ABSTRACT

Title of Document:	THE POWER OF SYNTHESIS: THE PURSUIT OF ENVIRONMENTAL SUSTAINABILITY AND SOCIAL EQUITY THROUGH DESIGN PRACTICE
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The paradigm of architecture and design is changing. Centuries of industrialization and rapid urbanization have placed profound stress on the earth's natural systems, presenting new challenges for architects and urban planners. As our collective awareness towards these challenges increases, designers are increasingly called upon to partake in the global transition towards a low-carbon future. These professionals are re-assessing their priorities and practices, striving for better ecological and social scenarios.

This dissertation explores how architects and designers successfully integrate environmental sustainability and social equity deliberations into architectural design practice by implementing more holistic sustainable design approaches. It advocates for a future reality where these considerations are naturally incorporated into the design process of any architectural project, and suggests a framework for their more effective integration.

The dissertation opens with a review of current sustainable design approaches and practices in the architectural design profession, focusing on the tools and methods commonly used for their integration in the design process. Next, it presents three case studies of exemplary architectural projects, each demonstrating a progressive design approach that successfully integrates both environmental and social sustainability agendas within the design process. Data collection methods included a series of semi-structured interviews with designers, architects, developers, clients and other stakeholders in the respective projects, as well as site visits. In each case study project, the process of its inception, development, settings and design methodologies were explored, aiming to evaluate the potentialities and effectiveness of these attributes for better integration of socially and environmentally sustainable design agendas.

Synthesis of the collected data ultimately offers a framework for more effective integration of these virtues within architectural design processes. The conclusions point to a multivariate threshold containing a combination of external conditions, recommended processes and design-based tactics to achieve such projects.

The conclusions underscore the method for application of these factors, not as isolated deliberations but as parts of a holistic, integrated process. When applied concurrently, these factors perform synergistically to produce holistic, well-rounded living environments that foster environmental stewardship alongside social and cultural wellbeing, empowering a community to flourish.

THE POWER OF SYNTHESIS: THE PURSUIT OF ENVIRONMENTAL
SUSTAINABILITY AND SOCIAL EQUITY THROUGH DESIGN PRACTICE

by

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Dedication

To my parents, for showing me the value of optimism, creativity and perseverance, and for instilling in me profound respect for the natural world.

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I wish to thank my wife, Shelley, for unquestionably taking this leap of faith with me.

I owe a great deal to Professor Garth Rockcastle, whose trust and belief in my path as a designer and an academic enabled me to indeed find the correct one. I also wish to thank Professor Emerita Marie Howland, whose guidance and support throughout my studies have been indispensible. Thank you both.

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List of Abbreviations

BIM: Building Information Modeling

CAD: Computer Aided Design

IDP: Integrated Design Process

IPD: Integrated Project Delivery

GT: Grounded Theory

ESD: Environmentally and Socially sensitive Design

PD: Pre-Design

SD: Schematic Design

DD: Design Development

CD: Construction Documentation

Chapter 1: Introduction

This chapter presents the thesis by providing background context for the subject matter under study. It offers a research outline, followed by the research objectives, motivation and rationale.

The architecture and design professions are currently undergoing a profound transition in response to the environmental, social, political and economic forces re-shaping our world, and our collective mindset. This transition is marked by a growing number of architects and designers re-embracing their primal role as agents of environment and society, heeding the call to address the current social and environmental crises through attentive practice. These professionals are demonstrating that architecture can serve as an environmental and social restorer without compromising its ethics or quality standards, synthesizing contextualized solutions to emerging urban challenges.

Sustainability, defined as living within our planet's renewable resources, is the most complex, far-reaching challenge humankind has faced to date, with the roots of un-sustainability embedded deeply within our contemporary lifestyles, institutions, and thinking. The age-old symbiotic relationship between humans and Earth has gradually distorted into a parasitic one, where natural resources are exploited and abused, and the mantra of economic growth and unbridled consumerism - both commercial and through our current lifestyle expectations - remains the dominating paradigm across geographies and scales with little concern for its ethical, environmental or social ramifications. The resulting predicaments of resource scarcity, increasing energy demands, a volatile climate, economic instability and gross

social inequity - set against an overpopulated Earth - are now being felt and are escalating.

In 2008, the global urban population exceeded the rural population for the first time in history (Seto, *et al.,* 2010). By 2050, roughly 6.4 billion people - almost the planet´s current population - will be living in cities (Muggah, 2016; United Nations, 2008). Urbanization is an irreversible trend and cities are expected to absorb all global population growth within the coming decades (Buhaug & Urdal, 2012). Alongside many positive effects of development and urbanization, these changes have accelerated many of the environmental and social perils that threaten the sustainability of human life on earth.

Sustainable urban development has been a formative paradigm for some thirty years, addressing economic and environmental concerns through policy, academic research and practice. However, the social aspects of sustainable development have proven harder to define and apply, and thus have been marginalized in comparison, both in theory and in practice (Boström, 2012; Giddings et al., 2002; Kunz, 2006; McKenzie, 2004). These social elements include a variety of 'softer', subjective ideas which must be addressed holistically, such as social equity, cultural diversity, collective and personal responsibility, access and inclusion (Bossel, 1998; Chapman, 2012; Dixon, 2011; Fletcher & Goggin, 2001; Woodcraft *et al*., 2012, Yeang, 1995).

Social equity is considered by many to be the 'orphaned' element of sustainable development, being the least defined and least understood element of the trio of economic viability, environmental stewardship and social equity (Agyeman, *et al.* 2002; Boström, 2012; Summers & Smith, 2014). In the perspective of urban planning and design, social equity indicates fair access to livelihood, education and resources,

full participation in the political and cultural life of the community, and self-determination in meeting fundamental needs (Ibid, 2002). Throughout this research, social equity was seen as inclusion and procedural fairness in planning and design, access to healthy, high-quality living environments and the enablement of a vibrant community in urban settings.

This dissertation is set at the intersection of two distinct value spheres - environmental sustainability and social equity - within the architectural design and development process. It explores how architecture and design professionals are echoing the need for change, and using their professional capacities to address current urban challenges by producing environmentally and socially sustainable architecture. In so doing, these pioneering practitioners are advancing this much-needed, dual agenda, raising the bar within the profession, re-aligning their communities' relationships with the natural world, and with one another, and are taking on new, non-traditional roles.

Creatives such as architects, landscape architects, urban planners and product designers – who will be referred to collectively as 'designers' from this point - play a vital role in the formation of the built environment, having the imaginative capacity, problem solving skills, contextual analysis skills and technical expertise necessary for the design of thoughtful, livable urban environments. These professionals have the capacity to recognize challenges and opportunities envision new solutions or contextualize existing ones, shape isolated instances into patterns, synthesize valuable information from stakeholders, and facilitate creative solutions within programmatic boundaries.

The design profession is naturally process-oriented and human-centered. Designers have the ability to adapt not only their foci but also their approach and

methodologies, adjusting them to address relevant timely agendas. British design theorist John Thackara describes this ability as the much-needed shift in the role of designers today "in this new era [of design for sustainability], designers are having to evolve from being the individual authors of objects, or buildings, to being the facilitators of change among large groups of people." (Thackara, 2005).

This thesis stems from a grave personal worry over a looming environmental crisis, but also from trust in the resilience of the human spirit and in the power of design as a catalyst for change. Cities concentrate economic activity, human population and resource use and thereby become ideal grounds for the equitable distribution of amenities and resources. Design is a potent, collaborative, inclusive practice, which can be instrumental in constructing a shared vision of a healthier future. I believe that designers have an ethical obligation to forge their professional vigor to become the much-needed change agents in the coming decades. They should be the first to adopt an ecological worldview and offer a clear vision for socially just and environmentally regenerative living environments. Through context-specific, reactive analysis, they can lead the way to more responsible, healthier and more prosperous living environments, ushering communities through these turbulent and defining times.

Background

1.1.1. The Anthropocene

Human societies have lived sustainably for millennia, subsisting on local renewable resources, solar energy (in the form of agriculture) and muscle power for work. The industrial revolution of the seventeenth and eighteenth centuries were a turning point in the human-environment relationship, as energy-concentrated fossil

fuels triggered development, production and consumption at unprecedented scale (Hurley, 2011). Advances in medicine, public health and nutrition lowered infant mortality and increased life expectancy rates, bringing the global exponential growth quotient to 2% by the mid-1960s (Bovill, 2015). With a larger population, technological innovations and an ever-growing hunger for fossil fuels, the post-industrial period is marked by a vast upsurge in urbanization and in the consumption of natural resources (Edwards, 2005; Hurley & Horne, 2006). These patterns of growing populations, incessant economic growth, bolemic consumption of resources and resultant environmental degradation have become the dominant pattern across the globe.

This dissertation is set against the backdrop of the Anthropocene, an unprecedented age when human activity forms the largest and most widely impacting force on the natural environment and other planetary systems (Crutzen, 2002). Centuries of population growth, industrialization and urbanization have brought most of the earth's environmental systems to the verge of collapse, requiring immediate action if we wish to avoid catastrophic effects on the future of mankind and the biosphere as a whole (Brown, 1990; Brown, 2012; Connor, 2005; Gilding, 2012; Greame, 2013; McKibben, 2011). Climate change, resource depletion, ecosystem decline, energy transition, economic crisis, political volatility and socio-economic inequality are among the major challenges that threaten the sustainability of contemporary and future life (Blizzard & Klotz, 2012; Dryzek, 1997; Walliser et al., 2012).

The three-year period between 2014 and 2016 has been documented as the hottest on record (NCEI, 2017), as ever-increasing levels of carbon emissions and

greenhouse gasses continue to drive global planetary warming. Natural disasters, such as widespread fires, massive flooding, superstorms, heavy winter snowfalls and extended droughts are becoming common phenomena. Furthermore, the chemical composition of our oceanic ecosystems is changing following the combined impact of nearly 7 billion people pumping gas emissions into the atmosphere, and dumping their excreta and industrial toxins into drains and rivers. Our collective actions are so successful in eliminating the very ecosystems we rely on for survival that, in Bill McKibben's words, "We're running Genesis backward, *decreating*" (McKibben, 2011).

Design theorist Tony Fry (2011) defines our current times as the 'age of unsettlement', referring to the millions uprooted following environmental or geopolitical instability. As an example, the Syrian drought of 2007-2010, exacerbated by human-related activities, is believed to have contributed to the triggering of Syria's civil war, leading to the country's rolling collapse, causing millions of refugees to flee to neighboring countries, the Balkans and Europe (Kelley et al., 2015; Lorenzo, 2015). Fry predicts "a huge design effort [as the alternative to chaos] will be required to deal with the anticipated changes to our ways of life" (Fry, 2011) brought by global climate instability and socio-political volatility.

1.1.2. Sustainable development

Development and sustainability are not new concerns, yet they have been framed together in recent decades, given the challenges they both present globally and locally. The concept of sustainable development emerged out of growing concern for environmental sustainability alongside the need for continued human development. Over the past half-century, the United Nations have held a number of international

summits and conferences on the topic of sustainable development, the first being the United Nations Conference on Human Settlements in Vancouver in 1972. Since this summit, the UN has held several conferences around sustainable development themes, each hailing larger turnout and greater global attention.

The Earth Summit in Rio de Janeiro in 1992 produced the Habitat Agenda and Agenda 21, formulated as a roadmap for sustainable development. The Second United Nations Conference on Human Settlements (Habitat II) was held in Istanbul, Turkey in 1996, and later that year the Habitat Conference held at the United Nations in New York. The 2002 Earth Summit held in Johannesburg, South Africa was a Rio +10 gathering and offered an opportunity to assess the progress of post-Rio actions. A Rio +20 conference held in 2012 offered a focused political outcome document, called '*The Future We Want'*, outlining clear, practical measures for implementing sustainable development. Most recently, the Conference of Parties (COP21) held in Paris in 2015 brought together nearly 200 representatives from over 200 nations, and produced the 2030 Agenda for Sustainable Development. On Earth Day 2016 (April 22), 174 countries signed the agreement in New York and began implementing it within their own legal systems (CSIR, 2006; Falk, 2016).

These conferences, and the progression of their foci and summaries, marked the transition from a strictly environmental agenda to a social, human-centered agenda, and the realization that environmental protection cannot exist without human development. Consequent discourse and policy on sustainability reflected a greater emphasis on social sustainability (human wellbeing) with economic prosperity and environmental stewardship as sub-sets (CSIR, 2006).

Following publication of the Brundtland Report in 1987 (UNWCED, 1987), the term 'sustainable development' emerged as a formative paradigm to managing environmental harms whilst continuing existing development models. This ethno-centric model outlined three essential components necessary for a sustainable society: environmental suitability, social equity and economic viability (Ibid, 1987; Basiago , 1998), also referred to as 'the three pillars of sustainability'. This simplistic concept was quickly echoed in the business world, promoted as the 'triple bottom line' approach, the bottom lines being People, Planet, and Profit, accredited to sustainable business theorist John Elkington in his 1997 book, *Cannibals with Forks*.

1.1.3. Sustainable design

Many of the stresses we enforce on Earth derive from the way we design, build, operate and use our built environments. Cities and buildings concentrate people, industry and energy, and thus account for some 80 per cent of global greenhouse gas emissions, and for some 75 per cent of global energy consumption[1], placing them at the forefront of the global battle against climate change (Muggah, 2016; OECD, 2000). Generally speaking, these figures can be attributed to the ill design of cities, with transportation and building designs shaped by anachronistic, post-war ideas such as endless cheap fossil fuels and industrial abundance. Throughout this dissertation, sustainable design will be framed as an overarching concept and a potential catalyst for change. It will be discussed as a path for design and development professionals seeking to make a positive environmental impact while also addressing social needs in their cities, by producing better buildings with greater environmental and social sensitivities.

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[1] This statistic estimate being a geography-based figure.

Sustainable design is the practical offshoot of the sustainable development paradigm. While this term is relatively difficult to define in absolute terms[2], it can be seen as an inclusive design approach that recognizes the complex relationships between the social and environmental realms and works to create a balance between the championing of both. As such, it is mostly implemented by designers of products, buildings or systems that consciously apply environmental considerations in their practices. Over the last two decades, sustainable design has shifted from a niche approach for the eco-conscious into the mainstream (Smith, 2007), offering an array of approaches and practical tools for design, measurability and recognition of efforts in this field. Yet in the architectural field, despite the availability of both knowledge and means, sustainable design largely rests in the hands of an elite minority, with the resources to pay a premium for more progressive design, higher quality products and innovative, healthy materials. This reality ironically places sustainable design solutions out of reach for the most vulnerable – and in some instances, the majority of urban dwellers - who would most benefit from affordable, well designed, healthy living environments.

1.1.4. Green design[3] in architecture

A closer look into cities and urban areas reveals that *within* cities, buildings are some of the most gluttonous and wasteful global energy consumers, making them leaders in resource consumption and greenhouse gas emissions: in the United States,

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[2] Definition of the terms 'sustainable development' and 'sustainable design' is presented in more detail in section 2.3.

[3] The term 'green design' will be used loosely throughout this chapter to describe a cohort of design approaches that focus on reduced environmental impact by energy-efficient building, mostly through construction-based technologies and buildings' mechanical systems.

buildings account for some 40 percent of national CO_2 emissions[4] and out-consume both the industrial and transportation sectors (Fowler, *et al.*, 2011).

The planning and construction industries have responded to these patterns by developing a wide range of methods to design, construct and operate buildings more efficiently. In the United States, the Leadership in Energy and Environmental Design framework and certification program (LEED) entails a comprehensive set of connected guidelines and standards addressing multiple aspects of design, construction and building operations of buildings, applicable from single-family homes to complete neighborhoods. The United States Green Building Council (USGBC) reports that LEED-certified buildings have, on avarege, 34 percent lower CO_2 emissions, consume 25 percent less energy and 11 percent less water (Ibid, 2011). According to World Green Building Trends 2016, a recent market study completed by Dodge Data & Analytics, the global green building sector continues to double every three years, with survey respondents from 70 countries reporting 60 percent of their projects will be green by 2018 (Dodge Research and Analytics, 2016).

1.1.5. Architecture and social equity

The modern movement of the late 19th century saw politics as an inherent part of its rationale, and expected broad societal change as an essential part of its architectural vision for the new age. Architects and urban planners of the time saw industrial growth, urbanization and technological progress as tools to be employed in service of social equity, and aimed to create universal places - rational, orderly, and accessible - that would give opportunity and freedom to everyone (Gamez & Rogers, 2008). By the early 1900s, many utopian social ideals of the time were manifested in

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[4] This statistic estimate being a sector-based figure.

the physical planning of cities and buildings. The modern movement emerged forcefully in many cities during the 1960s, as urban renewal programs and public housing projects re-shaped landscapes in distinctly modernist expressions throughout the world, but by the end of the decade, the demise of the modern project was well within sight (Ibid, 2008). Modernism as a movement was abandoned not because of the ideals on which it was built, but because of the conflicting principles by which was realized: mainly, the contradiction between the goal of social change and those of market capitalism and institutionalized power (Merrifield, in Harvey, 2002). The grand modernist narratives were replaced by local voices, universal truths were challenged buy contextual differences, and the international-style architecture was rejected in favor of local cultural expressions. It seems that both modernity and postmodernity have failed to deliver on their respective emancipatory promises: each promised to free the individual from repressive regimes, to improve social standards, and to distribute resources and opportunities equally (Gamez & Rogers, 2008).

One contextual expression of social equity in architecture is social, or affordable, housing in large cities. The case studies selected for research are all considered affordable housing according to the median income in their locale, partially or entirely.

1.1.6. Social housing

Social housing is generally defined as housing provided by government agencies or non-profit organizations to people subsiding on low incomes or with particular needs. The first instances of social housing can be traced back to the late 19th century England, as large numbers of rural laborers flocked to cities like London, Liverpool and Newcastle in search of employment with the advent of industrial

manufacturing. Throughout the 19th and early 20th centuries, for-profit private builders dominated the housing market and were allowed free and unregulated rein in the provision of working-class housing, without the planning, regulation and intervention that ensured the elegance of other fast-growing urban developments. Speculative *'jerry-building'* produced a working-class landscape of inward-looking, dead-end alleys, courts and streets, what has been called *'a perfect wilderness of foulness'* (Burnett, 1986).

At the time, over 80% of urban families were renting a room or a small flat in terraced rowhouses from private landlords. These buildings were typically built densely in unplanned neighborhoods, resulting in cramped, squalid living conditions for the working class, particularly in inner-city areas. The Housing of the Working Classes Acts of 1885 and 1890 were public health acts, but were essentially the first to regulate public housing by empowering local authorities to condemn slum housing. These acts marked the first instance of government intervention in the free market and, in so doing, fundamentally affected the expansion and planning of towns, incentivizing local authorities (councils) to erect 'council housing' for the working poor (Gauldie, 1978). Some of these housing projects were often operated, and later initiated by charitable trusts, charitable organizations or religious entities.

More recent development patterns of affordable housing complexes started appearing in the mid-20th century in Europe and the United States. Some of the best – known megaprojects were conceived as modernist, enlightened solutions for providing standardized and economical housing to needy urban populations. However, while these projects' architects surely had the best intentions in mind, most of these projects are notoriously towering, intimidating concrete or red-brick

structures, bland in character and lack any relation to human scale. The design of many of these 'projects', their grim appearance and location in busy urban settings has been named to isolate residents and discourage any sense of community, identity or belonging.

1.1.7. The role of architecture and designers

Despite the widespread recognition of the sustainable development ideal by policy makers and leaders, its effect on the rate of environmental decline has been marginal while current patterns of urban development, hyper-consumerism and caustic economic growth continue at alarming rates (Brown, 2012; Dryzek, 1997; Heinberg, 2010). With the spread of urbanization and industrialization at the turn of the 20th century, designers seem to have gradually abandoned their historic role as stewards of society and environment, opting to design for industry, as opposed to designing for people (Papanek, 1995). This shortsighted, capitalist approach has permeated the design profession across all fields and scales (Birkeland, 2012; Thackara, 2006; Wahl, 2016).

Traditionally, designers (architects and artisans) served society by providing physical objects to mediate between man and his environment, these objects being buildings and structures, tools or products. For example, builders and architects labored to produce structures enabling man to inhabit inhospitable climates and practice domestic, cultural and spiritual life, just as product designers labored to make the harsh new technologies of the Industrial Revolution more palatable for the masses by addressing aesthetics, safety and ergonomics. However, the mid-20th century saw designers apply their skills to encourage mass-consumption and stimulate economies

rather than provide a social service (Heapy, 2010; Papanek, 1995). In the product design sector, designers and the industry incessantly spew out new, short-lived products, most with no significant added value, offering consumers a false sensation of endless choice and abundance and thus causing more frequent purchase and discarding. This pattern habituates trend-based, thoughtless purchase behavior and leads to market saturation by inferior, short-lived products. Intensified production has not only grave environmental costs such as resource exhaustion, mounting landfills and polluted waterways (Birkeland, 2012; Klein, 2015; McLennan, 2003), but also destructive, inequitable social patterns, such as hazardous manufacturing facilities, modern slavery in sweatshops and forced child labor in many parts of Asia, Africa and Eastern Europe (UNHR, 2009).

The exploratory research outlined in this dissertation set out to re-discover the role of today's designers as stewards of society and the environment. Studying the motivations, practices and methods used by these professionals, oriented towards social and environmental wellbeing through more sensitive design and more holistic practices, will hopefully give voice to the slow shift already underway in the collective mindset of architects and designers of the built environment. In our intensely urban, industrialized, capitalist reality, designers must adopt an alternative approach and develop the vision, knowledge, and competence necessary to become leaders in the global transition towards a sustainable future.

1.1.8. A wider sustainability agenda

Despite its contribution to commerce, opportunity, public health and the dispersion of knowledge, urbanization is regarded as a major catalyst of

environmental, social, and economic problems. Current patterns of urbanization and building not only perpetuate environmental degradation through "business-as-usual" practices, but also expand social and economic inequalities at multiple-level scales, placing most environmental burdens of these practices on the weaker, poorer populations across all scales (Leichenko *et al*, 2010; Magis & Shin, 2009; Shue , 1999; Stiglitz, 2013). These inequalities are manifested in more local, urban contexts, through inequitable urban and regional planning (causing, for example, NIMBY development and citizen displacement), marginalization, unequal access and opportunity, exclusion and cultural disintegration.

Opposing this reality, many urban designers are attempting to change the system from within by pursuing a wider sustainability agenda in their building projects. Their approaches are characterized by a broader, inclusive approach, addressing the theme of social equity as equal to economic development and environmental protection. This view strives to regenerate vital resources, both human and planetary, recognizing that environmental sustainability cannot be achieved or sustained without social equity. It retains the more common concern for environmental performance of buildings and built environments, while addressing an equally urgent need for fairness in planning and design through stakeholder engagement, community participation and the creation of spatial contingencies that will lead to increased social sustainability.

There is growing consensus that a reductionist approach is not appropriate for interacting with our environment, which is essentially a dynamic, complex, living system, and that social issues of equity and inclusion are as important to sustainable architecture as are energy conservation, efficiency and resilience (Kunz, 2006;

McLennan, 2004; Orr, 2002). Academics and practitioners who advocate the integration of social and environmental sustainability stress the significance of incorporating these concepts at the earliest possible stage of the design process to realize their greatest effect (Brawne, 2003; Cross, 1982; Jernigan, 2007; Trebilcock, 2007).

This notion places the design process at the heart of this research, opening it for assessment in light of the present-day challenges brought forward by sustainable thinking and understanding. Integrated design thinking can potentially transform the way urban environments are instigated, developed and shaped, offering more rounded solutions that promote social and environmental wellbeing through thoughtful advancement of an inclusive, holistic design agenda. This dissertation is a contribution to the global increase in awareness towards how we, as design professionals, can operate in this realm of an urgent need for sustainable solutions in the face of turbulence and a rapidly changing reality.

1.2. Dissertation Outline

1.2.1. Introduction:

The objective of this dissertation is to explore an emerging movement within the sustainable architectural design arena, in which design professionals integrate two distinctive virtues - environmental sustainability and social equity - into their professional practices. It utilizes case study methodology to explore and identify best practices, strategies and methodologies used by these professionals, as well as the conditions present and decision-making interactions within the design process to advance this progressive sustainable design approach. These findings will be used to create a baseline of settings and best practices for ecologically progressive, socially equitable buildings, offer a framework for their future application, and suggest directions for future research in this field.

1.2.2. Organization:

The dissertation is organized in several chapters, as outlined below:

(i) **Introduction**: introduces the research and its objectives as well as the concept of sustainable design, presenting its theoretical origins and models in architecture. This section also defines specific terminology to familiarize the reader with the content on this topic.

(ii) **Literature Review**: examines current literature about sustainable design origins, methodology and practice.

(iii) **Research Methods**: outlines the methods used to conduct this research and the theoretical models to justify their application in this context.

(iv) **Case Studies**: presents selected projects in three successive chapters, each offering the findings and an in-case analysis with regard to the design process, practices and methodology, motivations and other conditions deemed necessary for the projects' successful design process and execution, as well as the challenges, obstacles and compromises made throughout this process. Each case study chapter concludes with an analysis of the findings in concentrated form.

(v) **Discussion**: presents a cross-analysis of the data gathered at the three chosen projects, followed by a proposed framework for the application of these findings in architectural practice.

(vi) **Conclusion**: presents a summary of the key insights, as well as the limitations of the research and suggestions for its future application.

1.2.3. Selection of case studies:

The case studies presented in this dissertation were selected from the portfolios of three contemporary architectural practices in the United States and Europe, considered leaders in sustainable design by the architectural community. Each of these practices demonstrates successful integration of environmental and social considerations within their professional design process. Analysis of findings from the case studies was used to produce a baseline of existing best practices and a framework for their more effective application. This framework follows the logic of generating theoretical framework from the practice of leading designers: "theory building… [can be advanced by] generating theory from the practice of leading contemporary designers, and developing such basic tools as a bibliography of resources for theory construction" (Friedman, 2003).

The selection of these exemplary case study projects was based on purposeful sampling, which relies on selection of information-rich, thematically related cases for study, as "studying information-rich cases yields insight and in-depth understanding rather than empirical generalizations" (Patton, 2002). This approach aimed to learn from leading practices of holistic sustainable design and suggest a framework for their application, following the analysis of the case study findings. The research could potentially be repeated using the same methodology of selection of case study projects, and interviewing of other designers to increase the reliability of the conclusions through analysis of additional data from these projects.

Finally, this research focused on studying the conditions present, design processes, methodology and strategies implemented within a number of exemplary architectural projects, all of them demonstrating a twofold agenda of rigorous environmental performance combined with progressive social deliberations. It did not aim to measure the effectiveness of specific methods commonly used by designers, or judge the quality of the projects in relation to one another; neither did it assess the construction processes, cost effectiveness, carbon footprints or categorical energy performance of the buildings under study, or the accuracy of the digital tools applied in their design process.

1.3. Research objectives

The goal of the dissertation is to offer a framework for a more holistic design process within existing practice-based models of design for sustainability, outlining ways in which architectural design professionals can achieve a higher level of social equity in sustainable design practice through synthesis and integration. Thus, the research focuses on the design process, suggesting methods for achieving a more comprehensive approach towards sustainable design. Case study analysis of exemplary sustainable projects was used to explore the motivations, methods and conditions needed to achieve more inclusive, collaborative design processes, yielding projects that are better suited to their environments, and in turn for their communities.

To develop this framework, this research surveyed practicing designers who successfully integrate environmental sustainability and social equity considerations into their design processes, exploring their motivations for pursuing projects with a wider sustainability agenda, the strategies and praxis they apply, the competencies they've developed, and other conditions necessary, for the successful realization of such projects. It aimed to deepen the understanding of this specialized niche in the design field through examination of the design process leading up to projects with greater environmental and social value.

Mixed-use and residential architectural projects are generally instigated and developed by a cohort of professionals from different fields, and thus undergo a dynamic development and design process. While the 'hard boundaries' of a building project such as purpose, budget and scope are often dictated by a developer, a municipal entity, or a client, the architect or designer commonly sets the project's 'soft boundaries' such as the architectural programme, contextual placement, aesthetics, and environmental and social attributes. Design can be described as this

ability for complex synthesis of cross-discipline issues whist venturing towards a desired, pre-determined outcome. Design process is the methodological, sequential process of implementing a formulated course of actions towards that pre-determined outcome. In this light, this research explored designers' strategies for incorporating environmental and social qualities in their professional practices, given the projects' dynamic development process, involving developers, officials, financiers and other stakeholders.

This research places architects and designers at the center of its consideration, following the belief that these professionals hold a unique set of skills necessary to mediate between disciplines and interests, synthesize multi-level limitations and facilitate change. The environmental crisis of our era is largely a design crisis, being a consequence of how objects and buildings are designed, how urban planning effects lifestyle choices and how natural resources are used (Birkeland, 2012; McLennan, 2003; Pananek, 1984; Ryn & Cowan, 1996); thus, urban designers hold a critical part in envisioning and shaping the future development of our cities effecting building, dwelling, transit and consumption patterns.

Many urban designers around the world are already engaged with restoring environmental wellbeing while fostering social sustainability and justice. These innovators are pushing the traditional boundaries of the profession by challenging their classic role as mere intermediaries between developers and occupants. They have been infusing their design agendas with social and environmental ideals, using radical strategies to create spaces that are not only environmentally sensitive, but also encourage inclusion, cooperation and trust. Such spaces advance community building, social cohesion, social equity, inclusive decision-making and actions in the collective

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interest. They echo their designers' venture for reimagining our relationship with our environment, and with one another.

1.4. Research motivation

Several key ideas form the basis for this dissertation:

(i) We, as a global society, cannot continue on a path of thoughtless resource consumption and environmental destruction without far-reaching environmental, economic and social disruptions in the very near future; most of the barriers towards a sustainable reality are not technological or economic, but conservatism, complacency, ignorance and fear;

(ii) Architects play a critical role in the production of the built environment, and are increasingly faced with client demand for added value in their work, expected to produce not just physical structures but ecologically sound environments for their occupants; as design professionals, we must lead the way in re-designing the places we live, work and play in;

(iii) Green building approaches and technologies aimed at reducing environmental impact are not enough; instead, designers must seize the opportunities offered through this shift and strive towards holistic, regenerative environments that nurture communities, revitalize neighborhoods and replenish natural resources, ensuring social and environmental wellbeing for occupants;

(iv) Set in a market economy bent on growth and profit maximization, the building sector is generally characterized by a conservative, 'lowest bidder wins' approach; however, the demand by end-users for building performance and environmental responsibility is slowly offering opportunity for designers with a broader agenda. By pro-actively pursuing these virtues and demonstrating their social, environmental and economic potential, architects can lead the market in adopting a performance-based culture, equipped to assess innovations and advances in material use, cost, durability and performance;

(v) Sustainable design does not 'trickle down', and currently it is perceived as an elitist luxury, largely available to privileged populations with the awareness and means to obtain it; finding synergetic, replicable, cost-competitive solutions for its implementation can be the way for its widespread implementation and for sustainable design to become the new standard in the building industry.

To fully develop the argument for this dissertation, it will begin by presenting the need for a sustainable design mindset, followed by an introduction of several concepts that are necessary for understanding the issues in question: sustainability, sustainable design, design process and integration.

1.5. Research rationale and justification

A review of the literature on sustainable design, design process and decision-making in sustainable architecture, and social equity in design has yielded substantial writings on these topics from both academics and practitioners. However, while these three themes are well developed as **separate** topics, they are rarely discussed in **joint** context. The dissertation aims to address this gap in the literature, particularly in light of typical integration approaches that largely disregard social imperatives in sustainable design.

Design-assisting tools, methods and inter-disciplinary teamwork play a crucial role in the integration of sustainability in the architectural design process (Buchanan, 2006), and research in the field gravitates towards the development of decision - assisting tools throughout the design process, each with a specific purpose. These tools can be categorized thematically, i.e. rating systems, checklists, guidelines, material specification catalogues, performance simulation tools, BIM tools, etc. These tools largely prescribe to the 'performance-threshold' approach (discussed in section 2.4.) and so have limited effectiveness within a holistic design approach (McLennan, 2004). Another area of literary research focuses on the methodology of the design process, recognizing the vital role that interdisciplinary collaborative teamwork plays in sustainable design. This area focuses on the implementation of the Integrated Design Process (IDP) by developing tools and methods to assist collaborative teamwork.

The foci of these areas of research represent a gap in the literature in the field of sustainable design practice, on several levels: firstly, current discourse on integration of sustainability into practice is generally one-sided, emphasizing performance-based design supporting tools and methods (such as energy-modeling

tools, rating systems and design guidelines); second, design assisting tools for sustainable design are largely prescriptive, top-down in nature, and most fail to address the idiosyncrasies and contextual issues of particular projects, or those arising from the dynamics of the architectural design process, which is a creative process and is never linear or straightforward; third and finally, integration in sustainable design generally relates to integration of performance-based considerations (such as energy conservation) yet disregards this field's social aspects, ignoring the integration of issues such as equity, citizen participation and inclusion in the design process.

This dissertation will aim to address this gap in the literature by opposing the prescriptive approach, by learning from practice through examination of the role of designers within sustainable design processes, exploring the methods, mechanisms and tactics they use to integrate a wider sustainable design agenda within their architectural projects. This study aims to 'tell the story' of three unique case study projects in three respective architectural practices, yet with a common subjective context, looking at their design processes holistically, mapping their course of design and development through interviews with multiple stakeholders at various levels.

The originality and academic contribution of this study lie in the decision to focus on four unconnected architectural projects which all share a profound concern for environmental performance and social sensitivity, both throughout the design process and as an intended outcome. These projects, located in different countries, differ in their approach to social topics such as inclusion, stakeholder participation, affordability and community wellbeing, yet their designers implemented similar tactics to ensure these imperatives are addressed. A case study research methodology was chosen to seek commonalities and pattern in the design process, aims to identify

the dynamics and the decision-making process among the various stakeholders throughout the length of the design and development process.

Chapter 2: Literature Review

This section will present literary findings regarding the themes of environmental sustainability and social equity, aiming to frame these topics in a contemporary architectural design context. While both have been discussed in the literature as separate issues, they have not been adequately addressed *together*, certainly not in the context of sustainable design practice. This research aims to address this gap in the literature, considering both topics jointly in the practice-based setting of urban and architectural design.

The review does not provide scholarly commentary on the precise subject area of the dissertation, since no publications on this topic have been found. However, several literary sources have been found that frame the topics in question: sustainable design practice, architectural design process, design for social sustainability, participatory design, socially responsive design and integration methodology. The literature also provided some understanding of how and why participatory design emerged as a method for promoting social equity in the last decade. The remaining questions have found answers through interviews and accounts of firsthand experience of practice in this area. These are outlined in the chapters 4-6.

2.1. Introduction

Over the past decades, alongside growing awareness towards environmental issues, there has been a substantial increase in research into sustainable design and its close parallels (eco-design, green design, green building, regenerative design etc.). This research was built on the foundations of earlier discourse developed over the past century, contributing to the discourse on these topics as new evidence and new voices emerge. This chapter aims to add to the current discourse on sustainable design by identifying the main gaps in research through examination of relevant literature.

This literature review explores explore several themes necessary for undertaking the study needed to answer the research questions, including the

origins of sustainability and sustainable design, sustainable design process, design methodology, participatory design and integration in design. The consequent research would then explore and evaluate cases of holistic sustainable design strategies applied in real-world projects with dual environmental and social agendas, executed by applying rigorous environmental design coupled with socially inclusive methodologies such as stakeholder participation and engagement.

2.1.2. Outline

This literature review begins by introducing the beginnings of sustainable design as a critical paradigm that emerged following the rapid processes of industrialization and urbanization around the mid 19th century. It continues by providing some definitions and approaches to the concepts of sustainability and sustainable design as they emerge from the literature. Next, these approaches are framed in architectural context, differing in their rationale albeit sharing a common underlying environmental philosophy. Different theoretical models for sustainable architecture are then discussed, with particular regard to their applicability to practicing architects and designers. Finally, the topics of participatory design and integration are presented and discussed.

2.2. The need for a progressive approach to sustainable design

David Orr[5], professor of environmental studies at Oberlin College and a pioneer in the field of eco-literacy, was recently asked about his vision of sustainable design as an integrative paradigm that could facilitate our collective transition towards sustainability. Orr suggested that we would have to co-create a meaningful narrative that will guide us through this transition:

"We will have to decide not just *how* we make ourselves sustainable, but *why* we should be sustained. That's a much more difficult thing!... You cannot make an economic argument for human survival; you must make a spiritual argument for human survival. We are worthy of it, and we are worthy of it in a higher sense" (Orr, quoted in Wahl, 2016).

Orr's philosophical approach exemplifies the difficulty in defining the core ideas of sustainable design and sustainability, and the need for the construction of narratives to guide us onward. His answer raises the need to ask *why* before we may ask *how*: by examining our own motivations and goals for a better future, we should be better equipped to pose the more pertinent, pragmatic questions of operability and action towards applicable solutions of a sustainable future.

The need for a progressive approach to sustainable design must be argued in the context of two issues: the dominant approaches towards the subject (discussed in section 1.5.), and the nature of the challenges we are facing. Following profound social changes beginning near the Industrial Revolution, and exacerbated following the two World Wars, the problems we now face are interrelated and connected,

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[5] David Orr is *Paul Sears Distinguished Professor of Environmental Studies and Politics* at Oberlin College and a *James Marsh Professor* at the University of Vermont

incorporating social, economic and environmental elements. Subsequently, there is a growing recognition for the need to replace isolated, incremental, specialized design practices with all-encompassing, holistic practices that will provide solutions to the multi-faceted challenges of the present day.

Several authors have argued that despite growing awareness, there is little understanding of the wider environmental, social and economic impacts of design: environmental considerations have immense implications for both environmental integrity and social wellbeing, yet they are still an afterthought in urban planning and design, as opposed to being fundamental to the way designers operate (Howarth & Hadfield, 2006; Stasinopoulos *et al.,* 2009). Others stress the need for a systemic design approach, affirming that the un-healthiness of the world today lies in direct proportion to our inability to see it as a whole (Capra & Luisi, 2014; Senge, 2006; Wahl, 2016). Anarow *et al.* (2003) claim that sustainability cannot be achieved in the absence of whole systems thinking, addressing the problems at a system level. In practice, many organizations focus on sustainability as an objective, but mostly limit their efforts to what can be achieved within the boundaries of the organization (Ehrenfeld, 2003).

Du Plessis relies on systems thinking to make a distinction between what she terms a "mechanistic worldview" and a "holistic worldview", the former having originated in the Cartesian thinking of the 17th century, by which nature was seen as governed by universal laws of physics, chemistry and mathematics, which could be controlled through science and technology for man's benefit and gain. Through the mechanistic worldview, quantitative data is the key to knowing, and thereby being able to master how things work. Through the ecological worldview, the world is "a

fundamentally interconnected, complex, living and adaptive social-ecological system that is constantly in flux" (du Plessis, 2012).

Mang and Reed (2011) use this distinction to explain their approach to regenerative design, a holistic design paradigm based on systems ecology, which emphasizes renewal and revitalization of natural resources through environmentally sensitive co-evolutionary design principles. They also point out the futility in attempting to understand the world using the heavily data-oriented tools and metrics developed under the mechanistic worldview (Mang & Reed, 2011).

Hes and du Plessis also point out our tendency to apply a mechanistic worldview for addressing systemic problems, dissecting them into separate problems, each with its own proposed solution or method for control, without considering effects found in natural systems such as balancing loops or reinforcing loops:

"It has also become clear that the mechanistic approach to solving some of the world's most pressing problems is failing, since the linear, reductionist methodologies used to develop strategies, cannot foresee the unintended consequences inherent in complex natural systems" (Hes & du Plessis, 2014).

These authors and others, coming from diverse backgrounds and addressing different aspects of design, all arrive at the conclusion that a radical change in perception and mindset are necessary if we wish to effectively address current environmental and social challenges. This change demands a unifying vision of the world around us, viewing it not as a machine composed of insulated building blocks, but as a single entity, a complex, adaptive, dynamic network of inseparable patterns of relationships, rendering the planet as a whole is a living, self-regulating system (Luisi and Capra, 2014). Furthermore, recognition of the need for this change is not enough

in itself, but must entail a profound shift in the practices and processes that will ultimately shape our future urban landscapes.

These ideas form the critical basis for this dissertation by highlighting an emerging agenda for sustainable design: a wider, holistic agenda not limited to reduced environmental impact, energy efficiency or other scorecard-based tactics for "being less bad" and minimizing harm, but rather embraces designers' steadfast role as agents of both society and our natural environment. This approach capitalizes on designers' ability to synthesize a multitude of issues and priorities within context, approaching problems from a holistic mindset as opposed to a fragmented, compartmentalized approach that disregards the inherent interactions and synergies between different urban and environmental issues.

2.3. Towards some definitions
Historically, the term 'sustainability' had been equated with environmental and ecological preservation (McLennan, 2004; Kidd, 1992). Various authors have attempted to reach a universal definition for it, and have been struggling with the challenges posed by addressing its core concepts for over thirty years (Fletcher & Giggin, 2001; Fuad-Luke, 2009). Most have found these concepts ambiguous and difficult to define given that they are "contestable, context-dependent concepts whose meaning are unstable and depend on the point of view, like liberty or justice" (Dresner, 2008; Hagan, 2001; Guy, 2002).

Sustainability's most-often cited application, sustainable development, also lacks a clear-cut definition, but the confusion possibly begins with the term 'development': Development is commonly understood as the modernization of

society in terms of economic growth, with increasing production leading to increased consumption and economic prosperity (Baker, 2006). This simplistic, one-dimensional model for growth relies on continued (and increasing) depletion of natural resources, which we know are limited and finite. It is only due to the uneven distribution of resources that we have been able to develop along Western models for so long (Meadows *et al.* 1972), with 80% of the world's resources being used by 20% of the global population at the turn of the Millennium (OECD, 2000).

Environmentalists adopted the idea of ecological sustainability in the 1970s, as it supported the theory of "limits to growth", which declared that the exponential population growth would eventually exceed the earth's carrying capacity (Meadows *et al*, 1972). For professionals working in development, while it was clear that development activities were compromising ecological sustainability, environmental protection could not be prioritized in isolation from social and economic needs (Walker, 2013). In the later half of the twentieth century, Europe had been able to balance socialism and capitalism in social market economies, but as the health of the natural world continued to decline, environmentalism often stood in stark opposition to both (McDonough, n.d.).

In the mid 1980s, global development specialists began to combine the agenda of environmental advocates and development needs. The term 'sustainability' became ubiquitous thirty years ago, following the publication of *Our Common Future,* a milestone report composed by former Norwegian Prime Minister Gro Harlem Brundtland and the Union for Conservation of Natural Resources. The report indicated a more refined understanding of how environmental, social and economic interests relate*,* linking corporate resource efficiency to human and environmental

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health. The report also articulated a definition of 'sustainable development', which remains perhaps the most cited definition of this term to this day:

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meets their needs" (WCED, 1987).

Commissioned by the General Assembly of the United Nations, the report sought to address the relationship between economic development and environmental concerns, and triggered decades of debates and discussions on the significance of sustainability as a global agenda, particularly as an approach for poverty alleviation. Despite its groundbreaking achievements in laying out a baseline and bringing together leading thinkers on environment, economy and law, the report ultimately adopted an ethnocentric approach, calling for greater balance between planetary obligations and societal needs with the aim of continued economic development "for the betterment of all nations" (Ibid, 1987).

From a pragmatic standpoint, the Brundtland report was applauded by the international community, triggering response by governments, global development agencies and other institutions. Besides increasing awareness and making some policy headway, these responses included a near-complete eradication of ozone layer-depleting chemicals, a global reduction in greenhouse gas emissions and carbon offsetting programs, and internationally coordinated efforts to preserve biodiversity and fight desertification. However, thirty years on, it is clear that despite the successes, the international community's response has a failed to match the scale and the pace of environmental degradation - which ultimately stems from unsustainable

production, consumption, and habitation patterns - that now undermine our very existence in the near future.

Brundtland's ethnocentric approach was challenged following the 1992 Rio Earth Summit, with the emergence of an awareness of rights - social, economic, spatial, environmental and interspecies (Haughton, 1999), with an emphasis on the institutional context in which rights are secured and protected (Ibid, 1999). According to the new advocates of these rights-based mindsets, sustainability depended not just on careful resource management, but also on organizational changes that address the political and institutional context within which local communities and cities operate (Allen & You, 2002).

Following the Brundtland Report's publication and the discourse that followed, sustainability became associated with appreciation of the complexity of intertwined human and ecological systems (multiple interacting factors and dynamic self-organizing processes in multiple interacting systems, at various scales, with pervasive and inevitable uncertainties, etc.) (Gibson, 2014). This awareness was also accompanied by indicator development initiatives, leading to the development of assessment guidelines and rating packages that encourage attention to a wider range of factors and connections, including social indicators, mostly involving poverty alleviation and access to education and medical care. The report also gave rise to a multitude of ecological impact and building assessment tools with the aim of incorporating multiple criteria for development, rather than individual concerns of energy efficiency and greenhouse gas emissions (Kohler & Lutzkendorf, 2002).

Over the next decades, academics have sought to identify the practical objectives that practitioners should pursue under the concept of sustainable

development. In 1996, urban planner Scott Campbell published a model of the sustainable development objectives of cities. Campbell suggested that there are three major planning interests relevant to sustainability: environmental protection, social equity, and economic growth (Campbell, 1996), sometimes called the "three E's of sustainable development". Under Campbell's model (illustrated visually as 'the planner's triangle'), sustainable development recognizes that these are not just objectives of good planning, but that environmental, economic, and equity outcomes are produced through linked systems of social and environmental interaction.

More recently, these challenges were outlined in the UNEP's 'Global Environment Outlook 6' (GEO-6) report, prepared in 2016 by over 350 experts hailing from fields as diverse as biochemistry, economics, geopolitics and urban planning. The report is the UN's main assessment of the state of the global environment, providing environmental trends for air, climate, water, land and biota. In short, it argues that our known environmental and social difficulties not only persist, but intensify, while new problems are constantly emerging due to the complex nature and ties between the environment and human society's living patterns. Some of these problems are never-before known to ecologists (such as oceanic dead-zones and lack of freshwater in areas with previously abundant water supply), and coupled with an expected climb in global population, due to reach 9 billion by 2050 (United Nations Environment, 2016).

2.3.1. Suggested models of sustainable development

Sustainable development, as proposed by the Brundtland Report became popular because of and *despite* the tension it expressed. Notwithstanding criticism of

the concept (called an oxymoron or an illusion by some [Livingston, 1994; Redclift, 1987]), its innovation in the field of sustainability was the recognition that combating poverty (which is not just economic) and protecting the environment (which is not just biophysical) were necessary to each other, and both were likely to fail if not addressed jointly (Farias, 2013).

The Brundtland report proposed recognizing a linkage and a balance between three dimensions - social equity, economic growth and environmental conservation, would palliate the negative impact of human activity on the environment (Dryzek, 1997; Huber, 1998). Rydin (2010) provided a comprehensive definition of the three dimensions, putting each in context:

(i)   "The economic dimension is about using market-based dynamics to meet people's needs, wants and desires and thereby provide the material basis for quality of life;

(ii) The social dimension is about the non-material dimensions of quality of life, and equity, including a sense of community, local well-being and security, and the elimination of poverty, perhaps even the achievement of a more equal society;

(iii) The environmental dimension encompasses all those environmental goods, assets an service on which we depend and are threatened by pollution, carbon emissions, resource exploitation and destruction of habitats." (Rydin, 2010).

The relationship and dynamics between these three elements have been discussed at length in the literature. Three well-known models that illustrate possible relationships are the Venn Diagram, the Russian Doll Model and the Three Pillars Model. The *Venn Diagram* is perhaps the most recognizable of all three, suggesting that sustainable development is achieved in the common area among all three spheres,

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indicating that each is equally significant yet mostly independent. The *Russian Doll Model* (also termed *The Nested Model*) echoes this relationship, but indicates that sustainable development can be achieved only when both society and the economic activity necessary for its wellbeing operate within environmental limits. The *Three Pillars Model* represents the analogy that sustainable development is 'upheld' by the three key dimensions, and consequently if one of the pillars is displaced, or not fulfilled, sustainable development is not achieved (Council, 2013).

Figure 0.1: Models for sustainability. Adapted from Giddings et al., 2002

A fourth model, which is seen as an elaboration of the three-pillar model, is the *Four Segment Pyramid,* or *Prism of Sustainability*. This model includes a fourth pillar, representing cultures, politics or **institutions**. The possibility of a fourth pillar signifies that sustainable development is only achievable if the mechanisms to deliver it are reinforced by social praxis (Ibid, 2013).

Figure 0.2The Four-Segment Pyramid, adapted from ability. Adapted from Spangenberg,, Fuad-Luke, & Blincoe, 2010.

2.3.2. A closer look at the 'three pillars'

Sustainable development has been recognized as a much-needed approach for the continued wellbeing and regeneration of our global systems, so that these can continue supporting human life and welfare. It has been argued that despite research and discourse, the underlying concepts of sustainable development are so abstract and undefined that they may not be useful in any pragmatic way, and that 'formula' of economics, environment and society has become so overused that no one understands what it actually means   (Findeli, 2008). Many others have voiced the need for a transition from the conceptual into the practical realm where change can be validated and quantified, for the 'sustainability tripod' to be balanced (Basiago, 1998; Dixon, 2011).

Genuine, continual sustainability requires a profound systemic and multi-scale change in natural resource use, production, consumption, transportation and urbanization through policy and design towards a conscious balance of economic,

social and environmental issues. However, the path towards balancing these three elements has baffled academics for decades (McLennan, 2004), and some argue that that equilibrium can never be reached between these tenets, given that each pillar has a specific worldview and the respective interests of the three contradict each other by their very nature (Moore, 2011).

Historically, the field of economics concerned itself with the satisfaction of human welfare. Over time, however, it evolved to become a complex model focused on profit generation and the accumulation of material goods above all else, even the interests of the collective (Doutwaite, 1992; Schumacher, 2013). Economic sustainability, by definition, demands a stable level of consumption in order to achieve sustainability, yet the realities of a market economy and Adam Smith's 'invisible hand'[6] place stability and competition at odds with each other, making economic growth a necessity. The environment requires the opposite: a slowing down of growth, and a steep decrease in our use of resources. It is extremely difficult, impossible even, to retain current rates of economic growth whilst operating within sustainable rates of natural resource use (McMahon, 2013).

In practice, the triple bottom line concept is often a balancing act, a series of compromises between competing interests, which ultimately results in minimizing environmental harm and social liabilities. A competing model to the Triple Bottom Line model, the Triple Top Line, has been offered by architect and sustainable design theorist William McDonough through his Cradle-to-Cradle design framework. The triple top line model engages the sustainability agenda from the strategic level in the company. A triple top line strategy focuses on top line growth though a focus on

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[6] Adam Smith described the "invisible hand" as the self-interest and competition that guide market economy, leading to self-regulation in resource allocation (Smith, 1776, 2001).

design and value creation through products that enhance the well being of nature and culture while generating economic value. Examples on the product level are systems that utilize cradle-to-cradle design, in which one product's waste becomes the material (or 'food') of another (McDonough and Braungart, 2002). From an architectural or urban planning standpoint, an example of a triple top line development may be one that introduces value to an existing urban setting by considering social concerns (e.g. accessibility, inclusion, affordability, community building) and environmental concerns (e.g. energy-efficient building, proximity to public transport) in addition to the economic considerations that would usually be part of any such development.

McDonough and Barungart, developers of the Cradle-to-Cradle framework for sustainable design, developed a tool for closer, relative evaluation of the three 'pillars' of sustainable development, called the Fractal Triangle. If the three-pillar model is illustrated as an equilateral triangle in which each of the three vertices aims to meet the others at the triangle's center, the Fractal Triangle (based on the Sierpinsky triangle of fractal geometry) is also an equilateral triangle, but one which is subdivided recursively into a set of smaller, equilateral triangles; Each of the vertices (ecology, economy and equity) has a respective triangle associated with it, which is also subdivided to three triangles signifying ecology, economy and equity, respectively, then divided once more.
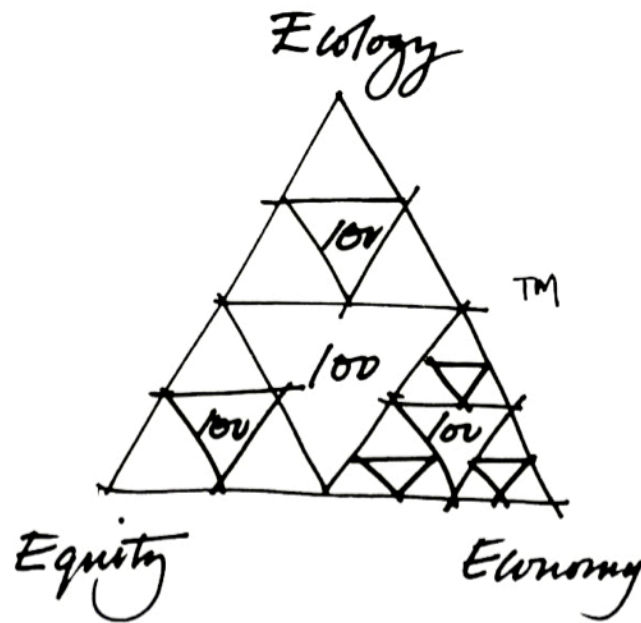
Figure 0.3 The Fractal Triangle model, from McDonough and Braungart (n.d.).

This graphic representation allows a closer consideration of each of the three aspects in every decision made in the design and development of the product or building in question, since each of the aspects must be considered in light of the other two at every step of the process. The Fractal Triangle was intended to show that at any level of scruitiny, each design decision has a multi-faceted impact, therefore, organizations should not aim for a balance between the three pillars, but for optimizing and maximizing value in all areas of the triangle through intelligent design (de Loura & Dickinson, 2016).

2.4. The social element in the sustainable design agenda

Many academics from the fields of economics, sociology and urban planning have voiced their beliefs that significant, long-term environmental sustainability cannot be achieved on any significant scale without social equity (Boström, 2012; Chapman 2005; Cuthill, 2010; Dempsey *et* al, 2011; Kuntz, 2006; Fletcher & Goggin, 2001; Giddings et al., 2002; White, *et al.,* 2008). Haughton claimed that "the unjust society is unlikely to be sustainable in environmental or economic terms; ...the social tensions that are created undermine the recognition of reciprocal rights and obligations, leading to environmental degradation and ultimately to political breakdown" (Haughton, 1999).

The social aspects of sustainability have been largely disregarded in mainstream sustainability discourse (Cuthil, 2010; Kuntz, 2006; Magis & Shinn, 2009), with research and policy traditionally focusing on economics and environmental policy. The constructs of these issues are tangible, measurable and thus represent, in many ways, the 'lowest hanging fruit' to address (McMahon, 2012). The need to shift the balance in sustainability discourse between economics and environment to include social and human concerns has been raised since the late 1990s in several international forums (OECD, 2000). In the literature, the social aspects of sustainability are often termed as social considerations if they cannot be dealt with by economic or environmental strategies (Findeli, 2008). As a result, social sustainability deals with the 'softer' and less quantifiable issues such as human behavior, cultural diversity, ethics, values, active citizenship, participation, personal responsibility as well as holistic perspectives, human rights, equity of living standards, justice, social governance and corporate responsibility (Bramley *et al.* 2006). Although recognized as a difficult but necessary task, the inclusion of social

aspects in any agenda leads to immeasurable elements, since social and human behaviors are intangible, unpredictable and difficult to control, predict or change (White, *et al.,* 2008; OECD, 2000 quoted in McMahon, 2012).

Planners and policy-makers largely prefer advancing economic and environmental sustainability, two areas where planning and policy can have measurable impact (e.g. environmental regulation, energy conservation, waste management, recycling and other end-of-pipe solutions). Many urban planners view 'the sustainability challenge' as a balance of tradeoffs among environment, economy, and society. This notion is echoed by the mechanisms developed to align environmental and economic objectives, gains and harms (Birkeland, 2012). Economic growth and job creation are common strategies in advancing social equity in cities, yet industry-based economic growth requires 'development,' usually involving new construction, generating pollution and straining natural systems. It has been shown that those who benefit from economic growth usually are not those who suffer most from these environmental and social consequences, in the United States and globally (Faber & McCarthy, 2003).

The challenge of current global social equity is immense, with unprecedented international income disparities. The total annual income of nearly 1 billion people, the combined population of the richest countries, is nearly 17 times that of the combined population of the poorest countries, 2.3 billion (United Nations Environment, 2016). This immense gap in income is exemplified by lack of access to potable water, education and medical care in developing countries. Closer to home, social equity is strongly manifested in our urban living environments through access and inclusion: mostly access to opportunity, transportation and employment, housing

affordability and inclusion in urban planning processes (or lack thereof). This dissertation is set against the backdrop of these compound crises emerging on several fronts, posing ecological, social and economic threats to human society as a global, connected whole.

2.5. Situating social equity within the environmental sustainability discourse

In 1968, American ecologist and philosopher Garret Hardin introduced an economic theory he called 'tragedy of the commons' (Hardin, 1968), authoring an article by the same title published in *Science* magazine. This economic theory described "a situation within a shared-resource system where individual users acting independently and rationally according to their own self-interest, behave contrary to the common good of all users, by depleting that resource"(Ibid, 1968). Hardin warned against the imminent devastation of vital shared resources following their over-exploitation by singular entities (be these individuals, governments or corporations). Hardin also claimed that humans demonstrate an intrinsically destructive relationship with their natural environment (Lavietes, 2003).

Despite public criticism, Hardin's commons theory is frequently cited to support the notion of sustainable development, meshing economic growth and environmental protection, and has had an effect on numerous current issues, including the debate over global warming (Ibid, 2003). This theory demonstrates an individual's incentive for selfish over-exploitation of a shared (common) resource, and the consequent collective burden caused by the exhaustion of that resource. While the profit is individual, the resulting environmental damage is necessarily shared, given the communal nature of the resource. Hardin further suggests that when an individual enjoys the profits of resource exploitation without sharing the burden of the cost with the community, resource exhaustion will inevitably follow (Greer, 2011).

Current discourse on sustainable development recognizes economic development, environmental sustainability and social equity as critical elements of sustainability, however social equity remains the least developed of these in both theory and practice (Chapman, 2012, Martin, 2007). In the traditional sense, social

equity presents the idea that all members of a population, not only an elite or chosen group, have the opportunity to prosper and succeed in order for the population to remain sustainable over time. This concept assumes a threshold of opportunity, livelihood and environmental quality under which no-one should fall. Within a community, it entails equal access to community resources and opportunities; in an equitable society, no individual or group should be asked to bear a greater environmental burden than the rest of the community. It is agreed that equity implies a need for fairness in the distribution of gains and losses, or profits and burdens, as well as the right of everyone to a sufficient standard of living. Within the domain of sustainable design and development, the term 'equality' was recently replaced by the more subtle term, 'equity'.

In 1996, the United States President's Council on Sustainable Development described social equity as "equal opportunity, in a safe and healthy environment"[7] (President's Council on Sustainable Development, 1996). Falk *et. al* have indicated that equity "represents a belief that there are certain things which people must have, and basic needs that should be met; burdens and rewards should not be spread divergently across the community... and policy should be delivered with impartiality, fairness and justice towards these ends" (Falk, *et al.* 1993). Thus, equity must emerge from the idea of moral equality, that people should be treated as equals (Jones, 2009). Equity commands just and unbiased treatment of all people and fair distribution of the resources available, as well as goods and services produced.

In 'Just Sustainabilities', Agyeman *et al.* demonstrate the close ties between environmental quality and human equality: Firstly, they suggest that across scales, higher environmental quality correlates with a more equitable income distribution,

greater civil liberties, political rights and higher levels of literacy; secondly, environmental problems impact disproportionately upon the poor, who often lack the means or access to power to avoid environmental 'bads' (or access to environmental 'goods'), while the rich contribute more significantly to environmental degradation; thirdly, they point to 'environmentally sustainable development', which, they claim, cannot be achieved without social and economic equality, both within and among nations (Aygeman, *et al*., 2003).

Policy Link, an American policy group, described equity as a "just and fair inclusion. An equitable society is one in which all can participate and prosper... The aims of equity are to create conditions that allow all to reach their full potential"[8] (Rubin,2009). The concept of equity is also well engrained in international law: the Universal Declaration of Human Rights states that the "recognition of the inherent dignity and the equal and inalienable rights of all members of the human family is the foundation of freedom, justice and peace in the world" (Weiss, 1990).

From the literary sources outlined above, the idea of social equity emerges to be quite context-dependent, realizing itself differently by economists, ethicists and social scientists. These view the idea of social equity as :

• Income equity

• Access to land and natural resources

• Infrastructure and services for basic needs and amenities

• Human health

• Education and economic opportunity

• Representation in governance and political processes

- Climate vulnerability and responsibilities

- Markets and International Trade

- Racial, social and gender equity

2.5.1. Social equity in urban planning

Since the formation of the first cities, leaders and planners have aimed to create livable, productive habitats for their residents, protecting them from exterior harm and facilitating livelihood. To accommodate growing populations, and through visionary attempts to create healthier living environments, most modern cities have been constructed through orthodox, top-down approaches. Planners of these cities largely applied conservative approaches to city planning and urban design commonly referred to as comprehensive-rational planning. Also, most concentrated on physical form, expecting the social issues arising from urban life to resolve themselves through natural processes and market forces (Papanek, 1984). As a consequence, it is agreed that from a human perspective, our modern attempts to create cities are mostly unsuccessful (Alexander & Mehaffy, 1988).

Norman Krumholz, who served as planning director for the city of Cleveland between 1969-1979, is seen as one of the earliest advocators of equity planning. Krumholz established city policies and community partnerships targeting urban issues such as poverty, housing, neighborhood revitalization and racial discrimination. While conventional planning practices usually entailed land use planning and development of a city's downtown area, Krumholz described the primary goal of equity planning in quite different terms, as "to provide a wider range of choices for those… residents who have few, if any, choices" (Chapman, 2004).

In 1996, planner Scott Campbell published a model of the sustainable development objectives of cities. His thesis proposed three major planning interests relevant to sustainability: environmental protection, social equity, and economic growth (Campbell, 1996). Campbell described a constant tension among these three divergent interests - "the property conflict, the resource conflict and the development conflict" (Ibid, 1996). Campbell's theory of sustainable development recognized that these are not just objectives of good planning, but that environmental, economic, and equity outcomes are achieved through associated systems of social and environmental interaction. Campbell also stated that existing models of cities and economy inevitably produce undesirable outcomes such as environmental degradation and social inequities (Ibid 1996).

Using a triangular model he called the planner's triangle ("Green cities, growing cities, just cities?", 1996), Campbell illustrated how these objectives compete with one another in public decision-making (Figure 2.6). The model of sustainable development was easily understood and helped public administrators "identify conflicts among objectives and make meaningful decisions in light of different objectives" (Campbell, 1996), bringing the elusive topic of sustainability into the realm of city planners and public officials.
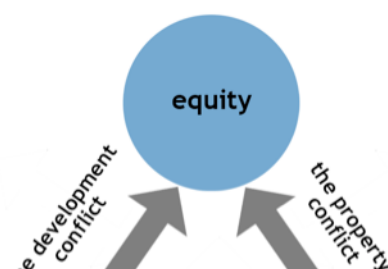
Campbell's diagram illustrates the systemic clear connections between equity and the two other sustainability interests, environment and economy. Economic growth and job creation are common strategies in advancing social equity in urban environments, yet industry-based economic growth requires 'development,' usually involving new construction, generating pollution and creating a strain on natural systems. It has been shown that hose who benefit from economic growth usually are not those who suffer most from these environmental and social consequences, in the United States and globally (Faber & McCarthy, 2003).

Campbell claimed that although we can strive to reduce environmental degradation while continuing to grow our economies if we do not also aim to improve social equity, it is unlikely that these severe social disparities will disappear on their own (Campbell, 1996). Moreover, as Haughton described, "the unjust society is unlikely to be sustainable in environmental or economic terms; the social tensions that are created undermine the reciprocal rights and obligations, leading to environmental degradation and ultimately to political breakdown" (Haugton, 1999).

Another theoretical approach to equity is inclusive planning, a term coined at the 1995 World Summit for Social Development (WSSD) in Copenhagen. UC Berkley planner Susan Goltsman defines equity as "equality of civic engagement

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across a community, or how widespread civic involvement is across class lines"
(Goltsman & Iacofano, 2005). This planning approach is claimed to promote social
and economic equity and community development, with full interaction and
accessibility for all residents (Ibid, 2005). Inclusive planning advocates that every
individual has the right to equal, complete participation in the processes that shape
their built environment, and thus shape their environment to meet their needs. This
view shared with the more design-based approach of participatory planning and
design developed by the SEED Network, which advocates and practices public-
serving design through public engagement, promoting civic responsibility and
respecting public knowledge.

Thus, social equity can be assigned to one of two complementing themes: the
first is a concept of fair distribution of shared resources, entailing access to resources,
public goods and services (referred to as 'territorial equity' by Krumholtz), as well as
shared burden of negative environmental phenomena or ills; the second theme ties
social equity to empowerment, civic engagement and social inclusion in local
governance and development process within an individual's community.

2.5.2. Assessing social sustainability - Urban Sustainability Reporting

In the 1990s, Virginia Maclaren, a professor from the University of Toronto,
chose to address urban sustainability through a holistic approach, underscoring
socially orientated criteria for evaluation. Maclaren developed a tool termed 'Urban
Sustainability Reporting' to help local governments, municipalities and businesses
assess their progress towards urban sustainability. She suggested that indicators used
for sustainability assessment should be "integrating", "forward looking" (inter-

generational equity), "distributional" (intra-generational equity), and "developed with input from multiple stakeholders in the community" (procedural equity) (Maclaren, 1996). Following goal definition and scoping, the process entails selecting potential sustainability indicators, evaluating them by a variety of criteria, choosing a final set of indicators, analyzing and presenting their results, and then periodically re-assessing indicator performance (Ibid, 1996). These indicators are described below:

(i) **Integration** suggests that instigators of urban development projects should adopt a holistic approach, addressing the four intertwining dimensions of sustainability. To fulfill this aim, developments should be designed so that not only various sustainability aspects are included, but their inter-linkages and inter-dependencies are also recognized. Integration and consideration of inter-linkages are essential factors for taking a holistic and systemic approach towards sustainable development. An integrated sustainability assessment framework should also account for indirect as well as direct impacts both within and outside the boundaries of the development (Gibson *et al*, 2005). This systemic approach would have the potential to reduce adverse cumulative impacts and promote positive cumulative impacts (Basiago, 1998). Gibson *et al* further indicate that it might be difficult, if not impossible, to take full account of all four dimensions of sustainable development (Gibson et al., 2005).

(ii) **Inter generational equity**, essentially the consideration of the needs of future generations, is pivotal to any sustainability related practice, whereby moral and regulatory obligations place the responsibility for ensuring an equal level of well being for future generations on the current generation. The inter-generational principle focuses on taking measures concerning the time dimension to ensure the

long-term effects of today's decisions are taken into consideration (Lozano, 2008), and the ability of future generations to meet their own needs is not compromised. Although the uncertainty of future conditions makes the prediction task for setting the reference points difficult and complicated, it is essential to have a meaningful set of reference points that can best proximate the conditions and requirements in the future time horizons (Ibid, 2008).

(iii) **Intra generational equity** essentially entails a level playing field, fairness and equity, to all citizens. The notion of equity embodies a wide range of measures that require the fair distribution of benefits and burdens (Fox, 2000). This includes equal accessibility to the resources and facilities; equal distribution of financial resources; equal housing for all; reduced social inequalities; an equal platform for all groups of individuals irrespective of their gender, age, ethnicity to participate in the decision-making process; improved living standards of poor, disadvantaged, and minorities and consideration of their cultural aspirations; enhanced safety for all, and consideration of trans-boundary issues and impacts (Maclaren, 1996). Intra-generational equity plays a substantial role in maintaining the overall well-being of the community. It is not an easy task to disseminate values such as tolerance, social cohesion, civic involvement, mutual respect etc., in an environment where citizens feel that benefits and burdens are not fairly distributed (Edwards, 2005).

(iv) **Procedural equity** refers to various decision-making processes for sustainable development, which should involve discussion among all stakeholders (Khakee, 1998). This criterion relates primarily to the social and institutional dimensions of sustainability, and advocates for input from citizens and their

involvement in the decision-making process in their community. Involving multiple stakeholders in the decision-making process is important for enhancing the procedural equity, and can be an effective way to develop a common vision; improve the project according to local needs; promote a sense of ownership and provide a learning environment for various stakeholders, thereby enhancing civic activities (Maclaren, 1996; Gibson et al., 2005). Maclaren indicates that stakeholders must be involved during three main phases of sustainability assessment: first, in *defining* the sustainability targets and objectives, and identifying the core criteria and indicators for assessment; second, during *prioritizing* the selected indicators; and finally after assessment is finished, through *providing feedback* on development. Institutionally, it is necessary to have some specific levels of devolution of power to the local authorities and establish a legal basis for civic participation (Maclaren, 1996).

(v) A fifth dimension, **contextualization**, is particularly relevant given the inherent differences and attributes of communities in various parts of the world or even local areas within one country from each other. These differences can be geographic (i.e. climatic, topographic), cultural (language or religious attributes) or urban in nature, rendering varying needs for the community in question. This requires taking adequate account of the differences between various localities with different environmental, social, and economic settings, as well as, acknowledging that different types of development (new development, brownfield regeneration, etc.) require different approaches (Sharifi, 2013).

2.6. Framing sustainable design in architectural context

In 2001, as the sustainable development paradigm was gaining traction in architecture and urban planning, the publication *Architectural Digest* approached a handful of seasoned architects, all considered leaders in the sustainable design arena, and asked for their thoughts on this emerging idea (the terms 'sustainable design', 'ecological design', 'eco-architecture' and 'sustainable architecture' will be used interchangeably throughout this section). The flexibility in defining 'sustainable design' is apparent in the array of opinions these interviewees offered:

"Sustainable design aims to meet the present needs without compromising the stock of natural resources remaining for future generations. It must include a concern for the principles of social and economic sustainability as well as the specific concerns of the energy use and environmental impact of buildings and cities" (Edwards and Rogers 2001).

"Sustainable design can be defined as ecological design — design that integrates seamlessly with the ecological systems in the biosphere over the entire life cycle of the built system" (Edwards and Yeang 2001).

"Sustainable design means doing the most with the least means. It is about Ideally using passive architectural means to save energy - rather than relying on wasteful mechanical services, which use up dwindling supplies of non-renewable fuel and produce pollution that contributes to global warming. But in the final analysis, sustainability is about good architecture. The better the quality of the architecture — and that includes the quality of thinking ideas as much as the materials used — the longer the building will have a role, and in sustainability terms, longevity is a good thing" (Edwards and Foster 2001).

Other authors criticize the restricting view of sustainable design that has been dominant in the last decades. Guy (2002) rejects of the predominant notion of defining sustainable architecture by balancing environmental damage with environmental repair; he argues that this approach relies on the false pretenses of ends (sustainability) being met by means (technological innovation), with both concepts assumed to be defined endpoints rather than evolving, subjective ideas. Guy also points out that this approach, termed 'the performance model', ignores the social dimension and local context of sustainability and is therefore limited in its effectiveness and traction.

Other authors offer these more broad definitions:

"Sustainable design is the philosophy of designing physical objects, the built environment, and services to comply with the principles of social, economic and ecological sustainability" (McLennan, 2004).

"EcoDesign is a meta-disciplinary approach in which diverse interests and expertise fuse into shared vision which generates collaborative solutions… Sustainable design must provide our basic needs for balanced healthy natural/human ecosystems that provide clean water and air, energy, food, and the safe recycling of all wastes" (Ryn and Cowan, 1996).

"Sustainable design acts as a philosophy that is applied by different companies, governmental entities, and non-governmental organizations to achieve a better future for the human race through the wise and low-volume consumption of Earth's resources" (Elmansy, 2014).

Hagan (2001) states that 'sustainable design' is commonly synonymous with 'environmental design' or 'environmental architecture', stressing that the term's meaning is not clear-cut and is context-dependent. Later, Hagan offers a comprehensive definition that highlights the environmental perspective of the term, and adds a social angle:

"When applied to architecture, the term 'sustainable' currently refers to environmental sustainability. Swept up in the concern for the environment, however, is an accompanying concern for social sustainability, as this implies public health and a fairer distribution of physical resources and physical risks. Economic sustainability, in the sense of value for money or return on investment, is also implicit within environmental sustainability" (Hagan 2001).

Other academics addressing this topic stress the importance of addressing the social aspect of sustainable design (DuPlessis 2001; Edwards 2001). These authors criticize the one-sidedness of the performance approach, which concentrates on energy efficiency and mechanical systems. Du Plessis (2001) identifies wider concerns than those related merely to building performance, i.e. an emphasis on the design of structures that will promote community cohesion and social harmony, as well as an emotional connection to place and culture. She further highlights the importance of context and regional circumstances, concluding that the best practice occurs when both local and global issues are balanced (Ibid, 2001).

Some authors suggest a deeper concept of the term 'sustainable design', choosing to define it as both a concept and a process, 'sustainable architecture' being both a process and the product of that process, just as the term 'design' can be considered a process and product. Williamson *et al* highlight the importance of the

design mindset, rather than outlining the characteristics of the outcome of the design process, indicating, "sustainable architecture focuses on the sustainability of architecture, both as a discipline and as a product of the discipline" (Williamson *et al,* 2003). Others point to the nature of the design profession as an iterative, largely intuitive process of continual synthesis of constraints and liberties, as one that defines 'design' as equally important process and outcome (Manzini and Jegou, 2003).

When reviewing these definitions from a design standpoint, Dominski *et al* offer the most relevant one, in reference to the idea of the 'sustainable city':

"Sustainability may be defined as a dynamic balance among three mutually interdependent elements: (1) protection and enhancement of natural ecosystems and resources; (2) economic productivity; and (3) provision of social infrastructure, such as jobs, housing, education, medical care and cultural opportunities" (Dominski *et al,* quoted in Fuad-Luke, 2009). This definition recognizes the services that nature provides and man's duty to care for it, invoking productivity rather than economic growth, and links sustainability to the overall social condition and wellbeing (Fuad-Luke, 2009).

With these competing definitions in mind, this dissertation will consider the idea of sustainable design a context-dependent, flexible concept, particularly given the difference in professional approaches to design and architectural practice across geographies and cultures. Notwithstanding, this dissertation will aim to challenge the dominant, narrow-view ethos of sustainable design in architecture: a performance-based attitude that concentrates on efficiency, energy conservation, material selection and durability in architectural design and build. While these issues are paramount in their importance, and we have made admirable progress in understanding and

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implementing them, they represent only one facet of a holistic, truly sustainable, regenerative design approach that addresses the often-neglected social aspect of our professional realm.

2.7. Terminology

This dissertation makes use of professional terms relating to design process, sustainable design and architecture. The most relevant of those are explained below:

Green building: a design approach to building design and construction that respects nature and that aims to minimize the negative human impact on the natural environment through a building's construction and use.

High performance building: a building approach that uses a whole-building design to achieve energy, economic and environmental performance that is substantially better than standard practice. Whole-building design creates energy efficient buildings that save money for their owners, besides produces buildings that are healthy places to live and work. (NREL, 2005).

Design methods: procedures, techniques, aids or 'tools' for designing (Cross, 2008).

Eco-balance: is a state or condition of a building where its needs (energy, oxygen, food, water), are completely satisfied by its immediate surroundings (Fisk, 1995). The term was coined by Pliny Fisk, founder of the Center for Maximum Performance Building Systems (CMPBS) and instigator of the world's first green building program. An example of this approach would be a goal by which the daily amount of oxygen required by building's occupants should be produced entirely by the vegetation existent on its site. Based on the notion that the building and its surrounding environment are parts of one holistic system, understanding the building needs enables setting performance goals (Stipo, 2013).

Conventional building design: "A design process where many individuals or teams

are responsible for optimizing their own particular system with limited interactive collaboration" (Muldavin, 2010:35).

Ecological literacy: Refers to developing an understanding of the ecological interdependency, developing an ethic of care and stewardship and developing systems thinking and skills necessary to instigate ecologically sustaining activity (Spariosu, 2004).

Integrated Design: "A design process that employs a collaborative and multidisciplinary project team throughout design in order to optimize the whole building" (Muldavin, 2010).

Integrated Design Process (IDP): a collaborative process that focuses on the design, construction, operation and occupancy of a building over its complete life-cycle, with a clear definition of environmental and economic goals and objectives. The IDP requires a multidisciplinary design team that includes or acquires the skills required to address all design issues flowing from the objectives (Zimmerman, 2002).

Integrated Project Delivery (IPD): a collaborative alliance of people, systems, business structures, and practices that employs a process that harnesses the talents and insights of all participants to optimize project results. As a result, IPD provides a better value to the owner, reduces waste and maximizes efficiency through all design phases, fabrication, and construction (AIA, 2007). The main difference with IDP is that IPD includes a contractual agreement of sharing risks and benefits from the project in equal parts, and an agreement of no liability between stakeholders.

Building Information Modeling (BIM): a cohort of emerging technologies that enable digital representation of physical and functional characteristics of a facility

and serves as a shared source for information about a building or facility (NIBS, 2008).

Computer Aided Design (CAD): the use of computer systems to assist in the creation, modification, analysis, or optimization of a design (Sarcar *et al*, 2008).

Interoperability: the capacity of BIM tools from multiple developers to exchange building model data and operate on that data, a capability that is critical for team collaboration (Eastman, 2008).

Design phases: according to AIA best practices (AIA, 2007), the typical course of architectural design is divided into phases of *schematic design, design development, construction documents, bid or negotiation* and *construction administration*. In Schematic Design (SD), the architect consults with the owner to determine project goals, requirements and scope. Deliverables for SD often produces a site plan, floor plan(s), sections, an elevation, and other illustrative materials; computer images, renderings, or models. Typically the drawings include overall dimensions, and estimated construction costs. In the Design Development (DD) phase, designers use the initial design documents from the schematic phase and take them one step further. This phase lays out mechanical, electrical, plumbing, structural, and architectural details. Deliverables for DD often include floor plans, sections, and elevations with full dimensions. These drawings typically include door and window details and outline material specifications. Once the owner and architect are satisfied with the documents produced during DD, they begin the Construction Document (CD) phase and the architect produces drawings with greater detail. The deliverables for CD are a set of drawings that include all pertinent information required for the contractor to price and build the project. In Bid or Negotiation phase, the first step is the

preparation of the bid documents to go out to potential contractors for pricing; the deliverable is a construction contract, and once signed, project construction can begin (AIA, 2007). In the Construction Administration (CA) phase, services are rendered at the owner's discretion and are outlined in the owner-architect construction agreement. Different owner-architect-contractor agreements require different levels of services on the architect's part. CA services begin with the initial contract for construction and terminate when the final certificate of payment is issued. The architect's core responsibility during this phase is to help the contractor to build the project as specified in the CDs as approved by the owner. The deliverable is a successfully built and contracted project (AIA, 2007).

Unique **design phases in IPD** are outlined by the AIA as: conceptualization phase [expanded programming]; criteria design phase [expanded schematic design]; detailed design phase [expanded design development]; implementation documents phase [construction documents]; and finally agency review phase.

Commissioning: is a systematic process of assuring that a building's performance matches the design intent and the owner's operational needs, "benefiting the owner, design and construction teams and building occupants" (Grumman, 2003).

2.8. Sustainable architecture: several divergent models

From a personal standpoint, I find current attempts to define, articulate and quantify 'sustainable architecture' somewhat ironic, given that man has been producing sustainable dwellings and urban environments for millennia, remove the last few centuries, before the proliferation of artificial lighting, climate control and availability of cheap fossil fuels. Architects and builders of those times had intimate knowledge of their local sites, their climates, material resources, topography and, most importantly, their ability to sustain life. Our 'professional ancestors' were rooted in their communities, understood their public's practical needs and lifestyles, as well as their cultural and religious preferences. Consequently, these designers, builders and craftsmen produced highly contextualized, time-tested architectural typologies at varying scales, in tune with the their environment and the rhythms of nature. Today, vernacular buildings and villages in non-industrialized nations echo this profound, sensitive architectural expertise.

From an academic standpoint, the term `sustainable architecture' is difficult to define and can undertake diverse descriptions and attributes, given both the difficulty in defining the term 'sustainability' as described above, and the range and interconnected nature of environmental issues within the built environment. The term 'sustainability' originated from the field of ecology, where it was used to describe a system that uses resources at the same rate or slower than it replenishes them. Sustainable architecture is thus seen as an approach to architectural theory and practice that recognizes the complex relationships between the social, economic and environmental issues in the built environment, consciously working to balance the wellbeing of each for the benefit of society (Guy and Moore, 2007). This chapter reviews several models of sustainable architecture from the literature.

In current times, most academic discourse around sustainable architecture focuses around developing a consistent model with regard to assessment and evaluation (Vallero & Brasier, 2008). Current models for sustainable architectural design, in development since the 1970s, are largely performance models, dependent on measuring environmental impact of buildings through quantitative methods (Hagan, 2001). Various authors have attempted to arrive at a baseline definition for sustainable architecture by re-framing the question to include a wider array of approaches:

"Sustainable architecture… refers not to one, but to a spectrum of architectures, from the traditional vernacular (which tends to be environmentally sustainable by default) to existing architectures-made-more-sustainable, to architectural determinism, to those few architects who are pushing environmental design into reflexivity, that is, into self-conscious expression of its more symbiotic relation with the natural environment" (Ibid, 2001).

To surpass this difficulty, Hagan (2001) proposes three criteria for both identifying and generating environmental architecture: symbiosis, differentiation and visibility. **Symbiosis** questions the relationships between buildings and nature, seeing buildings as dynamic systems that use and process renewable energy, water, air and building materials. **Differentiation** questions the recognition of, and response to, the identity of place, using vernacular techniques and local materials for differentiation. **Visibility** questions environmental architecture becoming self-conscious and expressive, where form is manipulated to represent environmental sustainability. Hagan proposes not only three identifiable groups based on the characteristics of the

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buildings, but also different levels of engagement with sustainability, from determinism and lack of reflection to a deliberate self-expression (Ibid, 2001).

A different position is offered by Guy and Farmer (2000), who point out that one of the main hindrances towards a unifying vision of sustainable architecture is the vast difference in views of environmental problems by individuals, groups and institutions, resulting in varied agendas and approaches. They suggest dealing with this diversity by consciously abandoning the search for a true definition of sustainable architecture, treating the concept comparatively, while still keeping sight of the many issues in question:

" [Sustainable design compares to] a bewildering array of contrasting building types, employing a great variety of different technologies and design approaches, each justified by a highly diverse set of interpretations of what a sustainable place might represent… by suspending the search for a true or incontestable, consensual definition of green buildings and environmental ethics, we potentially become more sensitive to the range of possible logics of innovation which may surface in new buildings" (Guy & Farmer, 2000). Guy and Moore (2007) suggest that pursuing an "ultimate and singular answer to sustainable living is unproductive, [given that] the environment is both physical and social, and [the two are] rarely interpreted in the same way" (Guy & Moore, 2007). They develop this statement further to conclude that the forces that determine sustainable form are not the products of a single, prescriptive, optimized ideal, but rather a multitude of combined interventions, applied at different scales.

Guy and Farmer suggest abandoning the search for a universal, 'one-size-fits-all' approach towards sustainable architecture, but instead search for meaning of its environmental and ethical elements within context. Following an extensive review of

the literature, they propose six different "logics of sustainable architecture" that relate to different environmental issues and design taxonomies:

(i) the *eco-technic logic* relates buildings to the planet; it is applies environmental management tactics to control the environmental impact of development. Designs are 'high-tech' and "attempt to maximize the efficiency of building in spatial, construction and energy terms" and lead to "innovations in building fabric and servicing systems." (Guy, 2001).

(ii) the *eco-centric logic* relates buildings to nature; it is rooted in the understanding of ecology as a system too complex to be described in terms of economics and commodity. Architectural design seeks not to control environmental conditions, but to work in tandem with them through passive cycles, working with local actors (social communities) within the system (Ibid, 2001).

(iii) the *eco-aesthetic logic* relates buildings to the expression of form. Stemming from the "postmodern paradigm", this approach emphasizes the role of the senses in the design of architecture, suggesting that 'a sense of place' assists in avoiding further environmental degradation (ibid, 2001).

(iv) the *eco-cultural logic* relates buildings to location and place. Drawing on the idea of a sense of place, Guy proposes that design approaches in this context are based on the indigenous and the ability to respond locally and culturally to environmental conditions (Ibid, 2001).

(v) the *eco-medical logic* relates building to health, linking issues of sustainability to concerns for wellbeing and health; this approach embodies a "humanist and social" perspective, often focusing on on the building interior and its

effects on its occupants; linking natural and passive, 'eco-centric' approaches to generate healthy environments (Ibid, 2001).

(vii) the *eco-social logic* relates buildings to their community considering them from a social hierarchies and networks perspective. It address the processes of community building, relying on public and stakeholder participation (Guy, 2001).

Other authors share Guy and Farmer's view of context-dependent Image of sustainable architecture and the environment, which relates directly to our personal understanding of our own environment, geography, and experience. Williamson *et al* (2003) criticize current tendency to approach the environment as one global entity with physical attributes, and suggest we adopt a more contextual view, which relates to more specific geographies and lifestyles. From this starting point, they refer to the 'images' of sustainable architecture, that relate to the mental concept that individuals have of their own environment, which combines global and local issues. The nature of images mean that they cannot be defined rigidly, but they rather incorporate a wide scope of possibilities that relates to their multifaceted nature and their relation to means, emotions and memory (Williamson *et al*, 2003). Further reinforcing this point, Wahl and Baxter (2008) argue that the parameters set by sustainability policies potentially pursue environmental performance objectives at the expense unquantifiable requirements. They claim that sustainability can not be explicitly defined as a sequence of objectives that represent social, economical and environmental requirements, because the nexus of values it constitutes are constantly evolving (Ibid, 2008).

Williamson *et al* propose three 'images' of sustainable architecture: the natural image by which buildings aim to reduce their ecological footprint; the cultural image

by which buildings aim to respond to local culture; and the technical image by which buildings rely on technological innovation as a mitigator of environmental harm (Trebilcock, 2014). Similarly, Guy and Farmer emphasize the cultural and social analysis of the environmental phenomenon rather than the mental concept of it. Nevertheless, both approaches can be seen as related since the natural image shares its principles with the eco-centric, eco-medical and eco-aesthetic logics; the cultural image shares its principles with the eco-cultural and the eco-social logics; and the technical image shares its principles with the eco-technic logic (Ibid, 2014). These criteria can also be associated with previous classifications given by Hagan (2001) suggest that symbiosis and differentiation correspond quite closely to the natural image and the cultural image.

One widely accepted approach to sustainable architecture, openly criticized in this dissertation, looks to technological innovation as the potential solution to our current environmental crises. This approach, which dominates environmental policy, proposes that advanced technology could rectify the multitude of problems created by industrialization (Guy & Farmer, 2000). It aims to assess the potential environmental impact of buildings through rational analysis of carefully collected, quantifiable data produced by the building's mechanical systems, engineer calculations and performance assessment software. This model, known as the **'performance threshold model'**, relies on a structured framework of measurable qualifiers that can be accurately gauged against a 'baseline' of targets, or other agreed-on criteria (Ibid, 2000). The authors point out the problematic assumptions of this methodology, questioning its validity:

"These techniques presuppose a degree of agreement on what defines sustainable building, and that certain types of technology and development can be shown to be more sustainable than others" (Ibid, 2000).

The authors further distinguish between two approaches to sustainable design: the **traditional-linear process**, and **the transitional process**. These approaches largely disregard the philosophical aspects and impetuses of design for sustainability, and instead concentrate on the design process. The traditional-linear process tends to prioritize variables such as monetary costs, scheduling constraints and building quality. The transitional model includes a Green Building Rating System (GBRS) such as LEED, BREEAM, Green Globes. The transitional model advocates for incorporation of technical input earlier in the design process, so the schematic design alternatives can be tested in advance to assure better performance of the building. The main difference between the linear process and the transitional process is the level of interaction and feedback among all stakeholders, which is more intensive and continuous in the latter (Ibid, 2008; Farias, 2013).

Vallero & Brasier embrace a rounded approach to sustainable architecture from the literature, one by which both the design process and its products must incorporate the principles, processes and cycles of nature (McLennan, 2004; Vallero & Brasier 2008; Yeang, 1995). According to these authors, such an approach entails (i) an exploration of different architectural forms to reduce ecological footprint and aspire to achieve eco-balance or net-zero energy performance (on or off-site production of the required energy for its function); (ii) a sustainable design strategy that aims to surpass the short-term economical benefits and view the design from a holistic viewpoint; (iii) a 'no-waste' approach, claiming that the built environment

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should aspire to re-create the way nature works, applying the biomimicry principle of 'no waste in nature'; and (iv) include operations and facility management in the design process and ultimate day-to-day running of the building, for an accurate evaluation of the building's performance (Vallero & Brasier, 2008).

To summarize, these academics suggest different taxonomies of sustainable architecture, each departing from their own personal viewpoints - be they 'mental images' of the environmental crisis, 'backcasting' towards desirable outcomes, human-centered approaches highlighting cultural and social issues, or conscious questioning of the 'place' of architecture within nature. All agree that there is no universal, objective architectural approach to address current environmental and social challenges. Also, all question the dominance of the performance-based approach of relying on technological innovation for reduced ecological harm. Instead, they offer new ways for understanding the agency of designers within both the built environment and the natural environment, with the hope of creating new narratives for future intervention.

2.9. Integration in sustainable design theory

In architecture, the idea of integration is generally considered synonymous with sustainable design practice. It is the over-arching concept that considers ecology, energy, resource use, and the social aspects of a building project, to achieve wellbeing both for its residents and its surroundings. Integration suggests a shift from the modern Western thought of dualism and reductionism to a holistic view of interconnectedness and wholeness of our living systems. Sustainability is thus an inherently integrative concept, as has been demonstrated in previous sections of this literature review.

Since the time of Descartes, Western thought has been characterized by dualism and separation between body and mind; matter and spirit and between reason and emotion (Fowles 2000; Williamson, *et al.,* 2003). This dualism led to a separation between culture and nature and between thinking and doing. A second characteristic of modem thinking is reductionism that sees knowledge gaining (epistemology) as breaking down a problem into its component parts, in a process of atomization (Hes & du Plessis, 2014), disregarding the natural concept of the whole being larger than the sum of the parts. Some see the separation of thinking from doing as the approach that eventually led to a division of labor that ended in specialist work, where each worker is occupied with a specific task and has little idea of the entirety (Fowles, 2000).

Fowles further suggests that sustainable architecture should be based on three principles: (i) man is not separate from nature, so architecture should extend this principle and acknowledge the processes of the natural environment; (ii) design is a social process where manual and mental activities, as well as theory and practice, should be integrated; and (iii) architecture should adopt a holistic approach that recognizes the inter-relatedness of all matter (Ibid, 2000).

As established in the Brundtland Report (WCED, 1987), the strategy for the combination of factors of sustainability and the recognition of their interconnectedness is paramount for sustainable development. This recognition came in response to previous practices and projects through U.N. initiatives, in which the interconnections among these key issues were ignored, causing the projects to fail, often leaving poor populations in worse conditions than before receiving their assistance (Stipo, 2013).

Research in the field of sustainable design has largely adopted the technical-performance approach that aims to reach a consensual definition of sustainable buildings that can be tested against clear performance targets, portraying the design process as linear and straightforward, in which the ways of informing the decision-making process are direct and deterministic (Guy &Farmer,2005). This approach attempts to streamline the design process of sustainable buildings, albeit with good intentions of efficiency and uniformity, yet often does the opposite, rendering it simplistic by oversimplifying the process through a 'cookie-cutter' approach that disregards the context and unique attributes of each project:

"…Green design, though not dauntingly difficult, cannot be achieved by any simplistic or formulaic approach: no single approach is likely to be adequate, let alone appropriate or even applicable, to all situations" (Buchanan, 2006).

Within the technical-performance model, the barrier is illustrated as "some people [researchers] know the truth about a problem", while other stakeholders "do not, and obstruct the solutions in different ways" (Hillmo quoted in Guy and Farmer, 2000; Trebilcock, 2009). Hobbs *et al.* (2003) aimed to tackle this disparity in the successful use of such tools, identifying barriers to their application by looking at the

structure, nature and quantitative characteristics of the tools themselves, however, the applicability of the tools to the architectural design process, or the creative process used by architects in project development, was not addressed.

An example of this dynamic in a design process can be found in case study I (the Rose), where the design team made extensive use of energy modeling and thermodynamic simulations; when time came to make hard decisions about commissioning some of the mechanical equipment and wall systems, it was the results of the rigorous design and engineering process, backed up by the energy modeling data, that enabled the team to go beyond the tipping point needed to authorize the commissioning of these costly systems (MSR, 2017).

In the next section, two established approaches to integrated design process are presented. Both are similar in their rationale and scope, and are essentially identical for the purposes of this research, the main difference between them being a contractual element in IPD.

2.9.1. Leading sustainable design frameworks - overview

Social equity considerations are slowly emerging in discussions around green building practices, and several design-assisting frameworks have begun addressing the issue of social equity within their guidelines and supporting material. USGBC's 2015 decision to release new social equity LEED credits marks an important step toward fulfilling its organizational goal of using green buildings to enhance the lives of all people in all buildings (USGBC.org, 2016).

While there are dozens of rating systems for evaluation of sustainable building and design in worldwide use, each with a specific locality, agenda, focus, and affiliation, the several of them stand out from the rest for their approach, breadth and

prominence in the market. Three such systems (or programs) were studied for the purpose of this literature review, and were chosen for their similar structure, approach and foci. These are **LEED**, **Living Building Challenge**, or LBC (both US-based frameworks) and **One Planet Living** (OPL), a UK-based framework. At their core, all three programs strive to deliver more sustainable, better-performing buildings and neighborhoods through detailed design, including strategies like energy and water conservation, proper site orientation, daylighting, indoor air quality, material selection and other factors.

LEED (Leadership in Energy and Environmental Design) was first rating system to gain traction and acclaim both in the U.S. and worldwide, marked by its longstanding presence, national affiliation and wide breadth. To achieve LEED certification, projects must satisfy a series of prerequisites then earn points (or 'credits'). Both prerequisites and credits required for certification vary based on project type, and there are currently five project types with their specific rating guidelines within the LEED system, including **LEED Neighborhood Development**. Although LEED is by far the most widely used green building certification system, it is often criticized for being documentation intensive, time-consuming and costly. The USGBC is often criticized for significantly influencing the market transformation of the building industry toward green building, focusing on the more profitable and marketable avenues within it and neglecting less profitable avenues for advancement of the green building agenda.

The International Living Future Institute created the **Living Building Challenge** (LBC), considered the world's most rigorous sustainability design and performance standard. Using the metaphor of a flower rooted in place, LBC's holistic

design approach entails seven performance categories, or "petals," representing seven aspects of sustainable design: Place, Water, Energy, Health and Happiness, Materials, Equity, and Beauty. Jointly, the petals include a total of 20 imperatives that must be achieved through actual, rather than projected, building performance to achieve certification (living-futures.org., 2016). The imperatives may be administered to different typologies, including buildings (renovation or new construction), infrastructure, landscape, and community development. To qualify as a Living Building, all criteria must be achieved based on metering during the first year of occupation, and there are no "optional credits" as in LEED, with three levels of certification offered (Living Certification, Petal Certification, and Net Zero Energy Certification). Reviewed in this essay is the **Living Community Challenge**.

One Planet Living, the brainchild of UK-based BioRegional, is the final framework to be discussed. This program's strength is the clear communicable objective of all humans living within the earth's carrying capacity. This message originates from the simple observation of society's unsustainable environmental impact on our biosphere, e.g. renewable and nonrenewable resource extraction, land and water pollution, living habitat devastation, and greenhouse gas emissions, with consequent climate change.

OPL cites unsustainable consumption rates of naturally-renewing resources and pollution of forty percent higher than the earth can sustain. Taking ecological footprinting and CO2 emission analysis as headline indicators, it argues that world population, living by Western European or North American living standards, would require the resources and absorption capacity of three to five 'planet earths' to sustain life; in China and South Africa, the overall average is one planet, but this hides the

massive differences in consumption between the rich and poor in these countries (BioRegional.com, 2016). OPL advocates for an acute curbing of global greenhouse gas emissions by 2020, aiming for a minimum 50% annual reduction from 1990 levels by 2050, in order to avoid catastrophic climate change (Ibid, 2016).

Distilled to their cores, each of these three frameworks could be described as:

LEED: minimizing environmental harm, whilst retaining lifestyle patterns;

Living Building Challenge: convivial living through regeneration of natural systems; and

One Planet Living: conscious, healthy urban living patterns within biospheric limit.

It should be noted that all three approaches generally gravitate towards sophisticated technological solutions and systems, rather than giving preference to less consumptive alternatives (e.g. air-handling units rather than passive cooling, chemical graywater-filtration systems instead of 'living machines'), although this approach is more evident with LEED than with the others.

2.9.1.1. Social equity in current sustainable design frameworks

LEED is the longest-standing sustainable design evaluation program, and the most widespread globally. It is also the most literature-intensive. Recent interest in equity and social justice has sparked partnerships with parallel organizations (SEED and Enterprise Green Communities), and adoption of these tools by the design community and stakeholders is slowly emerging. In 2015, **LEED Neighborhood Development** added three new credits to the LEED credit library, which address social equity from the perspective of "everyone who is touched or impacted by a

project - including the building's construction workers, designers, engineers and other project team members; its surrounding community; and those involved in the building's materials supply chain." (USGBC.org, 2016).

Introduction of these credits aims to build on overarching LEED imperatives of enhancing community, social equity, environmental justice and quality of life, and building a greener economy. The credits also help define LEED buildings as truly sustainable and advantageous to all people, especially more vulnerable populations who often have little say in a project's development (Todd and Kaplan, 2016).

The LEED social equity credits are:

- Social Equity within the Project Team
- Social Equity within the Community
- Social Equity within the Supply Chain

The Social Equity within the Project Team credit encourages a project's stakeholders to incorporate social equity into their work practices by treating all project workers fairly (e.g. fair wages, safe and healthy work environments and worker development), and by providing Corporate Sustainability and Social Sustainability reports. The Social Equity within the Community Credit aims to help projects address disparities in access and social inequities within a project's own community by addressing identified needs and disparities in the community surrounding the project. It outlines a process of engagement with community stakeholders, focusing on vulnerable populations to understand these needs, and also allows certification through established third-party programs such as the SEED Evaluator or Enterprise Green Communities (Ibid, 2016). Finally, the Social Equity

within the Supply Chain credit encourages social equity for those involved in the production of materials and products for our buildings, from raw materials extraction through final assembly. It rewards the establishment of supplier assessments, or scorecards, as well as the creation of Supplier Codes of Conduct that address basic human rights (USGBC.org, 2016).

In sum, LEED ND's approach to social equity is characterized by the same cerebral approach as LEED itself: strategies towards a socially equitable project are pinpointed and quantified, rather than providing an overall ethos or attitude to which design professionals and clients can revert to, as required per each project's needs. The program's rigidity often removes the responsibility from the designers, making it difficult to conform to the changing needs of particular projects. USGBC's credit-based approach is hailed as contributing to a "collaborative and representative, global green building rating system, one that meets the needs of diverse populations, cultures and environments." (USGBC.org, 2016). Yet, the logic behind the LEED rating system (credits are optional and substitute-able) makes for a weaker social equity design and evaluation tool.

Living Community Challenge's Equity Petal aims to guide stakeholders towards creating a sense of community for people of all ages and walks of life, to live with dignity, creating a global incentive towards a positive future for all inhabitants of all nations. The living building challenge claims that empowerment and belonging to community are part of the holistic approach to design, and these can minimize many of the social and ecological problems we are witnessing today (Du Plessis, 2015).

The equity guidelines tackle the dichotomous mindset of 'us versus them', which divides many nations, regions, and cities, and alienates different social groups

from one another, by challenging current ownership notions of public space and nature. Examples include private beaches, ownership of natural resources (such as water rights) and gated communities. LCC addresses these notions by changing the way development is considered, privileging the citizen over the consumer, yet this point is formidable given today's prevalent Western ownership model.

Imperatives of LBC's equity pedal include:

• Human and humane scale

• Democracy and social justice

• Universal access to nature and Place

• Equitable investment and Just organizations

Human Scale simply advocates planning for people rather than for cars or for industry: it provides design guidelines specifying surface cover, urban component proportions and street layout concurrent with walkable neighborhoods. The democracy and social justice guidelines call for the benefits of all stakeholders from the project, as well as accessibility within the project site, both physical and economic. Rights to nature protect natural capital around the site, as well as defining equitable access to clean air, sunlight and clean water. Equitable investment entails a donation of a minimum of 0.5% of a project's cost to a charitable cause, and Just organizations include transparency in business practices, which can be achieved by using an evaluation tool developed for this purpose, called JUST (justorganizations.com, 2016).

In all, Living Community Challenge demonstrates a more deeper, more rounded understanding of sustainable building and living, discussing the 'spirit' of

sustainability, aiming to build regenerative spaces rather than minimize harm. The fact that three of seven 'petals' are devoted to Health and Happiness, Equity and Beauty is a case in point for this holistic, ecological worldview, in which social impacts and environmental impacts are entwined. LBC emphasizes a more total approach to sustainable design, with its 'all or nothing' Living Building certification. LBC provides direct, performative guidelines towards access to natural elements, both dynamic (sunlight, fresh air) and stationary (fresh water, waterways, green space); this approach is repeated for other, more defined aspects of the project. Overall, the essence of LBC's program is demanding, authoritarian and performative. It provides the designers with the faith and confidence to apply the framework to the project in hand, trusting them to step up to the challenge.

One Planet Living's approach to social equity is not metric-driven like LEED, or process-driven like LBC; instead, it is site-specific and as such, very much goal-oriented. For example, for Zibi, a Canadian community in development, the overall approach includes "a mixed, integrated, socioeconomic community with a variety of housing units available for prospective renters / buyers within all socioeconomic levels" (bioregional.com, 2016). Following a rigorous analysis of the project's scope, resources and aims, the project team sets specific goals, and identifies a set of key performance indicators, complete with a baseline for each, to measure progress. Specific goals include:

- 7% of housing to be designated affordable housing.
- 20% of residents to be able to spend part of their time working from home or in a local disability - friendly office sharing facilities in the community.
- Precedence to smaller, local, and ethically run businesses with fair and inclusive hiring policies.
- At least 75% of retail space leased to non-franchised tenants.

- By 2020, 70% of residents will be participating in local or Fair Trade programs or purchasing local or Fair Trade products to some extent.
- At least 20% of the value of all food items sold on-site coming from local, organic, or fair trade sources (other than only coffee or chocolate).
- The community will provide opportunities for all its members to democratically participate in governing/managing of Zibi,
- Create a financially viable and socially responsible tourist destination.
- Create economic opportunities for First Nations & youth (bioregional.com, 2016).

One Planet Living's initial approach is somewhat of a mix of the two described previously. OPL uses statistical and analytical tools (ecological footprinting and carbon footprinting) as indicators for environmental sustainability. It advocates per capita 'global fair share' as a target to guide planners and designers in finding solutions. For example, for greenhouse gas emissions, OPL estimates a per-capita sustainable level of 4 tonnes per person per annum by 2020, reducing to 1 tonne per person per annum by 2050 (bioregional.com, 2016). This approach to sustainability is unique in its direct, 'no nonsense' outlook on resource distribution: if we, as an increasing human population have a single 'spaceship earth', required for our continued survival, then we must align our collective actions to the limitations of this 'spaceship' if we wish to preserve its livability.

Unlike other 'do less harm' approaches, which aim to retain a certain standard of living with regard to consumption, energy use and comfort, OPL's point of departure is external to society - it is the carrying capacity of earth and its natural systems, juxtaposed with an increasing global population and an already-degraded biosphere. POL's uniquely direct approach sets goals as starting points, *working its way back* from them, creating baselines for comparison and key indicators for progress evaluation. While these goals are definite, they encompass critical parts of

the project, leaving most of the decisions to the project design team. To an extent, this approach takes the best of both previous approaches: it sets the overall 'tone' for the project, without resorting to point-counting, having faith in the project design professionals to adhere to the agreed goals, yet offers the flexibility to interpret the overall aims as they see fit.

In sum, all three frameworks presented above acknowledge to the idea of social equity quite thoroughly; each of them views the issue differently, and addresses it through different tactics, given differences in origin, tenure, scope and their target audience. Disecting these frameworks, and their approaches to social equity, has been helpful in unwrapping the design processes of the three case studies, and understanding the motivations for design decisions made by their teams to complete their projects successfully.

2.9.2. Integration in sustainable design practice: process versus delivery

In the most basic sense, integrated design is based on a collaborative effort of a design team, aiming to optimize the project as a whole rather than individual parts of it; this team typically includes the client or developer, the architect, other designers and engineers, the general contractor and other trade partners (Heidemann & Gehbauer, 2010).

It is important to note that the term 'integration' is used in two very similar, yet different, contexts: **integrated design process (IDP)** applies to the process of conceptualizing, designing and engineering architectural projects, while **integrated project delivery (IPD)** is a delivery approach that builds on the principles of IDP, but includes a contractual element between the architects and engineers, the owner or

developer, and the contractor or firm executing the project. Such a contractual agreement typically states the three parties' commitment to the process, describes their respective responsibilities, obligating them to work collaboratively, outlines their shared profits and limits their ability to sue one another in case of major disagreement (AIA & Hill, 2007; Haubjerg, 2010).

With integrated design, designers consider the project's entirety, in context, as a unified whole, using environmental, social, economic and other contextual variables as problem-solving tools. More than conventional design process, the integrated design process requires a delicate balance between these considerations and greater sensitivity to their indirect implications to produce a successful project. This process requires collaboration and communication among stakeholders, as well as a solid understanding of each team member's challenges and responsibilities by their peers; also, it requires the team members to acknowledge and understand the interrelated nature of their respective design decisions, including spatial elements, energy strategies, mechanical systems, material specification etc. In sum, the integrated design approach requires all team-members to consider the project holistically rather than concentrate on their individual contributions or interests (Keeler & Burke, 2009).

One of the first definitions of the integrated design processes was offered at the National Workshop on Integrated Design Process in Canada in 2001:

"**The Integrated Design Process (IDP)** is a method for realizing high performance buildings [through] a collaborative process that focuses on the design, construction, operation and occupancy of a building over its complete life-cycle. The IDP is designed to allow the client and other stakeholders to develop and realize clearly defined and challenging functional, environmental and economic goals and

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objectives. The IDP requires a multidisciplinary design team that includes or acquires the skills required to address all design issues flowing from the objectives. The IDP process proceeds from whole building system strategies, working through increasing levels of specificity, to realize more optimally integrated solutions". (Larson, 2002)

Larson (2002) suggests that the main components of the Integrated Design Process are the following:

1. Interdisciplinary work between designers, engineers, operations people, costing specialists, *future occupants* and *other significant actors* participating at the beginning of the design process;
2. The addition of a specialist in the field of sustainability, energy performance and comfort;
3. No separation between individual building systems in the total budget; Budget restrictions are set at the whole-building level;
4. Discussion of the importance of performance issues, and a consensus on building performance between the client and the architects;
5. Clear definition of the performance goals and strategies that will be updated throughout the design process;
6. The addition of subject specialists, such as daylighting, for specific consultations with the design team;
7. Development of various designs alternatives that will be tested with energy simulation, to provide evidence-based design choices. (Larson, 2002; my italics).

Kow & Grondzik (2007), state that IDP is "knowledge applied in parallel", which refers to a simultaneous interaction among stakeholders, while conventional design is "knowledge applied in series", which is a linear sequence of steps rather than simultaneous activities. According to the authors, the steps towards an IDP are:

- Establishing commitment;
- Team formation and setting goals;
- Information gathering;

- Conceptual/schematic design;
- Testing of design alternatives;
- Design development;
- Construction; and
- Assessment/verification (Facility Management and operations of the building) (Ibid, 2001).

Integrated Project Delivery (IPD) essentially entails the same principles in IDP as discussed above, yet with an addition of a contractual delivery model, based on agreements on responsibilities for each stakeholder in every phase of the project's design process. The main difference between IDP and Integrated Project Delivery is in the inclusion of an <u>obligating agreement</u> between the stakeholders involved. An IDP does not necessarily bind stakeholders into risk sharing, benefits or liability issues. The collaborative environment and common goals of high performance buildings are shared in both concepts, but IPD goes one step further in terms of creating the legal framework for the team. In short, IDP is possible without IPD, but an IPD is not possible without IDP (AIA and Hill, 2007; Stipo, 2013).

The AIA Integrated Project Delivery guide lists the most common models for project delivery, ranking them from <u>worst to best</u> according to the IPD principles (AIA & Hill, 2007): Design-Bid-Build (also called 'Hard-Bid'); Multiple Prime;Design Build under Best Value Selection with Bridging; Construction Manager at Risk; Design-Build under Best Value Selection with Criteria; Design-Build under Qualification Based Selection; and finally, Integrated Project Delivery.

The AIA Integrated Project Delivery guide outlines these principles for successful application of IPD methodology:

- Mutual respect and trust;

- Mutual benefit and reward (sharing risks);
- Collaborative innovation and decision making;
- Early involvement of key participants;
- Early goal definition;
- Intensified planning;
- Open and enhanced communication;
- Appropriate technology (BIM);
- Organization and leadership.

"Mutual respect and trust" represents the commitment of the team to work collaboratively towards the common goal. "Mutual benefits and rewards" means that all stakeholders will share the savings, bonuses and risks. "Collaborative innovation and decision making" is an interdisciplinary effort to achieve the best possible outcome puts the focus on the project rather than the protection of self-interest. Any un-collaborative team member should be eliminated from the team. "Early involvement of key participants" means that the three main stakeholders (owner, designer and constructor) will be actively involved in the decision making of the design and construction process since the very beginning. However, some practices treat this guideline liberally, using it as grounds to introduce the occupants into the design process during the initial design phases, or throughout the design process. "Early goal definition and intensified planning" relates to the former idea of early involvement, where the entire team will define the goals for the project, in every aspect. "Open and enhanced communication" stresses the importance of Web-based or BIM transparency for information management during the design process, towards an open, direct and honest communication. "Appropriate technology" relates to the use of open standards (such as BIM tools) to solve interoperability issues that may arise. "Organization and leadership" looks for specific roles in leadership (champions) by members of the team, to improve communication and reduce risks.

One of the best-known advocates for integrated design, coming from the core of the design and construction industry in North America, is architect Patrick MacLeamy, former CEO of HOK - a global architecture, engineering, and planning firm. MacLeamy has spoken widely about the need to embrace new technologies and collaboration tools, in order to improve the quality and efficiency of the architectural design process (namely BIM). MacLeamy presented a graphic representation of the time-effort distribution tradeoffs in the industry known as the MacLeamy Curve, to illustrate the mounting costs of design changes in the traditional design process, versus those of an integrated, information-led design process. This illustration and MacLeamy's advocacy for BIM and an integrated, efficient design process remain some of the most often cited sources for a streamlined design process in the industry.
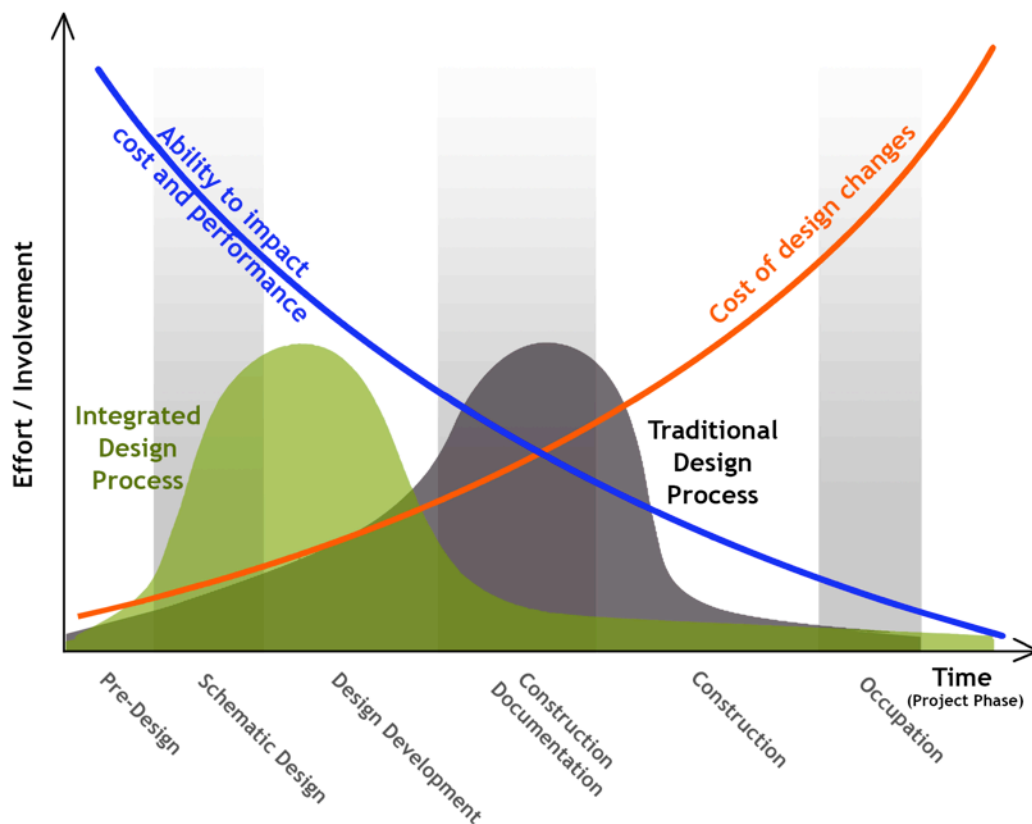
Figure 0.5The MacLeamy curve, adapted from www.HOK.com

2.9.3. Integrated design in practice

With or without a binding delivery agreement, integrated design is a collaborative effort of the project team in all stages of design, construction, delivery and often operations. The team's work is, by definition, cooperative, transparent and based on mutual trust rather than on competition, in a joint effort to achieve a high-performing building fit for its programme, scope and urban setting.

In the traditional design-bid-build approach, an architect designs a building to the client's specification, with input from engineers and consultants, followed by a bidding process, in which contractors bid for the opportunity to construct the building. The successful bidder oversees the construction, and building operators manage it. This traditional, 'assembly-line' approach is typically fragmented and compartmentalized, with each professional addressing their own 'piece' of the design undertaking; Through this approach, engineering or design flaws can become apparent during the construction phase, leading to 'change orders'; addressing such flaws can de-rail the construction schedule and add financial pressure which often leads the project to fall short of its original performance and sustainability goals.

Salmon (2008) summarizes the differences between an integrated design approach and the traditional approach, or what he terms 'the collaborative and the combative mindsets' (Salmon, 2008 quoted in Stewart, 2015):

Collaborative Agreements:	Traditional Contracts:
Promote Flexibility	Promote Rules
Target Cost Estimate	Fixed Price
Target Cost Adjustments	Change Orders
Waive Liability Claims	Shift Liability Claims
Serves as a Constitution	A Draconian Code
Guides Behavior	Dictates Behavior
Reward Collaboration	Punishes Collaboration (Salmon, 2008)

Table 2.1: Comparison between a traditional and an integrative design approach

An **integrated design process (IDP),** however, differs from the traditional design and construction process in its holistic approach and collaborative method. The owner, the developer, the design team, the general contractor and often the building operator collaborate from conception to completion of the project. Ideally, even before the design stage, these key stakeholders agree on shared values, goals and technical specifications for the project. They agree on a methodology by which information is shared among the group members, given their common interest in the project's success. This methodology creates mutual trust, and a professional conduct in which each stakeholder pursues the common interest, instead of trying to maximize their personal gain and minimize costs. Often, the stakeholders develop a common business model and, through IDP, a common contract in which they all share both responsibilities and rewards for success. The result is a project that is likely to run more efficiently and have a lower environmental impact.

Integrated design represents the level of synergy, collaboration, and sharing of information required to achieve high-performing, ecologically and socially sustainable architecture. The integrated design process is collaborative by nature,

drawing ideas and innovation from all disciplines: energy and building science, architecture and construction expertise, site and community contextualization, and social and behavioral sciences. It is often said that such holistically-designed buildings demonstrate the balance of art and science: elegant and poetic, but also high-performing, following data-driven targets, and tailor-made to its site and community.

In the context of this dissertation, buildings that are designed through an integrated process demonstrate a progressive application of the triple bottom line approach: they are extremely conscious environmentally, regenerative rather than simply reducing harm, sensitive to their site and its unique natural attributes, and are high-performing in their energy and resource use; as a consequence, they prosper economically due to significant energy reductions and added market value; finally, these buildings enhance human wellbeing by creating healthy interior spaces, also revitalizing communities by creating highly contextualized, 'people-friendly' public spaces that encourage citizen cooperation and community building.

2.9.3.1. Integrated design and delivery process

An old saying in the architecture and design sector is "we can design it well, fast or cheap; but you can pick only two". This saying (sometimes referred to in business management as *The Iron Triangle*) embodies the dynamics among these three competing attributes necessary to complete a project: Higher quality will require more time, expertise and costs, so less time would mean higher costs to keep the quality constant, otherwise it will erode the quality of design work. The same balance applies to the other constraints, respectively (Figure 2.7).
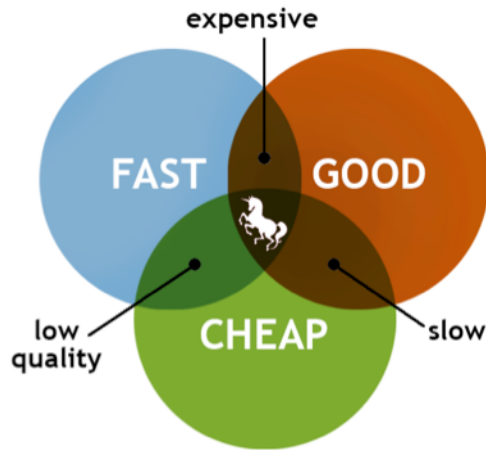
In conventional design-bid-build projects, the owner or developer tends to choose cost and schedule as the drivers for project procurement of a pre-determined programme and scope, hoping to get the best quality they can get within these parameters (Hootman, 2012). Sustainable projects typically add a fourth driver, **performance**, to the matrix of objectives and considerations (Figure 2.8).

Conventional management of objectives   Integrated management of objectives
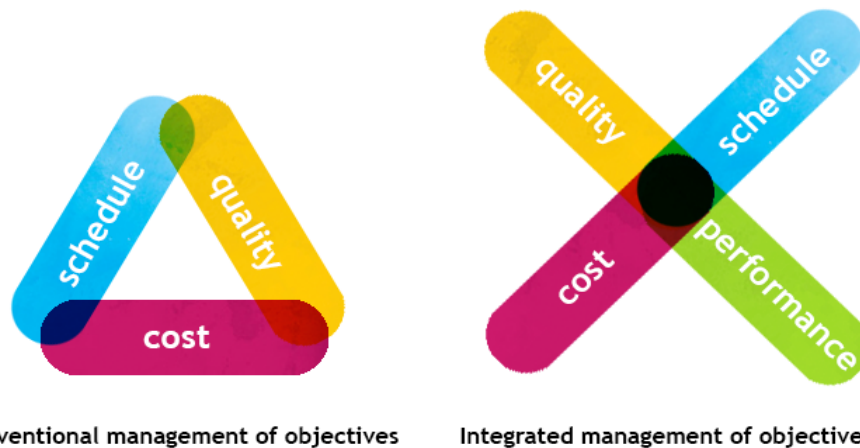
Figure 0.7 Managing project objectives (Hootman, 2012)

This diagram illustrates the difference in approach between the conventional project objective 'triangle' and the integrated project objective 'spoke and hub': procuring and delivering a sustainable, high-performing building requires prioritizing

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building performance so that it is on par with cost, schedule, and quality as drivers for the project (Ibid, 2012; Sharifi, 2013). An integrated design and delivery process is pivotal for ensuring that all four are equally influential when making decisions about the project.

Inclusion of the performance component in the project agenda has profound effects on the design process, on two levels: (i) achieving pre-defined performance goals (e.g. Net Zero energy or PassiveHouse, as illustrated in one of the case studies presented in this dissertation) typically requires a multidisciplinary design team and an integrated design process, and (ii) the design of high-performing buildings entails closer involvement of the designers, from conception through construction and building occupation, involving building operation, active resident education and allowing for user feedback. Unlike traditional design-bid-build practices, where designer involvement is usually phased out with the submittal of construction documents, a high-performing project demands continuous designer involvement throughout construction and occupation, for successful operation. Figure 2.9 illustrates the differences among these delivery approaches:
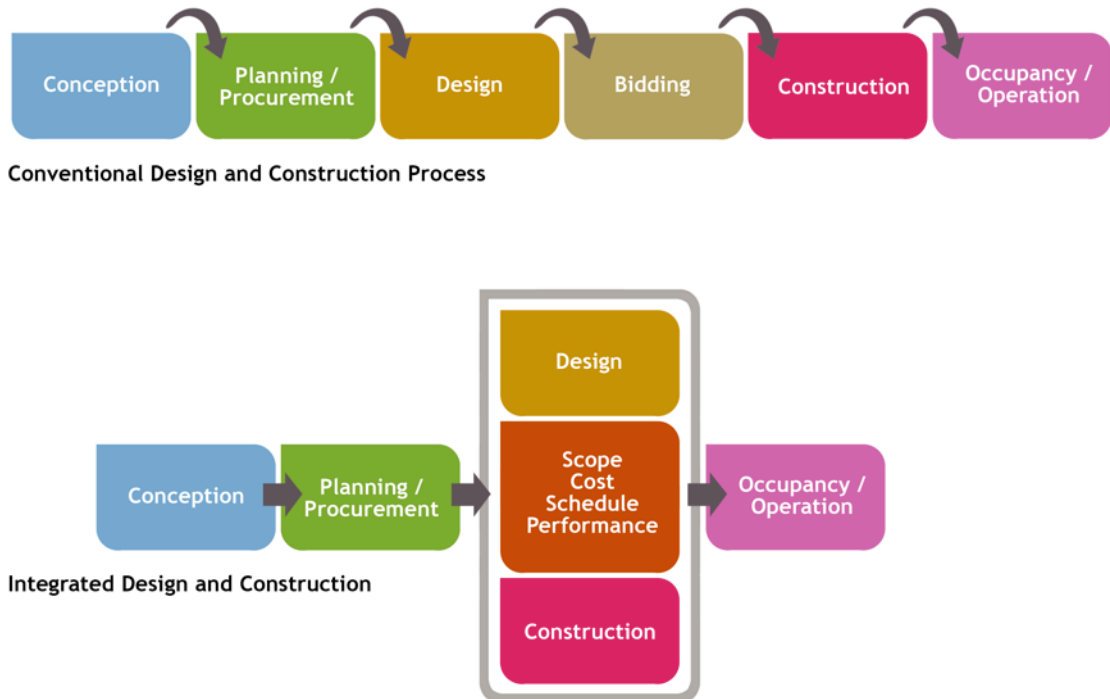
Figure 0.8 Conventional versus Integrated Design and Construction Process (adapted from Busby Perkins+Will & Stantec Consulting Ltd. (2007)

2.9.3.2. Project delivery phases

A conventional design-bid-build delivery process typically includes predesign, schematic design, design development, construction documentation, bidding and negotiations and construction phases (AIA, 2007; Hootman, 2012). The delivery process of an integrated design project differs from conventional delivery process, *regardless* of a contractual aspect of teamwork (as demonstrated in case study I, the Rose by MSR, in which the client and design team worked in *without* the complete legal aspect of a formal IPD process; see chapter 4). Contrary to conventional delivery process, which is linear and sequentially regimented, the phases of an integrated project are typically more interconnected and fluid, resulting in many potential overlaps where one activity continues while the next activity begins. Also, a

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conventional process considers the construction the peak (or realization) of the process, while the integrated process considers the occupancy or operation as its conclusion, which is considered a fertile ground for continued learning and improvement for the following projects (AIA & Hill, 2007; Hootman, 2012).

Broadly speaking, an integrated design and / or delivery project typically entails a progression through project definition and conception, an exploration phase, a design phase, a construction phase and, finally, an occupancy and operation phase, which includes evaluation and learning. The **conception** phase includes a landowner or developer approaching a design firm with a need for a new project, an assembly of a design and delivery team and an initial definition of the project needs, scope and goals. The **exploration** phase includes predesign research as done in the conventional process, but adds additional study, research and initial design activity, making the integrated approach a front-loaded process. Any cultural and social research, citizen participation and other community outreach activities typically take place during this phase. It should also be noted that each design practice tweaks this phase with regard to the project, its context and the 'professional DNA' of the practice (for example, this phase includes a 'visioning phase' at MSR and HZA). A **design** phase includes an iterative development of the ideas and approaches determined at the exploration phase, as well as a beginning of documentation production (unlike the conventional process, which sees documentation as a sharp conclusion of the design activity and a 'hand-off' to the contractor). The **construction** phase also differs from the conventional process in that it begins early in the exploration phase, with preconstruction services, and that the information flow between the construction team and the design team continues throughout the construction process. Finally, an **occupation** phase begins with a gradual hand-off to the client or operations company,

involving input from both the construction team and the design team, for performance corroboration, successful maintenance and operation of the building.

Diagram 2.10 demonstrates the differences in approach between conventional and integrated design and delivery methods:
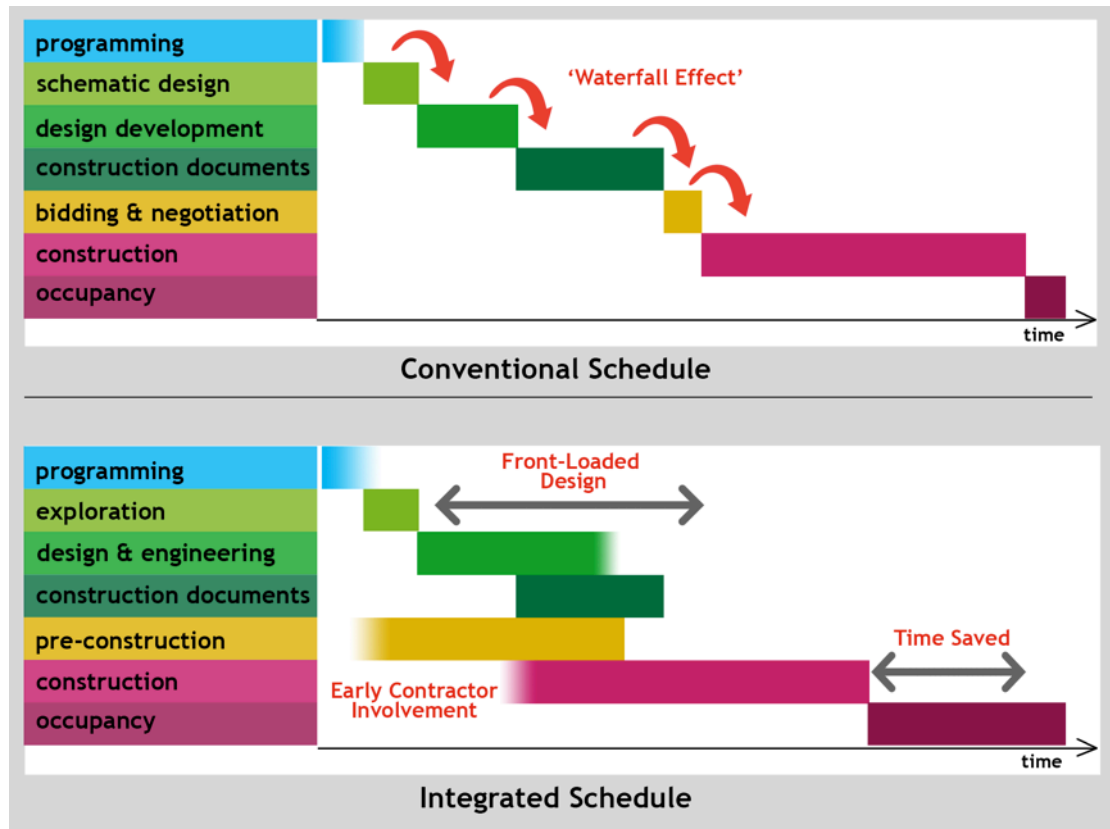
Figure 0.9 Comparison of design and delivery methods (Hootman, 2012)

Conception: A project is typically conceived when a landowner (or developer) expresses a need for a new building. The owner (or contracted consultant) will typically perform some discovery efforts, a feasibility study and due diligence research. The owner will then aim to define the project preliminarily, outlining project scope, architectural programme, budget, schedule and quality, and tentative qualitative and quantitative goals. The owner's personal involvement is critical for the

success of the process, and they are typically the one to define performance goals and define the contractual framework among the design and the construction team.

Building a project team for an integrated design process differs from typical design-bid-build processes in the team's multifaceted nature, and in the level of involvement of the team members throughout the process. In an integrated design process, the team typically includes not only the professionals required to design, engineer and construct the building, but a wide array of stakeholders such as owners, developers, financiers, building management and operation professionals and resident representatives who have an intimate knowledge of the site, the neighborhood and the existing residents of the area. All these stakeholders typically participate in the project's initial design and development meetings and have a say in the development and design process.

Selection of the design team, particularly the architects and engineers (A&Es), is critical in any high-preforming building project, even more so in an integrated design process, due to the heavy involvement required and the immersive nature of the design process. The A&Es can be selected through a competition (like in case study III, Housing for Youth in Furuset), through previous relationship or through qualifications, each of these approaches having its pros and cons. In most cases, a detailed RFP will be drafted, outlining the requirements needed, the performance goals of the project, the contractual relationship among the team members and the delivery method.

Exploration and assessment: The exploration phase begins with setting the project's scope and programmatic objectives in light of the site's attributes and the owner's needs, however in a high-performing projects, another point of departure is

the intended energy performance goal. The team initially establishes the baseline energy use, then sets an energy performance definition, energy use target and methods for its measurement. The site's climate, weather patterns and solar exposure and explored, as are other available resources that may apply for on-site collection. Often, local or contextually similar precedents are studied to determine the best strategy for meeting performance targets, and these are scrutinized against the projected building programme, purpose and occupancy.

Conceptual design: An integrated design process builds upon the critical work done at the exploration stage, and begins with multiple iterations and schematic models that aim to follow the site's constraints and the project goals. Once key strategies for meeting these are identified, the process gradually synthesizes and ideas merge towards an integrated whole (Hootman, 2012). The conceptual design phase is critical in the process since it will serve as the 'backbone' of the design for the entire project.

Design development: The next step in the design process involves studying, testing and evaluation of the initial design through performance simulations such as energy and daylighting modeling, cost analyses, structural studies and constructability assessment. With the project team consisting not only of designers and engineers, but also of construction professionals, the design is judged integratively, in 'real time', against the intended performance goals, and developed in response. The resulting process is essentially a design synthesis, where many ideas and strategies are considered, then gradually eliminated as additional information is generated by the team, until a single strategy or solution are reached. The use of Building Information Modeling (BIM), performance modeling software and the exchange of information

among the team members creates a wealth of information to be considered throughout the decision-making process.

Hootman (2012) suggests viewing these two parallel processes as two opposing pyramids: the design development phase can be seen as an inverted pyramid, where a wide range of ideas and options are considered at the beginning, then slowly synthesize to one singular solution; the decision-making process, on the other hand, can be illustrated as an upright pyramid, in which one key decision exists in the beginning (for example, a certain performance goal), acting as a guide from which all consequent, detailed decisions originate, alongside growth in the amount of information generated (figure 2.11).
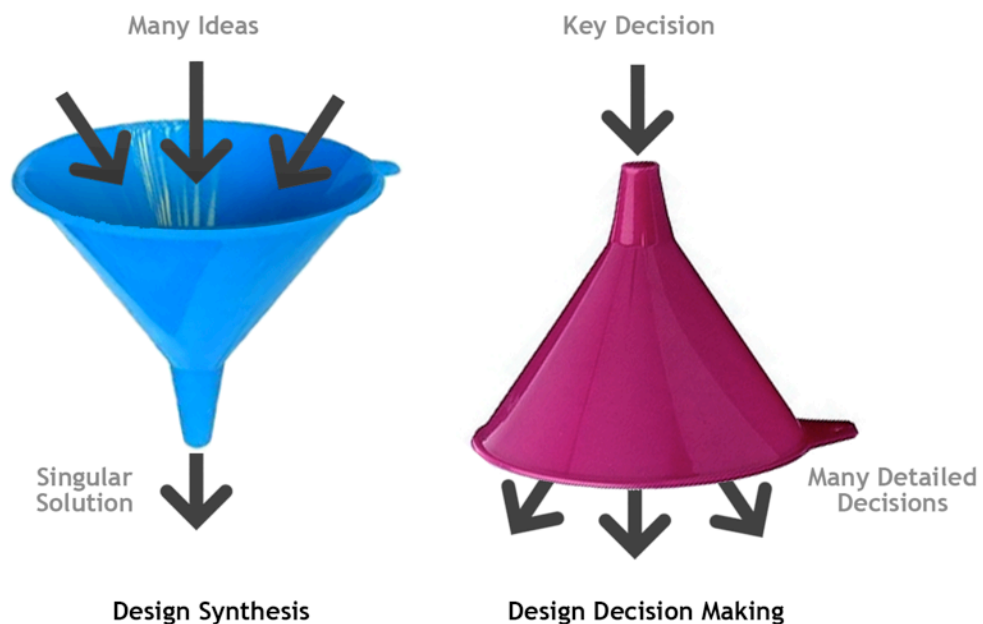
Figure 0.10 Comparison of design and project information flows and decision making (Hootman, 2012)

This is the part of the design process most relevant to this research: in a conventional design process, design development is often linear, fragmented and

compartmentalized, where each step is completed by a design team member without much input from adjacent members or consultants; inversely, an integrated design process (even an informal one, IDP versus IPD; see section 2.9.2.) entails a greater awareness, sharing information, collaboration and shared responsibility among team members towards a common objective, resulting in a more holistic and fit outcome.

Design documentation: The final phase of the design process includes producing a set of documents used to communicate the design intent to the construction team and its affiliates. In an integrated design process, the construction process can take place alongside design, since the design documentation of separate parts of the building can be completed while others are still finalized or in progress (Birkeland, 2012), and so the construction documents and shop drawings can be handed over as they are completed by section or area, rather than wait for completion of all documents and handing them off as a whole, as commonly done in a conventional design process.

Construction: Unlike in a conventional process, which typically approaches a contractor as the design process concludes, the construction professionals in an integrated design process become involved at the exploration phase, with preconstruction - a crucial service intended to inform all team members and assist in decision-making throughout the design and development process. This early engagement ensures both an open communication among the team members, and a collective alignment on the project's performance goals between the owner, contractors and the designers. The preconstruction process also helps the contractor gain a deeper understanding of the project which is essential for effective

communication later on, in the construction phase, between the contractor, the designers and all the trade partners (Hootman, 2012).

An engaged and collaborative construction team is particularly critical in high-performance buildings, due to the impact of building envelope, details, interior materials and mechanical systems on the building's ultimate performance, interior comfort and operation. This close correlation between building quality and performance also requires a smooth flow of information from the design team to the construction team, and vice versa. The construction team is made up of a network of builders, subcontractors, suppliers and vendors, making it critical for the design intent and project targets to be understood and followed throughout this network to obtain the targeted results in quality and performance. Collaboration and sharing of information is also critical with the many trade partners such as mechanical, electrical and lighting systems, building envelope and energy systems.

A final point worth noting is the ambitious, even elitist 'feel' of participation in a high-performing project. These projects are considered in the construction sector as exclusive, and thus viewed by many construction professionals and companies as the apex of their professional abilities. These seasoned professionals realize the tremendous efforts required to successfully complete such projects, and respect the commitment and additional labor put forward by the owner and design team. This point will be discussed and demonstrated when discussing the case studies (chapters, 4, 5, 6).

2.11. The New Role of Designers

The disciplines of architecture and design have traditionally trained individuals to practice in an introvert manner (looking from the inside, out) as opposed to extrovertantly (looking from the outside – in); this notion in architectural practice has been discussed in the literature discussing the nature of the profession, highlighting the reasons for many architects to be generally regarded as introverts (Brown, *et al.* 2010). Some of these reasons include (i) architects' need to listen attentively to clients, thereby attracting people with higher-than-average social sensitivity to the profession; (ii) the practice of performing multiple iterations, necessitating one to spend time alone and reflect; and (iii) the view that creativity usually happens in solitude, although the balance required between isolation and collaboration is mentioned as necessary in a team setting (Ibid, 2010).

The British Design Council (2006) criticized the traditional view of the designer as a 'sole practitioner' in a report in 2006, proclaiming design, its education and its business, although clearly creative, lacks diversity, collaboration platforms, and is therefore ill-equipped to work in increasingly multi-cultural societies and global markets (The British Design Council, 2006). In the 21st century reality of resource and space scarcity, it is crucial for designers to step out of their traditional spaces as service providers, only responsible for site-specific spatial problem solving, and attempt to broaden their design horizons to truly connect with the people they serve – seeing them not as passive clients but as co-creators. As Alastair Fuad-Luke terms it, there is a timely need to *reinterpret* the relationship between the designer and the 'co-creator' - who used to be the 'customer' and then the 'user' (Fuad-Luke 2013). Using the term 'co-creator' signals a shift in the way designers ought to view their target audience (the users of products or residents of buildings, and the larger

public affected externally by these), not as an accepting, faceless public, but as individuals with real insights and ideas that can be valuable in the design process.

Design is gradually becoming an interdisciplinary and collaborative activity, and designers are moving away from being tools of the design development process to being more influential in the process of conceiving design ideas (Brown, 2010). Since the 1990s, alternative design methods such as participatory design and social innovation have emerged with the aim of addressing this need for co-creation. Through these paradigms, designers are realizing that simply delivering 'more buildings' (or more products) is not enough; Instead, they aim to solve larger problems through a wider design agenda, and in so providing a higher quality 'product' to the user through thoughtful consideration of all the 'product's' implications (e.g. social, environmental, transportation, lifestyle). Embracing these methods include participatory ideas, engaging communities and individuals through the design process, accepting them as co-creators and shapers of their destiny. Designers' motivation is driven by satisfying *peoples'* needs, dreams and aspirations - instead of those of the CEO, technologists or business' economic drivers (Sanders, 2000).

At the basis of this approach is the view that in present-day society, design happens everywhere; That we live in a society in which everyone is a designer, and so approaching problems from multiple perspectives, with a wide and flexible approach, ultimately offers solutions from bottom-up processes with great richness (Manzini, 2007; Fuad-Luke, 2007; Walker 2007; Wahl and Baxter, 2008). Such processes require a higher professional maturity from design practitioners, understanding that they are not pushed aside, but rather recognized as facilitators of change and

innovation.

The work of Manzini (2009), and Meroni (2007) provides evidence and context to these approaches: Both researches present detailed case studies were designers become *'facilitators of solution provisions'* through their capacity to facilitate new visions, to initiate strategies (for example through the development of tools), to elucidate visions and transform them into real, efficient and accessible sustainable solutions, designers help to understand, and above all, inspire and stimulate these new forms of designing (Escobar-Tello, 2011). Designers become agents of change (Fuad-Luke, 2009) and transdisciplinary integrators that "contribute to the emergence of collective conventions and shared practices" (Schatzki 2002, in Shove *et al*., 2007).

2.12 Participatory Design

From a design perspective, participatory design is rooted in the "democratic design" of the Arts and Crafts movement and the Bauhaus school. Instead of designing for people from an elitist, authoritarian position, designers within the participatory design convention involve the people concerned and design with them, starting from their own needs, experiences, and desires.

In the larger sense, participatory design originates from the social, political, and civil rights movements in the 1960s and 1970s when people "demanded an increased say in the decisions that affected many different aspects of their lives" (Robertson & Simonsen 2013). Influenced by these movements, designers began to claim, "if we are to design the futures we wish to live, then those whose futures are affected must actively participate in the design process" (ibid, 2013). Robertson and Simonsen define Participatory Design as:

"A process of investigating, understanding, reflecting upon, establishing, developing, and supporting mutual learning between multiple participants in collective 'reflection-in-action.' The participants typically undertake two roles of users and designers, where the designers strive to learn the realities of the users' situation while the users strive to articulate their desired aims and learn appropriate technological means to obtain them" (ibid, 2013).

Mutual learning between the participants in a collective design process is considered a cornerstone of Participatory Design (Kensing & Greenbaum 2013). According to Robertson and Simonsen (2013), the two roles of users and designers reflect two fundamental aspects of participatory design.

In the context of this dissertation, participatory design is process-focused design approach, which collaboratively engages the stakeholder community (e.g. occupants, employees, owners, customers and other citizen members of the local community) of a built-environment project, seeking to gain design insight. In the fields of the built environment and sustainability, participatory design (also termed co-operative design, or co-design) is a methodology used to ensure that a project satisfies a community's needs on programmatic, distinctive, cultural and emotional levels. Other tangent, documented design approaches similar to participatory design include design for social impact, consensus design, inclusive design, community-led design, democratic design and public interest design (Walker, 2013), however for the purposes of this review, participation design will be highlighted as it can be seen as an overarching paradigm for the others.

Municipal planners and officials sometimes employ some elements of participatory design, since public participation in local decision-making is considered important to tap local knowledge, to allow local constituencies to shape their own future, and to foster a sense of stewardship and interdependence (Wheeler, 2013). Known as civic engagement, this process, while well structured and researched, cannot be compared to participatory design for substantial differences in theory, methodology, depth, breadth and expected outcomes.

As described before, participatory design entails two key players, the facilitators (or coordinators), and the participants. The dynamic between the two can be applied in more than one way, from solving an immediate practical problem encountered in a design context, to wanting to answer some wide-ranging philosophical questions about the nature of human activity in general (Segalowitz &

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Brereton 2009). Within the literature, several definitions of what constitutes a participatory design process, or program of research, have been discussed. Participatory design projects often focus on the specific challenges presented in real world projects, such as the specific role of participation, proposing specific project techniques and styles of project management, or dealing with particular individuals and situations that arise within a given case study (Carmel *et al*, 1993).

As a design methodology (rather than as a research methodology), participatory design firstly entails a deep commitment to community engagement on the designers' part, acknowledging its' collective insight and firsthand understanding of both issues and context, incorporating these into the design process by means of specific methodologies for both data collection, analysis and processing, and for prioritization and eventual synthesis and implementation.

This review of the literature on participatory design focused on framework, rather than theory or methodology, in an attempt to find commonalities among the sources and authors. Among the sources reviewed, several central themes include:

- Communication between facilitators (designers) and participants (stakeholders) was stressed as an imperative by all sources: from the initial contact between the two, the manner of approach and the disclosure of the motives for approach; specific stress was placed on the setting, even time of day and location of the initial contact;

- Shared knowledge among the facilitators, to ensure continuity in approach and methodology, and build case-based protocols for practice;

- Process disclosure and alignment of expectations between facilitators and stakeholders, with regard to the level of involvement of the stakeholders;

- Surveying and data gathering;

- Cultural competency of the facilitators, particularly ensuring minimized cultural bias on behalf of both parties (Bell, 2004) discusses why this is nearly impossible, given the power-trust dynamism between facilitators and stakeholders, particularly in projects undertaken in developing countries);

- A shared decision-making process, in which the stakeholders' contextual knowledge of the site, practical community needs and priorities are taken at face value, while the designers' integrity and abilities in translating these into a sound programmatic plan are trusted and eventually accepted;

- Ethics are discussed in some sources, particularly in cases of public interest design projects, where the designers are often employed by NGOs or are working pro-bono or for reduced compensation;

- Evaluation of impact is a key element in participatory design: unlike conventional architectural commissions, where the designers' task is seen as complete once the project has been 'handed off' to the client, participatory design projects usually carry some involvement of the design team post-habitation, ensuring that the product has met the community's needs, and helping with adjustments to new evolving needs (Anderson, 2014).

In sum, participatory design techniques are described as a potentially useful tool for designers, enabling the inclusion of contextual knowledge from local stakeholders. This process provides proven added value to the design process, incorporating identification of needs and values, articulation of community goals and evaluation of impacts. Participatory design fits comfortably with the philosophy of regenerative design: since participatory design addresses real needs of citizens and incorporates multiple viewpoints and agendas (Fuad-Luke, 2013), it is bound to bring

forth a richer and more balanced picture of the given design challenge, thereby enabling a systemic approach to issues at hand; the local knowledge and insights can impact the design outcomes favorably, having influenced the agenda of the design process to include the issues that matter most to the local citizens. Moreover, a local project executed through a participatory design process is bound to produce a deeper sense of ownership for the community, and thus ensure citizen involvement and caretaking in the future.

Chapter 3: Research methodology and design

This section will discuss the research approach and methodology used throughout this study in order to answer the research questions and meet the thesis objectives, as outlined in chapter 1 (introduction). It will introduce and discuss the research aims and purpose, case study methodology and grounded theory and the methods used to collect and analyze the data required for answering the research questions.

This research sets out to explore the motivations, actions and conditions necessary for design professionals to pursue and execute ecologically and socially sustainable building projects. Using a combined case study and grounded theory approach, and analyzing practice-based data, the research will develop a framework for the application of a more inclusive design process that outlines how architects can better integrate these environmental and social issues in practice. The offered framework will not be rigid or prescriptive in nature, but rather a narrative and open path, given the unique nature of the approach in question.

Research is a process that involves finding, gathering, and analyzing information of the world we live in, and which, in the end, will contribute to engender new knowledge (Robson, 2002; Davies, 2007). Different methodologies can be used to carry out research. While the discipline, its field of interest and scope play an important role in defining it, however, the research questions of the enquiry are major factors in deciding the nature and data collection techniques used. Research can be done in 'closed systems' where externalities are controlled (i.e. laboratory research) or it can be part of an 'open system' where "the situation is messy, uncontrolled, and complex" (Robson, 2002). The nature of this study is a typical 'open system', generally known as Social Research or Real World Research (Babie, 1990), which

correlates with a qualitative research approach. This approach is known to be non-linear, with no clearly defined objective at the beginning of the process, and the very act of researching may form or inform the fundamental research questions (Robson, 2002).

3.1 Research aims:

(i) To explore the role of existing process-oriented or methodological tools for the integration of environmental sustainability and social inclusion in the design process;

(ii) To outline the position of the architect in such inclusive design processes, mapping the dynamics of interdisciplinary work between the architect and other design and development professionals;

(iii) To explore the motivations for initiating and pursuing such projects;

(iv) To explore other influential factors that contribute to successful execution of architectural projects applying holistic design processes.

This research will aim to address these aims by 'telling the stories' of the selected projects, charting the path of their design processes with regard to the criteria described. This narrative approach is based on a naturalistic or constructivist system of inquiry, in which the basic ontological premise recognizes that there are multiple, socially constructed realities (Groat & Wang, 2002). In this case, it recognizes the complexity, uniqueness and contextual nature of the design process *de facto*. The naturalistic approach also recognizes that it is neither possible, nor necessarily desirable, to establish a value-free objectivity; so it is important to acknowledge the

role that interpretation will have played in reporting the findings of this study (Merriam, 1988).

Given the emergent nature of the described phenomenon, this research will adopt an inductive path, making few assumptions at the outset and remain as 'open' as possible throughout the processes of data collection and analysis. This approach lends itself to grounded theory (Glaser and Strauss, 1967). This method was selected for explaining how this emerging idea manifests itself in practice. Grounded theory is described later in this section.

To address these questions, this research will employ a combined approach of grounded theory and case studies research. Within the qualitative research paradigm, the case studies approach refers to the exploration of a case (or multiple cases) over time, through detailed data collection involving multiple sources of information, rich in context (Yin, 2003), such as frontal interviews.

3.2 Case study approach and methodology

This section will explain why a case study approach was chosen for this research; also, it will summarize several issues arising in the case study literature; finally, it will explain how the cases were selected, and outline the sources of information within them.

The case study approach was selected for this research for several reasons:

(i) The literature review found limited research addressing the dual design approach of rigorous environmental and social sensitivity, making an evidence-based data collection approach difficult and ineffective;

(ii) The research questions are process-focused, seeking to understand a relatively new phenomenon through an exploratory approach, for which a case-study approach is considered most suitable (Patton, 2002; Yin, 2003);

(iii) This approach is based on systems-thinking methodology which explores the key factors influencing the design process, decision-making within architectural practice *and* the implications of these factors and decisions on the outcome of the design process;

(iv) Such questions of 'how' and 'why' are considered to be particularly fitting for a case-study approach (Yin, 2003) since they seek to observe and understand phenomena (seeking *depth*) rather than seek to generalize through a large data-set (seeking *breadth*), better served through a survey approach (Babie, 1990);

(v) Finally, a case-study approach offered the opportunity for observing a larger number of different process applications and actions, and thus makes more generalizable conclusions (Flyvbjerg, 2006; Patton, 2002).

Focusing on the design process of each project, this approach aims to help identify the conditions, relationships, competencies, methodologies, and mechanisms (both formal and informal) that contribute to a successful project in the context presented. These case studies aim to create a baseline of existing best practices in the design industry as well as identify a framework for the application of these practices.

This approach originates in the desire to understand complex social phenomena, and is thus used to examine events, processes or dynamics in group or organizational settings. Yin tries to individualize the method of case studies from surveys, experiments and history, noting that a case study is when "a 'how' or 'why' question is being asked about a contemporary set of events, over which the investigator has little or no control" (Yin 2003). Yin also notes that a case study approach allows investigators to "preserve the holistic and meaningful characteristics of real-life events" (Ibid, 2003), making this approach quite suitable for capturing the unique character of the design process. In this context, the research aims to understand the specific phenomenon of integration of wider sustainability issues in the architectural design process. Yin also notes that case study methodology is particularly fit for "real life event, since the investigator is able to retain [their] holistic and meaningful characteristics" (Ibid, 2003), and that case studies are "particularly useful when the boundaries between the phenomenon and the context are not clearly evident", a fit description for the dynamics of the architectural design process, or any creative process, for that matter.

Yin describes using case study research to provide insights towards existing theory, thereby expanding on it and developing it in a desired (often lesser explored) direction. Yin explains the type of generalization that one would expect to emerge

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from case study research, which is described as quite different than that emerging from experimental or survey research: "… in doing a case study, your goal will be to expand and generalize theories (analytical generalization) and not to enumerate frequencies (statistical generalization)" (Yin, 2003). To apply this idea to the field, researchers would expect to use individual findings from case study research to provide insights towards the wider, more general field, and in so contributing to existing theory.

Flyvbjerg elaborates on the contribution of case studies towards theory, providing this example: "... researchers who have conducted intensive, in-depth case studies, typically report that their preconceived views, assumptions, concepts and hypotheses were wrong, and that the case material has compelled them to revise their hypotheses on essential points (Flyvbjerg, 2006). As such, the outcome of a case study based research is not "rule-based knowledge" but rather "a linking of concepts into process theories based on the observations made of reality" (Ibid, 2006). Through this approach, case studies can address or elucidate causal explanations for phenomena (Yin, 2003).

Eisenhardt (1989) offers a combined grounded theory and case study approach in what she terms "inducting theory using case studies" (Eisenhardt, 1989). Essentially, she describes case study theory building as a "bottom-up approach such that the specifics of data produce the generalizations of theory." (Ibid, 1989). Eisenhardt further describes the process of this process (from case selection, instrument crafting, data analysis and hypothesis shaping to making literary comparisons and reaching 'theoretical saturation').

This research will not attempt to construct a theory given the novelty of the

phenomenon in question and the limited number of cases reviewed; instead, it will produce a conceptual framework for possible practical application of the practices and pre-requisites for the integration of environmental and social ethics in sustainable architectural projects, as well as suggest potential directions for further research on this topic.

3.3 Grounded theory

Grounded Theory (GT) was originally developed by sociologists Glaser and Strauss in 1967 as a method that would permit social scientists to move from data to theory, enabling the formulation of new ideas. These emerging ideas, although context-specific in nature, would be 'grounded' in the data from which they had risen, rather than rely on analytical constructs, categories or variables from pre-existing theories.

This method is characterized by iterative study design, purposeful sampling, and a system of analysis. An iterative study design entails cycles of simultaneous data collection and analysis, where analysis informs the next cycle of data collection (Kennedy & Lingard, 2006). GT involves the progressive identification and integration of categories of meaning from data. It is both the process of category identification and integration (as method) and its product (as theory) (Corbin & Strauss, 1990; Melia, 1996). As a research method, GT provides researchers with guidelines on how to identify categories, (at first descriptive, then analytical), how to create links between categories, and how to build relationships between these. GT as a theory is the end product of this process; it presents researchers with an explanatory framework, which in turn enables the understanding of the phenomenon under investigation (Ibid, 1990; 1996).

A combined approach of grounded theory and case study methodology was chosen for this research. This approach seemed a good fit for the issues in question, given that grounded theory was designed to open up a space for the development of new, contextualized theories from data (Charmaz, 2006; Strauss & Corbin, 1998; Melia, 1996), and has been described in the literature as particularly appropriate for the study of emerging phenomena (Strauss & Corbin, 1998).

However, several authors point out that grounded theory should be used mindfully, and point out its limitations: "The grounded theory approach is designed to develop and integrate a set of ideas and hypotheses in an integrated theory that accounts for behavior in any substantive area" (Lowe, 1996, quoted in Gasson, 2004); "A single grounded theory research study would not be expected to generate formal theory. Formal theory emerges over time, and with reflection. It derives from the conceptual abstraction of a substantive theory across multiple research studies… Over a period of time (often years), enough studies may be conducted to justify the proposal of a formal theory" (Strauss & Corbin, 1998); [Grounded theory] "does not provide deductive validation required to "prove" or to rigorously extend existing theory in positivist terms" (Gasson, 2004).

With the above limitations of grounded theory in mind, the proposed outcome of this study is not a formal theory but a framework, or "a set of ideas and hypotheses" (Lowe, 1996), or "process theories" (Flyvbjerg, 2006), intended to facilitate further research and possible practical application of the actions and conditions necessary for the successful integration of environmental and social ethics in sustainable architectural design.

3.4 Case selection

The case studies presented in this thesis are drawn from the work of three contemporary architectural practices (one in the United States, one in Germany and one in Norway), all considered industry leaders in environmentally sustainable design by the architectural community, as Friedman (2003) suggested "studying… the practice of leading contemporary designers for theory generation" (Friedman, 2003).

Cases were chosen based on their respective relevance and programmatic attributes, as well as on the breadth of data available, mainly protocols of design meetings held over the course of the conceptual, schematic and detailed design phases. This criterion aligns with 'purposeful sampling', widely used in qualitative research for the identification and selection of information-rich cases related to the phenomenon of interest (Palinkas, *et al.*, 2013). Selecting such information-rich cases for study potentially yields "insight and in-depth understanding rather than empirical generalizations" (Patton, 2002).

The case studies were selected with a deliberate international distribution, aiming to disregard cultural and regional commonalities among projects while highlighting professional commonalities derived from architectural and design practices that are independent of geography, language and culture.

The number of cases was selected based on the criteria offered by Eisenhardt (1989), who suggests that a number between 4 and 10 cases is usually fit for theory building research. Fewer than 4 cases makes it difficult to generate theory with much complexity, while more than 10 cases creates problems in coping with the large amount of data (Eisenhardt, 1989). Four cases were initially selected for study, the fourth being BedZED development in South London, England. Although the project held the same attributes as the other three in terms of environmentally sustainable design, programme and progressive social agenda, it proved very difficult to study given that it had been built between 2000-2002. This presented a challenge since most of the design team had already dispersed, and it was difficult to reach the various stakeholders necessary for interviewing (the lead architect and co-developer, Bill

Dunster of ZEDFactory, had built a design office around BedZED's success and was largely unavailable for meeting in person due to frequent travel).

Each case study presents an "embedded unit of analysis" (Yin, 2003), consisting of the design process of a sustainable building designed by the architectural practice in recent years. This unit of analysis provides the relevant information regarding the phenomena in question, and is the focus of the analysis and development of the suggest framework described in earlier sections.

All three cases share similar architectural attributes such as programme and scale, as well as more process-based characteristics such as their development approach and multi-faceted team makeup. More significantly, they share an enlightened, dual-focus design approach committed to addressing both environmental and social issues. However, each project chooses to address different social themes, such as inclusion, stakeholder participation, affordability and community building. Also, each deals with these themes within its unique site and context.

It may be arguable that these cases are comparable given the large number of contextual attributes they each possess (and more so their locations in different countries). Moreover, the definition of 'social equity in design' is subjective, and manifested differently in each of the three cases, or in different proportions in each: it can be applied during the design process itself (e.g. stakeholder participation or community engagement) or in, for example, the project's initial audience and market framing (such as the decision to provide a percentage of apartments at affordable, below market value, rates), or through aspects of a project's character (like the decision to adhere to stringent interior quality materials or health standards).

I argue that these themes can all be considered part of the 'social pillar' of sustainability, since their concern is the social wellbeing of the individual (occupant) or public (community). Moreover, these themes can be seen as social, if not by virtue then by default; their inclusive approach opposes the dominant sustainable design approach, which, for the past decades, has gravitated towards environmental protection and energy conservation through technological and prescriptive measures. Also, these three cases are comparable *despite* their different contexts and locations, backgrounds and cultural settings. We are facing similar urban and social challenges both in Minneapolis, Munich and in Oslo, and designers around the globe are addressing these challenges in innovative ways.

This approach aimed to learn from leading practices of holistic sustainable design, and suggest a framework for their application following the analysis of the case study findings. The research could potentially be repeated using the same methodology of selection of case study projects, and interviewing of other designers to increase the reliability of the conclusions through analysis of additional data from these projects.

3.5 Data collection techniques and procedures

Data was collected through semi-structured interviews with the project architects, other members of the design team as well as other stakeholders and development team members (e.g. developers, engineers, financiers, project managers, community workers, city officials etc.) as needed to obtain a clear picture of the design and decision-making process, as well as through site visits and document collection (e.g. plans, sketches, models, meeting minutes etc.). The principle behind data collection was triangulation, using multiple sources of data for verification. Yin (2003) suggests that "the use of multiple sources of evidence in case studies allows the researcher to address a broader range of issues, and also has the advantage of developing converging lines of inquiry in a process of triangulation" (Yin, 2003). Eisenhardt (1989) suggests that triangulated evidence "provides the ground for emergent theory". The methods used to collect the data were diverse in order to provide multiple sources of evidence: interviews with multiple stakeholders, site observations and collecting various types of documentary documents produces throughout the design and development process. Multiple stakeholder interviews were particularly insightful, since it enabled to learn about the dynamic design and development process from different perspectives, with each interviewee (addressing the same project) sharing a different experience of the same process.

Patton (2002) suggests that the interview is the most important source of information when conducting case study research, enabling the researcher to adopt the interviewee's perspective: "We interview to find out what is in and on someone else's mind, to gather their stories" (Patton, 2002). The initial interviews for each of the case studies were held with a partner architect of the practice, with the aim of understanding the practice's ethos, professional culture, approach to design process

and towards sustainability, to invoke responses to research questions, and to verify the appropriateness of the chosen project as an embedded unit of analysis for the case study. The interviews with members of the design team and other stakeholders, were then used to evoke more process-specific answers to research questions and in so they will enable to chart the design process of the project.

The interviews were semi-structured, with a successive progression through the questions in the interview guide (presented in the Appendix), yet also allowing for free discussion when the interviewee felt the need to do so or to elaborate on a specific issue. This option for free conversation was helpful in exploring topics that later proved valuable (even during the transcription of the interviews). Many of the findings in chapters 4, 5 and 6 contain direct quotes made by the interviewees; all are insightful and convey the project's narrative and the dynamics of the design process better than any rewriting or analysis.

Interviews were held in person and in some cases through VoIP videoconference platforms such as Skype. In both cases, interviews were recorded and transcribed, and the data analyzed. A couple of the interviews for the Furuset project required an interpreter present throughout (the interviewees all spoke English, yet some, particularly the older interviewees, felt they lacked some precise vocabulary or terminology needed to convey their ideas clearly). Apart from the interviews, I collected various types of documents produced throughout the design and development process. These helped map the design process of each architectural project: sketches, drawings, plans, communication among the stakeholders, minutes from meetings, project reports and Excel sheets. Observations during site visits to both the architectural practices and the buildings were documented through notes and

photographs, and above all, helped convey the 'feel' of the project. Site visits typically took place immediately following the initial interviews with the architectural team (typically the same day), but before the rest of the stakeholders and design and development team members were interviewed (sometimes days or even weeks later).

3.6 Analysis strategies

Analysis strategies were based on inductive theory generation from grounded theory and case study research (Gasson, 2004), as well as on development of theory from case studies (Eisenhardt, 1989) and on theory construction in design research (Friedman, 2003). Although this dissertation did not seek to generate a theory, given the novelty of the twofold design agenda and the limited number of cases, these tools were used for analysis and were found to be effective in synthesizing the emerging data:

(i) The first stage involved **within-case analysis**: "this process allows the unique patterns of each case to emerge before investigators push to generalize patterns across cases" (Eisenhardt, 1989). At this stage, each case is treated as a self-contained unit and the critical analysis drew attention to the interrelationships within the unit;

(ii) The second level of analysis, and coupled with within-case analysis, was **cross-case analysis**. Eisenhardt (1989) suggests that the key to high-quality cross-case analysis is to look at the data in different ways;

(iii) The third stage of analysis consists of **triangulating the emergent framework** with the data provided by each case, and adopting a reflexive approach before iterating the study with the next case. This tactic enables the researcher to judge the effectiveness of the research tools (interview questions) and perform iterations as the study progresses.

Eisenhardt also notes that the final product of building theory from case studies could be "concepts, a conceptual framework, propositions or midrange theory that should emerge at the end, not at the beginning, of the project" (Eisenhardt, 1989).

In this dissertation, the final product is a conceptual framework for successful integration of social and environmental sustainability ethics in the architectural design process, with a focus on the role of design process methodologies and interdisciplinary teamwork.

Chapter 4: Case study I – Aeon the Rose

Figure 4.1: The Rose, view from southwest

4.1. Project overview:

Location: Minneapolis, Minnesota, USA

Developer: Aeon; Hope Community (co-developers)

Designers: MSR

Principal-in-charge: Paul C.N. Mellblom, AIA

Project lead designer: Rhys MacPherson

Landscape architect: Emmons & Olivier Resources

General Contractor: Weis Builders Inc.

Engineers: Karges-Faulconbridge Inc.

Energy modeling: The Weidt Group; MSR; Karges-Faulconbridge

Size: 145,000 sf

Partners: PLACE; University of Minnesota Center for Sustainable Building Research (CSBR)

Sustainable design framework: Living Building Challenge (developers did not seek full certification)

Completed: June 2015

Relevance as case study: Mixed-income housing; community-building

The Rose is a mixed-use, mixed-income housing complex located on the corners of Franklin and Portland Avenues in the Ventura Village neighborhood of

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Minneapolis, and considered to be the most sustainable, energy-efficient, materials-healthy affordable-housing project in the United States (Aeon, 2017). The project was realized through a partnership between developers Aeon and Hope Community and includes 43 market-rate apartments and 47 affordable apartments (including several units for formerly homeless residents) in a two-building configuration, ground-floor communal spaces, underground parking, and outdoor spaces designed for a variety of activities. The complex also includes a 5000sf urban garden that offers food production and educational programs for the benefit of the greater neighborhood community.

The Rose exhibits rigorous environmental design in its performance and healthy spaces, coupled with progressive social deliberations in accessibility and community building. In doing so, the project demonstrates the potentialities of leveraging urban infill projects to foster social equity and strengthen local communities, whilst building healthy, holistically sustainable buildings that are inclusive and affordable.

The Rose is a culmination of an ambitious four-year process undertaken by the design and development team, which included deep community listening, creative financing, design to the stringent Living Building Challenge (LBC) standard, and balancing cost effectiveness and replicability in the affordable housing industry with high performance in the harsh climatic conditions of the Twin Cities. Applying the LBC framework in the design process, the designers placed equal emphasis on providing environmental performance, equity and beauty, meeting the 2030 goals for reducing energy 70% below baseline and honoring a state funding mandate of $122/sf as a construction cost target (MSR, n.d.). A third-party evaluation estimated a

payback period for the project of 11.4 years and a 72% reduction in energy use compared with building to code (Brennan, ULI, n.d.). A resident-focused sustainable-living program offers education, engagement, and leadership around sustainable living practices to upkeep these ambitious efficiency targets.

The idea of social equity has also been seminal in the design and development of the project and is evident in all its components: from the location on a former brownfield site in a lower-income neighborhood, to the mix of units, to the integration of affordable and market-rate units within the building, "to the rents, to the budget limitations, to the architectural and mechanical solutions, to the residents, to the engagement of various community members and design professionals in the very early part of design" (MSR, 2016).

The successful integration of these two distinct value-spheres within the project make the Rose exemplary: the successful combination of a 'deep-green' design approach coupled with a balance between affordable and market-rate units in a mixed-income project, the integration of its development with ongoing community-building processes, and its many stakeholders' profound commitment to sharing information and a participatory design approach.

4.1.1. Relevance as a case study

The Rose was selected as a case study for this research due to its unique design approach in combining rigorous sustainability standards alongside its social agenda, but also due to other equally notable attributes: a holistic sustainable design approach, encompassing neighborhood revitalization, environmental performance and healthy interiors; the large number of stakeholders involved; the designers' transparent approach and keenness to share information throughout the design and

development process; the commitment to participatory community design and citizen engagement; and finally, the demonstration that sustainable, net-zero ready housing developments can be built affordably, and rooted within cultural and social contexts. All these make the Rose an exemplary project, demonstrating that even in the affordable housing industry, stakeholders are willing to collaborate towards ambitious environmental and social goals through participation, integration, community engagement and transparency.

The developers of the Rose chose to pursue sustainable building certification through two programs, the Living Building Challenge (LBC) and Enterprise Green Communities Certification (EGCC). Both of these programs require an integrated design process (IDP), which includes the various stakeholders (such as designers, engineers, developers, contractors, financiers etc.) from the very beginning of the design process and through to execution. The LBC framework is described in detail in section 2.9.1.

LBC is a holistic sustainable design framework and matrix intended for the architecture and construction industry, representing the highest standards of sustainable design and construction today, and entailing projects to be both net zero energy and net zero water, and to meet strict materials requirements. LBC criteria are based on seven different petals: Site, Water, Energy, Materials, Beauty, Equity and Health. Each petal requires its own individual certification, and each petal certification must be achieved in the development in order to gain full certification (ILFI, 2013). The Rose is both the first affordable multifamily housing project in the nation to pursue LBC certification, and the first building project to do so in the state of Minnesota.

EGCC is a sustainable development framework intended for developers, investors, builders and policymakers, that focuses on the challenges of affordable housing such as development process, financing, state and local policy and tax assistance and operations. The EGCC is encouraged for Multifamily and Single Family new construction and rehabilitation projects requesting Minnesota Housing financing. EGCC has created a standard that is based on health, energy efficiency, and environmental responsibility, and informs the design, construction, and operation of a development. The EGCC method is based on a point system and promotes an integrated design process throughout the entire lifecycle of the development (Canada Mortgage and Housing Corporation, n.d.).

From an architectural design standpoint, studying this project allows to appreciate the challenges with which the design team was presented, the mechanisms and tactics they used, as well as the compromises they made in response. The network of complex relations, partnerships and decision-making processes existing between National and State policy, developer, architect, contractor, manufacturer and local communities is an important characteristic of the Rose project, particularly given the large number of stakeholders involved (Healthy Materials Lab, 2016). High-performance sustainable buildings (such as LEED Gold or Platinum) are generally designed for high-end clients and executed with substantial budgets. The developers' and designers' persistence and dedication in demonstrating that sustainable, high-performing, healthy housing can be executed to rigorous environmental standards, on a lean budget and in Minnesota climate, are particularly noteworthy, making the

insights of the design and development process altogether more valuable.

Figure 0.1 The Rose, during construction
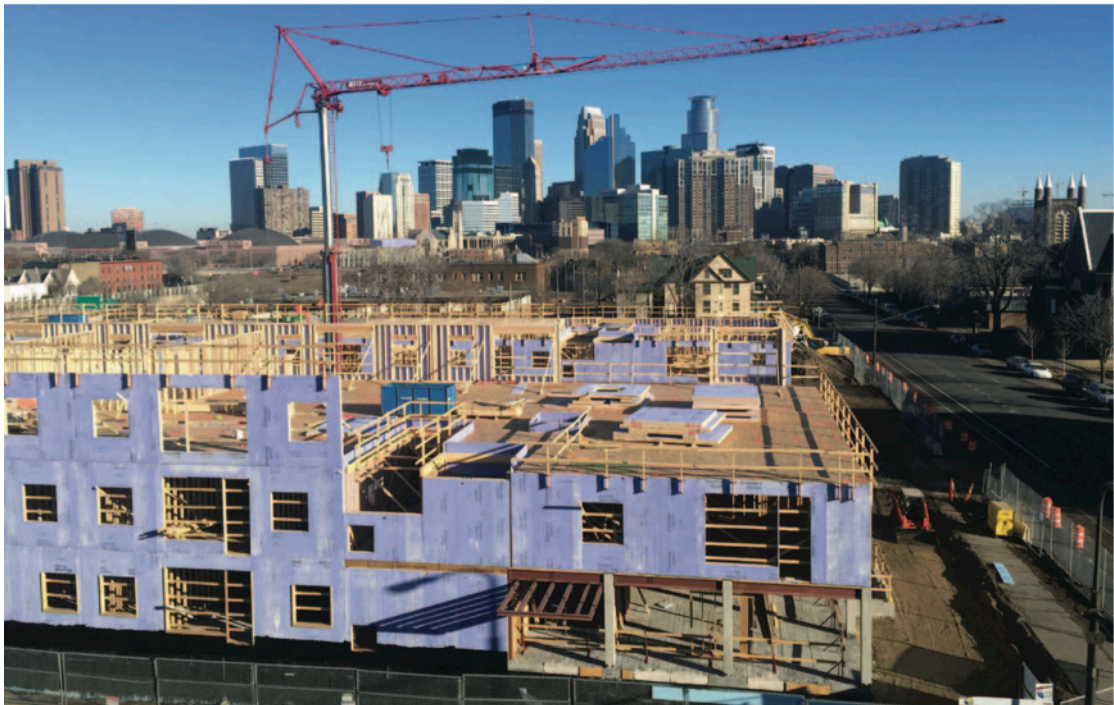
Figure 0.2: The Rose, during construction

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The Rose is the fourth phase in a four-phase re-development project in the city's South Quarter: Phases one through three of South Quarter included Children's Village Center, the Jourdain, the Wellstone, and Pine Cliff Apartments, a modern converted building. Interstate 35W and two other major roads frame the project site, making noise and air pollution significant issues. The Rose needed to align aesthetically with three housing complexes previously built at the same intersection by Hope Community.

The complex is composed of two rectangular four-story rectangular buildings separated by a fenced courtyard and play area, with a parking garage below each building, and a joint community garden. The public entrances are glassed in, and ground-floor units walk out to the street or the courtyard. Nearly half of the upper-floor units have balconies, and a few have projecting bays. Painted red, the bays animate the exterior surface, as do blocks of black graffiti-resistant masonry on the ground floor, and horizontal bands of siding set in a random formation on the upper levels. The variations on the exterior are mirrored inside the building, where modifications of the basic unit design give potential renters a choice in selecting their desired unit (Hoekstra, 2017).

The quality of the finishes and fixtures in each of the Rose's units is consistent in both the market-rate and the affordable rate apartments, and all materials have been specified through the LBC's stringent Red List Free specification support system and manufacturer disclosure tool. The interior paints, adhesives and sealers contain no VOCs (volatile organic compounds) that might off-gas like those used in standard binders and solvents. High-performing windows with insulated frames and low-e glazing maximize daylighting while blocking noise from the nearby freeway. A

rooftop five-step, dedicated outdoor air system (DOAS) ensures that each unit receives fresh, clean air—never recovered from other units – with possible moisture or smells - or contaminated by outdoor CO emissions or fumes. The resulting buildings are extremely energy-efficient and high performing, with an expected energy use intensity (EUI) of 30 (72% more efficient than the building code baseline). They also deliver resident wellbeing through extremely healthy interiors, thermal and acoustic comfort levels, and air quality.
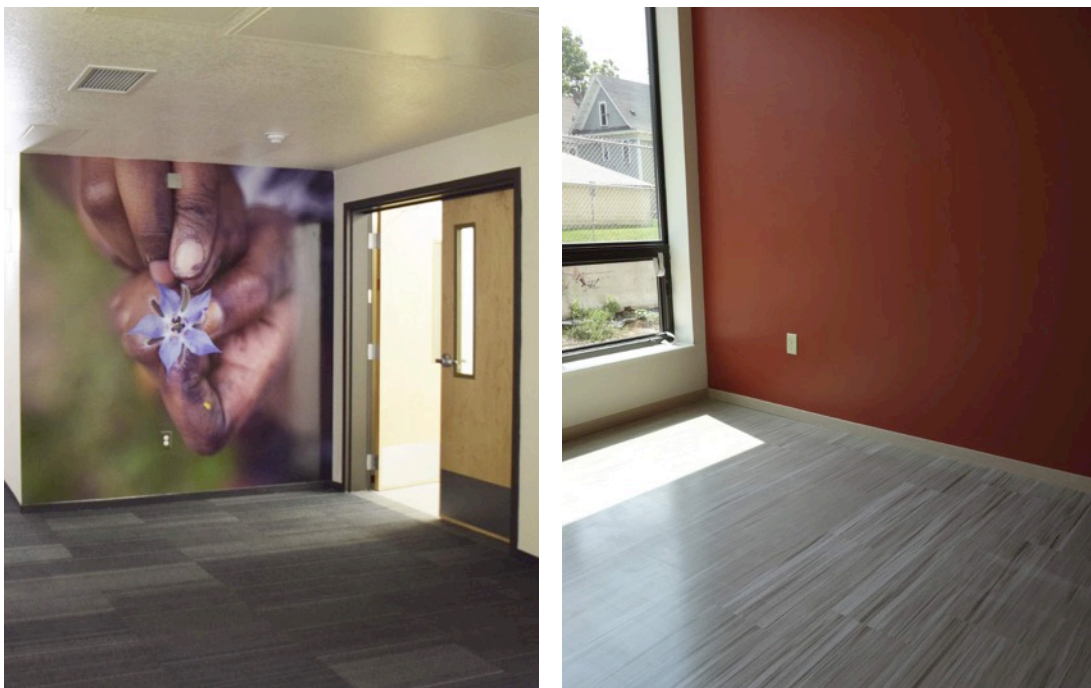
:Figure 0.3 The Rose, interiors

Figure 0.4 The Rose, apartment interior

4.2.1. Sustainable design features

The designers of the Rose didn't seek Living Building certification, but used the Living Building Challenge as a guiding framework for the sustainable design of the buildings. The highly integrative design process yielded an ambitious, high-performing building, constructed on a former brownfield site adjacent to freeways, that includes the following features:

• A host of energy efficiency measures and design features reduce overall energy use by more than 70 %;

• A five-stage dedicated outdoor air system (DOAS) offers excellent indoor air quality;

• Rigorous material specification, in accordance with LBC's Red List Free list, ensures VOC-free interiors;

- A solar-thermal water-heating system offsets over 35% of water heating energy input;

- Water-saving fixtures and Energy Star–rated appliances that reduce potable water use by nearly 50%;

- A 5,000-square-foot community garden offers a communal outdoor space and food-production programming for the neighborhood;

- A rain-garden collection system collects up to 90% of the rainwater on the property, and feeds it into cisterns for reuse in the community garden;

- Connectivity to services, transit, and bicycle lanes;

- Rooftops are set up for future installation of large photovoltaic arrays (Hoekstra, 2017).

4.3. MSR: Practice overview

MSR (Meyer, Scherer & Rockcastle, Ltd.) is an award-winning architecture and interior design firm founded in 1981 by Thomas Meyer, FAIA, Jeffrey Scherer, FAIA and Garth Rockcastle, FAIA. The firm describes its work as that of "enduring value: buildings that are expressly right for their time and place and that culturally and physically age gracefully" (MSR, n.d.). Typical projects include library, office, cultural, higher education, and residential spaces diverse in type, size, and location. The firm employs approximately 40 architects and designers in Minneapolis, Minnesota, and Hyattsville, Maryland.

MSR aspire to "create comprehensively high performing buildings: environmentally, culturally, socially, technically, and economically" (Ibid, n.d.). The firm has earned a national reputation for both designing new spaces and, through preservation, adaptive reuse, and renovation, designing innovative ways to reuse older buildings. Throughout the firm's history, the founders and many of the principals and staff have taught in professional academic programs and served on various boards, helping the firm foster an active learning environment (Ibid, n.d.).

The firm describes their approach to practicing architecture as one of collaborative art, where clients are actively engaged in order to understand the needs of the users, the opportunities of the site, and the budget, while considering the social, cultural, and environmental constraints and goals of each project. Each project includes a team of consultants in engineering, construction, cost analysis, landscape architecture, and environment, among others. In 2014, MSR was ranked number 33 in the nation on the ARCHITECT 50 listing by the American Institute of Architect's magazine *Architect*. The listing recognizes architecture firms that positively impact their communities, design energy-efficient buildings, mentor younger generations of designers and generally make their mark beyond the ability to run a financially viable design business.

4.3.1. Design process at MSR

MSR designers describe a design process that begins with a semi-structured meeting with stakeholders, called a visioning session (MSR, n.d.) in which expectations from the project are shared, and where goals are discussed and ultimately set. All stakeholders are encouraged to voice their own definition of success for the

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project. This discussion is framed by the MSR team through a framework of five factors – environmental, cultural, social, technical and economic (MSR, n.d.). Framing the discussion through these factors facilitate the generation of ideas around the project targets and help define its different boundaries and potentialities with these factors in mind. The MSR team contributes to the discussion by synthesizing given site constraints, and by reflecting on the goals expressed by the stakeholders at this initial stage of the design process. The desired outcome of this visioning session is a set of agreed project targets and goals, considered through the five factors listed before.

"We usually sit down with the client and try to get a sense of their values; we sometimes use a lot of wordsmithing to understand and define those core values; these help shape our future discussions. That way, when we hit against budget issues or performance issues, we can go back to these core values and check if we're in alignment with them" (MSR, 2016).

4.3.2. MSR's approach to sustainable design

The firm describes the environmental aspect of their design process as one combining performance and responsibility: the performance aspect entails energy and resource conservation, while the responsibility aspect relates both to the materials used in construction of a new environment and to the social contribution the project will have on its site and surroundings. Further, the materials chosen and specified are considered in terms of health and toxicity as well as the environmental impact of their extraction, sourcing, processing, manufacturing, fabrication, transport, installation, performance, aging, and potential future reuse. The Rose was particularly forward-thinking in its material selection, specification and procurement processes, which

adhered to the LBC guidelines in ensuring healthy interior environments by reducing exposure to toxic substances generally used in building products.

"I think any project that tries to be a good steward of natural gifts, and tries to improve on existing conditions for all those involved, can be considered sustainable… Then you have the question of whether you're going far enough, but I think this question will be with us forever" (MSR, 2016).

"We strive to produce work of enduring value, buildings that provide 'good service' and stand the test of time… I think sustainability is about 'doing the right thing', in the very fundamental sense. We ask ourselves how different aspects of the building and its surroundings are interconnected, cooperate and ultimately impact the overall living experience of the residents in the building. As architects we are allowed to imagine, to really ask these questions and think, what *does* 'good' look like, and how can we produce architecture of enduring value. The social equity aspect of sustainable design is essentially the answer to the question of 'why do these things?'" (MSR, 2016).

With regard to sustainable design process, MSR now performs energy modeling as standard practice on nearly all of their projects (MSR, 2016). The firm's architects utilize several modeling toolkits (energy modeling, daylighting, thermal behavior, etc.) to test what was previously were seen as 'healthy intuitions'. The availability and use of this data has essentially transformed the way architects at MSR work, and it is generally seen as a supportive approach, rather than a formulaic one, which can further advance the design decisions and project goals in sight (MSR, 2016). This data can also 'drive the design', particularly in collaboration with engineers, energy or façade consultants.

Another area of special concern at MSR is attention to interior environments and materials. As a firm with numerous libraries and educational buildings in its portfolio, the MSR approaches interior environments through the same rigor and environmental awareness as it does its projects' envelopes and mechanical systems:

"…we asked ourselves [in the design of the Rose], how can we provide these populations, who've lived in affordable housing their whole lives, with healthier living environments… Most of these people have health issues as it is, having lived near a highway all their lives, and have limited access to healthcare. It seemed worth the effort to provide them with 'no-VOC' interiors, with good quality interior air, with lots of light… The interiors have to be as high-performing as the envelope" (MSR, 2017).

MSR is also known for its expertise in adaptive reuse, an unusual sustainable design approach by which existing buildings are modified for use through a comprehensive adaptation process, typically involving extensive redesign of the building's systems, interiors and outdoor areas. Many consider adaptive reuse a progressive, forward-thinking alternative to new construction: the re-use of an existing structure within a site greatly reduces the energy and materials necessary for its erection; the existing building is generally refitted with new, high-performing envelope and mechanical systems; and the newly repurposed building, previously a burden on the urban fabric, reinvigorates it through infusing new life to the area.

4.4. Background and site history

In the 1990s, the Rose's surrounding area was one of the most dangerous in the city of Minneapolis, with some 22 vacant buildings and three abandoned gas stations.

Like many industrial cities throughout the American Midwest and Eastern Shore, Minneapolis saw its inner city falling to devastation around the 1960s, as the freeways ripped through urban centers, triggering suburban sprawl and white flight, and consequent disinvestment in the inner city neighborhoods. The Phillips neighborhood was hit hard by the crack cocaine epidemic, resulting in many landlords abandoning their buildings and violence surging in the streets (McKnight, 2004). While many parcels in the neighborhood lay vacant, the site of the Rose buildings was previously occupied by a couple of gas stations, a dry cleaner and a used-car lot.

Hope Community, a nonprofit community development organization, had been active in the neighborhood since the late 1970s. In 1996, believing in the potential of this once vital commercial corridor, Hope Community purchased 90% of the frontage on Franklin Avenue between Portland and Oakland Avenues. The property was largely vacant, blighted, and often the site of drug deals and violent crime (Hope Community, n.d.).

Hope describes its core ideology as the belief in the power of people and place, and in the potential of citizens – not only experts – to revitalize their communities and shape their future (McKnight, 2004). Beginning with a hospitality house and shelter for homeless women and children in a 100-year-old Victorian house, Hope persisted through neighborhood devastation and disinvestment, leveraging the power of the local community and working towards a model for change through citizen empowerment, engagement and real estate development.

In 1999, Hope Community envisioned a community revitalization a mix of affordable and market-rate housing, neighborhood commercial space, and a community center that will transform all four corners of a long-abandoned

intersection of Portland and Franklin Avenues. The opportunity appeared as the Minneapolis City Council placed a moratorium on auto-related businesses throughout the city, in so preventing the re-use of the 3 corners that Hope did not control. Later that year, Hope received a $500,000 grant from the Phillips Family Foundation, facilitating the purchase of the second of the four corners on the Franklin – Portland intersection. This significant level of ownership secured Hope's continued leadership in the redevelopment of the intersection, and would ultimately lead to the formation of the collaborative partnership between Hope and Aeon that would develop the entire intersection (Hope Community, n.d.).

Hope has become a respected community developer that owns and manages some 200 units of housing, 85% of which are affordable, and involves hundreds of people from surrounding neighborhoods each year. Will Delaney, Hope Community's associate director, describes their main goal at the Rose as "the creation of long-term, sustainable, safe, quality affordable housing alongside market-rate housing, [demonstrating] Hope's vision of community revitalization through real estate development and community spaces alongside engagement of the local community" (Delaney, 2017). Hope Community's development and renovation of both affordable housing and related public spaces in the neighborhood is evidence of the organization's community-focused mission. Their goals are to build for the future by providing housing that is well designed, constructed with quality materials, and thoughtfully sited to rebuild neighborhoods (Healthy Materials Lab, 2016).
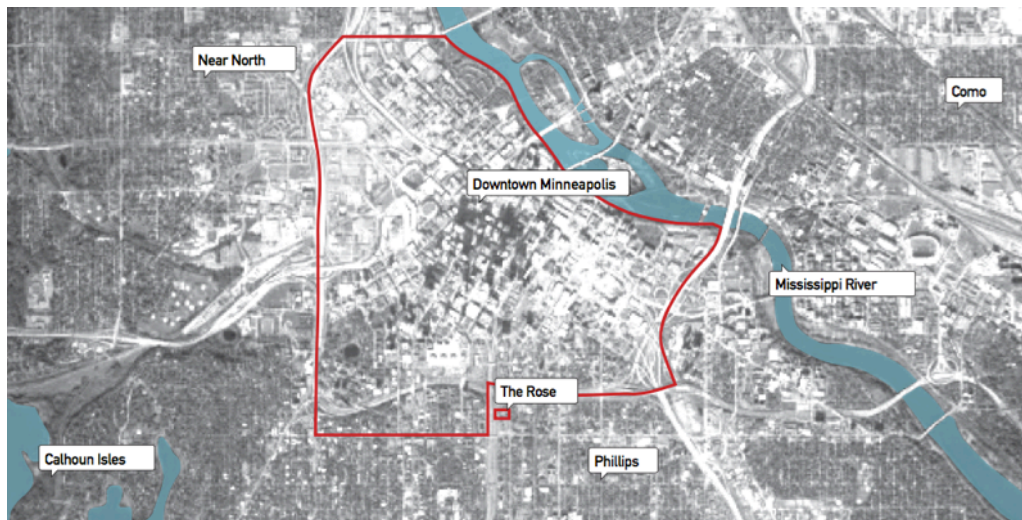
Figure 0.5 The Rose, in relation to downtown Minneapolis
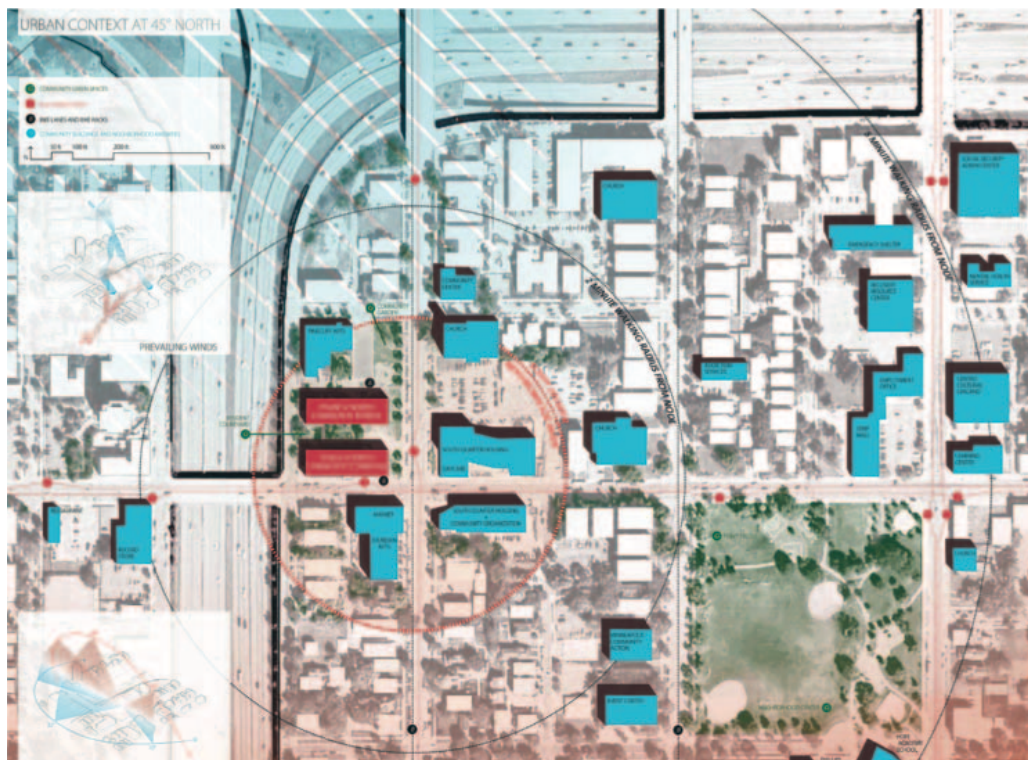
Figure 0.6 The Rose project (in red) in relation to its immediate surroundings neighborhood

4.4.1. Hope Community and Aeon – the beginning of a partnership

Hope community, having long-term presence in the neighborhood and close ties with the local community, had a vision of developing an alternative to the its emerging gentrification, striving to establish a mixed-use development to serve the existing population and bring in new residents. This vision was based on a long

process of listening to local residents, a core belief in the power of community to lift the area out of its unfortunate state, and an understanding that community revitalization demands both significant social capital and infrastructure, closely linked to the local's needs and lifestyles.

At the time of the project's conceptual beginning there were no investments in the neighborhood, from either neither from the city nor from the private sector. However, Hope believed there was great opportunity in the neighborhood given its proximity to downtown, to the light rail and close to job centers. Hope sought to redevelop the neighborhood for the long-term, through investment, but not only for the affluent, and without displacing existing low-income resident families in the process; Hope aimed to "knowingly turn the gentrification phenomena on its head" (Delaney, 2017).

In the early 2000s, Hope began acquiring additional land in the neighborhood and conceptualizing a vision for its development. Realizing that the site was too big for one nonprofit developer, they approached Aeon, which became co-developers, co-owners and co-project managers on all 4 corners of the Franklin – Portland intersection.

Aeon originally formed in the mid 1980s as 'Central Community Housing Trust'. The organization's goal has been to create high-quality affordable housing with long-term stability in mind. Aeon presently owns and manages some 2,400 apartments in the Twin Cities metropolitan area (ULI, 2015). Aeon is also deeply involved in the community as providers of community engagement programs involving hundreds of youth, adults and families each year in learning, empowerment and community leadership. The two developers found that their interests aligned,

since both see their mission as providing affordable housing and multi-use public spaces (such as community centers, gardens and playgrounds) for the benefit of urban populations.

Following the growing awareness towards green building certification in the affordable housing market, Aeon began a reflective educational process of raising sustainability standards in their construction projects, considering aspects like green spaces, energy-saving strategies and healthy interiors. Three pilot projects each completed through various certification frameworks (e.g. LEED, Well Build) contributed to Aeon's existing expertise in affordable, socially equitable and environmentally sustainable housing. Gina Ciganik, Vice President of Housing Development at Aeon at the time of the Rose development describes their motive to follow holistic design principles: "[we] wanted to find solutions for the most vulnerable populations who could most benefit from sustainability, health and affordability. If we find equitable and affordable solutions, then everyone could participate and benefit. Trickle-down sustainability does not work" (Ciganik, 2016).

The project's first phase was completed in 2003, the second phase was completed in 2006, and the third phase in 2008. The third phase (the Wellstone building) was built as a pilot under the Minnesota Green Community standard, a sustainable design standard that preceded LEED and is thus significantly less developed. All four phases were envisioned as mixed use, mixed income developments: Hope's offices and community space are located in the first phase building (the Wellstone building), a market is operating in the second phase building and a daycare center in the third phase building. The project's final phase, the South Quarter project, includes both The Rose and the renovation of Pine Cliff, a 30-unit

apartment building on the northwest corner of the block, which Aeon purchased out of foreclosure in 2001 as part of its plan to revitalize the area (ULI, 2015). Being the fourth and final phase, the Rose project was scheduled to be completed sooner, but took longer to advance due to the late 2000s recession (Delaney, 2017). In total, the four buildings at the intersection added 250 dwelling units and approximately 23,100 square feet of office and commercial space to the neighborhood (ULI, 2015).

4.4.2. Site and neighborhood – current

The Rose is located in the Phillips community – a neighborhood just south of downtown Minneapolis, with a mix of residential, commercial and industrial uses. Traditionally, it was both a community and a neighborhood (in Minneapolis, a neighborhood is a subdivision of a community). In 2002, Phillips neighborhood was subdivided into four smaller neighborhoods, now officially known as Ventura Village (where the Rose is located), Phillips West, East Phillips and Midtown Phillips. Franklin Avenue, which runs East-West, serves as the main commercial artery in the neighborhood and generates significant volume of motorized traffic.

The immediate neighborhood around the Rose's site consists of mostly single-family homes and apartments, many of which were built around World War I or earlier. The area suffered disinvestment from post World War II until the 1990s, although redevelopment projects in the last two decades have added both housing and employment. Freeways border the north and west sides of the neighborhood (ULI, 2015).

Home to some 20,000 residents, Phillips community has a long history of minority and immigrant residents including Native American and African American

populations (Hope Community, n.d.). Some 80% of the residents are people of color, making the neighborhood is incredibly diverse – it is home to one of the largest concentration of urban American Indian populations in the country, has a large Latino population and a large East African population (mostly Ethiopian and Somali refugees). Whites constitute some 20% of the neighborhood's population, as do Latinos. The median income in the neighborhood is about a third of the median income for the Twin Cities (Hope Community, n.d.)

Figure 0.7 The Rose, in relation to its immediate surroundings in Phillips neighborhood

Rezoning for the Phillips neighborhood was approved in 2013, and the area became an R6, Multiple-family District with NP North Phillips Overlay District. This adds specific district regulations, such as increased height and density, and other policies detailed below. The proposed program for The Rose was to include 90

additional dwelling units in two new buildings. In contrast to the other phases, this was to be a purely residential development.

Although R6 zoning allows for six story high buildings, The Rose was developed as two four-story buildings to remain consistent with the surrounding urban context and nearby properties in order to reinforce the fabric of the existing neighborhood. The Rose also features an inner courtyard, a productive garden, and several outdoor amenities to promote accessible community gathering. (Healthy Materials Lab, 2016).

When acquired by Aeon, the site was comprised of 13 parcels, some of which were contaminated by previous uses and required remediation, particularly the dry-cleaning business that ran unchecked for years (MacPherson, 2016). The Franklin-Portland Gateway was proposed to be developed as one cohesive project, even though the individual phases have been funded and constructed at different times. The corner site is a challenging one, primarily because of its location between two highways that are noisy and a source of local air pollution (Healthy Materials Lab, 2016). The team developed both a comprehensive sound barrier strategy to mitigate the impact of traffic noise from the highway, and an air filtration system that would help filter the air pollution from the highways (Ibid, 2016).

4.5. Pre-design: community listening

The developers of the Rose had clear ideas about their goals for the neighborhood, yet both felt that connecting to the visions of the residents would provide fertile ground for pre-design. The visioning and pre-design process began in the late 2000s as Hope initiated a process they call '**community listening'**, which includes extensive community and stakeholder engagement through structured 'listening sessions'. Five such listening projects have been conducted, with the topics "Jobs and education", "Concepts of community", "Peavey Park", "Community conversations" and "Youth". Each of these five listening projects were led by community workers and facilitators, who led between 20-30 listening sessions and engaged some 250-350 residents.

In 2011, a process of neighborhood **cultural auditing** was initiated and carried out by the Mithun Architects (a Seattle firm that did not continue with the Rose project), Hope and Place. Cultural audits are generally used for the study and exploration of a group's cultural characteristics, such as norms, values, assumptions and aspirations, and this process did yield valuable information used later by the designers to ensure they were working in alignment with the wishes, norms and virtues of the residents.

Hope's vision was to develop the Rose site and its adjacent areas for the long-term: a project-specific, two-year process entailed listening and **visioning sessions** a led by staff and community leaders aimed at engaging residents around the values, goals and aspirations for this new player in the neighborhood. The information collected and considered offered real community voices bout the proposed development as well as introducing the residents to the values and potentialities of the new project. Some of these sessions, called '**a new shade of green**' involved architects, designers,

community facilitators and residents discussing the space allocation in the neighborhood as well as sustainability features of the new development. Will Delaney describes the contribution these sessions had on the design process or the Rose, and the way sustainability features at the Rose fit neatly into the community vision, with LBC serving as a platform and framework to guide the design and development process:

"We knew that the community wanted the four corners [of the Franklin – Portland intersection] to include mixed use, mixed income affordable housing, with quality outdoor space, but these workshops really let people open up and discuss these ideas in greater detail… for example, the community garden – what do people want this place to do, and contribute… they asked not only for a place to grow food, but a place to learn about growing food, to connect with their neighbors… that was a good place for their kids to hang out… we wanted to recognize the multicultural heritage of the residents through the garden, educating for ethnic eating and pride. We contracted a permaculture expert to design the garden, locate the vine plants, nitrogen fixers, pollinating plants… The community voices really gave us the foundation from which we could then turn around and create this space and make sure it was technically functional and designed properly. We took all that information to MSR and they synthesized it to an actual plan. [We] educated people about healthy eating, eating better, and also about healthy interiors and lifestyle changes towards sustainability" (Delaney, 2017).

Delaney stresses the importance of ongoing engagement with the community in conversation, as opposed to sporadic, erratic or random talks:

"Some people approach community engagement in a very shallow way, like holding

one or two meetings around a topic, or asking people to pick out paint colors for a new building… as opposed to *really* taking the time to listen, *really* talking and reaching for values, asking 'what should this place be? How should it fit into your neighborhood? What values should it hold?'. That is a much more meaningful way of leveraging community knowledge. The community voice is crucial. I appreciate that MSR took that seriously. They all acknowledged it seriously." (Hope, 2017).
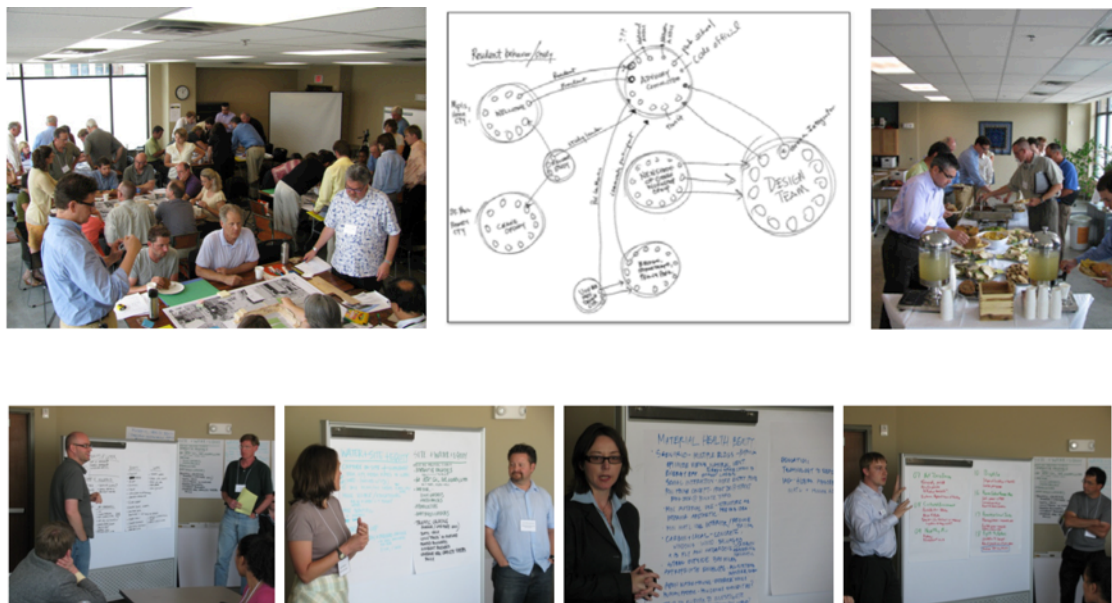
Figure 0.8: The Rose, Participatory design process through community charrettes ("A New Shade of Green").

4.5.1. Development process and financing

An essential step in development was securing the financing to enable the process of design and development of a high-performing project with ambitious goals. Aeon began applying for funding starting in 2010 and did not get to full funding until 2014. In 2011 and 2012, the Rose received financing from a total of 29 sources—including city, county, regional, and state governments and philanthropic foundations (ULI, 2015). In addition, to accomplish the health aspects driving the design,

additional funds were needed to support consultants and researchers required for adhering to the Materials Petal of the LBC certification, as well as for purchasing and installing healthier materials. Reaching out to philanthropic foundations, as well as utilizing a section of the contingency budget, proved successful for accomplishing these aspirations (Healthy Materials Lab, 2016).

To raise the capital needed for construction, Aeon used the Low Income Housing Tax Credit (LIHTC) program (a federal plan for affordable housing development that incentivizes the private sector to invest in housing for low-income populations). Although it is a federal program in which tax credits are most often applied for through the state, developers in Minneapolis apply for the tax credits through the city, which is the sub-allocator for the credits (Healthy Materials Lab, 2016).

Aeon applied for a 9% LIHTC, which raised the most equity from the federal program but is also a highly competitive process. Developers are required to first apply for the Qualified Allocation Plan (QAP), a list of state established requirements and criteria that address specific local needs for affordable housing. Aeon was awarded 9% LIHTC in 2012, putting the project on a direct course to closing. Aeon had two years to complete the project and put the building into service (Ibid, 2016).

Aeon also received a large grant from two foundations to support meeting LBC certification. Unfortunately, the project was bid during a high-volume construction period in Minneapolis, following the slow period of 2008-2009. The high demand in the market made led to labor shortage, and made contractors selective in bidding projects and offering higher bids. Accordingly, the bid for the Rose came back significantly higher than expected. The grant that was intended for an increase of

materials hard cost to meet LBC was largely consumed by increased project costs (MSR, 2017). This uncertainty in the business cycle represented an unforeseen challenge for the development team; however, instead of opting out of the LBC certification goals (and in so reducing material costs), the team managed to push on and use the philanthropic-sourced funds to compensate for this external given.

4.6. Team building and design process

From the outset, both developers of the Rose demonstrated deep commitment to the local community and to the mission of its empowerment through physical development and cultivation of local leadership. The two developers also believed in the need for their investment in the community to be as progressive and sustainable, while remaining accessible. The Rose is the first multifamily affordable housing project to pursue Living Building Challenge certification, as well as being the first project of any typology to do this in the state of Minnesota, where weather extremes pose an immense energy challenge. The development is also the most holistically sustainable and healthy project in Aeon's portfolio. The strong tripartite partnership between Aeon, Hope Community and MSR was essential for project's successful execution; however, the design process, and the professionals orchestrating it, was equally vital.

The design team led an informal Integrated Project Delivery process which was essential for alignment of goals at the early stages of the process, as well as for outlining main design decisions such as building form, massing and orientation, but also less tangible targets such as life cycle costs, energy budgets, ROI strategies and other detailed data necessary for both startup and ongoing financing cycles (Mellblom, 2016). This informal IPD process (referred to as 'IPD' from here on) included developers, designers and architects, as well as the general contractor, from the outset, but also community representatives and Aeon's in-house property managers, among others. This inclusive, open approach invited a positive attitude from the start and let everyone participate in the decision-making (Aeon, 2017).

Design meetings typically included representatives from Aeon (Aeon's VP of housing development, Gina Ciganik, operations managers Chris Winters and Steve

Plotz, and alternating project managers), Chris Velasco of Place, Billy Weber of CSBR at University of Minnesota, Rebecca Ellis of Questions and Solutions Engineering (commissioning agent), Jim Miles (owner's representative), the general contractor Weis Builders, mechanical and structural engineers as needed, as well as the MSR principal, project architect and other designers when necessary.

When approaching the design of the Rose project, the design team devised a process based on community engagement, sharing information and practices, streamlining design decisions and material choices and documenting the challenges of the process. To guide this process, the team developed a number of criteria to guide the design process. In addition to their use of the LBC and EGCC as guidelines, the team used six key principles to impact their decision making: 1) innovative design decisions 2) constructability and replicability 3) life cycle cost reduction 4) complexity and maintainability 5) flexibility/ability to retrofit 6) health and toxicity reduction (MSR, 2017). The project's design was also influenced by factors such as site conditions, standards laid out by the Minnesota Housing Finance Agency, extreme Minnesota climate, and the decision for all affordable and market-rate units to be designed to be similar in size, design and material finishes (Ibid, 2017).

The Living Building Challenge, while setting a high sustainability standard, was instrumental in the design process, serving as both a design framework and motivational goal (MSR, 2017). LBC, particularly the Materials Petal, became a tool for identifying potential material health hazards that have the most impact on residents. The revelation that the team would focus on the interior environment lead to the focus on healthier interior products and interior air quality, and helped to narrow the scope of research and the team's efforts (Healthy Materials Lab, 2016).

Another benefit of applying the LBC framework throughout the design process was the need for metrics when approaching the Energy Petal, necessitating a data-driven design process. This process (also called performance-based design) combines design experience, intuition and user behavior with scientific data such as local climate, sunlight, surroundings, building envelope (roof, windows, doors, and walls), and other factors. Data-driven design allows the design team to advise owners and developers about the optimal combination of design strategies that will result in lower EUI values and a higher ROI (return on investment). In so, designers provide owners and developers the tools to make smarter choices about energy use, systems durability and maintainability for the lifetime of their buildings. Data-driven design generally relies on employing passive design strategies to reduce the amount of energy needed. These strategies help make building envelopes tighter, using less energy by using more energy-efficient systems and making up for energy use with on-site renewable energy generation (MSR, 2017).

4.7. Summary: the Rose mixed-income housing

Numerous qualities and conditions, coupled with the approach of the design and development team, place the Rose well above other projects in the multi-family housing sector:

- The Rose had been the fourth stage of a development already revitalizing its South Minneapolis neighborhood;

- The extensive process of ongoing community engagement, including listening sessions, cultural auditing and visioning workshops, allowed for a participatory, multi-stakeholder decision-making process that created a promising atmosphere within the local community;

- The decision for pursuit of the rigorous Living Building Challenge was approached 'with open eyes', requiring designers, developers and engineers to develop appropriate strategies and competencies to accommodate the demands of this paradigm, particularly given the project's public funding and Minnesota's extreme climate;

- The final EUI target of 0.35 GJ/sqm/year (a reduction of 75% from code requirement);

- The design and development team's commitment to LBC standards of high performance, high efficiency, communal spaces, inclusiveness and healthy interiors.

The mission of the developers of the Rose was to provide affordable, accessible housing that will revitalize the local neighborhood, but also be healthy, high-performing and efficient. The decision to pursue the LBC provided both a methodological and a design and performance framework. MSR architects (together with their engineering team) relied on modeling-derived data throughout the design

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process to evaluate and direct massing, optimal building shape, orientation, density, access to sunlight and winds, user behaviors and other factors that drive the design process (MSR, n.d.).

The Rose's two buildings provided the neighborhood with much-needed accessible housing, but also with quality indoor and outdoor community spaces for recreation and gathering; realized 72% reductions in total energy use and 50% reductions in water use; recycled or reused all existing on-site trees and concrete left from buildings demolished on the site and old paving; feature dwelling units that are 100% free of toxic ingredients found in the most commonly used building products in the U.S.; substantially reduce tenant utility costs and provide an attractive, vital community and great long-term asset (MSR, n.d.).

Several key insights emerge from the study of the Rose, its design and development process through interviews and document analysis, in relation to the research questions of this dissertation as detailed in section 1.2. The conditions which made the Rose a success, the strategies and methodologies used by its designers, best practices and competencies are outlined below:

The tripartite partnership among Hope community, Aeon and MSR was crucial to the project's success and ability to fulfill its promise. The relationships among these organizations, and among the professionals who make up the teams within them, are strong and longstanding, resulting in trust, cooperation and mutual respect. Hope community's role within the project, particularly in the conceptual stage and project definition, was key to its starting off in the right direction. The long process of community engagement yielded a substantial amount of information that proved essential for its acceptance in the neighborhood.

The use of an informal integrated design process was effective in aligning expectations, efforts and objectives, and allowed for a more open, transparent and egalitarian process. This approach had its drawbacks in terms of time, pace and leadership, yet was overall effective in driving all stakeholders forward as one. The presence of three sustainability champions (Chris Velasco of Place, William Webber of SCBR (UMN) and Alison Mears of Parsons), each with their own expertise, was helpful in getting the client to understand the implications of pursuing a sustainable building standard, and eventually choosing LBC.

Creative funding strategies were instrumental to the success of the project, particularly given the added costs incurred with the Rose being the first affordable

housing, multi-family project to pursue certification. Selection of LBC-compliant materials meant higher costs for research, specification and purchasing. The Rose had a total of 29 capital sources, which required a creative approach to enable budget flexibility with regards to unplanned circumstances and mortgage terms (Healthy Materials Lab, 2016).

Finally, **design decisions throughout the project were made with the residents' wellness, comfort and equity in mind**. These eventually became some of the project's most defining factors: the decision to specify the same level of finishes for market-rate apartments and affordable apartments; the decision to create larger apartments and large, operable windows (including in utility areas such as laundry rooms); the decision to invest in the costly DOAS system to ensure air quality; the selection of healthy interior materials, finishes and products, ensuring resident health and wellbeing; and the inclusion of interior communal spaces, the playground and outdoor garden.

4.9. Analysis

4.9.1. Interviewee classification

From the 14 professionals who were invited to take part, 11 interviews were conducted, all of professionals closely involved with the development, design and execution of the project. The interviewees typically had experience of working on housing projects in both the private and affordable housing sectors. Both the organization and the position or role in which interviewees worked are shown in Table 4.1. All interviewees had previous experience of working on multi-family homes, as well as on projects pursuing sustainable building certification through prescriptive or performative frameworks (e.g. through LEED, WELL etc.).

Table 4.1: the Rose: interviewee categorization

Organization	No. of Interviewees	Position / Role
Architect	2	Design architect / Architectural manager / Sustainability Architect
Designer	2	Interior designer / specifier
Developer / client	4	Managers / community workers
Consultant / Engineer	2	Sustainability Champion / Owner's representative / Commissioning Agent
Management	1	Financier / business developer
Total	**11**	

4.9.2. Contributing factors towards sustainable, equitable design and development

Interviewees were asked to point out contributing factors, conditions and motivators towards successful design and development of sustainable and equitable building projects. Since no corresponding themes were identified in the literature (as

detailed in section 1.4 and chapter 2), and in line with a grounded theory process, the main themes arising from the data, are: process, economy, social responsibility, and industry (Table 4.2). Under each of these themes, several relevant sub-themes have been identified from the data.

Table 4.2: the Rose: Contributing factors to ESD

Theme	Sub-themes	Interview Quote
Process	• Clear commitment across all management levels at MSR • PLACE brought sustainable concept down to operational level • Transparency • Sharing information • Structured process and goal alignment • Strong leadership team • Belief in certification framework • Assistance from LBC headquarters • 'Elitist feel' of LBC	"We've done LEED Gold and Platinum buildings; Their results fell below expectations… Unlike the 'check the box' prescriptive programs, LBC is a performance, holistic program that necessitates a totally different way of thinking and working…it is pushing a different way of thinking and working together like no other program.". (Developer #3). "[PLACE] really took these really 'warm and fuzzy' ideas and brought them down to earth so we could understand and work with them" (Architect #2)
Economy	• Rising utility costs • Addressing market demand • Client retention • "Being pioneers" • Funding incentives	"We wanted to, essentially, flip the gentrification model on its head". (Developer #1). " "We looked at the ROI numbers closely… This made sense, but we knew we were swimming upstream" (Developer #3).
Social Equity / Responsibility	• Desire to benefit community - Hope • "Its the right thing to do" • Environmental remediation • Commitment to sustainability cause • Moral motivators	"I could put money into higher performing systems, but more users from more age groups will be able to enjoy, say, a better outdoor space. Such an amenity to me embodies social equity: The incorporation of features that will allow more people to enjoy more of their time on this site". (Architect #2).

Housing Industry	• Professional prestige (architects, developer) • Leading by example	"We're really seeing a need from the residents' end. I'm willing to pay a premium to satisfy that need. Of course we're also benefitting". (Developer #2).
Design Decisions / Tools	• Clear commitment across all management levels at MSR • Implications of LBC to design of the project • Healthy interiors • Added value to residents	"You can see the meaning of these [design] decisions when you walk the project. The air inside smells fresh. The outdoor spaces are really useful, the residents spent a lot of their time there. Its great to see these decisions and numbers translating into tangible goods" (Developer #1).

4.9.3. Barriers and challenges of sustainable, equitable design and development

Interviewees were asked to point out factors that were seen as inhibitors, barriers and / or challenges towards successful design and development of sustainable and equitable building projects. The main themes arising from the data are: process, economy, competence and industry (Table 4.8). Under each of these themes, several relevant sub-themes have been identified from the data.

Table 4.3: the Rose: Barriers to ESD

Theme	Sub-themes	Interview Quote
Process	• Cost (more money and time) • Cumbersome at times • The need to educate stakeholders • 'Too democratic' • Non-hierarchal • Perceived as elitist	"The fact that you have so many opinions around the table brought us to tears at times... Everyone has a say and anyone can set the whole team back even after an issue has already been agreed on". (Architect #2).
Economy	• Front-end loaded costs • Low market demand • Perceived risk • "The cost of being pioneers" • The need for creative funding • The need to educate	"We met too many financing people who had never heard of LBC and asked 'Well, why can't you just do LEED like everyone else?'". (Developer #3). "LBC actually hurt us with the bankers and funders" (Developer #1).
Competence	• Lack of knowledge – design team • Lack of knowledge – builders • Lack of knowledge – occupants • Unwillingness to change habits – design, commissioning, build teams	"After the Rose opened, the HVAC system kept malfunctioning... Residents had never lived with central HVAC and thought the system was broken... they were actually buying space-heaters that would work against it. We ended up translating the user's manual to Somali". (Architect #1).
Housing Industry	• No disclosure from manufacturers • Limited availability of materials • Builders ignoring specs • Subs not on board with LBC • Workforce resisting change	"Opening week, one of the alternate sub-contractors didn't know the building was VOC-free. He brought in cheap silicone grout and the fumes knocked our air-quality testing completely off the charts". (Architect #1).

4.9.4. Stakeholder involvement

Interviewees were asked to evaluate and reflect on their level of involvement throughout design and development process of the project, as well as that of the other role-holders (e.g. architects as a whole, PL office as a whole, developer / client etc.) in relation to the project phase. Interviewees answered these questions through subjective estimates, examples of milestones along the time span of the project

development and personal accounts. Each interviewee was asked to rank their own (and the others') efforts or involvement from zero to five (no involvement to intensive, consuming, hand-on involvement). Some of the answers were then multiplied in proportion to reflect the number of professionals engaged in the project at a given time (e.g. if the architect was equally involved in two of the phases, yet had one or two staff working on the first phase, and five staff working on the second phase, the level of engagement for the latter was proportionally multiplied to reflect the extra man-hours devoted to that phase).

While there interviewees' answers were subjective and by no means absolute, their agglomeration and plotting on a stacked-area chart paints a picture of the nature of the integrated process: it shows, for example, early involvement of the general contractor, or the two peaks of effort put in by the architects at the beginning (research and goal-setting) phase and just before the execution of the project. It also illustrates the continued involvement some of the stakeholders continued having with the design team even after the project's execution was well under way.

The results of this inquiry are summarized below: the ranking shows the perceived level of involvement or effort devoted to the design and development process across the project phases, from zero to five, for each role holder:

Table 4.4: the Rose: Stakeholder involvement

Project Phase / Role Holder	Architect	Developer	Contractor	Engineer	Commissioning Agent	Sustainability Champion (PLACE)	HOPE (Social Engagement)	Project Manager
Conception	1	1	0	1	0	1	4	0
Research	4	2	0	2	0	3	4	1
PD	5	1	1	2	0	2	3	2
SD	3	1	1	0	1	0	0	1
DD	2	1	0	0	0	0	0	1
CD	2	1	0	0	0	0	0	2
PR	4	0	5	3	2	0	0	1
CA	3	0	3	2	3	0	0	1
OP	1	2	0	0	0	0	1	1

<u>Key:</u> PD: Pre-Design; SD: Schematic Design; DD: Design Development; CD: Construction Documentation; PR: Procurement; CA: Construction Administration; OP: Occupancy and Operation

The rankings in the table above were plotted on an area graph, below:
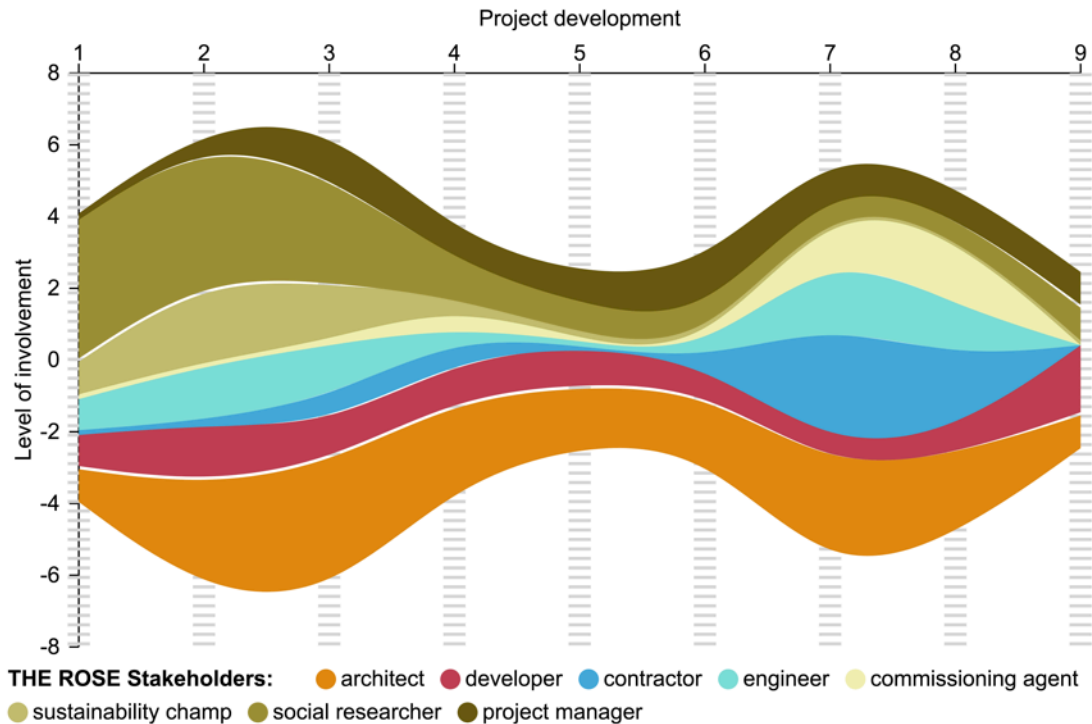
Figure 0.9: the Rose: Perceived level of involvement of stakeholders

4.9.5. Designer competencies

Interviewees were asked to evaluate and reflect on the performance and competence of, and roles assumed by, the designers and architects throughout the design and development process of sustainable and equitable building projects. Many of the interviewees were unable to answer this question directly, or even reflect on these themes in that context, much less answer this question reflexively (about their own performance as designers); however, answers to this question were synthesized from the discussions with the design team, through examples cited by the interviewees or through their accounts and descriptions of the design process.

Before presenting the themes arising from this synthesis, it is worth noting that designers and architects, by the very nature of their profession, are commonly

considered to be highly reflective and self-conscious in their professional conduct (discussed at length in Schön's theory of reflective practice; also see Cross, 1982). Without developing this point in detail, this tendency is commonly attributed to (i) designers' ability to grasp multidisciplinary issues and quickly recognize their synergetic effects in the project's context, and to (ii) the very nature of design practice, which entails multiple iterations and attempts at solving problems, usually spatial or morphologic, whereby the designer must constantly reflect and critique their own, previous iteration, and repeat the process until satisfied with the result.

The main themes arising from the synthesis were:

(i) Designers as facilitators: The designers of the Rose were charged with managing the complex design process by handling a large group of stakeholders, leading with relative neutrality both the process and content of the design meetings towards agreed, pre-determined goals. A successful facilitator is often described as one who provides leadership without taking the reigns, getting others to assume responsibility and take the lead (UVA, n.d.). John Thackara, a British design theorist, describes this ability as a much-needed shift in the role of designers, with extensive implications in design education and practice: "in this new era of collaborative innovation [for sustainability], designers are having to evolve from being the individual authors of objects, or buildings, to being the facilitators of change among large groups of people." (Thackara, 2005).

(ii) Designers as educators: Nearly all those interviewed voiced the need to introduce the novel approach of the Rose to collaborators or service providers in their respective fields. Some used the term 'educate', yet others simply explained the need to "walk people through what were doing, why we're doing it differently, and why

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this paradigm is important" (Delaney, 2016). Designers felt that all throughout the process of design, development and execution, they were required to educate other stakeholders, engineers, contractors and material suppliers; developers felt they needed to educate funders, state officials, operations personnel and residents; the general contractors felt they needed to educate their own workers, their suppliers and sub-contractors.

(iii) Designers as Dreamers: Designers are, in the words of Alastair Fuad-Luke, "licensed to imagine… making the unthinkable, possible" (Fuad-Luke, 2009). They have the ability to synthesize contextual and universal issues, to articulate their visions into actionable plans, and to challenge existing themes and integrate new ones into directives for social and environmental change. Good designers have the audacity required to ask "what now?" in the face of a crisis, equipped with the confidence to visualize a pragmatic solution integrating economic, social, cultural and environmental considerations.

(iv) Designers as advocates / agitators / activists: Mary Keefe, executive director of Hope Community, describes the organization's approach to changing the minds of the public in regard to the Hope block and neighborhood in early 2000s: "we began to develop a vision of what our neighborhood might look like. We came to call it an *agitational vision*, and agitate it did. The vision challenged people's view of what was possible in this neighborhood" (McKnight Foundation, 2015). If designers set out to innovate, they will be disturbing and challenging the existing norms and narratives. Such disruptions have the potential to agitate systems and individuals into action, offering an alternate narrative directed at gaining traction and eventual acceptance.

Another important point demonstrating designers' role as active advocators

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relates to LBC's guidelines in selecting Red List-free materials for specification. LBC requires that designers selecting materials for certified projects contact at least ten manufacturers to campaign for disclosure of the chemical content of their products (termed 'declaration' by LBC). In doing so, these designers advance a standard of transparency in the construction industry, and also encourage manufacturers to 'join the revolution' by gradually eliminating hazardous materials from their manufacturing processes.

4.9.6. Summary of findings

(i) Certification framework was critical for design and decision-making: The LBC framework served as a critical guide, which brought clarity and focus to the design process and helped the project team define performance and health goals. Green Communities Criteria was also used and assisted particularly in the development and funding phases. Both frameworks proved valuable for prioritization and decision-making at several critical junctions in the design process (particularly in selecting mechanical systems decisions, such as the DOAS system, and in selecting red-list compliant finishes and materials).

(ii) Modeling-derived data drives energy-efficient design decisions: Given the clear performative goals set with the help of the LBC framework, and extensive data from energy modeling sessions, the design team applied various strategies to achieve an EUI of 31 k.BTU/sf, a 72% improvement on the Minnesota building code (MSR, 2017; ULI, 2016).

(iii) Solid relationships, transparency and trust among stakeholders: The strong tripartite partnership between architects MSR, developers Aeon and community nonprofit Hope Community was cultivated over several years. This trust and sharing

of information enabled the three to see eye-to-eye and proceed with confidence even in the face of budgetary and bureaucratic hitches.

(iv) Integrated design process: The integrated design process (though informal) enabled input from the local community, consultants and the contractor very early in the design process, examining life-cycle costs and establishing energy budgets as the initial design was taking shape. This also helped in the commissioning process and the bidding cycles with better product alternatives that took place during construction (Healthy Materials Lab, 2016).

(v) Community partners give voice to residents: Development partners Hope Community kept the project inline with the genuine needs and aspirations of the local community. The deep community listening sessions and workshops provided a solid foundation for the conceptual stage of the design process. Hope's longstanding presence, trust and overall commitment to the neighborhood were essential in gaining the trust of the existing residents.

4.10. Discussion of findings

The design team of the Rose expressed the challenge in making design decisions through integrating, prioritizing, compromising and negotiating in many instances where tradeoffs or conciliation had to be made (MSR, 2016). Although this can be said, to an extent, about most design decisions in any conventional design processes, the complexity in the case of this project was greater given the novelty of the LBC framework, the ambitious performative goals set by the developers, objective climate conditions, large number of stakeholders and budgetary limitations, given that this was an affordable housing project.

Contrary to prescriptive or more rigid rating systems, the LBC framework forced both architects and developers to evaluate and re-evaluate their decisions with regard to the desired building performance and the ultimate wellbeing of its occupants; This change in perspective represents a profound shift in the way designers think and operate, and in the dynamics of decision-making throughout the design process. In the case of the Rose, the use of LBC proved to be a cohesive, aligning factor among the large group of stakeholders. The heavy use of data, particularly energy modeling, in very early stages of the process, proved critical for budget allocation and decision-making throughout the design phase and beyond.

Based on the work of Horst Rittel in the 1960s, Buchanan proposed that most problems faced by designers, particularly in the face of the sustainability challenges of our times, are "*wicked problems*". Fundamentally, wicked problems are real-world problems that acknowledge the complex interdependence of diverse factors and stakeholders, rather than simplistic, linear cause and effect abstractions that isolate the product of design from its context. Wicked problems call for integrated and flexible design solutions that are appropriately adapted to the eco-social complexity of their scale-linking context (Buchanan, quoted in Wahl and Baxter, 2008).

The designers and developers of the Rose demonstrated that in the case of the Rose, such 'wicked problems' could only be approached with an integrated, holistic mindset (this has been discussed in section 4.1). The Rose project was approached with a wider, holistic design agenda encompassing multiple environmental and social deliberations. This has outlook was evident in goal-setting and conceptual framing, design development and execution. It is therefore safe to assume that the design process carried out for the Rose was also considerably wider in scope and complexity

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in relation to more conventional projects. Given the themes outlined above, detailing the different capacities and roles assumed by the designers, it is evident that a demanding design process requires the designers to 'evolve' professionally to learn and assume these roles.

The ability to integrate the spectrum of factors, considerations and constraints throughout the design process, whilst keeping the process on track in regard to the goals outlined at the outset, can be termed '**designers as integrators**'. Such 'Integrator' designers must also partake in transdisciplinary design discussions, applying design methodology to engage team members and stakeholders in cultural, social and environmental predicaments through a sequential process towards predetermined goals. This notion was tested against the evaluation of the next case studies, as these were performed.

Chapter 5: Case study II – Multi-generational building in Ingolstadt

Figure 0.1 Hollerstauden residential building, view from southwest

5.1. Project overview:

Location: Ingolstadt, Hollerstauden district, Bavaria, Germany

Developer: St. Gundekar-Werk Eichstätt Wohnungs; Städtebaugesellschaft mbH

Designers: Behnisch & Partner Architekten, Stuttgart

Principal-in-charge: Stephan Leissle

Landscape architects: Grabner Huber Lipp, Freiburg

Construction: Ingenieurbüro seibold + seibold, Eichstätt

Engineers: PMI Building Physics, Unterhaching

Energy engineers: TB Stampfer, Salzburg;

Size: 6,150 sm (66,198 sf)

Consultants: Prof. Georg Sahner, HS Augsburg, Prof. Gerhard Hausladen, TU Munich

Sustainable design framework: e% - *Energieeffizienter Wohnungsbau* (Energy-Efficient Housing) program of the State of Bavaria; and EnEV 2009: *Energieeinsparverordnung* (The German Energy Saving Ordinance)

Completed: 2011

Relevance as case study: Multi-generational housing; inclusion and community-building.

The *Wohnanlange* Hollerstauden (Hollerstauden residential building, or HRB)[9] is a multifamily, multi-generational[10] housing complex located in southern Germany, on the outskirts of the city of Ingolstadt, in the Hollerstauden residential district. Home to some 200 residents, the project was instigated by nonprofit developer St. Gundekar-Werk to provide high quality, affordable accommodation for fringe groups within the housing market, e.g. young families, single-parent families, students and senior citizens. The project's ambitious sustainable design and high performance, combined with its confident social agenda, make it a prime example for successful integration of social and environmental values.

The HRB shares its site with two similar social housing buildings and is situated at the corners of Adam Smith and Albert Magnus streets, in a predominantly residential area between the city and the countryside, featuring residential buildings of various scales, configurations, and typologies. The project is located next to several buildings designed by Behnisch & Partner (B&PA) in the late 1990s: a Montessori school, a kindergarten and an assisted-living facility constructed by the same developer, originally built as social housing and currently a medium-scale assisted living facility (*Seniorenwohnheim*).

The apartments at HRB are grouped around a central atrium, under a glazed roof, serving as a shared public space available for use to all residents. This atrium

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[9] Due to the numerous German titles and names in this chapter, the original German titles will be provided in italics, with the English translation following in parentheses; If a title appears more than once, it will only appear as the English translation throughout.

[10] It should be made clear that the term 'multi-generational housing' is used throughout this chapter to describe a residential multifamily building designed to accommodate differently aged households, or differently aged tenants *in separate housing units* (e.g. a young family with children living in one apartment, alongside an elderly couple in a neighboring apartment); the similar topic of *multigenerational households* (e.g. family members of varying ages sharing one household, also termed '*multigen homes*') has been researched extensively, and is not the focus of this case study.

also serves as a well-lit winter garden and offers a gathering place in which the diverse mix of residents can come together and form neighborly, communal bonds. The exterior common areas include a series of intermediary spaces, meeting points and play areas linked by a central, spine-like path, which extends to connect the adjacent housing projects.

Figure 0.2 Clockwise from top left: interior of the HRB from top floor hallway; exterior view from the east; rendering of the central atrium.

5.2. Relevance as a case study

The concept of multi-generational housing has been considered in Germany since the 1990s following increased aging rates and the gradual breakdown of the

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classic family structure. Several successful multi-generational buildings have been designed and built in Germany over the past 15 years (several precedents are outlined in section5.3); however, the HRB is the first such building to combine this imperative social agenda with a rigorous environmental one.

The building was conceived by architect Günter Behnisch in collaboration with the developer and client, *St. Gundekar-Werk Eichstätt Wohnungs* (St. Gundekar-Werk Housing and Urban Construction Company of Eichstätt). The concept materialized following the collaboration of the architect and developer on the 'seniors' co-housing' (*Seniorenwohnheim*) project in 1995-6, immediately east of the HRB (the project is outlined in section 5.4.). This concept addresses of one of Germany's most pressing demographical and social issues: its rapidly aging population. Germany's average age is 46, second only to Japan's, with one in 20 Germans aged over 80, and expected to rise to one in six by 2050 (UN & WHO, 2016).

The building demonstrates a deep environmental commitment and high performance alongside the profound social commitment to provide affordable, high-quality housing for both borders of the housing market (the young and the elderly), two populations that would otherwise have difficulty finding accommodation at this location and quality standard. The building's architectural design incorporates several context-sensitive features such as healthy interiors, high physical accessibility and the option to combine and separate apartments according to the residents' changing needs and family dynamics. Being part of a larger complex (two other architectural firms have designed residential buildings in adjacent plots for the same developer), HRB works in concert with its surroundings, offering residents easy passage to neighboring buildings, with plenty of public and semi-private spaces, and a familiar social setting

with friends and acquaintances nearby. Finally, the building offers its residents the possibility of being part of a community.

In the competition for the *Deutsche Bauherrenpreis* (German prize for Residential Construction) in 2014, the co-developers (St. Gundekar-Werk Eichstätt, Wohnungs and Städtebaugesellschaft mbH) received a 'special recognition' award for the Hollerstauden development. The Federal Ministry of the Interior awarded the developers this prize for "outstanding quality at reasonable costs", noting the project's social agenda and innovative energy-conserving strategies (Gundekar-werk.de, n.d.). The *Deutsche Bauherrenpreis* is regarded as the most prestigious nationwide award for housing construction, awarded jointly by The *Deutsche Städtetag* (the GdW Federation of German Housing and Real Estate Companies) and *der Bund Deutscher Architekten* (the Federation of German Architects).

Since the project's successful occupation in 2011, similar multi-generation buildings have been constructed in Germany, both locally and nationally. The motivations for the creation of this project, as well as the design and development process which led to its present-day program, typology and sustainable features, are discussed in detail in this chapter.

5.2.1. Sustainable design - overview

The HRB is one of ten pilot projects from the program e% - *Energieeffizienter Wohnungsbau* (energy-efficient housing construction), a program used in Bavaria to evaluate the energy-efficient design in government-subsidized housing. Also, the building was designed following the EU's Energy Saving Ordinance (EnEV 2009)

guidelines and specification, and includes a high-performing building envelope, a zero-carbon energy strategy and optimized mechanical systems. The project was executed through low-carbon construction practices, including many prefabricated elements, and specification of recyclable materials, particularly in the interiors. Post-occupancy energy efficiency testing (required for state grant allowance) resulted in an average energy consumption of 21.8 kWh/m²/ year (compared with 35.4 kWh/m²/ year average in Germany, or 55.9 kWh/m²/ year average in the U.S.)[11]. While these figures vary widely due to their calculation methods, based on household size, national electrification rates and energy source mix (such as use of electricity from renewable sources), it does provide a solid reference for the building's performance and commitment to efficient design.

Specific features include:

- An ultra-tight envelope, approaching Passivhaus standards;

- A large central atrium offers daylighting, passive solar heat gain and year-round climate stabilization (glazing is internally shaded in the summer months);

- A responsive HVAC system provides fresh air and works in conjunction with the indoor atrium space;

- A dedicated solar-thermal heat storage system including an indoor 30,000 gallon water tank for heat storage and distribution;

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[11] Source: *Enerdata* Global Energy Statistical Yearbook 2016, via World Energy Council; *Deutsches Institut für Wirtschaftsforschung* (German Institute for Economic Research)

- Optimized daylighting in the apartments;

- A rooftop photovoltaic array and a solar-thermal system complement the central heating system;

- A rainwater harvesting system feeds the inner and outer gardens.

Figure 0.3: Exterior and interior views, showing the atrium.

5.3. Precedent of multi-generational buildings

Several European developers have offered purposely-designed multi-generational housing projects since the late 1990s, realizing the need for these housing models and their potential. Some precedents include the Carmelite Monastery in Bonn-Putzchen, Germany in 2000 (52 apartments and 16 townhouses), the Kraftwerk I in Zurich, Switzerland in 2001 (97 apartments), and the Runzmattenweg building in Freiburg, Germany in 2004 (31 apartments).

The first such project, *Sargfabrik* (coffin-maker) was conceived and executed in 1996 by a cooperative named '*Verein für Integrative Lebensgestaltung*' (Association for Integrated Living – or VIL). The building, located on a corner block in the 14th district in Vienna, Austria is an adaptive reuse of a former coffin factory in the heart of the city. It was designed by the two architects in the group, which calls itself a '*Baukünstler-kollektiv*' (Architecture Collective). The award-winning building includes 31 maisonette living units of just 45sm (484sf), and up to six units can be combined to form larger private apartments. All apartments owned and rented out by the VIL collective. Shared common areas and facilities include a shared kitchen, a library and cultural hall, bar, outdoor pond and an extensive roof garden.

A second building, *Miss Sargfabrik*, which followed in 2000, further implemented the multi-generational concept with a total of 37 different-sized units designed to accommodate various types of families, e.g. elders, single parents, young adults, refugees, pensioners, or disabled. It also offered a wider range of common facilities: an organic restaurant, community kitchen, seminar rooms, library, kindergarten, 24-hour spa facility with two swimming pools and a sauna, also accessible to the public, courtyards with a playground and ball court, and a green roof with a BBQ area and vegetable plots. Developed through public funding, the

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ground floors of both buildings include publically-accessible shared spaces (Feddersen *et al.* 2009).

Miss Sargfabrik's architect Franz Sumnitsch describes the building's mission as "creating a social architecture", one in which all generations can feel equally comfortable. "What we are doing here is not just building a residential building, but providing scope for a certain lifestyle… many of the residents moved in because they no longer wanted to live anonymously but rather wanted to spend their lives as part of a community. Single parents, for example, can make very meaningful use of the full range of facilities such as the kindergarten, the swimming pool and the events hall… the elderly enjoy being in a lively and a convivial atmosphere" (Sumnitsch, quoted in Lüdtke, 2012).

Figure 0.4 Sargfabrik, 1996 (left), and Miss Sarfabrik, 2000 (right).

5.4. Background and site history – Phase I

The HRB site was developed in two stages by St. Gundekar-Werk, a nonprofit developer under the diocese (bishopric district) of Eichstätt, a diocese of the Catholic Church in Bavaria. Founded in 1954, the company's main mission and activity are the provision, operation and renovation of affordable housing. In recent years the company has added housing for seniors to its focus of activity, given the growing numbers of seniors in Bavaria (the company also own and operates a nursing home in Ingolstadt). Typical projects for St. Gundekar-Werk include renovation of residential buildings, primarily in Ingolstadt, Nuremberg, and Eichstätt. These renovation projects include general restoration (e.g. new facades, roofs, windows and mechanical systems) but also energy retrofitting to meet higher energy efficiency standards (Bistum Eichstätt, 2014). The Hollerstauden project was considered a major undertaking for St. Gundekar-Werk since it involves the new construction of a multi-building complex (of which HRB is part) at a scale much larger than previous projects for this developer.

Figure 0.5 Phase I of the Hollerstauden residential project: Seniorenwohnheim Ingolstadt-Hollerstauden. View from the east, at the current site of the laubenganghauser (portico house).

In 1994, Behnisch & Partner Architekten were approached and asked to develop housing for "marginalized groups in the real-estate market, like single-parent

families, students and pensioners" (Behnisch Architekten, 2017), as well as several small-scale institutional buildings in the Hollerstauden district. The project kicked off in 1996 with Günter Behnisch (then of Behnisch & Partner Architekten) designing a Montessori school and a kindergarten, built approximately 200 meters to the east of the present HRB project, and continued with a set of three residential buildings also designed by the practice: "It was only after the construction of these educational buildings that the developer understood that it is necessary to build the social residential complex for seniors and families nearby" (Behnisch Architekten, 2017). When these two buildings were occupied in 1997, the east-oriented apartments (those facing the school and kindergarten) were intended for families with children and single parents, the south-oriented apartments were intended for senior citizens and the second and third-floor apartments intended for students living as roommates. The original plan included two buildings with a total of 60 apartments intended for families and students (each 750-1000sf) and another 70 apartments intended for seniors, each approximately 450-600sf (Ingolstadt.de, n.d.). However, only the first phase of design was executed, and included 37 apartments for seniors (3 of which are wheelchair accessible) in a three-building configuration, later converted to private assisted-living residences. Contrary to the surrounding apartment blocks of the area, typically bland, four to five story row-houses, the project was immediately set apart by its colorful facades, with added depth and use of new facing materials, in its private gardens and its orientation, offering accessibility from all sides (see figure 5.6).

Figure 0.6 Phase I of the Hollerstauden residential project by Gundeker-Werk, designed by Behnisch Architekten in 1994-96.

5.4.1. HRB conception and development – Phase II

The HRB project was conceived in 2008, as the developer sought to renovate and develop the site for residential use, and approached landscape architects Grabner Huber Lipp (GHL) of Freising to design a masterplan for the multi-plot site between the streets Adam Smith (south), Hollerstaude (east) and Albert Magnus (north) in Hollerstauden. After securing capital from several government sources, including a generous development grant from the city of Munich for the revitalization the Hollerstauden district (Herbst, 2009), the developer held an invitation-based architectural competition, soliciting offers for the development of the entire site (Behnisch Architekten, 2017).

Behnisch & Partner submitted a comprehensive design for the entire plot, proposing a set of five freestanding buildings, each of them built around central atrium, working in concert to form a residential neighborhood with its own character, social rationale and spatial rhythm.

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Figure 0.7 Two of the competition boards submitted by Behnisch Architekten for the comprehensive design of the plot, proposing a set of atrium-houses with flexible ground-floor layout.

The architectural competition concluded with Bogevisch Beuro Architekten of Munich as the first-place winners. However, the developers chose to divide the plot

among the winners and the two runners-up: Behnisch Architekten of Stuttgart, and Architekturbüro Brand of Ingolstadt. Bogevisch Beuro was awarded the contract for masterplanning the site and for design of the larger, eastern parcel; Architekturbüro Brand was awarded the contract to design the western parcel; while Behnisch & Partner were awarded the contract to design the center parcel, immediately bordering the three existing buildings on the plot designed by Behnisch Sr. in the 1990s. The overall layout can be seen in figure 5.16: the U-shaped building by Brand, called the *innenhofhaus* (courtyard house) is on the western end, the apartment complex by Bogevisch, called *laubenganghauser* (portico house) at the eastern end, and the HRB by Behnisch, called *atriumhaus* (atrium house) is at the center of the plot, alongside the three pre-existing buildings designed by B&PA in 1996 (a high-end assisted living for seniors). All three firms were required to design multifamily buildings with a similar architectural programme, all in compliance with the e% - *Energieeffizienter Wohnungsbau* (Energy-Efficient Housing Construction) guidelines for energy efficient buildings (Lüdtke, 2012).

The entire development includes a total of 142 apartments, 21 of which were sold at market rates, while the others were state-subsidized and are offered for long-term rent at affordable rates, with a maintenance and operations agreement with the developer. Each building includes ground-floor wheelchair-accessible apartments (Bettac, 2013). The developer owns 1,878 apartments in Ingolstadt, which constitute 43% of its total stock of 4,362 apartments.
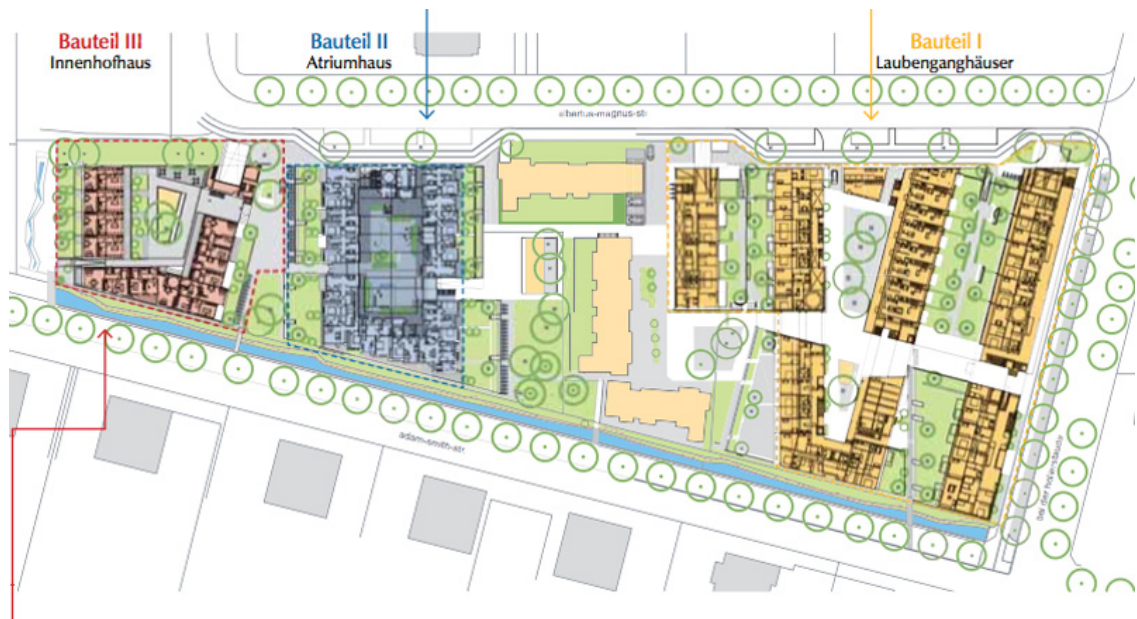
Figure 0.8 Layout of the Hollerstauden residential development by St. Gundekar-Werk.

5.4.2. City background and history

Ingolstadt is a medium-sized city (population 131,000) in the center of the German state of Bavaria, on the banks of the Danube River. It is part of the Munich Metropolitan Area, which has an estimated population of 2.65 million (worldpopulationreview.com, n.d.). The main regional employers are the AUDI industrial plants with some 30,000 employees, while local employers are Klinikum Ingolstadt (a regional hospital, and the largest employer in Hollerstauden) and a large oil refinery. Ingolstadt is a regional hub of service and commerce, and home to three universities – The University of Applied Sciences, The Ingolstadt School of Management, and The Catholic University of Eichstätt – which is the first and only Catholic university in the German-speaking world. Its *Hohe Schule* building, once used by the first Bavarian state university and the Anatomical Institute (now the Museum of Medical History), is the setting in the novel *Frankenstein* by Mary Shelley, where the scientist Victor Frankenstein creates his legendary monster.

The planning of Ingolstadt was heavily influenced by its military history. Since 1537, Ingolstadt was developed as a military stronghold, with an extensive system of stone walls and a fortress, which, during World War I, held the would-be French president Charles de Gaulle as a prisoner of war. In 1861, Ingolstadt had a population of 7,200 civilians and 12,750 soldiers. In 1909, the German government stationed a battalion of army engineers and planners, combined with a cohort of civilian manufacturers and companies, in the city, earning Ingolstadt the name "the cradle of the Bavarian pioneers" (Presslein-Lehle *et al.,* 2014). Following the two world wars and after the formation of the *Bundeswehr* (the United Federal Defense Forces of Germany) in the mid-1950s, Ingolstadt again became a garrison town and home to two pioneer and tank reconnaissance battalions. Military barracks and land and water training facilities were built in on formerly farmed areas on Manchinger Strasse (Ibid, 2014).

In more recent years, all formerly military sites in Ingolstadt and its suburbs have undergone extensive changes. In 1994, the Bavarian Government initiated a special program (*Entwicklungsmodell*), investing in housing projects and re-appropriation of abandoned areas after World War II. This project also affected the Hollerstauden district: the area around the HRB site, the northern part of the Hollerstauden, has many multifamily row houses developed in the 90s and 2000s housing many working-class families. The south of Hollerstauden is dominated by single-family homes.

5.4.3. Urban planning background

Ingolstadt has three concentric 'green belts' that shape the city's physical layout. These rings are to be kept free of development and act as conservation and

natural buffer areas, allowing individual neighborhoods to be developed between them, while keeping close to the city's green areas (Ingolstadt.de, n.d.). The *Glacis* is the oldest and innermost green ring; the second green ring follows the course of the former service works, while the third and innermost ring follows the course of the former fort (figure 5.18). The system of green belts is intersected by several linear development axes: the *Natürliche Entwicklung* (natural development) axis is shaped by the Danube River and its important floodplain forests and surrounding valleys; the *Stadtraum* development axis (north-south), on both sides of the railway, is the main axis for the interior city development. The latter offers the opportunity to develop the city inwards, through adaptive reuse of existing structures and space-saving construction, with more extensive land-based development on the outskirts of the city (Ingolstadt.de, n.d.).
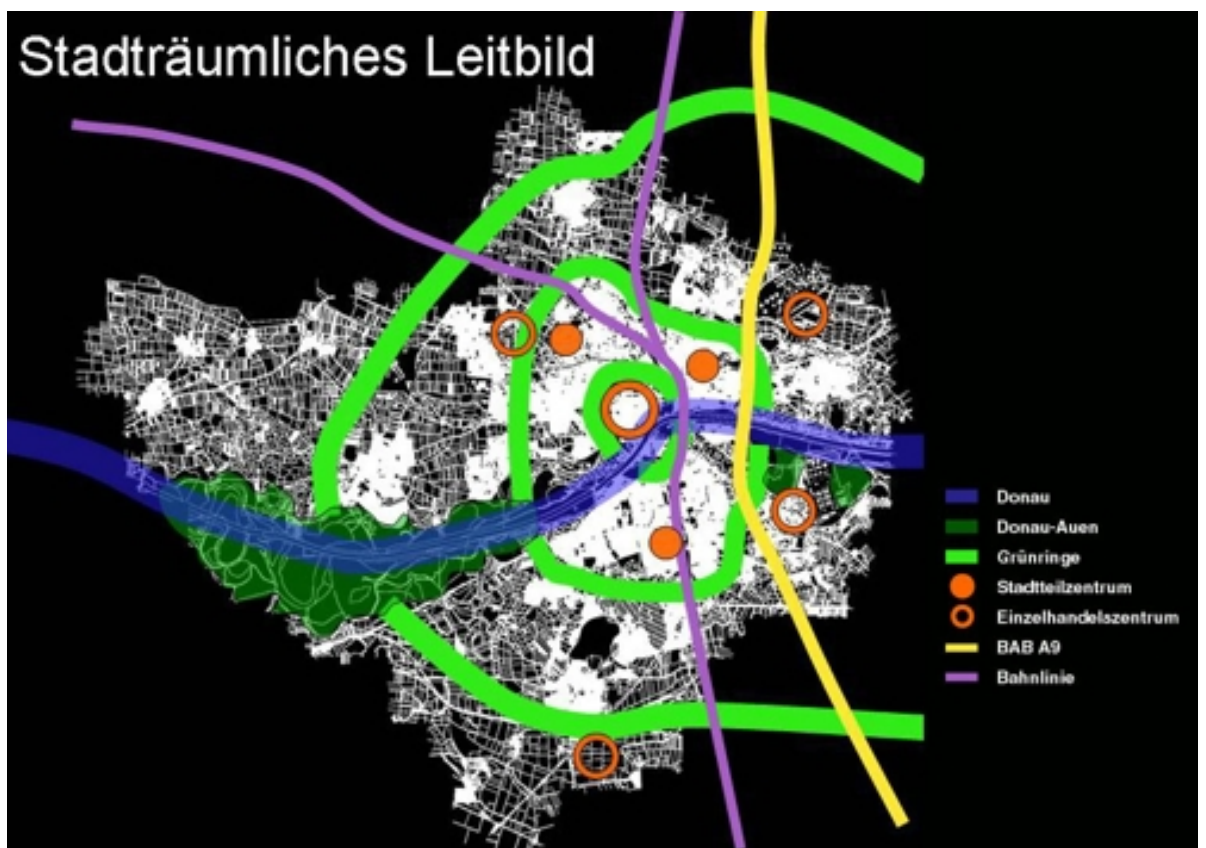
Figure 0.9 Ingolstadt urban plan

5.4.4. Changing demographics, new developments

In comparison to other municipalities and regions in Germany, Munich is considered to be a 'young city' due to natural growth and occupational migration. Still, the stable increase in the numbers of people aged 75 and over is considered one of the most profound demographic changes in the Bavarian state capital. Life expectancy is believed to rise in more than 25%, from about 115,000 residents aged 75 and above in 2013, to almost 150,000 in 2030 (*Oberste Baubehorde*, 2010).

It can be assumed that the future generation of the elderly will be very different from today's in terms of expected lifestyles, homogeneity and roles; and the image of the elderly in society is already changing. With their different individual resources and competences, they will have very diverse demands on their structural and social environment. "Eldering" is, therefore, one of the central themes of a viable urban development in Germany (Pommereau, 2007). For example, recent studies by the *Frankfurter Schule* Institute for Social Research found that due to better health and means (compared to previous generations), many elderly people lead more active lives, and that many voiced a desire to be productive again and the community level, and help young people and families with children – not necessarily their own relatives. "We want to offer our services, take a load off young parents, share our wisdom with young people, and when needs be, get the support of others… Many people have a third of their lives before them. They need a task. Without a specific task, life has no meaning." (Duffner, quoted in Pommereau, 2007).

This was one of the triggers leading to the development of several multi-generational residential complexes that offer old and young residents the chance to

connect and engage. Several States in Germany began supporting entrepreneurs who decided to develop social housing projects for seniors and young families (Lüdtke, 2012). These multi-generational buildings have begun appearing in Germany, taking on the character and scale of their locale. Most projects try creating a village or family atmosphere for its habitants, with walkable surroundings and well-designed public spaces. This concept changed the lives of many seniors, who can now enjoy being part of a community again, living among younger people and children. The shared time and close neighborly ties are surely a win-win situation for both resident populations.

5.5. Behnisch Architekten & Partner: Practice overview

The Behnisch Architekten Stuttgart office is part of the firm Behnisch Architects, Inc. BA was formed in January 2006 as an evolution from Behnisch, Behnisch & Partner, established in Stuttgart, Germany in 1989 (the original Behnisch was founded in 1952 by renowned German architect Günter Behnisch, later to be joined by his son Stephan Behnisch and Günter Schaller). The practice employs approximately 50 staff and is led by partners Stefan Behnisch, Stefan Rappold and Jörg Usinger. Among the firm's notable projects are the Munich Olympic Stadium (*Münchner Olympiastadion*), for the 1972 Munich Summer Olympics, the Plenary Complex of the German Bundestag (*Plenarbereich des Deutschen Bundestages*) completed in 1992, and the Academy of Fine Arts in Berlin (*Akademie der Künste*), completed 2005 (Behnisch Architekten, 2017).

In 2005, after several changes in structure and name, the Stuttgart office adopted its current name, Behnisch Architekten. Under Stefan Behnisch's leadership,

the firm has developed years of international experience with offices in Stuttgart (since 1991), Los Angeles (1999-2011), Boston (since 2006), and Munich (since 2009). All three firms operate under the name of Behnisch Architekten (archinform.net, n.d.). The Hollerstauden project materialized in the transition between Behnisch & Partner Architects and its current Stuttgart office, Behnisch Architekten, which will be referred to as 'BA' throughout this chapter.

The practice describes their overall approach as one that seeks to add quality to the built environment, emphasizing the non-quantifiable dimension of architecture and human wellbeing over the quantitative factors such as energy performance, costs and deadlines. The architects suggest that despite their critical role in the design and execution of a project, these quantitative factors have limited impact on a building's quality and cultural value: "[these factors] play a far-reaching role in the planning process, but once a project has been completed, they recede to insignificance" (Behnisch, *et al.* 2003). For this reason they prefer to devote their efforts to the 'softer' aspects of a project, particularly its social aspects, its human experience and regional and local contexts (Ibid, 2003).

5.5.1. Design process at Behnisch Architekten

BA architects describe the design process at the practice as structured, three part progression: the first phase includes sessions of unrestricted ideas and concepts potentially arising from any number of directions; in the second phase the ideas are tested against the project's contextual boundaries and pragmatic aspects, then it is often discarded and the process begins again; the third phase includes 'grounding' and application of the successful idea, after which it is carried forward and implemented. Consultants and fellow designers are brought in for collaborative sessions throughout

the process, and the architects note that they prefer fellow team members "who want to contribute to something special [project], and who are interested in innovation" (Behnisch *et al.* 2003).

The principals typically assign project roles, with a typical healthy mix of younger and more experienced staff working alongside each other. Energy modeling is typically outsourced to specialists who have a longstanding relationship with the firm: "They [these specialists] know their work best. We are architects, and they are engineers. We can try to be engineers, but we are not" (Behnisch Architekten, 2017). Founding partner Stephan Behnisch describes his role in the practice as a moderator and an advisor, who accompanies his employees on the journey of a project, with the designs emerging in discourse between them (Behnisch Architekten, 2017).

5.5.2. Behnisch Architekten's approach to sustainable design

The architects at BA describe the practice's approach to sustainable design as highly sensitive, communicative and integrative by nature. The sensitivity they refer to continues the practice's position on the traditionally misplaced emphasis on the quantitative aspects of a project: "sustainability nowadays has become foreshortened as a quantifiable term in public consciousness. i.e., reduced purely to measurements of energy use and CO_2 emissions… [sustainability] is so much more than a numbers game" (Behnisch *et al.* 2003). Instead, they advocate for a shift in focus towards the more qualitative aspects of a project, "those that will be appreciated and highly valued by the inhabitants and will remain as honest attributes for years to come" (Behnisch Architekten, 2017). The practice makes a point of introducing a set of subtle qualities to the project that will project outwards and appreciated by building's surroundings (Ibid, 2017).

The communicative aspect refers to a sustainable project's role in broadcasting the idea of sustainable architecture. Stephan Behnisch claims that this role is often overlooked, but should be "at the forefront of our thinking, just as the Eifel Tower was an icon for high-tech structural innovation and technical competence and ingenuity" (Behnisch Architekten, 2017). The practice believes that sustainable architecture should be leveraged to promote and circulate the idea of higher quality, higher performance, and greater environmental sensitivity. "We've been designing sustainable buildings for a while now… LEED Platinum is great, we've done a few of them… but who really needs a plaque on the wall? We still don't have a great sustainable building that is a real icon, one that excites the crowds, and says to them, 'this is where we should all be going!'. We need icons to show us the potential of sustainable buildings… we need the Eifel Towers and the Crystal Palaces of sustainable architecture" (Behnisch, S. quoted in Transsolar GmbH, n.d.).

The integrative design process the BA architects refer to is the standard *modus operandi* at the practice. Such integrative practices differ from the traditional process of an architectural team proposing a set of designs and handing them over to an engineering team for testing and evaluation. Instead, the practice seeks engineering input from the initial stages of the project (conceptual design), working with the engineering partners collaboratively to optimize an energy strategy as early in the process as possible (Behnisch Architekten, 2017). This collaborative process yields "highly optimized designs and more solid buildings…"; "it has a price, we have to let everyone [consultants and engineers] see what we're doing, at every step, to look over our shoulder, and provide their comments and hear them out, but at the end it works. What you call integrated process, we call working collegially, efficiently and logically" (Ibid, 2017).

5.6. Building design and performance

5.6.1. Background

The larger Ingolstadt Hollerstauden building complex was designed and constructed following guidelines set by the e% - *Energieeffizienter Wohnungsbau* (energy-efficient housing construction) program, initiated by the Bavarian State Government in 2007. Since then, the Experimental Housing Authority sponsored over two dozen energy-optimized renovation and new construction projects across Bavaria, all high-performing, with an energy consumption of 40-60% below baseline, using renewable energy. The 'e%' program follows the State's special "Development Model" program that was launched in 1995 with these principles in mind.

In 1995, the State of Bavaria and 12 city authorities initiated a program to advance development for innovative, exemplary new housing projects and residential neighborhoods. The State provided 200 million DM (100 million Euro) in low-interest loans to local authorities or jointly owned development corporations for the up-front financing of planning costs, site acquisition, clearing and provision of services for these developments. A decade later, the Bavarian Government decided to privatize state holdings in large-scale enterprises to enable investment in infrastructure, primarily in the technological and social sectors. The total volume of these investments, given the title "Pro-active Future Bavaria" (*Anstößige zukünftige Bayern*), is 2.9 billion Euro. 100 million Euro of these funds were provided for innovative urban development and housing projects (siedlungsmodelle.bayern.de, n.d.).

The design standards of the "*Wohnmodelle Bayern*" (Housing Models of Bavaria) follow the three main concepts e%:

(i) Building concept (*Gebäudeleistung*): optimization of building structure and building envelope;

(ii) Building technology (*Gebäudetechnik*): efficient energy use, with a high percentage of renewable energy; and

(iii) Alteration or **adjustment** (*Änderung*): Adaptation of technical systems for habitants' lifestyles (Baubehorde, 2010).

It should be noted that the e% program is performative (as opposed to prescriptive) in its approach: the building's performance and overall quality is evaluated following execution, as opposed to the designers being asked to apply a 'check-box' approach or include certain features without regard to their context. Certain features or qualities can be substituted with others, as long as an overall sensible approach to sustainable design, energy efficiency and interior quality is obtained, and target goals are met.

To put the above in context, the goal of St. Gundekar-Werk was to implement these standards whilst providing affordable housing for their target audience - senior citizens, limited-mobility people, single parents and singles. "The development of a high-performing building was a sound decision in economic terms, it made sense to us, both because of the government subsidies and the lower utility rates, and because of the opportunity to offer our residents a high-quality space. The seniors are a growing market [audience] and we felt we could provide for them the same level of quality living, even in affordable housing" (St. Gundekar-Werk, 2017). The creation of barrier-free living spaces enable the elderly and limited-mobility residents to be provided with appropriate apartments and enable them to stay longer in their own homes. Furthermore, additional services such food delivery, part-time cleaners and

on-demand nursing staff support the residents (Archidiocese de Gitega, 2011). The developers' decision to focus on the elderly population follows the increased demand for senior housing in Germany in the last decade (St. Gundekar-Werk , 2017).

Finally, the project's unique design places greater emphasis on creating an identity for itself, highlighting not only the building's sustainable design commitment but also its attention to the social aspects of its residents' lives: "The development was created to be unique in its neighborhood… [the design team] selected natural building materials, which are extremely economical and with the attention on a natural overall image and a sustainable milieu; the architects placed many social spaces around the plan, with small squares, courtyards and open spaces" (Ibid, 2017).

5.6.2. Building design

In approaching this project, Behnisch Architekten recognized the developer's mission of providing affordable housing for marginalized groups while acknowledging changes in the makeup of the population, new lifestyles and behavior in Germany. Thus, is was important to "not only address issues such as sustainable housing oriented only towards energy efficiency, but also to the social realm of the project, respect for residents' sense of safety, the use of quality and durable materials, accessibility and the flexibility in view of changing uses; an optimal use of daylight… these are important factors in order to ensure the long-term success of a residential complex, in addition to optimized energy consumption." (Behnisch Architekten, 2017). This approach underlines a balance between the energetic, social and qualitative aspects of the building. The site is located in an area whose built character transits from urban to more village-like settings. Through the design, the plot develops its own character, which is a land of structures, public spaces and landscaped areas, which also serve the immediate neighborhood.

Notable design features of HRB are:

(i) The apartments are grouped around a central atrium, flooded with light and visible from any point on the interior of the building. The atrium enables the private living space to be expanded into a semi-private, yet public, space. Spacious experience. The interior space is characterized by a permeable outer layer, formed through a series of projections and regresses into the atrium, at different heights, defining entrances and balconies.

(ii) The green areas (across the entire plot) are subtly divided to public, semi-public and private gardens, with no fences or other harsh boundaries marking the end of one building's yard and the beginning of another; a wide path links the properties, and public seating, play facilities and meeting points enrich the outdoor social space.

(iii) A perennial interior garden helps regulate fluctuations in temperature and humidity, thereby reducing the apartments' energy demand for heating and cooling. The walkways, balconies and vegetation in the atrium also help 'break' the large void, aiding the acoustics inside.

(iv) The building is constructed of prefabricated wooden walls, resting on a concrete foundation with suitable thermal breaks. The apartments are flexible in arrangement, and can be paired with each other (a select few in the ground floor have one to two movable walls for separation of private and public areas). On the exterior, southern walls are staggered to provide optimum sun protection, preventing overheating in summer and solar gain in the winter.

(v) All ground-floor apartments are wheelchair-accessible and designed for wheelchair-bound or walker-assisted living. Exterior windows were designed with

lower *unterkants* (windowsills) to enable outside view even for those in wheelchairs, or simply sitting, providing a line of sight to the outside.

5.6.3. HRB's sustainable design strategy

The architects described their sustainability goals as (i) minimization of energy and water consumption applied across the entire lifetime of the building; (ii) creating a healthy and comfortable interior climate for the residents (air quality, daylighting, thermal, visual and acoustic comfort); (iii) minimized environmental impact of the construction process (Behnisch Architekten, n.d.).

The use of pre and post construction funding through the e% program of Munich offered the developer a 10% increase in the state funding already offered towards the planning and construction costs (being an affordable housing development). This funding was in addition to substantial tax incentives received following construction, and after the building's performance is tested and evaluated. These tax incentives are dependent on a proven reduction of 40% - 60% of energy use compared to baseline, and that the energy strategy includes a mix of renewable and local energy sources (Ritzer, 2013), and offset the costs of most of the building's mechanical systems (Behnisch Architekten, 2017). The demand for heating in the buildings is 18.9kWh/sqm/year, 60% of which is met through its rooftop photovoltaic system with approximately 1,300 m2 of solar collectors (Gundekar-werk, 2009). The remaining energy demand is met by district heating, which is fed from the waste heat of local factories and industry (Herbst, 2009).

Specific building features include:

- Prefabricated wooden construction reduces the building's carbon footprint and speeds up construction time; exterior walls are prefabricated 5-ply solid 'sandwich' panels, and an inner 24 cm thick wall structure with a final larch wood cladding. The cavity formed was blown out with cellulose insulation. On the outside, the walls to the side walls were covered with gypsum fiber and fiber cement boards for fire protection reasons. The wall construction is airtight (blower door tests were performed to eliminate defects on the construction site).

- Use of a dedicated solar-thermal heat storage system, consisting of rooftop solar-thermal collectors feeding into an interior some 55 cubic meter (30,000 gallon) water reservoir that sits upright at the building's core; the closed system circulates the heated water throughout the building for heating in radiators and sub-floor heating.

- Use of the atrium as a regulator for climate control (temperature and humidity), keeping indoor temperatures around 12C (53F) in winter and 27C (77F) in peak summer months, given both cooler nights and top gable vents; the atrium roof is double glazed with foil-based low-e coating;

- Selective shading and natural ventilation of the atrium in the summer to achieve comfortable conditions;

- 'Intelligent' (sensor-operated) air circulation in the summer to avoid summer cooling loads;

- Vegetation in the atrium regulates moisture and improves indoor air quality;

- Rooftop photovoltaic system of nearly 1,300m² supports the heating system;

- Water-conserving measures in all apartments' washrooms;

- Rainwater collection system diverts water to outdoor wetlands;

- HVAC system includes a heat recovery system with 80-90% efficiency;

- Interior materials such as flooring, wall and ceiling finishes and countertops are largely naturally based [12] and locally sourced; finishes are all low-VOC compliant; paints are water-based.

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[12] Attempts to recover more specific information regarding the certification level or sourcing of the finishing materials were unsuccessful, since materials were specified by the interior fit-out subcontractor following recommendations from the architects; the e% program regards energy efficiency as its main focus and doesn't dictate specific interior material specification.

5.7. Pre-design research and community engagement

The development process of the HRB project should be framed with the context of the wider efforts and policy in Ingolstadt's outlying districts, the city of Ingolstadt, the Munich metropolis and the State of Bavaria. The general development objectives for Ingostadt were set in the city's 1996 land use plan. The concept of the "compact city", formulated in the 1990s, aimed at the development of the land potential in the core city as well as the division between the districts, is an integral part of Ingolstadt's urban planning plan (Ingolstadt.de, n.d.).

Unlike many other cities in Germany, Ingolstadt is still a growing city, and demographic projections show not only a future rise in population but also a change in the population structure, e.g. the number of one- and two-person households is expected to increase, as is the number of seniors. The city chose to address the future needs for housing through internally oriented residential development. Two areas selected for the application of this policy are urban infill and development with the city's districts (like Hollerstauden).

To prepare for this process adequately, the city of Ingolstadt commissioned a study from Schäuble Institute for Social Research[13] in May 2011, aimed at exploring and defining the social needs for housing and the development opportunities in in various parts of the city. The study included quantitative statistical and geographical research as well as a qualitative portion, consisting of resident interviews, workshops and lectures followed by Q&A. The conclusions were presented to the public through

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[13] The Schäuble Institute for social research (*Schäuble Institut für Sozialforschung*) in Munich offers socio-economic analyses and evaluations, as well as facilitation of planning dialogues through citizen and public participation. Its clients are typically governments at federal, state and municipal levels, but also resident associations and NGOs (schaeuble-institut.de, n.d.).

a series of publications, events and an open exhibition, titled *Lebenswelten* ('Lifeworlds') (Ingolstadt.de, n.d.).

Lifeworlds painted a picture of how the city as a whole is perceived by its citizens and offered relevant opinions from inhabitants' interviews. The results of the study and interviews focused on the theme of diversity in new housing developments in urban areas, providing inspiration for various living forms in the different districts: one of the emerging themes discussed seniors' housing and offered the concept of multi-generational housing[14].

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[14] The idea of multi-generational housing is claimed by both BA (claimed to have been developed jointly by Günter Behnisch and the developer St. Gundekar-Werk in the late 1990s) and by the city of Ingolstadt's planning department. For the purposes of this study, it seems largely irrelevant who initiated the concept, yet its success as a housing model is evident from the multiple authorship claims.

Figure 0.10 Extracts from the 'Lifeworlds' study report, exhibition and workshops

The city of Ingolstadt chose to incorporate several of the insights from the commissioned study in its 'Ingolstadt City Development Plan for 2025', published later in 2011, in a chapter dedicated to 'new housing forms':

(i) Social goals were outlined as participation in the planning and construction process, mixture of households of different income and economic constellations, modern housing for young and old, with disabled and non-disabled, families,

single-parent families, housing communities, new housing, young people and adults;

(ii) Particular qualitative goals for new housing developments included the provision of common areas, both interior and outdoors;

(iii) Aims of sustainability were outlined as and living in community, energy efficiency and maximum self-sufficiency, use of regenerative building materials and life-cycle assessments, space-saving construction including green and usable roof surfaces, low-car housing, car-sharing co-ops and new mobility concepts (e.g. Zipcar);

(iv) Planning goals were outlined as communication, transparent conduct and participatory planning, discontinuation of development over common and green areas, neighborhood infrastructure development (called 'white areas', or areas without distinct use, for future development), and application of a mixed housing key, which addresses different age groups and household sizes (Living value 2025, 2011).

5.8. Summary: Hollerstauden multi-generational building

       The HRB was conceived in unique circumstances. A mission-driven developer and competent designers joined forces, leveraging government programs and community-based research to form this exemplary project in the affordable housing sector:

- The HRB is part of a larger, multi-building constellation by the developer; the buildings work in concert with each other and function as a unique neighborhood of their own, particularly during the workday (when the younger families are away at work and school);

- A process of community outreach, including interviews and workshops, raised the issue of housing for seniors in the larger Munich area;

- Both local and regional municipalities recognized the need for such projects in the Hollerstauden area, offering HRB the status of a pilot project under EnEv with subsequent grants which contributed to offsetting the costs of the mechanical and energy systems;

- Government incentives brought the developer to seek high performance through the e% program, with regional specifics such as local material sourcing;

- The design team created a building that brings the resident community together, focusing both inwards and outwards, and offering spatial opportunities for communal interaction, while sensitively catering for a multi-aged audience.

The developers of HRB sought to provide affordable, high-performing housing that will offer seniors and young families quality co-habitation. Both developers and architects relied on government support – financial and programmatic, respectively – to help these visions come to fruition. The most influential practices and methodologies used by the design team to

materialize these visions are outlined in section 5.9.2.5.8.1. Key insights from interviews:

The Hollestauden Residential Building project was completed in 2011, making research somewhat challenging given than most of the design team members have moved on to work at different architecture firms. Even once tracked down and contacted, most weren't interested in participating in this study, or simply said they had inaccurate recollection of the design process.

Insights from the research process arrived through frontal interviews with the project team, and through analysis of meeting protocol documents (in German, translated by a research assistant), all relating to the research questions of this dissertation as detailed in section 1.2. Documents from the planning department of the city of Ingolstadt, and an interview with the Ingolstadt city architect's office were particularly helpful in understanding the wider set of conditions that made the project possible, and ultimately successful. These conditions, and design decisions used by BA's designers, are outlined below:

The long-standing trust between Behnisch Architekten and St. Gundekar-Werk was fundamental to the project's sensitive conception and design process, and successful execution. The relationship between Günter Behnisch and the developer, going back to the early 1990s, laid the foundation for a long design process described as mutually respectful and appreciative by both parties.

A 'local culture' of integrated design process was used to manage objectives and consolidate efforts to meet prescribed targets set from above by the client and the Bavarian State funding program. Although not researched or proven with other local architecture firms, the architects at Behnisch reported that such an

integrated process was generally standard practice at both their firm and many other progressively-practicing firms in Germany; they listed the virtues of working in an integrated manner and the many advantages this methodology offers (efficiency in design, 'hitting' performance targets, lower costs). Another noteworthy point made by the architects was that several issues perceived as disadvantages in the U.S. are deemed acceptable in Germany, seen as a natural offshoot of the integrated process – issues like a longer design process (due to multiple iterations), multi-stakeholder meetings, more mature architects, a larger consultant-cohort or longer process due to increased delegation of responsibilities and transparency (BA, 2017).

State and municipal support were critical: both financially, and for alignment of expectations between developer, government and designers. The developers received tax incentives offsetting a substantial share of the costs of the building's mechanical systems (following reduction of 40% - 60% of energy use compared to baseline), while post-occupancy grants through the e% program by the Munich government offered the developer a 10% increase in the state funding already offered towards the planning and construction costs, being an affordable housing development (Behnisch Architekten, 2017; Ritzer, 2013).

Residents' social wellbeing and environmental performance were considered as equally influential drivers of design decisions. These two value spheres offered the most unique attributes of the building: the central atrium, functioning as both a social space and a climate-regulating feature, the mix of apartments, including the senior-friendly units on the ground floor, the tight building envelope, PV and HVAC systems, the selection of healthy interior materials and products, ensuring resident health and wellbeing; and the inclusion of exterior

communal spaces and connection to the neighboring buildings.

5.9.1. Interviewee classification

From the 9 professionals who were asked to take part, 6 interviews were conducted with architects, designers and developers. The interviewees typically had experience of working on housing projects in both the private and affordable housing sectors. Both the organization and the position or roles in which interviewees worked are shown in Table 5.1. All interviewees had previous experience of working on projects with sustainable design agenda and through government-affiliated schemes.

Table 5.1: Hollerstauden Residential Building: interviewee categorization

Organization	No. of Interviewees	Position / Role
Architect	2	Design architect / Architectural manager / Sustainability Architect
Designer	1	Designer / material specialist
Engineer	1	HVAC engineer
Developer / client	1	Developer / owner
Management	1	Architect / project coordinator
Total	**6**	

Note: Conducting interviews was a challenge in this case study, since the project had been completed in 2011, and most of the design team members had moved on to work at different firms; the lead architect and project leader however, were still employed at the Stuttgart practice of Behnisch & Partner Architekten.

5.9.2. Contributing factors towards sustainable, equitable design and development

Interviewees were asked to point out contributing factors, conditions and motivators towards successful design and development of sustainable and socially

equitable building projects. Since no corresponding themes were identified in the literature and with a grounded theory process in mind, the main themes arising from the data, were: process, economy, social responsibility, and industry, as well as a unique theme for this project, policy (Table5.2). Under each of these themes, several relevant sub-themes have been identified from the data.

Table 5.2: Hollerstauden Residential Building: contributors to ESD projects.

Theme	Sub-themes	Interview Quote
Process / structure	• Strong conceptual design • Clear definition of performance goals by client • Solid programme composed with client • 'Shared' consultants, designers and engineers • Being part of larger effort	"It was clear to us where this project needs to go, and what it should broadcast externally [exemplifying green design]" (Architect #2); "Working with two other firms on the same site was challenging. But it was helpful to know we were all striving for one goal, and each firm had their own strategy for making a good building" (Architect #1).
Economy	• Demographics of aging population • New market to tap into • Accessible financing	"We knew we were onto something [development for seniors] when the demographics came in… We studied the predictions and there was no doubt – we must address this need" (Developer).
Social Equity / Responsibility	• Desire to benefit community • Religious / spiritual motives • Professional responsibility • Commitment to sustainability cause • "Cultural norm"	"We must consider the entire wellbeing of the resident: the air quality, natural light, thermal, visual and acoustic comfort. It is our duty to consider these" (Architect #2). "This is our social and human duty. We will all grow old one day…!" (Developer).
Housing Industry	• Professional advantage • Market demand	"We were not the first to see this trend, but we were the first to act on it… Now it is growing" (Developer).
Policy	• Tax incentives • Clear program at municipal and regional levels	"When the client is incentivized to be 'eco', they arrive at your table ready to work. Then our work is easier in that sense". (Architect #1).

| Design Decisions & Tools | • Clear commitment towards integrated process
• Nearby precedents (including the firm's own project) and support from neighboring developments
• Intentional 'inwards' design of living units
• Prioritizing communal spaces and features | "It was very clear to us what we should do to make the client's vision work; we knew the area around the site, and we knew the [unique nature of] working with that sector [seniors]" (Architect #1).

"We used a simple greenhouse structure for the atrium… nothing fancy. But it brought an added value that we didn't imagine, both climate-wise and design quality…particularly for families (Architect #2). |

5.9.3. Barriers and challenges of sustainable, equitable design and development

Interviewees were asked to point out factors that were seen as inhibitors, barriers and / or challenges towards successful design and development of sustainable and socially equitable building projects. The main themes arising from the data are: process, economy, competence and industry (Table 5.3). Under each of these themes, several relevant sub-themes have been identified from the data.

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Table 5.3: Hollerstauden Residential Building: Barriers to ESD projects.

Theme	Sub-themes	Interview Quote
Process	• Sustainability approach and targets dictated from above • Performance goals dictated energy and design strategies • Multiple architects working on one plot caused slow progress at times • Integration had already taken place, 'at the client's level'	"We had a well-defined programme and performance targets, but no clear 'recipe' for the method of application, and limited freedom in pursuit of these"; "The client came to us very well prepared but still much had to be figured out to tailor an energy strategy". (Architect #1).
Economy	• Financing and tax incentives enabled a structured progress pace • Great local demand (apartments 'sold like hotcakes' when available)	"The financing options were helpful, but they are never enough for such a complex project. I wish they were better today" (Developer #1).
Competence	• Architects and engineers had to work in close collaboration to achieve performance targets • Some materials were difficult to locate	"We knew what our task was, and what the client's expectations are, and we did it". (Architect #1). "What you call 'integration' we simply call working collegially, efficiently and logically" (Designer #2).
Industry	• Limited availability of toxin-free materials	"The construction industry [in Germany and western Europe] knows how to deliver these solutions. They just need us to specify them and for the market to demand them…. ". (Architect #2).

5.9.4. Stakeholder involvement

Interviewees were asked to evaluate and reflect on their level of involvement throughout design and development process of the project, as well as that of the other role-holders (e.g. architects as a whole, PL office as a whole, developer / client etc.) in relation to the project phase. Interviewees answered these questions through subjective estimates, examples of milestones along the time span of the project development and personal accounts. Each interviewee was asked to rank their own

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(and the others') efforts or involvement from zero to five (no involvement to intensive, consuming, hand-on involvement). Some of the answers were then multiplied in proportion to reflect the number of professionals engaged in the project at a given time (e.g. if the architect was equally involved in two of the phases, yet had one or two staff working on the first phase, and five staff working on the second phase, the level of engagement for the latter was proportionally multiplied to reflect the extra man-hours devoted to that phase).

While their interviewees' answers were subjective and by no means absolute, their agglomeration and plotting on a stacked-area chart paints a picture of the nature of the integrated process: it shows, for example, early involvement of the general contractor, or the two peaks of effort put in by the architects at the beginning (research and goal-setting) phase and just before the execution of the project. It also illustrates the continued involvement some of the stakeholders continued having with the design team even after the project's execution was well under way.

The results of this inquiry are summarized below: the ranking shows the perceived level of involvement or effort devoted to the design and development process across the project phases, from zero to five, for each role holder:

Table 5.4: Hollerstauden Residential Building: Stakeholder involvement

Project Phase / Role Holder	Architect	Developer	Contractor	Engineer	Sustainability	Project Manager	Municipal Liaison
Conception	2	1	0	0	2	1	3
Research	3.5	2	0	1	2	1	2
PD	4	2	1	2	2	2	1
SD	3	1	1	0	0	1	1
DD	2	1	0	0	0	1	0
CD	2	1	0	0	0	2	0
PR	4	3	5	3	0	2	1
CA	3	1	3	2	0	1	0
OP	1	2	0	0	0	1	0

Key: PD: Pre-Design; SD: Schematic Design; DD: Design Development; CD: Construction Documentation; PR: Procurement; CA: Construction Administration; OP: Occupancy and Operation
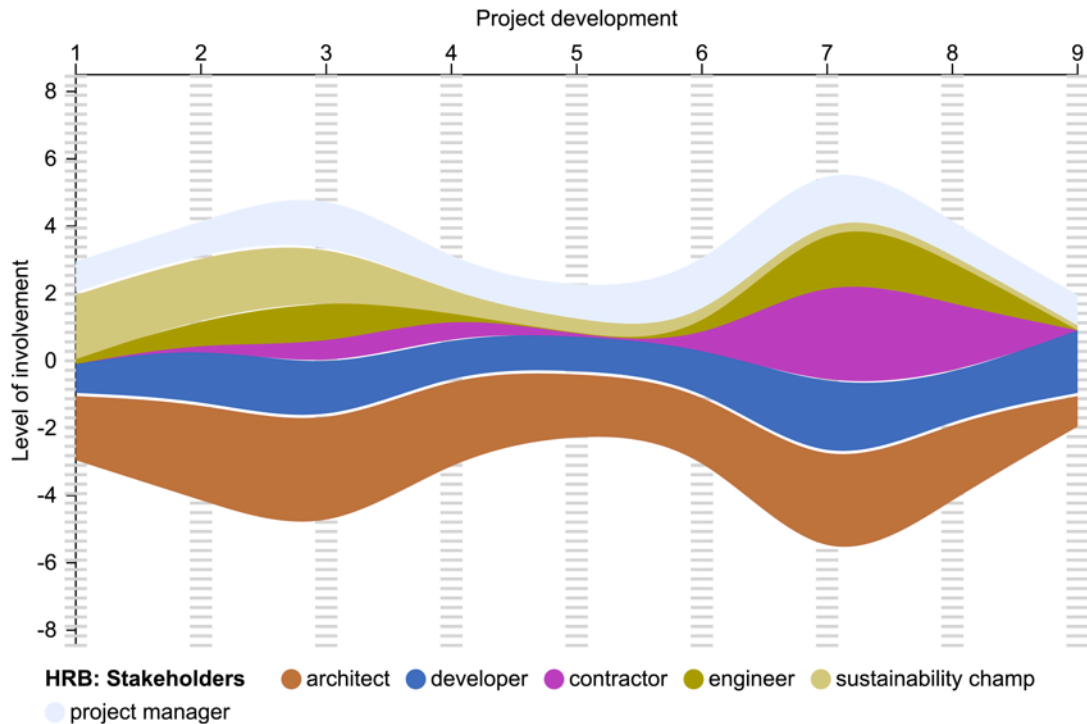
Figure 0.11 Hollerstauden Residential Building: Stakeholder involvement

5.9.5. Designer competencies

Interviewees were asked to evaluate and reflect on the performance and competence of, and roles assumed by, the designers and architects throughout the design and development process of sustainable and equitable building projects. Responses from the design team members were naturally, quite subjective, yet some highlight quotes did offer invaluable insight into the dynamics of the project's design and development process, as well as to the idiosyncratic challenges of this particular project.

The main themes arising from the synthesis were:

(i) Designers as integrators: The designers of HRB faced the task of taking a set of programmatic, budgetary, technical, social and performative targets and delivering a

building that would best meet them, on time and on budget. This statement is true for any architectural project, however the specific conditions and goals make this project more demanding. Working shoulder-to-shoulder with two competing firms presented a challenge in terms of the workflow, since some of the engineers and consultants had been assigned to the entire plot (the three new construction projects) and were thus forced to divide their attention across them. Designers noted that there was a lack of contextual experience in the field addressing the triple-challenge at hand: "We know how to design for high efficiency, or eco… we know how do design affordable housing, and we know how to design senior residences; but we never did all three in the same building… at this budget and to perform to e% standards" (BA, 2017).

(ii) Designers as social leaders / promoters of social equity: Designers felt that throughout the process of design, development and execution they were faithfully executing the wishes of the developer for inclusion and comfort for the elder population, however some commented that "advancing such social causes should come from us… the market is mostly profit-driven, and if we don't advance these causes, [projects] will most likely not cater to these populations… or address their specific needs" (Ibid, 2017).

5.9.6. Summary of findings

(i) Longterm relationship and trust between developer and architect: The fact that the architect and developer have collaborated before on a project with similar goals was critical for efficient communications and collaboration. Both parties described their 'multi-tiered' relationship and its contribution to the success of the project.

(ii) Energy performance frameworks were pivotal in making design decisions:

Both the e% and the EnEv programs provided clear performance goals; combined with the building's programme compiled by the architects and developer, these performance targets made for efficient decision-making, particularly with the building envelope decisions, energy strategy and overall building design – most notably the decision for the atrium as the main feature of the HRB.

(iii) Integrated design process: The integrated design process welcomed input from the consultants and the contractor early in the design process, examining life-cycle costs through dedicated modeling and establishing an energy strategy for the building as the plans materialized. In the case of this project, integration was logistically more difficult given that some of the consultants were sharing their time with the other two buildings developed.

(iv) Architects leveraged spatial design tools to reinforce social wellbeing and livability: The designers of HRB used good, timeless design principles – like contrast between open spaces and closed spaces, and between public and private spaces, using volume, rhythm and movement – to reinforce a sense of community within the building while offering residents a sense of privacy and seclusion when necessary.

(v) Community participation: The citizen interviews and workshops provided a 'grounded' departure point for the developer to offer this project for consideration by city officials, and cultivate it by demonstrating not only real need (apparent from statistical analysis), but resident desires.

The design team of the Hollerstauden multigenerational building was tasked with developing the design to address its unique programme and target audience, as well as meet performative goals; they voiced their desire to complete these tasks whilst aiming to keep both the environmental and social concerns equally relevant throughout the process. They were able to achieve this goal by applying both process and design tools.

The process is integrated design as it is practiced at Behnisch Architekten, fir to match the professional DNA of the firm, and the German mindset, however the foundations of integrated design remain universal: perform contextual research, build collaborative partnerships and trust with stakeholders, listen to local community, share information, make decisions jointly and keep resident and community wellbeing in mind throughout the process. The BA team described their integrated process methodology as "very natural to our way of working" (Behnisch Architekten, 2017), highlighting its logic and effectiveness, yet aware of its limitations (mentioned in section 5.8). In the case of HRB, this methodology was critical not only for meeting performative goals but for staying on budget and for effective collaboration with the other architecture firms working alongside them on the other parts of the larger project.

The design of the HRB was realized by the architects and designers through thoughtful consideration of the residents' wellbeing, both as individuals and as a community. The building's spatial design lends itself for accommodation of different lifestyles and inhabitation dynamics on daily, seasonal and multi-year scales. The inclusion of senior residents in a project that would otherwise be less accommodating for them has proven effective and synergetic for all residents, and the continued

development of similar mixed-age housing projects speaks volumes to this end (St.

Gundekar-Werk, 2017).

Chapter 6: Case study III – Housing for Youth, Furuset

Figure 0.1 Housing for youth, Furuset (rendering, view from southwest)

6.1. Project overview:

Location: Furuset (suburb of Oslo), Norway

Developer: *Stiftelsen Betanien* (Bethany Foundation), Oslo

Designers: Haugen Zohar Architects, Oslo

Principal-in-charge: Dan Zohar

Landscape architect: Dronninga Landskap AS

Construction: Wood Con (timber construction), Czech Republic

Project manager (PL): CM Project AS

Energy engineers: Steinsvik Architectural Office AS

Consultants: Rambøll (RIB); Dagfinn H. Jørgensen AS (RIV); Høyer Finseth

Size: 2,800 sm (30,140 sf)

Sustainable design framework: FutureBuilt (The Norwegian low-carbon building scheme), 2016

Partners: FutureBuilt; Innovation Norway; *Husbanken*, Oslo Municipality; Enova

Completed: May 2017

Relevance as case study: Mixed tenure; Inclusion and community-building

Furuset Housing for Youth project (FHY) is a 36-unit affordable housing development in the Alna district of Furuset, a suburb on the northeastern outskirts of Oslo. The project was realized by nonprofit developer Bethany Foundation Oslo to address a need for two- and three-bedroom rental housing in Alna, particularly for young people who want to re-locate to Furuset. The project, which emerged through the developer's partnership with Oslo's FutureBuilt program exhibits a bold sustainable design approach combined with a clear social agenda, making it a prime example for successful integration of these values.

The FHY project, nicknamed 'Ulsholtveien 31' for its street location, includes 9 new adjoining buildings, each divided to 3 apartments, and the adaptive reuse of an older building already on the plot, converted to 9 additional apartments with common areas on the ground floor. The designers aimed to create a model for high-quality affordable housing that is environmentally sustainable and socially vibrant, designed for young people renting their first home.

FHY's design demonstrates the designers' emphasis on environmental design and resident wellbeing: the buildings are built in massive cross-laminated timber and finished with natural materials; all homes are built to Passivhaus standard, with a substantial part of their energy supplied by rooftop photovoltaic systems and on-site geothermal wells; mechanical systems and interiors are robust to reduce the need for maintenance; the site is highly accessible and designed for reduced car use, facilitating pedestrian and cyclist transportation; common areas (indoors and out) were designed for social interaction; finally, outdoor social amenities are available not only to FHY's residents but to the larger neighboring community.

FHY is positioned on a hillside, with a gentle incline to the south and a steeper cliff to the west. The site had an existing two-story building called the *Furuhuset* (pine house), built as an orphanage in the 1950s, and used as a nursery since 2004, and an old garden to the south. The designers chose to keep the building intact, bringing it to building code standards and adapting it for residential use, and reserving its ground floor for common spaces. New buildings were constructed to the west side of the site, taking advantage of the sloping terrain, with private and public outdoor spaces on the two-leveled landscape. The designers prioritized the social aspect of the project, placing all entrances facing an inner residential path, forming a living environment with a unifying and strong social character (HZA, n.d.).

Figure 0.2 The site of Furuset Housing for Youth project.

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Like many large cities across Europe, Oslo is experiencing an increased need for adaptive housing strategies. The pressure of natural new demand for housing is intensified by an influx of immigrants over the past three decades. In a housing market dominated by homeownership, young people (both natives and immigrants) are facing hardship trying to find adequate and affordable housing (Hausbanken.no, n.d.). Furuset is an area of great diversity, where nearly half of the inhabitants have either immigrated themselves or were born in Norway by immigrant parents, with residents from more than 140 countries in the district as a whole. This diversity involves both great resources and challenges for urban development (Futurebuilt.no, n.d.).

In the FHY project, the developer sought to address a known shortage in affordable rental apartments in Furuset, particularly for young people taking their first steps in the housing market. Targeting young singles and couples, with and without children, wanting to settle in the district, the developer aimed to create a safe, affordable living environment that will enable them stability and growth. The developer described their objective in instigating the FHY project as "providing a quality, safe environment… achieving good planning and architectural responses for a climate-friendly use of the property, and with flexible housing solutions for young peoples, within a financial structure that is adapted to the local rent levels" (Betanien, 2017).

The FutureBuilt program was established "to support climate-friendly urban development in the Oslo region" (Futurebuilt.no, n.d.). Initiated in 2010, the ten-year program aims to develop at least 50 pilot projects of climate-conscious buildings and urban projects. The program's main benchmark includes a minimum of 50% carbon

footprint reduction in construction and operations compared to baseline buildings, 60 years forward. Other criteria include low-carbon transport, conscious resource use and use of natural materials in construction. Thus, the developer's early partnership with the FutureBuild program seemed like a natural step for the Bethany Foundation. As a religious organization, the Foundation's leaders were excited to learn of the program's mission, which coincide with the Methodist Church's rationale of Care for Creation (see section 6.3).

From a design perspective, the FHY project has a clear social, human-scale emphasis: the newly constructed buildings occupy the edge of the site, framing a central courtyard with the existing building; the 'social' rooms (dining / kitchen) of the apartments face the courtyard to create a convivial façade with movement and people; the site is open to the south, enabling children to play in the courtyard and everyone to enjoy the sun; the site is close to Furuset city center and Metro (about 6 minutes by foot); the existing building has a large common room for classes and events; there is an on-site bicycle service shop; finally, the project was designed for minimal car use, including just 9 parking spots for the 36 apartments (two of these spots are reserved for the Oslo Car Collective).

The clear social agenda of the developer, targeting young people and immigrants, combined with the high-performing Passivhaus strategy of the buildings, make this project an ideal case study. Also, the methods used by the architects to enhance the livability and sustainable lifestyle of the residents are particularly noteworthy, encompassing building positioning and construction materials, interior design decisions, technological efforts to achieve comfort and high performance, accessibility and a variety of amenities for resident wellbeing throughout the project.

6.2.1. Sustainable design - overview

The FHY project is part of FutureBuilt, a Norwegian government initiative aimed at demonstrating the potential of low-carbon building to both the general public and the architectural and construction community. The program also aims to disperse the specialized Norwegian knowledge of low-carbon and Passivhaus construction and strengthen the local construction sector.

All buildings are designed to **Passivhaus standards** (all residential new construction in Norway is required to be Passivhaus rated by code as of 2014), following four main design principles:

(i) A superinsulated envelope, with strict adherence to the U-values of the walls, floors and windows;

(ii) Fewer and smaller openings, with all windows having a U-value of 0.8;

(iii)Buildings are detailed with great care to avoid thermal bridging;

(iv)Balanced ventilation of air intake and expel, with heat recovery systems at 90% efficiency.

Besides the Passivhaus-rated design and construction, FHY has an extensive **energy strategy** to uphold the mandated 50% reduction in carbon emissions to enjoy the FutureBuilt status. To do this it relies on several synergetic technologies:

(i) The site includes 8 geothermal wells, each just over 200m deep;

(ii) A south-facing vertical solar-thermal system heats water for resident use, dumping the excess hot water to the bottom of the wells, effectively heating the earth when possible to provide a better starting point for the geothermal system;

(iii) A set of rooftop photo-voltaic systems are used to operate the geothermal pumps, and feed access power to the grid via an inverter (HZA, 2017).

(iv) A decentralized HVAC system is used to regulate fresh air intake and expel in the apartments, relying on pairs of ceramic centrifugal fans working synchronously to recover heat (the system is detailed in section 6.7).

A first greenhouse gas emissions analysis report (prepared through Futurebuild's calculation tool shows a reduction of about 50% for the new buildings and 35% for the existing building compared to baseline. The new buildings also achieve a 45% reduction in construction materials used due to the extensive use of CLT (cross laminated timber). Combined with energy supplied from the building's heat pump, solar thermal system, photovoltaic system, graywater recovery system, the new buildings have a calculated carbon emission rate of 67% lower than baseline (FutureBuilt, 2017).
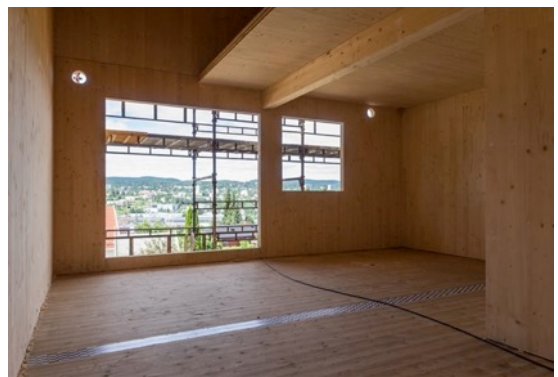
Figure 0.3 Images of the FHY project during construction

6.3. Background

Furuset is a small suburb (population 5500) about 15 minutes away from Oslo city center. It is residential and suburban area, consisting of both multifamily buildings and single-family houses. Built in the 1970s, Furuset was a separate borough of Oslo until 2004, when it became part of the new borough of Alna. The area has good public transport coverage with bus and metro, and most resident commute into Oslo for work. Furuset has large green areas, but the E6, the main east-west highway, creates a barrier towards Østmarka – a forested area to its south.

In 2014, the municipality of Furuset launched an action plan called "_Smart Drabant I Forkant_" (Revitalizing the Satellite City) proposing the revitalization of several areas in the district, alongside city-wide projects in the transportation, energy and architecture sectors. The plan's principles aligned with FutureBuilt́s criteria for climate-friendly development.

The plan's concept is to establish two intersecting urban spaces: a new 'town street' will create an urban artery in the east-west direction, while a continuous park will be created to form a north-south connection. A continuous green space, with natural stormwater systems and rehabilitated streams, was a central element in upgrading the outdoor spaces, as well as Trygve Lies Square, located where the two town spaces meet and forms the heart of the plan. The Furuset Housing for Youth was the first housing project realized through this plan, and is seen as a driving force for other projects.
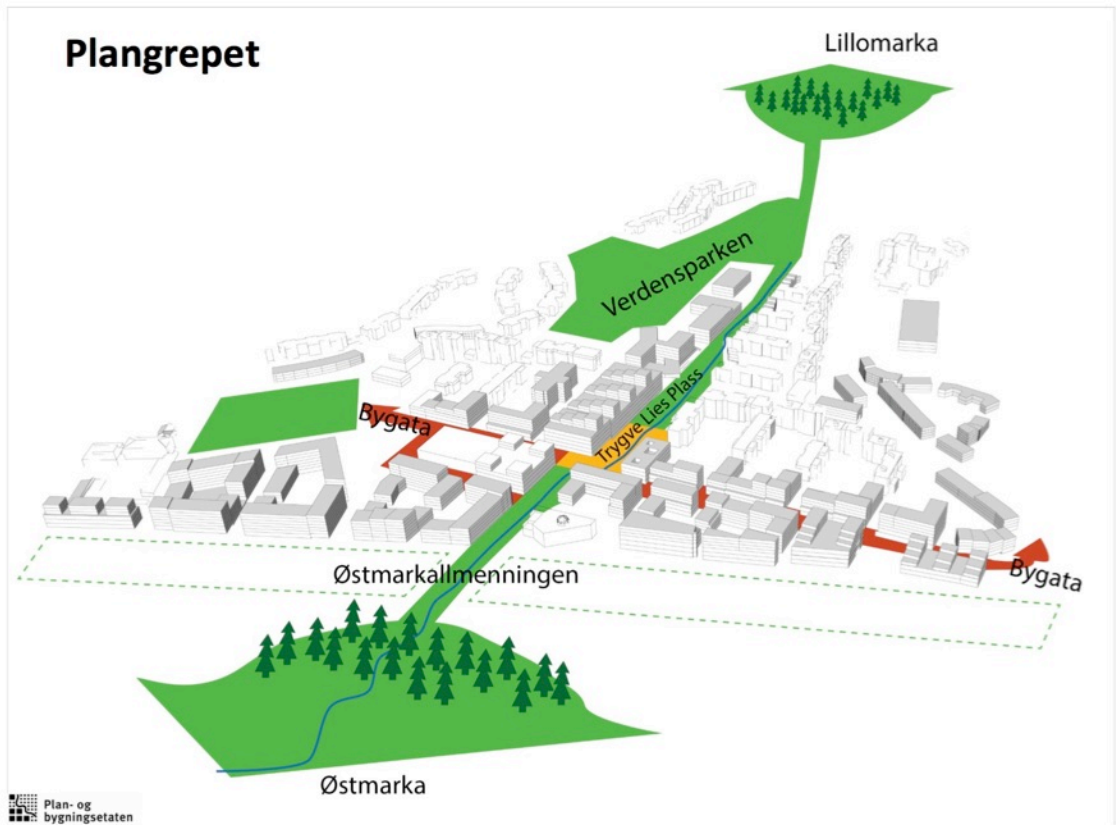
Figure 0.4 'Revitalizing the Satellite City' rendering and scheme and plan for Trygve Lies Square.

6.3.1. Project Inception: The Bethany Foundation

The Bethany Foundation Oslo (*Stiftelsen Betanien Oslo*) was founded in 1897 by the Methodist Episcopal Church in Norway. The Foundation's work began as three young deaconesses[15] in Oslo formed a nursing cohort which later evolved from homecare to hospital operations and nurse education in Oslo, Bergen and Skien. Next year they came home and started A Sister Home (monastery) for Bethany Deaconesses in Oslo. The work was later divided to three different independent foundations with boards elected by the Methodist Annual conference. The Bethany Foundation in Oslo ran its hospital until 1980, and Betanien College of Nursing merged with Lovisenberg College of Nursing in 1994.

Today, the Bethany Foundation "aims to contribute to a better everyday life for vulnerable families, including immigrant families and families struggling with mental health issues". (betanienoslo.no, n.d.). The Foundation's work involves teaching classes, seminars, group sessions and individual support to enable change and development in the family. The foundation also trains and provides guidance to municipal employees.

The Foundation operates in several districts in Oslo and municipalities in Lower Romerike as well as in other parts of the country. Much of their work is in Oslo East, an area with a steady increase in the number of cases in immigrant families requiring care.

In 1922, the Foundation opened a small orphanage in Kirkehøy with four homeless children. Three decades later, the orphanage later moved to the existing building at the FHY site. In 2004, the Foundation established a family center in the

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[15] A Deacon is an ordained minister of an order ranking below that of priest.

former orphanage on the FHY site, in collaboration with the municipality of Alna (now Furuset). The building, called *Furuhuset,* housed a daytime nursery and an afternoon family health center, where "thousands of Alna residents have found friendship, belonging and security over the years" (Betanienoslo.no, n.d.).

The Bethany Foundation describe their goal for FHY as "to establish a living environment where different groups of young people can live together and mutually promote each other's well-being, security, health and integration in society. The main goals for this project are youth / young adults and small families who need good experiences in their first home". (Ibid, n.d.).

Figure 6.7: The original Bethany orphanage in Kirkehøy (left), and the current building on the FHY site, after renovation (right).

6.3.2. Project beginning

In 2012, the Bethany foundation sought to make a solid, stable investment, which will also embody the foundation's mission of community betterment and target young families and marginalized individuals. Having just sold a large building in Oslo, they allocated some 4M USD to building an affordable housing development intended for these audiences.

The foundation initially contacted the Norske Arkitekters Landsforbund (the Norwegian Association of Architects) in Oslo to seek professional advice. Following dialog with the foundation, the NAA suggested applying for FutureBuilt qualification and holding a public architectural competition to select a project architect. Prior to the competition, an advance conference was held with the Planning and Building Agency. The competition proposal formed the basis for the detailed regulation of the land, with the aim of achieving a higher degree of utilization and with a reduced requirement for car parking than given in the housing plans (Arkitektur.no, n.d.).

The competition yielded applications from some 50 design offices in Norway and beyond. Following a prequalification stage, five design offices were selected for future consideration and invited to present conceptual sketches. The proposal "Good morning Alna" by Haugen / Zohar Architects, Steinsvik Architectural Office and Dronninga Landscape architects emerged as the winning entry.

HZA, the youngest and smallest design office chosen to participate in the conceptual stage, presented a unique proposal with several bold design decisions:

(i) **Placing the new construction at the western part of the site**, leaving the higher, prime area, at the center completely free of development (all other entries placed the new development in this area); this scheme suggested the new buildings would block the prevailing wind from the west, and produce a pleasant open space in the central part of the site, open for social activity;

(ii) **Adaptively reusing the existing building on the site**, retrofitting it to today's energy efficiency standards, and building 9 apartment units within it (all other entries suggested demolition and new construction); this step awarded the project a significantly lower carbon rating, yet from a financial perspective, demolishing the

old building and constructing a new one may have been cheaper and, in many ways, easier. The existing building is constructed of Cipolex (a porous, pumice-like artificial stone with little load-bearing abilities), requiring a load-bearing structure to be retrofitted on the interior before the building could be fitted-out. Also, the ground floor of the existing building had a marginal ceiling height by current codes, demanding the floor to be dug approximately 30cm (12"), adding to the budget and impacting the carbon footprint of the project negatively. Finally, elevators were installed to comply with current building codes.

(iii) **Leaving the site open to the public park** on the east, and not erecting a fence or wall to seal it off. In doing so, the architects gestured to the existing neighboring community, inviting them to take part in the activities in the public space, and created a significantly larger public natural, continuous grassy yard for the project. This decision will be re-evaluated after a year or two of occupation.

(iv) Untypical at the conceptual stage, **HZA's entry included a fairly developed plan for material use**: the choice of massive timber (CLT – Cross Laminated Timber) as the main building material for the new houses. This decision drove many of the consequent decisions after the selection of HZA's entry, and had numerous advantages towards achieving Futurebuilt's baseline regulations (due to the CLT's 'carbon-negative' properties) and tight, Passivhaus-quality construction.

(v) Choosing to **invest significant efforts in landscape development for public use**. In Norway, due to the long winter and fall, most new construction developments devote little attention to making outside common areas habitable for public gathering: "We thought it should be treated as your community's outdoor living room… where kids can play and parents can socialize before retreating into their own private apartments" (HZA, 2017).

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LANDSKAPSSITUASJON

Figure 6.8: Competition schematics of positioning the new buildings on the site (top right, in green)

The developer's early partnership with the FutureBuild program seemed like a natural step for the Betania Foundation. As a religious organization, the Foundation's leaders were excited to learn of the program's mission, which they feel aligns with the Methodist Church's rationale of Care for Creation: "A relationship with God's creation and a ministry of caring for and healing the earth are integral to what it means to be a United Methodist". (Church, U.M. 2017).

The following is an excerpt from the *Social Principles: The Natural World:*

"All creation is the Lord's, and we are responsible for the ways in which we use and abuse it. Water, air, soil, minerals, energy resources, plants, animal life, and space are to be valued and conserved because they are God's creation and not solely because they are useful to human beings. God has granted us stewardship of creation. We should meet these stewardship duties through acts of loving care and respect." (Ibid, 2017).

6.4. Haugen Zohar Architects: Practice overview

Haugen/Zohar Arkitekter (HZA) is an Oslo-based practice founded in 2007 by architects Marit Justine Haugen and Dan Zohar. The practice describes itself as "operating at the overlap between architecture, function and art", and originated with the firm belief that "architecture is, by its nature, earthbound, drawn by and for people." (HZA, n.d.). The practice holds a portfolio of national and international projects including residential buildings, public landscape design, public art (such as memorials) and a large art installation for the Oslo Sculpture Biennale. The practice has won successive design competitions in Europe and Asia, including a recent a new addition to the local art museum in Akershus, Norway, and employs around five architects and designers in its Oslo office (Ibid, n..d).

Dan Zohar, HZA's co-founder, describes the practice's outlook on the role of architects in today's society: "We see ourselves as an active entity in society… much like the teacher, or metalsmith, journalist or poet – we aim to make society better by using the tools we master. We derive great satisfaction and pride from working on actual, concrete problems… solving them, we know we did our share towards providing people – and ourselves - a better place to live and work." (HZA, 2017).

The practice has built a name for itself with several low-cost, high-impact projects (one of which is outlined in section 6.4.1.) with a clear social agenda and progressive use of digital fabrication tools. "We enjoy bringing the user into the design, thinking from the inside, outwards… [for example] when we design for children we try and think of their experience within the finished structure or object… the use of parametric design is a way for us to lower costs, since in Norway tradesmen and fabricators price their work by the hour. 'Digitizing' the work means that these

fabricators, in a way, don't have to think – they receive most or all the drawings as 'file-to-production' and their task becomes very clear".

Figure 0.5 Selected work of HZA, clockwise from top right: Fireplace for children (2009); Akershus Arts Center (2014); Julius Palties Plas memorial (2015); Studio for artist (2012); Sea You Soon Coastal park in Tel Aviv (in development); Vestnes Harbor (in development).

6.4.1. HZA's approach to sustainable design

HZA partner Dan Zohar describes their approach to sustainable design as one that doesn't necessarily concentrate on high-performance, novel technologies or other

grand gestures, but instead aims to focus on intentions and 'small gestures' that make way for a change in resident behavior and mindset. "When [Green architecture was] introduced a few years back, it gave us another avenue to exercise our expertise and influence on the quality of the places we design, to the benefit of both the residents [or users] and the environment. But – often a developer says – 'if this is a green project, I don't want it… If it's green, then its not for me. I'm not green. I'm out.' [In this case] our place is knowing how to advance this agenda through smart persuasion, and showing the developer its benefits, moving past the initial resistance and misconceptions (Ibid, 2017).

This unique approach to sustainable design is evident in many of HZA's projects, which emphasize the social, behavioral and lifestyle aspects of sustainability rather than focus solely on measurable building performance. Many of the practice's projects highlight their social qualities such as community-building, transport behavior, lifestyle and social innovation. One project that exemplifies this approach is the '**Trafo'** project completed in Oslo in 2011.

This project transformed the courtyard of Torshov Kvartal VIII, a 1920 municipal apartment complex[16], and one of the largest housing projects in the city. Its vast open courtyard (inspired by social housing and the European garden cities movements in Europe) had an unused, single-story building, previously used as an electric transformer, which had been locked for 85 years. The project entailed reclaiming this derelict building and transforming it into a common space for the benefit of the whole neighborhood of 180 families. The electric transformer inside was buried besides the building, liberating the space for resident use.

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[16] This is also the private residence of arch, Dan Zohar and Marit Haugen and their daughters.

The re-purposing of the building progressed over five years through volunteer design, coordination and physical labor by the architects, themselves residents at the complex, neighbors and others from the wider neighborhood. Today, the 75sm (810 sf) space contains a common room, kitchen, bathroom and a mezzanine floor for overnight guests. The new space is occupied 75% of the week, hosting all ages and all types of events: Funerals, weddings, baptisms, confirmations, children's birthdays, corporate parties, adult parties, project meetings, board meetings, Christmas parties, theme nights, movie nights, sporting events, exhibitions, sales issue, flea market, lectures, opera evenings etc. The building can be booked online and is accessed vie key-card, with each resident cleaning up after themselves and keeping the space tidy for future use (HZA, n.d.). The project has won recognition and publicity for its community-building achievements and fresh approach.

For the completion of the zero-budget, self-initiated project, HZA developed a detailed design process that included extensive community participation, engagement and empowerment:

(i) **Outlining a building programme** following community listening sessions and brainstorming;

(ii) **Posting a webpage** inviting all community members to keep informed on progress, provide their input and offer help;

(iii) **Mapping all relevant human resources**, both amateur and professionals;

(iv) **Soliciting relevant businesses** (e.g. real estate, law or engineering offices), tradesmen (e.g. plumbers, electricians, carpenters), professional training schools and factories (e.g. metal shops, lumber yards) to provide their services pro-bono;

(v) **Creating a buzz** around the project kept residents engaged and helped retain passionate community spirit around the collective effort.

Figure 0.6 The Trafo project, clockwise from top right: Historic photo of the site, with the electric transformer building at the center; Project concept; Mapping process; Construction by the residents and volunteers; Winter celebrations in the courtyard; Interior of Trafo building after completion.

6.5. Pre-design and project layout

In the two case studies outlined in chapters 4 and 5 of this dissertation, the development process included a fairly structured social research phase (the Rose had this performed by Hope Community and Place, while the Hollerstauden building relied on an extensive study commissioned by the city and performed by the Schäuble Institute); however, the developers of FHY saw no need for a dedicated process. This could be attributed to the fact that the developer is a community empowerment

organization that feels they know their target audience already (HZA, 2017). Another possible reason to waive a social research effort could be the fact that FHY was built in a relatively low-density, suburban area and thus the developer felt that the project shouldn't require the same level of sensitivity as if it were built in the heart of the city.

Ultimately, the architects relied on a previous project from 2011 that brought the community together (the 'Trafo' project outlined in the previous section), applying the methodologies that proved effective and other lessons learned. Most of the principles carried forward were: choosing to locate the new buildings on the western edge of the site (as opposed to the center) to create a common courtyard; creating a lively façade oriented inwards to the common space by placing common rooms (dining rooms and kitchens) on the eastern elevation, facing the courtyard, and orienting the more private rooms and spaces to the west; linking the stairs to a common footpath that connects the new homes with the ground floor of the existing building; creating as many common spaces of different nature – such as the bicycle workshop – to invite residents to spend time in communal spaces; and finally, creating a large, multi-purpose common room on the ground floor of the existing building, aiming to re-create the familiar and welcoming atmosphere at the 'Trafo' project in Oslo.

6.5.1. Project delivery structure

In Norway, most building projects are delivered (procured and executed) through one of three management models: total enterprise, main enterprise or divided enterprise. Each of these models is unique in the level of owner involvement and in the way the work is contracted. All three models include a project manager (called

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Project Leader, or PL) responsible for the project's progress and execution: the Project Leader manages all contracts, scheduling and sourcing, while the Building Leader manages day-to-day progress and subcontractor workflow, and a second Building Leader manages on-site safety and material supply. Together, PL and BL form the management team that oversees the design, procurement and construction process from start to finish.

The design and delivery process of FHY (divided enterprise) had profound impact on the project's overall quality and ultimate social and environmental performance; to understand this model's contribution to the ultimate success of the project, it process must be framed within the competing, more common models. The three models are outlined below:

Total Enterprise:

Through this model, the client expresses the need for a building project, and contracts a single construction company to complete the full design and delivery process (design, engineering, procurement and construction). The company typically has an in-house team of architects, planners, engineers, landscape architects etc. as well as in-house (or contracted) construction professionals who execute the project. In this model, the owner has one contract, with one entity, whose responsibility it is to carry out the project to the specified 'function description' (design intent and architectural programme), budget and timeframe. This model is comparable to the 'Design-Build' model in the United States.

Pros: one point of contact for the owner; Typically takes less time since much of the bidding process is eliminated.

Cons: very little owner control over quality, since there are no design drawings at the time of contractual agreement; the PL usually 'cuts corners' due to the lump-sum contract (e.g. if the PL finds a cheaper alternative material or mechanical system, the company will pocket the savings); changes are difficult to make once project has begun, requiring change orders, back-tracking and possibly locating new suppliers or subcontractors; typically the most expensive model since no competitive bidding took place.

Main Enterprise:

Through this model, the planning team members (the architects, but may include other planning and design professionals) are hired by the owner, and perform initial design and specification. Following this stage, a PL is contracted and handed the project for bidding, contracting and execution. At times, a larger part of the design team (like engineers) are contracted by the owner, but this varies according to the project at hand, relevant building codes and the level of complexity required. This model is usually seen as the closest to the 'design-bid-build' model in the U.S.

Pros: direct contracting of the planning and design team by the owner ensures higher quality, and better control of the final outcome;

Cons: demands higher owner involvement (e.g. in bidding process), but not direct management; typically the more expensive model.

Divided Enterprise:

Through this model, the owner contracts an architect to produce schematic design drawings and compose a specification document, then contracts a PL, who in turn contracts a cohort of builders, fabricators and suppliers needed for the project's

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execution. In this model, the PL is responsible for the bidding process with some several dozen such sub-contractors and suppliers, schedules their work and manages the entire construction process on-site on a daily bases.

Pros: constant dialog between PL and architect; high owner involvement at the initial stages grants higher control over the project's quality; high influence by the architect on the final outcome, since the architect is involved closely throughout the process (e.g. PL can involve the architect to solve problems or devise a plan to solve discrepancies in the execution, as well as budget hitches); this approach is also cheaper than the previous models;

Cons: PL is highly invested in the contracting, budgeting and procurement, with dozens of sub-contractors to manage, and different contracts for supply of the various materials (e.g. wood, steel, concrete, windows etc.), making the project hinge on the PL's ability to coordinate all these tasks.

In the divided enterprise model, members of the planning team may choose to bind themselves in a **solidarity agreement**, agreeing to compensate each other for any mistakes in the design, or any changes due to unforeseen circumstances, and limit their ability to sue each other in the event of a colossal disagreement (HZA, 2017). Examples of the team members to use this instrument are architect and structural engineer, or architect and landscape architect.

The FHY architects describe it as a wise choice: "Divided enterprise was absolutely the best method for this project. We couldn't have done it any other way, for a few reasons: first, there was a lot of building geometry involved, and the production files were 3D-oriented, while most of the building and management team were older and not fluent with 3D, forcing us as architects be in constant discussion

with the PL; Second, this is a Futurebuilt project – meaning that it had to show carbon reduction of 50% of the baseline, so many consultants were involved - a main enterprise model couldn't have accommodated all these; finally, since the technology of massive timber is relatively new in this context, we had to be flexible and adjust the design in accordance with many issues that came up during the construction" (HZA, 2017).

"If we were the ones making the decisions, we would have chosen a different cohort of planners and designers, some with a greater emphasis on design and higher aspirations, particularly in terms of the Futurebuilt parameters [some of the consultants selected by the PL were more inclined towards 'conventional' building and less experienced with both Passivhaus and CLT technologies]; of course the price was a large factor as well; having said that, although we didn't have the right to veto anyone, the PL did consult with us along the way and we had some say in who joined the team" (HZA, 2017).

Negotiation model: This is a specific construct of the Total enterprise model, by which the PL cotracts the various subcontractors, but with a 'open book' approach: every subcontractor submits a bid which is visible to the other stakeholders and subcontractors, including their profit margins (note: in Norway, both individual and business tax records are public and visible to everyone). This 'open book', transparent pricing approach is also allpied when using the divided enterprise model.

6.5.1.1. Giving back to the local community: a design strategy

In the divided enterprise model, any moneys saved are redistributed within the budget. In the FHY project, these funds, combined with the flexibility of the DE delivery model, were allocated to develop several 'gifts to the community'. HZA

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architects describe that this was not a last-minute idea, but a strategy for community acceptance from the project's initial conceptual stages. They explain the powerful message such 'gifts' send to the local neighboring community.

For example, in Furuset the developer decided to build an on-site bicycle workshop for the benefit of the project's tenants, which is also open to the surrounding neighborhood. The workshop is approximately 40 sm, has a PV rooftop array, tools and spare parts and is intended to function as a meeting place after work for some residents and neighbors. The developer built and outfitted this workshop without any visible gain, financial or otherwise; however, in offering it to the local community, the developer hopes to gain their gratitude and acceptance. "No one wants 80 young, penniless people to come live next to them... By offering this gift to the public we are demonstrating 'our character'… showing faith that this new development can be beneficial to the existing community" (HZA, 2017).

Another 150 sm of the ground floor of the existing building are allocated for public use; firstly for the residents, and secondly, to the larger community. This multi-function public space, equipped with a large kitchen, audio-visual systems and furniture, is designated to be the common room for parties, movie screenings, pot-luck dinners and other communal events. It was consciously designed on the ground floor and at the site's entrance, to convey its accessibility and openness. "The cost is not only the construction and development – but also the upkeep and maintenance over the years. But this is a developer who believes in doing good, in spreading good" (HZA, 2017).

A third example of giving back to the community is through the allocation of two electric-car parking spaces to the Oslo CarPool program (an hourly-based car

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sharing scheme similar to Zipcar in the U.S.). This is a considerable gesture, given that there are a total of nine parking spaces for the entire development, home to some 80 residents. In return for these two spaces, the developer and architect have negotiated a better rate for all residents and neighbors when they join the program. The Oslo CarPool currently has some 3000 cars, all electric or hybrid (HZA, 2017).

Finally, the social aspect of the project shows through via the design of the site: to the south, the project site butts against an existing public park, which is minimally developed; the architects decided to leave this side open, enabling the two areas to enjoy the shared space between them. "Another architect would have closed this off, put up a fence of would separate this park; but HZA convinced us that this approach [keeping the southern edge of the project site open] will benefit the residents and provide an open atmosphere, both in actuality and as an attitude. This also helped the local neighbors accept us more easily. When you erect a fence, it sends your neighbor a message, and usually not a good one" (Betanien, 2017).

In Norway, the architectural design process typically consists of three design stages:

(i) *Sketchproject* or '**sketch phase**' (conceptual design and discovery);

(ii) *Forproject* or '**preliminary phase**', which entails massing, schematic design and drafting a preliminary bill of materials, includes costing and bidding, and applications to the relevant municipal entities;

(iii)*Detaljprosjekt* '**detailing phase**' in which the design is finalized and construction drawings are prepared.

The *sketchproject* phase typically includes exploratory research into the site and its attributes, as well as deciding on an architectural programme. Following this step, the architects can digest the opportunities and limitations the site presents and decide on a design strategy to implement their proposed vision. The *forproject* phase includes much of the 'legwork' of developing the design through iterative refinement, to arrive at a solid set of drawings that can be submitted for initial pricing and quantifying. Once the *forproject* phase is completed, the project documents are summarized and submitted to the owner for approval, with all the technical, regulatory, scheduling, and cost aspects taken into account. This re-evaluation process is performed once again, at the end of the detailing phase, and is seen as a go / no-go step in the overall project delivery process (HZA, 2017).

Norwegian architects, designers and engineers are typically compensated on an hourly basis. When bidding on a new project, they submit an estimate of the number of hours they require for their design work for each stage of the project – despite not knowing at the outset what each stage will entail; This model presents a potentially

problematic reality for architects, requiring them to estimate their hourly timeframe *before* the project is detailed

Zohar describes how they work around this difficulty: "This is where we have two lifelines – an experienced PL, and a culture of good communication; a good PL will know ahead of time where hitches can occur, and he can be prepared. Also, he needs to be pragmatic and understand the dynamics of working with many people each completing a piece of a puzzle – if someone is struggling, he knows when to push them and when to let them work through it, or offer support. He can instruct the other consultants to help them or take on additional duties to keep the work flowing smoothly. He can also take money that was saved in one part of the project and allocate it to one of the designers, for example, who's required to do more work; its all about trust, communication and flexibility. We all know we're pushing [the project] forward and have faith in each other that everyone is doing their best and completing their role in good faith" (HZA, 2017).

The delicate art of project management through the divided enterprise model is apparent in these two **examples** in the Furuset project: two of the consulting mechanical engineers had little experience working with 3D models, resulting in the both of them not using the 3D interface for communication, but working traditionally, in 2D paper sections and elevations, leading to several design conflicts. The complex geometry of the new buildings (the roofs in particular) was difficult to grasp in the traditional methods, and required the use of 3D viewing with a simple PDF viewer or similar software. This 'technological discrepancy' was problematic given the nature of the CLT technology, which requires absolutely precise alignment between walls since any opening or hole larger than 70mm in diameter was pre-cut by CNC during

production. Ultimately, the architects ended up performing the extra design coordination work that these two engineers were unable to perform; this was conveyed to the PL and the architects were somewhat compensated for the extra hours. The entire coordination process was cumbersome and took many hours of back-and-forth communication which could have been avoided had 3D-competent engineers been contracted initially.

Another **example** was a situation in which one of the subcontractors was unprepared for the type and volume of labor involved in building with CLT technology; this led to escalating difficulty on their behalf, almost leading to their bancrupcy or walking out of the project. Noticing this difficulty, the PL devised a plan for this subcontractor to re-align their scheduling and divide their efforts differently, eventually keeping them on site and avoiding the potential disturbance to the entire project's workflow.

6.7. Summary: Furuset Housing for Youth

The project stands out in its quality, environmental design and performance, and innovative technical solutions, and also in its emphasis on resident wellbeing and community-building. The sum of these qualities places the FHY as a leader in the sustainable affordable housing market.

- The FHY sought to fill a need in the affordable housing market in Furuset specifically targeting young people and young immigrant families;

- There was no structured process of pre-design community engagement prior to the project's conception; however, both developer and designers relied on their previous experience to inform the process: the developer has a long record of involvement in the Furuset and Alna communities through their community work with immigrant families– including the *Furuhuset,* previously on-site; the architects relied on their firsthand experience of facilitating a community-building process through design and resident engagement;

- Early in the conceptual phase of the project, the developer partnered with FutureBuild to achieve a pilot project status for FHY, requiring architects and engineers to develop the strategies to achieve the set performance level;

- FHY received support from Oslo Municipality's climate and energy program (offsetting 40% of the cost of the photovoltaic systems in the project); other grants were received from Innovation Norway, *Husbanken*, the Bicycle Project in Oslo Municipality and the Enova grant for reuse of existing buildings;

The final carbon emissions analysis (taking into account materials used, construction and operations) revealed the new buildings' performance to be nearly 50% of baseline (FutureBuilt, 2017; HZA, 2017).

6.8. Key insights from interviews:

Several key insights emerge from the study of FHY, its design and development process through interviews and document analysis, in relation to the research questions of this dissertation as detailed in section 1.2. The conditions that made the project successful, the strategies and methodologies used by its designers, best practices and competencies are outlined below:

The divided enterprise model was essential to the project's ability to meet both design and performance goals. The divided enterprise facilitated, in effect, a 'localized version' of an integrated design process; although the bidding and procurement were carried out more traditionally, the engineering and material specification took place around the table, involving all relevant stakeholders. This process ensured the project was kept on track (budget and time – wise) but also enabled value engineering, material and mechanical system compliance and an overall high-performing building.

Clear communication between the developer, lead architect and Project Leader was critical to the project's success. The three had to be in continuous communication from the project's kickoff, through contracting and bidding to construction and completion; such 'open channel' communications made the PL aware of sensitive design issues pointed out by the architect, and vice versa. This dynamic also helped overcome obstacles during construction and production: for example, the selection of CLT involved a steep learning curve for the PL and BL, as well as for some of the engineers, a challenge that could have derailed the project if it weren't for the transparency between the PL and architect.

Partnering with national and municipal entities was mutually beneficial.

Early in the process, the developer decided to partner with FutureBuilt and other Oslo Municipality schemes (like the Climate and Energy program and the Bicycle Program); these partners provided both funds and programmatic support for the project; the knowhow gained following FHY's construction was leveraged to encourage similar projects in Norway (FutureBuilt, 2017).

In sum, **development and design decisions were made with the residents' wellbeing and equity in mind**. These decisions translated to some of the project's most significant factors: the deliberate targeting of young people, immigrants or natives; the emphasis of bicycle transport and consequent bike-workshop; the decision to leave the central part of the plot for communal activity; the decision to allocate the ground floor of the existing building to a common multipurpose room; and the selection of healthy interior materials, finishes and products, ensuring resident health and wellbeing.

6.9. Analysis

6.9.1. Furuset YPV - Interviewee classification

From the 10 professionals who were invited to take part, 8 interviews were conducted, all of professionals closely involved with the development, design and execution of the project. The interviewees typically had experience of working on housing projects in the affordable housing sector. Both the organization and the position or role in which interviewees worked is shown in Table 6.1. All interviewees had previous experience of working on new construction projects, however some had experience with multi-family homes while others had more experience with institutional or public projects

Table 6.1: YPV Furuset: interviewee categorization

Organization	No. of Interviewees	Position / Role
Architect	3	Design architect / Architectural manager / Sustainability Architect
Designer	1	Interior designer
Developer / client	1	Managers / community workers
Program coordinator	1	Sustainability Champion
Management	2	Project leader (manager)
Total	**8**	

6.9.2. Contributing factors towards sustainable, equitable design and development

Interviewees were asked to point out contributing factors, conditions and motivators towards successful design and development of sustainable and socially

equitable building projects. Since no corresponding themes were identified in the literature and in accordance with a grounded theory process, the main themes arising from the data, were: project structure, architectural design, social responsibility, and housing industry (Table 6.2). Under each of these themes, several relevant sub-themes have been identified from the data.

Table 6.2: YPV Furuset: Contributing factors to ESD.

Theme	Sub-themes	Interview Quote
Structure	• Competition set the table for a highly progressive design approach • Divided enterprise model • Mutual trust between client and architects • PL controlling workflow and pace • Lower price • FutureBuilt aligned performance goals early on	"We only work in Divided Enterprise [integrated process]. This is the only way to achieve a really sustainable, innovative project. Other process models are rigid and so the work is technocratic and unflexible… with DE everyone has to be flexible, within reason, the project can move forward" (Project Leader #1).
Economy	• Being competitive in offering quality affordable housing	"We are not a developer in any sense, [nonetheless] the project must be competitive on the price and quality aspects" (Owner)
Social Equity / Responsibility	• Moral / religious obligation • "Its the right thing to do" • Commitment to sustainability cause	"We looked at the FutureBuilt materials… read their rationale and thought, wow! That's our mission! We share all these values! We knew we must do it". (Owner).
Housing Industry	• Use of CLT construction • Use of Sitka wood	"We know the manufacturers are 'dying' to push out these ultra-green products… its our job to respond to them". (Architect #2).
Architectural design	• Heavy 3D design (e.g. 'file-to-production', BIM clash detection, etc.) • Clear program at municipal	"When the client is incentivized to be 'eco', they arrive at your table ready to work. Then our work is easier in that

and regional levels		sense". (Architect #1).

6.9.3. Barriers and challenges of sustainable, equitable design and development

Interviewees were asked to point out factors that were seen as inhibitors, barriers and / or challenges towards successful design and development of sustainable and equitable building projects. The main themes arising from the data are: process, economy, competence and industry (Table 6.3). Under each of these themes, several relevant sub-themes have been identified from the data.

Table 6.3: YPV Furuset: Barriers to ESD.

Theme	Sub-themes	Interview Quote
Process	• *Forproject* phase didn't allow adequate time and budget to develop foundations for later in the project • BIM coordinator was not hired, resulting in the architects taking on this additional workload	"We spent many, many hours on specifying and designing details in the *Forproject* stage, only to have them changed by the PL later on in the bidding stage". (Architect #1).
Economy	• Front-end loaded costs • Perceived risk • "The cost of being pioneers" • The need for public funding	"Financing for affordable housing is hard enough… if you say you want it so high-tec and high-end, you are on thin ice" (Developer).
Competence	• Lack of proficiency in 3D design and construction literacy (Project leader and the 'simpler' contractors	"It was madness. Real madness [having the roofs at multi-plane angles]. You could bring in some younger people to replace us as project leaders, they would surely understand this 3D stuff". (Project leader #1).
Industry	• Not all contractors up to standards of building Passivehaus envelopes, or working in a Divided Enterprize model	"We chose Divided Enterprise since we trusted Anish [PL] and believed this way was best... But having 40 contractors meant you have to control all of them ".

6.9.4. Stakeholder involvement

Interviewees were asked to evaluate and reflect on their level of involvement throughout design and development process of the project, as well as that of the other role-holders (e.g. architects as a whole, PL office as a whole, developer / client etc.) in relation to the project phase. Interviewees answered these questions through subjective estimates, examples of milestones along the time span of the project development and personal accounts. Each interviewee was asked to rank their own (and the others') efforts or involvement from zero to five (no involvement to intensive, consuming, hand-on involvement). Some of the answers were then multiplied in proportion to reflect the number of professionals engaged in the project at a given time (e.g. if the architect was equally involved in two of the phases, yet had one or two staff working on the first phase, and five staff working on the second phase, the level of engagement for the latter was proportionally multiplied to reflect the extra man-hours devoted to that phase).

While there interviewees' answers were subjective and by no means absolute, their agglomeration and plotting on a stacked-area chart paints a picture of the nature of the integrated process: it shows, for example, early involvement of the general contractor, or the two peaks of effort put in by the architects at the beginning (research and goal-setting) phase and just before the execution of the project. It also illustrates the continued involvement some of the stakeholders continued having with the design team even after the project's execution was well under way.

The results of this inquiry are summarized below: the ranking shows the

perceived level of involvement or effort devoted to the design and development process across the project phases, from zero to five, for each role holder:

Table 6.4: YPV Furuset: Stakeholder involvement

Project Phase / Role Holder	Architect	Contractor	Engineer	Project Leader	Owner	FutureBuilt
Conception	4	0	1	0	1	2
Research	5	0	1	2	1	2
PD	5	2	2	1	0	1
SD	3	0	1	1	0	0
DD	1	1	0	1	0	0
CD	3	2	0	1	0	1
PR	4	4	2	2	1	0
CA	3	3	1	2	1	0
OP	1	0	0	2	2	1

Key: PD: Pre-Design; SD: Schematic Design; DD: Design Development; CD: Construction Documentation; PR: Procurement; CA: Construction Administration; OP: Occupancy and Operation
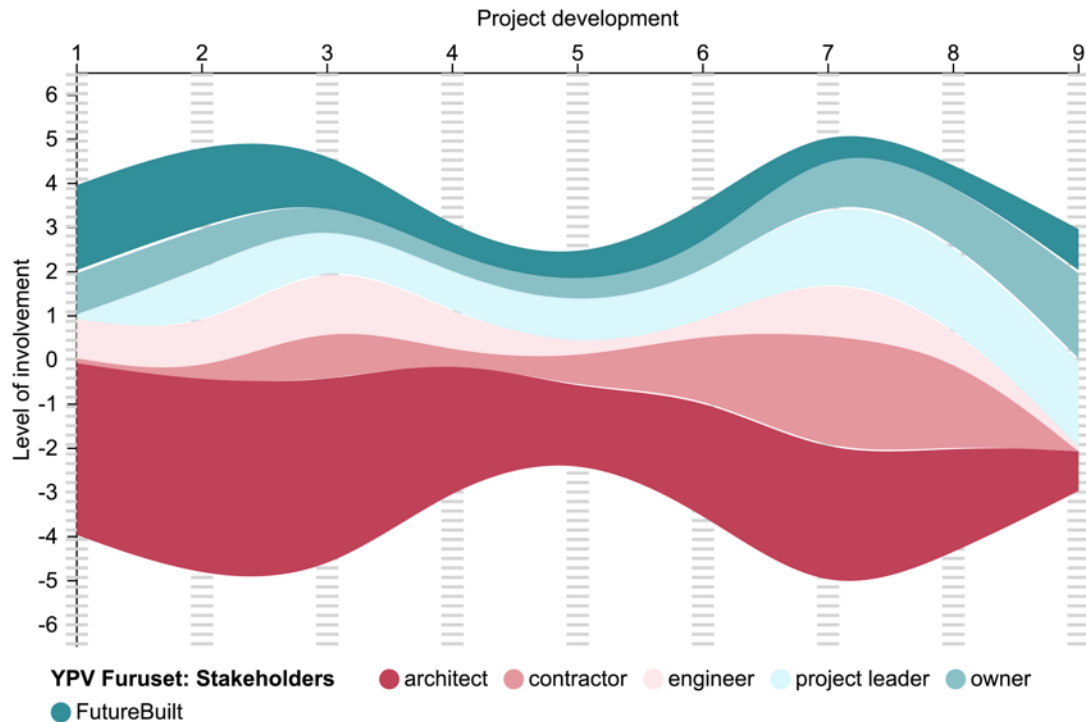
Figure 0.7 YPV Furuset: Stakeholder involvement

6.9.5 Summary of findings

(i) Cooperation and trust between developer, PL and architect: The decision to use the divided enterprise model proved essential for the project's successful achievement of performance goals.

(ii) Energy performance framework was used to guide performance targets: the FutureBuilt program provided clear performance goals – not only for the Passivhaus standard but for peripheral systems such as energy and mechanical systems, and decisions related to parking and bicycle preference

(iii) 'Locally adapted' integrated design process: The small size of the design team (energy engineers partnered with HZA since the competition phase) made for a flexible, united front when making decisions early in the design process. The coordination and positive dynamic between the stakeholders encouraged transparency

and collaboration even when unexpected issues came up during the construction process.

(iv) Architects used the site design to enhance community cohesion and livability: HZA made clever use of the small plot, enhancing the community feel through use of building orientation and design.

(v) Developer and architects used 'neighborhood gift' strategy for local acceptance: The developers and architects designed several offerings to the local community (outside of the FHY project) to gain their acceptance and trust; this was not done in a superficial or deceptive way (making these offerings into bribes), but genuinely and honestly. Both designers and the developer truly believed in the power of such gestures, whether they are symbolic or hold real benefit (such as a parking space or a free bicycle tune-up), to bring a community.

Chapter 7: Discussion

This chapter builds upon the research carried out in the literature review, and in the case studies chapters, which explored the design practices of three architectural firms through three unconnected projects, unfolding their respective design processes. This chapter resumes by cross-analyzing the components of these processes, categorizing them to draw out emerging parallels between the cases. Drawing these parallels together forms the basis for suggested framework, informing the potential application to future environmentally and socially well-designed (ESD) projects.

7.1. Introduction

This dissertation set out to explore the ways in which design professionals integrate environmental sustainability and social equity into their professional practices, and their motivations to do so. The previous three chapters provided detailed descriptions, narratives and individual analyses of each of the three case study projects. These individual accounts were used to unearth the specific characteristics of each project, painting 'project personalities' that underscore their idiosyncrasies. These specific personalities arise from a broad range of external influences such as economic, cultural, political, regulatory, climatic and other factors, or contextual influences such as the social and urban fabric of the project or the character of the developer and architects. The narratives of the case study projects have been outlined, analyzed and discussed at the conclusion of each case study chapter.

While this analysis yielded distinctive features for each project, it also yielded commonalities that suggest a potential pattern for the phenomenon under study in this thesis. The case study analyses suggest that, while each project required a different design and development approach, the architects and designers interviewed used

similar tactics for integrating environmental and social considerations into their projects. Moreover, there are several reoccurring themes in the external condition, or settings, and in the processes of all three projects, beyond design aims or tactics.

These reoccurring themes can be roughly divided into **setting**, **process** and **design**-related themes.

7.2. Settings: favorable conditions for ESD projects

The setting constitutes the environment and conditions in which the project was conceived, planned and executed. This includes external conditions such as context, specific circumstances and opportunities, as well as more human-related, 'internal' conditions such as the motivations and competency of the actors at play:

(i) **Commitment and motivation:** All ESD projects require a committed group of individuals to envision, conceptualize, develop and execute them. All three case study projects were developed by nonprofit developers (Aeon, with PLACE as a consultant) or community-based nonprofits (Hope Community, Gundekar-Werk, Betanien Oslo); naturally, these developers carry a moral or ethical agenda that acts as a major impetus for the pursuit of ESD projects (the latter two are subsidiaries of religious organizations). Although the architects and designers sympathized with these altruistic incentives, citing the desire to "give back" and "to do the right thing" (MSR, 2016; Behnisch Architekten, 2017; HZA, 2017) they also named other, more earthly, motivations:

a. **Professional prestige**: All architects interviewed mentioned the recognition their firm received as one that that goes 'above and beyond' in relation to its competitors, not only in terms of producing high-performing buildings that display rigorous environmental design and performance (ambitious in and of itself) but in terms of advancing the social aspect of their projects. One of the architects described this motivation: "…these types of projects [high-performing or ESD projects] usually bring in public relations capital, its never a bad thing, and we try to uphold our reputation in that respect; Behnisch is known for emphasizing the immeasurable qualities of a project, we do this on every project. The clients know this and I hope that is why they approach us…

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we try to do this whenever we can" (Behnisch Architekten, 2017).

b. **Attraction of work:** This type of holistic design approach was recognized as a contributor not only to the firm's image, but also for attraction of commissions, and particularly "likely to attract new work from progressive, like-minded clients that see us as partners for their worldview" (MSR, 2017). This was also mentioned as a way to set the practice apart from competing firms. HZA described the firm's work on the Furuset project, which was secured by the practice in an open competition, as "a way to demonstrate our priorities, our capabilities, what sets us apart from others… we were the only ones to selected the [western] edge of the property, when all the others [other competitors] chose the center. This was intentional, we stood by it, and the client [was convinced that this was the optimal design decision]" (HZA, 2017).

c. **Added value for both client and residents:** All three design cohorts named the opportunity of introducing greater value to the project as a motivator, allowing the architects to step out of their territories in some conventional projects, as form-givers or technical planners of the building; instead, they felt they were awarded the prospect to rise above these traditional confines and therefore produce improved living environments, with more profound impacts on their residents' lives and surroundings: "You [the architect] fulfill the promise of achievement in these projects… your range of impact is much bigger [than in conventional projects]… bringing in greater value for your clients by attracting higher-quality residents, having less turnover and lower maintenance fees; you also attract like-minded partners [engineers, contractors] to make the work flow better… you end up with a much higher-

quality product" (MSR, 2017).

(ii) **Economic incentives:** Being affordable housing projects, the developers of each project made extensive use of public funds through national, regional or local government support programs, as well as some funds from philanthropic and Foundation sources. This research did not probe deeply into the levels of incentives, tax breaks or funding received, however monetary incentives played a significant role in the developers' decision to pursue these projects: "…We even halted the design progress a few months into it when the need for additional funding became apparent; we knew we had to secure another 'X millions of dollars' if we were to apply the decisions about the interior finish materials and some of the mechanical [systems], so we went after these funds and picked up after we secured a contingency budget for this purpose…" (Aeon, 2017).

(iii) **Location and timing:** Contributing to the projects' success was the fact that all three development teams selected the sites of their buildings carefully, to ensure that the project to fit well into its wider urban environment as well as to its more local urban fabric. In so doing, all three succeeded in leveraging municipal interests in the projects, advancing them at a particular time and location. According to the developers interviewed, these decisions were the determining factors for the embracing of the projects by local authorities. For example, the Project Leader (PL) from the Furuset project explained "We knew there was a nice piece of land here in Furuset, with an opportunity for a project for young people… we knew this place for years; we waited for the right time to approach the city with our plan, and this wait paid off. It was good time[ing]" (CM Prosjekt

AS, 2017). The architect of the Hollerstauden project further refines the importance of weaving the project into the existing urban fabric: "…we knew the client for years, and we knew the site of course… the commission was not what we expected [with respect to the open competition] but the client knew we were very experienced with this type of sector [senior living] and we were not starting from scratch, they trusted our decisions in placing the building and everything [orientation, massing, density etc.] so the result will be agreeable to the area" (Behnisch Architekten, 2017).

(iv) **'Right' market and industry conditions:** A fourth consistency among all projects was the developers' decision to pursue them at the 'right time', when both the market and the local construction industry were seen as ripe and ready for these high-performing projects. To refine this point, it can be can be sub-divided into developer motivations, and architect actions, detailed below. In sum, it can be argued that the market conditions acted as the *motivator*, while the industry conditions acted as an *enabler* of these projects; the development team delivers the vision and need (the 'what'), while the design team provides the way to achieve this vision (the 'how'):

  a. **Developer motivations:** Developers and clients in all three projects gave a reason of 'ripe market conditions' when asked about the decision to pursue these ambitious projects. They chose the timing for these projects based on their sites, project types and target audience following market observations, available funding and municipal interests – all of which align and embody the notion of 'the right market conditions'.

  b. **Architect actions:** All three design cohorts interviewed cited the 'right conditions in the market', referring to both a need for the specific housing

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typology, location and price level that their project offered, as well as to a 'right time' when the local construction industry was competent and 'professionally mature' to execute the vision of these high-performing projects. The architects of HZA cited this example: "We used a company in the Czech Republic [to construct the CLT walls], since there is expertise there in CLT construction. Wood is plentiful, the knowledge is there and so is the motivation. The building industry was ready for this technology; we felt it did exactly what we wanted and as designers we should support the industry, just as the industry supports us [in our creative ambitions]" (HZA, 2017).

Industry readiness is evident not only in the competence and expertise of the construction industry, but also in those of the organizations that advocate and deliver sustainable design knowledge. In the case of the Rose, both developers and designers described the professional support they received from Living Futures Institute as greatly helpful given the high bar set by the design team: "[We] hit a wall pretty early on when we started specifying interior materials, the manufacturers simply wouldn't work with us to disclose [what potential toxins are in their materials]… we called Living Futures and they helped us around and through this problem. We knew [the Rose] was the first affordable housing project ever in the US using the Living Building framework and we felt they were eager to help. They saw the potential of this project" (MSR, 2017).

7.3. Process: the social dynamics necessary for ESD projects

The increasing awareness for environmentally sustainable buildings yields higher expectations for total building performance. The design and execution of such high-performing buildings requires a more complex design process, involving more consultants and contractors, challenging design and construction companies with soaring amounts of information on the design, engineering and procurement fronts.

The design process is typically described as a successive, creative and technical process, relying on the designer's rational thinking and experience, and on the engineer's technical competence. From the breadth of the literature reviewed, only few studies frame the design process as a social dynamic influenced by the social interactions of the members of the design team (Cross& Cross, 1995). In this discussion sub-chapter I argue that an Integrated Design Process (IDP), carried out collaboratively and equitably by a well-balanced team of stakeholders, holds great value to the success of any high-performing project, even more so an ESD project.

IDP is defined[17] by the Canadian Equilibrium Communities Initiative as an "interdisciplinary team approach in which participants bring a wide range of knowledge and expertise to the process, enabling the final product to work as an integrated system; It enables participant input to be considered before critical design decisions are made" (CMHC, 2013). IDP engages all stakeholders - owner, architects, engineers, construction manager and subcontractors - to form a collaborative effort, aiming to organize project teams to work efficiently, cut costs and improve productivity to create better-quality buildings. In an IPD process, owners select the team members based on their technical expertise and teamwork, forming a truly

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[17] IDP has several published definitions, however the one cited here is, to the author's opinion, is the most well-rounded and fits the rationale of this research.

collaborative environment in which risks and rewards can be shared among team members. This collaboration results in building designs based on actual equipment and systems, superior constructability reviews and information prior to construction implementation documents, as opposed to 'lowest bidder' tactic of Design-Bid-Build. Team-wide use of technology is vital to the successful implementation of IDP, and building information modeling (BIM) methods consolidate data collection and distribution, resolve conflicts between systems prior to construction to reduce risk, and gain efficiencies to the project (AIA & Hill, 2007).

The integrated design process is not a rigid or dogmatic formula but rather an elastic set of guides and methods to ensure that the team practices as one collaborative unit and approaches the project goals with a holistic mindset. These guides and methods are echoed in the parallels arising from the case study processes.

(v) **Setting the table: stakeholder engagement and teambuilding:** The selection and commitment of the project partners and other stakeholders was similar in the three case study projects. Although none of the teams used a formal IPD process involving mutual risk-and-benefit contracts, the de-facto deign process of all three involved transparency, sharing of information, fairness and equivalence around the table in an effort to produce greater integrity in the process: " We had these stakeholder meetings… and we had to make sure everyone was heard" (MSR, 2017); "…having the contractor [representative] with us from the start proved invaluable… for aligning the discussion, getting an idea of the costs and constructability of some of the ideas" (Aeon, 2017).

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(vi) **Integrated design as an overarching ideal:** The design process of all projects involved the staples of an integrated design process, outlined in section 2.9. This process can manifest itself differently in different projects with regard to varying conditions, makeup of the design team, project scope or sector (Hootman, 2012). Although all three projects had vastly different contexts and attributes, and thus had different processes, several re-occurring characteristics in these processes did emerge, and can be recognized as an integrated design process. These characteristics are outlined below:

a. **Inclusion of all stakeholders around the table:** Ensuring that all stakeholders and project team members (designers, engineers, owners, developers, construction manager, and residents' representative) are, indeed, present at the conceptual stage of the project and have a say in the team meetings. Later discussions can also include 'second level' persons such as key subcontractors and other consultants, but in any case, these were brought to the table *before* their actual involvement in the project's design or execution, allowing them to provide input to be weighed in during the pre-design discussions.

b. **Ensuring all stakeholders are invested in the process:** In a formal IDP process, the owner, architects and contractor typically invest capital and agree to share both risks and profits. Although none of the case study projects was a formal IDP, stakeholders demonstrated their commitment to the process by actively participating in the meetings, some (like engineers and construction managers) performing initial estimation and analysis to assist in making preliminary design decisions. This commitment is unusual in a conventional design process, and the hours invested by these stakeholders can be seen as a non-monetary investment. The Project Leader of the Furuset project sums this

notion: "We [stakeholders] do all the work before the project begins, we sit together, and we spend a lot of time on this preparation [phase]. We believe that this is the best model [divided enterprise / CM model], we share the risk because we believe in the process" (CM Prosjekt, 2017).

c. **Approach the process with an open mind:** Meetings were held in an open and positive atmosphere, in which "anyone can speak their mind, providing they're speaking with the project's interest at heart, not only their own" (MSR, 2017).

d. **Apply a structured process:** Meetings were typically structured and documented; this was particularly helpful when decisions were later challenged and the team was able to trace back their source (Behnisch, 2017).

e. **Share ideas and information openly:** Architects noted the importance of information flow among themselves and engineers, construction staff and fabricators. The critical aspect of this information flow is the willingness to share it openly, and for this flow to be mutual and bilateral between the architects and the consultants, for example. This holds true for costs, and all three design teams reported that project and system costs were relatively 'open book', allowing them to appreciate the tradeoffs that had to be made at multiple points in the design process. The technical methodology of sharing information was not consistent across all projects, and although all three architecture firms reported their proficiency in using BIM (Building Information Modeling), it was reported that not all consultants and construction staff were comfortable using it, leading to a slower process. In one case (the Furuset project) the lack of proficiency in CAD and 3D drawings made the process significantly more difficult and time-consuming since the architects had to step in and act as a go-

between with at least two of the consultants, who were unable to collaborate on BIM platforms (HZA, 2017). Despite this difficulty, technical and performance-related information was still shared through conventional methods, and applied.

f. **Iteration, reflection and analysis are critical:** This point speaks to the heart of the integrated process of a continual iteration of ideas, strategies and solutions; these are evaluated through the eyes of all stakeholders and across the project's lifecycle, making for more robust decisions; this point is illustrated in section 2.9.3.1.

(vii)   **Applying a sustainable design framework:** Whether pursuing certification or not, all three projects relied heavily on a sustainable design framework or system: the Rose used Living Building Challenge, the Hollerstauden building used the national EnEv and the local e%, and the Furuset project used Norway's FutureBuilt. All design teams and developers referred to these systems as "extremely helpful", not only for receiving grant moneys or permit acquisition (which presented great incentives in themselves) but also for aligning the performance goals at the earliest stages and adapting an energy and material strategy (MSR, 2017; Behnisch Architekten, 2017; HZA, 2017).

These sustainable design (SD) frameworks were critical not only for aligning goals but for streamlining the decision-making process in a multi-stakeholder scenario with several 'layers' of challenging interests and restrictions (e.g. budgetary, coding, zoning, programme etc.). All three design teams interviewed named their projects' respective frameworks as an element that focused the stakeholders and designers around an agreed set of qualitative and performative

goals, and in so doing offered an initial consensus that facilitated better dialog. The architects of the Rose described this as "…it [the decision to use Living Building Challenge as a framework] was a great tool we used to get everybody in line, once they were on board; in the design, we were moving through a series of successive approximations necessary to produce this high-performance building, and LBC let us all huddle around the same goals without resorting to comments like 'who's idea is THAT?' or other conflicts that slow the process down if people get defensive [when their ideas are criticized]" (MSR, 2017).

(viii) **Targeting specific social concerns:** All three projects were initiated by developers seeking to solve a concrete social need, and targeting a specific audience. These projects go beyond the provision of affordable housing for underprivileged populations: they labor to ensure that the project is 'the right fit' for the specific target population in question.

This approach was applied in several ways:

a. **Bringing the local community into design process:** All three project teams made meaningful community engagement efforts both **before and after** the design process; pre-project efforts included neighborhood meetings, 'community listening' sessions (the Rose), surveys (HRB) and a website welcoming resident feedback (FHY). Post-project efforts are outlined in sub-chapter 7.4 under point (xi): designing for community.

b. **Conducting social research:** All three teams performed social research at the pre-design phase of the project: the Rose had this performed by co-developers Hope Community, complemented and developed by sustainability champions

PLACE as well as by CSBR; the Hollerstauden project was conceived following extensive social research commissioned by the City of Ingolstadt; the Furuset Housing for Youth materialized following decades of community work of the developer (Bethanien) with the local community in Alna district through their informal education and family health outreach programs.

c. **Maintaining post-occupancy contact with residents:** The developers of all three projects remained involved long after the buildings' occupation, not only within the building's operations, maintenance or rental office, but in the life of the resident community. This point reflects the commitment the developers have for the residents' wellbeing and success. Bryn Bell[18], co-founder of the SEED network, described this as "Architects are used to hand over the keys to a building, taking a photograph, and walking away… We kind of feel that's the beginning of the story" (Bell, quoted in Garlock, 2015). At all three projects, the developers run informal education programming throughout the year aimed at building the community, promoting health through lifestyle clinics and family education. Betanien, the developer of the Furuset project sums it nicely: "…We would like to provide these people with a fair chance in life, and better lives for their children… they will do well if we give them the tools, like that [workshops and continued support], we have done so for years. Now at Furuset they have a fair chance"(Betanien Oslo, 2017).

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[18] Bell is the founder of the Public Interest Design Institute, and a co-founder of SEED (Social Economic Environmental Design) framework. He has supervised the Structures for Inclusion lecture series that presents best practices in community-based design, and is a published author in the field of public interest design and inclusion (www.seednetwork.org).

7.4. Design: giving form to ESD projects

The case study projects outlined in the previous chapters paint a picture of progressive affordable housing projects, being both environmentally high-performing and socially sensitive. Sections 7.2-7.3 summarized the specific conditions and the processes used to bring these projects to fruition. However, this picture wouldn't be complete without considering the **design implications** of these projects: timeless, universal design principles of human-centered design that resonate through all three buildings. The following example illustrates this point in the affordable housing segment:

Kate MacIntosh is a Scottish architect, who, working for local authorities in the greater London areas in the 1960s and 70s, was responsible for some of the most lively and progressive social housing projects of the time. Designing her first such building at 28, Macintosh used the term *'ostentatious parsimony'* to describe the design ethos of the social architects of the time. MacIntosh was responding to statements made by penny-pinching housing ministers proudly suggesting to strip out 'extravagances' in public housing such as balconies, windows and gardens. Despite this difficult political mindset, Macintosh succeeded in producing humane, animated buildings using a "restricted material palette of concrete block, dark timber and iron railing" (Macintosh, quoted in Moore, 2015), and advocated for the creation of lively, aesthetic, humane residential environments where residents can thrive (Moore, 2015). Her professional efforts to 'swim upstream' produced exemplary social housing projects in England, some of which become icons of this housing segment and studied to this day (Utopia London, 2015).

MacIntosh's powerful example of well-designed social housing resonates through the design of all three projects studied, and is further reinforced through the

labor, dedication and many decisions made by their architects and design teams. All three projects demonstrate that affordable housing, despite its economic and regulatory constraints, can provide its residents high-quality living environments and well-designed, healthy spaces where residents can succeed.

The following framework lists the design tactics used by the designers of the case study projects to produce these high-quality projects:

(ix) **Designing for community:** All three design cohorts interviewed emphasized the importance of applying humanistic design in a project with a social agenda by looking beyond the obvious, and "trying to really create a safe, healthy place for residents of all ages to thrive" (MSR, 2017); The design teams went a step further and created multiple thresholds for social wellbeing:

a. **Creation of common spaces:** The Rose fitness room and garde, FHY's 'party room' and bicycle workshop or HRB's atrium: the designers of all projects created spatial contingencies within them aimed at promoting community life, designating multipurpose spaces for shared resident activity. This is a particularly strong imperative since the cost of these shared spaces is not only monetary but also spatial.

b. **Creating convivial environments:** Architects applied design tools to enhance the living experience, planning the movement in, out of, and through the buildings; incorporating 'meeting opportunities' and points for short-term sitting; orienting windows towards the more populated common areas to create an animated façade, or eyes-on-the-street à la Jane Jacobs (Jacobs, 2016).

c. **Giving back to surrounding community:** The designers of all three projects

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made 'gestures of good will' to their buildings' surroundings: the Rose has a vegetable garden and public space accessible to the public, the Hollerstauden building has an inviting path through its center, connecting it to the adjacent buildings, and the Furuset complex has an open courtyard, bicycle workshop and Oslo CarPool parking spaces – all accessible to neighbors of the project. The decision of all three design teams to include these features (and that of the owners to support them) speaks volumes of their holistic approach and commitment to a better 'wider environment' of their residents.

(x) **Designing for human health and comfort:** All design teams demonstrated admirable concern for interior health and comfort, incorporating thermal and acoustic comfort measures (Rose, FHY, HRB), specialized measures or systems to ensure good air-quality (Rose, FHY), natural moisture regulators (FHY, HRB), and specifying interior materials following stringent regulations for healthy materials, going well above building code regulations to ensure resident health: "Most of these people have health issues as it is, having lived near a highway all their lives… many of their kids have breathing problems… it seemed right to provide them with good-quality interiors and fresh air" (MSR, 2017); "We are designing for the elderly… some of them are frail or simply have failing health. The interiors were designed for them to feel well and keep feeling well" (Behnisch, 2017).

(xi) **Designing for environmental regeneration:** In line with their holistic approach of ESD, the designers of all three projects made an effort for their buildings to 'tread lightly' both in the wider sense (energy consumption, transportation) and

locally. The environmental commitment of these designers and owners shines through the many design decisions made throughout the design process. Some unifying attributes are total building performance (efficient envelope and mechanical systems), water conservation, extensive use of daylighting, responsible material selection and healthy interiors.
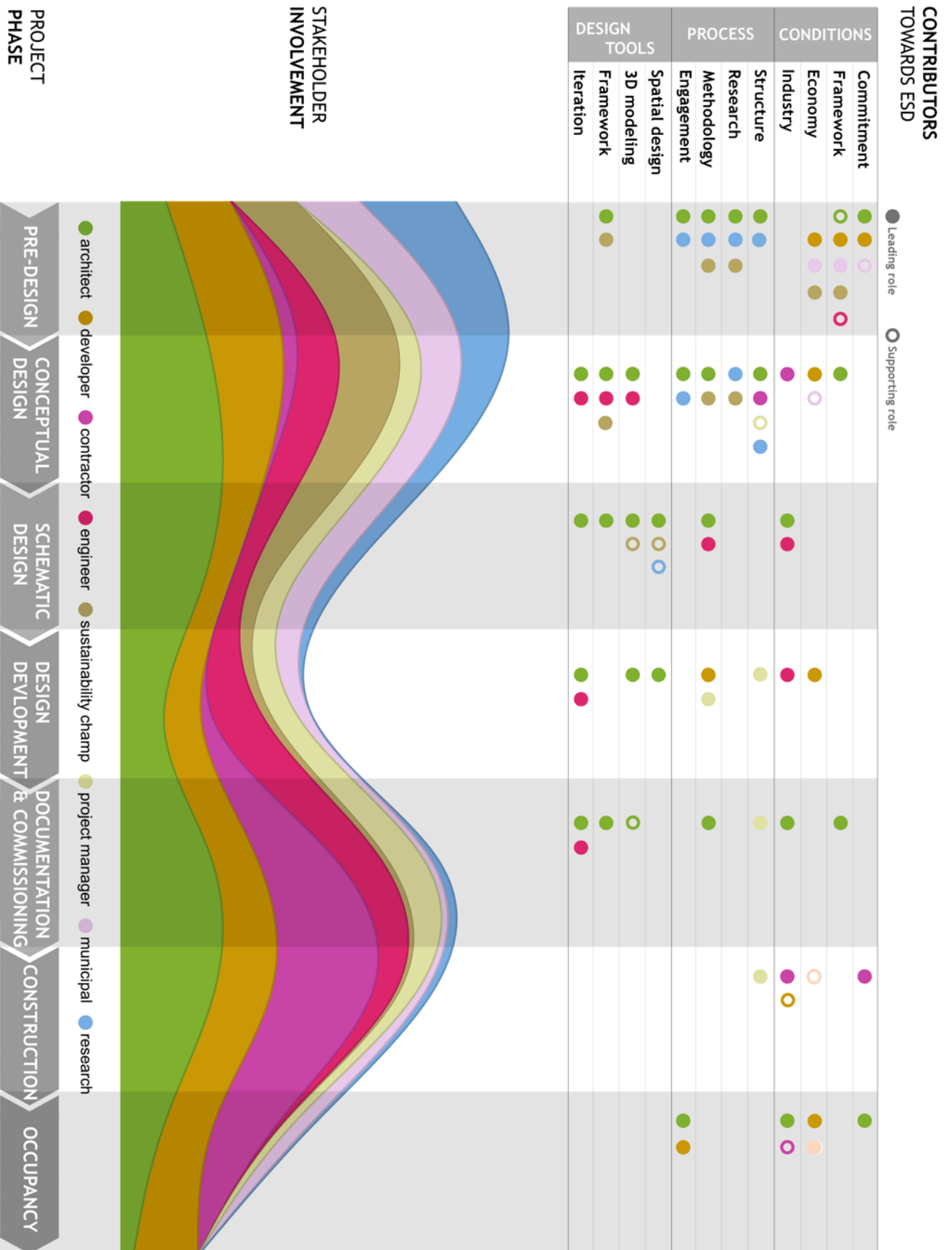
Figure 7.1: Process-mapping of ESD imperatives as imperatives and attributes, set against the level of stakeholder involvement, across the various stages of the design process.

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7.5. Summary

The cross-analysis of the case study findings yielded a set of re-occurring themes, or attributes, can be generally divided to three categories: **conditions, process-based** and **design-based** themes. These themes manifest themselves differently in the hands of different architects, owners and developers, and given the conditions and context of each project; however, at their core, they conform to a uniting pattern for the three projects studied.

Based on the data analysis, section 7.2 (settings) indicates favorable conditions and motivations for successful ESD projects; section 7.3 (process) outlines process-based attributes that build upon these conditions; finally, section 7.4 (design) specifies design-based tactics that can be applied, following the process. These shared attributes do not suggest a one-size-fits-all approach for ESD projects; the projects are highly conditional and contextual, and it would be naïve to expect these shared qualities to deliver the same results if replicated elsewhere without considering their new context. However, their thoughtful application can be highly beneficial for the success of such ambitious projects.

Mapping of these attributes offers further insight into their contribution to successful ESD projects. The mapping graphic analysis suggests that:

(i)   Any one attribute (or set of attributes) has a potentially critical role depending on its arrival in the sequential design process;

(ii)   Attributes that act as requirements in one phase of the process can in fact become results in following phases (e.g. the introduction of a sustainable design framework can shift into an implantation of that framework in later stages);

(iii)   Most of these attributes cannot exist in isolation but require the presence of the

others to be effective, and often cannot be applied if previous attributes are not in place; and

(iv)   When applied in coordination, most attributes act synergistically to enhance the effectiveness of one another.

Arguably, these parallels clearly indicate the need for a shift in conventional design approach: firstly, they suggest a basic transition from the traditional, fragmented, linear, object-oriented design and development approach that focuses on the product (building) instead of the subject (resident); second, they suggest the need for a well-rounded, collaborative, integrated design process *within* current sustainable design practices - mainly from an ecologically-focused approach to a holistic approach.

The next chapter concludes the study by reflecting on these discussions, discussing the implications of the analysis and offering future directions for research.

Chapter 8: Conclusion

This chapter concludes the dissertation by summarizing the previous chapters and demonstrating their contribution to meeting the objectives detailed in chapter 1. It also presents a framework for future application and practice of the imperatives needed for ESD projects. The chapter concludes with the limitations of the research and further research questions.

8.1. Introduction

In order to appreciate the findings and conclusions of this dissertation, it is necessary to return to the motivations for its undertaking. The initial provocation for this research topic stemmed from the observation that, while sustainable design is steadily gaining traction as a thematic pursuit within the architectural profession, it's practice tends to be largely one-sided, gravitating towards environmental performance, usually through prescriptive frameworks with segregated, close-minded approaches; this limited approach to sustainable design ultimately produces buildings with a limited impact on resident wellbeing, albeit the best intentions of its designers and developers. Thus, this research set out to explore motivations for the design and development of projects with a more holistic definition of sustainability, and methods used to execute such projects more efficiently, leading to projects with greater environmental and social gains.

Case study analyses of such exemplary projects revealed a shared pattern of progressive, integrated design processes that differ from the predominant traditional processes in their collaborative, egalitarian nature and transparent dynamics. When applied in concert with certain pre-existing conditions, these processes can greatly advance projects that benefit both their environments and their residents. This chapter

will discuss the findings in chapter 7 in light of each other and the design process as a whole.

8.2. Achievement of the research aims

The aims of this dissertation have been to explore the most effective ways to advance environmentally sustainable, socially equitable, well-designed (ESD) projects, ultimately offering a framework for a more holistic design process within existing practice-based models of design for sustainability. The discussion chapter outlines these and illustrates their relative weight throughout the design process by isolating them into pre-required conditions (settings), process-based methods and design-based tactics, also describing the scheduling of each along the timeline of the design process of each of the case study projects.

The conclusions of the dissertation arise from analysis and comparison of the case study data, as well as from contrasting these with findings from the literature review, particularly the sections describing integration within design practice. It is important to keep in mind that the case study projects were selected for their novelty in design practice, IDP and a more holistic, wider sustainability agenda as described in chapter 3; as such, these case studies reflect the practices of the 'elite' with regard to sustainable design practice and integration. Having said that, the aim of the dissertation was to generalize theories (analytical generalizations) rather than to enumerate frequencies (statistical generalizations) as described in section 3.2 (Yin, 2003); with this point in mind, the framework offered later in this chapter is one suggested for pursuit, practice and application of ESD projects rather than aim to construct a theoretical model of the phenomenon of ESD. Its potential implications for continued research and design education are discussed at the end of this chapter.

8.3. Conditions required for pursuit of ESD projects

The cross-case analysis and consequent discussion of findings revealed a multivariate threshold of conditions, both absolute and subjective, that must be present and synchronized for the effective inception, and later development and execution, of ESD projects. These can be further refined by separating them to three 'layers' of imperatives, consisting of conditions, processes, competencies and tactics, all deemed necessary for the successful execution of ESD projects.

1. The first and basic tier of application pre-existing conditions, made up of external, objective conditions (e.g. government incentives towards sustainable development projects or market demand for projects with such added value) and contextual, subjective conditions (e.g. professional competence and awareness, developer commitment and motivation). These conditions represent a set of baseline imperatives without which an ESD project cannot even begin, and as such, they must be in place *before* the design and development process can commence;

2. The second tier of imperatives are those relating to the design and development process and its practice, and specifically how the process is framed and initiated, the presence of a robust sustainable design framework to guide the process, social research and engagement efforts, how the design team is assembled what stakeholders are present at the onset, the structural relationship of the team and the management model which it adopts;

3. The third and most refined tier of provisions relate to the designers' ability to synthesize the vast collection of programmatic needs, goals, constraints, site conditions, industry and construction obligations, time and budget boundaries into a clear and coherent design, using design-based tools and decisions to achieve environmental and social benefit of the site and community.

These requirements appear as a set of sequential imperatives, each hinging on the presence and implementation of those of the previous stage; they can be seen as concentric layers, with the external conditions of lesser context at the outmost layer, and the highly contextual, pragmatic conditions at the center (figure 8.1):
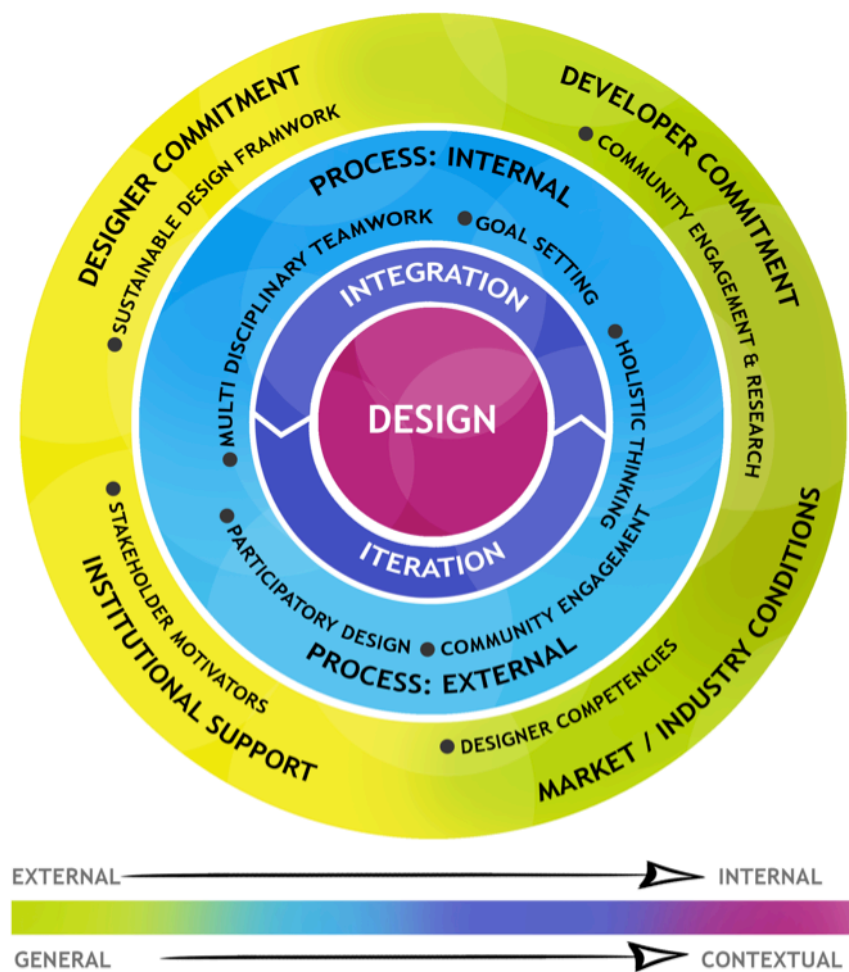
Figure 0.1: Schematic mapping of ESD imperatives

These imperatives can be divided further according to their placement within the design process, their connected and dependent nature and their level of appearance as either required imperatives or resulting imperatives. They are refined in the

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framework for pursuit and application of ESD projects, detailed in the next section.

8.4. Suggested framework for pursuit of ESD projects

Beyond a thematic list of imperatives, the framework also presents a visual mapping of the complex, interconnected web of essentials, showing their interdependency, sequencing and hierarchy. The diagram, next, illustrates the placement of each imperative within the design process, as evident from the case study cross-analysis and following discussion in chapter 7.

The framework is detailed following this graphic representation.

Figure 8.2: Process-mapping of ESD imperatives as sequential required versus resulting imperatives and attributes, across the various stages of the design process.

i. **Motivations of developers, clients and designers for pursuit of ESD projects lead to strong commitment:** these are typically a co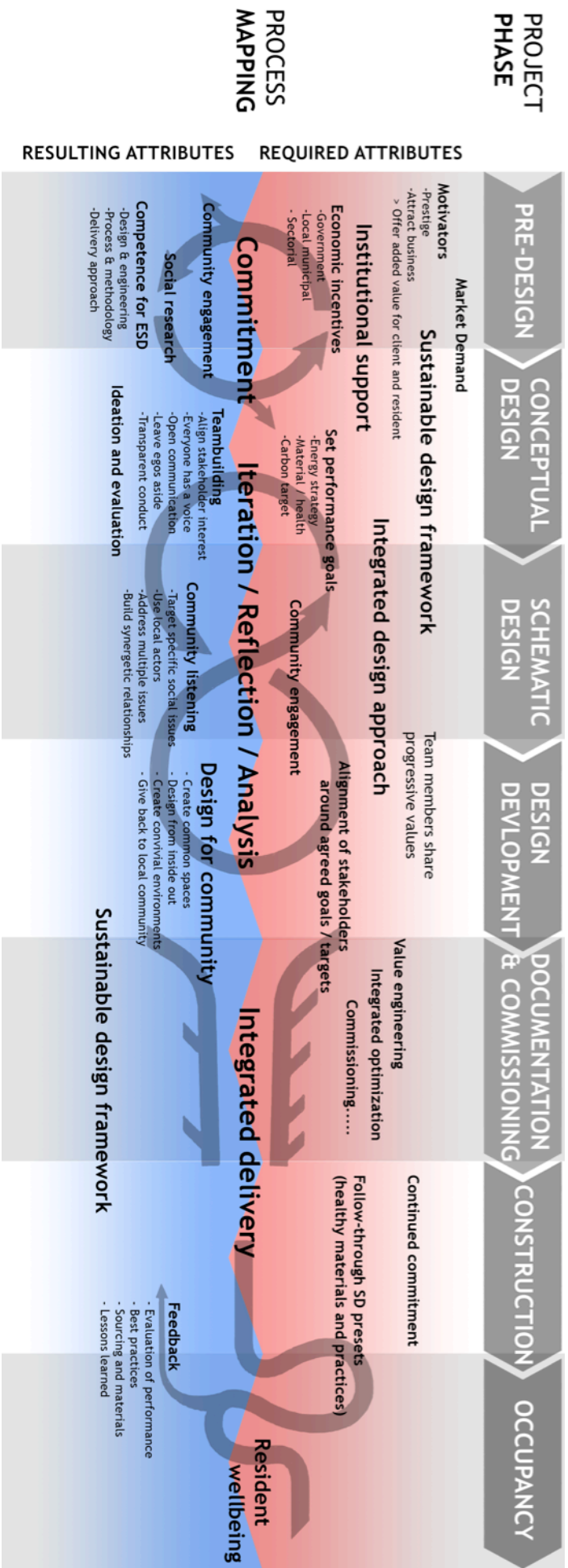mbination of strong moral impetuses, based on complementary worldviews or resulting from years in the profit-centered development, design and construction sector, alongside an opportunity to fill a market gap, earn professional prestige and attract new work – typically seen by developers or owners as a win-win situation. **Resulting imperative: leader commitment.**

ii. **Institutional support is critical for project inception and developer or client commitment to the sustainable design agenda:** Developer and /or client commitment is essential for the pursuit of ESD projects; it is often stimulated, and further bolstered by institutional support in the form of local, regional, national or sectorial incentives, monetary or procedural. Creative funding and professional recognition also play a role. **Resulting imperative: continued leader commitment.**

iii. **Strong relationships, long-term acquaintance and mutual trust between developer and architect are critical for any integrated process:** previous acquaintance through work, similar worldviews and matching aspirations are strong adhesives that bring like-minded professionals to purdue such demanding ESD projects. A 'multi-tiered' trust is also highly beneficial (e.g. management with management, finance with finance, logistics with logistics, etc.). **Resulting imperative: cooperation and trust among stakeholders.**

iv. **Social research and outreach efforts lead to community participation in the design process:** citizen engagement methods provide valuable insights for both the developers and designers, making for a solid foundation for the conceptual stage of the design process; architects can choose to make

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'community- benefiting gestures' to bring added value to the surrounding community. **Resulting imperative: community trust and acceptance.**

v. **Cooperation and trust between developer, community, contractor and architects:** community outreach and genuine engagement efforts form the basis for a strong partnership between architects, developers, contractors and the community; such a bond ensures a smoother alignment of goals and a quicker, more open design process. **Resulting imperative: solid relationships, transparency and trust among stakeholders.**

vi. **Holistic sustainable design frameworks are pivotal in framing the project in the conceptual stage, and making design decisions throughout:** such programs bring clarity and focus to the design process, helping the project team define performance and health goals and also assist in the development and funding phases; such frameworks are also helpful for prioritization and decision-making at critical junctions in the design process following contextualized adaptations of central priorities from these frameworks. **Resulting imperative: application of an integrated design process.**

vii. **Integrated design process:** a formal or informal integrated design process encourages input from all stakeholders and consultants very early in the design process, examining life-cycle costs and establishing energy budgets as the initial design takes shape; this input is vital later in the commissioning and bidding process. Such a process encourages consultants and the contractor input early in the design process, examining life-cycle costs through dedicated modeling and establishing an energy strategy for the building as the plans

materialized. **Resulting imperative: holistic design, high-performing building with real added environmental and social benefits.**

viii. **Use of design tools to promote community cohesion, social wellbeing, health and livability:** solid, timeless design principles should be applied to enhance community wellbeing through use of open spaces, public and private areas, connection to existing urban fabric, acoustic design, scale, volume, order, rhythm and movement – to produce spaces that reinforce a sense of community and openness within the building while offering residents a sense of privacy and security. **Resulting imperative: High quality housing that fosters resident and community wellbeing.**

ix. **Designers as integrators, facilitators and social leaders:** designers have the capacity to promote social equity through their ability for synthesis: they can cope with a multitude of programmatic, budgetary, technical, social and performative targets and envision a design that would best meet these. Working in the context of two competing supposedly spheres, the environmental and the social, they can use the imperatives above to navigate through these obligations, ultimately producing quality buildings that promote both resident and environmental wellbeing.

8.4. Research limitations

      While a great deal of time and effort were invested in this research, it inevitably has several objective limitations in scope and achievable goals within the given timeframe, as any academic project.

8.4.1 Methodological limitations

      The decision to use case study methodology was made mainly due to its fit to the novelty of the phenomenon in question, and is discussed in chapter 3; however, a typical criticism of this methodology is that the data collected cannot necessarily be generalized or applied to the larger realm of the field under study (in this case, architectural practice); data collected through cross-section case studies is sometimes seen as very much context-specific and not very useful for general consideration (Eisenhardt, 1989). Another criticism is that it is very difficult to generate cause-and-effect conclusions from case studies. This research aimed to address this limitation through awareness of this potential weakness and by comparing the data collected to that of the literature before moving on to analysis, discussion and conclusions.

      The scope and breadth of the research would have benefitted from additional case studies, which would have constituted a wider base for study and analysis. The research began with an intended four case studies, the fourth project being BedZED (Beddington Zero Energy Development), designed and executed in 2002 as a pioneering sustainable community in Hackbridge, South London, England. It was envisioned as the UK's first large-scale, mixed-use development with some 100 homes and office communal spaces. The study of BedZED in this research started but came up against several logistical difficulties in obtaining

data; the project had been designed over 15 years prior to undertaking this research, making it very difficult to reach relevant persons to in interview. Although both the developer (BioRegional) and the lead architect and visionary (Arch. Bill Dunster of ZEDFactory, London) have leveraged the knowledge, experience and publicity gained from BedZED to develop offices that continue such developments, both were largely uninterested in discussing the project; BedZED itself is in full occupancy and operation, and resident turnover is extremely low (OPAL Report, 2016), however the development has experienced several drawbacks in the years since its opening, both technical and social. It must be judged, however, in light of its ambitious goals at a time when sustainable or green building was not as well-known as it is today, and the project's residents have, to an extent, played the part of willing Guinea pigs within the project's context.

Another methodological limitation is that of interviewing project stakeholders and professionals in the aftermath of a project: while this is certainly efficient and enables the interviewee to reflect on the process as a whole (often a years-long process), there is a self-confessed tendency for such professionals to remember the design and development process with rose-colored glasses, often 'gliding' over certain crises that occurred along the way, but were ultimately resolved.

Some additional limitations include other, objective aspects of the methodology:

(i) **Interview limitations:** 'Office politics' are a natural occurrence in any professional setting, even more so in a competitive, spirited architecture firm. In the case of this research these sensitivities were particularly apparent when

presenting questions about the performance of other consultants or colleagues, from the same firm or in other firms; there were several instances where an interviewee politely refrained from answering or 'pointing fingers' when asked about the performance or competence of a colleague. In one instance, one leading consultant was frustrated with the conduct of the architecture firm, and refused to be interviewed if the architects were also interviewed about the project. This issue led to the avoidance of citing direct quotes by individuals throughout the case study chapters (e.g. personal quotes are cited by the firm's name, rather than by the individual's name). It is my belief that while this presents a less accurate picture of the office dynamics, the quotes themselves are included in the study, and largely reflect the views of the firm, not only of the individual who made the statement; this seemed like a good compromise and preserves the richness of the direct quotes.

(ii) **Sampling limitations:** the cases for this study were chosen based on 'purposeful sampling', for their relevance and similar programmatic attributes, as well as on the breadth of data available, mainly protocols of design meetings held over the course of the conceptual, schematic and detailed design phases. However, while additional cases could have been found to match these criteria, not all would have been met with cooperation and enthusiasm on the part of the design teams, clients, developers etc. All four cases initially planned for the study (BedZED included) were designed by firms in which the author has some acquaintance or connection, academic or personal. It should be added that many architectural and development firms do not naturally disclose process-related information about past projects; moreover, even when professionals from these firms agree to an

interview, they are reluctant to discuss any sensitive issue, financials in particular. While all three cases studied are publically funded, at least

(iii) **Time limitations:** Since all three case studies involved practicing professionals, the time allocated to the interviews was typically one hour, with some back-and-forth email correspondence before the interview, and after it if necessary. Meeting the interviewees involved travel, with sites visited for approximately 2-3 hours; naturally, the research would have benefited from a longer period of time spent together with the project architects and some of the developers.

(iv) **Language limitations in interviews:** out of over two dozen interviews held, two were held in presence of a local interpreter, although the interviewee spoke fair English; however, with a couple of the case study projects in non English-speaking countries, interviewees spoke fair to very good English. This led, at times, to a less thoughtful conversation and more 'basic' insights. Questions and answers were limited to what the interviewee could comfortably articulate, and at times it was apparent that there is a deeper point to be made, but the interviewee is having trouble explaining themselves in English.

8.5. Contribution to knowledge

This dissertation aimed to address a gap in the current literature regarding sustainable design with a wider agenda by presenting the narratives of three case study projects. The niche of a twofold design agenda (environmental and social) is relatively underexplored, reinforcing the need for this research. The insights generated through the case study cross-analysis contribute to new knowledge in the areas of sustainable design practice and design for social sustainability.

In the area of sustainable design practice, the research shows the potential of a genuinely integrated process for buildings of both high-performance and social inclusivity. By presenting the design processes of the three projects, the integrated process is explored by highlighting its conductive and prohibitive properties for ESD, to allow best practices to emerge. The data, collected from some twenty-five professionals engaged in integrated design practices, reveals the attributes that make for an effective integrated process: open dialogue, trust and equality among stakeholders, transparency in design and engineering, sharing of information, use of BIM and energy modeling tools, budgetary transparency and collegiality amongst all involved.

In the area of design for social sustainability, these cooperative projects demonstrate that a cohort of committed professionals working collaboratively towards a common goal can facilitate an environment of critical enquiry, diverse skills, open dialogue, transparency and diversity. It is this type of environment that can best draw out the power of synthesis: designers' intrinsic capacity to deal with 'wicked problems' and other complex, multivariate issues that must be addressed to provide better performing, more holistically designed environments.

8.6 Directions for future research

The limitations of this research and neighboring topics that were not addressed both represent an opportunity for future research and a deeper understanding of the topic of ESD projects and process, beyond this dissertation. Two examples of such topics are outlined below.

(i) Understanding the role of institutional support: it was shown in all case studies that the support of institutional and government entities is not only critical, but often represents the initial motivator that urges developers or land-owners to 'take the plunge' and pursue such demanding, progressive projects; these aspects of the development process were not explored in any detail, yet understanding their weight and leverage would be beneficial and contribute to a richer picture of these projects.

(ii) Applying the suggested framework to differently-scaled ESD projects: the framework suggested earlier in this chapter could easily be applied to, for example, urban planning projects or even larger-scale residential neighborhoods with the objectives of environmental and social wellbeing; for example, the municipality of Barcelona, Spain, has been implementing a breakthrough walkability and green transport policy in recent years, aiming to moderate the car-centric nature of the city and re-introduce the streets to pedestrians. Although this seems like a completely different endeavor than social housing, its objectives fall within the wider sustainability agenda of advancing environmental sustainability (lower car traffic and walkability) with social wellbeing (cleaner air and more convivial streets). Juxtaposing the design process of this project with the suggested framework for ESD projects could produce insights for the benefit of both.

Finally, the combined topics of social equity and environmental sustainability in design could be opened for deeper consideration, bringing this idea closer towards an established theory, and perhaps even towards policy. Advancing these as a joint paradigm could potentially lead to a shift in the considerations, motivations and processes that govern the design and development of most of the built projects around us today. There's no question that such a shift is the call of the hour, and will be instrumental in our transition to healthier, more responsibly designed environments for all.

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