plays in the formulation of a subject's (body) everyday life movements and experiences, thus reinforcing the ability for architecture to actively connect the body with the city. This theoretical framework supports an understanding of the crucial role 'design research' has towards the formulation of a design strategy.

Current digital technologies have allowed the comprehension, exploration and fabrication of the relationships expressed between 'subject performance' and 'performance of form' to be realised as an alternate design solution. The role digital technologies play in bringing together complex problems and working with overlapping parameters allows the architectural discipline to become increasingly fluid as it moves between the digital and real worlds, navigating the parameters of the body or bodies in conjunction with the compositional constraints of context and form. These connective relationships between the body, form, digital and real become increasingly powerful to the formulation and development of architectural realisation. It can be seen that the application of these digital technologies as a research tool in the development of design solutions can become an invaluable means of solving design problems.

This theoretical framework provides a launching point for further design research, where 'shifts in scale' becomes the active agent responding to the theories discussed. As a result design based parameters and digital tools are used to facilitate and explore the notion of performance, supporting diversity and reacting to the problem of homogeneity in the city.

⁴⁴ COLLETTI, M. 2010. Digitalia - The Other Digital Practice. *AD Exuberance: New Virtuosity in Contemporary Architecture*, 80, 141. p19

Figure | 10 Diagram expresses scale as an active agent, and how it fits within the performance framework

Case Studies

The following case studies have been split into two groups, both of which relate to the following design 'Acts' and loosely fit within the areas of 'subject performance' and/or 'performance of form'. The case studies present a spectrum of scaled works ranging from Performance Art (with relevance to 'Act One') to complex architectural buildings (with relevance to 'Act Two'). The studies chosen provide a variety of performance based design approaches while also offering insight into the works of others whom are experimenting towards the practical application of performance in architecture.

*Figure | 11 Opposite Page: N-Nature 2009
by Open Source Architecture*

Subject Performance Studies

These performance artworks consider how spatial acts can prompt the body to engage, move, and interact. These works support the theory of 'Subject Performance' providing evidence into how spatial and material organisation influences the subject's action. An example of this can be seen in Olafur Eliasson's *'The Weather Project'* (fig 12) where the Tate Modern is transformed into a soft golden world, prompting many occupants/subjects to sit, lie down and close their eyes. The art installation is not just a glowing sun but the combined and interconnected performance of both the sun and its subjects, where the sun's presence effects the performance of the observing/interactive individual subjects.

Performance Art and Installation

Figure | 12 **Olafur Eliasson:** *The Weather Project*, Eliasson's 2003–2004 installation at London's Tate Modern.

Figure | 14 **Doug Aitken:** *Sleepwalkers* was a video installation that covered the exterior of MoMA in 2007.

Figure | 13 **Fujiko Nakaya's:** *Living Chasm Project* was a site specific installation using pure water to create a fog-like effect.

Figure | 15 **Ann Hamilton:** *'The event of a thread'* is a multimedia installation which uses cloth and bodies suspended in motion. The large scale work is responsive to site and creates an immersive environment for the viewer

Figure | 16 **Rafael Lozano-hemmer:** *People on People* is an installation designed to displace the individuals image real-time, creating a platform to experience co-presence.

Figure | 17 **Ronit Eisenbach:** created a design studio experience for the students. The hanging sheets created interactive space where the body and space performed together.

Subject Performance Studies (cont)

Shifting from a controlled interior to an urban street environment, the work of Rodrigo Tisi's *'Plastic Forest'* (fig 18) uses the subject as a medium to paint/trace movement paths. A dense forest of vertical standing plastic tubes are placed in the path of oncoming pedestrians. The subjects navigate their way through the forest of plastic poles, creating a path as some poles break and others bend. This work recognises the individual's role as an actor, where the body/subject leaves a trace or impression, influencing the movements of other individuals and the physical world we move through. These works support and highlight 'Subject Performance' theory's importance in the development of performative architecture. Bernard Tschumi's architectural methods also support the 'Subject Performance' theory. Tschumi considers not only Form and Function to be critical to architecture but the importance of 'Event', which considers the subject (body) to be the key aspect of design.

Performance Art and Installation (cont)

Figure | 18 **Rodrigo Tisi:** *'Plastic Forest'* was design part of a music festival in 2005. As the subject navigated their way through the plastic poles would break forming a unique pathway.

Figure | 20 **Philip Beesley:** *'Hylozoic series'* Beesley considers all matter to have a life of its own. This installation interacts and responds to its environments and audience.

Figure | 19 **Bachelor of Architectural Computing Students and Staff:** *Draft Design of Euphonious Mobius Wall* based on physical pixels. The form directs the subject with added media interaction.

Architecture

Figure | 21 **Oren Sagiv:** *'intersection'* (PQ 2011) at the Prague Quadrennial for art and space. The work intersects compact intimate interiors with the everyday life of the city, creating scaled degrees of privacy.

Figure | 22 **Bernard Tschumi:** *Parc de la Villette Paris, 1982-1998.* Each of the 25 steel folies support events. Lines between the folies influence subject (body) movement.

Figure | 23 **Foreign Office:** *International port terminal, Yokohama 1995-2002.* Uses the subject movement as an architectural generator.

Performance of Form Studies

In reference to the theory of 'Performance of Form' the case studies below consider how form has the capacity to act. The works of Andrew Kundless (fig 24) and Manuel A. Báez (fig 25) follow a 'design through making' process. This allows the material and spatial constraints to be established throughout the investigation, resulting in a form which is efficient in its abilities to perform. The making process is a very important step in design as it generates and supports the ability for reflection and critique to occur. This is also important when CAD is used in the design process. This can be seen in Gramazio and Kohler work (fig 29) 'The Sequential Wall', where a 1:1 scaled test of a parametric system is generated to check material tolerances, sizing and the physical effects of gravity.

Process based form installations

Figure | 25 **Manuel A. Báez:** *Suspended Animation: Coiled serpent*, from the Phenomenological Garden Installation, Cranbrook Academy of Art. Made from Bamboo dowels & rubber bands. This was design through process based design.

Figure | 24 **Andrew Kundless:** *P_Wall*. (2009) Plaster cast wall, casting uses gravity sticks and cloth in sections. This is process based design where by the design was formulated from experimentations.

Figure | 26 **OCEAN Research Design Group:** 2008- 09 The design is a collection of spatial nets and membrane arrays, generated through a physical and digital form-finding method.

Figure | 27 **Greg Lynn:** *Bloom House Los Angeles*, 2010. Cast in fibre glass. Digitally designed then generated physically. The form divides the space, sitting some where between a light and a wall.

Figure | 28 **Open Source Architecture:** *N-Nature* 2008-09. This design responds to the existing characteristics of the gallery space.

Figure | 29 **Gramazio and Kohler:** 'The Sequential Wall' Specifically designed at 1:1 scale. The design method acknowledges performance of materials and their construction constraints. The wall considers both form and function using digital and physical robotic technologies.

Performance of Form Studies (Cont.)

When a form act's in response to many different parameters and achieves this efficiently the building begins to express 'performance of form'. Reiser + Umemoto's '014' building is such that the form acts as; structure, solar shading, façade exterior and interior wall, while providing a flexible open office space on every floor. Buildings such as Foster + Partners' 'GLA (Greater London Authority)' and Foreign Office 'International Port Terminal' show signs of bringing together performance in architecture where both 'Subject Performance' and 'Performance of Form' are addressed. These works present performative architecture that is both responsive and sensitive to the body/subject but also successfully respond to the building constraints and physical parameters that contribute to the shaping of the form.

Figure | 30 **UNStudios: Villa NM.**
Finished in 2006. The buildings form follows the landscape with one side stepping up for parking. Through the shifting of form the two volumes cross creating spatial intersection.

Figure | 31 **Preston Scott Cohen: Tel Aviv Museum of Art** presents a balancing act between the optimal white box of a gallery and the structural system aligned to various axes.

Figure | 32 **Coop Himmelb(l)au: BMW Welt's.** The built form supports the delivery of cars to the premier floor, while also delivering air changes using thermal currents and air stream as part of the building's functional and environmental performance.

Figure | 33 **Reiser + Umemoto: '014'**
Dubai completed in 2009. The perforated exoskeleton performs environmentally as a solar shade while framing views and providing structural support. A separation between the skin and form supports a stack effect reducing cooling loads.

Figure | 34 **Gehry Partners, LLP / Gehry Technologies: IAC Building, New York** 2007. Frank Gehry's team has focused on the performance of delivery systems for architecture. They deal with an integrated BIM system which provides a feedback loop between visible and functional aspects of the design.

Figure | 35 **Foster + Partners: GLA (Greater London Authority) City Hall, 2002.** Fosters and Partners bring together aspects of social, technological and environmental conditions with a unique parametric design process generating performance of form. They are not after a final solution but a range of design solutions based on the functional parameters.

Design Proposal

The research agenda

In the previous sections, the interconnected theories of ‘subject performance’ and ‘performance of form’ presented alternate perspectives, each being fundamental to the practical application of performance in architecture. It was determined that spatial and material organisation is the active agent influencing the body’s performative response. The research proposes that ‘shifts in scale’ is the active agent towards the generation of performative architecture.

The overall design process consists of recursive design iterations split into two distinctive testing conditions, titled ‘Acts’. Act One primarily tests the relationship between the subject (body) and spatial organisation, supported by the theory of ‘subject performance’, while Act Two builds on this research with the addition of context. In contextualising the design iterations, they are scaled up to the size of the city, where the following design iterations begin to respond to added parameters, referencing back to the ideals of ‘Performance of form’. The two part process endeavours to addresses the initial research questions, considering how ‘shifts in scale’ can influence the performance of space? and secondly, how the performance of space can create a connection between the body and the city?

Each ‘Act’ contains a series of critical design iterations, together they develop a strategy towards addressing the notion of architectural performance, supporting diversity and reacting to the problem of homogeneity in the city.

Figure | 36 This image is an exploration
between body and scaled form

Design Iteration Method

*Curiosity drove him to ask hard questions about what worked and what didn't work. He embraced the messy process of trial and error. With intense reflection he revised the process until he was able to perform the procedure to perfection and with confidence.*⁴⁵

This section explains the overall process and the controlled method in which each design iteration endeavours to answer the questions set forth in the thesis. The iterations follow a controlled method, consistently shifting between digital and physical modelling. Each iteration contributes to the development of the following iterations, where the recursive nature of design is celebrated through critique. The following is an outline of the general design method/approach undertaken for each design iteration;

1. The environment for the development and testing of the design iterations is formulated initially by a parametric visual based coding tool called Grasshopper (for Rhino, fig 37), which allows a hierarchical design logic to be created and adapted while the output is viewed in Rhino (3D CAD software, fig 38). Grasshopper's parametric tools provide the capability to test a design logic against a multiplicity of parameters, resulting in an extensive array of design options for the architect. Parameters within the visual code can be replaced entirely or changed slightly while the rest of the design logic remains unaffected, thus resulting in major to very minor differing outputs. The extensive array of outputs, allows the architect to evaluate a diverse set of options before moving on with the design.
2. Once a parametric⁴⁶ iteration is formulated in accordance with parameters controlled by the design intuition of the architect, it can be 'BAKE[d]' (grasshopper command), this creates a digital 3D model in Rhino (fig 38), detached from its constraining parameters. Here the architect (fig 40) has a complete range of digital tools in which to manipulate the digital design before preparing it to be outputted for physical conception.
3. Physical conception throughout the design iterations has occurred in many different ways. Some of the iterations are separated into individual components and fabricated independently, while others are conceived as entire/continuous forms. The fabrication of these digital models includes the use of;
 - digital nets (assisted by Pekakura) Laser cut out of card and folded into 3D forms,
 - 3 axis Modella and CNC Routers (Computer Numerical Control) used to cut components out of solid material,
 - 3D printing, providing printed plastic forms,
 - and in support of the conception of these physical models, digitally produced

⁴⁵ This quote is recited by Musallam in his TED Talk which was from his surgeon before heart surgery. 2013. Ramsey Musallam: 3 rules to spark learning. In: TALKS, T. (ed.) *Education*. TED ideas worth spreading. http://www.ted.com/talks/ramsey_musallam_3_rules_to_spark_learning.html Time 3:30 – 3:55

⁴⁶ Parametric – is a process of working within a set of parameters, where one condition (or equation or set of conditions) can be altered and as a result affects the connected conditions resulting in a set of differing outputs. From DAVIS, D. 2013. *A History of Parametric* [Online]. Available: <http://www.danieldavis.com/a-history-of-parametric/> [Accessed Nov 6 2013].

renders and visualisations presented a further understanding of the spaces being designed.

The digital to physical design process draws from Bob Sheil's 'Design Through Making' article, where the physical making process and designer interaction is considered to be fundamental to the development of critical design skills. Sheil argues that Design Through Making "is a body of knowledge and experience that goes beyond the production of information."⁴⁷ The process considers both the efficiency of parametric designing, and the body's importance in design. Jesse Reiser and Nanako Umemoto support the design process, commenting in their book 'The Atlas of Novel Tectonics', that "[t]he architectural design process allows openings and advances to occur before the problem's sheer recalcitrance shuts down development. Thusly design practice becomes agile enough to avoid getting stuck."⁴⁸

Each design iteration is broken down into parts expressing; the aim of the design, the parameters considered, what tools were used, and the successes or failures of the design outcome.

⁴⁷ SHEIL, B. 2005. Design Through Making. *Architectural Design*, 75, 5-12. p5

⁴⁸ REISER, J. & UMEMOTO, N. 2006. *Atlas of Novel Tectonics*, Princeton Architectural Press. p21

Figure | 37 Grasshopper logo

Figure | 38 Rhino logo

Figure | 39 Modelling tool kit

Figure | 40 Subject (body)

ACT ONE Process Diagram

DESIGN ITERATIONS

ACT TWO Process Diagram

DESIGN ITERATIONS

Figure | 41 Above: Design iteration diagram for ACT ONE

Figure | 42 Opposite: Design iteration diagram for ACT TWO

Act One – Shifts in Scale

Testing the performative relationship between ‘shifts in scale’ and the body

The first series of design iterations question how ‘shifts in scale’ influence the performance of space. Each iteration targets an alternative aspect of spatial and material organisation, consisting of; components, volume and surface. This series is purposefully contextless, providing a pure experiment regarding the body’s connection to ‘shifts in scale’ and its performative value to space. Each design iteration is identified for it’s position in relationship to both ‘subject performance’ and ‘performance of form’ as a means of establishing their value towards the design of performative architecture.

Figure | 43 Opposite Page: Photo showing components in reference to the body

Figure | 44 Opposite Page; Material intersection
illustration of two digitally
fabricated plywood components

Design Iteration 1 - Intersection

Design Iteration 1 - Intersection

Aim: The first design iteration explores the 'shift' aspect of 'shifts in scale' where intersection supports the transition between components.

Design: The design is an interaction that allows two pieces of timber to intersect at any given angle producing a specific fixed joint. The design focuses on the capabilities of digital parametric tools in the generation of an adaptable solution with variable constraints, whereby, the use of CNC cutting tools can transform digital models into a physical reality. The designed intersection uses material, physical and fabrication

Figure | 45 Below: Authors illustration showing locked intersection

Figure | 46 Right: Authors illustration showing component geometry pre-intersection

Joint Angle

Each component is paired where the unique cut geometry corresponds to one another, producing the desired angled intersection. The intersection has one constraint and two flexible angles (fig 46, 110 and 127 degrees). Both of which are parametric while the third angle must remain 90 degrees due to fabrication constraints.

Locking Joint

Due to the natural flexibility of timber a lock mechanism could be built into this joint providing a connection which uses no nails or glue.

This system allows for a chain effect where each component can be paired to different partners. This prompts the question of how to label each intersection. A drill hole numbering solution was tested.

parameters, where constraints are set and variables explored. The detailed design has built-in tolerances and a clip which holds the half-lap intersection together. (fig 46)

Method: Grasshopper's digital programming capabilities are used to create and calculate the designed intersection and its tolerances. Parametric sliders in Grasshopper allow the user to define the angles of each intersection while also specifying the unique geometry for the

CNC (Computer Numerical Control) router to cut. The fabricated pieces of material are uniquely paired and pushed together, producing an angled intersecting material composition. (fig 45)

Result: The final 1:1 scale model consists of a 9 part intersecting system (fig 54), demonstrating the application and potential as a series of intersecting components. The intersection provides the possibility to shift between scaled components.

Figure | 47 Above: Section of Grasshopper definition used for defining intersection angle and cut geometry

Figure | 48 Rhino visualisation of Grasshopper output

Figure | 49 Photo by author showing the completion of CNC fabricated components

The intersection is formally perceived as a simple half-lap joint, while the complex inner workings support the connection and specified angle. It can be noted here that when two entities intersect they create a third entity, that being the intersection. (fig 50) This design iteration sparked a further inquiry into the influence intersection has in facilitating shifts in scale.

Conclusion: From this experiment the intersection became its own active agent supporting the roll of 'shifts in scale'.

Figure | 50 Top Right: Intersection creating third identity

Figure | 51 Left top: Two intersections

Figure | 52 Middle Left: Physical intersection between two pieces of 18mm hoop pine plywood

Figure | 53 Left: Intersection geometry cut by CNC Router with identification count

Figure | 54 Below: Photo of nine unique plywood intersections

Figure | 55 Opposite Page: Author Illustration
digital scaled surface

Design Iteration 2 - Scaled Surface

Aim: This research builds on Iteration One's material intersection. Design Iteration 2 aims to create a surface which 'shifts in scale'. Each component unique size creates a puzzle of intersections, together forming a surface. The scaled surface aims to become an active agent influencing 'Subject Performance'.

Design: The design attempts to create a series of interlocking flat panels scaling in size, which follows a given double curved surface. Due to the complex parameters required to achieve this design outcome, a systematic process was used to engage parameters separately. Outlined below are the parameters used and resultant outputs.

Method: Grasshopper definitions (visual script of commands) are created as a means to deal with complex overlapping parameters.

Figure | 56 Above: Author illustrations regarding scaled surfaces potential as an active agent

Figure | 57 Below: Screenshot of Grasshopper definition for scaling surfaces

Double Curve Surface

Figure | 58 Above: Double curved surface, visualised in grasshopper

Figure | 59 Above surface converted to a mesh

Figure | 60 Above a series of images from grasshopper showing the division of surface and number of each surface segment

Figure | 61 Left: Double curved surface with surface segments laid out horizontally

t e s t 2 . 1

Double Curve Surface

Test 1: A grasshopper definition was developed to split a double curved surface into various sized components where by each was numbered. Each component was digitally flattened into 2D outlines ready for laser cutting. Once cut from flat cardboard they were connected loosely with 'joiners' producing a surface made of intersecting components. Unfortunately the intersections required additional 'joiners', failing to produce the clean intersections seen in Design Iteration One.

Figure | 62 Above: Authors illustrations components adapt parametrically to surface

Figure | 63 Above: Authors Illustration of component vectors shapes out from grasshopper

Figure | 64 Below: Authors photo, Physical card board model

t e s t 2 . 2

Scaling Surface

Test 2: A separate digital definition was developed to incorporate rectangular panels which could be scaled uniformly on any given surface. This was a success digitally, where the size of the rectangular panel could be controlled on any given surface. The physical application was not further tested due each component needing a linking panel (joiner), resulting in a similar outcome as Test One.

Figure | 65 Above: Authors illustration, digital screen shot of scaled components in Rhino

Figure | 66 Above: Screenshot of Grasshopper definition for scaling surfaces

t e s t 2 . 3

Intersecting surface

Test 3: The parameters were refined removing the curvature from the surface to achieve the production of a physical output. A new grasshopper definition was developed which shifted every alternate component off axis so as to develop intersections. Each component had four intersection points and material thickness, with specific cut geometries corresponding to the angle of each adjacent panel. The output consisted of a set of nine intersecting square plywood components, of uniform size each with unique cut geometry.

Figure | 67 Authors Illustration: Top
Right: Authors photo close up model of intersection

Figure | 68 Right: Authors image, conceptual representation

Figure | 69 Above: Photo of Author holding 1:1 Prototype

Results: The result was unexpected. Due to the complexity of the overlapping parameters many desired outputs proved to be unattainable. The stepped process enabled the aim to be explored systematically, as each parameter was tested individually, resulting in the production of a flat surface, as opposed to a curved surface as was specified at the outset.

Conclusion: The complexities of creating a scaled, intersecting, double curve surface was ambitious. However, the outputs provided valuable insight as to how the development of scaled surface can become an active agent. The output definitions also developed technical information supporting the production of following design iterations.

Figure | 70 Opposite Page: Photo by Ben Sutherland, Author holds physical 1:1 scale model of Test 3; Nine intersecting plywood panels

Design Iteration 3 - Scaled Volume

Design Iteration 3 - Scaled Volume

Aim: This design iteration aims to produce volumes which 'shift in scale' while also navigating a path (trajectory).

Design: This design iteration supports the generation of intersecting volumes where the shift from one scaled volume to another could occur.

parametric logic

grasshopper definition

net outputs

Figure | 72 Top: Authors series of illustrations explaining the parametric logic

Figure | 73 Middle: Section of Grasshopper definitions snapshot

Figure | 74 Bottom: Net output from Pepakura

Movement following a path through scaled volumes provides the perceived shift in scale. In reference back to Design Iteration One the intersecting volumes provide a third overlapping resultant space. This design was set up parametrically where many digital outputs were produced for assessment, following the method the digital designs were chosen to further explore the design physically.

Method: The parametric definition supported the designers ability to adjust each threshold along a path, as well as the path itself. The definitions logic consisted of parametric constraints, these were; intersecting points along a path/curve from A to B. At each point a different size threshold was created, as seen outlined by a rectangle in the digital model. These rectangles were lofted together to create a series of intersecting scaled volumes. Once an iteration had developed to a stage where benefits from a physical model was clear, flattened nets were outputted from Pepakura for laser cutting. Once each net was cut, the physical making process manifested in the assembly of complex intersecting volumes. Design decisions were made regarding which volume had precedence over another. The making process became part of the design experience.

Figure | 75 Top right: Authors photo of model

Figure | 76 Bottom: Authors photo of model

Figure | 77 Below: A series of alternate parametric designs

perspective

plan

elevation

axonometric

design iterations

Output: A series of 10 digital models were developed along differing paths, each with varying sized thresholds. Three designs were chosen to be physically modelled, each consisted of sequenced intersecting volumes, creating resultant overlapping scaled spaces.

Figure | 78 Above: series of Author photos taken of physical design

Figure | 79 Right: Author image, demonstrating the subjects connection to space

Results: Each physical model can be experienced by viewing from either end. The viewer gets a sense of movement through the volumes as one looks around inside the design, each threshold of scaled space draws you further in. The success of the models were intuitively evaluated based on experience.

Conclusion: The design exceeded expectations. As the designs can be conceptualised at many scales, the design series can be seen to be supporting 'subject performance' where the space prompts action and provokes enquiry. The navigation through the interconnected scaled volumes along defined paths adheres to 'performance of form' as the volumes respond to the given parameters.

Design Iteration 4 – Scaled
Components

Figure | 80 Opposite Page : Authors Illustration:
Concept design for Act ONE

Design Iteration 4 -
Scaled Components

Aim: The aim of this design is to pull together attributes from previous design iterations in order to generate a full scale design which considers how 'shifts in scale' can influence the performance of space.

Figure | 81 Top Left: Authors illustration showing a view looking down through the design iteration

Plan View

Figure | 82 Top Right: Authors illustration showing an elevation in reference to the scale of the body

Figure | 83 Bottom Left: Photo by Ben Sutherland: Looking down through the assembled design iteration

Figure | 84 Bottom Right: Photo by Ben Sutherland of Author beside compiled assembly showing true scale

Perspective

Design: The intent was to create a form which focused on 'shifts in scale', consisting of; components, surface and spatial volume. The design incorporated the use of; material intersection (Design Iteration 1), scaling (Design Iteration 2) and the forming of interconnected spatial volumes along a path (Design Iterations 3), to form a single object.

Method: A parametric definition was developed allowing control over; the angle of intersection, the shape and size of each component, as well as material thickness. The design process took two weeks, cycling between physical prototypes and digital modelling.

Complex Overlapping Parameters

Figure | 85 Above: Selection of Author's diagrams explaining the complexity of scaled intersections between digital components and fabrication outputs

Figure | 86 Above: Authors Photo; CNC 3 axis Router room

In preparation for the CNC cutting a new definition was developed which placed each piece of geometry horizontally, supporting a more fluid transition between the digital and physical. The components were CNC cut with consideration for tolerances needed for the different drill pieces and material types. Each component was totally unique in shape and intersecting cut geometry, all of which fitted together, as designed, in half an hour.

Figure | 87 Above: Authors Photo; CNC Router cutting components

Figure | 88 Photos series by Ben Sutherland: Showing different scale intersections

Output: When assembled, the design components shifted in size and thickness of material, intersecting at each end and spiralling down from largest to smallest. The form created an invisible surface which bridges between components, scaling in size vertically, while the design formally is neither inside or outside. Each material intersection provides the capability to shift from one scale to another. When looking down or looking up through the form, the inside space shifts in scale, but not convincingly, further design iterations will continue this shifting scaled space investigation.

[CLICK LINK BELOW TO VIEW ASSEMBLY](#)

<http://youtu.be/kMmJL9p8GpE>

Figure | 89 Top Left: Photos by Ben Sutherland, Assembly phase

Figure | 90 Bottom: Photo by Ben Sutherland, Showing component scale in reference to the body

Result: The design was positioned, in the School of Design and Architecture foyer, for public interaction as the feature of an exhibition specifically organised for this thesis research. The exhibition ran for two weeks. A time-lapse camera was setup to record the interaction between the form and subject(s) for several days. The design was suspended from the ceiling, with the designs most delicate components being hung 300 millimetres from the ground. One of the most unexpected outcomes was how people interacted with the design;

some individuals lay down on the ground to look up through the form, most individuals examined how the material intersections were created, and generally the form created a point for conversations to take place. This design shifted the subject's everyday action demonstrating 'subject performance'. These qualitative observations provide alternative understandings of performance in space.

Figure | 91 Below: Authors Photo looking up through design iteration in foyer

Figure | 92 Above: Authors Photo; Design exhibition showing timelapse subject engagement

Conclusion: The design iteration produced a full scale project, placed in the public realm for assessment. It pulled together 'shifts in scale' consisting of; components, surface and volume. The design can be seen to have altered 'subject performance' where by its presence influenced the performance of space.

Act One Reflection

Act One’s design iterations support the notion that material and spatial ‘shifts in scale’ influence the performance of space. One of the most interesting outcomes was the role of the intersection. The intersection facilitates the shifts in scale while also creating a third volume of space encapsulated by the resultant overlapping spaces of the first and second volumes. This notion of intersection as the facilitator of scales became a primary aspect of further design iterations in Act Two. Another important outcome involved ‘shifts in scale’, where subject movement through space activated a perceived shift from one scale to another.

Act Two – Performance of Space

Testing the influence of ‘shifts in scale’ within the context of the city.

Building on the ‘subject performance’ research presented in Act One, Act Two focuses on the ‘performance of form’; where the design iterations shift in scale to respond to the size of the city.

The design iterations respond to the site specific parameters and follow a similar method, shifting between digital and physical modelling (where possible). The cumulative design process leads to a speculative architectural proposal, where intersecting components, volumes and surface ‘shift in scale’ to facilitate a connection between the body and the city.

*Figure | 93 Opposite Page: Photo of 3D
Printed portion of the model*

Figure | 94 Opposite Page: Authors
Illustration of Wellington CBD,
Data collected from Koordinates

Site and Context

Figure | 95 Above: Bing Maps, Birds Eye view
 site plan of Wellington CBD

Situated in Wellington’s CBD the design proposes a physical connection stretching from suburban Clifton Terrace towards the Water Front. It straddles State Highway 1, The Terrace and Lambton Quay before funnelling down Brandon Street. The surrounding buildings and infrastructure shift in scale, ranging from; single and double storey dwellings on single lane streets, to twenty storey office tower blocks and a busy four lane traffic arterial.

s i t e

Context Model

A digital model of the existing building volumes showing heights in relation to the street and topographical terrain. The dashed line presents the possible design path.

Figure | 96 Below and Right: Authors Illustrations; axonometric and plan showing path

This site has been chosen for the range of contextual environments it spans, both in its social and economic functions, as well as its physical shifts in height and scale. The site follows similar pre-existing transverse cuts through the city, running parallel with The James Cook Hotel and the Cable Car. These cuts provide direct and elevated connections between Lambton Quay and the Terrace. This site offers the opportunity to form a connective relationship with the juxtaposing scaled conditions of the suburban perimeter in conjunction with the dense monolithic cityscape.

Figure | 97 Left: Authors Photo looking down at Lambton Quay

Figure | 98 Middle: Satalite view of site

Figure | 99 Site snap shots from birds eye view

Figure | 100 Bottom Left: Photo looking up Brandon Street

Figure | 101 Opposite Page: Final volume output
with sections highlighted in orange

Design Iteration 5 - Scaled Volume,
Intersection and Context

After playing with Grasshopper controls I began to design how the volumes could interact with the site.

Axonometric

Figure | 102 Above and Right: Authors Illustration; axonometric and plan of output 5.1

Plan

Aim: This iteration aims to create 'shifts in scale' through the insertion of intersecting volumes. The intersections support the transition between volumes along a set path, similarly to that found in Design Iteration 3. This iteration aims to produce 'performance of form' as the volumes respond to the city's surrounding contextual parameters and boundaries.

Figure | 103 Above: Grasshopper visual script

test 5.2

Digitally to Fabrication

This test reveals the complexity of fabrication and construction.

Axonometric

Figure | 104 Above and Right: axonometric and plan of outputs, visually this complex connection confuses the impact of a single joint.

Plan

Design: The design considers the placement of intersections along a chosen path in conjunction with the size of the volumes (lofted thresholds), both of which respond to the site specific parameters. The volumes at this stage are not considered as a building envelope but as boundary extents.

Method: The parameter values are based on site specific criteria's including; sunlight, height from street, connections with other buildings, and sight or view lines. The parameters are adapted to achieve 'performance of form' whereby the design relates directly to the site specific parameters. Following the method the digital design is physically modelled at 1:500 assisted by nets outputted by Pepakura. The nets were laser cut from ivory tutor card, folded and glued. The method was repeated three times, where each model was assessed for its 'performance of form' and potential influence on 'subject performance'.

Figure | 105 Above: Authors photo of model looking up Brandon St from the water front

Figure | 106 Below: Authors photo of model on base in context

t e s t 5 . 3

Refined forms with reconsidered connections

This test considers the surrounding context, particularly the small dwellings on the hill as well as the relationship to street level through refining the intersections and volumes.

Figure | 107 Above and Right: Authors Illustration; axonometric and plan of test output 5.3

Axonometric

Plan

Output: The resultant design iteration is a building consisting of a series of forms which scale from large to small, navigating the constraints of the built environment. The design intersected at critical points within the city, while also intersecting with the landscape. In some places the design iteration is cut away allowing existing buildings to remain intact.

Figure | 108 Right: Authors photo; Birds eye plan of model

Figure | 109 Below: Authors photo; test 5.3 on model base

Figure | 110 Above and Right: Authors Illustrations; axonometric and plan of output test 5.4

Axonometric

Plan

Conclusion: The design iteration's form successfully navigates through the existing city context achieving 'performance of form'. While the design is simple in theory, it acts as a giant volumetric sculpture, with a complete lack of inhabitable function. The following design iterations focus on incorporating added parameters considered to be important to architecture, such as; occupancy, programme, skin and structure.

Figure | 111 Right: Birds eye photo of final volume configuration

Figure | 112 Below: Model photo of test 5.4 volume navigating the city

t e s t 5 . 5

Intersections

Axonimetric

Figure | 113 Above and Right: Authors Illustrations; axonometric and plan of output test 5, showing spatial intersection in orange

Plan

Figure | 114 Above: Intersection diagram showing; the volume overlapping forming a third spatial condition space

Figure | 115 Left: Close up plan view of model intersections in context

Figure | 116 Left: Series of photos showing physical model volume intersections

Figure | 117 Below: Close up shot of the number identification system used to assemble the nets as well as the construction lines revealing the process

Figure | 118 Top Left: Authors photo modelled volume connecting to the land

Figure | 119 Above: Volume Connection (looking down Lambton Quay)

Figure | 120 Left: Photo looking down the terrace, this intersection conflicts with the street.

Figure | 121 Opposite Page: Volume
divisions made from Voroni

Design Iteration 6 - Voronoi Divisions

Figure | 122 Above: diagram explaining how the voronoi works

Aim: This iteration focuses on dividing the volumetric boundaries established in the previous design iteration, generating intersecting scaled space. In addition, scaled floor heights are introduced providing the opportunity for inhabitation to occur.

Method: The design consists of a two part process involving; the division of volumetric boundaries and the addition of floor levels. Part one uses the existing parametric definition found in design iteration 5 in conjunction with a well-known digital tool 'the Voronoi'⁴⁹ to divide up the volumes into various scaled spaces. The Voronoi definition requires reference points within digital space and a boundary box defining the area to divide. Following the definition requirements, the boundary boxes are fitted closely to each existing volume and reference points are placed at critical site specific locations within digital space. The Voronoi tool produced cell like geometry dividing each existing volume boundary into a new set of scaled spaces.

Part Two defines the scaled floor levels. This definition was developed to generate profiles within the existing volumes at scaled heights between 2.4m and 10m. These profiles were extruded 400mm supporting an indicative floor thickness.

This two part method provided an opportunity for the intersection between the new set of divided volumes and scaled floor levels to occur. Each floor and boundary intersection generated an opportunity to either, continue the floor plane or create an opening.

⁴⁹ "The voronoi** cell is bounded by the intersection of these bisectors***Voronoi diagrams are a class of patterns called Dirichlet tessellations, irregular tessellations of the plane that occur spontaneously in nature at every scale." ARANDA, B. & LASCH, C. 2005. *Tooling*, Princeton Architectural Press. p77

Figure | 123 Above: Authors image of birds eye perspective of volume output with regular floor level height intervals

Axonometric

Figure | 124 Below and Right: axonometric and plan of outputs shows the voronoi division within the intersection.

Plan

Figure | 125 Below: Site section showing the intersections divisions with floors.

Figure | 126 Right: Close up illustration showing the interaction between the floor levels and Voronoi divisions

Section

Result: The output did not produce geometry which supported the aim due to the Voronoi divisions failing to correspond to the parameters established by the points given. This phenomenon has been described by Reiser and Umemoto in the *Atlas of Novel Tectonics* as 'The Abuse of Data'⁵⁰. This occurs when the transference of data is miscommunicated or aligned with the desired aim or outcome.

⁵⁰ The example given is three rainfall graphs over three years each producing a curve. The abuse happens when the graph curves are used literally as the shape of the roof lofted together. REISER, J. & UMEMOTO, N. 2006. *Atlas of Novel Tectonics*, Princeton Architectural Press. p217

Intersections

Voronoi space break down

Figure | 127 Right: Illustration showing the voronoi divisions of the volumes from design iteration 5 test 4.

Conclusion: This Voronoi Division based design produced a series of intersecting occupiable spaces, unfortunately the relevance of the design output to the overarching iteration's aim failed to respond to some critical contextual parameters. Therefore the Voronoi tool will not be used in the proceeding iterations, however, the scaled floor levels will continue to be used throughout the following design iterations as a means of supporting inhabitation. The unresolved aim of this iteration will be further explored in a more convincing manner in Design Iteration 8.

Figure | 128 Left: Close up interaction between the intersections, divisions and context.

Figure | 129 Opposite page: Diagram showing the possible point to point trajectories of a traversing body

Design Iteration 7 – Traversal, Circulation and Access

t e s t 7 . 1

BIKE CIRCULATION

Aim: The design aims to provide access to the extents of the existing volumetric boundaries (established in Design Iteration 5) while also creating traversal between one area and another, supporting the opportunity for fluid movement to occur throughout the scaled spaces. The scaled floor levels developed in Design Iteration 6 in conjunction with volumes and intersections from Design Iteration 5 provide parameters towards the generation of a traversal system. Each traversal path considers both scales of; speed (travelling by bike or on foot) and path size (width, length and height).

BIKE CIRCULATION

Note: Bike paths are not shown in final drawings

Figure | 130 Left: Illustrations of bike circulation through the building volumes

t e s t 7 . 2

TRAVERSAL

Method: A matrix of points was created within the existing volumetric boundaries using grasshopper. These points correspond with critical areas based on a performance criterion addressing: sight lines, sunlight, connections with surrounding buildings and accessibility. Each point placed, can be considered as an individual's position in time and all other points in the matrix can be considered as the individuals projected position.

Figure | 131 Above: Illustration shows point to point connection creating lines of possible traversals

Figure | 132 Left: Rhino image of scaled floor plates and possible body traversals

1) Vertical traversal - Elevators

2) Medium traversal - Stairs

3) Lower traversal - Ramps

Figure | 133 Right: Traversal diagram separated into possible accessibility; elevators, stairs and ramps represented in colour

Method Continued:

A circulation diagram was created using grasshopper to connect all associated points within a given distance, forming a line matrix of interconnected points. Each line can be considered an individual's possible traversal. The circulation diagram provides information regarding areas of intersection, intensity and calm, supporting the size of each designed pathway to achieve an efficient 'performance of form'.

1) Vertical traversal - Elevator

Figure | 134 Above: This illustration shows possible ELEVATOR positions, the orange intersections provide a point of reference.

2) Medium traversal - Stairs

Figure | 135 Above: This illustration shows possible STAIR positions, the orange intersections provide a point of reference.

3) Lower traversal - Ramps

Figure | 136 Above: This illustration shows possible RAMP positions, the orange intersections provide a point of reference.

Method Continued:

To achieve successful circulation paths the traversal trajectories needed to become accessible. A grasshopper definition was created to establish the circulation trajectory angles. This information was then used to filter each trajectory into a category based on its associated angle. Trajectories with angles between 0-4.75 degrees were categorised as wheel chair accessible ramps; angles 4.75 -20 degrees were categorised as service

ramps, angles of 20-32 degrees were categorised as public stairs access, 32-47 degrees angles were categorised as services stairs only, while any angle over 47 degrees was categorised as a lift. These filtered trajectory diagrams proved to be an incredible resource in developing functional circulation design.

Figure | 137 Above: This illustration shows each group of traversals as a colour together in context with the city and boundary volumes

Figure | 138 Above: Close-up section of the illustration showing the complexity of the buildings traversal system

Figure | 139 Right: This illustration shows the traversal diagram within the boundary volumes. The highlighted volumes will be the focus of further development.

To productively develop the research, an exemplary portion of the entire design has been chosen, consisting of three intersecting volumetric boundaries. These volumes are to be developed further throughout the following design iterations.

Figure | 140 Above: Plan Illustration showing highlighted boundary volumes for further development.

Figure | 141 Above: Ramp design

Figure | 142 Right: Illustrated axonometric showing designed circulation based off the circulation diagram

Result: The outcome is a complex three dimensional circulation model including ramps, stairs and lifts, cutting across three existing volumetric boundaries and two of their corresponding intersections. Interestingly, due to the nature of traversal, the existing volume intersections became the point of divergence where the circulation paths met.

Conclusion: The scaled volumes have shifted from being a sculptural form situated in the city to a bridging architecture, where functional circulation provides access to every level. A reverse approach to the design is established, where the circulation through the building is determined and privileged before a building programme is set in place. The circulation paths support subject movement, where the activation of perceived shifts in scale occurs while traversing between the scaled spaces and floor levels.

Figure | 143 Above: Illustration showing circulation access, this includes; stairs, elevators, escalators and ramps modelled to NZ building code

Figure | 144 Opposite Page: Photo from inside model looking North down Lambton Quay at the designed volumes. The model has been 3D printed in plastic composite.

Figure | 145 Opposite Page: Exploded diagram showing volume divisions and intersections. The Blue volumes are the outer layer mostly containing the circulation.

Design Iteration 8 - Volume Intersection

Aim: The aim of this Design Iteration is to create a new set of intersecting volumes placed within the extents of the existing volumetric boundaries established in Design Iteration 5. The insertion of these volumes aims to create a secondary set of spatial scales for the body to shift through and inhabit.

Design: While housed within the existing volumetric boundaries, the new intersecting volumes navigate the circulation defined in the previous Design Iteration. The intersecting volumes create areas of left over resultant space, providing a new set of spatial conditions for inhabitation. Each new scaled volume establishes a set of intersecting perimeters for the housing of premises. These volumes are also considered for scales of privacy between spatial functions.

Figure | 146 Above: Illustration showing how all the volume boundaries fit together

Intersection 1 and Volume Boundary (A)

(A) is the resultant space from the existing volumetric boundary where much of the primary circulation runs.

(B) is the resultant space from the newly inserted volumes where internal premises based circulation occurs.

(1) Intersecting space established by existing boundaries.

(2) Intersecting space established by newly inserted volumes.

Volume Boundary (A) Divided into two intersecting boundary volumes creating a third identity intersection 2

Method: Similar to the methods in design iteration 3 and 5, rectangle thresholds are drawn in plan on alternate floor levels. These are extruded to varying heights stopping where the extrusion meets another volume to intersect. This method is applied throughout the three original bounding volumes. The extrusions are Boolean intersected with the circulation and new inserted volumes to produce a unique geometry.

Inside Volume Boundary (B) another set of intersecting volumes are created developing Intersection 3 and Volume boundary (C)

Figure | 147 Above: These illustrations show the logic for the volume intersections

Result: The design is a complex intersection of volumes where the traversing body can shift around and pass through these scaled spaces. The shifting between scales would generate a similar body experience as shown in design iteration 3. These new spatial divisions provide the opportunity for scaled levels of privacy to occur as a means of defining the hierarchy of spatial functions within the building.

Figure | 148 Opposite Page and Above:
Illustrations of the volume
boundaries and intersections

Conclusion: The intersecting scaled volumes perform at a high level allowing the body to shift through the interconnected spaces. These shifts between scaled volumes supports a connective relationship between the body and space prompting 'subject performance', and subsequently the performance of space.

Note: At this stage because of grasshopper's parametric ability, it is possible to change any of the parameters which resultantly effect the current design output. However, at this point the computing power required to run the excessive calculations was proving to be inefficient. Any further parametric work using Grasshopper definitions will be used independently.

Figure | 149 Opposite Page:
Exploded illustration of the
volume boundaries and
associated circulations

Figure | 150 Opposite page: This illustration shows the selected volume boundaries developed with speculative programme

Design Iteration 9 – Programme

Aim: This design iteration focuses on the potential for programme, aiming to demonstrate how the varying scaled spaces can perform socially and economically, supporting a diverse range of premises. This process can be considered similar to how tenancy operates in the city, where vacancies are filled by undetermined venders.

Design: Each volume suits a particular type of tenancy based on variable; floor size, ceiling height, outlook, location, foot traffic and access. These spatial attributes support a range of rentable values attracting a broad variety of tenants, resulting in diverse social occupation.

Method: The intersecting volumes are grouped into potential programmes based on scaled privacy (explained in Design Iteration 8) and rentable value as potential premises. A speculative occupancy is assigned to a specified volume, based on the needs of each tenant. These consist of high value offices, hotels, apartments, retail, entertainment, food dispensaries and other lifestyle needs. These speculative tenancies are represented in plan and axonometric drawings created in Autodesk Revit to show how each premises fits together with the circulation running between them.

Results: Scaled Intersecting volumes provide a range of spaces, speculatively providing a diverse range of economic and social entities. The uniqueness of each space provides the opportunity for the architecture to support and develop the tenant's (or business') identity.

Conclusion: This design iteration provides an insightful enquiry into how intersecting scaled space can influence the performance of space based on its potential occupancy.

Critique: This design iteration was compromised through the specification of default standardised walls and window components. Further comment can be referred to in Act Two Reflection.

Figure | 151 Opposite Page: Exploded axonometric showing how the building could support a diverse programme

Figure | 152 Left: Plan Illustration showing lower level programme

THEATRE AXONOMETRIC

Figure | 153 Above: Illustration shows possible programme; theatre and basketball court are two examples

HOTEL PLAN LEVELS 1 TO 4

Figure | 162 Left: plan illustration showing top level programme

HOTEL AXONOMETRIC

Figure | 163 Above: Illustrations showing possible programme; hotel

Figure | 164 Opposite Page: Illustrates
the floor structure in red and
scaled structure in black.

Design Iteration 10 – Structure and Skin

Aim: This design iteration aims to create a structural skin responding to parameters consisting of the; laws of physics, current design form, sunlight and shading, adhering to the 'performance of form'. The structural skin is to be made up of scaled surfaces of intersecting components aiming to be an active agent influencing 'subject performance'.

Method: The Grasshopper definitions developed in Act 1 were used to create an adaptable design logic responsive to the current design parameters. The definition required input data specifying the; surface size, surface divisions and the components shape. Each of the buildings faces were modelled separately in grasshopper using the same definition each time altering the data inputs when required.

Figure | 165 Below: The illustration shows the skin and structure working together physically and environmentally

STRUCTURE

Figure | 166 Left: Illustrations showing structure steel square hollow section 500 x 500mm

SKIN

Figure | 167 Left: Illustration showing the exoskeleton, timber notched joint

Figure | 168 Above: Illustration shows the relationship between the structure, skin and partial building

Result: The iteration produced two design outputs; structure and skin, both scaling vertically and horizontally in size across the faces of each volume. The skin supports shading and sufficient lighting apertures, while the structure supports the physical requirements of the form achieving 'performance of form.' Interestingly, the application of the scaled structure and skin to the intersecting volumes adds a new measure of scale. When experienced from the exterior, the volumes read as finely latticed scaled surfaces, whereas when experienced from the interior, the skin and structure re-engage the body with the fundamental scaled intersections, becoming a measure of the buildings enormity.

Conclusion: The design adheres to 'performance of form' where the structure is constrained to the parameters defined in the aim. The added exterior skin can be seen to influence the perception of space, altering 'subject performance'.

Figure | 169 Above: Close up skin illustration showing the latticed skin in scale with the human body

Design Iteration 11 – Performance of Complex Architecture

This design concludes Act Two's series of iterations, focusing on a strategy towards the generation of a complex architecture situated in Wellington's CBD.

Aim: The aim of this iteration is to visually present the outcome of the design strategy being explored and developed in the previous iterations. The exemplary design uses scaled space and intersections supportive of 'subject performance', and 'performance of form's' dynamic ability to navigate the complex physical parameters of architectural reality.

Design: Plans, sections, axonometric drawings and rendered visualisations provide a means of comprehending the speculative Architecture. The images present a complex architecture where circulation weaves through and connects the scaled intersecting volumes which house a range of occupancies in support of social diversity.

Figure | 171 Opposite Page: View looking West up Brandon Street. The blank volume in the foreground is the tail end of the undeveloped building

Figure | 172 Left: Birds eye view of building winding through the city context

Figure | 173 Left: Sectional perspective looking down on to Lambton Quay

Figure | 174 Above : Illustrated plan showing 3D section cut lines and the position of viewer 1's perspective direction

Figure | 175 Above: 3D perspective showing scale of space.

V I E W 1

LARGE INTERSECTION SPACE

Figure | 176 Above: Interior perspective on the northern corner of the building

Figure | 177 Above : Illustrated plan showing 3D section cut lines and the position of viewer 2's perspective direction

Figure | 178 Above: 3D perspective showing shift in scale of space as the subject follows the circulation

V I E W 2

ACCOMMODATION ENTRANCE

Figure | 179 Above: This interior view shows the a more intimate space while seen in the background the space opens up

Figure | 180 Above :Illustrated plan showing 3D section cut lines and the position of viewer 3's perspective direction

Figure | 181 Above: 3D perspective showing scale of space.

VIEW 3

INTERSECTING PATHWAYS

Figure | 182 Above: Interior perspective shows how the circulation paths cross and intersect

Figure | 183 Above : Illustrated plan showing 3D section cut lines and the position of viewer 4's perspective direction

Figure | 184 Above: 3D perspective showing scale of space. This shows the subject moving from the dentist to the accommodation spaces above

V I E W 4

SMALL STAIRS FROM THE DENTIST

Figure | 185 Above: Interior perspective shows the scale shift from one floor to another

Results: The design demonstrates how, perceived and physical 'shifts in scale', can manipulate how social and economic body's perform within a complex architecture. By giving priority to the Subject's (body's) traversal the design begins to demonstrate how spaces might begin to interact and perform.

The building provides a set of opportunities based on its non-standard intersecting geometries. It shows the potential for the facilitation of unique moments of interaction where the coming together of intersecting components in conjunction with social and economic conditions generates a performative environment.

Conclusion: Cumulatively these iterations develop a strategy to deal with a set of specific design problems. The generation of visualisations provide a speculative means of communicating the potentials for the creation of performative architecture to be realised and imagined. The buildings spaces are visually communicated at a range of scales, depicting how the architecture responds to both the city and the body. The scaled visualisations / drawings present a contextual perspective of the intersecting buildings, showing how parameter based constraints can create 'performance of form'. Interior moments are depicted where the; skin, structure, floor plane, ceiling height, circulation and occupation come together to influence 'subject performance'. It's clear to see that both 'performance of form' and 'subject performance' are interdependent conditions influencing the other equally.

Figure | 186 Opposite Page: Street view looking North up Lambton Quay. The building stretches from building to building, showing a formal (similarly as experienced in Act 1) intersection at the scale of the city

Act Two Reflection

Act two explores 'subject performance' and 'performance of form' through the sequencing of cumulative design iterations. Each design iteration creates outputs for revision and critique supporting the process of design, while developing a practical strategy towards the generation of a performative architecture in the city. The successes and failures of the design iterations outputs are reflected on below.

The architectures volumetric boundaries shift through the city, effortlessly changing in response to contextual conditions supportive of the design method. In conjunction with this, the building challenges legal boundaries and the scale of existing built forms in the city. As a result the building stretches across Lambton Quay, breaking the legal boundaries and negatively impacting the streets sunlight conditions in places. However, the architecture reaches from suburb to central city, acting as an elevated secondary streetscape, providing a functional pedestrian connection. Each intersecting volume facilitates a shift in scale, where the spatial interplay between volumes can be experienced by subjects (occupants) inhabiting the spaces or travelling through the spaces.

The scale shifts are not required to be linear, due to the non-linear path of a traversing subject. This highlights one of the most critical moments in the process where shifts in scale became an active agent through Design Iteration 7 (Traversal, movement and access) which privileged circulation as the primary function.

The allocation of programme as a speculative condition, supports the natural tenancy of a city where vacancies are filled based on space appropriacy. Design results provided insight into how scaled space supports diversity, both social and economic. These conditions, in combination with circulation generated scaled degrees of privacy, which supported programme allocations and public interaction.

On reflection, some of the design iterations failed to address a cohesive approach to design. These included the use of standard walls and windows in conjunction with the separation of structure and skin. The application of spatial divisions and openings was compromised through the specification of default standardised walls and window components. The application of these components detracted from the potency and efficiency of the design outcome, lacking to respond to the body and building's contextual parameters. Based on the theory of 'performance of form' the design outcome failed to combine the buildings structure and skin components, resulting in a lack of efficiency and tightness of built form. If these conditions were combined the design form would have been able to read as a cohesive expression allowing the interaction between body and form to be read with clarity, similarly to the design approach of Reiser and Umemoto's '014 Tower' in Dubai.

However, while these structural and skin conditions were separated, they did achieve 'subject performance' through surface based 'shifts in scale.' The interaction between these two scaled conditions produced a third spatial condition, bringing awareness to a layered composition and filtered light qualities, subsequently influencing the performance and occupation/inhabitation of space.

The buildings intersections provide differing scaled conditions creating; a range of economies, differing degrees of privacy and public space, supporting social diversity and interaction. The building design supports the performing programme of a city where the building acts as a city within a city.

Conclusion

Changes in scale influence the performance of space.

This thesis presents the ‘performance of scale’ as a design strategy, where it acts within every scale of design, creating connections between the body and the city.

This design strategy provides a solution to the homogenous built environment seen in many cities. The design demonstrates how ‘shifts in scale’ can influence the performance of space and act as the generator for diversity, both socially and economically.

The theories of ‘subject performance’ and ‘performance of form’ are pulled together, grounding the practical framework which expresses the ‘performance of space’ as a connecting factor between the body and the city. A design-led process included a series of 11 progressive design iterations following a method which incorporates technological parametric abilities in combination with the physical making process. This process, provides the ability to deal with complex overlapping constraints while freely exploring design possibilities.

In response to the theory of ‘subject performance’ the privileging of the body (subject) throughout the design process became a critical agent in the formulation of design decisions. The exemplar design centred itself around circulation and spatial connection where the body’s traversal defined the relationships between the scaled spaces. Thus the design can be considered to have been shaped around the needs of the subject and its potential for engagement with varying spatial conditions. Responding to the theory of ‘performance of form’, digital parametric tools provide the opportunity for architects to conceptualise and fabricate highly complex buildings, achieving non-standard geometries and forms. These non-standard geometries give the opportunity for ‘unused’, ‘awkward’ or ‘in-between’ spaces to be re-engaged as critical spaces for people to connect with and inhabit, providing the ability to re-enlivening dead monolithic space within the city.

Through the intersecting of entities, whether they be; components, surfaces or volumes, shifts in scale occur generating a resultant third condition. This third condition is considered to be an active agent, prompting performance where the navigation of spatial change is experienced. The uniqueness of each space provided by the design process breaks down conformist ideologies of modernist urban planning techniques and economies. This provides a set of tenancing opportunities where vacancies are filled based on space appropriacy, stimulating social and economic diversity.

There are many future opportunities where the ideas and methods behind this design strategy can be extended and developed further. Some of these opportunities lie within the exploration of ‘shifts in scale’ within other contexts, such as; at a domestic scale where the intersection of two alternate sized residencies produce the opportunity for a shared common space to occur. Or where the intersecting of towns/suburbs/cities could converge to produce a resultant urban connection.

While this exemplary design only touches on the research opportunities, it challenges the mind to think to the future and see the potential for what the design strategy could bring to prospective problems in the city. This approach could begin to address the expansion and densification of cities, reengaging people with the city. ‘Shifts in scale’ influence the performance of space, acting to bring social and economic diversity to cities, creating a frictional condition which influences the connection between the body and the city.

The ‘performance of scale’ helps build a strategy for how we could better design cities for people.

List of Figures

Figure | 1 GEHL, J. & ROGERS, R. 2010a. Cities for People, Island Press p4

Figure | 2 GEHL, J. & ROGERS, R. 2010a. Cities for People, Island Press p2

Figure | 3 GEHL, J. & ROGERS, R. 2010a. Cities for People, Island Press p119

Figure | 4 CUT, F. 2012. The Human Scale - Poster. In: POSTER, F. C. F. R.-V. B. K.-. (ed.). finalcut.tictail.com Final Cut.

Figure | 5 Authors Illustration

Figure | 6 Authors Illustration

Figure | 7 Authors Illustration

Figure | 8 Authors Illustration

Figure | 9 Authors Illustration

Figure | 10 Authors Illustration

Figure | 11 GROBMAN, Y. J. & NEUMAN, E. 2011. Performatism: Form and Performance in Digital Architecture, ROUTLEDGE CHAPMAN & HALL. p154

Figure | 12 Eliasson, O., n.d. Art and the Natural, Olafur Eliasson: Perceptions of Selected Work | Field Guide to Nature URL <http://fieldguidetonnature.wordpress.com/2013/09/10/art-and-the-natural-olafur-eliasson-perceptions-of-selected-work/> (accessed 2.14.14).

Figure | 13 Rathod, V., n.d. Living Chasm by Fujiko Nakaya's throughvinslens.com. URL <http://www.throughvinslens.com/1/archives/12-2012/1.html> (accessed 2.14.14).

Figure | 14 sleepwalkers-moma3.jpg (590x393) [WWW Document], n.d. URL <http://www.dougaitkenworkshop.com/wp-content/uploads/sleepwalkers-moma3.jpg> (accessed 2.14.14).

Figure | 15 Ewing, J., n.d. ANN HAMILTON: the event of a thread : Program & Events : Park Avenue Armory [WWW Document]. URL http://www.armoryonpark.org/programs_events/detail/ann_hamilton (accessed 2.14.14).

Figure | 16 Seabright, A., 2010. Rafael Lozano-Hemmer Shown at Manchester Art Gallery, Manchester, United Kingdom. URL http://www.lozano-hemmer.com/showimage2.php?img=manchester_2010&proj=People%20on%20People&id=2 (accessed 2.14.14).

Figure | 17 EISENBACH, R. 2008. Placing Space - Architecture, Action, Dimension. Journal of Architectural Education, 61, 76-83.

Figure | 18 HANNAH, D. & HARSLØF, O. 2008. Performance Design, Museum Tusculanum Press, University of Copenhagen. p83

Figure | 19 Araullo, J.R., 2012. Interactive Surfaces and Modelled Environments: Sydney Architecture Festival at Customs House in Sydney [www Document]. METROBLOGS. URL http://blog.worldarchitecturenews.com/?category_name=sydney&paged=2 (accessed 2.14.14).

Figure | 20 Beesley's, P., 2012. Philip Beesley's Hylozoic series [www Document]. Top 12 of 2012 – Art Installations in Sydney | METROBLOGS. URL <http://blog.worldarchitecturenews.com/?p=3388> (accessed 2.14.14).

Figure | 21 Photo by Miroslav Halada, n.d. 'Intersection' Studio Oren Sagiv [www Document]. Oren Sagiv. URL <http://orensagiv.com/project/intersection> (accessed 2.14.14).

Halada, M., n.d. Intersection - Studio Oren Sagiv [www Document]. Oren Sagiv. URL <http://orensagiv.com/project/intersection> (accessed 2.14.14).

Figure | 22 Tschumi, B., n.d. Bernard Tschumi Architects [www Document]. URL <http://www.tschumi.com/projects/3/> (accessed 2.14.14).

Figure | 23 Saggio, A., n.d. Architecture and Modernity. From the Bauhaus to the information revolution. [www Document]. URL <http://saggio-architettura.blogspot.co.nz/> (accessed 2.14.14).

Figure | 24 Kudless, A., 2009. August « 2009 « MATSYS [www Document]. URL <http://matsysdesign.com/2009/08/> (accessed 2.14.14).

Figure | 25 Báez, M.A., n.d. Manuel A. Báez – Crystal & Flame: Form and Process | WeWantToLearn.net [www Document]. URL <http://wewanttolearn.wordpress.com/2011/11/01/manuel-abaez-crystal-flame-form-and-process/> (accessed 2.14.14).

Figure | 26 GROBMAN, Y. J. & NEUMAN, E. 2011. Performatism: Form and Performance in Digital Architecture, ROUTLEDGE CHAPMAN & HALL. p144

Figure | 27 Powers, R., 2010. GREG LYNN FORM – Bloom House [www Document]. URL <http://glform.com/buildings/bloom/> (accessed 2.14.14).

Figure | 28 GROBMAN, Y. J. & NEUMAN, E. 2011. Performatism: Form and Performance in Digital Architecture, ROUTLEDGE CHAPMAN & HALL. p154

Figure | 29 GROBMAN, Y. J. & NEUMAN, E. 2011. Performatism: Form and Performance in Digital Architecture, ROUTLEDGE CHAPMAN & HALL. p162

Figure | 30 Photo by Richters, C., n.d. ViLA NM by UNStudio [WWW Document]. URL <http://www.architecturenewsplus.com/projects/2710> (accessed 2.15.14).

Figure | 31 GROBMAN, Y. J. & NEUMAN, E. 2011. Performatism: Form and Performance in Digital Architecture, ROUTLEDGE CHAPMAN & HALL. p79

Figure | 32 BMW Welt | Coop Himmelb(l)au | Architecture | BMW | Design | milo 3oneseven [www Document], n.d. URL <http://3oneseven.com/bmw-welt-coop-himmelblau-2/> (accessed 2.15.14).

Figure | 33 GROBMAN, Y. J. & NEUMAN, E. 2011. Performatism: Form and Performance in Digital Architecture, ROUTLEDGE CHAPMAN & HALL. p170

Figure | 34 Idib p124”Figure | 36 This image represents a model as part of a thesis proposal on scale” on page 36

Figure | 36 Authors own image

Figure | 37 Open Architecture Office - OAO | rediscovering the joy of running an architecture office [WWW Document], n.d. URL <http://openarchitectureoffice.wordpress.com/> (accessed 2.16.14).

Figure | 38 Rhino News, etc. [www Document], n.d. URL <http://blog.rhino3d.com/> (accessed 2.16.14).

Figure | 39 Authors photo

Figure | 40 Authors Illustration

Figure | 41 Authors Collection of Illustrations

Figure | 42 Authors Collection of Illustrations

Figure | 43 Photo By Ben Sutherland Taken 15.05.2013

Figure | 44 Authors Illustration

Figure | 45 Authors Illustration

Figure | 46 Authors Illustration

Figure | 47 Authors Illustration

Figure | 48 Authors Illustration

Figure | 49 Authors Photo taken 24.04.2013

Figure | 50 Authors Illustration

Figure | 51 Authors Photo taken 13.04.2013

Figure | 52 Authors Photo taken 13.04.2013

Figure | 53 Authors Photo taken 13.04.2013

Figure | 54 Authors Photo taken 13.04.2013

Figure | 55 Authors Illustration

Figure | 56 Authors Sketch

Figure | 57 Grasshopper Definition Screen Capture

Figure | 58 Rhino Screen Capture

Figure | 59 Rhino Screen Capture

Figure | 60 Rhino Screen Capture

Figure | 61 Rhino Screen Capture

Figure | 62 Rhino Screen Capture

Figure | 63 Vector outputs from Rhino

Figure | 64 Photo by Author 05.03.2014

Figure | 65 Rhino Screen Capture

Figure | 66 Rhino Screen Capture

Figure | 67 Authors Photo Taken 20.03.2013

Figure | 68 Authors Photo Taken 20.03.2013

Figure | 69 Authors Photo Taken 13.03.2013

Figure | 70 Authors Photo Taken 13.04.2013

Figure | 71 Authors Illustration

Figure | 72 Grasshopper Definition Screen Capture

Figure | 73 Authors Illustration

Figure | 74 Pekakura output

Figure | 75 Authors Photo Taken 29.04.2013

Figure | 76 Authors Photo Taken 29.04.2013

Figure | 77 Rhino Illustrations

Figure | 78 Authors Photo Taken 29.04.2013

Figure | 79 Authors Illustration Photo Taken 29.04.2013

Figure | 80 Authors Illustration

Figure | 81 Authors Illustration

Figure | 82 Authors Illustration

Figure | 83 Photo taken by Ben Sutherland Taken 17.04.2013

Figure | 84 Photo taken by Ben Sutherland Taken 17.04.2013

Figure | 85 Illustrations and images from Rhino and Grasshopper

Figure | 86 Authors Photo Taken 18.04.2013

Figure | 87 Authors Photo Taken 18.04.2013

Figure | 88 Photo taken by Ben Sutherland Taken 17.04.2013

Figure | 89 Photo taken by Ben Sutherland Taken 18.04.2013

Figure | 90 Photo taken by Ben Sutherland Taken 18.04.2013

Figure | 91 Authors Photo Taken 19.04.2013

Figure | 92 Authors Photo Taken 20.04.2013

Figure | 93 Authors Photo Taken 26.09.2013

Figure | 94 Authors Illustration

Figure | 95 Bing maps and Authors Illustration

Figure | 96 Authors Illustrations

Figure | 97 Authors Photo Taken 31.05.2013

Figure | 98 Bing Maps

Figure | 99 Bing Maps

Figure | 100 Drawing from Rhino

Figure | 101 Authors Illustrations

Figure | 102 Authors Illustrations

Figure | 103 Grasshopper Screen Capture

Figure | 104 Authors Illustrations

Figure | 105 Authors Photo Taken 23.07.2013

Figure | 106 Authors Photo Taken 23.07.2013

Figure 107 Authors Illustrations	Figure 150 Authors Illustration
Figure 108 Authors Photo Taken 23.07.2013	Figure 151 Authors Illustration
Figure 109 Authors Photo Taken 23.07.2013	Figure 152 Authors Illustration
Figure 110 Authors Illustrations	Figure 153 Authors Illustration
Figure 111 Authors Photo Taken 16.02.2014	Figure 154 Authors Illustration
Figure 112 Authors Photo Taken 16.02.2014	Figure 155 Authors Illustration
Figure 113 Authors Illustrations	Figure 156 Authors Illustration
Figure 114 Authors Illustrations	Figure 157 Authors Illustration
Figure 115 Authors Illustrations	Figure 158 Authors Illustration
Figure 116 Authors Photo Taken 23.07.2013	Figure 159 Authors Illustration
Figure 117 Authors Photo Taken 23.07.2013	Figure 160 Authors Illustration
Figure 118 Authors Photo Taken 23.07.2013	Figure 161 Authors Illustration
Figure 119 Authors Photo Taken 23.07.2013	Figure 162 Authors Illustration
Figure 120 Authors Photo Taken 23.07.2013	Figure 163 Authors Illustration
Figure 121 Authors Illustrations	Figure 164 Authors Illustration
Figure 122 Illustration from Aranda, b. & Lasch, c. 2005. Tooling, princeton architectural press. P77	Figure 165 Authors Illustration
Figure 123 Authors Illustrations with Bing image as background	Figure 166 Authors Illustration
Figure 124 Authors Illustration	Figure 167 Authors Illustration
Figure 125 Authors Illustration	Figure 168 Authors Illustration
Figure 126 Authors Illustration	Figure 169 Authors Illustration
Figure 127 Authors Illustrations	Figure 170 Authors Illustration
Figure 128 Authors Illustration	Figure 171 Authors Render merged with authors photo
Figure 129 Authors Illustration	Figure 172 Authors Render merged with Bing maps image
Figure 130 Authors Illustration	Figure 173 Authors Render merged with authors photo
Figure 131 Rhino screenshot	Figure 174 Authors Illustration
Figure 132 Rhino screenshot	Figure 175 Authors Illustration
Figure 133 Authors Illustration	Figure 176 Authors Render
Figure 134 Authors Illustration	Figure 177 Authors Illustration
Figure 135 Authors Illustration	Figure 178 Authors Illustration
Figure 136 Authors Illustration	Figure 179 Authors Render
Figure 137 Authors Illustration	Figure 180 Authors Illustration
Figure 138 Authors Illustration	Figure 181 Authors Illustration
Figure 139 Authors Illustration	Figure 182 Authors Render
Figure 140 Authors Illustration	Figure 183 Authors Illustration
Figure 141 Authors Illustration	Figure 184 Authors Illustration
Figure 142 Authors Illustration	Figure 185 Authors Render
Figure 143 Authors Illustration	Figure 186 Authors Render merged with authors photo
Figure 144 Authors Photo Taken 20.02.2014	
Figure 145 Authors Illustration	
Figure 146 Authors Illustration	
Figure 147 Authors Illustration	
Figure 148 Authors Illustration	
Figure 149 Authors Illustration	

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