



Enhancing quality of life in residential high-rises by sustainable design responses

Elena Stoyanova Kalcheva

P1414759X

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Personal motivation

My interest in Architecture dates from my childhood. I have always been concerned about how people live and interested in the ways architecture influences their lives. So this research is to a great extent the answer to long-term aspirations and I found it gives me the opportunity to investigate in depth the role of the architecture in the everyday life of the people. Some urban design issues also were raised, and it was great to be able to exercise my abilities and apply my knowledge as an Urban Designer, so I gladly embraced the chance to conduct this research.

Abstract

After the end of World War II, in England was observed a proliferation of high-rises, replacing the destroyed buildings by the bombing and the existing slums. However, their popularity varied with time, at first being seen as a great improvement of the living condition, but later the authorities faced many complain that these buildings were unfit for normal living and especially for families and children. Nowadays England has to cope with a great heritage of towers from the 60s' and the 70s', as well as an increase in the construction of new high-rise buildings especially in the capital London. This research recognises the need to improve the design of the existing and future high-rises so they are in the same time sustainable and provide a better quality of life for the occupiers. Therefor an overall aim of the study was formulated: to investigate strengths, weaknesses, opportunities, and threats of the impact of high-rise buildings on quality of life through four objectives. The first one is to evaluate the connection between sustainability and quality of life indicators in high-rise buildings. The second one it to analyse liveability of high-rise buildings for better quality of life. The third one is to analyse energy-efficient solutions and their impact on enhancing quality of life. The final objective is to produce a conceptual framework for designing sustainable high-rise residential buildings enhancing quality of life. The methodology adopts an interpretive and realist paradigm and the data for this research was gathered from primary and secondary sources: interviews, observations and archival data. After searching SkyscraperPage database, it was found that two types of high-rise persist around UK and are numerous in London and Manchester: 12-16 storey buildings with brick cladding and 22-30 storey buildings with concrete cladding, so a limited number of buildings with these characteristics were selected for the case study. Actually, an effort to interview 3 to 5 residents in the same building at low, middle and high floors was made, instead of interviewing single residents from numerous different high-rises, in order to evaluate the significance of the height. The preferred method was interviews, as questionnaires were found to provide superficial data,

open to misinterpretation from the researcher. Interviews, on the other hand, provided in-depth information about the social phenomenon: high-rise living, many surprising answers and most importantly, attitudes and preferences that were not influenced by the formulation of the questions but were formulated by the interviewees themselves.

Seventeen interviews with residents were conducted in two old high-rises in Manchester and four in London to include the users' needs into the research process. Twelve interviews with residents in new high-rises illustrated the existing variations for the design issues. Additionally, twelve architects shared their proven experience designing residential high-rises, offering invaluable expertise for the design of sustainable residential high-rises providing better quality of life. The data generated then were analysed by content analysis and dynamic simulations with DesignBuilder of an approximated model of one of the studied high-rise complemented the interviews, investigating different building envelopes and HVAC scenarios. This quantitative method supported the somewhat subjective findings regarding thermal comfort and cost-efficiency from the interviews.

The main findings showed that specific sustainable design solutions are adequate for enhancing the quality of life in residential high-rise buildings. Some alerting data from the interviews with the residents reveals difficulties imposed by the design on the social interactions, more common in the old high-rises lacking any amenities. Other important findings inform that both existing and contemporary designs are not orientated towards the needs of the families with children, a major weakness stated by both the architects and the residents. The observations provided support for a view that both modern and old high-rises often fail to enhance and improve the built environment by both appearance and mix of functions, a valuable facet of the high-rises' social impact.

The analysis led to the elaboration of a theoretical framework that can be used by professionals and academics to guide their design process and constitutes the major contribution to knowledge.

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I would also like to thank my family as well for their patience and kind support which made this journey possible.

Declaration

This thesis is submitted to De Montfort University to fulfil part of the requirements of the degree of the doctor of philosophy in accordance with this institution rules and regulations. Accordingly, I declare that this work is based on original research and have fully acknowledged the work of previous studies. Therefore, and to the best of my knowledge, no materials in this work have been published in any format apart from articles derived from the research data.

Publications resulting from this research

A number of papers have been presented at conferences and accepted by journals as follows:

Perception of Indoor Environmental Quality of the Residents of High-Rise Buildings in Bulgaria; Kalcheva, E.; Taki, A. H.; Hadi, Y.; Journal of Civil Engineering and Architecture Research, 3 (4), pp. 1371-1378

Residential High-Rises and Meaningful Places: Missing Actions in the Isle of Dogs regeneration; Kalcheva, E.; Taki, A. H.; Hadi, Y.; ICCEA 2016: 18th International Conference on Civil Engineering and Architecture, 19-20 May, 2016, Berlin, Germany

Foundations of the Vertical city in England: Architectural Theory and Practice; Kalcheva, E.; Taki, A. H.; Hadi, Y.; 4th Annual International Conference on Architecture and Civil Engineering (ACE 2016), 25-26 April, Singapore

Sustainable high-rises in a Sustainable Development-the Case of Salford Quays; Kalcheva, E.; Taki, A. H.; Hadi, Y.; Procedia - Social and Behavioral Sciences, 216, pp. 960-973

High-Rises and Urban Design: The Reasons for Unsuccessful Place-making with Residential High-Rises in England; Kalcheva, E.; Taki, A. H.; Hadi, Yuri; ICBAU 2016: 18th International Conference on Building, Architecture and Urbanism, March 14-15, 2016 in Paris, France

Focus on Lived spaces and Identity: the Paradigm of the Urban Design with Residential High-Rises in England; Kalcheva, E.; Taki, A. H.; Hadi, Y.; ARCHDESIGN '16, 3rd International Architectural Design conference on design and nature, June 17-18, 2016, Istanbul, Turkey, pp. 106-111

Social and Environmental Sustainability for Better Quality of Life in Residential High-Rises; Kalcheva, E.; Taki, A. H.; Hadi, Y.; Journal of Buildings and Sustainability, 1 (1), pp. 13-24

Infrastructure of Bulgarian High-Rise Estates: Realities and Hopes; Kalcheva, E.; Taki, A. H.; Hadi, Y.; In: Govil, J.N. (ed) Socio-Economic Empowerment. New Delhi, Studium Press, pp. 123-140.

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Abbreviations and Acronyms

Acronym	Explanation
QOL	Quality of Life
SWB	Subjective Well-Being
RIBA	Royal Institute of British Architects
PCA	Principal Component Analysis
STRB	Super Tall Residential Buildings
AHP	Analytic Hierarchy Process
WWR	Window-to-Window Ratio
LEED	Leadership in Energy and Environmental Design
UCZ	Urban Climate Zones
SVF	Sky View Factor
WVR	Wind Velocity Ratio
WV	Wind Velocity
FAR	Floor Area Ratio
BCR	Building Coverage Ratio
TVF	Tree View Factor
HVAC	Heating, Ventilation and Air-Conditioning
CFD	Computational Fluid Dynamics
IAQ	Indoor Air Quality
GHG	Greenhouse Gases
SBEM	Simplified Building Energy Model

Chapter 1 Introduction

1.1. Research Background

With the increase of the population and the process of rapid urbanisation, cities become a weighty realm of human activities and interaction. There is a certain level of transformation resulting either in suburbanization or densification of the city centre or both. However, the researchers are looking for the sustainable city form that will meet the needs of the current population without compromising the opportunities for the future one. The Commission of European Communities (CEC 1990) made a strong support statement for urban concentration envisioning the sustainable urban form as a compact city (Zhang, 2000).

During the 21st century, the cities orient towards compact cities and specifically sustainable compact cities. The notion requires the construction of the urban elements efficiently but compactly. Such actions should lead to fighting global warming by reducing energy consumption and revitalising the traditional city centre, declining as a result of suburbanization. One of the best solutions to achieve the compact city form are the high-rises because they can centralise the numerous functions of the city. (Shin, 2010).

There is an intrinsic discourse between the concepts of sustainability and high-rise. High-rises represent the values of rivalry, originality, power and affluence. The sustainability concept, on the other hand, acknowledges the need to maximise depleting resources by mutual gain and long-term strategies (Worthington, 2010). Sustainability for the urban areas is described as a reduction of the resource consumption and waste and in the same time improvement of liveability (Newman, 2001). Sustainable essentially means approaches to design, construction and maintenance securing minimal effect on the environment and the users (Ali and Armstrong, 2008).

Social sustainability is defined as the ability of a social system, for example, a country or neighbourhood to function indefinitely, providing certain social well-being (thwink.org). It refers to topics like social equity, liveability, health equity, place-making, cultural liveability and community resilience. If these issues are underestimated in the design process high-rises can turn into vertical sprawl: structures built inefficiently and taking too much space. Sustainable building is characterised by enhanced energy efficiency and minimum harmful influence on human health and the environment via better location, design, construction, operation and maintenance (Almatarneh, 2013).

Before discussing the discourse about high-rises and sustainability in connection with quality of life, it is helpful to clarify some terms. Quality of life has also been defined "as the satisfaction of an individual's values, goals and needs through the actualisation of their abilities or lifestyle" (Emerson, 1985, p. 282 as cited by Felce and Perry, 1995). In general it reinforces the notion that satisfaction and wellbeing are related to how individual's perception of their objective situation and their needs or aspirations fit together (Andrews & Wlthey, 1976; French, Rogers, & Cobb, 1974 as cited by Felce and Perry, 1995). The conceptual model by Campbell et al. (1976) as cited by Felce and Perry, (1995) exemplifies and base their standards of comparisons on aspirations, expectations, feelings of what would be just, reference group comparisons, personal needs, and personal values. Baker and Intagliata (1982) as cited by Felce and Perry, (1995) talk about need levels, beliefs, and attitudes as crucial parts of the bio-psycho system element of their model. Parmenter (1988) as cited by Felce and Perry, (1995) encompasses beliefs, goals, values, and aspirations within the self-element of his model.

Quality of life has proven to be a central notion in recent research. Residential buildings in connection with the quality of life are a part of a decisive general debate on the quality of life in a world, facing continuous industrialisation (Pacione, 1984). There is a shared

scientific position that quality of life is multidimensional. It covers five dimensions: “physical well-being, material wellbeing, social wellbeing, emotional wellbeing, and development and activity.” (Felce and Perry, 1995, p. 51). Providing well-being requires increasing the individual level, improving the surrounding environment to provide superior conditions for the substantial population of people. The personal satisfaction and requirements for physical and social settings surrounding the humans are crucial factors for defining human well-being (Lee, Je, Byun, 2011).

One definition of quality of life states that Quality of Life (QOL) is the extent to which objective human needs are met in terms of personal or group viewpoints of subjective well-being (SWB). Human needs are basic needs for Subsistence, Reproduction, Security, Affection, Understanding, Participation, Leisure, Spirituality, Creativity, Identity and Freedom. “SWB is assessed by individuals’ or groups’ responses to questions about happiness, life satisfaction, utility, or welfare. The relation between specific human needs and perceived satisfaction with each of them can be affected by mental capacity, cultural context, information, education, temperament, and the like, often in quite complex ways. Moreover, the relation between the fulfilment of human needs and overall subjective well-being is affected by the (time-varying) weights individuals, groups, and cultures give to fulfilling each of the human needs relative to the others.” (Costanza, et al., 2008).

“While most dimensions of the framework for statistical measurement of quality of life deal with objective functional capabilities of persons (such as material living conditions, living environment, leisure and social interactions, employment etc.), any measurement of quality of life should also extend to cover the subjective well-being of persons.” (EUROSTAT, 2017).

Another concept, often used interchangeably with quality of life, is well-being. Shin and Johnson (1978) as cited by Dodge et. al (2012) define wellbeing as “a global assessment of a person’s quality of life according to his own chosen criteria” (p. 478) and this statement is still used in today’s literature.

Liveability is another concept related to quality of life. Vuchic (1999) as cited by Haan et al. (2014) claim liveability is dependent on the elements of the city and is: “generally understood to encompass those elements of home, neighbourhood, and metropolitan area that contribute to safety, economic opportunities and welfare, health, convenience, mobility and recreation”. Veenhoven (1996) as cited by Haan et al. (2014) adds that liveability is the quality of life in the nation — how well it provides compared to the needs and abilities of its citizens. It is notable that all definitions are inherently anthropocentric — liveability reflects the ‘quality of life’, ‘wellbeing’ and/or the satisfaction of the people’s needs.

Sustainable development is related to progress enhancing quality of life ensuring healthy and safe environment, strengthening the the social, economic and environmental prospects of the present and future generations (Ortiz et al., 2009 as cited by Atanda, 2018). Also, it is described as a harmony between the accessible technologies, procedures of development and the approaches of governments (Volenbroek, 2002 as cited by Atanda, 2018). In the same way, Fricker, (1998) as cited by Atanda, (2018) state it is the non-material aspect of life- the impulsive, emotional, inventive and spiritual, demanding all our ways of learning (being and insight as well as doing and knowing). It is a dynamic state of equilibrium achievable by balancing a long-term environmental, economic and social health (Dempsey, Bramley, Power, & Brown, 2011 as cited by Atanda, 2018).

Sustainable housing should be available and sufficient in supply, high quality in technical and supply level, affordable with an opportunity to provide for the initial cost and

exploitation expenses for a large number of households. It needs to encompass aspects including “ecological having energy saving, ecological building materials, sustainable waste management, aesthetical design, comfortable and cosy having in mind a social-psychological aspect, representing home, which would better suit the needs of a person” (Maliene and Malys, 2009, p. 427).

Social development in conjunction with resource efficiency and environmental protection is the sustainability agenda of the residential high-rises. Successful high-rise architecture is well adapted to its topographic and climatic conditions. Eco-architecture relies on site-specific solutions, passive measures, natural resources, and relevant structure ensuring harmonious coexistence of nature, humans and the built environment interactions at public spaces – plazas, streets, public transport, etc. Places for social interactions are crucial for maintaining beneficial atmosphere among the neighbours. Planning for minimum needs has to be shifted for planning for surpluses (Yeung, 1977), fighting anonymity and lack of interaction with the neighbours in high-rise complexes.

Derived from the literature, the most healthful design provides the inhabitants with plenty of natural light and air, views of natural elements, and close relationship to outdoor natural settings. Landscape architecture seems to be one of the vital factors at the clear scale to healthy mind and body (Jackson, 2003). Promotion of mixed residential buildings using policies against segregation and in favour of all forms of tenure and differentiation of the buildings’ types seems like the path to success, especially if the land is recycled or reclaimed, there is good public transport and provisions for pedestrians and cyclists.

Mixed-use districts minimise the use of automobiles and maximise the opportunities for people, so the answer is diversity. It is crucial to avoid vertical slams creating places for the people that comprehensively correspond to their desired lifestyle. The vertical city can

accommodate vital functions such as living, work, and leisure on a limited piece of land, thus solving housing problems for a significant portion of the population, reducing trips to work and leisure and eliminating displacement. A well-designed high-rise that includes energy saving and energy producing technologies can significantly reduce CO₂ emissions. Green skyscrapers that provide as much energy as they consume (“zero energy buildings”) or more than they consume (“positive energy buildings”) are increasingly important in today globalised cities (Al-Kodmany and Ali, 2013).

A leading aspect of the inspiring high-rise buildings is their symbolic value for the communities they are implanted in. High-rises are a symbol of economic growth; they can turn into landmarks, enhancing the residents’ pride and satisfaction. Symbolism requires depends on the relationship between technical and social development, however the social processes are often complex and difficult to govern (Acuto, 2010). Maintaining the biodiversity of the ecosystems is related to basic human needs. Wilson (1984) claims that humans have a particular need for interaction with nature and more precisely, they seek to retreat in surroundings similar to those related to our evolution. These notions mean that incorporating a good relationship with the nature of a high-rise benefits the well-being of the residents and subsequently makes it sustainable.

The recent boom of high-rises in the traditional urban fabric in Britain makes this country an intriguing research realm. The high-rise development in the British cities is seen as a competitive power in the competition with the Asian cities as future centres of global development and urban quality of life (Kearns et al., 2011). It is a matter of research and experimental design to achieve living program consisting of public spaces, programs, participation, and ecological living and design (Cho and Lee, 2011) that will increase the gratification of the users and lead to a sustainable community.

1.2. The statement of the problem

High-rises are a controversial typology in the UK; they persist in every big city and noticeable neighbourhood. Tower blocks, now accounting for 20 percent of the housing stock, are perceived as a salvation from poor living conditions. Therefore architects always struggle to adapt the high-rises characteristic to the features of the social capital and the social needs. Mixed development required that councils build a mixture of housing forms – flats, maisonettes, and houses – different in regards to heights (Municipal Dreams in Birmingham, Housing, 2015).

Post-war buildings, however, showed little response to the social dimensions and were soon rejected as inhabitable. Arguably, they were not suitable for families with children, people were deprived of private space, concrete quickly became shabby, there was fear of crime, they soon started representing the slams of the future, and on the top of it, they did not really cost less. High-rise living is associated with social breakdown, crime, and misery. The described situation decisively do not prevail only in Britain and is also not just due to the concentration of impoverished residents in the British post-war developments (Smith, 2012).

A new, more adequate response to the specific features, characteristics, and demands of the social groups inhabiting the high-rise buildings is required. Such an advance can be synthesised from theory and practice, emphasising the working solutions integrated into existing towers and theoretical constructs. The development of UK specific standards that extract experience from the world's best examples of the failures of the past and mindful of the unique nature of UK society would lay firmer foundations for sustainable future high-rise developments in this country (Watts et al., 2015.).

Recent high-rise buildings have demonstrated an advancement in architectural designs in terms of energy efficiency, façade design, architecture, and engineering. Old high-rises offer a lucrative area for research quality of life of their inhabitants. They are dispersed in many big cities in the UK, but for the research, the author has chosen London and Manchester for the different characteristics in height and construction of their overall high-rise building stock. Many topics are covered in the literature review such as energy use, energy production on site, public amenities, influence of building shape and envelope, climatic design, advanced materials, residents satisfaction, facades design, etc., however there are some deficiencies such as the dynamics between sustainable design and quality of life; energy efficiency in connection with quality of life; and which new technologies can improve the quality of life of high-rise residents which will be explored through qualitative and quantitative research in this thesis. There are some residents' assessment of high-rises, however what is missing is are there enough outside view, daylight, sunlight, natural ventilation, does it keep away undesired agents from the building: noise and pollution and does it provide privacy both visually and acoustically, securing safe personal space, especially for the UK context and the research intends to bridge this gap through in-depth conversations with UK high-rise residents. Also in the literature it is not present what amenities the UK high-rise residents find enhancing their quality of life, which will be explored through interviews. The implementation of mixed use is not researched enough: it is problematic in one article and praised in another, so the research will trace the attitudes of professionals and residents to seek a common ground. However, mixed-use districts minimise the use of cars and maximise the opportunities for people, so the answer is diversity. It is a cardinal goal to avoid vertical slams creating places for the people that comprehensively correspond to their desired lifestyle. The vertical city can accommodate vital functions such as living, work, and leisure on a small piece of land, thus solving housing problems for a significant portion of the population, reducing trips to work and leisure and eliminating displacement.

The focus on how the design affects the quality of life in the literature is insufficient. The architects should pay a particular attention to the satisfaction of the occupants of living in high-rises, the meeting of their actual needs and if a quality of life is successfully taking place on the premises. The sustainable community has become a common goal of authorities and developers leading to efforts to end the segregation and the polarisation based on race and class. In this connection, affordability and qualities of design become the main factors. Modern high-rise complexes have a variety of positive features such as spaciousness, in some cases even with space to spare, plenty of green spaces, good public transport, relatively good position regarding the city centre and can benefit from a social plan for improving the living conditions of specific target groups.

To fill this gap in the existing research, this study aims at providing a methodological evaluation of the quality of life in residential high-rises in Manchester and London, Britain, to inform the parties involved in the development of high-rises in Britain. It will also make a theoretical contribution to the quality of life in residential high-rises. To do this, these two research questions have been raised:

- What are the principles of sustainable high-rise buildings?
- What problems the sustainable design responses need to address in residential high-rises?

The theoretical basis for the research questions is presented in Chapter 3.

1.3. Overall aim and research objectives

The aim of the study is to investigate strengths, weaknesses, opportunities, and threats of the impact of high-rise buildings on quality of life through four objectives:

1. Evaluate the connection between sustainability and quality of life indicators in high-rise buildings
2. Analyse liveability of high-rise buildings for better quality of life
3. Analyse energy-efficient solutions, related to thermal comfort with its impact on enhancing quality of life
4. Produce a theoretical framework for designing sustainable high-rise residential buildings enhancing quality of life

The contribution to the knowledge resulting from this study is considered to be two-fold: First, a theoretical framework linking quality of life and sustainable design responses, secondly a theoretical output recognising high-rises strengths and weaknesses in connection with sustainability and quality of life to inform academic and professionals on the matter.

1.4. Brief statement of the research methodology

1. A literature review was conducted on sustainability, energy efficiency of the high-rise buildings and design and technology. It is guided by the research objectives and provides the framework for further work.

2. Observations was carried out in two British cities: London and Manchester to capture features of high-rise buildings relevant to sustainability and quality of life.
3. Interviews were conducted among residents in high-rise buildings to explore the sustainable features of the design and quality of life.
4. Twelve interviews with prominent architects were conducted to investigate the relationship between quality of life and sustainable design responses.

SkyscraperPage database provided an extensive overview of the existing high-rises in the UK and two types of high-rise persisting around UK were identified. They are numerous in London and Manchester: 12-16 storey buildings with brick cladding and 22-30 storey buildings with concrete cladding, so a limited number of such buildings were selected for the case study. As a matter of fact, an effort to interview 3 to 5 residents in the same building at low, middle and high floors was made, instead of interviewing single residents from numerous different high-rises, in order to evaluate the significance of the height. Interviews were found more relevant, as questionnaires were found to provide superficial data, open to misinterpretation from the researcher. Interviews, on the other hand, give access to in-depth information about the social phenomenon: high-rise living, many surprising answers and most importantly, attitudes and preferences that are not influenced by the formulation of the questions but were formulated by the interviewees themselves.

In additions, the knowledge of twelve high-rise architects was sought, in connection to sustainability, placemaking and quality of life. They were selected, based on examination of their previous projects after searching SkyscraperPage database. Their answers illustrated the theoretical basis for certain designs implementation that were compared with the attitudes of the residents. The interviews part of the thesis is followed by computer simulations of energy

consumption and thermal comfort that illustrated the objective performance of a typical building with 25-storeys and the margin for improvement.

These methods and techniques will be explained in detail in chapter 4 and an informative diagram of the research methodology is presented at Fig. 1.1.

The literature review was conducted to assess the current state of research related to sustainable design response in residential high-rise buildings, enhancing quality of life. Once an area to work with for a research project was determined, a search of relevant literature helped discover what is already developed as knowledge and to what extent the topic has been researched. Experts on the topic have been identified and key questions about the topic that need further research were defined. Also methodologies used in past studies were determined in order to identify what approaches most benefit the research. *The observations* allowed to better understand and capture the context within which people interact and first-hand experience to allow to open to discovery and inductive, rather than guessing what the context is like. They allowed to capture things that routinely escape awareness of the participant using a different method and provided a chance to learn about matters that people were unwilling to discuss in an interview. *The interviews* created possibilities of collecting detailed information about the research questions identified in the literature review. Moreover, in in this type of primary data collection the researcher was in direct control and had a chance to clarify certain issues during the process. However, some aspects were found to be accessible from objective point of view, such as thermal comfort and cost efficiencies, so the *simulations* provided measurable, objective data to clarify some contradicting data from the interviews. Then the data analysis allowed to explore the data, find patterns in it, and ask and answer questions, making sense of data gathered in research by proper application of methods. Finally, the analysis allowed the elaboration of the theoretical framework and conclusions.

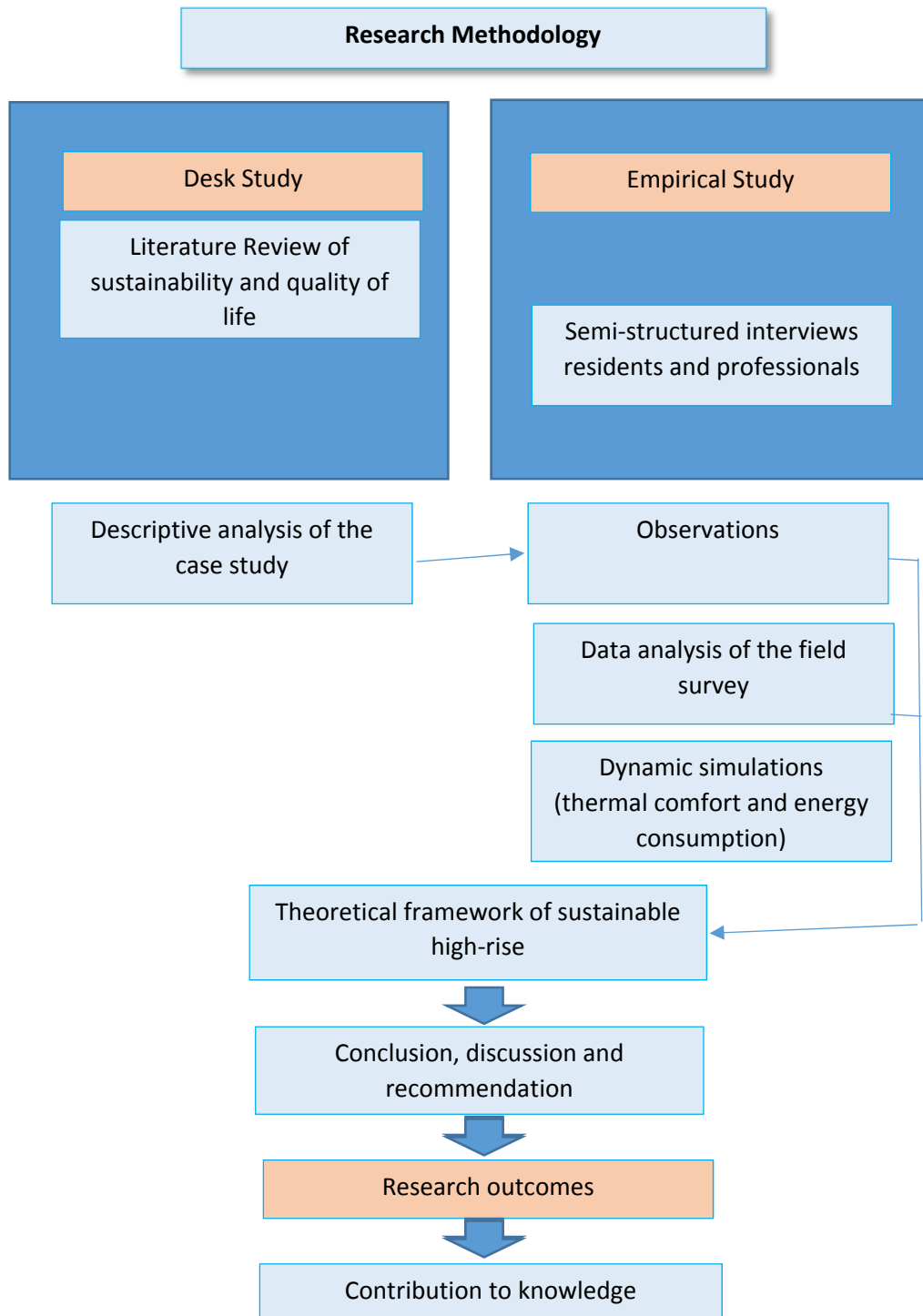


Fig. 1.1. Research methodology outline

1.5. The research outline

This thesis is divided into ten chapters, starting with an introduction that outlines the research content, main research objectives and questions. The first chapter is followed by a chapter presenting a literature review which discusses sustainability, energy efficiency and design and technology of high-rise buildings. Chapter 3 is focusing on the theoretical basis of the research. Chapter 4 discusses the research methodology adopted in this study describing the research procedure and the way it was conducted, the philosophy, the approach and the strategy used to gather and analyse the data, as well as the case study criteria. Chapter 5 presents the case study, its context and the observations. Chapter 6 presents the data collected through interviews with residents of problematic high-rise buildings and the data gathered from residents of new buildings, along with comparative analysis. Chapter 7 presents the data and analysis from interviews with 12 architects, describing factors relevant to sustainability and quality of life. Chapter 8 is focusing on the results of the dynamic simulations in DesignBuilder. Chapter 9 presents the theoretical framework developed to inform the academics and the professionals about the sustainable design responses applicable, based on the case study results and analysis. The final chapter concluded on the research, highlighting the main findings and achievement of objectives as well as the extracted contribution to the knowledge, the study limitations and suggested areas for further studies. Fig. 1.2. illustrates the thesis structure and procedure.

1.4. Conclusion

Initial recognition of the background and the problems associated with high-rise living and the state of this matter in Britain provides a basis for research abundant with various possibilities for improving the quality of life for a significant number of people through viable concepts and sustainable design solutions, which is the rationale of this study. This chapter outlines the methodology of the research and how it is structured to fulfil its aim.

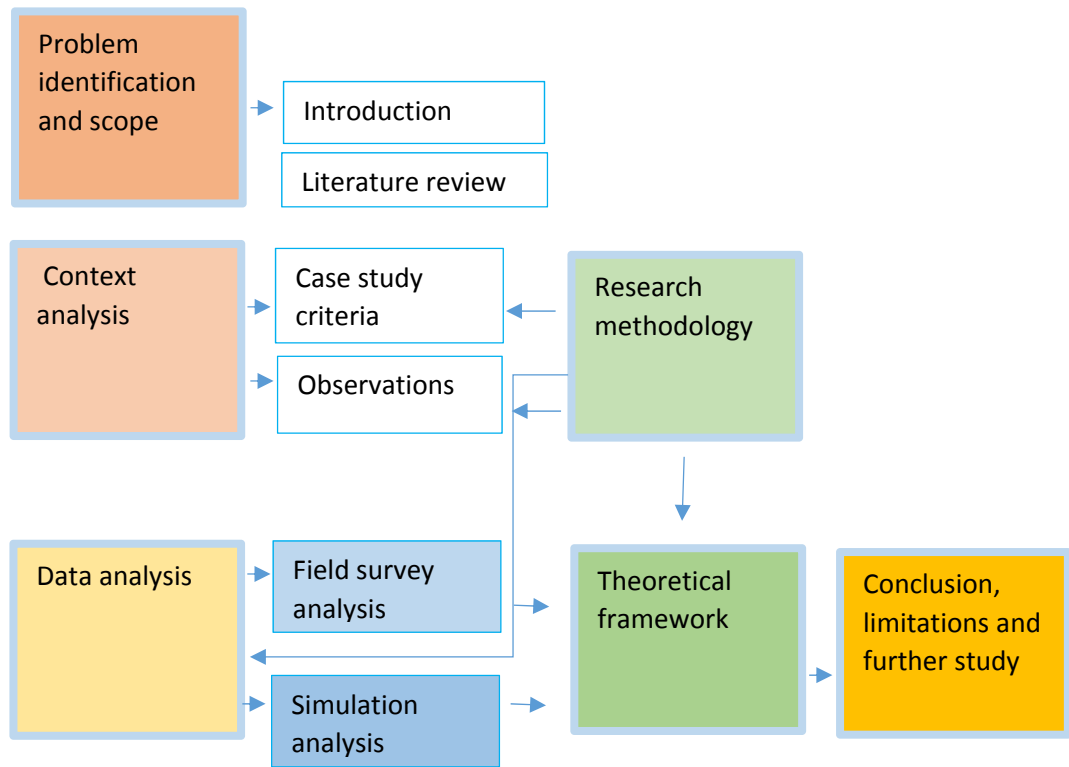


Fig. 1.2. Research outline

Chapter 2 Literature review

2.1. Introduction

High-rise buildings have a huge impact on their surroundings, consume a lot of energy and are decisive for the community development and the quality of life of many people. Their sustainability, energy consumption patterns and design and technology are a subject of numerous studies. Residents' opinions are crucial for questions such as accessibility, landscaping, security issues and indoor environmental quality. It is found a positive correlation between residents' participation and residents' satisfaction. High-rise buildings can provide a decent quality of life for a social sustainability of the community, and sustainable housing is a key to it. In the cases when it is integrated with a variety of amenities, the community is thriving. The so-called densification: mixed-use and higher density sure have its advocates, though higher density can lead to isolation and as a result: social withdrawal. There are other negative sides of the high-rise living presenting challenges for designers and planners, namely the comfort of families with children, missing social interaction and sense of community. There is also a correlation between fear of crime, mental health issues and high-rise living.

Some authors turn to vernacular architecture to solve these problems, other approach the high-rises potential for producing energy on site. Energy efficiency and sustainability are closely related. Many factors influence the energy performance of the building and windows are definitely one of them that is why the choice of glazing system is very important for the designers. Along with the windows, it is crucial to consider and the construction of the partitions and the external walls. Embodied energy should be reduced in the design process. Research on the design and technology shows that thermal insulation in the building envelope significantly reduces the costs for heating and cooling. Enhancing the natural ventilation is another approach to environmental sustainability. All these issues should be taken into consideration when designing a sustainable high-rise building that enhances the quality of life for the residents.

2.2. Sustainability

Sustainability is a concept that some of the authors relate to the enhanced quality of life. Environmental sustainability can improve the physical settings of the residents, while social sustainability is related to the quality of the community and the social interactions. Therefore a separate part of the literature review investigates the different aspects of sustainability in connection with the high-rise living. In the last years, Hiremath, et al., (2013) as cited by Ahvenniemi et al. (2017), p.235, described urban sustainable development as “achieving a balance between the development of the urban areas and protection of the environment with an eye to equity in income, employment, shelter, basic services, social infrastructure and transportation in the urban areas”. However, a shift in research led to concentrating on neighbourhoods and districts instead on single buildings, thus allowing parallel assessment of “built environment, public transportation and services”, etc. (Haapio, 2012 as cited by Ahvenniemi et al., 2017, p.235). Nevertheless, sustainable design responses for the individual high-rise are the basis for incremental change on a larger scale and therefore are the focus of this study and this part of the literature review.

2.2.1. Social Sustainability

In the literature, social sustainability and urban development are often in close relationship consequently representing the development of physical spaces that enhance the quality of life of the users. According to Woodcraft (2015), as cited by Munzel, Waarden and Galan (2017), p.1, social sustainability is “a process for creating sustainable, successful places that promote well-being by understanding what people need from the places in which they live and work.” Considering urban life, it “combines design of the physical realm with design of the social world” (Woodcraft, 2015) as cited by Munzel, Waarden and Galan, (2017, p.1).

“The WACOSS model of social sustainability includes a set of principles which represent the goals of socially sustainable communities, namely:

1. Equity – the community provides equitable opportunities and outcomes for all its members, particularly the poorest and most vulnerable members of the community. While equity is listed as a separate principle, it is such a fundamental component that it cannot be separated from the other principles. In this way, equity is a filter through which all other principles are viewed.
2. Diversity – the community promotes and encourages diversity.
3. Interconnectedness – the community provides processes, systems and structures that promote connectedness within and outside the community at the formal, informal and institutional level.
4. Quality of life - the community ensures that basic needs are met and fosters a good quality of life for all members of the individual, group and community level.
5. Democracy and governance – the community provides democratic processes and open and accountable governance structures” (WACOSS 2002:7 as cited by Partridge, 2005, p.2).

Basing his insights on the experience of experts, Zare (2015), explores urban space content serving as a premise for social interactions leading to social sustainability. Social interactions are referred to as vital needs, basic for the thriving of the human beings. (Rafi’pur, 2003 as cited by Zare, 2015).

When discussing social sustainability, achieved through policies and actions, the goal is to improve quality of life by well-distributed natural and artificial features.

“Human beings are social and sociable beings who need positive interaction with other humans for their own health and welfare” (Zare, 2015, p.2). Social interaction is crucial for satisfying human needs, attachment and connection to a place. This article revealed urban spaces as social assets are related to social interactions, lead society to sustainability, resulting in urban sustainable development. Public spaces allow people from various generations to communicate.

Some researchers do not focus on a general definition of social sustainability and instead describe its main characteristics and the key themes. For instance, Baines and Morgan (2004) and (Sinner et al, 2004) as cited by Colantonio, (2007), summarize the main features of social sustainability such as covering basic needs, successfully live with a personal disability, ensuring that the needs of future generations are met through personal including social responsibility. Other themes are to have a rich social life and be a harmonious part of the civil society, equity, promoting diversity and ensuring people are included in choices for development and decision-making.

These themes represent the thematic areas of social sustainability “as being basic needs and social well-being, social capital, equity and social and cultural dynamism” (Colantonio, 2007, p.5)

Residents’ satisfaction with liveability is a major point in large-scale high-rise projects which should consider the comfort of the inhabitants in the early stages of the design. Residents in the high-rise now understand better the dimensions of well-being and are now seeking improved living conditions. (Lee, Je and Byun, 2011). This correlation between the physical settings and the resident’s satisfaction is central for the liveability concept. Liveability of residential environment must be understood as a resident-centred appraisal statistically measuring individual’s subjective appraisal of the residential environment and a number of factors through the residents’ perceptions and experiences of their living environment. Residential satisfaction

often measures the subjective evaluation of living environment (Amerigo and Aragonés, 1997, Liu, 1999 as cited by Li, Sun and Jones, 2012).

Mohit and Rahim (2012) conduct a study of case studies from Kuala Lumpur investigating the residential satisfaction in a high-rise condominium. They conclude that if the design process is optimized in terms of conditions and requirements, less problems will occur and will be more solvable. Addressing physical planning, future condo developments should fulfil general facilities requirements including recreational area, surau for the Muslim residents and a pleasant social environment enhancing the quality of life of the residents. The authors are positive that housing needs regular and working evaluation of the people and space resulting in liveable and attractive environment perceived as more than simply a shelter. Especially in regard with community spaces, they are not arbitrarily. They must be reorganized according to user patterns and needs. The demands of the residents are crucial. Outdoor rest places, gyms, and saunas as well as renovating or expanding current facilities are promising options. Moreover, places with little use but high demand such as study rooms and book clubs also are required and must be a part of the living programs. Equally important, design of places according to age or generation will be more adequately meeting needs (Cho and Lee, 2011).

Two variables influence the residents' satisfaction: the objective characteristics of the built environment and factors, called moderators, not dependant on the residential environment. These moderators are related to differences in outcomes, being part of a causal connection between the environment and the outcomes' (Evans and Lepore, 1997 as cited by Li, Sun and Jones, 2012). Different studies reveal two groups of moderators: personal demographical characteristics of residents and features of macro-context (Amerigo and Aragonés, 1997, Adriaanse, 2007 as cited by Li, Sun and Jones, 2012). The role of demographical factors, such as gender, life-stage, and income level for the moderation of the residents' evaluations on high-rise housing has been proven in many studies however the role of climate, housing system, and diversity of housing types, is yet to be investigated. For example, Mahdavinejad, Sadraie and Sadraie, (2014)

discovered that buildings with attractive entry and lobbies decrease the levels of communication among neighbours speak less about the buildings problems with each other and building security is less effective and buildings that are more secure, they have less beautiful landscaping;. in buildings with beautiful green space, inhabitants trust each other less.: relations that, however, are not explained in the article and need further investigation

Li, Sun and Jones (2012) find that particularly for dwelling unit, related so closely to liveability, no institutional impact is existing to secure the quality of residential interior design and decoration. The user-centred planning and management concepts in China are not implemented. A serious problem is the lack of effective procedure to gather opinion and feedback from the users, resulting in inadequate policy designs. Li, Sun and Jones (2012) conclude that when liveability increases its importance when planning and designing, the voices of the users must be heard.

Cho and Lee (2011) conduct a study suggesting a conceptual model for sustainable communities in high-rise developments in Korea. Li, Sun and Jones (2012) do not focus on particular design features, while Cho and Lin (2011) list a number of interesting concrete findings: attractive community spaces provide more life-style options for residents and consequently increase residential satisfaction. Moreover, higher satisfaction with community programs leads to better overall residential environment satisfaction, thus playing a significant role in the developing sustainable communities in the apartment complex. The correlation analysis between living program and residential satisfaction reveals that satisfaction with the shared community spaces, community programs, and residents' participation in the community results in higher overall residential environment satisfaction and the authors see them as the basis for a healthy, resilient, sustainable community where needs are met and lives are rich together with their neighbours (Cho and Lee (2011). The article is not very detailed: what community spaces, what design features are important from the residents' perspective needs to be further investigated. The article could provide the answers to more questions such as does the tall building guarantee enough outside

view and does it take advantage from the natural agents: daylight, sunlight, natural ventilation with the implications for the social climate. Important questions also are does it keep away undesired agents from the building: noise and pollution and does it provide privacy both visually and acoustically, securing safe personal space. Finally, it can ask does it secure comfortable thermal and visual environment to work, rest and for other daily activities and is there a healthy environment: fresh air and hygiene. (NG and Wong, 2003).

Mahdavinejad, Sadraie and Sadraie, (2014) go further when investigating the social sustainability of high-rises buildings by studying nine high-rise buildings in Shiraz in terms of social environment and architecture by observation and questioning residents. Their finding indicate that units with more light increase the responsible behaviour among neighbours, as well as the tendency to solve problems. In buildings with provided wider views, residents tend to discuss problems related to construction more, however, those buildings are often characterised by less green spaces, a correlation that was not clearly analysed in the article and needs further investigation.

Enhanced natural ventilation is related to more Contribution to keep the neighbours' children, however, disturbing sounds of the outside and neighbours are more frequent. Buildings with attractive greener space, also had a better exterior solemnity and identity. In Buildings with better access to Roadway and pedestrian way, trust among inhabitants decreases and Social network and helping neighbours are less effective. This is contradicted by Tu and Lin (2008), who discovered that in Taipei City's residents regard 'mutual help' among neighbours under the 'human' aspect as well as 'sense of insecurity' and 'sense of pressure' under the 'contextual' aspect as important issues. The authors explain that Taipei's high-density and mixed-use urban settings associated with 'environmental stressors' such as crowding, traffic, as well as strangers, provoke the need for mutual help among neighbours, however, aggravating the senses of insecurity and pressure. Such contradiction needs further investigation in regards to what factors are different in both cases.

In buildings with better physical identity and solemnity exterior, green landscape and good quality in lobby and entrance, security is unsatisfactory indicating that building's appearance do not cover liveability issues alone and with building design, security remains a concern (Mahdaveinejad, Sadraie and Sadraie, 2014). The article could be focusing more on social health with factual data from the 9 example buildings and discuss more the notion of "vertical community" (Lee, Ahn and Kim, 2010).

Taipei City's residents particularly consider 'ground floor access' as a crucial evaluative factor under the 'spatial' aspect: It is likely that Taipei's mixed residential-commercial land use and high population density associated with heavy traffic resulted in access problems (Tu and Lin, 2008).

Similarly, Filion et al. (2000) as cited by Tu and Lin (2008) found that car-oriented development and heavy traffic lead to unfavourable walking experiences. The separation between 'public' and 'private' spaces in residential buildings in Taipei City is unclear, which could have increased the number of stranger invasions. The authors speculate that residents may feel 'insecure' thus seeking help from neighbours. Crowding has negative impact on residents' social interactions and psychological health, such as restriction of movement, preclusion of privacy, emotional threat (Stokols, 1976 as cited by Tu and Lin, 2008) as well as psychological distress and less residential satisfaction (Gomez-Jacinto and Homebrados-Mendieta, 2002 as cited by Tu and Lin, 2008).

Adequate transport, such as public transportation parking, and road connectivity, are crucial for the residents. In Tokyo, Hong Kong and Singapore, there are similar perception of 'transportation and commercial services'. Tokyo's residents closely relate 'accessibility to work and shops' as well as 'parking facilities' to residential satisfaction (Savasdisara, 1988 as cited by Tu and Lin, 2008). Hong Kong's Residents relate 'convenience of location' (ease of access by public

transportation, convenience of stores or markets) strongly to residential satisfaction (Liu, 1999 as cited by Tu and Lin, 2008). Singapore's residents regard f 'adequacy of transport services', 'easy access to significant areas of activity', and 'location and adequacy of basic local facilities and services' crucial for satisfaction from residential environment (Western et al., 1974 as cited by Tu and Lin, 2008). Tang and Yiu (2010) agree with the authors' results that different cultures, gender and spatial environments are possible to produce different attitude to density and prevention of the required privacy, stressing the role of the moderators for the residential satisfaction, which however, needs further investigation.

2.2.2. Quality of life

There are good reasons for the opposite opinions of the high-rise residents. High-rise living is characterized by many advantages and disadvantages. Wu (2005) points out certain economic benefits such as the optimum use of scarce land and reduced time for travelling; social benefits such as larger living space and environmental benefits such as more efficient infrastructure and more space for landscaping. On the downside, there is lack of privacy in the stack buildings and fear of crime. Bharat (1997) lists some more: lack of habitable space, no flexibility and playing space, stereotyped planning, and no differentiation between floors, small ground floor and no areas for socialising. There are numerous actions to be taken for the better quality of life and social interaction in the high-rise buildings. Gill (2008) claims that if a building aims to relate to its global environmental context, it must take into account the existing conditions: environmental situation, connection with existing and future developments, politics for the site development. The author also notes that high-rise buildings contribute significantly to the cities' sustainability and efficiency.

The interest in high-rise development worldwide is growing because of new thinking on sustainable cities, where high-rises as a way of reducing urban sprawl through consolidation and densification are desirable (Jacobs, 2012). Gill (2008) stresses the importance of the eliminating

the redundant structure, the daylighting, heat gain, green roofs and views of greenery, solar and geothermal power and wind turbines. The article presents several exemplary projects each observing different sustainability features. However, the opponents of the high-density living point out the problems deteriorating the quality of life and the social integration: air, light, noise, waste and risk of fire (Ng, 2009). The findings of Kearns et al., (2011) demonstrates that many residential results are worse for people in a high-rise, especially in connection with noise and security issues. The article is not reviewing the connection between sustainability and attractive, affordable housing with interventions leading to more social interactions.

One of the most important questions related to the quality of life is the age-considerate design. Children and elderly have different social and physical needs than the average space user. The designers must explore tactics to make the buildings and their surroundings inclusive and safe for different age groups, while in the same time account for vulnerabilities, mobility capabilities and the differences in the interests. Carstens (1998) explores outdoor spaces for elderly, starting with a review of the literature and then suggesting guidelines for site planning, design and detailing, guidelines based on the older people's social and psychological needs, directions for garden plots, social interactions, sensory details and enjoying nature. Encouragement of independence, site furniture, security is also important issues that are addressed. Francis (1998) comments on educational philosophy and child development, stressing on the correlation between the quality of space and the children's behaviour. The author explores relevant literature, the importance of variety and opportunity that supports plenty of activities, sensory stimulations, manipulations, amount and quality of spaces, natural exploration, equipment and safety.

Despite their disadvantages, the quality of life in high-rises can be improved by modelling a range of indoor environmental attributes. Lai and Yik (2009) claim that crucial for the living quality of the residents besides the apartment size and layout are various other factors such as outdoor facilities, proximity to infrastructure and facilities and internal housing features such as the

position of the living room. According to the study, the lowest performance rating pointed out by the residents was for noise for all the four types of building.

One of the study's conclusions is that no matter of private or public type and resident or visitor purpose of the users on their perceived importance of the factors, thermal comfort is firmly stated as the most important. However, thermal comfort and noise, regarded by the residents as the two most important factors, have both their performance ratings lower than their importance ratings. This is useful since once the problem factors are pinpointed, the factors can be improved through redevelopments or new designs. For example, if thermal comfort in the public area of the building has the highest importance rating but its functioning is rated the lowest by the residents, the facilities manager might recognize the need for improving it. The article is not discussing relevant questions of the connection between living quality and social sustainability.

Din and et al., (2013) study theoretically seven dimensions of Urban Quality of Life and suggest they might be further investigated empirically. Environmental urban quality of life should promote the access to clean air, water, land and non toxic materials; promoting both protection of people and the biodiversity. Resources must be preserved and energy demand minimized with the help of new technologies. There must be opportunities to enjoy nature by the means of green areas situated within the neighborhood. Waste control and management are also crucial.

Lee, Je and Byun (2011) work on a well-being index model for the appraisal of Korean super tall residential buildings (STRB). The study has three stages. It starts with comprehensive research on the well-being of STRB residents which have been comprehensively studied. Next, well-being indices have been extracted from the expert surveys and factor analysis. Finally, an Analytic Hierarchy Process (AHP) is used for the systematization of all of the well-being indices.

Ecological environment is has the strongest social impact since it is related to sustainability, however, is not appointed as a crucial residential index by inhabitants. In relations to social well-being when considering the tackling of global warming and saving resources, this is not

favourable. Plans are needed for the recognition of the effects of the ecological environment index in order to prevent the global warming and reduce the CO₂ emissions, as well as the use of materials with less CO₂ emissions, a focus on materials, similar to that of Din and et al (2013), buildings that have a longer life, and recycling systems, rather than the impractical introduction of new and renewable energy, which, however, Din and et al. (2013) find applicable.

Din and et al. (2013) talk also about the physical urban quality of life: compact, mixed-use, pedestrian friendly neighbourhoods along with services and facilities answering the people's needs. Eco-buildings, adequate streets and open spaces, hierarchy of complete street networks, management and maintenance are also crucial.

In connection with the Mobility urban quality of life, car alternatives in order to save resources and reduce pollution, activities, independence for elderly and young people, friendly streets are crucial. In terms of the Social urban quality of life, equity social justice, universal design, broad range of housing types at different prices, and social integration, healthy society through civic buildings and public spaces along with social participation are found crucial.

Regarding Psychological quality of life, identity through heritage and historic remains preservation must be promoted. Opportunity to personalize space, in attractive urban environment are important actions to be taken. However, it is not investigated in the article what importance these issues have through the perspective of the residents.

Lee, Je and Byun (2011) develop a model, in which, health is the most influential index for well-being, while safety/security was found to be the second in importance. Health is also the most common index in the literature, and is the key index to define well-being. Clean facilities, pleasant indoor air quality are crucial for improving this index. . Noise, the most harmful to residents' mental health, must be prevented, which is an important planning factor within super tall high-density residences. Safety and security are seen more vital than convenience and

management. This implies that STRB residents demand attention to the prevention of disasters, security from urban crimes and individuals' privacy in high-rise. However, it is not clear what specific design actions can enhance the well-being of the residents encompassed by indexes. The indexes omit some important connections: Psychological well-being promoted through attractive, meaningful urban settings, as well as the importance of age-related design, accessible and efficient for different people, stressed by Din and et al. (2013) and Carstens (1998) for the health of the community.

2.2.3. Resource consumption

Residents' activation, residents' assessment of the living environment, considering the behaviour of the residents are all powerful approaches to achieve sustainability in all of its dimensions. They should lead to recommendation steps on how to use this potential to create more informed and holistic high-rise design.

Wener and Carmalt (2006) argue that the minimisation of resource consumption has been possible due to a number of technical advances but a little research has been dedicated to the response of occupants of high-rises, or to the relationship between the successful reaching of sustainability goals and the behaviour of the users. However, this kind of good interaction with the environment must be depends on the human scale and residents' perspective. Therefore, the human aspect is critical (Wang and Chien, 1999). Wang and Chien (1999) concentrate on the environmental situation in Taiwan with the background of successful economic growth, growth in population, urbanisation but the degradation of the quality of the built environment. The article applies the concept of growth management to analyse the influential area of environmental behaviour and to propose density control strategies for urban land. Wang and Chien (1999) state that physical environment and human behaviour are connected but the notion is very underdeveloped. For example, the need for thermal comfort in connection with the environmental behaviour of the building and the resource consumption, could be investigated in detail.

Since social sustainability is an integral part of the sustainability concept, a great part of understanding the matter takes the relationship between the revolution in technology in sustainable buildings and how it affects the residents. The study of Wener and Carmalt (2006) clarifies that the behaviour of residents of a sustainable high-rise is the major factor in defining to which degree the building meets successfully its environmental goals, though the authors are aware that the precise level of impact needs to be reviewed in future research. The adapted approach towards an evaluation of the health and comfort of occupants is also not presented: the work needs an integrative multi-disciplinary approach taking account of positive and negative reasons for users' satisfaction and concerned with the "actual" needs of the people (Bluyssen, 2010). (Bugliarello, 2006) points out the many challenges ahead of the today's cities, rapidly growing urban populations and need for 'good enough' solutions that are more affordable and meet more needs. Bugliarello, (2006) also stresses on the urgent need for determined and continuous commitment by the residents and leaders of a city. Steps such as re-use and recycling, alternate forms of energy and containment of sprawl are crucial, requiring new technologies, public understanding and new policies.

If cities cooperate they can more easily address common problems, discover needed technologies, organizational practices, and practices of common usefulness.

Physical environment includes sunlight, wind, natural light, air, noise, building use, open space, skyline, landscape, traffic, and public facilities\equipment, affecting human environmental behaviour. Previous studies of high-rise buildings focus on technological solutions, and the human environmental behaviour and management control strategies are understudied. Growth management strategies must take into consideration the human scale and inhabitants' perspective (Wang and Chien, 1999).

However, it might present another challenge that Wang and Chien, (1999) and Wener and Carmalt (2006) overlook. In the biosoma paradigm, describe by Bugliarello (2006) a major notion is that of the interactions and trade-offs among its parts, all of which have differences in predictability

and performance. The biological and social components are semi-definite in predictability and performance. The environment also is hard to predict considering recent tsunamis and earthquakes. This may mean that the human behaviour will be hard to model. On the other hand, well-designed machines, are more predictable in performance. So, a synergy between policies modelling the desired human behaviour along with smarter machines might be a basis for an interesting further research. The different capabilities of the biosoma parts provide many possibilities when tackling urban sustainability. The author also argues that quality of life might be higher in less inhabited cities, having in mind the problems of the big cities such as high living costs and poverty. The author points out that the technology in material, water and energy supply might be crucial for determining the future sustainable urban concentration. Many authors agree with him that the suburbs are the least efficient representation of urban concentration. Day, et. al., (2014) argues that large cities are often seen as more energy efficient than suburban and rural areas and Modarres, (2010), claims that many published works link to the suburbs a lot of the imperfections of our society: environmental destruction, segregation, racism, individualism, consumerism, poor health, alienation, loss of community, and a sense of place that previously existed in cities.

Sustainability is related to long-term change and its impact on intergenerational equality. It also addresses natural resource scarcity and the limited carrying capacities of ecosystems. (Harrington, 2011). Cho and Lee (2011) point out that along with the efforts for sustainable development, the study of housing is focusing on the sustainable community development in recent works. As a part of sustainability equation Cukovic and Ignjatovic, (2006), Maliene and Malys, (2009), Oktay, (2002), Seyfang, (2010), Zhang et al., (2011) and Zimmermann et al., (2005) identify various green parameters in order to achieve energy efficiency in the sustainability development (as cited by Roufechaei, Bakar and Tabassi, 2014). Maliene and Malys (2009) review sustainable housing as a key to delivering healthy and attractive communities. The authors

discuss the current housing situation in the UK, sustainable homes related to resilient communities, regeneration to sustainable homes and a model of its further implementation.

2.2.4. Noise mitigation

High-rise buildings must be examined for air quality, thermal comfort, noise and day lighting which should not be inferior to those found in the traditional villages and created by traditional techniques. All these factors largely affect the indoor environmental quality and subsequently the lives of the inhabitants. There is a variety of possible solutions that can be done such as applying thermal and sound insulation to improve the characteristics of the apartments in high-rise buildings as soon as there is enough research on the matter since there are already reported many problems.

Sustainable buildings can have problems with the aural comfort which are reviewed by Swift and Stead (2008) in an article that discusses noise source identification and mitigation for high-rise buildings and also claims that there are additional acoustic issues related to sustainability. The amount and type of noise and vibration sources increase in connection with sustainability design features such as natural ventilation which can compromise the acoustic qualities of the facades, as the outdoor openings provide little resistance to noise. The authors give for example many other sources of noise sources such as chillers, boilers, cooling towers, pumps, vertical transportation, waste pipe and downpipe flow, speech, sound systems and footfall, etc. The majority of building noise sources produce noise and vibrations that can be defined and their mitigation needs to be calculated. However, there are some potential noise sources, such as those from wind from geometrically similar structures, where it might be hard to predict, but significant results from wind might happen. The article provides good knowledge about the causes of the problems and also their possible solutions. It could discuss how the acoustic quality improves liveability and makes the building attractive for more different social groups.

The effects on the building envelope on the aural comfort are studied in the reviewed literature. Lee, et al. (2007) examine the influence of building envelope and balcony design on the reduction of exterior noise by assessing the noise from traffic at an apartment complex located next to a road as well as the sound field characteristics of an area surrounded by four apartment buildings. They conducted traffic noise measurements and used a scale model to study the noise reduction. The findings of the field measurements in an apartment complex indicated that sound pressure level in most floors was under the 65 dB A Korean legal limit of exterior noise, the upper floors of the building are subjected to a maximum level of traffic noise; however, with a small difference in traffic noise between each floor. The scale model revealed that predominantly the noise reduction level gradually improved with the implementation of absorbing material and parapet. Nevertheless, there was a decrease in the apartment complex test because of the increased abundance of reflected sounds and long reverberation time. Also, the use of different absorbing surfaces on the inclined ceiling and parapet produced a maximum noise reduction of 10 dB at 1 kHz in the apartment complex test. However, the measurements in the article are not combined with an evaluation of the quality of life of the residents which is an interesting area to explore.

2.2.5. Planning and neighbourhood design with high-rises

High-rise buildings are the answer to the fast urbanization problems and the land scarcity. Bharat (1997) deals with different aspects of the high-rises such as physical, social, economic, political, etc. in connection with the high-rise buildings huge potential but also problematic areas. He states that high-rise construction which does not take into consideration the environment is a poor approach to sustainable development. He sees the environment as a dynamic, complex system related to the inter-dependence of life forms and their relationship with nature. The author presents the following problems of the high-rises: lack of habitable space, no flexibility and playing space,

stereotyped planning, and no differentiation between floors, small ground floor, no areas for socializing, some lack of important uses like places for clothes drying, etc.

The external physical impact includes: noise is a major problem, individual identity based on appearance is impossible, nearness helps create intimacy, compactness creates crowding which eventually leads to annoyance, nervousness, confusion, anxiety, discomfort, tension, loss of control, etc. Another problem is lack of interactive and semi-private space. Nowadays urban planning focuses more on the placemaking with tall buildings. Because of characteristics of their massing, skyscrapers significantly affect placemaking. Also, taking into consideration their morphology and appearance, the high-rises design should acknowledge culture and operation in relation to functionalities and facilities (Al-Kodmany and Ali, 2012).

A further challenge for social sustainability is the coexistence of traditional and modern forms of built environment when new architecture arises near old buildings (Tavernor, 2007, Gunce et al., 2008, Soini and Birkeland, 2014). Tavernor (2007) examines the impact of high-rises on the visual and cultural sustainability of London, particularly on the protected views of London. He compares sustainable urban design definitions from national policies (PPG1 and PPS1) and policy aiming at preserving the settings of historic buildings and conservation areas (PPG15) with the suggested management of protected views. According to the current Labour Government, there are several circumstances because of which tall buildings are considered desirable assets in London: the provision of a sustainable compact city, of a sustainable public transportation system also commented by Bharat (1997) and the limited land available at London's core.

The author reviews current policy documents that aim at achieving good design quality. He points out the definite distinction between traditionalists and modernists: against the tall buildings and for them under the banner of urban sustainability. The author reviews a vision of modern London and claims that that London is sustainable by efficiently relying on its 'urban villages' makeup by having more liveable compact centres as well as high-density high-rise living. He also gives a thought of a traditional versus modern urban design, townscape as assessment, spatial urban

development strategy through The London Plan and the setting the visual limits of sustainable urban design. However, the paper omits to examine the strength, weaknesses, opportunities, and threats for heritage programs in one of Britain's most historic city. It might be challenging since as Bharat (1997) states that there is often no individual control over materials, design, maintenance and landscaping (visual limits of sustainable urban design), only good shared transport facility. It is a symbol of status and power, may improve or distort the city skyline, but is often out of scale. It can be disruptive in a neighbourhood with a small structure; open space around, becoming playground; view blocking. It also includes: many structures have no detail on ground level to which they can relate, social exclusion, loss of uniqueness, boredom due to the blank walls along the streets, shadows, multi-functions, parking problems but strong urban influence.

Housing poor, vulnerable households with various needs, results in an abundance of problems and pressure on social and other support services, as well as inadequate local management for the residents sharing the estate. The residents of problematic high-rises are known to be creating generations of ghetto dwellers (Costello, 2007) and not living a high-quality life with plenty of social interaction.

The social effects of high-rise structures are as follows: ignorance, forced interaction, less friendship because of crowding, alienation, social isolation and indifferences, more crime and vandalism. High-rise housing is related to bad lifestyle, deprived areas, locations in isolation, a poor population, a negative image, anonymity, pollution and crime (Helleman and Wassenberg, 2004). Kearns (2011) systemizes the problems in several categories, built form related to the low quality of the buildings: moisture, insufficient thermal comfort, poor sound insulation, inadequate interiors and problems with privacy. The authors also point out increasing height associated with the danger of accidents, loneliness among residents, unattractive architecture, visually unlikable and low demand for housing.

(Kearns, 2011) also examines the estate context: the number of towers creates an oppressive feeling, too many residents on the estate and residents of the tower. The authors also review anonymity among neighbours and lack of informal social interaction, amenities on estates not existing, prevalence of social exclusion, problems with the defensible space, lack of engagement with the other residents, fear of crime and no sense of safety, robust materials, no landscape features and green spaces, unfavourable location disconnected from the amenities of the urban area. The management is also mentioned with its costly and insufficient maintenance of buildings.

One advantage the UK high-rise might have over the other types of dwellings is their satisfactory energy efficiency.

Also problematic according to Bharat (1997) are: mostly indoor living, children cannot play outside, relation to murder, suicide and child-abuse, ignored maintenance due to the perception that it is somebody else's duty, the absence of social necessities like walkways, children paths, cycle paths, leading to health hazards. Culturally, ethnic cultural identity is lost and they affect the near-by area. Economically, it increases the values of the near-by areas, gives more tax from one place which helps the community, land use and values change, ensures economical use of the land, tend to attract more investment. Natural effects include smog, causing people to want to live on lower levels, air, water problems due to the number of people in one place, affect the air flow, increases production of heat energy and decreases rates of heat loss, causes air to move slower in the cities because of the obstruction of the structures. It includes dust, noise, danger and street blockage during construction, noise pollution, adds to solid waste, water pollution, increases consumption of energy, destructs surrounding eco-system. However, it is not clear which of this problems are of utmost priority for a certain population.

Regenerating and improving outdated high-rises is the way to achieve high levels of residents' satisfaction. It is vital for deprived city areas to improve the living conditions, revitalize the community environment, and provide public resources (Wang, et al., 2014). Bates, Lane and Power (2012) research energy efficiency measures and their social impacts on low-income areas.

The chosen research subject is a large estate in the north of London Borough of Hammersmith and Fulham, called Edward Woods and containing three high-rise blocks which are regenerated by 2009.

The researchers interviewed the households using semi-structured questionnaires. The main findings include a great amount of overall satisfaction, though some people described their homes as cold or damp. The people were proud to live in the estate mainly because of the way it is maintained, the green space and the location. Two-thirds described their quality of life as good or excellent, but there are concerns about the lack of facilities for the young people. Nearly a third said they are having contact with their neighbours, family or friends on a regular basis. Almost all residents felt safe in their homes. Energy bills tend to vary because of the variation in the thermal efficiency of the building and how residents use energy. The report concludes that a large scale refurbishment project is beneficial in terms of modernizing and improving homes and energy savings. However, it is important in this context to have sustainability appraisal and energy efficiency analysis, demographics of the population and research on the potential for better quality of life in the renewed premises.

Sustainability of the high-rises is not a constant factor. The decline after the peak of first skyscrapers was due to numerous technical and social problems and negligence of the demand for environmentally friendly solutions. (Lotfabadi, 2014, Wassenberg, Turkington and Kempen, 2004). By the 1960s several impulses emerged for the construction of high-rise buildings: housing scarcity, the egression of innovative technologies, the “Modern architecture” movement for fair society, the need to protect the green belts from construction, the quest for better living standards, rivalry between councils for modern residential premises and the government approval of hard solutions to deal with residential problems (Wassenberg, Turkington and Kempen, 2004). However, Newman (1996) points out that with the raise of the concentration, the more inhabitants find themselves in insolation with greater differences. The size of the project is connected to stigmatization that is from the external source and from the high-rise residents themselves.

Stigmatization leads to apathy resulting with indifference first from the residents, followed by the management, and finally by the municipality and its agents responsible for the project: police, education, parks and recreation, refuse collection, and social services. The size of the project relates to an operable area by gangs that contaminate the public space. Despite this, Wassenberg, Turkington and Kempen (2004) find stronger reasons for building tall: the desire to improve quality of life since in the 1960s the high-rise flats were altogether luxurious and spacious and provided with a lot of amenities. Childcare, laundry, shopping and recreational facilities make the life more convenient. However the problems persisted such as: structural problems caused by unfit construction methods and low quality of materials, resulting in asbestos pollution, poor sound insulation, dampness, condensation and draughts. There were also internal design problems related to small rooms, inadequate central heating, sanitary equipment and storage space; the lack of amenities such as lifts and communal facilities, and poor external space; urban design problems such as bad locations, high density, pollution from traffic and noise. The work does not discuss how the amenities and their absence affect the quality of life. There is an interesting approach towards sustainability in modern Singapore, in regards to this conflict.

The modern high-rises in Singapore create a strong dilemma: to be seen as a modern solution to the housing problems or as a foreign intrusion unrelated to the old housing traditions in Singapore and characterized with liveability problems. However, they offer flexibility and adaptation to the global demands and are inevitably a part of any housing strategy and affordable housing scheme along with the provision of amenities and the potential as landmarks to create and sustain a sense of place. When they are turning for solutions to the vernacular architecture of Singapore, it, even more, enhances their possibilities to meet the needs of the growing population.

Chang (2000) studies the impact vernacular architecture has on the modern Singapore developments. He points out the obvious difference between the modern and the vernacular architecture. The vernacular architecture is built by common people using traditional technologies over a long period, while the modern buildings are constructed by the skilled and specialized

labour force. For many Singaporeans, high-rise buildings are a foreign typology completely unrelated to any long hold traditions in Singapore. The author recognizes a vernacular in the high-rises of Singapore pointing out that it is crucial to understanding the culture.

The development of the high-rise vernacular is related to the ability of the societies to adapt and change in response to global demands. The example of kampong-Malay for a village is given to illustrate what is typically thought as vernacular. The architecture of kampong created behaviours such as the use of the verandas as a man social area and the back with the kitchen as women informal social places. The uneven layouts expressed gender differences. In contrast to the Malay kampongs, the Chinese houses demarcated their property expressing a greater sense of territoriality than the Malays. In both cases, the social functions places such as worships halls, markets and tea/coffee shops also determined the layout of the kampong. With the rapid modernisation of Singapore, many of the same features have been detected in the arisen cities and high-rises. One area where Singaporean is explicit s the use of exposed areas at the base of the high-rise known as void decks. They are the scenery for many daily activities including weddings and funerals. This illustrates the great tolerance towards noise and pollution towards each other in these socially integrating structures. They had “old women corners” and became the typical place to waiting or sending children to school. Like the kampong carefully situated services at convenient locations, high-rise new town planning uses layouts to guarantee that services are at a convenient distance from the housing. The markets and the food courts are also reminiscent of the culture of the kampong. No matter that the contemporary buildings are influenced of modernist Le Corbusier “Tower in the park”, they like the kampong houses which are built about circulation paths, relate closely to transit paths and commercial centres, services and amenities.

The author sets the question whether a modern vernacular can be formed, such as in the United States and Australia. He also touches the question of rapid institutionalization leading to conservatism in design and ill adaptation to residents’ needs, and gradual loss of original culture.

The only thing that could improve the article is more case studies illustrating the points of the author and the impact of design on quality of life.

2.3. Energy Efficiency in High-rise residential buildings

2.3.1. Building envelope

Raji, Tenpierik and Dobbelsteen (2015) state that the building envelope is the part of the construction that interacts with the surrounding environment. How much energy the building uses is affected greatly by the design of the envelope elements. Hence, to reduce significantly the energy consumption of a building, design interventions that are highly efficient should be discovered and then optimised. Saroglou et al., (2017) also consider the building fabric to mediate the indoor and outdoor, substantially affecting the energy consumption.

Raji, Tenpierik and Dobbelsteen (2015) analyse energy-saving proposals for the envelope composition of high-rise office buildings in temperate climates. To do this, they study a typical existing office building in the Netherlands, comparing through simulations in DesignBuilder the energy use before and after refurbishment. A sensitivity analysis and many energy performance simulations revealed the elements of the envelope affecting the building's energy consumption the most and need to be improved.

Four interventions chosen to improve the energy performance of the building envelope are glazing type, window-to-wall ratio, sun shading and roof strategies. The envelope behaviour is sensitive to three factors. First is the facade design factors including glazing type, window area and shading. Secondly, the building material properties including the thermal mass, insulation and airtightness are crucial for the efficiency of the envelope. Finally, and site factors including building orientation and climatic features are influential. In regards to the glazing type, it was found that with double-glazed clear glass for the inner pane and single-glazed clear glass for the outer pane

produces the most economic scenario. The high-performance envelope (low U-values for glass and solid parts), the best results are observed when the window-to-wall ratio is around 50%, the optimum balance for lower heat transmission and higher solar heat gains in winter. For heating-dominant climates where passive solar gains are a plus, passive strategies such as operable shading devices and electrochromic glazing produce significantly better results than fixed external shadings. Locating the blinds outside of a double façade is more efficient than locating them inside the cavity, while for heating indoor blinds are performing a little better. Saroglou et al. (2017) describe a scenario that confirms the results of Raji, Tenpierik and Dobbelsteen (2015) with the use of shading devices with the Ecotect ‘Shading design wizard’, positioned on the south, east and a west elevation. The best results were achieved for the south elevation with a horizontal shade with vertical fins on either side of the window, and for the east and west elevations a 45° angle shading that blocks 50% of the window, due to the low angle sun on these elevations. 28% less cooling energy on SW and SE zones and 17% on NW and NE was achieved, however, heating energy increased 2.5 times for SW and SE, and 1.5 times for NW and NE.

For a non-insulated roof, a 10 cm green roof can produce a total consumption reduction of around 0.7%. However, if the roof is well-insulated adding a green roof hardly affects energy consumption. “Finally, the integration of high-performance design solutions offers a considerable saving in energy by around 42%, 64%, and 34% for total energy, heating energy and electric lighting energy use, respectively” (Raji, Tenpierik and Dobbelsteen, 2015).

Insulation can also have a huge impact on energy consumption as demonstrated by Saroglou et al., (2017): extruded polystyrene (XPS) –with 15 mm/Thermal conductivity factor, λ : 0.029 W/mK. U-value was reduced from 2.16 W/m²K to 1.02 W/m²K. and consequently heating energy was reduced with a significant 57% for SW and SE zones, and 44% for NW and NE, while cooling energy has increased by 15% for SW and SE zones and 18% for NW and NE. The increase of cooling energy is observed by other authors too. Bojic, Yik and Sat (2001) investigate the thermal behaviour of two residential apartments in Hong Kong after the introduction of thermal

insulation of different thickness and position, and concrete of different thickness for flats with different size, orientation, and occupancy using the detailed building heat transfer simulation software HTB2. Simulation results suggest that with thermal insulation on the external walls for flats air conditioned in the evenings during the seven “summer” months, maximum yearly cooling load reductions of 6.8% can occur when the insulation is on the internal side of the wall. However, as observed by Saroglou et al., (2017), adding thermal insulation could also increase the yearly cooling load when the insulation is on the outer side of the wall. The orientation of the flats, size and occupancy patterns are also influential and the degree of their impact is not determined in the research. There is a contradicting result by Cheung, Fuller and Luther (2005): 100 mm thick insulation on the inside of the wall results in the maximum saving of 19.4% in annual required cooling energy. The maximum reduction of 29.2% in peak cooling load is achieved with 100 mm thick insulation was situated on the outer side of the external wall. Increasing the insulation layer leads to greater reduction in both annual required cooling energy and peak cooling load, regardless of the position of thermal insulation. Dowd and Mourshed, (2015) claim that if the insulation is installed outside of the multi-layered walls it demonstrates the best performance, representing a thermal resistive barrier against the elements where the average temperature is below the internal set-point temperature most of the year. “This does not change the wall’s U-value but does change the admittance (Y-value) of the wall. If insulation is positioned at the inside of the wall, the room would either heat up or cool quickly, requiring frequent interventions from the HVAC with increased energy use” (Dowd and Mourshed, 2015). The contradictions needs to be explained by further simulations.

Saroglou et al., (2017) also describe a scenario where they replace windows with low-emissivity, spectrally selective, tinted double-glazing (LoE Spec Sel Tint 6 mm/13 mm air/clear glass 6 mm), infiltration 0.6ACH with the assumption that changing window systems including improved sealants and frames, will reduce infiltration. High cooling loads are reduced by 39% for SW and SE, and 37% for NW and NE while heating energy dropped by a 13% for SW and SE zones, and

a 32% for NW and NE. Cheung, Fuller and Luther (2005) go further, combining strategies: applying 100 mm thick EPS insulation to the inner surface of external walls; Changing the external wall colour to white with a solar absorptance of 0.2; Replacing the glazing with 6 mm thick Evergreen™ glass with reflective coating; applying 1500 mm long overhang and wing wall to all windows. By modifying the building envelope by the combination of strategies, the annual required cooling energy (sensible) for the whole flat is reduced. with 31.4%. The peak cooling load also reduced significantly: 36.8% reduction.

Saroglou et al., (2017) describes several more scenarios: application of 15% WWR that applied to all zones increased to 20% for SW zone, 20% for SE zone, 17.2% for NW zone and 19.6% for NE zone, to reflect the WFR specifications per zone. The increase of windows ratio in the SW and SE zones resulted in 35% less energy for heating while cooling demonstrated 18% increase. In NW and NE zones, heating dropped by 12%, and cooling increased by 8%. Incorporation of balconies 3 m deep x 4 m wide (South elevation) and 2 m deep x 4 m wide (West and East elevations) and a glass door per apartment resulted in a slight drop for cooling for all zones; SW and SE a 6%, and for NW and NE 3% while heating increased for SW and SE by a 31%, and for NW and NE a 7%.

Windows are crucial for the energy performance and their type should be considered with care. The climate, the type of building and the orientation affect the window performance which depends on where the window will be used, Actually, performance can defer in accordance with many influences and it is hard to generalize because of the many factors in effect (climate, type of enclosures, internal loads, infiltration, ventilation, etc.) (Urbikain and Sala, 2009). The glazing technology has advanced significantly in recent years which will have an enormous impact on the way building facades and control systems interact with solar radiant heat and daylight, and which will affect building heat loss parameters. (Robinson and Hutchins, 2003)

Bojik, Yik and Sat (2002) utilize HTB2, advanced building heat transfer simulation software, to study the fluctuations in the yearly cooling load (Q) and in the peak cooling-load (D) in two

residential apartments because of different windows and different apartment's orientations. The studied glazing types are clear glazing, tinted glazing, reflective glazing, and tinted and reflective glazing. Currently, the most used pane in residential buildings in Hong Kong hot and humid climate is a single pane, clear glazing.

The authors claim that several analyses must be done in order to evaluate the effects of design and retrofit of Hong Kong high-rise residential buildings. The paper analyses three cases. In the first case, the clear glass would be replaced with a glass with a lower reflecting coefficient, with the same orientation of the flat. The results of the analysis show that the biggest decrease of Q of roughly 10% is obtained when the flat is facing west and the clear glass is replaced by reflective, tinted glass. In the second case, two flats are analysed for the difference in Q and D. The highest decrease in Q of up to 7% and in D of 11% is shown depending on the windows' orientation. If the flat employs the tinted, reflective glass, then drop in Q would maximally reach 3% and in D 5%. In the third case, two flats with different orientation and glazing are analysed. The maximum decrease of 13% in Q and 16% in D are found in the flat with tinted reflective glazing facing south compared with the flat with clear glazing facing west. The research is still limited to the conditions in Hong Kong and for more reliable analyses more locations must be chosen. The article is technical and is not concerned with one important question: how better envelope design can improve quality of life in the building for people concerned with liveability.

Bojic and Yik (2007) analyse the effects of advanced glazing on energy saving in a typical high-rise residential building in Hong Kong, evaluating it by the simulation software EnergyPlus. The results show that the application of low-e glazing leads to a lowering the cooling electricity demand by up to 4.2%. The implementation of low-e reversible glazing would save up to 1.9%; double-clear glazing up to 3.7%; and clear plus low-e glazing up to 6.6%. The results indicate that for the high-rise buildings in Hong Kong, the use of costly advanced glazing would not be economically sustainable in terms of saving energy from cooling load. The benefit-cost analysis shows that only the single pane low-e glazing could be cost-effective to some extent, but all the

other types are not. If the cooling energy saving is a single aim, cheaper fenestration, for example, reflective glazing, is acceptable. However, the high cost of more efficient fenestration in relation to less energy for cooling are the main reasons this is not an applicable solution.

2.3.2. Energy consumption

Wan and Yik (2004) conduct a survey to gather data about the architecture and energy performance of high-rise residential buildings in Hong Kong. The survey utilizes two methods, the first one uses a questionnaire for a member of each household providing data and the second one is conducting home interviews. The authors obtained building design characteristics of the surveyed buildings including “floor areas of residential flats, the ratios of the areas of bedrooms and living and dining rooms to the total flat area, the window-to-wall area ratios, the types of fenestration, and the external-shading devices in facades of residential buildings.” (Wan and Yik, 2004). They also obtained energy consumption information and the type and quantity of appliances used in residential units.

Based on the gathered data, the annual energy use for air-conditioning and water heating in residential units in Hong Kong have been estimated. The households with air-conditioners and electric water heaters consumed around 29,500 MJ. Those with air-conditioners and gas-water heaters had an annual energy consumption of about 35,500 MJ. The households without air-conditioners but with gas water heaters consumed annually around 30,000 MJ. The most used electricity consumers among the domestic appliances were air-conditioners, electric water-heaters and electric space-heaters, use varying with the season. Air-conditioners are rarely used in the winter, unlike electric heaters. Electric water-heaters for bathrooms are used during the whole year but more frequently in the winter. The pattern of use of electric appliances is stable but unfortunately, since the electricity-use data is collected from aggregated consumption data it was impossible to achieve accurate break-down. However, the article is missing carbon footprint and also useful implications for both residential energy efficiency planning and further study of

variations in use patterns. The model can be used to more profoundly research relationships between urban form, population density, fuel availability, energy use, and carbon emissions in different regions of the country and the factors leading to more quality of life.

To reduce the negative impact on the environment from emissions of carbon dioxide the construction sector will face the need to use a lot less energy than in present times. Perlova et al. (2014) study a developing trend in Russia to switch to low-energy consumption houses.

Taking into account the additional losses due to the Russian climate, the authors anticipate the need for implementing higher regulatory demands for thermal insulation and heat recovery of exhaust air.

A barrier in front of the promotion of Zero Energy House is the popular opinion that energy-efficient houses cost more. Investigations show that one m² of efficient building costs only 8-10% more than the average cost of a regular construction. There is a 10-20 years period of costs returns because of the lower operating costs such as due to the reduction of heat loss through the external walls.

The research studies the design of a building that energy consumption is near zero designed to be built on the Polytechnic University territory. It will be used as a laboratory for energy-saving and innovative technologies in construction. There will be energy monitoring of buildings, a study of envelope thermophysical parameters, determining the actual values of energy consumption. In order to serve this purpose, the building will be supplied with modern measuring complexes and systems.

Design and layout strongly affect the energy consumption of the building. "The selection of the optimal form of the building, its orientation, location, the purpose of the area light openings,

control filtration processes reduce the negative heat effects of outdoor climate on the thermal balance of the building” (Perlova et al., 2014).

Architectural techniques are also crucial for a positive effect on the energy efficiency of the building. They might include maximum glazing of the North-West facades for the Russian conditions, dead walls in low-light scenes directions (after measurements) and reduction of the building envelopes’ area by smaller area of the exterior wall. Dowd and Mourshed, (2015) investigate building envelope in order to achieve energy use reduction. Heating and lighting are the activities that produce the largest demand for energy in the UK buildings, to levels that to a great extent are determined by the building form and envelope and the construction thermal properties. The results illustrate that wall construction and window size mostly determine the thermal behaviour of the building. It was found that 20% glazing level resulted in minimal energy consumption for all with the exception of the concrete wall without insulation. These types of walls can benefit if glazed up to 30%, meeting the heat losses with solar heat gains. However, small savings were possible for insulation beyond 50 mm, negatively affecting the payback period. Nevertheless, the importance of an advanced HVAC system is not illustrated in the article.

The initial measures to reduce the energy consumption of the buildings are careful consideration of the thermal properties of the construction and the properties of the glass areas. The building envelope includes the foundation, roof, walls, doors, windows and all the remaining parts linked to the exterior of the building. It is designed to secure safe and comfortable indoor conditions and to shelter the users from the nature elements which is the most energy consuming process

Perlova et al., (2014) claim that the construction must comply with requirements such as an effective layer of thermal insulation of the building envelopes (U value for walls - no more than 0,09 W/(m² K), for the coating no more than 0.07 W/(m² K), for the floor no more than 0,09 W/(m² K). Also a minimum of thermal bypasses in the nodes and the abutting joints, low-e coated

glass (with a coefficient of heat transfer $U \leq 1 \text{ W/ m}^2 \text{ K}$) and high air tightness of building envelopes during the lifetime of the building (over 30 years). The heating system should provide an alternative to conventional heat sources (ground heat pump). The air supply and exhaust mechanical ventilation are with heat recovery of the ground and the exhaust air. The ventilation system has CO₂ (carbon dioxide) and RH (humidity) sensors. During the cold months, extra fresh air with 18-19°C can be circulated through the heat source. The cooling system should be characterized by low power consumption, high reliability and ease of management. The article is informative and valuable, providing important technical parameters of the desired building envelope (U-values) and the HVAC system.

2.4. Design and technology

2.4.1. On-site resources

Tall building nowadays need to be up to the last advances of the design and technology to be in harmony with their urban habitats. A review of the latest techniques and approaches is needed to enlighten the questions of technical adequacy of these buildings for better liveability and more social integration. Special attention is paid to green design and the adopted green strategies such as passive solar gain, high-performance façade technology, solar energy, wind energy, fuel cells, smart materials, etc.

Optimizing the building envelope is one way to make the high-rise buildings more sustainable. Another approach is to realise the energy efficient possibilities on-site.

In low-rise residential buildings in China solar water heating system has been increasingly popular, however, its implementation in high-rise apartment is still rudimental. Shi, et al. (2013) investigate the present use of a solar water heating system in high-rise residential buildings in China. The study introduces demonstration projects of high-rise residential building, discussing

the application feasibility and limitation of the system, and some appropriate planning types. The study also assesses the feasibility of solar water heating systems for tall buildings flats that are typical in connection with various factors: architecture and construction. The comprehensive planning of building construction and solar collectors is of great importance for the implementation of a solar water heating system in high-rise buildings.

For the study, both advantages and disadvantages of flat-plate solar collectors and evacuated tube solar collectors were assessed. The study finds out that the distance between buildings, according to relevant standard of Chinese urban residential building does not provide enough power for collectors situated on the south elevation. There is a margin for a hybrid of technologies of solar water heating system to fulfil the hot water demand. Application of solar energy technology should be considered during the whole process of architectural design in terms of implementation of needed materials, system styles, colour and ease of application of solar energy system, which have great influence on building facade design. He (2016) also states that the places with optimum solar irradiation are crucial for the installation of the solar collectors, as well as the integration of solar systems with the building.

The article is missing energy saving calculations and cost-benefit analysis to convince the reader of the economic viability of installing the solar panels. It is also not discussing how the production of energy onsite can evoke interest in the residents and lead to better quality of life. He (2016) discusses the Beijing Meilifang Project and the Tianjin Dingxiuxinyuan Project which apply solar water heating systems with centralized collection & decentralized supply. The research demonstrates that the initial temperature in two heat exchange tanks were at about 22° C gradually increased from 9:00 to 13:00 and showed a little different cases; then finally trended to the same final temperature about 45° C at 15:30. It indicates that the solar water heating system with centralized collection & decentralized can provide very uniform heat supply making them applicable for high-rise residential buildings.

A big ongoing polemic exists on about the use of façade area for power generation of wind energy. Bayoumi, Fink and Hausladen (2013) introduce a method for maximizing the performance of façade integrated wind rotors. The use of wind energy has a great potential especially in combination with other renewable strategies (solar panels). The methodology for a precise analysis is using Computational Fluid Dynamics (CFD). In the study, four model high-rise buildings forms were selected: square, rectangle, triangle and octagon. They were calculated in three different heights: 90 m, 180 m and 270 m. For the scope of this paper, the square form is predominantly considered. In the simulation process, three angles for the fluid emission were chosen: 0°, 45° and 90°. The results are found to be very helpful for architects. Since the turbines can have a major effect on the building appearance causing shades in unwanted places, it is useful to have an idea of their position, number and size, the way they should be integrated on the facades. Used as a planning tool it is of great help for architects trying to optimize the performance of their building as early as possible. Lu and Sun (2014) consider the turbulence and low speed areas that could appear with the existence of buildings. They suggest wind turbines to be installed on the windward half above the high-rise building near less-obstacle half side under dominant wind direction. If the hub height is assumed to be 5 m and the cut-in velocity is 3 m/s near these areas, the estimated utilization time of wind power is around 60% in a year according to their simulation. These phenomena and recommendations could be very useful to locate and install wind turbines for maximum usage, stability and safety reasons.

A big limitation of the proposed method for Bayoumi, Fink and Hausladen (2013) is that the CFD-Analyses are done for generic buildings that are isolated and not surrounded by a built context. Lu and Sun (2014) state that wind energy in buildings, with turbines being installed on or integrated into buildings, can be challenging compared to stand-alone wind energy systems and wind farms. Some present types of wind turbines installed at the high wind speed zones in urban buildings are building mounted (small-scale wind turbines), including Horizontal Axis

Wind Turbines (HAWT) and Vertical Axis Wind Turbines (VAWT), and building integrated turbines.

The green technologies for the production of on-site energy in high-rise buildings can combine energy sources. Chong et al. (2011) study the innovative wind-solar hybrid renewable energy generation system with rainwater collection feature for electrical energy generation from technical and economic perspective. In the study is calculated the energy output of the designed hybrid system on the basis of its technical characteristics and relevant weather data of wind speed, solar radiation and rainfall. Also, the economic and financing characteristics of Malaysia were used to calculate the financial characteristics of the system. By LCC method are calculated the range of costs.

The analysis demonstrates the system's energy savings are 195.2 MW h/year. The green technologies incorporated in the system: urban wind turbine, solar cell module and rain water collector, supply part of the energy for the building. The design was developed based on similar wind turbines in the Malaysian context. It is compact and can be installed on top of high-rise buildings for green energy. The low-speed wind can be overcome by power-augmentation-guide-vane (PAGV) before it enters the wind turbine at the centre part. The appearance of PAGV can blend into the building architecture by appropriate design, which makes it safer for people and reduce noise pollution. The system can minimize the problems such as poor starting operation in low speed, noise, visual impact, electromagnetic interference, safety and environmental factors. Since the authors selected a site situated at low wind speed region, a shorter payback period can be expected for sites with higher wind speed. It is also not clear how interest in living in the energy producing building can lead to more quality of life.

2.4.2. Ventilation options

For the subtropical climate, it is worth to review the optimization of the potential for ventilation at outdoor spaces during the summer in hot-humid climate. Yang, Qian and Lau (2013) aim to

examine in a study the micro-scale effect of urban form and density (of building and/or greenery) on outdoor ventilation potential. The authors are using empirical data from an extensive field measurement. Ten high-rise residential sites in inner-city Shanghai were selected and grouped in four urban climate zones (UCZ) according to the urban cover and urban structure. According to the wind statistics, there is significant influence from the surrounding urban morphology. The results present that increasing sky view factor SVF by 10% could increase pedestrian level WVR by 7–8%. The observed weak wind environment suggests an urban design approach preferring a “diverse” instead of a “uniform” wind conditions. Observing weak wind conditions, thermal buoyancy is found the main driving factor.

This resulted in higher WV during the day than in the night, though there is lacking thermal control due to the high air temperature. During the night the comfort zone can be reached (after 6 pm) so night-time usage becomes an important factor and to the lighting and safety facilities should be paid special attention. On-site, the building floor area ratio (FAR) and building coverage ratio (BCR) are negatively related to WVR, demonstrating the wind effect of building density. In the station, three variables, sky view factor (SVF), tree view factor (TVF) and green plot ratio (GPR) are invented to quantify the degree of the enclosure at a pedestrian location. The three variables are significantly interrelated with WVR as shown by three of the four UCZ data. The article is missing the air flow patterns, temperature distributions and the ventilation flow rates. SVF shows the highest explaining power on WVR. It indicates most accurately the degree of the enclosure (or openness) to ambient airflow, and to short-wave radiation heating, so the air movement in calm conditions. The final results demonstrate that diverse environment helps to preserve outdoor comfort no matter the temperature conditions. A variety of outdoor spaces, organized systematically, should offer the users great choices. SVF potentially can indicate to map the solar and wind incidence, thus informing designers and aiding the climate-responsive design process.

Ventilation is crucial for achieving good indoor air quality. Priyadarsini, Cheong and Wong (2004), conduct a “feasibility study on the application of passive and active stack systems to enhance natural ventilation in public housing in Singapore” (Priyadarsini, Cheong and Wong, 2004). The main objective of the paper is to evaluate a scaled model of typical four-room flat in a wind tunnel. The study obtains the status of a natural ventilation and aims to develop enhancement of natural ventilation by passive and active stack effect. The methodology assesses the plan of a typical four-room flat with a floor area of 100 m² and height of 3 m. It shows that passive stack effect fails to improve the rooms’ ventilation, but the active stack successfully accomplishes it. The enhancement of velocity is much higher when the doors are closed, but when they are opened, the velocity increase is much more evenly distributed. So much more attention is paid to the night-time when the doors are closed. The numbers show the percentage increase in the velocity up to 550% and maximum velocity 0.67 m/s. 0.26 m/s was achieved even with the smallest stack. High velocities were achieved for larger stacks even when the wind tunnel was turned off. A conclusion can be made that on a calm evening thermal comfort is achievable. As well, for larger stacks, it is found greater fan speed has no significant effect on the air velocities. The article is missing a summary of potential energy savings due to stack effect.

Natural ventilation becomes increasingly popular due to the energy, indoor air quality and environmental problems typical of mechanically ventilated buildings. The mechanical system for heating, ventilation and air-conditioning (HVAC systems) are responsible for a great deal of the energy consumption. Wang, Nyuk and LI (2007) study “the benefits of natural ventilation, including reducing operation costs, improving indoor air quality and providing satisfactory thermal comfort in certain climates” (Wang, Nyuk and LI, 2007). Natural ventilation, used for passive cooling of the houses has become a feasible solution to the problems associated with mechanical ventilation and air-conditioning. The study states that 86% of the Singapore population live in HDB (Housing and Development Board) residential buildings, where natural ventilation is anticipated. The results show that a value less than 2.5 W/m²K for the U-value of

facade materials for north and south orientation should be achieved than and this number for materials for north and south orientation should be less than $2 \text{ W/m}^2 \text{ K}$ in order to prevent thermal asymmetry near the openings. North and south facing facades provide more comfortable indoor environment than east and west facing facades in Singapore. Shading devices are necessary for east and west facing facades. Direct east and west facing facades are unfavourable. If residential buildings face east or west due to the site limitations, the buildings should be about 45° to the west or east to increase ventilation. The coupled simulations show that the most favourable window to wall ratio is around 0.24. Horizontal shading devices are necessary for all the orientations to complement an improvement of the indoor thermal quality. In studies to come, vertical fins and horizontal shading could be researched on west and east facing facades for better indoor thermal comfort. Again these results will defer in different climates.

Natural ventilation in the high-rise buildings can be manipulated by various design interventions. Prajongsan and Sharples (2012) conduct a study of computational fluid dynamics (CFD) analysis of the possible utilization of ventilation shafts in high-rise residential buildings in Bangkok. The goal is to enhance natural ventilation and to provide better thermal comfort (respectively lessen air conditioning energy demand). The study takes place in a room with single-sided ventilation (with openings on just one external wall). The mechanism allowing a shaft located at the rear of the room to raise the average air velocity across the room is the increased pressure between the room's window and the shaft's exhaust at roof level. The authors use a hypothetical room in a 25-storey residential block in Bangkok. The methodology includes assessing air velocities in the predefined occupied areas of the room without and with a ventilation shaft (called reference and test room respectively) using the CFD package in the DesignBuilder modelling software.

The summer comfort hours were calculated in both rooms, using room's operative temperature after they have been treated by the elevated air velocities. The results suggest that the air velocities in the reference room were insufficient to cool it, despite the external wind conditions, but in the test room they greatly increased. The comfort hours in percentages during the summer went up

from 38% in the reference room to 56% in the test room. This can be translated into approximately 2700 kWh of air conditioning energy saved in the room by using the proposed ventilation shaft. Altogether, the ventilation shaft can be an effective wind-induced ventilation system for creating cross ventilation and relatively high indoor air velocities that can improve thermal comfort in a single-sided residential unit. However, this strategy is insufficient to provide thermal comfort. In a real situation, more rooms will be connected to the shaft and the air velocities in each room will decrease. The study should examine more realistic situations with optimal configurations and consider optimal operation times. The article is not discussing the significance of enhanced ventilation and improved thermal comfort for different social groups to improve quality of life in the high-rises.

Enhancing the natural ventilation can be achieved by other design approaches than shafts and can be very efficient. Kotani, Satoh and Yamanaka (2003) observe light wells centred in high-rise apartment buildings in Japan, by the name 'Voids'. Gas water-heaters integrated into Voids discharge exhaust gas and a large enough opening has to be provided at the bottom of the Void to keep the indoor air quality (IAQ) good. The calculation method in the article reviews the ventilation rate induced by wind force and thermal buoyancy through openings in the bottom, aiming to secure the indoor air quality from contamination. It is not feasible to use mechanical ventilation with exhaust fans because of the large volume of space but using the Void as a supply and exhaust duct via natural ventilation has the advantage of saving energy. The authors use a modified Bernoulli's equation as a simple method to calculate the ventilation rate. Also, a forty-storied building is used for the creation of model experiments and calculation studies to estimate the validity of a simple method of calculation of airflow rates. Airflow patterns in Void are visualized by laser light sheet and tobacco smoke. Experimental model is situated in an open-circuit type wind model.

The temperature in the upper parts of the Void is higher in the most cases. When the ventilation rates were high and the heat generation was big, the temperature in the vicinity of the Void stays

relatively higher than the temperature in the middle. Ventilation rate Q has a positive correlation with wind velocity and heat generation rate, which can be easily explained from the thermal buoyancy generated by the heat and wind pressure difference between the lower opening and the top of the Void. The calculation tends to overestimate the ventilation rate. The ratio of calculated value to those measured varied from 1.26 to 1.51 for single zone model ($n=1$) and 1.16 to 1.48 for eight zone model. Eight zone model is superior to single zone model to predict ventilation rates in Void. The results demonstrate several things: the flow visualization illustrated the circulating flow in the lower part of the Void and several reverse flows from the outside into the top of the Void; the temperature at the top of Void had a negative correlation with wind velocity and positive correlation with the heat generation rate. “The ventilation rate had an almost positive correlation with wind velocity and heat generation rates; the calculation methods used in the study were valid to predict the vertical temperature distribution and ventilation rate of Void. Further studies must be conducted because: the similarity requirements were not satisfied in the experiments, so the results could not necessarily be applied to a full-scale building.”(Kotani, Satoh and Yamanaka, 2003). More research is needed in the future. The calculation method should be adapted to full-scale measurements because the shape of the building was a simplified model. It is also not discussed if the implementation of the light-well makes the building more attractive to different social groups improving quality of life.

2.4.3. Passive design

Passive design to climatic conditions provides human thermal comfort with minimum operating energy consumption and as such is the main sustainability factor. Bay (2004) studies socio-climatic design for high-rise buildings. The case study, Bedok Court Condominium demonstrates that the socio-climatic characteristics of the traditional tropical vernacular villages (kampong) are re-adapted and re-invented successfully, enhancing the quality of life in the high-rise, high-density conditions, and are also providing diverse passive modes of environmental control. In time the socio-climatic design of the kampong in the South-East Asian region has developed an

equilibrium system between socio-cultural and climatic-ecological demands. The design of the condominium includes large open entrance terraced courtyard to each apartment and air-wells between apartment units. This, along with the street-like in linear corridors reminding the streets in kampongs with a view of verandas creates an atmosphere of visual connectivity, plenty of natural light, natural ventilation and tropical comfort welcoming a different kind of activities. However, the main difference is that these are streets in the sky with more than one level of visual connectivity, 3-dimensional multi-layered streets and with much higher density. The condominium consists of 280 units of mixed heights of 4 to 21 storey.

The architect describes that his inspiration is coming from his first-hand experience of the village verandas and the strong atmosphere of security, friendliness, the visual connectivity, social connectivity, familiarity and sense of community found in the kampong. The verandas offer space for frequent seeing the other neighbours and also facilitate gardening in the semi-opened places, perfect for social interactions. The benefits from the plants are reduced heat island effect, pollution and good air quality. The study of thermal comfort points out that the verandas provide shade and ventilation, which keeps the apartments cool and provides thermal comfort for longer periods suitable for social activities. Personal expression, visibility and interaction with the neighbours are building closeness and sense of community. This is in sharp contrast with the omnipresent generic high-rise architecture. Wood (2007) states that the problem with the import of Western models which contribute to the degradation of the local culture and homogenization of the urban centres globally can be solved according to the author by turning to the vernacular arsenal. He argues that with a short history of more than 100 years rooted in North America, in the most non-Western countries there is certainly no presence of an established high-rise vernacular. In the search for breaking away from the standard, air-conditioned, steel-glass box, design principles can be a starting point for a new vernacular, presenting interesting building form and rooted both physically and environmentally into the idiosyncrasies of the place.

However, the Bay (2004) leaves some opened questions. The usability throughout the year is not specified: are all seasons suitable for the use of the verandas; what is the approach to open space planning; concerns about noise; what social groups are using them and is there social integration of different social groups fostered by the design. It is also interesting what are the factors for increased users' satisfaction from climatic comfort; are they causing any infrastructural troubles and are there any lacking features.

Bay (2002) also studies the incorporation of traditional features of Asian villages into high-density structures. The author states that the implementation of traditional schemes into modern developments is the basis of the progress towards contemporary Asian architecture. He points out that a common critique of new urban environments is that unlike the traditional cities they tend to be transient and alienating, embracing very little social interaction and integration. They tend to provide communal facilities in separate complexes on a large scale compared with the wide variety of small communication spaces found in the traditional schemes encouraging a lot of neighbour contacts. Omer (2008) states that vernacular architecture as attractive as educational. One important aspect is that traditional architecture uses various devices to achieve thermal comfort and no fossil fuels are used for it. Sun shading and cross ventilation are two major techniques as well as capturing sun in winter through the south elevation. Without denying the human right of enjoying comfortable modern lives, the use of energy must be reduced.

Bay (2002) discusses The Pearl Bank Apartment which is one of the first condominiums in Singapore and an initiator of the idea of common areas with shared amenities, which became a central theme in the future developments and evolved from a simple swimming pool to sophisticated parks and clubhouses. An example of award-winning project is the complex in Tampines, completed by 1995, including large central parks with play areas overlooked by hundreds of apartments.

In conclusion, the goal is to discover the modern Asian solution for sustainable high-rise high-density architecture. However, the articles are giving too little consideration of the mentioned problems with security and surveillance and have no data on the inhabitants' satisfaction of the mentioned facilities.

The sustainable responses to climatic and environmental problems are rarely inspired by the long traditions in the local villages or towns which can significantly increase the quality of life. Wood (2007) outlines the quality of high-rise buildings as a sustainable part of the future urban hubs. The study presents several case studies utilizing sustainable tactics and in doing this, it proposes several design approaches which could be interpreted as a new vernacular for the skyscraper based on sustainability.

The design principles are variation with height, new building programs, communal spaces, envelope opacity and vegetation. There are traditional devices like monsoon windows or houses like the attap, kampong and Malay houses (Chang, 2000) that are not discussed in the article which should have been focusing more on the traditional technologies and planning approaches applicable for the high-rise buildings from the vernacular vocabulary. It can also discuss what are the hindrances in front of the building a high-rise vernacular such as institutionalization and planning rigidity. Altogether there are many topics that may be of interest for further study.

Omer (2008) states that modern people will not tolerate poor indoor environment such as in the past was acceptable. However, the depleting resources available lead to the need to devise various means of constructing their houses compatible with the climate. When designing passive and low-energy architecture for the future to adapt the designs to respective regional climatic conditions and use the ecotechniques in combination with a high grade of modern science.

2.5. Conclusion

High-rise living has many design aspects such as accessibility, landscaping, security, indoor environmental quality, design against crime, sustainable housing. Socio-climatic design for high-rise buildings through adapting traditional tropical vernacular villages (kampong) can enhance successfully the quality of life in high-rises, within high-density conditions, and is also providing diverse passive modes of environmental control. The literature also provides good basic criteria for assessing liveability. The literature covers important topics such as green spaces, environmental quality, lifecycle performance, influence of the building envelope and shape, energy production on site, passive design, thermal comfort, etc.

The energy performance and benefits of natural ventilation are also topics that receive large attention. However, there are issues that can be further investigated such as how energy efficiency affects quality of life. One neglected topic is that of ‘vertical community’, which has a great potential in the high-rise buildings. Leisurescapes are an interesting little-researched topic. More research is needed on the residents’ satisfaction with their premises. There is not enough clarity on affordability, psychological and social function of the housing, the connection between sustainability and design trends and the connection between sustainability and quality of life. It is also needed adapted approach towards the evaluation of the health and comfort of the occupants. Site development and material selection are not getting enough attention. Problems such as anonymity, lack of facilities and mixed-use can be further investigated along with alternative sustainable materials. Energy saving calculation and cost analysis of the sustainable design intervention are equally important.

In the literature are presented some sustainable approaches, however, a broader framework for assisting professionals and the public is needed, encompassing categories such as energy and resource efficiency, location and density, sustainable construction and materials, preventing segregation and displacement, upgrading inadequate housing and slum areas, ensuring public participation, protecting cultural heritage, amenities and more.

Chapter 3 Theoretical basis for the research questions in connection with the Context

3.1. Introduction

A theoretical overview provides a basis for the two research questions of the thesis. However, no holistic theories related to the research questions were found through an exploration of the existing literature and the chapter can only quote discrete conclusions from relevant articles. The context of the research field study is strongly connected to the nature of the research questions, since it reveals continuous problems and opportunities for further investigations, related to environmental and social sustainability and the quality of life, as well as sustainable building design principles and problems to be addressed with sustainable design responses.

3.2. Context

Most of the largest high-rise neighbourhoods in Britain appeared between 1960 and 1975, however many were planned before that and some construction was still carried out in the early 1980s. At first, the demand for new homes has been strong because of the growing urban economies. However, research demonstrated that shortly, mass housing became undesirable to families with children who needed to be nearer to jobs and closer to the ground in a conventional housing. ‘Streets in the sky’ implemented fatal misconceptions about human interaction and social control. The underlying theory defining the architectural form of the resulting developments covered two points: that hard physical solutions would erase the slums and that large-scale housing was possible through public funding within the flourishing industrial societies. Both ideas failed when actual needs and underestimated social paradigms emerged. The theory basis itself was the failure of built form in meeting people’s needs and about the abilities of professionals and politicians to control people’s lives (Katz, 1995 as cited by Power, 1999).

However, in modern times the demolition of high-rise housing faces various kinds of resistance. Views are often opposing each other in the communities, with those against a suggested destruction getting more media recognition than those favouring removal and change. Some of the people against removal like high-rise living, some groups of local people are afraid that demolition and redevelopment programme will negatively affect their community, being not necessarily supporters of high-rise living. (Kearns, et al., 2011) A current review of the redevelopment programme in the UK suggests that one of the biggest difficulties challenging policy and practice was that ‘demolition can prove a distressing experience and the process needs intensive management and community support to minimise disruption’ (Cole et al., 2010, p. 30 as cited by Kearns, et al., 2011, p.99).

In the 60s’ the flats were gaining better opinions, so the quantity and the floor number of the towers increased. However, the official report of the Flats and Houses (Ministry of Housing and Local Government, 1958 as cited by Turkington, van Kempen and Wassenberg, 2004), high-rises cost more to build than the competing types of housing. What turned the conditions in their favour was the state subsidy established to municipal housing authorities that was raised in 1956, and in 1961. “The numbers of high-rise dwellings (6 storeys and above) rose from 6,000 in 1956 to 17,000 in 1961, 35,000 in 1964 and 44,000 in 1966. Within the high-rise category, there was a marked trend towards increasingly tall blocks. Blocks of 10-14 storeys expanded from 0.7% of public housing in 1955 to 8.4% in 1963. Blocks of 15-19 storeys expanded from 0.1% in 1955 to 8.3% in 1964” (Dunleavy, 1981, p. 41 as cited by Turkington, van Kempen and Wassenberg, 2004). The towers differed largely by construction methods and types (Association of Metropolitan Authorities, 1984 as cited by Turkington, van Kempen and Wassenberg, 2004). Technologies were imported from countries with proven knowledge of high-rise construction, mainly from Scandinavia.

In Britain, the proliferation of high-rises covered the worst incidence of lack of housing and slum existence. Greater London; urban Scotland mainly Glasgow; the North West and West Midlands regions accommodated almost 80% of the high-rise blocks built in the 60's. When the construction aimed at slum clearance, there was a weaker link with the Modernist vision of the Radiant City. The best scenario was including the high-rises in 'mixed' housing types, the worst it was chaotic expedient housing. The layout was inspired by the popular concept of the 'housing estate'. Theoretically, this should have provided an infrastructure needed for community flourishing, mainly shops, schools, leisure facilities etc. What happened was that the stress to meet housing targets and cost limitations often ruined the execution of such plans which was catastrophic for the peripheral sites of the cities (Turkington, van Kempen and Wassenberg, 2004).

In the 70s, the high-rise programme faced a difficult end, mainly explained by financial and technical reasons, but there were more significant issues. Despite the lack of proper research, the issues linked to high-rise living emerged since 1950s, mainly concentrated on the negative consequences on children and families (Department of the Environment, 1975; Gittus, 1976; Jephcott with Robinson, 1971; Royal Institute of British Architects, 1957 as cited by Turkington, van Kempen and Wassenberg, 2004). After 1980, high-rise was a regaining popularity housing type, mainly because their demolition would cost a discouraging amount of money with no subsidy attached.

Because high-rises have a specific structure and are often situated next to other buildings, the cost for demolition reached half a million pounds per block which were quite high for the period. Besides, a Conservative government was elected in 1979 aiming at promoting owner-occupation and shrinking the public sector support for housing which hugely affected the high-rises. The popularisation of the 'right to buy' for municipal tenants in 1980 led to the sale of one-third of

the 'council housing'. As expected, these was housing among the most popular, mainly single-family cottages. Flats in the towers, sold only ten percent of the total, situated generally in London and Scotland.

The 1990s were critical years for the towers. With growing call for affordable dwellings, there were authorities that rejected policies which did not tolerate families in the apartments which continuously worsened as living conditions. For instance, Birmingham City Council rejected its 15 years 'no children in flats' policy in 1992, then was informed by a profound technical survey, that 200 of its 414 towers needed 'urgent' structural renovation (Birmingham City Council, 1994 as cited by Turkington, van Kempen and Wassenberg, 2004). The future of the high-rise living seemed brighter after a network of residents' groups in tall buildings and the results of surveys of tenants' opinions promoted it (The National Tower Block Network, 1992 as cited by Turkington, van Kempen and Wassenberg, 2004). For instance, a study conducted for Housing Action Trusts dealing with tall buildings in Liverpool and Castle Vale, Birmingham found that many residents, especially the long-term ones, were happy with the flats. The surprising results made both Trusts to think about the preservation and renovation of the flats, even though they remained with uncertain future. Regrettably, the 'case studies' also pointed out the high cost of the renovation of the deteriorating towers and its viability.

The population of the high-rise buildings demonstrated significant change and caused great concerns. The first populations were mainly young families with an income from full-time employment, and with fewer elderly, childless and single residents. Three trends changed these statistics. To begin with, after the abandonment by the initial wave of residents, people with less choice replaced them, mainly, the unemployed, students and 'problem families'.

At a certain point, there were notorious towers that the municipal housing authorities turned into 'dumping grounds' for difficult tenants. Next, since 1979, the declining numbers of affordable

rented housing created a demand for a system giving priority according to the housing need. The demographics consisted of statutorily 'homeless' families; people with serious physical illness, and people from mental hospitals or different institutions. The last trend concerned the occupants who moved in in the 1960s and have reached retirement age and beyond. Their interactions with the more recent residents were limited and they usually were dependant on state welfare benefits. Unlike their original role, high-rise estates sheltered mainly low-income residents with a great number of older tenants in poor health. For instance, the 1995 social surveys conducted for the Liverpool HAT indicated that: there were 51% of retired tenants; 45% with income at the level of state benefits; 45% families including somebody long-term ill, and; 20% of all tenants unemployed (Liverpool HAT, 1995 as cited by Turkington, van Kempen and Wassenberg, 2004). These statistics are valid for many blocks and estates throughout Britain.

According to Manchester City Council Manchester Core Strategy 2012 to 2027 (2012) "The large and growing Black and Asian populations have deep roots in Longsight, Rusholme and Moss Side and the communities have spread out into adjacent neighbourhoods over the past 10 years. The central area has a high percentage of people aged under 25 across all ethnic backgrounds. This population growth, combined with the additional influx of students, key workers and young professionals from the university and hospital core, has created localised areas of high housing demand and a range of busy district centres, such as Rusholme and Longsight. The area also has a wide variety of property, with high quality historic civic and residential buildings existing alongside lower quality dense terracing and more recent social housing estates, often with housing quality and layout problems." The strategy accepts the opportunities for better quality of life and sensible use of resources, provided by high-rise buildings, but not unconditionally. The conditions such as complementing the local context and high-quality architecture, along with the growing housing demand make Manchester a suitable city for undertaking a case study and benefit from its outcomes.

According to the Mayor of London The London Plan (2016) “At its best, London can provide what is amongst the highest quality of life to be found anywhere. Unfortunately, this is not the universal experience of Londoners, as indicators like the disparities in life expectancy in different places across the city show. There is also a perceived tension between the demands of growth and the conditions for a good – and improving – quality of life, and a concern about the loss of things that have made living in London and its neighbourhoods a distinctive experience. It is unsurprising, therefore, that consultation on proposals for this Plan have shown a growing concern with quality of life issues, such as ensuring there are enough homes meeting the needs of Londoners at all stages of their lives and whatever their circumstances, and designed so they actively enhance the quality of the neighbourhoods in which they are located.” The unprecedented population growth, stated in the Plan, combined with diversity and need to focus on quality of life also make London a suitable context for the case study.

3.3. Principles of sustainable high-rise buildings, enhancing quality of life

“The clearest explanation of sustainable high-rises, using sensitively the resources, eliminate high amounts of environmental pollution, considers the residents’ health and comfort and meets economically these criteria, wins the favourable opinion of the community”(H Begeç, 2013 as cited by Begeç and Hamidabad, 2015, p.1). Such an attitude towards health and comfort is connected to the quality of life and need to be further investigated through the relation between sustainability and well-being. Living in a favourable environment is also representing an aspect of users’ satisfaction and is related to the quality of life, enhanced by sustainability. A characteristic and aim of sustainable buildings is the large utilization of natural resources; this is closely related to climate. However, besides energy demand, low energy needs, the local and prevailing climatic circumstances are a key player. The following principles are connected to the usage of natural resources: to provide high thermal efficiency, higher heat and solar insulation

are needed; relying on the advantages of the passive solar system; relying on the building structure as thermal storage; relying on the natural ventilation capability (Lotfabadi, 2014).

Environmentally friendly buildings should use any chance to implement sustainable steps and decisions for their design. These buildings are possible by promoting sustainable solutions in their creation not only when it concerns the building services (e.g. use of renewable energy, LED lighting) as well as the architecture, built form (green roof and walls, windows), orientation (to sunlight, wind), materiality, context on the site, water and waste strategies (e.g. rainwater and grey water recycling, automatic taps, dual flush WCs). The considered design strategies should aim at reducing life cycle impact and life cycle costs (Tang, 2012 as cited by Abdellatif and Al-Shamma'a , 2015). Such savings can lead to additional financial resources for the end users that can be allocated for other purposes, affecting their wealth and thus representing a connection between sustainability and quality of life.

Thermal comfort is a single side of quality of life. However, it is simpler to describe thermal comfort operationally than the quality of life in general. Actually, the fuel poverty lobby has achieved a lot in this important aspect, the lack of comfort, debilitation and sicknesses resulting from the fuel poverty. Considering thermal comfort as the crucial part of the quality of life which is related to the domestic fossil fuel use, information is needed instead of a distorting oversimplification. In a broader aspect, both the environmental and quality of life are tangible, very important for sustainability and strongly connected to each other through occupants behaviour (Levett, 1998). This is clear indication that some aspects of sustainability generally affect the quality of life and need to be a part of a dedicated research. For example, health is a subdomain of quality of life that can be directly linked to thermal comfort and the sustainable ways to provide it.

Social sustainability is a complex idea, related to the question ‘what are the social goals of sustainable development?’ with many possible answers, and no cohesive opinion how these goals are determined (Hopwood et al., 2005, Littig and Griessler, 2005 as cited by Dempsey, et al., 2011). The theoretical debate on defining social sustainability is limited, even though current European policy debates on ‘sustainable communities’ and social cohesion. The ‘Bristol Accord’ develops a common European attitude towards ‘sustainable communities’ accepted by EU member states, which is founded on previous EU initiatives such as the Aalborg Charter and Agenda 21.

Sustainable communities are described as ‘places where people want to live and work, now and in the future. They meet the diverse needs of existing and future residents, are sensitive to their environment, and contribute to a high quality of life. They are safe and inclusive, well planned, built and run, and offer equality of opportunity and good services for all’ (ODPM, 2006, p. 12 as cited by Dempsey, et al., 2011). Such an interpretation reveals the physical context in which communities are situated (Dempsey, et al., 2011).

According to the OECD Project, sustainable buildings can be described as buildings that produce the least negative impacts on the built and natural environment, including buildings themselves, their close context and the broader regional and global context. Sustainable buildings integrate high economic, social and environmental performance. Relatively, the considerate implementation of natural resources and sensible management will reduce waste limited resources, energy efficiency will increase, and environmental quality will improve. The OECD project presents five objectives for sustainable buildings: efficient use of resources; energy efficiency (with less harmful emissions); less pollution (with indoor air quality and less noise); Coexistent in harmony with the environment; Integrated and systemic approaches (John, Clements-Croome and Jeronimidis, 2004).

Sustainable Architecture produces buildings that are well integrated into local social–economically, culturally and environmentally, considering the coming generations. They must importantly minimise energy consumption in buildings (maintenance and embodied energy), utilizing passive design strategies, such as reducing the use of energy demanding systems like HVAC or artificial lighting, through a sensible consideration of the local climatic context (Baker and Steemers, 2000 as cited by Correia Guedes, Pinheiro and Alves, 2009).

Architects must face again the gap between occupants and the natural environment common to the traditional mega-structures. A solution might be to provide easy and numerous options to daylight and vegetation within the building, with increased ventilation to the external air and avoidance of toxic materials, provision of window light and views. Planners can look at control over the internal environment (temperature, air flow, and lighting) of the residents to enhance comfort, satisfaction, and productivity and achieve flexibility when addressing changing local conditions (Wener and Carmalt, 2006).

OIKODOMUS (2011) develops several valuable housing concepts which are relevant to the presented research. Housing concepts that might help the research process are customization or to customize a house understood as designing and building a home according to the particular needs or demands of the residents or to change an existing home to meet such needs and demands. Another concept is flexibility and variety or the design of houses that take into consideration the prospective development of the site as well as life and social circumstances and with the ability to make relevant alternations of the living environment.

Flexibility and variability give an opportunity to provide living conditions according to the new requirements as the spaces are used. It is applicable to urban and architectural design connected to the present and future needs of the people occupying it. In the urban context, it is relevant

generally to the location of amenities in a city and community in order to design specific areas for shops, services, offices, leisure and culture.

Another concept is housing amenities and utilities. The level of the housing quality originates from the basic and superior living standards within the flat, as well as the number of additional functions implemented, supporting health, education, shopping, working, recreation, etc.

The meeting of all human needs and desires are related to a variety of issues, which must be considered and then implemented in any arrangement of living conditions. The existence of mixed areas including a proper combination of residences, amenities, working and public spaces ensures comfortable, delightful spaces targeting different demographics.

Design of the residential areas consists of mutually intertwining architectural elements from the cultural and social milieu. They must relate to all standard needs of the individual and community through its existence. Another relevant concept is mixed-use housing: Mixed-Use Housing Development, also been known as “Compact Development”, is not just a design/planning pattern related to a multi-storey building whose ground floor encompasses commercial uses together with other floors with residential purposes. Instead, it is a solution that accommodates three or more major urban activities that results in shorter trips, reduces automobiles dependability and promotes alternative mobility modes such as walking, cycling and public transportation.

3.4. Problems that must be addressed by sustainable design responses in residential high-rises

The literature is providing broad strokes on the problems associated with high-rise flats. They can be architectural, urban and social, but as a whole need profound research and listing as result of

the experience of residents and professionals so to provide a basis for the framework that will connect problem and solution.

A significant connection between sustainability and quality of life is the creation of people-friendly buildings. Social needs of the end users are crucial and must be perceived as a vital component of sustainable communities. Living and social spaces for the residents must be a part of the building's function as much as the aesthetics and comfort of living; these are usually not a part of the green labels or smart systems, however, environmental stressors such as vibration, poor air quality and insufficient lighting result in many cases in negative stress. (Abdellatif and Al-Shamma'a, 2015). Such a stress is connected to the reduced quality of life and must be dealt with by sustainable design responses targeting the needs of the end users.

To provide solutions, the research needs to be informed about the problems associated with residential high-rises. A significant issue of the many high-rise areas is their 'monotony' by appearance (similar looking); by function (housing); by dwelling type (apartments); by tenure (often rented); by price (cheap); by population (domination of social groups) and by use (short term).

Many attitudes are applicable to provide more variety for high-rise communities such as refurbishing blocks with aiming at identity, in Britain for example; by implementing different homes, in the Netherlands for example or by rethinking external space, as in Finland and Sweden. Spain and Slovenia in recent years exemplify the attention to the amenities on estates, for example, providing shops, leisure facilities, police stations and libraries. Although the location is a constant, improving public transport affects it or there are the advantages of an uncongested outer urban location (Turkington, Kempen and Wassenberg, 2004).

The high-rise layout provides large areas of open land where facilities can expand, such as libraries, sports grounds and community centres. However, without considerate land-use planning, these spaces are threatened to stay left over, to be mismanaged and ultimately to produce problems (Cheng, 2010).

Even though being highly advantageous, amenities in developments in these years, with few exceptions, do not reflect a realization of social spaces as a high priority. This is an urgent issue which neglected can result in the introduction of a new set of towers that will prove unsuccessful in the coming years. The question “What are the challenges in providing communal facilities in tall buildings like those of their low-rise counterparts and what could be the probable solutions?” is becoming more and more relevant (Modi, 2014, p.27-28).

High-rises can be the best possible solution to address population growth around the world. However, high-rises are not always appropriate: in some cases, eight-storey buildings combined with squares and streets can be better for the urban landscape. Such high-density living is quite different from some areas of Hong-Kong where enormous residential towers produce a sense of claustrophobia and light hardly finds its way through, mainly at lower levels (Shuttleworth and Taylor, 2011). Hong Kong is an example where compact development created as many problems as it solved. This example demonstrates the uncertainty that urban compaction is intrinsically associated with environmental benefits (Zhang, 2000).

Ahmad, Aibinu and Thaheem (2017) highlight some problems that sustainable design responses could solve. Energy efficiency can be increased by implementation of energy efficient systems/plants, by wider utilization of reusable power diminish the use of fossil fuels and by controlled entrances of high-rises that can reduce crime and fear of crime. However, findings demonstrate that more crime is related to high-rise. Also, high-rises can address missing identity

with their symbolic power in key locations. Nevertheless, flats can lead to disappearing sense of neighbourhood or community

Living in high-rise allows less control of people over the living conditions and safety. It results in a gap between people and nature and the isolation through psychological state and behaviour problems leading to health and productivity loss.

High-rises can mitigate market risks due to the mixed use of buildings. The verticality allows the ground level to be used for public purposes and amenities such as plazas, shopping and recreation or green spaces. However, this open land without owner can be a danger as well by going in control of undesirable elements.

Children living in high-rises display more behavioural problems than other children. There are also lower rates of helping others in high-rise buildings. High-rise residents report 6 types of fear. There is fear of fall or jump from a high window, being trapped inside during fire, the entire building falling from an earthquake, attack of the building, strangers sharing their dwelling or becoming sick from communicable diseases generated by others.

3.6. Conclusion

Two research questions have been developed after a careful review of the relevant literature. They introduce the discourse around sustainable design principles of residential high-rises and housing concepts, problematic areas about this typology, thus preparing the ground for solid and well-focused research.

Chapter 4 Research Methodology

4.1. Introduction

This chapter presents the adopted methodology and demonstrates how the research questions were answered. The foundation of the selection of approaches, strategies and techniques is explained along with the justification for the choice of the adopted methods. The chapter also highlights the most common techniques and procedures utilized to collect and analyse data. The term methodology is related to the theory through which the study was conducted, based on philosophical assumptions to define the strategies and methods by which the data will be collected.

The structure of the chapter covers the research procedure and application to conduct the central research activities. In the beginning, it outlines the significance of philosophy of the research course. Besides this, it presents how crucial is the understanding of reality and how the different assumptions on how the research must be conducted and the role of the researcher coexist. There is a difference between the positivists and interpretivists outlook for the world. Positivism claims that only “factual” knowledge gained through observation (the senses) and measurement, is applicable. The role of the researcher is defined within the processes of data collection and interpretation through the objective approach, and the results are in general visible and measurable objectively. Interpretivists claim that research to socially constructed reality is possible only through social phenomenon such as language, consciousness, shared meanings, and instruments (Myers, 2008). This study adopts this position. Then the choice of an approach is presented to achieve the thesis aim and objectives.

The Research Design presents the schematic procedure, and then a conclusion is drawn to guide the reader to the main features and outcomes anticipated by the research.

4.2. Background

The study must implement an appropriate methodology identifying research questions through viable research strategies by the research aim and objectives. Kothari, (2004) claims that research methodology is the scientific construct that systematically approaches the solution of the research problem. One interpretation states that it is the science of studying how research is conducted scientifically. It involves the different stages that are included by the researcher in tackling the research problem in a logical sequence. The research methods/techniques are crucial but also the researcher needs to develop a methodology. Researchers not only need to know how to apply relevant research techniques, but also the relevance or its absence of the methods or techniques and the reasons for it. Researchers also need to be aware of the assumptions supporting different techniques and the criteria that make particular techniques applicable and procedures relevant to specific problems along with others that are not. Through the development of the study, the researcher needs to be very specific about the research methodology which will lead to the fulfilment of the objectives. The literature reveals that research methodology highlights three vital concepts in the research paradigm as summarised by Saunders, Lewis and Thornhill (2012) encompassing research philosophy, research approach and research techniques based on the research onion.

Generally speaking, any research aims to find solutions that either solve existing problems or create a framework within systematic procedure featured by valid research methods and techniques. In particular, the presented research mainly seeks to develop a framework for professionals and authorities to design residential high-rises with enhanced quality of life. It highlights the reason why the features of the existing high-rise residential buildings need to be explored through the experience of the users which is essential to achieve a better quality of life. To meet this objective, an exploratory research methodology is required to arrive at new

knowledge based on existing research philosophies, however amid lack of extensive previous studies of the problem.

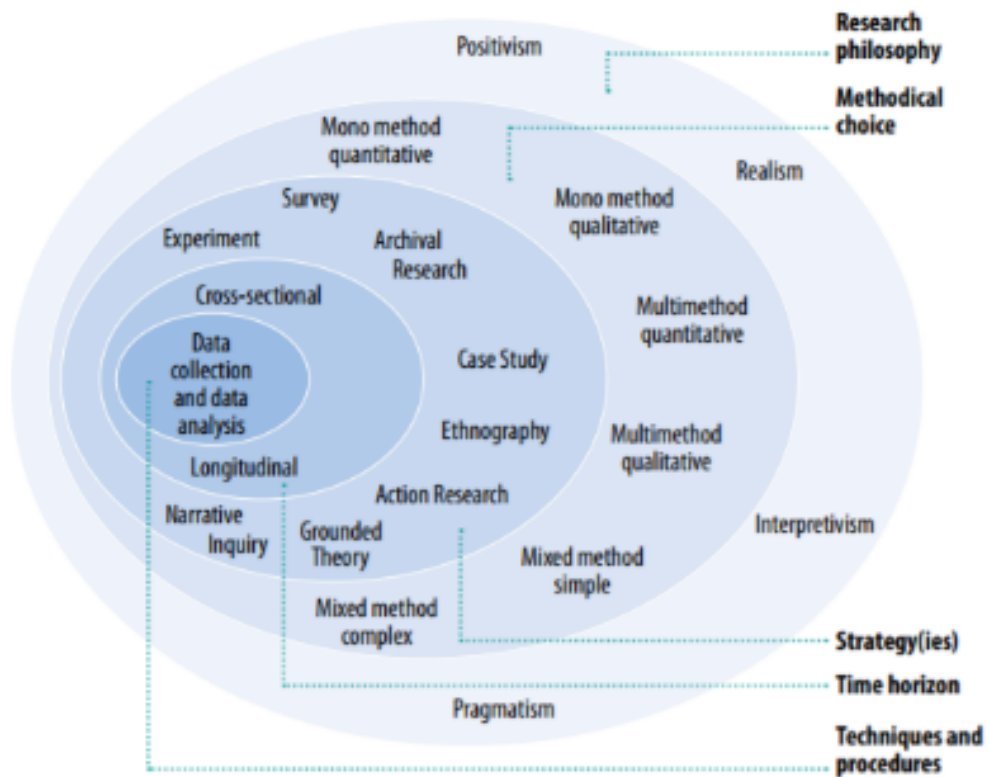


Fig. 4.1. The research onion

Source: Mark Saunders, Philip Lewis and Adrian Thornhill (2012)

The popular types of exploratory research methods are the observational method, case study method and survey method. Case study research is based on an in-depth study of an individual or group of individuals. Case studies often arrive at testable hypotheses and permit researching rare phenomena. In survey method research, participants reply questions distributed through interviews or questionnaires. They all have been implemented in this research. The next sections explain further the philosophical assumptions appropriate to define the overall approach and research strategy.

4.3. Research Philosophy

Research philosophy encompasses the crucial researcher's assumptions, and these assumptions underpin the research strategy. According to Bryman, (2012) research philosophy represents the set of beliefs related to the nature of the reality that is studied. It is the underpinning clarification of the characteristic of knowledge. The assumptions described by the research philosophy administer the justification for the way the research is conducted (Flick, 2011). There might be different research philosophies depending on the aims of research and on the best way to arrive at them (Goddard and Melville, 2004). The selection of a particular research philosophy is determined by the type of knowledge subject of the research (May 2011). Hence, developing the research philosophy can help clarify the assumptions underlying in the research and how this relates to the methodology in place. Easterby-Smith et al. (2002), points out three reasons why research philosophy is an originator of the research methodology. The first reason given by him is that by a comprehensive research philosophy it is possible to refine and clarify the research method adopted in the study and as a result to aid the researchers in data collection and to address the research questions. Another reason is that the clarification of the research philosophy will allow the researcher to comprehend different types of methodologies, avoiding unfruitful routes. Finally, by comprehending the outstanding significance of research philosophy and having a grasp of its advantages and benefits, the researchers can be more creative and exploratory in their work.

Saunders, Lewis and Thornhill (2012) describes the philosophical standpoint of various philosophical approaches adopted by the research philosophy.

Table 4.1. Philosophical Approaches				
	Positivism	Realism	Interpretivism	Pragmatism

<p>Ontology: the researcher's view of the nature of reality or being</p>	<p>External, objective and independent of social actors</p>	<p>Is objective. Exists independently of human thoughts and believes or knowledge of their existence (realist) but is interpreted through social conditioning (critical realist)</p>	<p>Socially constructed, subjective, may change, multiple</p>	<p>External, multiple, view chosen to best enable answering of research question</p>
<p>Epistemology: the researcher's view regarding what constitutes acceptable knowledge</p>	<p>Only observable phenomena can provide credible data, facts. Focus on causality and law-like generalisations, reducing phenomena to simplest elements</p>	<p>Observable phenomena provide credible data, facts. Insufficient data means inaccuracies in sensation (direct realism). Alternatively, phenomena create sensations which are open to misinterpretation</p>	<p>Subjective meanings and social phenomena. Focus on the details of the situation, a reality behind these details, subjective meaning motivating actions</p>	<p>Either or both observable phenomena and subjective meanings can provide acceptable knowledge dependent upon the research question. Focus on practical</p>

		(critical realism). Focus on explaining a context or contexts.		applied research, integrating different perspectives to help interpret the data.
Axiology: the researcher's view of the role of values in research	Research is undertaken in a value-free way, the researcher is independent of the data and maintains an objective stance	Research is a value-laden; the researcher is biased by world views, cultural experiences and upbringing. These will impact on the research	Research is value bound, the researcher is part of what is being researched, cannot be separated and so will be subjective	Values play a large role in interpreting results, the researcher adopting both objective and subjective points of view
Data collection techniques most often used	Highly structured, large samples, measurement, quantitative, but can use qualitative	Methods chosen must fit the subject matter, quantitative or qualitative	Small samples, in-depth investigations, qualitative	Mixed or multiple designs, quantitative and qualitative

Source	Saunders, Lewis and Thornhill (2012)			
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However, there is no requirement to adopt one paradigm even if it is more beneficial as long as the study performs different social or physical enquiries. The research has adopted the interpretivist's paradigm view to collect small samples of in-depth information to understand the residents' satisfaction with their high-rise buildings and attitude towards improved design thus answering the research questions and fulfilling the aim of the study. Hence, it was imperative to qualitatively investigate residents' comfort and quality of life issues with their built environment as well as their preference of housing designs. It also qualitatively investigates professionals' outlook of high-rise building design.

However, the research needs to perform an investigation that would implement numerical data describing the buildings thermal efficiency, so a realist's paradigm is adopted for a quantitative approach.

4.4. Research approaches

Saunders, Lewis and Thornhill (2012) claim that research approaches are connected to the research philosophies, and the deductive approach is mostly preferred by researchers with traditional natural scientific outlooks (positivism), whereas inductive approach is mainly related to phenomenology (interpretivism).

Dewey (1933) talks about a general research situation where the scientific approach consists of inductive discovery and deductive proof. Deduction starts with universal understanding and goes to specifics; inductive starts with discrete facts to a general overview of the matter.

The deductive approach is based on initial hypothesis testing, where the theory is confirmed or changed. The hypothesis is a supposition about some of the concepts in a process explaining the connection between them. Concepts are abstract ideas that constitute the theories and hypotheses. The inductive approach starts with data collection, after which the data is analysed in search for patterns that establish relationships between variables. Following this process, it is possible to create generalisations and even theories. The process enables the research to establish a common principle (Gray, 2014).

INDUCTION Observation → Pattern → Tentative hypothesis → Theory development and testing
DEDUCTION Theory → Hypothesis → Observation → Confirmation

Fig 4.2. The main approaches procedures

The clarification of the research questions in the thesis is a leading stage since the researcher can narrow down the scope and extent of the study. The deductive approach, in general, leads towards the development and application of hypotheses. Hypothesis defers from a research question; it represents a projected explanation or presumption declared by insufficient still credible evidence (Salkind, 2010). The theory mainly focuses on the study direction and in this way makes it possible it to proceed with further research in connection with a particular topic. However, the inductive and deductive reasoning have certain disadvantages which can affect the study's results. The inductive approach conclusion might lack plausibility, as it heavily relies on the observation for the purposes of data collection. The deductive approach may end in study rigidity due to its inherent formality based on its stress on rules (Salkind, 2010)

Table 4.2. Major differences between inductive and deductive approach	
Deduction emphasises	Induction emphasises
Scientific principles	Gaining understanding of the meanings humans attach to events
Moving from theory to data	A close understanding of the research context
The need to explain causal relationships between variables	The collection of qualitative data
The collection of quantitative data	A more flexible structure to permit changes of research emphasis as the research progresses
The application of controls to ensure validity of data	A realisation that the researcher is part of the research process
The operationalisation of concepts to ensure clarity of definition	Less concern with the need to generalise
A highly structured approach	
Researcher independence of what is being researched	
The necessity to select samples of sufficient size in order to generalize conclusions	

Source: Saunders, Lewis and Thornhill (2012)

The choice of research approach depends on some practical criteria. The main criteria are the emphasis on the research and availability of theories on the research topic (Table 4.1). A topic of which are conducted many studies allows defining a theoretical framework and a hypothesis, and it is more logical to use a deductive approach. If the topic is new with little literature about it, suggests inductive approach with generating data, analyse it and reflect upon the theoretical themes it reveals (Creswell, 2002 as cited by Saunders, Lewis and Thornhill (2012). Deductive

approach is less time-consuming in most of the cases, while inductive procedures may lead to protraction.

Since there is little research on sustainable design responses leading to better quality of life in residential high-rises, this study adopted inductive approach by gathering data from interviews that better inform on the life in a high-rise than quantitative methods.

4.5. Research Strategy

Saunders et al. (2009), p.600 as cited by Wedawatta, Ingirige and Amaratunga, (2011) describes the research strategy as “the general plan of how the researcher will go about answering the research questions”. With the similar definition, Bryman (2008) as cited by Wedawatta, Ingirige and Amaratunga, (2011) calls the research strategy “a general orientation to the conduct of research”. Remenyi et al. (2003) as cited by Wedawatta, Ingirige and Amaratunga, (2011), provides the overall direction of the research along with the research process. Saunders et al (2009) as cited by Wedawatta, Ingirige and Amaratunga, (2011) states that the successful research strategy is based on research questions and objectives, the availability of existing knowledge on the research subject area, the time limitations and resources available, and the philosophical stance of the researcher (Wedawatta, Ingirige and Amaratunga, 2011).

This study investigates what sustainable design responses will lead to enhanced quality of life in residential high-rise buildings. Hence, such research requires obtaining data from residents of residential high-rises that clarifies what is their current quality of life by factors that influence it. Data is also gathered from professionals who through their design philosophy can point out appropriate principles and solutions.

The case study is based in London and Manchester commencing at the beginning of 2016 as an exploratory study in order to clarify field survey problems and test the validity of the proposed methodology. The reasons for choosing these cities are that they have a relatively diverse population with a variety of high-rise buildings that was a premise that the researcher will gather a rich sample of data concerning age, ethnicity and other demographic characteristics, and also from people exposed to different designs.

However, the interviewed people were reluctant to share personal information and there is a limited number of observations of people with a different colour of skin and ethnic group face variations. In a smaller city, it was doubtful that there would be enough volunteers to participate in the interviews and also it would be difficult to find smaller towns with dispersed ethnic groups living in high-rises. The research started with preliminary observations to collect information about the living conditions the selected high-rises offered. The interviews with the residents were conducted with 17 respondents in old high rises in the period of February 2016-March 2017 and 12 respondents in new high-rises in the period March-August 2017. Twelve semi-structured interviews with professionals were conducted February-August 2016. The size of the samples is determined by the literature. If the interview respondents form a homogenous group, for a particular group, saturation often occurs between 12 and 15 (Guest, Bunce, and Johnson, 2006).

The reasons for choosing the two types of high-rises are as follows:

There are two types of buildings considered for the analysis. The old ones are from the 60's and the 70's and the new ones are built after 2000. It is estimated that based on the following criteria this selection will provide the author with enough material to feed in her design framework. The design features that were explored were attractiveness of the facades, the visual impact of the materials and exteriors, massing and contribution to the sense of place. The exposure to a different design regarding age according to different Building Regulations, presents unique problems to

address such as lack of amenity or poor flat layout. An effort has been made to choose buildings with amenities which foster social interactions. The old buildings lack any.

The research employs a triangulation technique: semi-structured interviews and observations could be used to support the quantitative data from the computer simulation as this method do not necessarily create a comprehensive picture of the thermal comfort and the energy efficiency.

Finally, desk studies focusing on design framework uses the findings from the case-study and the simulation to provide guidance for the design of sustainable high-rises with high-quality of life.

The strategy encompassed by the research includes the following steps:

- Archival research
- Case study
 - Context
 - Observations
 - Semi-structured interviews with residents
- Semi-structured interviews with professionals
- Computer simulation
- Elaboration of theoretical framework

The literature review allowed to understand the significance of previous studies, identify their strengths and weaknesses, as well as determine gaps and questions, requiring further research. It also assisted in the choice of particular methodology for the presented research. The literature review helped clarifying how the presented research filled the gaps in the existing literature, either by resolving contradictions or by developing new knowledge. It helped identify the context that was not extensively studied as a promising area of investigation: The UK and two major British

cities. *Case study* was chosen as an appropriate methodology since case studies are invaluable for revealing insights about complex phenomenon and assisting decision-making once the phenomenon is well understood. The case study included appraisal of the context (archival and observations) and close attention to the opinions of the residents of the studied areas. The purpose of the case study was to gather information that will enable in-depth analysis of a phenomenon, described in the literature: dissatisfaction with high-rise living and a margin for improvement, consequently illuminating a course of actions that will lead to improvement of the situation: enhanced quality of life in residential high-rises.

The observations provided contextual information needed to frame the case study and to clarify the data collected using the interviews. It provided broader data: activities, interactions, environment, pointing to issues requiring further exploration through interviews. They provided a starting point for the answering of the research questions. Since there were two sometimes colliding point of views: those of professionals and those of residents, the observations were needed to establish an objective basis for the analysis of the data, namely, what were the qualities of a certain design, how it was used and related to the quality of life of the residents. Later the interviews revealed the attitudes of the residents and the architects also created sometimes contrasting picture of the sustainable high-rise providing good-quality of life. As a part of the strategy, it was intended to obtain the residents' views on the phenomena under investigation. The interviews provided explanations and information on material that is not directly accessible: perceptions, attitudes and values, the analysis of which satisfied the nature of the research questions. *The interviews with the professionals* were needed to underpin the theories behind a certain design, theory that needed to be examined in the light of the views of the users for its value and actual necessity of the propositions in order to answer the research questions maximum accurately.

Finally, some issues such as thermal comfort and cost efficiency were found to be able to be explored through quantitative methods that could triangulate the finding from the interviews. This was needed to enhance the validity of the study, so *simulations* were included in the research

design. The results partially answered the research questions in terms of applicability of certain design solutions in order to solve problems and were there actually problems with thermal comfort.

4.6. Research design

The research design is a plan and the procedures for research directing the research through the general selection of methods of data collection and analysis. This includes the assumptions the researcher brings to the study; procedures of inquiry (called strategies); and the main activities included in the research. The choice of research design depends on the nature of the research problem or problems studied; the researchers' personal experiences, and the target audience (Creswell, 2008).

Yin (1994) states that "Simplifying the matters, the design is the logical sequence that connects the empirical data to a study's initial research questions, ultimately, to its conclusions. Colloquially, a research design is an action plan for getting from here to there, where here may be defined as the initial set of questions to be answered, and there is some set of conclusions (answers) about this questions."

The literature review investigated literature related to sustainable design response in residential high-rise buildings, enhancing quality of life. Besides determining what was already discovered about the topic, methodologies used in past studies were identified in order to inform what approaches most benefit the research. It also helped identifying what context will benefit from the research. *The observations* helped to better understand and encompass the context within which people interact and first-hand experience to allow to open to discovery and inductive, rather than guessing what the context is like. They set the direction for the interview protocols along

with the gaps identified in the literature review. *The interviews* gathered detailed information about the research questions identified in the literature review. However, in terms of objectivity, some issues such as thermal comfort and cost efficiencies were addressed through quantitative methods, so the *simulations* provided measurable, objective data in order to explain complex data from the interviews. Then the data analysis allowed to investigate the data, find patterns in it, and ask and answer questions, making sense of data gathered in research by proper application of methods. Finally, the analysis allowed the elaboration of the theoretical framework and conclusions.

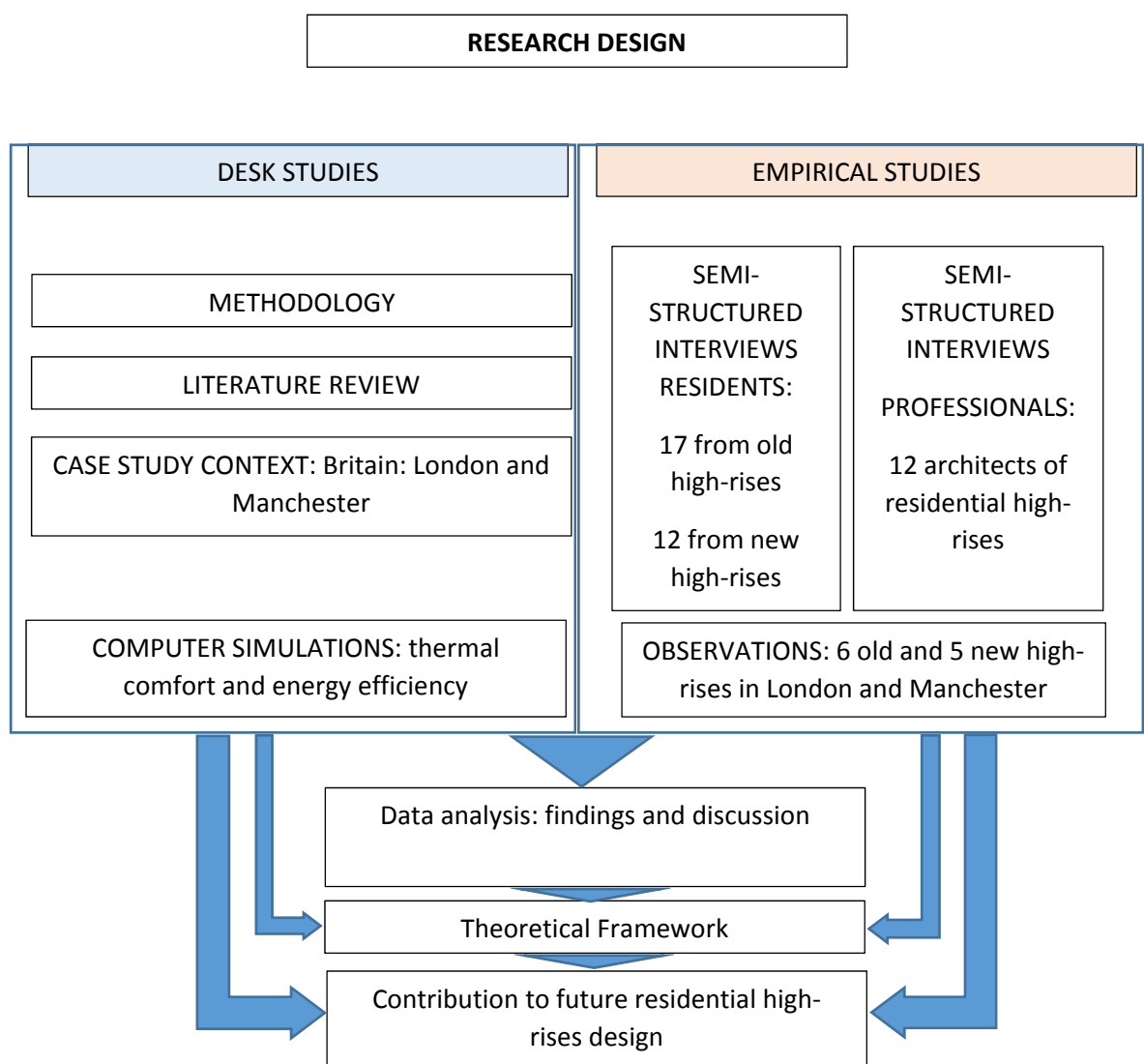


Fig. 4.3. The research design

17 residents, 3 elderly, 6 parents and 8 empty-nesters in old buildings were interviewees, and an effort was made to gather respondents from different floors in Eddystone Tower (5 respondents) and David Lee Point (5 respondents). 12 residents from new buildings were interviewed: 9 professionals, 1 parent and 2 elderly.

Patton (2001) as cited by Golafshani (2003) claim that validity and reliability are problems the researcher must focus on while designing a study, analysing results and evaluating the merits of the research. Yin (1994) states that four aspects of the quality of the design must be maximised: construct validity, internal validity for explanatory or causal case studies only, external validity and reliability.

Validity in research is representing the degree of accuracy and truthfulness of scientific results (Le Compte and Goetz 1982 as cited by Brink, 1993). A valid research should precisely reflect the reality, and a valid instrument or measure should be used according to the researcher's true intentions described in the methodology. Internal validity is the term used to relate to the degree the research results truly reflect or represent the reality and not the effect of unrelated variables. External validity of the findings refers to the degree the findings can be applied to broader groups (Brink, 1993).

Reliability refers to "the consistency, stability and repeatability of the informant's accounts as well as the investigators' ability to collect and record information accurately (Selltiz et al. 1976:182). It refers to the ability of a research method to yield consistently the same results over repeated testing periods" (Brink, 1993), p.35.

A technique to enhance the study validity is triangulation. Triangulation is defined to be "a validity procedure where researchers look for convergence among multiple and different sources of information to form themes or categories in a study" (Creswell & Miller, 2000, as cited by

Golafshani, 2003, p.604). Patton (2001) as cited by Golafshani, (2003), p.603 promotes triangulation as a technique by stating “triangulation strengthens a study by combining methods. This can mean using several kinds of methods or data, including using both quantitative and qualitative approaches”. Mathison (1988) as cited by Golafshani, (2003), p.603 states: “Triangulation has risen an important methodological issue in naturalistic and qualitative approaches to evaluation [in order to] control bias and establishing valid propositions.”

4.6.1. Data collection methods

Emerging from the literature review and theoretical basis of the research, the research questions led to the crystallisation of investigative objectives aiming at which requires specific methods and techniques to be implemented. The methods and techniques in this study are determined according to the nature of the expected outcomes. The study adopts mixed-methods data collection technique to gather data from residents, professionals, sites including context assessment and results from computer simulations. In the study, various data collecting methods were used to answer the research questions that will inform a theoretical framework on sustainable design responses enhancing the quality of life in residential high-rise buildings.

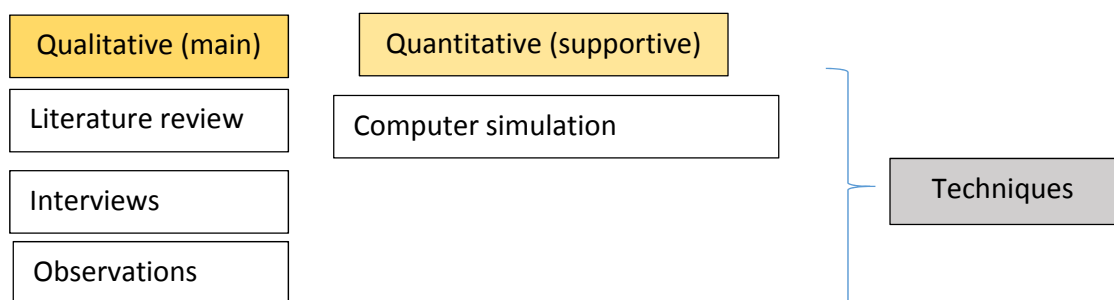


Fig. 4.4. Data Collection methods

4.7. Archival research

A literature review has been conducted to thoroughly understand the topic, to get acquainted with similar work within the area, to find gaps in the knowledge that require further investigation and to compare and critique existing findings. The review helped develop and partially answer the research questions through an extensive analysis of sources such as journal articles, books, dissertations and authority guidelines. The study intends to develop a framework for implementing sustainable design responses in residential high-rise buildings that enhance the quality of life, and it is, therefore, vital to understanding what specific approaches to sustainability affect the quality of life, especially the available design and technology solutions as well as energy efficiency measures. This path is based on a comprehensive investigation of the existing knowledge in this area to be able to bridge the gaps and suggest further actions.

4.8. Empirical study

Empirical research is conducted based on observation or experience alone, in many cases not involving system or theory. It is based on data, and the conclusions can be validated by observation or experiment. It is crucial to obtain the facts first and actively produce the needed data. Evidence gathered through empirical studies are considered nowadays the most reliable proof of given hypothesis (Kothary, 2004). Although an archival study had been very useful for directing the research in the right direction and for defining the scope of the thesis, it in itself was not enough to ensure the fulfilment of the research objectives. Therefore primary data has been obtained through observations and subjective data collection.

Both quantitative and qualitative research methods are employed with a focus not only on the characteristics of the researched buildings but also on the participants' attitudes and behaviour. The observations complement the information gathered with interviews. The combination of an

objective and subjective survey will reveal the weaknesses of the design of selected high-rise buildings and will clarify the users' preferences and needs to improve future high-rise housing.

4.8.1. The Case study

Yin (1989) as cited by Noor (2008), p.1602, states that case study is “an empirical enquiry that investigates a contemporary phenomenon within its real-life context using multiple sources of evidence.” Case study enables the researcher to explore and comprehend complex problems. “It can be considered a robust research method particularly when a holistic, in-depth investigation is required” (Zainal, 2007), p.1.

Using case study research in educational context challenges the researcher to upgrade the process from a mere description of ‘what happens’ to a provision of a real contribution to knowledge (Rowley, 2002).

Yin (1994) as cited by Tellis (1997) described minimum four applications for a case study model:

1. When explaining complex causal links in real-life interventions
2. When describing the real-life context in which the intervention has occurred
3. When describing the intervention itself
4. When exploring situations in which the intervention being evaluated has no clear set of outcomes.

Yin (1994) and other authors have identified some specific types of case studies: Exploratory, Explanatory, and Descriptive.

Table 4.3. Types of case studies			
	Descriptive	Exploratory	Explanatory
Number of cases	One	One	More than one

Aim	The primary interest is the case itself	Give insights into an issue or refine a theory	Test a theory or a framework
Scope	In-depth understanding of a particular case	Understand a particular case in order to help understand a wider issue.	Compare cases to identify causes and explain outcomes

Source: Adapted from Stake (1994) and Yin (2009). As cited by Nelson and Martin, (2013)

A descriptive case study delivers a thorough description of a single phenomenon studied in its context. The main focus is on the case itself, which is being exceptional or unusual which makes it worth studying. This is why it can also be called intrinsic case study (Stake, 1994 as cited by Nelson and Martin, 2013) because the scientific value lays in the characteristics of this particular case.

An exploratory case study aims at illuminating a problem or refining a theory. With this type of case study, the case is secondary. As a primary research objective, it is set to use the case to comprehend the dimensions of a particular problem. This is why it is sometimes called instrumental case study (Stake, 1994 as cited by Nelson and Martin, 2013) since the interest is not particularly in the case but in the tackling of an issue.

With explanatory or collective case study the researcher aims to find causes and explain results. Usually, several cases are studied, and comparisons are made between them. (It can also be called cross-case comparison). The main objective is by some case studies to test a theory or generalisation and conclude generally about the topic.

Britain was preferred as a context of the study as a country with a long and turbulent history of high-rise living where the favour and dislike of the typology are in constant dynamic relations. In

some countries, high-rise buildings are a norm like USA, China, Hong-Kong, Singapore, Dubai, etc., but their geographic location determined difficulties in obtaining data from observations and interviews. The scope of the thesis was limited to the climate in Europe, and also there are development trends in Britain such as continuingly accommodating growth by high-rises that enhance the contribution of the study.

After determining the UK as the country for the study context, case study criteria were developed. They included lower liveability due to outdated design, buildings, lacking amenities, green features or efficient envelope and HVAC systems, etc. After establishing these criteria, Skyscraperpage database was used to identify cities where buildings, satisfying the criteria were present. Also, the Internet was searched for cities where future actions both in regard to refurbishing old high-rises or building new residential towers were pending.

Manchester and London have been selected as a context of the case study representing the two major British cities with numerous old and new examples of high-rise buildings, many of which satisfy the case study criteria. Manchester Draft Residential Growth Prospectus, 2013, set as a target building more new homes to meet expected population growth. There is information in the press that many of this new homes will be high-rise flats. In Manchester, there is also wide-spread refurbishment of the tower blocks from the 60's and 70's. Spittles, (2014) reports that two hundred London skyscrapers are under construction or have been approved by the authorities, 150 of them residential towers of at least 20 storeys. The next decade is a decisive point when the capital's skyline will be changed, with high-rise clusters in Shoreditch, Nine Elms, Greenwich, Elephant & Castle and Croydon contributing to those in the City and Canary Wharf. The reason for this major construction is London's spiralling population and land scarcity.

However, these processes will be ineffective without taking into consideration how community functions, as well as the demands of the residents and this thesis intends to involve the residents' point of view into the design process. Chamala (1995) as cited by Claridge, (2013) points out efficiency benefits from participation, including different parties and empowering community

participants in programs, from local to national level, enhancing the efficiency of solutions of sustainable resource management problems. Participation improves project efficiency empowering by community ownership of development process and supports the taking of the right decisions (Kelly and Van Vlaenderen 1995; Kolavalli and Kerr 2002 as cited by Claridge, (2013).

In both of the cities, there is a great variety of high-rise buildings, old and new and the next point might highlight why they were chosen for the context of the case study:

The great difference between new and old high-rises regarding building materials and architectural qualities, which enables comparing.

Multicultural societies which suppose different respondents' demographic characteristics that will be a beneficial basis for diverse and interesting answers to the interview questions.

Ability to choose between different types of high-rises that can represent different trends of the typology design populated through the country.

After identifying London and Manchester as cities for the case study, letters were send to residents of different buildings, satisfying the case study criteria. An effort was made to involve participants of different age, family status, ethnic groups and culture, however, once the participant satisfied the criteria for being part of the three groups: empty nester, family with children, elderly, little regard was paid to his ethnic group or culture, due to difficulties to involve participants with children and the elderly. The buildings were representative of two omnipresent types of high-rises: 25-storey towers with concrete cladding and 12-13 storey towers with brick cladding. This two types were persistently reappearing in the database used and were selected as a convincing representation of the high-rise buildings in these two cities from the 60s'and the 70s'. As for the modern high-rises, and effort was made to interview residents from buildings with amenities and striking architectural quality so to compare their life-style satisfaction with the residents in the old high-rises.

The buildings were visited two times: August 2016 and July 2017. The researcher could evaluate different features such as building form, construction materials, spatial organisation around the buildings and activities enabled by the design. This research adopted single case study due to timescale employing triangulation strategy of using semi-structured interviews with professionals and residents and observations.

4.8.2. Case study criteria

The case study criteria are based on the literature review and the thesis objectives. Altogether the old buildings are expected not to be sustainable due to various factors listed below.

1. The buildings are characterised by lower liveability, due to outdated and inadequate design.

Liveability responds to human needs such as food, basic security, aesthetics, cultural expression, and a sense of belonging to a community or a place. High-rises as a typology are the most important buildings regarding developing a liveable city and healthy, sustainable community (Ali and Armstrong, 2008). This is why how high-rise provide liveability is a paramount aspect of any buildings research. Liveability is a crucial factor to evaluate an environment based on the local people's immediate needs and experiences of the environment from the subjective and micro point of view (BrookLyndhurst, 2004 as cited by Li, Sun and Jones, 2012). To provide a useful perspective on the living conditions affecting the life of the residents that high-rise provides, the author needs to look at the liveability as a meeting point of environment satisfaction and needs. The liveability of high-rise neighbourhoods is a paramount question in the field of urban design and planning. Famous tall buildings, attractive skylines, and green building systems are no longer enough for successful and sustainable developments. The lack of liveability criteria in urban design can lead to serious problems of health, safety and urban sustainability (Abdelbaset, 2015). There is a sentiment that the density decreases the liveability in the cities, associated with

isolation, crime and pollution. To prove low liveability in old high-rise will be a great standpoint to suggest areas of improvement. The significance of a quality and liveable environment and the need to balance urbanisation and nature is also identified (Chan, 2005).

2. There is a margin for implementing modern technology, such as geothermal energy and solar panels.

Geothermal and solar technology provides green energy from a long-term source in a situation of demand for electric energy is going to overgrow the supply, in times when the traditional sources of energy such as natural gas, coal and nuclear plants are negatively affecting the greenhouse gas emissions. The proliferation of high-rises presents an excellent opportunity to implement these environmentally friendly technologies. Given appropriate support, renewable energy technologies can provide for the growing demand at prices lower of the traditional energy sources (Johansson, et al., 1993). The margin is based on solar panels on the roof and the façade and geothermal wells under the building and in the yard if the budget permits it. With the development of economy and increasing of comfort demand, building energy consumption got higher year by year, which leads to the development of building energy-saving technology, such as an application of solar energy and other renewable energy in a building. The application of the solar thermoelectric cooling technologies and a combination of heat pump and free cold source used in zero energy consumption buildings were analysed and proved to be very relevant technology (Ma et al., 2016).

3. The building envelope is not energy efficient.

The proper design of the building envelope is a crucial part of the sustainable design of buildings (Ali and Armstrong, 2008). The buildings in the developed countries consume a significant part of the world energy. In many cases, the energy consumption can be considerably reduced by adopting energy efficiency strategies (Sadineni, Madala and Boehm, 2011). High-rises are tremendous consummator of energy; this is why their energy demand should be minimised by considerate design. The building envelope is the part of the building contacting with the outdoor

environment. A building's energy consumption mainly depends on certain envelope design characteristics. As a result, for achieving high levels of energy-saving in buildings, design measures with high impact should be firstly defined and then optimised (Raji, Tenpierik and Dobbelsteen, 2016). Passive design strategies, namely insulation, thermal mass, the colour of external walls, glazing systems, window size and shading devices can affect positively internal temperatures and therefor reduce building energy consumption by adjusting the building to respond to the local climatic conditions (Cheung, Fuller and Luther, 2005). In cold climates, building envelope thermal conduction is decisive for the thermal performance of the envelope and the energy use (Feng, Sha and Xu, 2016).

4. The quality of life is low due to lack of facilities and amenities

Quality of life is related to a residents' satisfaction with residences, road conditions, crime rate, jobs, or public spaces. Residents began to commonly demand healthy communities based on traditional residential culture. To provide quality of life is paramount, to be competitive in the ever-improving living standards and a better awareness of healthy housing conditions. (Cho, Choi and Jung, 2010 as cited by Cho and Lee 2011). Sustainable communities are identified as places desirable for living and working, now and in the future. They meet the various needs of existing and future occupiers, are responsible to natural and artificial context, and provide satisfactory quality of life (Cho and Lee, 2011). Researching how to design sustainable high-rise and how to enhance the quality of life, it is impossible to neglect the role of the provision of functions and amenities. Lack of such a provision can result in negative social processes. Social exclusion involves lack or deprivation of resources, rights, goods and services and the impossibility to participate in common relationships and activities, available for the most of people in society, with an impact both on the quality of life of the citizens and the equity and cohesion of the society as a whole (Levitas et al. 2007 as cited by Taket et al. 2009). The main purpose of residential space, comprising residential unit plan, site plan and proximity is valued nowadays in high-rises as well as conventional residents (Je et al., 2007). Successful public spaces can make better the

quality of living in urban, high-density environments (Huang, 2006). Evaluating the quality of life in connection with high-rise infrastructure is the basis for suggesting design responses that could provide the residents with better living.

5. The residents' satisfaction with the living condition is expected to be low.

Defining the issues that influence residential satisfaction will help with both planning and design of such developments, increasing quality and help ensure a lower resident turnover rate and promote acceptance and popularisation of high-density living (Buys and Miler, 2012). Qualitatively the type of housing not satisfying the family housing needs, comfort, social, cultural and religious needs is a problem of serious importance as it affects the quality of life and the psychosocial issues of the inhabitants (Mohit, Ibrahim and Rashid, 2010). The life satisfaction approach to environmental valuation researches how self-rated subjective well-being (life satisfaction, "happiness") changes once with income and then with environmental quality (Welsch, 2007). If satisfaction is low, there is presented a need to examine what aspects of the built environment are provoking such a response and subsequently address the problems with sustainable design solutions.

6. There is no utilisation of green building materials.

Building materials are considered green if they can be recycled, for example, aluminium roofing shingles. If the product is made of recycled materials, the benefits are increasing. Building materials are also ecological if they are made of sustainably harvested renewable resources such as flooring made of lumber or bamboo. Green materials are also durable (Kubba, 2010). The towers of the 70s are built before the recent considerations about green materials and the availability of wide range of green products.

Thoughtful choice of environmentally sustainable building materials is the simplest way for architects to begin incorporating sustainable design solutions in buildings. Natural materials have in general better parameters in terms of embodied energy and toxicity. They require less

processing and are gentler to nature. When low-embodied-energy natural materials are included in building products, the products become sustainable (John, Clements-Croome and Jeronimidis, 2005). Tall buildings have a considerable and constantly growing impact on nature in terms of carbon emissions and use of resources and energy. Using green materials can lead to less negative effects and more eco-friendly construction process. The shift should lead to sensible environmental, economic, financial, and social benefits. But in order for this to happen, steps are needed not only about the implementation of adequate technologies but also when thinking of the materials. Selecting unsuitable materials can be costly, but more importantly, it may affect negatively the eco-agenda (Castro-Lacouture, Sefair, Flórez and Medaglia, 2009)

7. Passive design to climatic conditions hasn't been implemented

Although there are many significant scientific improvements for energy efficiency difficulties, there are still huge problems, especially failure in analysing the efficiency of different passive solar strategy criteria, for tall buildings (Lotfabadi, 2015). The largest part of the building consumption is associated with the utilization of active systems to ensure the interior comfort. Passive design strategies help to make better the interior comfort conditions, increasing the energy efficiency in buildings and less energy use (Ubinas et al. 2014). If the passive design is not implemented, there is a correlation with the residents' satisfaction with the flats that may influence the design to recommend passive energy strategies that can help with the energy consumption.

8. Comfort levels are expected to be altogether low

An adequate indoor thermal condition in buildings is a vital aspect because it affects occupants comfort. Besides this, it is affecting building energy consumption, staff productivity, less absenteeism, health and well-being. Energy consumption can be considerably influenced by using energy efficiency strategies in high-rise buildings. Because of the environmental issues and high energy costs in recent years, energy efficiency in buildings has been of great importance (Mirrahimi et al. 2016). Old high-rises are not known to have efficient envelopes unless

refurbished, which is why it is expected the indoor climate to be below standards and the comfort of the occupants to be unsatisfactory. If these issues are addressed, it is expected that comfort levels will be increased, thus enhancing the quality of life of the occupants, which is the main aim of this research. Human beings have struggled to come with indoor environments in which they can be comfortable.

Human health is the paramount factor when assessing the overall comfort of the environment. If there are factors leading to built environment provoking sickness or negative impact on occupant health, then it should be investigated and could point to some design or technical problem in the building system (All Horr et al. 2016). Comfort can also be addressed early in the design process when taking decisions on the layouts of the building or the materials to be used. It is important to investigate this factors in buildings that are not known to be the most beneficial when it comes to materials or spacious floor plans.

9. There are no significant landscape features in and around the building

Landscapes are connected to the quality of life in multiple ways, some of which are threatened by global market forces and traditional management approaches (Martin et al., 2016). The focus is shifted to the long-term improvement of the quality of life and environmental quality, related to better government of the natural assets (Antrop, 2006). The old buildings are often surrounded by green features, but their quality and diversity are very unsatisfactory which defines the need for more in-depth research on the issue.

10. The design does not consider mixed use for working, leisure and shopping near home

The relation linking the built environment and human behaviour has long been in the focus of the field of urban planning, mainly to the subfields of urban design and transportation planning. The theoretical, empirical, and practical achievements in these fields have in general tried to achieve “enhancements to quality of life, improvements in system efficiency, or reductions in environmental impacts—in other words, the physical health of the community rather than the

personal health of its residents” (Handy et al., 2002, p. 64). Mixed-use is one of the factors that greatly influence the residents’ behaviour by providing new opportunities for better life. Mixed-use creates a number of potential advantages. It promotes vitality through activity and diversity. It creates safer areas. It also decreases the need to travel, making people less reliant on cars with the associated environmental advantages (Coupland, 2004). The old high-rises are in predominantly residential areas with no great network of functions, which makes mixed-use analysis an important part of the study

The new buildings were selected to be built after the year 2000 for their symbolic exterior with memorable shape, the certain levels of amenities incorporated in the design and the quality of their immediate surroundings to be able to compare with the old buildings regarding residents’ satisfaction.

4.8.3. Semi-structured interviews

The qualitative research represents a type of scientific research. Generally speaking, scientific research investigates an issue through

- looking for answers to a question
- systematically applying a predefined set of procedures to answer the question
- collecting evidence
- producing results that were not predetermined
- producing results that are valid beyond the immediate boundaries of the study (Mack, et al., 2005)

Qualitative research exhibits the same features. Also, it aims at comprehending the researched problem by studying the involved population’s perspective. Qualitative research is especially

applicable when specific information about the values, opinions, behaviours, and social contexts of particular populations is sought (Mack et al., 2005).

One of the most popular methods of data collection in qualitative research is the interviews. There are structured, unstructured and semi-structured interviews. The semi-structured interviews are used very often because of their flexibility, in addition to the capability of revealing major and often hidden aspects of human and organisational behaviour. This is what often makes them the most effective and useful way of gathering information (Kvale and Brinkmann, 2009 as cited by Qu and Dumey, 2011). Since they rely on a human conversation, a proficient interviewer is able to experiment with the style, pace and sequence of the questions to receive rich information from the respondents. Furthermore, the respondents are enabled to provide answers reflecting particularly their situation, their way of thinking and use of language. Interviews are indispensable when the researchers are to comprehend the interviewees' perception of the social world that is being investigated. (Qu and Dumey, 2011)

This research adopted semi-structured interviews to allow the respondents a margin for freely expressing themselves and their thoughts on the matters in question. Seven interviews were conducted in the homes of the respondents, providing an opportunity to investigate the interiors of the researched buildings and ten interviews were conducted via phone. The number of respondents is defined according to guidance from the literature.

The interviews with residents were approximately 15 min long and covered the following aspects:

- Places for social interactions
- Thermal comfort
- Aural comfort
- Attitude towards renewable energies
- Attitude towards amenities
- Mixed use

- Architectural qualities of the buildings

The interviews with the architects were approximately 40 min long and covered the following aspects:

- Social and environmental sustainability of residential high-rises
- Placemaking with residential high-rises
- Solutions for better quality of life in residential high-rises
- Attitudes towards renewable energy applied to residential high-rises
- Architect's design philosophy
- How to achieve high social value of a high-rise project
- Possible dangers of growing vertically
- Designing with the cultural context

Fig. 4.5. Demonstrates the interview process:

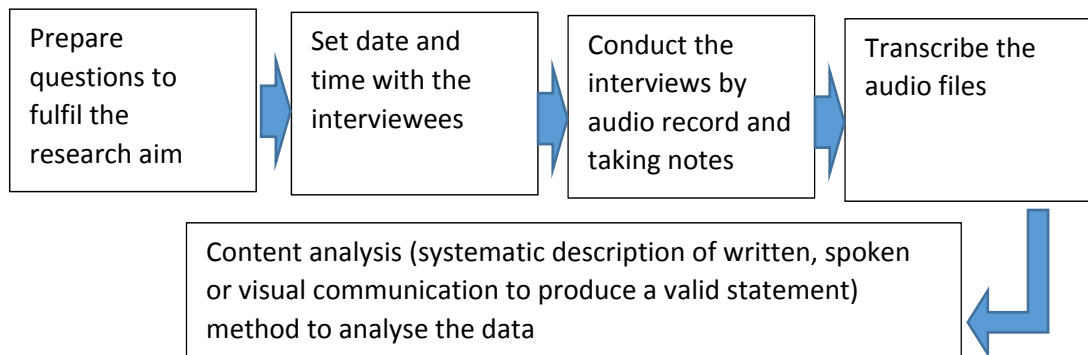


Fig. 4.5. Interview Process

4.8.4. Observations

The literature strongly supports the claim that the quality of life of the population is connected to the place where people live and not only the kind of people they are. There are researches on the effect on crime, or fear of crime (Newman, 1972; Perkins, Meeks, & Taylor, 1992; Brown, Perkins, & Brown, 2004 as cited by Dunstan, et al., 2005), and also on health (Kawachi & Berkman, 2003; Curtis & Rees Jones, 1998; Macintyre & Ellaway, 2000; Weich et al., 2001 as cited by Dunstan, et al., 2005). As a result, the role of the built environment is closely examined since it is possible to be changed by local authorities and central government. Nevertheless, the mechanisms by which place influences the people using it are not completely clarified, with some exceptions proposed (Taylor, 1999; Brown, Perkins, & Brown, 2003 as cited by Dunstan, et al., 2005)

Bechtel et al. (1987) as cited by Golicnik and Thompson, (2010) finds that the observational methods in the environment–behaviour research are valuable for getting insight into research questions and issues. Cooper, Marcus and Francis (1998) also value observation as a method: “with a very limited investment of time the investigator can achieve considerable insight into the actual use of designed places – a vast improvement over the conjecture and guesswork generated by studying a site plan from the remove of the studio or office” (Cooper, Marcus and Francis, 1998, as cited by Golicnik and Thompson, 2010).

Observation checklists and structured questions were implemented to help define and illustrate the state of the built environment around the researched residential high-rise. Several aspects have been assessed:

- the physical form and the visual impact
- correspondence to human scale
- seamless connection with the surroundings
- identity
- massing, proportions and materials matching the surroundings
- a properly scaled mix of uses and functions

- is the nature well integrated with the design
- informal and formal seating
- activities in quality place
- a sense of place
- important views
- skyline

4.9. Data analysis procedure

4.9.1. Qualitative data analysis

Miles and Huberman (1994), p.6, state “qualitative research is conducted through an intense and /or prolonged contact with a “field” or life situation. These situations are typically “banal” or normal ones, reflective of the everyday life of individuals, groups, societies, and organisations. The researcher’s role is to gain “holistic” (systematic, encompassing, integrated) overview of the context under study: its logic, its arrangements, its explicit and implicit rules.”

To make some sense from the data, an analysis must be applied. As Flick (2014), p.17, explains, “qualitative data analysis is the classification and interpretation of linguistic or visual material to make statements about implicit and explicit dimensions and structures of meaning-making in the material and what is represented in it. Meaning-making can refer to subjective or social meanings. Qualitative data analysis also is applied to discover and describe issues in the field or structures and processes in routines and practices. Often, qualitative data analysis combines approaches of a rough analysis of the material (overviews, condensation, summaries) with approaches of a detailed analysis (elaboration of categories, hermeneutic interpretations or identified structures). The final aim is often to arrive at generalizable statements by comparing various materials or various texts or several cases.”

Several steps formed a procedure applied to the analysis of the qualitative data from the interviews. The steps are as follows:

- Transferring the audio records or preliminary field notes into transcript written format
- Coding and grouping these codes into small groups
- Writing a summary meanings for each grouped data
- Generalise the data by connecting it to the existing theories found in the literature
- Identifying the key points in patterns to explore them further
- Developing a theory based on the key aspects and relationships in these patterns
- Drawing a conclusion from the analysis

4.9.2. Simulation analysis

Simulation appears as a suitable solution to a difficult problem of delivering valid appraisals of design decisions in realistic situations. Or, they can create future realities while designing (Clarke, 1985). It is a powerful aid for architects and engineers in their attempt to understand building performance and users' behaviour. The sustainability of a building is a direct result of the performance of its envelope energy consumption which affects the annual energy usage, so monitoring this parameter is an important part of this study. DesignBuilder offers a standard summary of the annual energy consumption for heating and cooling, along with zoning and calculations for conditioned and zones that are not conditioned. Additionally, DesignBuilder allows the application of various templates and libraries of different materials, occupancy, lighting, and appliances, cooling and heating systems along with convenient drawing possibilities. A wide range of climate data and weather files and other outdoor environmental boundaries are also available.

DesignBuilder because of the high validity and accuracy of the simulations can also be used to calculate the following BREEAM credits:

“Hea 01 - Visual comfort, daylighting credits using DesignBuilder Radiance daylighting simulation

Hea 04 - Thermal comfort using DesignBuilder EnergyPlus simulation.

Ene 01 - Reduction of CO2 emissions using DesignBuilder SBEM

Ene 04 - Low carbon design using DesignBuilder EnergyPlus simulation (and Detailed HVAC for most of the free cooling system options).” (DesignBuilder Support Desk)

4.10. Summary of this chapter

This chapter clarifies the methodological approach and techniques adopted to achieve the aim of this study. The way a phenomenon is approached to conduct research is defined as research philosophy, and the choice of a specific method or technique depends on it and the understanding of the phenomena. Triangulation as a robust technique that ensures a deeper understanding of the phenomena was implemented: triangulation of data collection and triangulation of sources. The justification for choosing London and Manchester as case studies and the particular buildings was presented in detail. The strategies and techniques of the research were also explained. The types of data collected through subjective and objective surveys were also described and explained. Thus, this chapter presents the entire selection of research methodology.

Chapter 5 The case study of Manchester and London: context and observations

5.1. Introduction

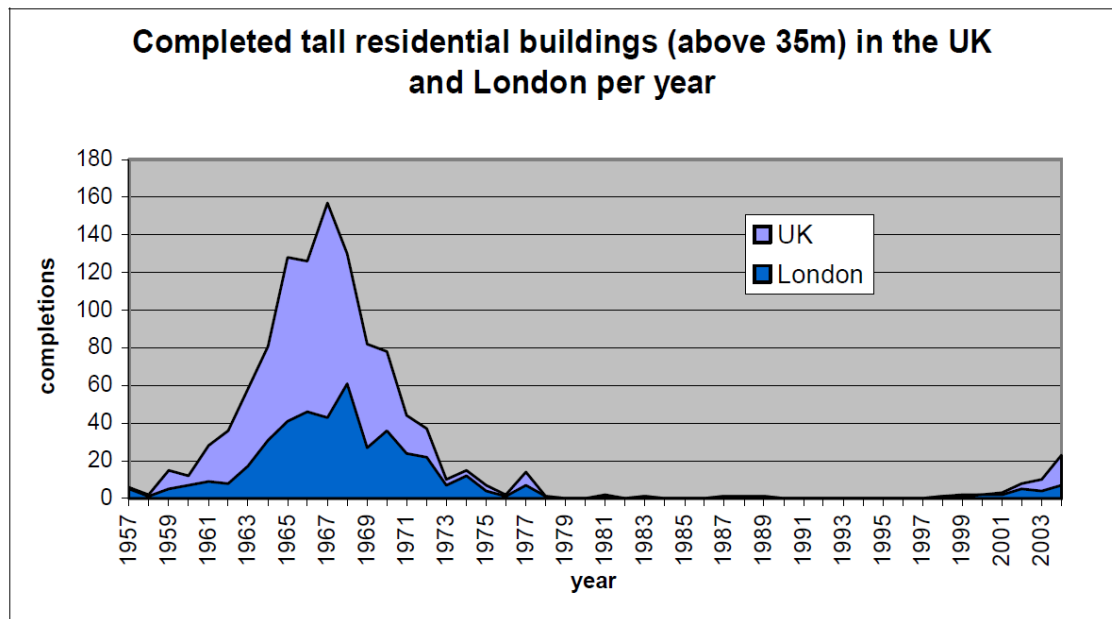
5.1.1. Context

After the end of the Second World War, France, Germany, Denmark, Ireland and Britain experienced an unprecedented shortage of homes. The most important thing was quantity but novel concepts about ‘streets in the sky’, ‘worker housing’ and ‘machine living’ evolved spreading ideas born of the pre-war Bauhaus movement in Germany and Le Corbusier’s unrealized dream of ‘nuclear cities in parks’ (Wolfe, 1981 as cited by Power, 1999). The notion of destroying the slums and introducing a uniform, wide spread, compact answer to a post-war baby-boom, homelessness, squatting and refugee camps as well as to the surviving pre-war slums gain momentum. Modern housing with new fittings and unseen amenities were perceived as a great improvement and an answer to the recent destruction of war (Power, 1999).

Modernist design and planning faced its critiques in the late-1960s, starting with the problems of social breakdown, crime and vandalism on estates. Later, research focused on negative health and social effects of high-rise, not all the examples in different circumstances were negative. There are five categories of potentially harmful effects of high-rise living: crime and informal social control; mental health effects; social effects; impacts on families and children; and physical health effects. (Kearns, et al., 2011). The British context is reviewed in detail in Chapter 3, while this chapter focuses on the situation for the case study cities: London and Manchester.

The domination of London in the debate might be unchallenged but a number of other cities in Britain are on the same track. Manchester, Liverpool, Leeds, Birmingham and Newcastle embraced a more development-friendly attitude to planning and review the tall buildings as a

“symbols of civic pride and economic progress.” (Knight Frank, 2004, p.3 as cited by Kunze, 2005).



Source: Kunze, 2005

Fig. 5.1. Number of high-rise buildings completed in London per year

However, a number of issues related to the existing stock of high-rise buildings emerge in various articles. The report *Streets in the sky – Towards improving the quality of life in Tower Blocks in the UK* (Church and Gale, 2000 as cited by Kunze, 2005) claims that besides the insufficient quality of the towers stock, inadequate financial support for housing maintenance in social housing has aggravated the problems.

British social sector high-rise housing faces a controversial future. Its history has been very turbulent from a development symbolising progress in the 1950s and 1960s in association with housing failure ten years later. A recent improvement of their image symbolising urban regeneration and modern urban housing did not remove the stigma on this typology. Public sector high-rise encompasses some of the most notorious examples of housing in the British housing

sector, however in the private sector, for example, the modern towers in densely populated London, high-rises represent the most affluent urban lifestyles. This contrast constantly characterises the story of high-rise housing in Britain (Turkington, van Kempen and Wassenberg, 2004).

Table 5.1. Issues related to the existing high-rises

physical problems	social problems
inadequate heating systems	tenant isolation / depression
asbestos	racial harassment
unreliable lifts	fear of crime as well as crime itself
cockroaches	noise, litter, refuse
lack of safety for children	
poor fire safety	
inadequate play facilities	
lack of security	

Source: Church and Gale, 2000 as cited by Kunze, 2005

The dominating dislike of the typology is unexpected in the light of the long high-rise living tradition in urban Britain (Sutcliffe, 1974; Towers, 2000 as cited by Turkington, van Kempen and Wassenberg, 2004).

Poor design, in particular hardly defensible semi-public space presented problems in the towers suffering from crime, vandalism and antisocial behaviour. The lack of appropriate facilities for children and young people caused constant complaint, along with the absence of amenities: shops, crèches and gathering spaces. Seen in many places in Europe, the lack of such facilities has negatively affected the social climate in many neighbourhoods, a problem additionally aggravated

by poor and/or expensive public transport. Management and maintenance were poor which was the reason for many of the mentioned problems. The lack of focused management can lead to a neglect of the problems and the relation of many people to a single structure can have long-term consequences if those problems are not addressed.

The technical refurbishment is supposed to prolong the life-span of a tower and enhance residents' quality of life. It is very expensive and could be applied to one or all of flats, blocks and the estate environment. A number of interventions such as new overcladding and roof renewal, window change and new heating systems are available. The renovation that takes into account the most painful issues can have long-term consequences. Proper repainting and colourful cladding provided the towers with a stronger identity and better internal design allowed for more lifts, a concierge service or social facilities. Rethinking of the surroundings can reduce 'confused space'; implement play areas and remodel the plain green features with useful private or communal gardens (Turkington, van Kempen and Wassenberg, 2004).

2.4. Observation survey

Several issues were considered when conducting the observations as shown in Table 5.2.

Table 5.2. Observation Checklist
Visual impact
Is the design visually captivating and interesting?
Are there visual conformity and continuity?
Are there good proportions to the street?
Is there smart implementation of human scale?
Is there seamless connection to the surroundings?

Is the building with a strong identity?
Are the massing, proportions and materials matching the surroundings?
Is the building enhancing the skyline?
Is there a composition created around a point of civic interest?
Are there visual order and harmony?
Functions and Uses
Is there a plaza, or diversity of functions, a network of functions?
Is the nature well integrated with the design?
Is there formal and informal seating, street furniture?
Are there shops and restaurants?
Are there recreational and cultural facilities?
Is the design considering protection from the elements in peak times?
Quality activities
Is the place designed for a diversity of people?
Is there active participation in the urban life?
Are there places to meet, chat, sit, read, eat, etc?
Sense of place
Is the place constituting a meaningful location?
Is there public art?
Are there important views created?
Is the building well integrated into the pedestrian system?

Table 5.3. Buildings overview				
Building	Age	Size	Location	Main features
Daubeney Tower	Completed 1966	26 floors	Deptford, London	Simple design, concrete cladding, light colours, worn out and out of fashion

Eddystone Tower	Completed 1962	26 floors	Deptford, London	Simple design, concrete cladding, light colours, scruffy and unattractive
Nightingale Heights	Completed 1968	25 floors	Woolwich, London	Simple design, concrete cladding, light colours, unusual roof-top
Sandyhill Court	Completed 1960, Renovated 2007	12 Floors	Manchester	Simple design, brick cladding, reinforced concrete and steel frame, no sense of place
Brookway Court	Completed 1969	17 floors	Manchester	Simple design, brick cladding, green accents, unattractive and out of fashion
David Lee Point	Completed 1965	21 floors	Newham, London	Simple design, concrete cladding, light colours, unattractive and out of fashion
St. George Wharf Tower	Completed 2014	49 floors	London	Cylindrical glass and steel structure, impressive silhouette, dominates the skyline, amenities
Ontario Tower	Completed 2007	31 floors	London	Impressive cylindrical glass and steel structure in a group of similar style high-rises, amenities
Pioneer Point	Completed 2011	31 floors	London	Steel and glass structure, dominates the skyline
Imperial Point	Completed 2001	16 floors	Salford	Stylish steel, glass and ceramic cladding structure, in harmony with the context
Landmark East and West Tower	Completed 2010	44 floors	London	Elegant steel and glass structure, minimalistic design, in harmony with the context, strong sense of place

5.2.1. Old Buildings

5.2.1.1. Daubeny Tower

Analysing the physical form and the visual impact of Daubeny Tower, London, it makes an impression that the façade looks worn out and out of fashion. The design is uninteresting and

boring. There is no visual conformity and continuity with the brick low-rises around, neither smooth transition in height. The street looks too narrow for a large building like this. However, chaos and disorder have been avoided by neat, clean lines. The base corresponds to human scale but there is no seamless connection with the surroundings. The building is lacking strong identity, it looks like the towers near-by. It provides legibility, makes the place recognizable. The massing, proportions and materials do not match the surrounding brick buildings: it is a white concrete box. However, it enhances the skyline and the neighbourhood image. There is a composition around the important spot that is the tower. There is visual order, and harmony based on contrast. As the properly scaled mix of uses and functions, there is no plaza, just a pocket garden and a park in front of the building. It does not seem there is a diversity of functions. There is an abundance of planting, enlivening the visitors' perception of change. Nature is well integrated with the design. There is some, not much, informal and formal seating. There are no shops and restaurants on the ground floor. However, there is space to play outside, good but not great and recreational facilities, but no network of functions. The design offers comfort in peak hours in regards to sun, shade, windiness. There is visual intrusion caused by parked cars and no non-car street promotion. There is no street furniture, you can seat on a wall, watching the tower or the park, and no change in levels to obstruct pedestrian movement. The streets around are not meant to be used as plazas.

As for the quality activities in quality place, there are no spaces for cultural activities. It does not seem used by a diversity of people. There is space in the park for picnicking, sleeping, reading, sunbathing, sprawling, but no obvious residents' participation in the urban life. It is accessible but pedestrian freedom is not given a priority over the car traffic. Retail, civic functions are missing, there are places to meet, chat, lingering, watch, stand, sit, read, but there is no traffic calming, it is not vibrant, it is very quiet which might be a plus since it is a residential area.



Fig. 5.2. Daubeny Tower, July 2017: building in its context

Space is welcoming but looks redundant. One of the reasons is there is no retail, façade with café and restaurant. The impact on public life and community perception looks insignificant.



Fig. 5.3. Daubeny Tower: surroundings

As for the strong sense of place, the size and the architecture define it as important, but not necessarily meaningful location due to the lack of a network of functions. The connection with the natural environment is seamless. There is no public art or variety, except for the natural features. The high-rise contributes to the sense of place by strong landmark and aggressive

exterior. There are no important views, but the building ties well into the pedestrian system. There are walls and bollards to guide the pedestrian movement, no planters, sculptures, nooks and corners to promote variety. The area, however, has a strong image and complexity of materials and height. There is a park for encounter and gathering, but no urban amenities such as plaza concentrating urban activities to make it vibrant. It meets needs such as going out, enjoying the nature, but not shopping and eating and drinking. It is attention-getting but hardly a meaningful experience. The skyline is scattered and not memorable: three high-rises among brick low-rises. The atmosphere is quite dull.

5.2.1.2. Eddystone Tower



Fig. 5.4. Eddystone Tower, July 2017: visual impact

As for the physical form and visual impact of Eddystone Tower, the architectural style, design and façade are in harmony with the other high-rises around, but not with the surrounding low-rise buildings.

There is no visual conformity and continuity. The proportions related to the narrow street are out of scale. However, the arrangement is well structured without chaos and disorder. The treatment of the base corresponds to human scale and helps for a better connection with the surroundings due to the change of material: concrete for the tower, brick for the base. The building is recognisable, due to its size, but has no strong identity, it looks exactly like the high-rise nearby.



Fig. 5.5. Eddystone Tower: surroundings

It does not help: being a concrete box, for continuity of the street frontage and for the enclosure, but the private and public spaces are clearly defined. It promotes legibility, being a landmark for the area. The massing, proportions and silhouette are in sharp contrast with the immediate surroundings, however, it is not the only tall building in the area. As a group, they improve legibility of the area, by emphasising a point of civic and visual significance and enhancing the

skyline and image. The composition is space defining around a pocket garden but is lacking harmony.

As for a properly scaled mix of land uses and functions, there is no plaza, only green spaces with alleys. They are plenty, but with no diversity of functions. Nature is separated, not integrated with the design, the building has a parking lot in front of it. The planting is not rich, grass and some trees, no change of colour or texture. There is some formal and informal seating that looks redundant, facing the buildings around without a significant view. There is some area allocated for playing outside, but it is not enough for a good experience or different needs. There are no recreational facilities. There are some shops, but no restaurants or food outlets. The area is comfortable in peak hours in regard to sun, shade and windiness. There is visual intrusion caused by parked cars and no non-car street promotion. No change in levels to obstruct walking. Space is welcoming but redundant. The impact on community perception and public life seems insignificant.

As for quality activities in quality spaces, there is a community centre in front, promoting cultural activities, but does not seem like a diversity of people are using it. There is space for picnicking, sleeping, reading, sunbathing, sprawling, but there were only a few people, walking on their way. It is accessible, retail and civic functions are minimal, there are no cafes. Places to meet, linger, walk, watch, stand, sit or read are provided but not used. It is not vibrant, it is very quiet, even the streets.

As for the sense of place, the tower does not create the feeling that space is a meaningful location. The sense of place comes from the seamless connection to some natural features. There is no public art or variety, there are no beautiful views, more of a clutter of buildings and cars. The high-rise contributes to the sense of place, providing a landmark that can be seen from a big distance. There is a good guidance for the pedestrians, by clear paths. Variety of forms, colours is present but it mainly creates disharmony. There are no nooks and corners, but the exterior of the tower is quite aggressive. There is no plaza, but the garden in front can be used for gathering

and encounter. The infrastructure is adequately relating to the place. The quality of the place is mediocre and not many people use it. It is attention-getting, with character, but the skyline is scattered and not memorable. However, there is a real distinction between spaces, promoting legibility.

5.2.1.3. Nightingale Heights



Fig. 5.6. Nightingale Heights, July 2017: surroundings

As for physical form and visual impact, it has nice architectural detail, materials used are in harmony. There is no visual conformity and continuity, with the surrounding low-rise buildings, nor smooth transition in height. Proportions to the street are unpleasant: the building is too high for the narrow street.

However, in regard to arrangement, there is no chaos or disorder. The massing of the base corresponds to human scale, but there is no seamless visual connection to the surroundings. The building has a strong identity, the only high-rise in the vicinity, with memorable roof top. It enhances legibility providing recognisable route and landmark to help people find their way around the building form. It emphasises a point of civic significance, once again improving legibility. The buildings around it form a memorable composition around important spot which is the tower. There are visual order and harmony.

As for the properly scaled mix of land uses and functions, there is no plaza, just a small green space and parking lot. There is no diversity of functions. Nature is integrated to some extent with the design, but the planting is not rich, no change of colour or textures. Formal and informal seating orientations are missing. There are no shops or restaurants associated with the tower, no place to play outside, no recreational facilities, altogether no network of functions. There are no fruitful urban design interventions at all, but there is visual intrusion caused by the parked cars and no non-car street promotion. The street does not link businesses and communities. There is no street furniture, or seating facing interesting views. The street is not intended to act as a plaza, it looks redundant, no retail to enliven it, altogether the impact on public life and community perception seems low.

As for the quality activities in quality places, there haven't been spotted any cultural or recreational activities around the tower. There was some diversity of people, but they were just passing by. There were no spaces for picnicking, sleeping, reading, sunbathing or sprawling. The building is quite accessible, but pedestrian freedom is not encouraged by a variety of routes and there were many changes in levels, obstructing the paths. Very little retail activities were present

and they were far from the building. There were no cafes or leisure activities present. There were no places for lingering, meeting and chatting, gather, watch or sit down. There were no traffic taming measures. It is not a vibrant or attractive place. However, the street was very quiet, meeting decent health standards.

About strong sense of place, the place did not strike as a very meaningful location. There is very weak reconnection with nature, no public art or variety. Important views or landmarks were not protected. The tower contributes to the sense of place with impressive size, but nothing else. However, as much as there is some pedestrian system, the place ties well with it. There is no guidance for the pedestrians in the form of walls, bollards or planters. There is no wide variety of colours, surface structure, no seating, no nooks and corners, just a very small green space by the tower, only used to cross the space between the buildings. The area can be described to have strong image, however there is a certain complexity with the low-rise buildings. There was no plaza where the high-rise could play a power symbol, no spaces for encounter and gathering, but decent, developed infrastructure in good connection to the building. The space do not address different needs. It certainly do not feel safe and secure, more vacant than it should be for a residential area. There are no cafes, shops, community centres or bars associated with the building. The quality of the place influenced the people use: it looked redundant. There were no orientation creating or identity. Altogether it cannot be described as providing meaningful experience other than memorable skyline that was not great.

5.2.1.4. Sandyhill Court, Manchester

As for physical form and visual impact, the architectural design is quite unimpressive. Some brick cladding and concrete panels create quite boring appearance with a style that is common for buildings from the 70s' and the façade looks rather plain beside the effort to add variety by the contrast of the materials. The problem comes from the form, the building is a rectangular box with nothing intriguing to offer to the observer.



Fig. 5.7. Sandyhill Court, July 2017

There is visual conformity but no continuity due to the fact that there are several other high-rises in the vicinity, with matching form and materials. There is no smooth transition in height important for the good streetscape. The relations to the street are out of proportions: the building is too tall for the small street. However, by careful arrangement of the high-rise and the adjacent buildings, chaos and disorder are avoided. The base is supposed to correspond to the human scale, but looks very compressed and is not articulated to solve the problem with the human scale. The connection with the surroundings is mitigated to be seamless by introducing green spaces, but enclosure was impossible to be achieved by these forms. Legibility is good, promoted by development that provides recognisable routes, landmark buildings to help people find their way around the building form.

There is no interesting massing, the silhouette is simple, the proportion clearly vertical with a good relationship to the other high-rises that have similar characteristics. As a group, they improve the legibility of the area, by emphasizing a point of civic and visual significance which appropriate and enhance the skyline, which however is quite scattered and the image which is of

old, dull architecture. There is no composition around a single, important spot. The area, however, is characterised by visual order and harmony, due to the clear, straight lines of the buildings. There is certain richness from the diversity of materials and contrasting sizes.

As for the properly scaled mix of uses and functions, there is no plaza, only a parking lot. The diversity of functions has not been observed. Nature is helping the design to some extent, but there is no rich planting used to enliven the visitors' perception of change, colour, light and textures. There are no formal and informal seating orientations, no shops or restaurants, cafes, associated with the building, no space to play outside, no recreational activities or a network of functions. The design does not offer anything to use in peak hours in terms of shade, sunlight and windiness. There is visual intrusion caused by parked cars in front of the building. There is no non-car street promotion or street furniture. There haven't been spotted any seating walls viewing interesting sights. However, changes of levels to obstruct pedestrian access were missing. The street cannot be used as a plaza. The space looks quite redundant. The impact on public life and community perception is insignificant.

As for quality activities in quality places, there haven't been observed a variety of people busy with diverse activities around the tower mainly because there are no facilities for this. It does not offer anything to facilitate picnicking, reading, sleeping, sunbathing, sprawling. There is no obvious resident participation in the public life. The building is accessible, but pedestrian freedom is not encouraged due to fences and vegetation. Retail and civic functions are missing. There is no café around or in the building. There is no space to meet and chat, linger, watch, sit, stand, no traffic calming. It is not attracting people to create a vibrant environment. However, the street is meeting minimum health standards, it is very quiet.

As for a strong sense of place, the observant is not getting the idea that this is very meaningful location, nature is existing, but not creatively used in the design process. There is no public art, the building is accessible, but is missing a variety of functions. There are no important views and landmarks protected. The building does not contribute to the sense of place, mainly because the

placemaking component in the design process has been entirely omitted. As much as there is a pedestrian system, quite simple actually, the building ties well in it. There is no guidance of the pedestrians in the form of walls, bollards or planters. There is no variety of forms, colours, surface structures, seating, nooks and corners, trees and bushes. The image of the area is quite dull, the exteriors unimpressive, lacking symbolism.

A great omission is the lack of plaza where high-rises can play power symbol. There are no spaces for encounter and gathering, even though the infrastructure is adequate, but space does not meet different needs. However, there is a feeling of security in the place. Coffee shops, community centres, central stores and bars could enhance this feeling. The quality of the place affects the use: it is quite redundant and is not attention-getting. Altogether, it does not provide meaningful experience in the user and has no character, memorable skyline or vivid atmosphere.

5.2.1.5. Brookway Court

As for physical form and visual impact, the architecture of Brookway Court does not impress, the style is similar to many towers built in the 70s'. There is no visual continuity in regard to the street, but there is some conformity due to the use of brick cladding as the surrounding low-rises.

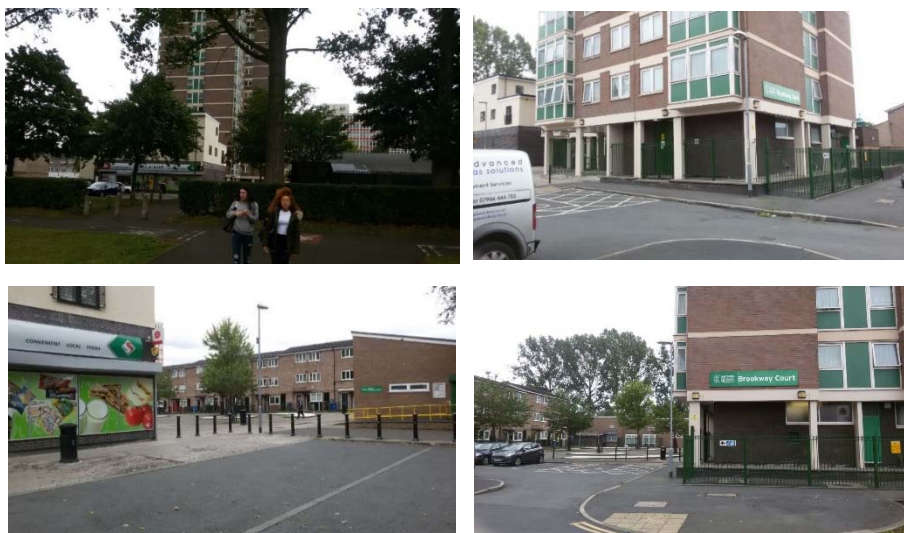


Fig. 5.8. Brookway Court, 2017

Smooth transition in height to achieve good streetscape has not been implemented. The proportions in relation to the street look out of scale: large volume, small street. However, the structure of the arrangement avoids chaos and disorder. The base is supposed to correspond to human scale but looks very compressed and uninteresting, it hasn't been articulated. It is hard to achieve seamless visual connection with the low-rises but the same materials used quite help. The building lacks identity, it is a boring concrete block, similar to so many others. The form does not promote continuity of the street frontage, neither enclosure. However, the legibility is good through the development of memorable routes and landmarks that help people to orientate around the urban form.

Proportions are predominantly vertical, the silhouette is simple, the massing is bulky, in comparison with the other structures it looks built in a different architectural era. Individually, it improves the legibility of the area, providing a point of civic and visual significance where appropriate and enhances the skyline and the image of the area. It plays the role of an important spot for the buildings composition. There are visual order and harmony, achieved by contrast in height.

As for the properly designed mix of land uses and functions, there is very low-quality public realm. Plazas and other public spaces are not implemented. Nature is present, but lacking richness and variety. There is no rich planting to enliven the visitors' perception of change of colour, light or textures, nor formal and informal seating orientations. Functions such as shops and restaurants or cafes associated with the tower are minimal. There is no space for playing outside, nor recreational facilities, the network of functions is quite poor. The design does not offer comfort in peak hours in terms of light, shade and windiness. There is visual intrusion due to parked cars and no non-car street promotion. There are no interesting sights towards which seating can be orientated. However, the pedestrian movement is not obstructed by a change of levels. The street is not intended to act as a plaza with closing for traffic. Space is not welcoming and looks

redundant. Steps and planters are missing. Altogether the impact on public life and community perception is insignificant.

As for quality activities in quality spaces, recreational activities around the building were not observed, nor a diversity of people. There is a little bit more choice across the road. There are no places for picnicking, sleeping, reading, sunbathing or sprawling. There is no obvious residential participation in the urban life. Pedestrian freedom is not encouraged by a variety of routes. Retail, civic functions are not implemented in the tower. There are no places to meet, chat, watch, linger, stand or sit. Traffic calming has not been implemented. It is not attracting people, neither is vibrant. However, the street meets basic health standards being very calm.

In terms of strong sense of place, the place does not represent a meaningful location and placemaking has not been a part of the design process. It is important to rebuild a sense of place in urban environments through reconnecting to nature, which is missing as a design intervention. There is no public art, a variety of forms and uses, protected important views and landmarks. The building is accessible and ties well into the simple pedestrian system. There is no guidance for the pedestrians by the means of bollards, walls and planters. A wide variety of forms, colours, surface structures, seating orientations, nooks and corners are not present. The exterior is not symbolic, a plaza where the high-rise could be a symbol of power is missing. There are not places for encounter and gathering, but there is decent infrastructure as streets and sidewalks that connect the community. It does not address different needs but looks safe. Coffee shops, community centres, central stores, bars and restaurants could enliven the place, making it more secure, nor redundant as it looks now. The quality of the space affects the use: people do not stay there. It also lacks identity due to banal form and materials. It is not attention getting and do not provide a meaningful experience, it has no character, does not form a memorable skyline and the atmosphere is quite dull.

5.2.1.6. David Lee Point



Fig. 5.9. David Lee Point, July 2017

The architectural style of David Lee Point is typical concrete Modernist Architecture, with clean, strict facades but very uninteresting appearance. There is no richness of styles and details on the façade. The building is dominating its low-rise context and there are no smooth transitions in height. There is enough distance to the street so the height does not create a canyon effect. Altogether the composition of building and surroundings is neat and with no chaos and disorder. The architectural treatment of the tower base is corresponding to human scale and is clearly articulated to mitigate the tallness. There is plenty of space to the nearest low-rises so there is no visual discord, however, it is difficult to talk about a seamless connection of the high-rise to the surroundings.

The building has a strong identity, achieved by size and façade treatment. However, the legibility of the place is not clear, the building is difficult to approach, with hardly recognizable routes for this landmark building and its twin nearby. The building is one solid block, with predominantly vertical proportion, slender silhouette, and no visual reference to the surrounding buildings. As a group the twin towers more disrupt the skyline than enhance it, and provide a point of visual

significance in an area that has nothing to offer as urban design intervention. There is no plaza or garden as public spaces, only car parking and streets, the area is completely deprived of different features enhancing user's experience or diversity of functions. There is no natural features integrated into the design, or rich planting to enliven the visitors' perception of change of colour, light, smells, sounds and textures, no formal or informal seating.

The nearest shops are five minutes away on a busy street. There are not implemented considerations for the users comfort in regards of sun, shade or windiness, space is simply exposed to the elements. There is sensible visual intrusion caused by parked cars and the planning for cars dominate the area. There are no streets acting like plazas: no streets permanently closed for traffic, connecting business and communities, thus providing a calm and vivid environment for experiencing where many people can use it and with retail facades with coffee and restaurants to enhance the city life. Space does not seem welcoming and looks redundant. Altogether the impact of the place on the public life is insignificant and no diversity of people are observed to use it.

There is no provision of venues for activities such as picnicking, sleeping, reading, sunbathing, sprawling which could be a part of a happy lifestyle, so it is no surprise that there is no obvious residents participation in any public life, especially when the routes are complicated and do not encourage pedestrian freedom. There were no cafes or leisure opportunities, it seemed hard to meet people and chat or linger, there is nothing to watch, it is not vibrant and not an attractive place and altogether not a meaningful location. There is no variety of styles and places, important views or landmarks. The ties with the pedestrian system are unclear and complicated. The area has no strong image, it does not address different needs, and it has no memorable character.

5.2.2. New Buildings

5.2.2.1. St. George Wharf Tower, London

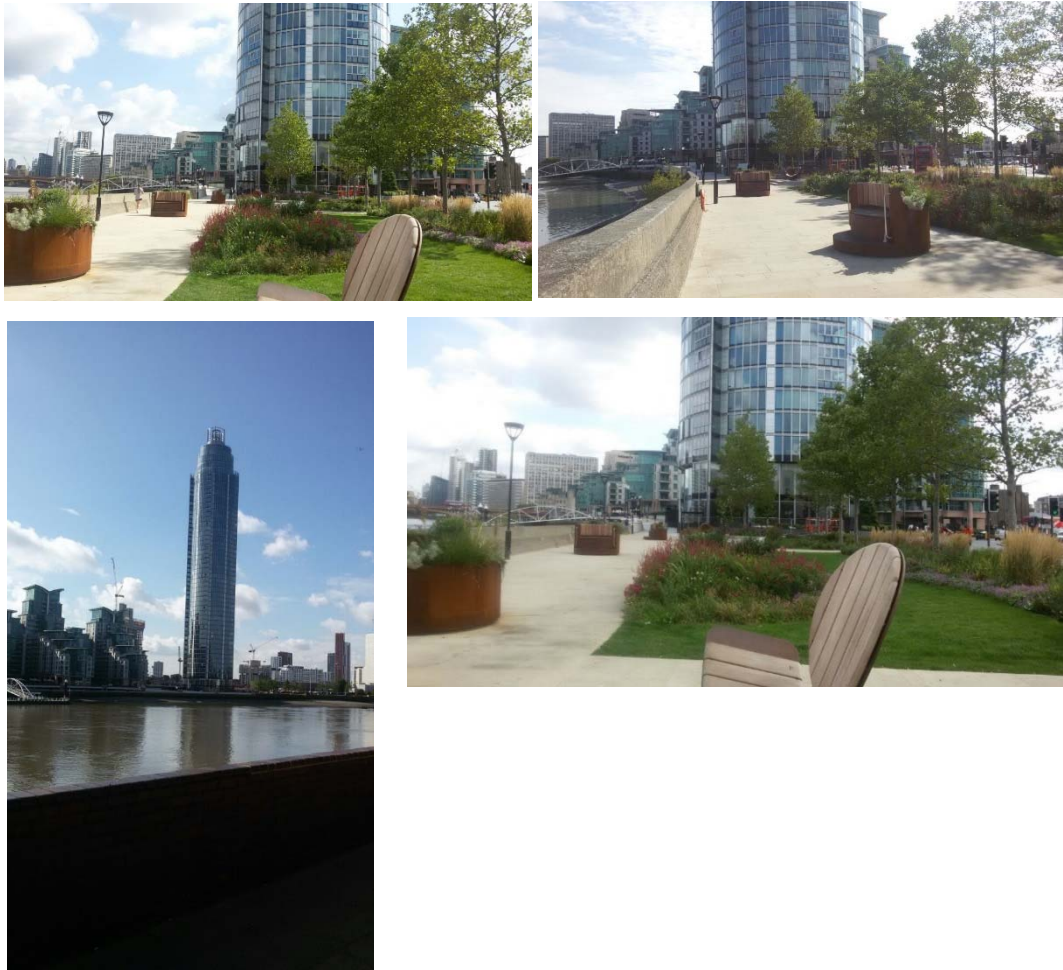


Fig. 5.10. St. George Wharf Tower, July 2017

St. George Wharf Tower is modern residential high-rise built in an international style with very impressive architectural design due to its height, shape and slick glass façade. Smooth transition in height is not achieved, the tower is significantly taller than the neighbouring mid-rises, but the architectural character of the location is tolerant to the visual impact of the huge structure. Since there is enough free space around the tower, with the water body nearby, and a garden of a decent size, the design is not too aggressive with its predominantly vertical proportion

The structure of the arrangement is harmonious and there is no disorder or chaos between the quite different as styles facades of the adjacent buildings. However, the base of the building does not correspond to human scale mitigating the effect of tallness of the tower. The massing is simple, the silhouette is elegant, the materials luxurious and there is a strong relationship with the infrastructure.

The green features and the permeable environment created by the surrounding buildings provide a seamless connection between the tower and the context. There is quite a good legibility achieved through recognizable routes, and by performing as a landmark helping the people to find their way around. The legibility is also improved by the tower serving individually by emphasising a point of civic and visual significance and enhancing the skyline and the area image. However, there is not a single spot of importance, the composition of the buildings is linear along the water body, but with visual order and harmony, and richness of façade styles and architectural forms. Between the buildings are fitted pleasant public spaces: garden, seating, passages. Nature is well integrated with the design, with rich planting, enlivening the users' perception of change of colour, light, smells, sounds and textures. Formal and informal seating with different orientations is presented.

There weren't found facilities for playing outside, recreational facilities are present, however the character of the place is enhanced by the water features. There is no visual intrusion caused by parked cars and there are non-car spaces. There are plenty of shops and eateries in the vicinity, the streets successfully connect communities and businesses. The impact on the public life and the community is significant: there are a certain number of activities: walking, jogging, reading and waiting, drinking coffee around the building by a diversity of people by age and gender. The garden provides spaces for plenty of activities such as picnicking, sleeping, reading, sunbathing or sprawling and the whole area is very accessible, encouraging pedestrian freedom by a variety of routes. People have spaces to meet and chat, to enjoy the water, it is attracting the people. The place is definitely a meaningful location, even though it is not central. Important views are

preserved. The high-rise with its strong presence contributes to the sense of place and the strong image of the area. There is a lot of interesting visual complexity. The sense of place is supported by numerous places for chance encounters and gathering. Space addresses different needs. It is attracting attention and enhances a memorable skyline.

5.2.2.2. Ontario Tower, London



Fig. 5.11. Ontario Tower, July 2017

Ontario Tower is a modern high-rise in a much-secured area in London, built in international style, in harmony with its tall neighbours. There is no conflict high-low because the surrounding buildings with which the tower forms a residential complex are of similar height. The street between the buildings is not wide, but there are green spaces that mitigate the canyon effect. There is a seamless connection between the adjacent buildings. The arrangement of buildings is well structured: there is no chaos and disorder. The detail of the base corresponds to human scale, but

its height is only one storey, this is why it looks compressed by the huge tower. The legibility is good, the routes around the building are clear and well designed, the tower serves as a landmark with strong identity due to its distinctive shape and helps the people to find their way. The tower provides a point of visual significance and enhances the skyline. The buildings form a composition around the public space developed as a green space. The treatment of facades is rich and interesting, but not disordered by too many expressive details. There is no plaza, only the street between the buildings, which is heavily used and no traffic calming or no-car measures for a street as a plaza; however, green features soften the perception of stark, bland and cold surfacing. The planting is rich, enlivening the users' perceptions of change of colour, light, smells, sounds and textures. However, seating is problematic, there is none, be it formal or informal. One can sit and watch only in a small café by the tower. Even though the green spaces are not supposed to be used for activities such as playing on them, there were people with small children circulating around them. The design is not considering comfort in peak times in terms of sun, shade and windiness. There is a minimum visual intrusion caused by parked cars and opportunity for pleasant, even though limited sightseeing. The spaces around the building are relatively used, it does not look like they are redundant. However, they do not seem suitable for activities such as picnicking, sleeping, sunbathing, reading or sprawling. The residential arrangement has a positive impact on public life and community.

The building is accessible and to some extent encourages pedestrian freedom, but it is not attracting many people. It is definitely a meaningful location, with a variety of architectural styles that contribute to the sense of place. The area has a strong image, created by the influential exteriors of the towers and the urban design intervention in the place between them, but does not seem to address many different needs. It is getting the attention and enhances the city skyline.

5.2.2.3. Pioneer Point, London

Pioneer Point is a pair of two modern towers situated on a busy street in a vibrant and crowded neighbourhood. The architectural design is thoughtful enough to correspond to the facades of the

adjacent buildings as materiality and rhythm, nevertheless, the tower looks quite disruptive for the context of low-rises with its daunting height. With its great vertical proportion to the street, it could look out of place if the base of the buildings didn't correspond so well to the human scale by its architectural detail.



Fig. 5.12. Pioneer Point, London, July 2017

With its strong image, the buildings dominate the street but the slick design does not cause chaos or disorder. The buildings are stepping directly onto the street so there is a seamless connection with the surroundings in the form of one continuous frontage.

The distinctive shape and façade solutions determine the strong identity of the towers. It improves the legibility of the area providing a point of visual significance and enhances the skyline, having great impact visually and for the life of its residents. There is small plaza across the street, but it does not serve a diversity of functions, there is no seating or art or water features. The trees soften the perception of cold, bare place but it will be far stretched to say nature is well integrated into the urban design. The plaza simply welcomes the visitors of a supermarket located there. The

design does not consider comfort in connection with sun, shade and windiness. However, many people are crossing it on their way in and out of the shop.

The observation did not find any designated area for various activities such as picnicking, sleeping, reading, sunbathing or sprawling. The buildings are accessible and the pedestrian freedom is encouraged. It is vibrant basically because of the many retail venues along the main street. Altogether it can be said that the location is meaningful, with a moderate sense of place created by the landmark buildings and the good connection between buildings and infrastructure. It is good for orientation from a long distance.

5.2.2.4. Imperial Point, Salford Quays

Imperial Point is a contemporary residential high-rise situated into an impressive regenerated area: The Salford Quays. Its architectural design, style and facades solutions are in complete harmony with the surrounding buildings. The heights of the buildings are contrasting, but not in conflict, due to their fine proportions. The structure of the arrangement is not characterised by chaos and disorder, on the contrary, well-designed changes of rhythm and materials create a seamless connection between the adjacent buildings. The architectural detail of the base of the high-rise mitigates the effect of the height for the observers.

The building has a strong identity achieved by materiality and massing. The legibility understood as an ability to easily read the environment and get to the points intended is highly increased by the high-rise that provides a highly visible point of civic and visual reference for the plaza encompassing a great concentration of retail and cultural functions, shops and restaurants. Thus, the buildings create a uniform composition around an important spot but stay easily accessible. The plaza is very memorable, of good size in connection with the buildings, interesting pavement and full of life. Nature complements the design from the side of the canal where there is lush greenery that stimulates the users' perception of change of colour, light, smells, sounds and textures. There is both formal and informal seating orientated to interesting sights.

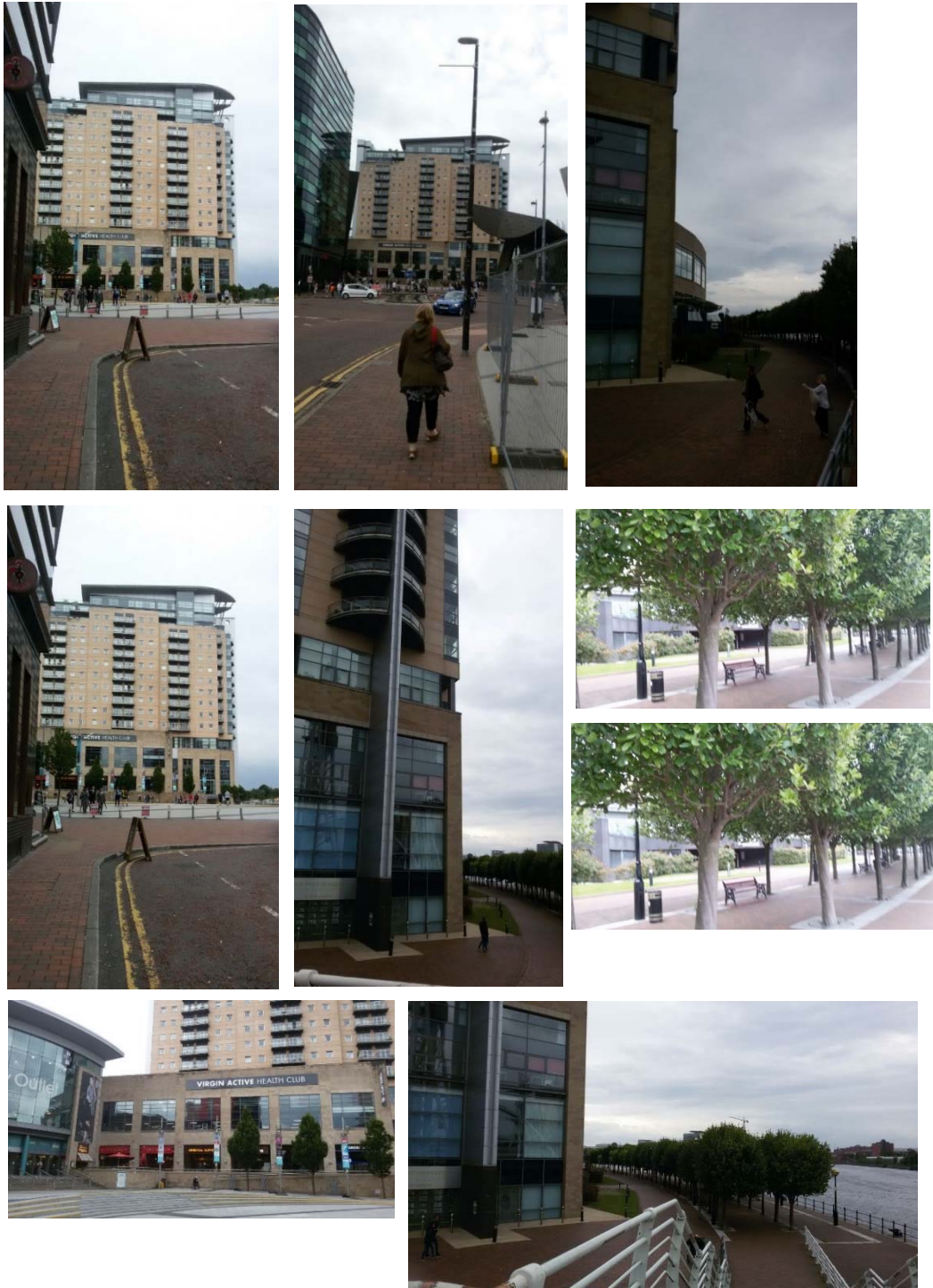


Fig. 5.13. Imperial Point, Salford Quays, July 2017

Space is heavily used without being crowded. There are steps and planters that break the monotony of the large empty space. The arrangement has a great impact on public life and community perception. The greenery along the canal does not allow all the activities such as picnicking or sleeping, but certainly provides for reading, sunbathing and sprawling, and the Lorry at the plaza provides for shopping and cultural activities. The place is absolutely a meaningful location, with preserved important views and landmark buildings, with a strong image, plenty of spaces for encounter and gathering, great infrastructure connecting it to the rest of the development, addressing different needs and since it is so high-quality space: attracting a lot of people.

5.2.2.5. Landmark East and West Tower

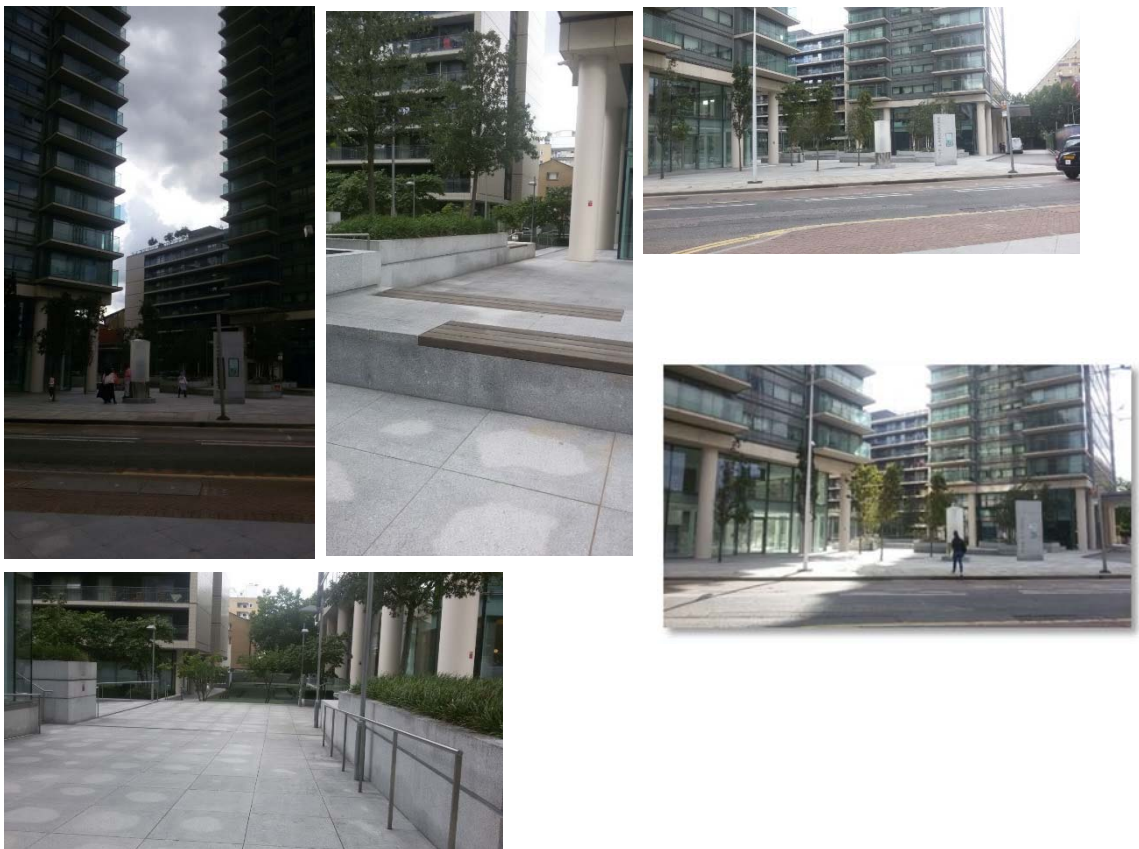


Fig. 5.14. Landmark East and West Tower, July 2017

Landmark East and West Tower are two stylish new high-rises five minutes away from the Canary Wharf. The architectural design, the style and the facades are in harmony with the surroundings. There is no conflict with lower structures due to the difference in height. The vertical dimension is quite articulated but the proportion to the street looks good. There is no visual chaos and disorder created by the interaction of different styles and façade treatments. The architectural detail of the bases corresponds to human scale mitigating the effect of the buildings' size.

There is a seamless visual connection with the surroundings due to thoughtful use of materials in harmony. The buildings have a strong identity with distinctive architecture. The legibility is enhanced by high permeability of the space between the buildings and clear paths. The massing is simple and the design distinctive, so the positive visual effect is achieved by simplicity. The buildings create a point of visual significance and enhance the skyline and the area image. They also form a composition around a major spot. There is a richness of architectural details that make the area distinctive. There is small public space between the buildings introducing nature to the context and providing space for encounter and gathering, with a number of seating and gardening. The planting, however, is not abundant and is hardly exhibiting a change of colours, smells, textures and sounds. There are some cafes and other public functions in the vicinity, promoting socializing.

The arrangement offers comfort considering also the sun, shade and windiness. It is accessible and attractive, but not many people were using it, most of them just waiting for a car to pick them up, so the impact on the public life and community perception is limited to the provision of elegant residence in a prime location. It is also not possible to use the public space for a variety of activities such as picnicking, sunbathing, and sleeping, however, it enhances the pedestrian freedom. The place is difficult to be described as a meaningful location since it is underused, quiet and with bigger potential than displayed, but the buildings definitely create some sense of place along with the public space between them and it has a strong image. It also connected with a great

infrastructure to important locations nearby. It feels safe and secure, important characteristics for a residential area.

5.2.3. Summary of the chapter

Six old high-rises built in the 60s'and the 70s' and five new high-rises built after the year 2000 were included into a detailed observational survey. The research was conducted in four areas of: physical form and visual impact, properly scaled mix of land uses and functions, activities in quality places near the buildings and sense of place. In particular, the architectural design, style and overall visual impact, the structure of the arrangement, visual connection between high-rises and surroundings, massing, proportions and silhouette, legibility, order and harmony, availability of public places, nature integrated with the design, facilities, seating, retail facades, impact on public life and community perception, diversity of users, residents' participation in urban life, pedestrian freedom, places to sit, watch, stand, meaningful location, public art, building access, important views and landmarks, ties into the existing pedestrian system, area's image, infrastructure, safety and security, character and skyline were examined and described. There were striking differences between the surroundings of the new and old buildings related to all the indicators.

Chapter 6: Interviews with residents

6.1. Results and analysis of the interviews with residents in old high-rise buildings

Six old buildings had been studied through interviews with seventeen residents. Daubenev Tower is a 26-storey high-rise in London, completed in 1966 that hadn't been refurbished. Eddystone Tower is a 26-storey tower in London, finished in 1966 that hadn't been refurbished. Sandyhill Court is 12- storey high-rise in Manchester renovated in 2007. Brookway Court is 17-storey building in Manchester that wasn't renovated since its completion in 1969. David Lee Point is a 21-storey high-rise in London finished in 1965 that wasn't renovated ever since. Nightingale Heights is a 25-storey building in London, completed 1968 and renovated 1994.

Table 6.1. Residents demographics					
Initial and gender	Building	Age	Marital Status	Ethnicity	Culture
L., male	Eddystone tower, 3 rd floor	41	Married with children	White	British
C, female	Eddystone Tower, 10 th floor	35	Married with a child	White	British
K., female	Eddystone Tower, 10 th floor	30	Married with a child	White	British
H., female	Eddystone Tower, 15 th floor	60	Married, elderly with children	White	British
T., male	Eddystone Tower, 18 th floor	55	Single	Black	Jamaica
D., female	Sandyhill Court, 9 th floor	50	Married with children, elderly	White	British
A., male	Sandyhill Court, 3 rd floor	26	Single	White	Iraqi
P., male	Sandyhill Court, 4 th floor	24	Single	White	British
Sh., female	Daubenev Tower, 6 th	27	Single	White	British

A., female	Daubeney Tower	18	Single	White	British
M., female	David Lee Point, 4 th floor	42	Married with children	White	Lebanese
A., female	David Lee Point, 4 th floor	18	Single	White	Lebanese
N., male	David Lee Point, 11 th floor	50	Married with children	White	Indian
A., male	David Lee Point, 9 th floor	46	Married with children	White	Iraqi
J., male	David Lee Point, 9 th floor	39	Separated, living alone	Black	Caribbean
C., female	Nightingale Heights, 7 th floor	28	Single	Black	Nigerian
M., female	Brookway Court, 2 nd floor	34	Single	White	British

6.1.1. Children facilities on site and in the buildings

Regarding child-friendly environment, the respondents are relatively satisfied with the facilities around their tower. There could be more provisions for smaller children, but other than that the facilities enhance the quality of life of the families with children. The design features of the studied playgrounds such as provisions for running, jumping and climbing, variation in shapes, colours and textures, provision for different activities helps with preventing disruptive behaviour in children and building new skills which are principle for the harmonious life of the family. However, the parents admit their children don't use the facilities too often, maybe three times a week. There also should be installed equipment for development of fine motor control, which is presently missing, as well as cognitive play areas, which will benefit the quality of life of the families.

Is it important for you to have opportunities to manipulate elements in the environment to develop fine motor control? “There should be that because there is nothing like that around here. She is only one; there is nothing for her age. The elder kids they can climb in the park, it is a piece of wood with handles, she cannot climb that because she is only one.” (K., 30, Eddystone Tower, interviewed 08/08/2016)

There is a correlation between well-designed and organised child play facilities and cooperation and productive behaviour in children as opposed to disruptive behaviour and disciplines problems (Francis, 1998). Nicholson (1971) as cited by Fjørtoft and Sageie, (2000) claim that there is proof that all children are sensitive to elements of their surroundings, such as materials and shapes, gravity, smell, etc, available for discovery, exploration, and experimentation. This focus on inventiveness, creativity, opportunities to discover is closely linked to the characteristics of the environment.

Have the colours, textures and shapes of design elements been chosen to provide a range of sensory experience?

“It got different shapes, but it is not much left, it is all broken now.” (M., 42, interviewed 24/03/2017, David Lee Point)

Higher provision of loose equipment and higher levels of supervision contribute more possibilities for energetic play at the playgrounds. Fixed play equipment and markings (especially in various colours) are perceived by children as areas promoting active play and with an impact on moderate activity levels.

Is there a provision for a variety of activities? “About four, slide, two swings and one climbing area, and a roundabout.” (N., 50, interviewed 24/03/2017, David Lee Point)

Various possibilities are available for increasing the physical activity levels of children when they could choose to be active or inactive. The availability of more supervision, equipment, and organized activities during these times might lead to more students end choosing to be more physically active (Mckenzie, et al. 2000). According to the respondents, both fine and gross motor skills are stimulated by the provided equipment, so this is good for the development of the children and the quality of life in the buildings. Children are driven to a mix of playground areas with different surfaces including open spaces (Willenberg, et al. 2010). According to the respondents, there is a natural area to be explored by the children around Eddystone Tower, so this is enhancing their quality of life. However, the parents from David Lee Point think there should be more green areas.

Is there some natural area for exploration? “Not around the building, and there is a construction that will take it.” (N., 50, interviewed 24/03/2017, David Lee Point)

Do you require some natural area for exploration? “There are loads of green spaces around.” (K., 30, Eddystone Tower, interviewed 08/08/2016)

Interaction with nature is crucial for the child’s development. Even though the role of neighbourhood greenery in children's physical rather than mental health is more supported by evidence, there are some reasons why natural elements may be connected to children's emotional and behavioural adjustment. First, children's are driven to environments that contain natural elements (Evans, 2006 as cited by Flouri, Midouhas and Joshi, 2014). Second, access to natural, outdoor settings improves adjustment, including attention (Faber Taylor et al., 2001, Faber Taylor et al., 2002, Kuo et al., 1998 and Wells, 2000 as cited by Flouri, Midouhas and Joshi, 2014), self-regulation (Faber Taylor et al., 2002 and Kaplan, 2001 as cited by Flouri, Midouhas and Joshi, 2014), and motor skills (Fjortoft, 2004 as cited by Flouri, Midouhas and Joshi, 2014). Nowadays,

a popular uneasiness is present in both the U.S. and U.K. about the possibilities ahead of children play outdoors. Various sources have claimed that present children are being deprived of the outdoor play opportunities available for previous generations. Aitken (1994) as cited by Valentine and McKendrick (1997), for example, has claimed that the modern built environment: high-rises, office clusters, suburbs, has reduced children’s opportunities to play autonomously. Such conditions will, in the end, badly affect children’s quality of life along with their geographic skills. The respondents report the availability of areas for watching the children playing, but no cognitive play areas. However, the respondents do not feel that living in a high-rise deprives their children from access to some playground facilities. Regarding liveability, analysis of which is one of the objectives of the research, it is needed some clarification of the concept. Simplifying all the notions, liveability is dimensions are the features of living environments that make them attractive (Throsby, 2005 as cited by Leby and Hashim, 2010). Wheeler (2001) as cited by Leby and Hashim, (2010) suggests a definition of liveability as living conditions that are pleasant, safe, affordable and support the community.

Table 6.2. Liveability Dimensions Defined in the Selected Studies

Omuta (1988)	Holt-Jensen (2001)	Visser et al. (2005)	Heylen (2006)	ODPM (2006)
Housing	Aesthetics of living environment	Housing	Dwelling	Environment quality
Amenity	Personal	Social environment	Social environment	Physical environment
Nuisance	Social relations	Physical environment	Physical environment	Functional environment
Socio-economic	Functional	Functional	Safety	Safety

Source: Leby and Hashim, 2010

By this definition of liveability, there is a correlation between liveability and quality of life. Typical indicators of the quality of life can be “Having access to quality education, jobs, services, housing and leisure; Living in an environment which is healthy, resilient and stable now and into the future; Living and working within a society which is democratic, just, engaged, diverse, responsible, supportive and vibrant; Being fulfilled, healthy and with sufficient personal resources to enjoy life” (London, Sustainable development commission, 2012). Liveability adds to the quality of life regarding the environment that is supporting healthy and fulfilling life. In this connection, David Lee Point residents are experiencing worse living conditions since their children are deprived of quality child play facilities, while Eddystone Tower residents are enjoying better environment for children with plenty of natural features and their quality of life can be assumed to be enhanced. It will be socially sustainable to provide access to social life resources such as quality playgrounds where adults and children can gather and communicate.

6.1.2. Elderly facilities on the site and in the building

The environment for the elderly is of quite poor quality, with crucial features missing. Elderly people are deprived of spaces to interact or relax. There is a difference between the provisions of Eddystone Tower and Sandyhill Court, the environment around Sandyhill court is missing essential features enhancing the quality of life of the older residents. It is only a parking lot and fenced landscaping while the situation of Eddystone Tower is slightly better with plenty of garden features and viewing and seating opportunities.

Is there a provision of appropriate viewing and observation areas so people can easily see landmarks, significant landscaping, recreation and activity areas, e.g. fountains, bird feeders, gardens, picnic area etc.? “Nothing of the kind, there is a little bit of a garden outside.” (D., 50, Sandyhill Court, interviewed 25/03/2016)

For the elderly, it is progressively important to have comfort, safety, security, ease of access to the surroundings and to have social interactions and places for them. It is also crucial to be able

to enjoy nature, contribute to health by short walks and feeling the sun, but these needs are often neglected (Carstens, 1998). This kind of neglect is found in the two researched buildings design.

Is there a provision of a garden-like setting with trees to stroll through? “You can walk around, it is not very big, we have no trees, but I think they have put a bench there and then we have the surrounding area, it is just a small thing.” (D., 50, Sandyhill Court, interviewed 25/03/2016)

There are no active doing places, arrangement for groups and chance encounters, and altogether the elderly respondents are not satisfied with their tower surroundings and communal areas. This lack of satisfaction is a margin for improvement by proper design interventions to enhance the quality of life. Older people deprived of peer contact are susceptible to isolation, leading to depression. Social interactions reduce isolation and improve quality of life allowing the older people to exchange ideas and experiences for mutual benefits. Design intervention that can foster social interactions is communal design spaces with opportunity for chance encounters and design lounge areas to resemble intimate living spots in scale and character (Pynoos and Regnier, 1991). When retired, people tend to enjoy parks, recreational activities, and other community facilities more since they have more leisure time (Mohammad and Abbas, 2012).

Is there a provision of secluded 'retreats' and reflective niches? “Yes, there are quiet areas, the communal area is quiet.” (T., 55, Eddystone Tower, interviewed 08/08/2016)

Older people have special needs and specific outlook on their life. By Principal components analysis (PCA) are defined seven domains that older persons associated with their quality of life. “In order of importance (highest to lowest): a feeling of safety, health and mobility, autonomy, close entourage, material resources, esteem and recognition, and social and cultural life” (Meylan et al., 2015, p.979).

High-rise residential towers which are connected, provided with mezzo scale and macro scale facilities, are some of the typologies that can be designed to promote the creation of friendly spaces for the elderly, by considering the existent context that belongs to the community

(Pandelaki, Wijayanti and Pribadi, 2014). Borst et al. (2008) as cited by Koh and Wong, (2013) discovered that trees and front gardens along paths, and paths within parks, are considered attractive for walking which can be associated with the feeling of safety, health and mobility from the quality of life domains. The scenery is also found to be a crucial factor of quality walking environment especially by the elderly (Tsukaguchi et al., 2009 as cited by Koh and Wong, 2013). A satisfying garden environment is one that meets physical, psychological and social needs of the elderly people. The design should be comprehensive of physical limitations that the elderly people have to encourage usage by them thus addressing the autonomy domain of the quality of life. The design needs as well to satisfy the social needs of the elderly encouraging participation in social activities. Identifying certain environmental issues and their related design criteria can foster the provision of design decisions directed to the inclusion of the elderly in outdoor activities (Othman and Fadzil, 2014). According to the answers of the respondents and the observation, liveability of the researched buildings for the elderly residents is suffering the lack of vital provisions in the environment, negatively affecting the elderly residents' quality of life especially in the domain of social and cultural life. It is possible to bring the nature into the building by providing winter gardens or roof gardens that should be easily accessible and properly designed with activity spaces, viewing and sitting opportunities as a provision for active and passive recreation, as well as gathering and communication. This is a provision directed to the improvement of the social climate for the buildings, which makes it socially sustainable design response.

6.1.3. Spaces for social interactions

The first common question for the three demographic groups is where in the building are you having your social interactions? Researchers in many fields have come to discover the crucial impact of the built environment on the users' socialisation. By transforming contiguous space into discrete but interconnected units, buildings define patterns of movement and encounter and therefore directly affect social interactions (Fisher, 2009). Having social interactions in the towers

is quite problematic. The majority of the respondents have their interactions in the communal areas.

Where in the building do you have your social interactions? “If we interact it is usually in the communal areas like downstairs reception or the elevator.” (L. 41, Eddystone Tower, interviewed 08/08/2016)

This is not the best case scenario since the communal areas in these buildings are small and with no windows. Another report no space for social interactions and no such activities, because of lack of space. Modern high-rises solve this problem by implementing lounges on different floors where people can communicate in comfort. Other amenities, such as roof garden, café, pool, gym or spa are also the best way to provide residents with places for a chance encounter. One stunning example is EVO in Philadelphia, designed by Erdy McHenry Architecture. The social interactions are supported by a number of lounges, pool on the roof and an acre of designed green space in front of the building. This kind of spaces are vital because some of the people share that they have their social interactions outside, in the park or a garden.

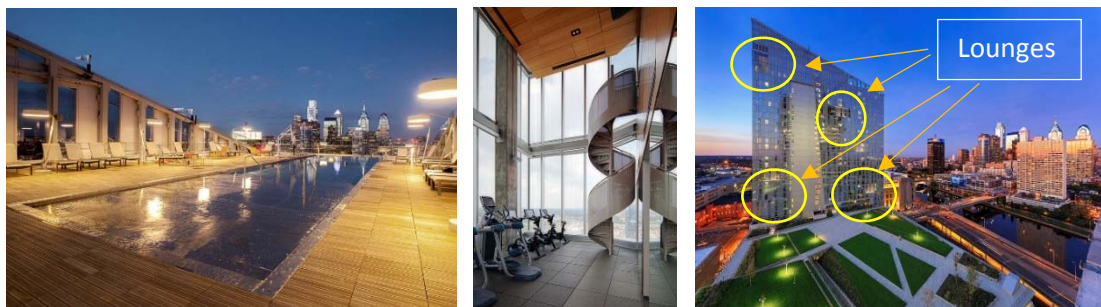


Fig.6.1. EVO: spaces supporting social interactions

Where in the building do you have your social interactions? “Outside, in front of the building, we only say hi and buy in the corridors.” (A., 18, Daubeney Tower, interviewed 12/08/2016)

Two respondents have a lifestyle that is impeding social interactions, but their lifestyle could be modified if the buildings were better equipped with spaces for that purpose. The social life of tall buildings is paramount for placemaking. People's engagement is a critical factor in making successful places because a place without people is lacking vitality. The economic viability of a space is directly linked to the social life of space; people need the services as well as the crowds that can be a result of the services. A recent problem is that many indoor spaces in the tall buildings are disconnected from outdoor spaces. They stand as isolated, rather than integrated elements in the city. Lack of connected socio-economic space on the ground floor has a negative impact on the vitality of the building social life and ruins its sense of place (Al-Kodmany, 2013).

Where in the building do you have your social interactions? "In the lift, we say hello, how are you doing but there is no place in the building where we can actually socially interact." (J., 39, interviewed 24/03/2017, David Lee Point)

The authors interviewed twelve architects and the answers high-lighted several common issues: availability of social encounter space within the buildings, amenities, such as lounges, green roof, dining room, game room, lobby, pool, fitness. Another theme is the mixed-use: retail, offices, spaces that activate the streetscape. These are approaches orientated towards having more social interactions in the building. Some environmental features can foster neighbourhood social interactions, thus underlying a foundation for better health and quality of life in regards to an attractive environment. Factors of the physical environment are related not only on individual but also on social level (and vice versa) (Diez-Roux, 2001 as cited by Cohen, Inagami and Finch, 2008). Much of the research on place attachment (and linked ideas) has concentrated on its social aspect; people are valuing places that foster social relationships and group identity. Fried's (1963) as cited by Scannell and Gifford, (2010) study a neighbourhood that was quite decayed but showed that the positive neighbourhood bonds could stem from interpersonal interactions.

Some physical factors, such as density, proximity, and the presence of amenities and other social arenas strongly affect these interactions (e.g., Fried, 2000 as cited by Scannell and Gifford (2010)). However, the spaces for social interactions in the researched buildings are limited to the communal areas, the lift, outside the buildings or are just missing. Considering that one of the dimensions of the liveability is social relations, the lack of opportunities for social encounters in the buildings seriously damages the liveability of the residents and consequently their quality of life in regard with an attractive environment. Factors of the physical environment that assist the social interactions of the building such as amenities and mixed-use are socially sustainable design responses that can enhance the quality of life. It is sustainable even in a broader sense because of the connection between the social life of the buildings and the placemaking, the vitality of the active socio-economic ground floor and life-fulfilling sense of place.

6.1.4. Flat layout and residential satisfaction

In general, people are satisfied by the flats layout, only a minor part of the respondents require extra rooms or a quieter place. According to the Zappetini (2001), as cited by Ismail, et al. (2015) physical design aspects encompasses the size of the interior division, material and workmanship. Good quality materials are also relevant. Poor quality material can increase maintenance costs. Also, the occupants lack of comfort when exercising activities in that house. The quality of workmanship is the quality of the house's construction. Bad implementation is related to defects in the house leading to costs for repair work. The comfortable flat layout is crucial for the quality of life of the residents. The results are contradicted by literature: tall buildings provide no suitable living conditions because residents felt locked and separated from people and life, or because children are missing the direct connection with nature (Moser, 1981). These adverse tendencies might be mitigated by designing a comprehensive set of amenities, such as children play rooms or lounges that will benefit everyone beyond the deficiencies of the individual flats. That could enhance liveability and affect positively the quality of life and would be socially sustainable

design response because it will support a large number of people's private and social life, in other words, help to maintain and improve the well-being of a significant part of the society.

The discovery that recently constructed homes do not provide two desired qualities is a critical result of a relevant survey. The number of rooms was less crucial on the priority list (an issue for 32% of respondents) – but people needed rooms with proper size (42% said the size of rooms was top of their list). The research revealed that residents in private homes lack enough space for their furniture, to store their possessions, or to socialise. Even flats with a spare bedroom are claimed to lack space adequate to their needs (RIBA, 2011).

Is the flat layout satisfying yours and your family needs? What rooms do you need? “No, we need more rooms.” (M., 42, interviewed 24/03/2017, David Lee Point)

Is the flat layout satisfying yours and your family needs? What rooms do you need? “Yeah, I do like the layout, I think it is a good size for a single person, for two people at the most, it is a good size. I am pretty comfortable with the layout.” (C., 28, Nightingale Heights, interviewed 06/09/2016)

Is the flat layout satisfying yours and your family needs? What rooms do you need? “I am a single man, so one room is ok, but if I have a family, I will need more rooms.” (J., 39, interviewed 24/03/2017, David Lee Point)

The architects also discuss the quality of life in the blocks. Architect 2 thinks one inherent problem with the high-rise building is isolation, and that you removed people from the ground. He sees the solution as the provision of social spaces. Architect 12 stresses on the importance of balconies or sky gardens, or public spaces enabling access to light, air and views, which is similar to what Architect 4 says when talking about the features related to high quality of life within a high-rise: access to light and views as a first necessity; amenities hosting social interaction, exercise and entertainment; units adapted to different lifestyles; location; the importance of transportation,

work, green spaces, groceries, entertainment, cultural activities, and the connection with the nature.; concierge service;

Architect 10 emphasises on warm and comforting materials and also on the spaces in the building, such as a public area that has television and lounge furniture, a fitness centre, a swimming pool, suitable to accommodate the lifestyle of younger people. The notion of the city in your living room is really relevant when meeting people and trying to accommodate many of them in the city centre.

6.1.5. Thermal comfort

The next question investigates if the air temperature is pleasant. Regarding air temperature in the flats, the opinions are divided. Seven respondents are unsatisfied; it is too warm or too cold, ten think the temperatures are ok. However, the group that is satisfied admits it uses air-conditioning and high levels of heating.

Is the air temperature pleasant? "If it is a hot day, it gets really, really hot, and if you open all the windows, it is quite a powerful breeze. Actually, it is quite decent, but it is too hot, and even with the windows opened it is still quite horrible. But it has good moments; it is ok." (C., 28, Nightingale Heights, interviewed 06/09/2016)

Is the air temperature pleasant? "It is warm, and the heater is not on at the moment" (M., 42, interviewed 24/03/2017, David Lee Point)

Is the air temperature pleasant? "Yes, it depends on the time of the year, in the winter we use the heating, this time of year we get it from the windows." (N., 50, interviewed 24/03/2017, David Lee Point)

In the UK the old buildings are replaced very slowly with a rate of about 1% a year, so to reduce energy use it is crucial to meet the problems of the existing buildings. This can be achieved by reducing energy consumption through passive measures such as retrofitted insulation, placement of windows and proper airtightness, and providing adequate ventilation. (Roberts, 2008). *The Warm Front* goal is to increase thermal comfort mainly by increasing the operative temperature in the flats by improved insulation and heating system. Insulation preserves heat through more efficient building envelope, and a central heating system improves the comfort by better distribution of heat throughout the building (Hong et al. 2009). According to recent prognosis, 75–85% of the current UK building stock will still be operational in 2050 (Power, 2008 and Ravetz, 2008 cited by Dowson, et al. 2012). This is a vital factor because millions of these homes are characterised by poorly performing solid walls, single glazing and un-insulated roofs/floors accounting for a major wasted heat. These elements can be costly and difficult to improve. Also, limited available space and planning restrictions can curb the improvement (Beaumont, 2007 and EEPH, 2008 as cited by Dowson, et. al, 2012).

It is difficult to generalise household energy demands and carbon emission sources. Space heating mainly depends on technical factors such as the type of building, how well insulated it is and how efficient the HVAC system is. A factor is also the choice of internal temperature, the average of which has risen by about 6 °C between 1970 and 2001 (Shorrock and Utley, 2003 as cited by Druckman and Jackson, 2008). This can be partly a lifestyle choice, for example, wearing summer clothes indoors on cold winter days. It may also depend on the technical characteristics of home HVAC systems. For example, with the distribution of central heating, residents may now be inclined to maintain all rooms at one temperature than use heating controls to distribute temperature changes between living, sleeping and unoccupied rooms. Also, energy consumption for water heating, dishwashers and washing machines, etc., is technically determined (the efficiency of the appliances), as well as user's behaviour such as frequency of washing and duration of showering (Druckman and Jackson, 2008). So the satisfaction and dissatisfaction of

the air temperature in the flats can be a result of intangible factors such as the efficiency of the building envelope and tangible factors such as the mode of usage of the HVAC system and choice of clothing. However, even when satisfied by using heating the energy consumption reduction is a crucial environmental issue. Creating an energy efficient building by applying sufficient thermal insulation and with efficient HVAC system suggest a concept of a house providing affordable comfort linked to the quality of life. Sustainable design responses are connected to one of the research questions: what housing concepts are relevant to sustainable design responses enhancing the quality of life by the comfort with less energy consumption. It also draws a connection between sustainability and quality of life. Efficient building envelope and HVAC system can also be one of the principles of the sustainable high-rise building, addressing the research question “What are the principles of sustainable high-rise buildings?” Considering that some of the respondents are expressing dissatisfaction with the air temperature in the flats, this can be one of the problems as in the research question “What problems the sustainable design responses need to address in residential high-rises?” Liveability in flats that do not perform well in terms of thermal efficiency is not agreeable, and the quality of life must be enhanced by appropriate measures.

As for sources of unpleasant radiant heating, eleven residents report some unpleasant sun penetration. This problem cannot be simply resolved by blinds because the residents will lose one important benefit from living in a high-rise: the view. This problem can be solved by installation of smart glass windows that change their opacity when the sun is overheating. This can positively affect the liveability which at the moment is not great according to this factor, and enhance the quality of life, and it can be a sustainable solution decreasing the use of air-conditioning. Such measures against unwanted sun heating can be one of the principles of a sustainable high-rise building answering a research question. Sun heating through the windows is also one of the problems that need to be addressed answering another research question.

There is some level of dissatisfaction from humidity, seven of residents complain that it is too damp, one that is too dry. Humidity levels can be controlled by using exhaust fans while cooking and bathing or opening a window to exchange fresh, drier air.

Similar is the situation with wearing too much or too little clothes. Nine of the respondents admit there is thermal discomfort which makes them adjust their clothing according to the weather. The others are feeling fine. The intervention required is related to the response to unpleasant air temperature already discussed.

Five of the respondents say there is a draught; the rest say the air movement is normal. The response to that might be installing new windows in place of the leaky one and providing window vents for ventilation. In various buildings is observed leaking heat through gaps in the joins of their windows or doors. Heat losses by ventilation can be effectively decreased by improving the air tightness of the building. It is a cheap and effective measures. The different types of materials constitute brushes, foams, sealants, draught excluders, and tapes (Xing, Hewitt and Griffiths, 2011). Sufficient air tightness is crucial for reducing heat loss due to ventilation (Everett, 2007 as cited by Roberts, 2008). Draught proofing requires small savings but is very cost-effective (CIBSE, 2007 as cited by Roberts, 2008). The process includes draught-stripping, replacing leaky windows and closing off unused chimneys. About 80% of houses were proofed by 2001 (BRE, 2003 as cited by Roberts, 2008). It is efficient and economical to add loft insulation where there is less than 150 mm already in place (BRE, 2005a as cited by Roberts, 2008). The Building Regulations increased requirements and typically around 250 mm of insulation is demanded where laid between joists (BRE, 2005b as cited by Roberts, 2008).

6.1.6. Quality of the air

Five respondents report pollution in the air from the roads around. The problem can be solved by controlling the ventilation in the flats, and by filters installed to purify outdoor air entering the home. The degree to which this problem affects liveability is not great, but it is worth the designers' attention. In case of naturally ventilated buildings, it is recommended to keep windows and doors shut during peak traffic times (morning and evening rush hours) and use a stand-alone filtration unit. This will improve the quality of life of the residents by creating a healthy indoor environment which is socially sustainable.

6.1.7. Aural comfort

Regarding the noise in the flats, it is relevant to note that acoustical comfort for a person affects not only the receiver of the sound but also the source of the sound. It can be annoying to be subjected to noise from neighbours, but it can be equally annoying to find out that your activities are being heard, meaning no privacy. Insufficient sound insulation of the flats can be a reason for conflict and limited activities (Rasmussen, 2010).

Is there step noise in the flat? "No, if somebody has heels you can hear it."

Is there air-born noise in the flat? "No, at the moment because the people on the block it is quite quiet. If the children are playing outside, from the street, and you have a window open, you can hear them." (D., 50, Sandyhill Court, 25/03/2016)

Is there step noise in the flat? "It is terrible, absolutely terrible." (M., 34, Brookway Court, 26/03/2016)

The majority of the respondents, nine of them, say they have step noise in their flats, and some of them even describe it as terrible. Those who do not complain share that in fact, it depends on the shoes. Also, there are many residents: eight that have air-born noise in their flats. This is an existing problem with low liveability according to the aural comfort factor. Acknowledging the continuing and expected extensive renovation of housing in Europe, closer attention to the improvement of sound insulation between flats should be promoted, as it now seems to be disregarded in spite of the importance to residents of flats (Rasmussen, 2016). Sound insulation might be a viable solution for the problem and applying it to the flats might be one of the concepts of housing with enhanced quality of life, as well as a principle of a sustainable high-rise building. The comfort provided for the residents will be beneficial for their health: a common indicator of social sustainability and quality of life making the insulation a socially sustainable response enhancing the quality of life.

6.1.8. Energy efficiency

The opinions are also divided when it comes to installing energy saving windows in the flats. Nine of the respondents are satisfied with the windows they have, but the rest eight will definitely approve new windows. The first generation double glazing in the UK is displaying poor performance, with U -values of 3–4 W/m² K where factors are poorly insulated frames and narrow air gaps (e.g. 6 mm) (UCL, 2007 as cited by Roberts, 2008). Double-glazed windows with whole window U -values of 1.2 W/m² K are becoming available in the UK and will possibly be the norm within ten years (Strathclyde University, 2006 as cited by Roberts, 2008). Windows can be important reasons for heat loss in the winter and heat gain in the summer. It is estimated that average flat may lose 30 percent of its heat or air conditioning energy through its windows.

Would you like energy saving windows instead of double glazing? “The windows are single glazed, the flats have been built in 1960, so I definitely prefer energy-saving windows.” (D., 50, Sandyhill Court, 25/03/2016)

Would you like energy saving windows instead of double glazing? “The windows that I have now because they are old, I thought to change them because they are ugly, that would be the only reason, other than that the windows I have now are quite good, I am happy with that.” (C., 28, Nightingale Heights, interviewed 06/09/2016)

Implementing energy conservation approaches can decrease heat loss or gain. In the choice of windows for a building, the usual decision criteria seem to be appearance and cost. But energy efficiency is also crucial (Hawks and Peterson, 2005). Inefficient windows can be the reason for overheating unwanted infiltration or exfiltration of air. Efficient windows, on the other hand, affect the dwelling's energy consumption and therefore its sustainability (Friedman, 2012). Windows in many cases are considered the less energy efficient building component with a larger maintenance requirement. Many studies imply that fenestration is crucial for optimum thermal comfort and access to light in a home. Their contribution to architectural quality is also significant, affecting the building's aesthetics. Recently, the technologies demonstrated important advances in windows properties, including solar control glasses, insulating glass units, low emissivity (low-e) coatings, evacuated glazing, aerogels and gas cavity fills along with improvements in frame and spacer designs (Sadineni, Madala and Boehm, 2011).

Dynamic tintable or the so-called smart windows can change their solar factor and the transmission of radiation in the solar spectrum responding to an electric current or the changing environmental conditions themselves. The implementation of this type of windows can lead to a drastic improvement of the performance of buildings incorporating high levels of glazing, changing the heating, cooling and electric lighting consumption (Baetens, Jelle and Gustavsen,

2010). The glazing is very important part of the building envelope and represents the least insulating part of the thermal envelope (UNEP, 2007 as cited by Abdellatif and Al-Shamma'a, 2015). Passive dynamic glazing such as photochromism and thermochromism; active dynamic glazings such as electrochromism and dynamic façade control are applicable regarding light and heat conservation and control (Abdellatif and Al-Shamma'a, 2015). Smart windows technology reveals the potentials of further development of glass for buildings and building control systems. Monitoring and evaluation of the performance of smart windows are crucial to observed effects of new glazing methods on entire building performance (Xing, Hewitt and Griffiths, 2011). However, these major points do not affect the opinion of half of the respondents, which may indicate that education and promotion are needed.

About implementing geothermal energy in high-rise buildings, only four respondents like the idea, with the prevailing number of the residents: ten, never heard of it and three not approving. The lack of interest in geothermal energy is disturbing especially considering its potential for environmentally friendly energy production. The usage of geothermal energy in the country is still underdeveloped (Bachelor et al., 2005 as cited by Lund, Freeston and Boyd, 2005). More recently, ground-source heat pumps are recommended for heating, cooling and hot water. When connected to the electricity grid, heat pumps positively affect the overall carbon emissions replacing fossil-fuelled systems. These findings lead to several official energy programs. The recent calculation is that there are about 550 geothermal heat pump units operating in the UK with an installed capacity of 10.2 MWt and an annual energy use of 45.6 TJ/year, based on 1800 equivalent full-load operating hours per year (Lund, Freeston and Boyd, 2005). Direct application is relevant to both high- and low-temperature conditions and is therefore much more presented worldwide than electricity production. Direct application is, on the other hand, depends on the site, as steam and hot water are usually transported at short distances, with the longest hot water pipeline of 63 km, in Iceland (Fridleifsson, 2001). This imposes limitations on the implementation of the technology for high-rises in England since the country has no high-temperature

resources. Geothermal power production causes less emissions of greenhouse gases compared to other technologies.

When compared with other energy sources, it is essential to monitor the entire production cycle, i.e. all phases before, during and after power production. Geothermal power plants have especially low CO₂ emissions in comparison to other technologies; they are therefore more sustainable options for power generation than coal, oil or gas (Rybach, 2003). Only a small part of the geothermal potential has been used nowadays, and there is a great margin for increasing the use of geothermal energy both for electricity generation and direct applications. (Fridleifsson, 2001). With world population increasing and growing environmental concerns, sustainable development is gaining much attention. Geothermal resources are potentially a significant contribution to sustainable energy use in many parts of the world. Sustainable geothermal production relates to long-term energy production (100–300 years), (Henchoz, Hepbasli and Ozgener, 2004).

Geothermal energy is especially helpful for the design of high-rises since the communal areas can be supplied by it, thus creating an incentive to implement more amenities for the electricity of which no one wants to pay. It is also true for solar panels on the roof. However, people are not familiar with its potential, and there are other limitations such as the absence of site under which the pipes can be situated, mentioned and by some of the interviewed architects. Some of the researched buildings such as Eddystone Tower have large open areas as surroundings, but most of the buildings are surrounded by closely situated other buildings which makes it unfeasible to talk about applying this solution.

Ten of the respondents enthusiastically approve the installation of solar panels on the roof, and three are just not that informed about the potential of this technology. Four disapprove, doubtful that the system will produce enough energy in the UK climate conditions and for a large building.

Operational energy is the largest portion of the life cycle energy distribution, therefore decreasing it seems to be the most crucial issue for the design of buildings which require less energy throughout their life cycle. To reduce this demand, passive and active measures such as installing better and insulated building envelope, and gas-filled multiple pane windows with low emissivity (LE) coatings, ventilation air heat recovery from exhaust air, heat pumps and solar panels, etc. are studied in life cycle point of view by many researchers. It is found that reductions in life cycle energy of the buildings in comparison with the conventional ones are related to the degree and number of energy saving responses implemented in the building (Ramesh, Prakash and Shukla, 2010).

Do you fancy solar panels on the roof? "It works if you are in a house, on this roof it won't help the whole building; the whole building draws too much energy." (N., 50, interviewed 24/03/2017, David Lee Point)

Do you fancy solar panels on the roof? "It will be good." (T., 55, Eddystone Tower, interviewed 08/08/2016)

This is why it is important for the designers to choose the technology with the lowest operational cost and not necessarily the lowest initial cost. The distances between high-rise buildings can strongly affect natural lighting, natural ventilation, and solar energy. Improper planning can lead to increase in energy for electric lighting and mechanical cooling/ventilation, and implementation of solar energy systems can be greatly limited (Hui, 2001). The utilisation of solar energy or PVs for the domestic electricity purposes has several benefits: reduces resources consumption and damaging nature by greenhouse emissions, oil spills and toxic by-products (Omer, 2008). Solar energy promises to be the most advanced backup energy as it is superior to most of the other resources. Solar energy easily obtainable and clean energy source are coming from the sun for direct electricity production (Saidur, 2010 as cited by Mekhilef, et. al, 2012). It releases no

pollutants, requires low maintenance and high reliability, with life span expectation of 20–30 years which makes the solar energy the most attractive energy choice of the future (Saidur and Mekhilef, 2010, as cited by Mekhilef, et al. 2012).

A vital segment of the PV market, however, is formed by Building Integrated PV (BIPV). This market is significant for implementation of PV for two reasons: space is not wasted because the panels are installed on existing or new buildings and BIPV mostly apply to the private consumer electricity market that is more expensive. This makes PV in this segment competitive with the existing grid and even can count on no subsidies (Defaix, et al. 2012).

The architects point out similar solutions for energy efficiency. Most commonly they talk about energy efficient HVAC system and building envelope, with insulation and a reduced amount of visual glass. Smart solar orientation is also cited as crucial and passive design strategies are applicable in the reduction of energy consumption. Water management, energy saving appliances and light are also quoted as successful strategies. Energy efficient windows are also a solution that has been mentioned.

The number of residents in favour of their double glazing is not prevailing so much over the residents who would like energy saving windows, and considering the advice of the architects for energy efficient envelope, it can be considered as a valuable sustainable response that will save money and enhance the quality of life. It can be a principle of the sustainable high-rise and be part of a concept for sustainable housing. As for the geothermal energy, the lack of knowledge is discouraging the residents from wanting to implement this solution. However, being a clean source of energy just like the solar panels, these solutions can be implemented as a sustainable design response enhancing the quality of life and be a part of a concept of sustainable housing.

6.1.9. Attitude to amenities

The majority of the residents: eleven would like to have a roof garden with modular seating. Only a few are concerned with the safety of the children. The attitudes of the respondents vary from “nice”, “good”, “lovely”, which implies moderate desire to have the amenity to “definitely” and “should be” which represents stronger need to have a roof garden.

Do you fancy Roof garden with Modular Seating and Dining Areas? “No, because the roof is on the 24th floor so that people can throw stuff off, people can jump off.” (L. 41, Eddystone Tower, interviewed 08/08/2016)

Lindheim and Syme (1983), Evans et al. (2000), and Wells (2000) as cited by Jackson (2003) summarize results that life on the upper floors of high-rises are related to lower physical activity, behavioural problems, and respiratory illnesses in children, and with neuroticism and social isolation in stay-at-home mothers and military wives. Wells (2000) as cited by Jackson (2003) claims that improved access to the outdoors is the key to fight these adverse health effects. A roof garden can mitigate the adverse effects of separation from the ground. Exposure to landscape settings can reduce the negative effects of congestion and improve psychological well-being contributing largely to the quality of life in urban environments (Jim and Chen, 2010).

Do you fancy Roof garden with Modular Seating and Dining Areas? “That would be lovely.” (H., 60, Eddystone Tower, interviewed 08/08/2016)

Also, prominent architects and designers are searching for ways to implement nature into their designs. A new term—sky gardens—is used to describe planted spaces situated above the ground: in intermediate floors of high-rise buildings or as roof gardens (Ong, 2003). Nature with available structures is not only mitigating the climatic conditions; it fosters a friendly environment that

promotes social interaction, frequently on under-utilised places such as rooftops (Tan and Sia, n.d.). To use green roofs is a common practice since ancient times. There is abundant proof that visual and physical contact with vegetation in natural settings substantially benefits the mental health and the quality of life in general. Living or green roofs could promote more contact and improve the use of the roof space (Hui, 2006).

To decrease car dependence as a leading liveability goal, the urban neighbourhoods must become amenity-rich spaces, decreasing the necessity for occupants to leave their neighbourhood for everyday living (Van, Buys and Aird, 2012). However, the five buildings are situated in poor, underdeveloped districts with no amenities available which indicates the need for amenities in the building, even though it may reduce their everyday pedestrian experience. It can also increase the possibilities for social interactions which in the present are not great. The majority of the residents: twelve, would like to have a gym in the building, but few of them say they won't use it. The attitudes of the respondents vary from "would love", "good idea", "nice" which imply certain desire to have a gym, without being a necessity to "brilliant", "amazing" and "definitely" which indicates a stronger need for the amenity. A gym will stimulate physical activity and contribute to a healthier lifestyle. The same can be stated for a pool in the building. Such amenities can significantly improve the quality of life of the residents.

Do you fancy gym in the building? "I would love a gym because I want to lose my baby fat, there is no gym, there is no really local gym for me to use." (K., 30, Eddystone Tower, interviewed 08/08/2016)

Do you fancy pool in the building? "I think a pool would be good for the kids." (K., 30, Eddystone Tower, interviewed 08/08/2016)

Do you fancy pool in the building? “Yes, in summertime definitely.” (J., 39, interviewed 24/03/2017, David Lee Point)

The same is with the opinions on should there be a pool in the building. Thirteen approve the idea. Their attitudes are not the same: they vary from moderate approval: “nice”, “good” to stronger feelings such as “wonderful”, “would love it”, “better than brilliant”. Even though eight of the residents like the idea of having a spa in the building, eight say they won’t use it, and there are other cheap places, and one does not know what it is. Only a small fraction of the respondents: three don’t like the idea of child play room in the building, the remaining fourteen say it will be lovely, and some say it will strengthen the feeling of community in the building.

Do you fancy childplay room in the building? “Yes, that would be good especially in building this size, you can imagine the amount of young children, it will help build a community, when kids grow up they might all be the same age, they don’t know each other, if we have something like that the parents will get to know each other, the children will know each other, it builds a community.” (N., 50, interviewed 24/03/2017, David Lee Point)

Do you fancy child play room in the building? “Yes, it would help the single mothers, neighbourhood interaction, community.” (J., 39, interviewed 24/03/2017, David Lee Point)

Especially valuable is the notion expressed by the residents that a childplay room will foster social interactions and a sense of community.

Few respondents: six don’t want restaurants and café in the building, but the majority of eleven thinks it is a great idea. One says firmly “there should be” while the others express more reserved attitudes like “lovely” and “good”.

Do you fancy café and restaurant in the building? “I am not sure if it is going to work.” (M., 42, interviewed 24/03/2017, David Lee Point)

Do you fancy café and restaurant in the building? “No, because not everybody likes the same food, for example, if there was a Spanish restaurant, not everybody likes Spanish food, it has to be multicultural.” (J., 39, interviewed 24/03/2017, David Lee Point)

Do you fancy café and restaurant in the building? “Yes, on the first floor to grab a coffee with a friend.” (C., 28, Nightingale Heights, interviewed 06/09/2016)

Those who disapprove are concerned with activities in the building that might disrupt the normal way of life of the residents, but those who approve enjoy the notion of grabbing a coffee in the cold weather and chatting with a friend, which can enhance their positive experience of living in the building.

Some of the respondents: seven don't want shops in the building, the remaining ten like the idea. There are expressions like “good”, “we can benefit”, “convenient” which reveal the need for such an amenity.

Do you fancy shops in the building? “No, I won't go anywhere, but still it is convenient, so that would be nice too.” (C., 28, Nightingale Heights, interviewed 06/09/2016)

Do you fancy shops in the building? “We do have shops on the ground floor, not in the building but just outside the building, so we don't need it in the building.” (J., 39, interviewed 24/03/2017, David Lee Point)

Do you fancy shops in the building? “Yes, because of all of the shops around here close so early, my local shop closes at 6 o’clock.” (K., 30, Eddystone Tower, interviewed 08/08/2016)

The major concern of the residents is that shops are not needed but most of them appreciate the convenience a shop can bring.

Five residents don’t want lounge in the building, the rest think it will be great to have a place to socialize.

Do you fancy Living room lounge with billiards and TV? “There used to be one, and no one really used it, I am not sure it is going to get used, they made it into normal flat now.” (M., 42, interviewed 24/03/2017, David Lee Point)

Do you fancy Living room lounge with billiards and TV? “Yes, that’s where we got back to the roof, in the summertime everybody to chill out, have few drinks, conversations, music, low, other neighbours will have noise pollution so the higher, the better.” (J., 39, interviewed 24/03/2017, David Lee Point)

Do you fancy Living room lounge with billiards and TV? “I don’t know if I would like to meet with the other neighbours in the common space.” (M., 34, Brookway Court, 26/03/2016)

It makes an impression that such a useful amenity that fosters social interaction is accepted with doubts if it is going to be used.

Even more respondents: fifteen want a library in the building, with only two rejecting the idea.

Do you fancy library with 24 hours business centre in the building? “Yeah, maybe for the older kids, study there.” (M., 42, interviewed 24/03/2017, David Lee Point).

Do you fancy library with 24 hours business centre in the building? “Definitely, knowledge is power, the more you learn the better.” (J., 39, interviewed 24/03/2017, David Lee Point)

Do you fancy library with 24 hours business centre in the building? “Libraries are good and most people don’t go there, but you can have one in the building, yes that would be a good idea.” (N., 50, interviewed 24/03/2017, David Lee Point)

All the amenities in question promote health, leisure opportunities, social interactions and support the everyday life of the users making them socially sustainable resources. Their absence in the researched buildings underpins the presumption that the liveability in the buildings could be better, and their implementation in future residential high-rises might mean that quality of life could be enhanced. They might present a principle of the sustainable high-rise building and be a part of a concept for housing where sustainable design responses enhance the quality of life.

6.1.10. Mixed use

The majority of the residents: nine, don’t like the idea of having offices in the buildings, thinking it is too noisy already or it will destroy their community. However, the true about amenities in the building reducing car dependence is valid and for the work near your flat situation.

Do you fancy offices in the building? “Yes, I don’t see why not.” (H., 60, Eddystone Tower, interviewed 08/08/2016)

Do you fancy offices in the building? “No, it will take away from the community, people coming, doing their work and run away.” (N., 50, interviewed 24/03/2017, David Lee Point)

A mixed-use residential-office building has the advantage of easy access to employment opportunities, and have the potential to enliven areas with scarce land like the city centres. There are design practices that minimize the negative impact of the mixed-use, such as situating one or a number of floors of office areas immediately above the ground floor to mitigate the impact of the commercial uses on the residential spaces on the upper floors. Another important aspect is the aural comfort, which can be achieved through construction solutions that reduce vertical noise transmission between levels, such as acoustically insulated partitions. However, even though architects around the world praise the opportunities created by mixed-use buildings, the residents that were interviewed cannot easily accept the need to share their personal space with people uninvolved in their daily routines.

The majority: twelve, also don't like the idea of having a hotel in the building. Some of the respondents: seven also rejects the idea of a nursery in the building, but ten approve.

Do you fancy a nursery in the building? “That might benefit the people that work, not having to rush the kids off in the morning, it will be convenient.” (M., 42, interviewed 24/03/2017, David Lee Point).

Do you fancy a nursery in the building? “Yes, it will help build the community.” (N., 50, interviewed 24/03/2017, David Lee Point)

The architects interviewed have different opinions about mixed use. Architect 7 gives, for example, a building in Birmingham: The Cube, which is characterised by mixed use. Besides residential function, it has shops, restaurants, hotel, and a featured sky restaurant. According to

her, mixed-use ensures that the building can adapt to changing economic situation, that it addresses different members of the community, it also means the planning should take into account flexibility, between the different uses, for example, turn the retail top level into office which is the situation. The difference between an apartment and the hotel this is another place where the hotel could take place. So the building does not become empty if the situation suddenly changes. It prolongs the life of the building. The supply of the building also becomes advantageous because flats demand water morning and evenings, and the offices need it during the day so it facilitates, including the heating and hot water. It is shared benefit and efficiency in demand. Architect 3 also gives, for example, a mixed-use building in Washington, City Vista; it has a retail base, grocery store, several restaurants, multiple other businesses, guest club, hardware store, basically became, so this building itself created a lot of job opportunities in that neighbourhood. It changed the neighbourhood from a place with a bad reputation to a popular destination, enlivens the vicinity, promotes employment, and draws attracts more successful neighbours.

Architect 5 quotes lack of space and the need to fit a certain number of students. So it drives you vertically where you cannot spread. Besides the functions that are supported by the buildings like cafeteria and fitness centre you have classrooms, recital hall and practice rooms, retail on the ground floor, a high-rise housing that is not associated only with the resident hall but with mixed use.

Considering the resistance of the residents to incorporating hotel and offices in the buildings, further research will demonstrate if there are further factors in favour of such a solution. Introducing a nursery, however, can improve liveability with convenience and community spirit.

6.1.11. Architectural qualities

The architectural qualities of the building offer something different to every resident. Several respondents like the big windows, the views and how secure it is. One says they have everything they need. Some like the colour, some the flats, some the spacious rooms. It makes an impression that the architecture itself is not pointed out as enticing, meaning that this old design is not having followers nowadays. Some declare they don't like anything about their building. Features related to the social interactions like amenities and communal areas are also not mentioned. However, less than the half of the respondent: eight, think there is a sense of community which is not unusual for buildings with minimum provision for social interactions. If this aspect is improved, the social climate in the building might improve accordingly. Less than the half of the respondents: seven, think the building has a strong identity, but those who think it has attributed it to its size more than to its architecture.

Nowadays, many contemporary high-rise designs suffer from a lack of purpose. Cities lack strong regulations that would demand buildings suitable for the specific climate and there exist arbitrary height regulations. The design community is in an eclectic period where anything can become a reference (Gang, 2008). However, there are architects of the new high-rises therefore rely on memorable shape and great architectural detail to distinguish their buildings from the rest of similar constructions, and it should be this way. Nevertheless, people seem proud to be living in these buildings which creates an obligation to maintain and improve them; thirteen say they are proud. Participants in a relevant study (Michael, Green and Farquhar, 2006) pointed out some specific factors of attractiveness: gardens and well-kept yards, the design of buildings and streets, and interesting sights to look at. Particular examples of design factors that contribute to a neighbourhood's visual attractiveness comprise the presence of a variety of architectural styles within one block, historical landmarks, and curved streets.

According to the residents, the green spaces around the buildings are not enough, nine of them have no mitigation of the effect of living in the city environment. There are not also enough seating and viewing arrangements which is not good for the quality of life of the residents, ten of them saying there are no provisions of the type. While Eddystone Tower and Daubeney Tower are surrounded by plenty of green spaces and have some seating, that is not largely used, Brookway Court, Sandyhill Court and Nightingale Heights are completely deprived of landscaping elements, as the observation showed. Accumulating empirical proof shows that the availability of natural areas enhances the quality of life in many ways.

Along with many environmental and ecological benefits, urban landscapes deliver crucial social and psychological advantages to the communities, which improve human life with meanings and emotions (Chiesura, 2004). Exercises in landscape settings—or green exercise—is also crucial to mental health. Barton and Pretty (2010) as cited by Wolch, Byrne and Newell, (2014), for example, provided a meta-analysis of UK studies, demonstrating that there was a substantial effect of green exercise on several measures of mood and self-esteem. Another meta-analysis (Lee and Maheswaran, 2011 as cited by Wolch, Byrne and Newell, 2014) discovered connections between various indicators of psychological health and urban green space (Maas et al., 2009 and Ohta et al., 2007 as cited by Wolch, Byrne and Newell, 2014). In a major Dutch study Van den Berg, Maas, Verheij, & Groenewegen (2010) as cited by Wolch, Byrne and Newell, (2014) demonstrated that respondents with abundant natural features near their residences enjoy more satisfactory life than those with less greenery, claiming that natural features reduce stress. Also as a focus of social interaction urban parks can enhance perceptions of safety and belonging (Kuo et al., 1998 as cited by Wolch, Byrne and Newell, 2014). Citizens around the world express a need for interaction with nature and each other, delightful settings, leisure, privacy, more involvement in their community design, and a sense of shared identity.

The studies in the research provide solid evidence that the design of urban green spaces significantly affects the quality of life and behaviour of users and nearby residents (Matsuoka and Kaplan, 2008). Green spaces also make available the general interaction with biodiversity and the 'natural' environment for a variety of people (Jorgensen et al., 2002 as cited by Barbosa, et. al, 2007) and may affect the physical and mental well-being of those people (Ulrich et al., 1991, Takano et al., 2002 and Jackson, 2003 as cited by Barbosa, et. al, 2007). In the case of public green space, can provide more significant social benefits as interaction places focusing on diverse communities and neighbourhoods (Germann-Chiari and Seeland, 2004 and Martin et al., 2004 as cited by Barbosa, et al. 2007).

6.1.12. Summary of the chapter

This chapter provides a comprehensive picture of the residents' experience of living in a high-rise from the 60s' or the 70s' in Manchester and London. The provisions that facilitate the life of the elderly and the families with children have been investigated. It has also been found that the buildings do not provide adequate space for social interactions and the thermal comfort is problematic. There are also some amenities that are desirable but not present in the buildings. Mixed use is rejected as potentially diminishing the quality of life as the residents state. The architectural qualities and the feelings of the residents about living in the buildings in question are also explored. Altogether, the chapter provides a unique basis for further suggestions and actions that could enhance the quality of life in residential high-rises.

6.2. Results from the residents' responses in the new buildings and comparative analysis

Five contemporary buildings have been researched through interviews with twelve residents. Pioneer Point North is a 31-storey tower in London finished in 2011, fitted with restaurant and gym on the first floor. Ontario Tower is a 32-storey tower in London, completed in 2008 and fitted with a gym. St. George Wharf Tower is 49-storey building in London, fitted with spa, pool and gym. It was completed in 2014. Imperial Point is a 16-storey building in Salford Quays finished 2001, fitted with a gym. Landmark East and West Towers are a pair of two 30-storey buildings in London completed in 2009, fitted with a gym.

Initial and gender	Building	Age	Marital Status	Ethnicity	Culture
F., female	Pioneer Point, 7 th floor	22	Single	White	British
L., female	Pioneer Point, 7 th floor	34	Single	White	British
S., female	Pioneer Point, 7 th floor	25	Single	White	British
H., male	St. George Wharf, 6 th floor	31	Single	Asian	Chinese
F., female	Imperial Point, 8 th floor	35	Married with a child	White	British
T., female	Imperial Point, 9 th floor	70	Married with children, elderly	White	British
I., male	Landmark West Tower, 16 th floor	70	Married with children, elderly	White	British
M., male	Landmark West Tower, 13 th floor	32	Single	White	British/Italian
N., female	Landmark West Tower, 11 th floor	26	Single	White	British/Russian
N., female	Landmark East Tower, 9 th floor	22	Single	White	British

S., female	Landmark West Tower, 13 th floor	34	Single	White	Arab
V., male	Ontario Tower, 14 th floor	30	Single	White	Greek

6.2.1. Children facilities on site and in the buildings

Different colours and shapes implemented in the playgrounds of the new and old buildings are the only persistent feature for the three places and in the answers of the respondents. Another common theme is the size of the facilities which is described as good. The mother from the new building Imperial Point describes high-quality child play areas with plenty of activities and natural settings for exploration. This is in sharp contrast with the child play facilities for David Lee Point, where the green areas are taken from construction and there is minimal provision for different activities. This diminishes liveability and quality of life for this old building, while there are better conditions for Imperial Point and Eddystone Tower.

6.2.2. Elderly facilities on the site and in the building

The elderly from the old towers are deprived of major characteristics of the elderly-friendly environment. They don't have activity places, Sandyhill Court has no access to the small garden, no viewing opportunities, while the greener settings around Eddystone Tower are better. Imperial Point, on the other hand, is situated in a very lively, well-developed district, where water channels, paths, roads and bridges enhance permeability and connectivity of different urban design solutions such as plazas and gardens, as well as cinemas and shopping centres. The resident actively uses them, for example when shopping, having comfort and safety which are so important for the elderly and affect positively their quality of life. Landmark West Tower has similar

favourable settings, and the resident of the tower actively takes advantage of them for the benefit of his health and mobility. So there is a sharp contrast between old and new, and the new building display much better opportunities to support the high quality of life for their residents.

6.2.3. Spaces for social interactions

The old high-rises have no dedicated areas to foster socialising, so according to the respondents, they interact with their neighbours in the communal area, some use the concierge office for meetings, or do it in front of the building, or in the flats, with four residents having no social interactions. The new buildings have amenities; however, three respondents interact in the lift. Two use the dedicated area at the entrance, other the bar and three the spa in the gym and the spa. Some do not use the gym or pool they have, as the St. George Wharf Tower resident, or the bar as the two Pioneer Point residents who claim there is no place for meeting people. They apparently can use an amenity more like a lounge or roof top garden, where you can relax and focus only on the communication. However, the new buildings offer healthier settings for the social life of the residents, and it is affecting their answers concerning the place attachment.

6.2.4. Flat layout and residential satisfaction

In the old buildings, the majority of the respondents are satisfied by the layout of the flats with only a few needing bigger or more rooms. In contrast, the people in the new apartments have more troubles with claustrophobic rooms, big corridors and small kitchens. This is an area for improvement to enhance the quality of life in these buildings. The results from the interviews represent a user demand that should be taken into consideration by authorities and professionals. Small units that are not serving their purpose properly can seriously harm the comfort, perception of privacy and the mental health of the residents, for example, two respondents in the new flats describe a room as claustrophobic, which is a strong word directly connected to the unpleasant mental condition. Enough number of rooms will enhance the quality of life by supporting the

autonomy of the family members. Sufficient size of the rooms will enable activities such as guests welcoming, exercising, praying or playing games with the children otherwise restricted in the flats that can hardly contain the furniture, not to mention necessities like prams or wheelchairs. Another solution to the small flats is the concept “city as your living room” mentioned by the architect from Erdy McHenry Architecture in the professional interviews in this thesis. The convenience found in the facilities around the building compensate for the little disappointing size of the flat, along with amenities in the building multiplying the spaces you can enjoy and also good for the feeling of the community in the building.

6.2.5. Thermal comfort

In the old buildings, only seven of seventeen respondents express dissatisfaction with the air temperature. As expected, due to the lower U-value required for new buildings in the UK Building Regulations, the modern flats have no problems with the air temperature, with only two respondents reporting the air getting hot during the summer. This problem is associated with the typical for the new construction big windows that may cause problems depending on the sun orientation of the flat. Obviously, the lower requirements for U-Value for the refurbished buildings is problematic and if possible should be exceeded for better thermal comfort in the buildings which will ultimately affect the quality of life.

As for sources of radiant heating, eleven respondents from the old buildings report a problem, in contrast with the five respondents from the new buildings where with only two the problem is serious. It is surprising considering that the new buildings have much more glazing than the old, and can be explained with proper orientation so to avoid sun hitting the apartments. However, this is a problem that can be addressed with special glass that changes its colour with the sun, thus eliminating the need for blinds and preserving the valued view.

As for damp and mould in the old flats, seven of the respondents complain the humidity is too high, while all the respondents from the new flats say it is ok. This contrast is due to increased ventilation in the new flats as well as better insulation which prevents the structure from getting cold. These measures must be taken into consideration when refurbishing the buildings from the 60s' and 70s'.

As for adjusting to the air temperature in the old flats, nine respondents admit they have to wear clothing determined by the unfavourable thermal conditions in the flats. The residents in the new flats are feeling fine, with only two admitting some thermal discomfort, too hot or really cold, which makes them dress accordingly. The measures in those cases are already discussed: smart windows and sufficient thermal insulation of the external walls.

Five respondents from the old buildings report draught, and all the respondents from the new buildings report it is ok. It proves the high-quality of the windows installed in the modern towers and lead to the need to improve the windows during refurbishment in the flats from the 60s' and the 70s'.

6.2.6. Quality of the air

Some of the respondents: five from the old and six from the new buildings report dust or gases from the road. It is a problem that can be addressed by filters installed on the vents of the windows and control over the times when the natural ventilation takes place (not during evening and morning rush hours).

6.2.7. Aural comfort

From the old buildings, the majority of the respondents, nine of them, hear step noise in their flats. Also, there are many residents: eight that have air-borne noise in their flats. In the new buildings,

three have step noise sometimes but don't see it as a major problem. Three respondent hear different sources of air-born noise, but it is not a major problem. So aural comfort is an issue only in the old buildings where some sound insulation could be inserted during refurbishment.

6.2.8. Energy efficiency

As for energy saving windows, nine of the residents in the old buildings are satisfied by the double glazing they have, and eleven in the new buildings can't see a reason to change their windows with energy saving. And while in the new buildings it is expected the quality of the glazing to be supreme, it is surprising how many respondents from the old buildings can't see the benefits from the energy saving option. Further research is required to assess the feasibility of this sustainable design response.

Regarding the geothermal energy, a great number of the respondents don't know what it is, three don't approve, and four think it is feasible. In the new buildings, the resident of St. George Wharf Tower doesn't know what it is, even though the building is using a heat pump, and the heating requires one-third of the usual amount of energy for heating. The majority of the respondents also do not know what geothermal energy is. The two respondents who approve it, respectively think renewable energies implementation must be stimulated and it is a solution for the constant supply of hot water. Obviously, the professionals' views must also be taken into consideration to decide if this solution should be encouraged.

Regarding the installation of solar panels on the roof, ten of the old buildings respondents are more than happy to agree, and three are just not that informed about the potential of this technology. Four disapprove. Only one respondent from Landmark West Tower disapproves as he thinks the building might look bad, the other respondents from the new building say "nice" as it is not a priority, but is acceptable, "good" as acceptable, "perfect" as desirable, and talk of

energy efficiency as a major concern. The results undoubtedly confirm that solar panels on the roof are a solution that must be taken into consideration with new and old high-rises.

6.2.9. Attitude to amenities

The respondents from the old buildings like to a different degree the idea of a roof garden, while the residents in the new buildings are ten to two in favour of the amenity, expressing different levels of desire from “lovely” to “amazing”. This turns this amenity into an issue that definitely needs considerations when designing high-rises to ensure high quality of life in them.

The majority of the respondents from the old buildings: twelve, like to a different degree the idea of having a gym in the building, while the respondents in the new buildings who all have or will have gyms find it a really good or even necessary amenity. This consensus means that gym should definitely be considered when designing residential high-rises for a higher quality of life.

Thirteen respondents from the old building approve the pool with a different degree of enthusiasm, while in the new buildings the answers vary from “not necessary” to “amazing”, “good” and “useful” with only two not feeling the need for it due to age or just because he has it in his work. This agreement from respondents with different financial abilities makes the pool an amenity that should be definitely considered when designing residential high-rises for a better quality of life.

The opinions of the residents in the old high-rises are divided equally between yes and no about the spa, while only one elderly lady from the new buildings says she doesn't need it, while the

others use strong words like “definitely”, “suits such a high-class building”, “a plus”. The spa is an amenity that gets no 100% approval. However, many respondents would like to have it, so it must be considered if feasible in the design of residential high-rises.

From the old buildings, fourteen residents approve having a child play room in the building, where very valuable is the realisation that it will strengthen the sense of community there. From the new buildings, only two respondents don’t find it necessary, the rest of them even when concerned with noise are in favour of the solution. It makes an impression that in the old buildings the noise is not a concern. An informed guess is that people need this amenity more than worrying about possible side effects. Such a high level of approval even from people who have no children make this amenity necessary to consider when designing residential high-rises for enhanced quality of life.

Eleven respondents from the old buildings would like restaurants and café in the building. The attitudes vary from “there should be” to “lovely” and “good”. The respondents of the new buildings are on the opposite opinion; ten say no. This is because the new buildings were selected to be with a prime location so the residents prefer to explore the vicinity than to look for social contacts in the same building. However, if not present in the surroundings, these amenities should be considered for the high-rises when designing them for enhancing the quality of life in them.

Seven of the respondents in the old buildings don’t want shops in the building, the remaining ten like the idea. They define their attitudes like “good”, “we can benefit”, “convenient” which implies this amenity is needed. In contrast, the residents in the new buildings don’t like the idea, with only four approving but not demanding using words such as “nice”, “good”, “only a grocery”, “one shop maybe”. It is again due to the location: the respondents find it safer to have

shops near but not inside the building. However, if the location of a high-rise project is deprived of commercial activities, it is relevant to consider shop in the building.

Eleven residents in the old buildings think it will be great to have a place to socialise such as a lounge. Nine residents in the new buildings say “nice”, wanting it “very much”, “good”, so not enthusiastically wanting it but still, it will be a plus for the building. Since the majority of both selections of buildings would like to have it, it is appropriate to consider it in high-rise residential projects.

Fifteen respondents from the old high-rises would like a library in the building, for the benefits of the kids or the convenience of a quiet area. Seven of the respondents in the new buildings to some degree need such an amenity, but not as a priority, judging from expressions like “nice” and “good idea”. Such a great extent of approval makes this amenity an issue to consider in residential high-rise buildings.

6.2.10. Mixed use

The majority of the residents in the old buildings: nine, don’t like the idea of having offices in the towers, concerned with noise or the preservation of their community. Five of the respondents of the new buildings are fine with the idea since there will be “good food”, “will be cheaper”, “provides jobs”, so this option should be considered as disputable and arguably negative for the lifestyle in these buildings.

The majority of the residents in the old buildings: twelve, also don’t approve the idea of having a hotel in the building. In the new buildings, five people are fine with the idea, the rest are concerned with strangers and defending their privacy. This option also should be carefully considered if it is going to be applied in future residential high-rises. In the old buildings, ten approve having a

nursery in the tower. In the new buildings five respondent say yes, “it would be ideal”, “interesting”, seven disapprove. Again it is a viable option provided that in the vicinity there isn’t one.

6.2.11. Architectural qualities

Common ground in the old and new buildings is the security and the big windows, along with the views and light colours. No one of the residents in the old buildings points out the location, which is mentioned by three respondents from the residents of the new buildings. It means that urban design responses are equally significant to enhance the quality of life of the residents as the treatment of the towers itself. High life standard is also cited as important. It makes an impression that none of the amenity they have is mentioned so an informed guess could be that the importance factor for these benefits is not so high.

In the old buildings less than the half of the respondent: eight, think there is a sense of community: not surprising considering the minimum provision for social interactions. In the new buildings, eight respondents say no, but nobody expressed a significant discontent from this fact. This aspect can be improved by more amenities fostering social interactions, and even if the respondents don’t recognise it at the moment, it can greatly benefit their quality of life.

Less than the half of the respondents in the old buildings: seven, think the building has a strong identity, but because of its size more not because of its architecture. Only three respondents in the new buildings don’t think so. The others say “absolutely”, “100%”, “very attractive” so that is something to be considered with residential high-rise projects, it might increase the satisfaction of living in a recognisable building, enhancing the quality of life of the residents.

Surprisingly, thirteen residents in the old high-rises say they are proud living in their building. It is to inform that pride is not something attributed to appearance, even though one respondent says he is not proud because the building could be more modern. In the new buildings, four respondent

don't see anything special in their buildings to be proud of, but the rest find many qualities to admire. Pride can strongly enhance the satisfaction with the people living condition, enhancing their quality of life, but it comes with other qualities of the building such as a sense of community and spectacular design that need to be present.

Nine of the residents in the old building say green spaces are not enough; there are not also enough seating and viewing arrangements which is not good for the quality of life of the residents, ten of them saying there are no provisions of the type. The same is with the new buildings: five respondents only think there is a good provision of green spaces. Interaction with nature is important for the health of the residents, and if they cannot be provided in the urban context of the high-rise project, it makes the importance of the winter garden or the roof garden even bigger.

6.2.12. Summary of the chapter

This chapter presents the comparative analysis of the findings in the new and the old buildings. It had been discovered that due to their well-developed surroundings, the new buildings provide better opportunities for the elderly and the families with children to have active, satisfying lives. Regarding social interactions the amenities, the new buildings are fitted with providing a better environment for the neighbours to gather and communicate. However, the layouts of the new flats are more unsatisfying than in the old towers. As expected, the better U-value required by the building regulations for the new buildings ensure better thermal comfort, and there is also general satisfaction with the glazing. Noise is also a bigger problem in the old buildings than in the new ones.

Energy efficiency solutions such as geothermal energy and solar panels on the roof are also welcomed by those informed about them in both selections of buildings.

The interviews also review the general attitudes towards different amenities and mixed use in the buildings, as well as about the architectural qualities of the buildings which the respondents value the most and how the buildings make them feel.

The chapter is very informative about the differences in living standards when inhabiting a building from different periods.

Chapter 7: Interviews with professionals

Twelve architects discussed the sustainable design strategies linked to better living of the residents in residential high-rise buildings. Due to difficulties to interview British architects only two of them are from the UK, the remaining ten are from the USA. However, the leading design principles seem to be universal, and there are great similarities in the responses of the colleagues from the different countries, especially when talking about social and environmental sustainability, placemaking and barriers in front of the implementation of sustainable solutions in residential high-rises. A brief summary of the expertise of each architect is provided in Table 7.1.

Table 7.1. Interviewed Architects Expertise
<p>Architect 1 is a founding principal of Cunningham Quill Architects, with over twenty years of experience in residential, infill, mixed-use, and commercial architecture. Some of the high-rise projects of his company include The Alta, Washington, seamlessly mixing modern architecture and city living with green building strategies, offering to residents ground-level retail, a second-floor lounge, and a parking garage. Another interesting work is the master plan for a mixed-use project is located in the City of North Little Rock, Arkansas. The western parcel contains an 11-story tower with structured parking for general office, residential, and retail uses, while the eastern parcel contains a 7-story hotel building with structured parking lined by conference room spaces and a restaurant.</p>
<p>Architect 2 from STUDIOS ARCHITECTURE is proud for more than ten years with them to solve complex challenges through simple and organised architecture. The architect is known to lead his clients and colleagues through rich, collaborative process to produce dynamic, unexpected solutions informed by the program, site and the culture of each client and project. The architect has made major contributions in master planning and has been involved in some</p>

of the company award-winning projects. Some of the projects of his company include The Sailor's Union project in San Francisco, North Bethesda Market Project, and Luna Park Houses (Brooklyn) façade solutions.

Architect 3, as a firm Principal of Torti Gallas, truly expresses the company philosophy when designing residential, mixed-use, and institutional building that are relevant to their environment, while being functionally and aesthetically innovative, economically sensible and delightful. The architect specializes in large-scale urban infill projects, transit-oriented developments and inner-city revitalizations with deep involvement in different aspects of the services for the clients. Some of the projects from his company are Aertson Midtown mixed-use, and the award-winning mixed-use development CityVista in Washington.

Architect 4 joined Pappageorge Haymes Partners in 1987 and since then provided leadership in the design and construction of projects ranging from planned communities, high-rise apartment and condominium towers to single-family homes. He has served as senior project architect on such major work as K2 Apartments; a 33-story, 496-unit luxury apartment complex (LEED® Silver Certification). Other works include Alta at K Station; an 848-unit, two-tower apartment complex (LEED® Gold Certification), and Echelon at K Station; a 39-story, 350-unit apartment, each part of the highly acclaimed mixed-use K Station Master Planned Development in Chicago's West Loop.

Recent work in Chicago includes The Shops & Lofts at 47, an award-winning redevelopment of an entire city block including a large mixed-use building, and three new infill residential buildings. Also, Kenect Chicago, a new mixed-use complex comprised of a 14-story, 179-unit high-rise fronted by a triangularly shaped 4-story, 48-unit low-rise with 14,000 sq. ft. of commercial space between the two sites. His has worked on The Hudson, a 25-story, 240-unit high-rise with 10,000 sq. ft. of commercial space; and North Park, a 48-story, 444-unit, an elliptically shaped residential tower between Navy Pier and the iconic Tribune Building.

Architect 5 worked for Pfeiffer for many years with a focus on projects for cultural and educational clients. The company employs 50 professionals—architects, planners and interior designers—with offices in New York City and Los Angeles, who have been drawn together by a shared philosophy regarding the built environment. The interest in this company was created by the Colburn, a building that mixes residential and educational facilities.

Architect 6 leads SCB's research and work in the areas of sustainability and building performance, including consulting with project teams to set sustainability and performance goals and assess appropriate strategies. The architect has built SCB's capabilities with in-house building simulation and analysis, including conceptual energy modelling and daylighting analysis, allowing SCB's designers to quickly and economically study the performance impacts of early design decisions. The architect also manages the LEED certification process and leads SCB's research groups on various topics such as healthy materials and building bike infrastructure. Stunning high-rise projects of the firm include Marquee at Block 37, Chicago; 399 Fremont, San Francisco; 1001 South State, Chicago and more.

Architect 7 is from Make, an international, award-winning architecture practice with one purpose: to design the best buildings, places and spaces in the world. Founded by Ken Shuttleworth in 2004, the practice has grown to over 150 people across studios in London, Sydney and Hong Kong. It provides full architecture, interior design and urban design services from concept to completion, and its portfolio spans a range of sectors, from office and residential to hotels and education. The architect was selected due to her involvement in the design of the CUBE, Birmingham, an iconic residential high-rise in the UK.

Architect 8 joined Jestico + Whiles in 2002 where he has worked on a wide range of residential, mixed-use and masterplan designs in and around London and the South East. The architect is currently leading a team on phases one to five of the competition winning masterplan at Greenwich Millennium Village. He is also providing a design monitoring role for the London Legacy Development Corporation for two projects in Stratford, adjacent to the

2012

Olympic

park.

Previously the architect's work has included the RIBA House of the year shortlisted House 19 and Housing Design Award-winning schemes at Abbots Wharf, on the Limehouse Cut and plot MO114 at Greenwich Peninsula. He has also led teams on the Grahame Park redevelopment and West Point apartments in North London plus a number of feasibility studies, planning applications and competitions for housing sector projects.

The architect specialised in environmental architecture at the university where he gained a Master of Science in Energy Efficient Building. He is an active member of the Jestico + Whiles sustainability team. He was interviewed in connection with his company involvement in High Street, Stratford, London high-rise.

Architect 9 experience is in architectural design, interior design, project management, and implementation including multifamily residential, corporate offices and commercial interiors, urban mixed-use, institutional, municipal, commercial retail and LEED projects. He coordinates R2L's work in commercial interiors and oversees the graphic design components of the firm. The architect is involved in project design as well as technical coordination and implementation during construction. Inspiring projects of the company include The EXO at Excelsior Parc in Reston, Virginia; Adaire, Virginia; 450K at Washington and more.

Architect 10 is a principle in Erdy McHenry and his work has been recognized by the American Institute of Architects for excellence in design, earning more than 11 local, regional and national design awards. The practice uses a unique business model and Design Philosophy: Integrated Decision Making as a Design Tool, where Budget, Program and Schedule are reconciled each in terms of the other with each design decision. This approach enables them to create a "value proposition" on all projects regardless of budget and still produce cutting edge

work. Inspiring high-rise projects include 3201 Race Street Apartments and EVO, Philadelphia.

Architect 11 from Sieger Suarez Architects has been a practising architect in many states since 1972. In addition, during his decades of construction management, he has overseen billions of dollars in new construction, including mixed-use high and mid-rise residential properties and single-family homes, commercial/retail and religious projects. Selected works of his company include 1010 Brickell, Miami; 50 Biscayne, Miami; 600 Indian Creek and more.

Architect 12 from Pickard Chilton has design leadership experience on prominent projects around the world. Some of his firm projects include 145 Broadway, Akamai's new headquarters in Cambridge, 2&U, a mixed-use office tower in down town Seattle, Rosslyn Plaza and many more.

7.1. Social sustainability

The first question of the interview with the architects is what design features of the residential high-rises ensure social sustainability.

There are several highlights in the answers of the architects who obviously share a similar design approach: availability of social gathering space within the buildings since high-rise housing has been considered to have less socially supportive relationships with neighbours (Cooper, 2006).

There are examples of communities where conditions in both urban and suburban contexts have generated a sense of isolation because there are no spaces that encourage social interaction. Deprived of this activity, neighbours become a nuisance as connections never fully develop (Hurlbut, 2008).

“Probably the key element to social sustainability for residential high-rise buildings is really the point that you get into that building and where that public space is established.” (Architect 2, interviewed 07/05/2016)

“A lot of our projects that we do we work very hard to create social spaces where people can interact.” (Architect 10, interviewed 23/06/2016)

“But people do seem to like a place inside the building, like a coffee shop where they can be around people. So, most of our projects have some kind of party room which might be available for rental, but sometimes they have spaces like a coffee area, that might have tables, and places where people have wi fi, like a coffee shop, but it is not a business, it is just part of your building.” (Architect 6, interviewed 05/04/2016)

Better communal areas and amenities such as lounges can improve the experience of the residence in connection with their relationship with the neighbours which is ultimately socially sustainable. A way to increase social interactions is to provide spaces such as lounges, green roof, dining room, a game room, a lobby, a pool, a fitness. The literature informs that high-rises are more problematic than other housing forms for most people, that they are not providing enough comfort for children, social relations are superficial and helping behaviour is occurring less often than in other housing forms, crime and fear of crime are more frequent, and that they may independently be blamed for some suicides (Gifford, 2006). Amenities can turn this tendency. Amenity space can be understood as crossing the building at multiple levels, including balconies, hallways, communal spaces and outside into the space around the building.

Recognising the importance of these spaces and how they can function together as a whole will permit the quality of the amenity spaces to be increased by conceiving them collectively and planning them in a connection. In the shared amenity spaces a sense of ownership and participation are appearing in fostering a sense of ownership of the spaces (Watts, et. al, 2015). It is found that elderly in garden apartments have a significantly stronger general sense of community than were those in high-rise apartments. Garden apartment residents also demonstrate a greater sense of membership, a community reinforcing trait (Zaff and Devlin, 1998). This is why, if the environment of the high-rise does not include comfortable green areas, a roof deck is highly recommended. A lot of the research on window views and outdoor access is related to

captive populations with little chances for nature experience outside of the home. The researchers acknowledge the need for broader studies, however, it appears more important that buildings especially oriented towards less flexible citizens, include green features that are accessible visually and physically (Jackson, 2003).

“In Chicago, the tendency is to have smaller apartment sizes, mainly for cost reasons. And in exchange for doing that we have a lot of amenities space within the building and so people tend to use those amenities spaces more often because the apartments are so small. So they have larger gathering or party, or they have a number of friends over so they tend to use the public areas of the building more than their private unit. For example, they have a community dining room that has a kitchen with it.” (Architect 4, interviewed 19/04/2016)

Socially sustainable high-rise housing demands a smart and considerable approach related to the ideas and expectations of its users. For better high-rise market, steps must be implemented into delivering the same favourite features from the low-rise neighbourhood (Modi, 2014). They should be fitted to satisfy the needs of different social groups.

“So our first mission or one of our objectives is to have the building fit appropriately in the context, within which it is going to be built. What that means is study the context both in terms of social settings, programmatic requirements for the building, appropriate layout of the units so they work culturally within the environment they are planned for. Secondly, with the buildings that we design, we very much want them to fit within the environmental context, the general topography, the general climate, etc. So, in terms of having the building fit into the environmental context, it has primarily to do with how we orient the building for proper solar orientation, how we create the right proportion and dimension, within the building plan configuration, how we create spaces that allow the inhabitants to have access to outer doors, the balconies or terraces gardens, sky gardens, etc. the responses are in terms of design means usually very specific to the local context.” (Architect 12, interviewed 22/06/2016)

Context becomes another common ground in the answers of the architects. Both social and geographical context is considered and the architects claim that without proper appraisal the building won't be able to perform its purpose. Buildings irrelevant to their size are always seen as a part of a whole. The work of the architect is to respond to the unique local character and the specific needs of this part of the society. It is especially important for a high-rise building, relocating a large amount of materials and accommodating a great number of people to be carefully integrated into the existing urban fabric.

The second common theme is the mixed-use: retail, offices, spaces that activate the streetscape. Putting together residential space with offices and commercial use leads to more efficient land use and 24 hours utilisation of the building with their different time occupancy use for different functions (Shim, Park and Park, 2004). To offer a feasible solution and attractive investment opportunity in urban areas, mixed-use building typology must efficiently address the space problems created when accommodating mass amounts of commercial, office, hotel, and residential space (Hyeong, n.d.). This may include access, vertical transportation, acoustics and problems sharing community spaces. From the developer's point of view a mixed-use development is considered as a favourable typology because it provides the following benefits: convenience of a live-work-play solution in one situation, satisfying the desire to live in a vertical city, reducing traffic congestion (Rabianski and Clements, 2007).

“Thinking of the Cube, mixed-use, it is not just residential, but it is shops, restaurants, hotel, a featured sky restaurant. Mixed-use ensures that the building can respond to changing economic situation, that it serves a lot of different aspects for the community, it also means we should plan for flexibility, between the different uses, so for example the top level of retail to be converted into office and it has happened, so there has been three levels of retail and the top level has been converted into offices.” (Architect 7, interviewed 28/01/2016)

“A lot of the sites that we work on are targeted on places where there is good transit options and good jobs nearby, neighbourhoods to shopping and living that reduce the typical suburban

existence. Typically there is a mix of uses in our larger projects, the retail is usually at the base so retail is on the ground floor along streetscape it's like restaurants, stores, things like that not typically helping the high-rise portion.” (Architect 9, interviewed 13/06/2016)

The attention to the context and proper infrastructure provided for the high-rise building is a general aim of the ground floor level to support continuity; mixed and complementary uses can and should assist transitions in the public realm. In addition, the plot must also encompass necessary open spaces, such as playgrounds. In general, ground-floor areas are under great pressure created by these different forms of use (STEP, 2025). The fourth common theme is the availability of affordable units. This can create equity. Another approach is associating the building with important role for the skyline. Aesthetics appear be a vital factor for the quality of the city skyline (Delafons 1990; Habe 1989; Preiser and Rohane 1988 cited by Mak, Yip and Lai, 2005). It is to a great extent related to the height or the appropriate design of a building. Some writers try to associate the design with the preferences. These are important directions on how to ensure social sustainability by residential high-rise buildings.

The second question is how to design in order to achieve more social interactions. Social and psychosocial relations are often not good in high-rises, particularly how many contacts with neighbours people have and the quantity of issues of control and recuperation at home (Kearns, Whitley, Mason and Bond, 2012). The common ideas in the answers of the architects are again the amenities, allowing gathering and exchange of ideas in a safe environment.

“So in that sense, the pool is one of those spaces, but I would kind of say that the real basic answer to the key for social interaction and social health is providing opportunities for people to have chance encounters around things they are going to do anyway.”(Architect 2, interviewed 07/05/2016)

“Almost all our projects have a fitness centre, they have a lounge, they have a lobby. Now it is interesting in Chicago the lobby tends to be really formal, but in San Francisco, some of the

lobbies actually become more like a coffee shop space where people can sit and work, we are starting to see bike rooms becoming a bigger deal.” (Architect 6, interviewed 05/04/2016)

“We have roof gardens and pools, all type of activities, this is what we do to ensure people have social interactions by gathering them in larger areas.” (Architect 4, interviewed 19/04/2016)

“I think that that starts with the deep understanding of urbanism, about the way that buildings meet the ground, about the way that there is some path through the building and a lot to do with spaces that allow spontaneous interaction between people. Amenities are a great idea. We have been doing a lot of live-work kind of buildings.” (Architect 1, interviewed 16/05/2016)

The lobby is one of the space that attracts the most attention. Huang (2006) found that among five space types, significantly more social interactions are taking place in circulation spaces, and significantly less social interactions are conducted in seating and vague spaces. In connection with the percentages of social interaction, scenic and activity spaces score first and second, respectively, and are significantly higher than the other space types (Huang, 2006). However, observations show that many high-rises from the 60s’ and 70s’ in UK suffer from small circulation areas without access to view and light that are utterly unsuitable for accommodating the gathering of the residents. It is also observed lack of amenities which are highly recommended in order to increase social interactions. For a building to support this kind of activities, the architects suggest dedicated social spaces. Roof gardens, lounges and fitness are again recommended.

“The types of different amenities that we include for interaction could be anything from interior green space that upgrades courtyards, plazas piazzas, depending on the context and depending on the site, and then within the building public lobbies, shared amenity spaces, and then as I mentioned, sky gardens, exterior terraces, roof top gardens.”(Architect 12, interviewed 22/06/2016)

The spaces that support neighbouring and informal contact with the neighbours and constitute adequate play spaces for the children draw specific interest (Evans, Wells and Moch, 2003). High-

rise towers which are connected and have an active corridor, supplied with mezzo scale and macro scale amenities, are some of the types that can be introduced in order to support the supply of friendly spaces for the elderly, considering the existing context and the community (Pandelaki, Wijayanti and Pribadi, 2014). Another aspect cited by the architects is mixed use and considerate context and infrastructure. Results of studies suggest that natural elements such as trees help the increase of opportunities for social interactions, monitoring of outdoor areas, and supervision of children in poor districts (Coley, Sullivan and Kuo, 1997). Some architects designed a cresse in their buildings and the security becomes a major issue. Safe activities are the ground for quality interactions.

“So I think allowing interaction people through landscaping, allowing places where people can meet and interact. Safety is a big issue, so allowing people to feel safe in buildings, so we have this security by design standards, plus we created roof terraces, thing like that, there is the cresse that is built in this gym, so allowing place for people to kind of mix safely.” (Architect 8, interviewed 28/01/2016)

It is important to design the living environment in a way that creates a sense of safety and security for the residents. Security threats can be summarised as crime, disorder and emergencies. Anonymity within the building often contributes to the problem. Elevator crimes and breakdowns are among the considerations of the residents. A solution is a restricted number of entry points. Thus, the security team can more easily monitor access by people, vehicles, and goods. Live-work arrangements have their advantages for the social climate in the buildings.

“It is again mixing uses. Imagine someone leaving the office, having coffee in his apartment and then inviting someone for a breakfast. It is absolutely interesting because it feels like you are on a High Street instead of if you were in a traditional tall building. And then you might get invited from that person, go to their apartment, there is sort of connection there, and maybe you both go to the gym, or hotel, it is mixing the commercial world and the residential world, it makes it more like a community, because you are sharing an experience with someone that isn't just your

colleague at work. I think in the Cube the retail levels incorporate the gym, and that is something the hotel uses, the residents use and the office uses and is a kind of shared facility that benefits everybody. And obviously, it adds viability to the building.” (Architect 7, interviewed 28/01/2016)

Activities among residents in apartments enhances a sense of community and belonging and thus creates a strong community culture in tower complexes. Connections and a sense of community are enhanced by inclusive lifestyle (Cho and Lee, 2011). Because social aspects are vital components of sustainable development, it is crucial to comprehend the connection between technological progress related to sustainable buildings and the behaviours of, and influences, on the residents (Wener and Carmalt, 2006).

To answer one of the research questions, what are the principle of the sustainable high-rise building, the architects’ responses can be summarized. They talk about buildings with better communal areas, amenities and mixed-use which makes the buildings socially sustainable. Sensitivity to the context is also important if the residents use amenities available in the vicinity, there is no need to implement them in the high-rise.

7.2. Environmental sustainability

The next question is what design features ensure environmental sustainability of the residential high-rise buildings. Sustainable building involves analysis of the whole life of buildings, considering ecological footprint, proper functions and account for the future. The sustainable building design is hence the mindful integration of architecture with electrical, mechanical and structural engineering solutions. Besides some traditional aesthetic issues including massing, orientation, proportion scale, texture, shadow and light, the building designers must face the long-term environmental, economic and human costs (John, Clements-Croome and Jeronimidis, 2005). There is less consensus what the environmentally residential high-rise looks like, but there are

few common issues: energy efficient envelope: windows and walls, proper solar orientation and efficient HVAC systems, as well as storm water management.

“This can be either by meeting LEED rating, or Green Globes, or some of these other sustainable levels that you have to achieve. That is just part of it, you know, the city requires that. In addition to that and part of it comes with things about saving energy and how energy efficient the envelope is, how energy-efficient your windows are, the low flow facets, landscaping that doesn’t utilize a lot of water, we have car-sharing programs within the buildings, there are electric charging stations, there are premium parking spaces for energy efficient vehicles, all of these sorts of things are part of these requirements. As well as green roofs and ways in which we can recycle rain water for landscaping, other things like that.” (Architect 4, interviewed 19/04/2016)

“So here you will be talking more about energy efficiency. We do high-quality buildings, good designs, but it is not necessarily an experimental cutting edge. It is good quality, better than a lot. These are very expensive buildings to build, they are very expensive to finance, so most people are not interested in that unless they think they have to compete. In certain cities is a little different, we do a lot of work in New York, the biggest issue is split incentives.” (Architect 6, interviewed 05/04/2016)

As a result of research, it was found that today’s knowledge can help improve the energy efficiency of the building level through the use of passive heating, cooling, ventilation, and daylighting strategies. Comfort and better energy performance are more adequately addressed through building design codes along with voluntary schemes (Okeil, 2010). The building envelope is at the base of the energy exchange between outdoor environment and indoor spaces and hence determines the overall energy performance of the building. In sustainable high-rises particularly, an integrated process is needed because of their scale and the fact that green design defines so many different factors of a building, such as daylighting, which in turn relates to siting, orientation, building form, facade design, floor-to-floor heights, interior finishes, electric lighting controls, and cooling loads, among other things.

“Our firm tend to build LEED-certified buildings. We try to use water wisely, you try to reduce your energy consumption and you try to if you can to harvest energy by solar cells and things like that. We put a lot of thought into building orientation, shades, facades facing south, to reduce the gain, there are a lot of things you can do.” (Architect 5, interviewed 19/04/2016)

Green or vegetated roofs, with their importance for storm water harvesting, building structure, building form, thermal insulation, and plantings, are another feature where integration is appropriate (Malin, 2006). The aim is to reduce thermal losses during winter and thermal gains during summer (Sozer, 2010).

“We have very well built envelope. Have a large amount of insulated panels. The needs of office and residential are quite different so we came with an envelope that serves both of them, has more glazing in the North façade and less glazing on the South façade, in the office so you can control the solar gain, and then in the apartment you can have more windows, and more light and fresh air, and the view. But it all fits in one façade grid, so the idea is creating more unity, we divided the façade so different uses and requirements can be served through the same facade. It is a way to reduce energy consumption through passive strategies. The courtyard is interesting because uses shading that minimizes energy use.” (Architect 7, interviewed 28/01/2016)

Some architects talk about the sustainability of the materials: recyclable or harvested locally.

“We always look at ways to bring landscaping and greenery into the building, up into the tower, be it sky gardens or elevated terraces, things like that. I mentioned the selection of the materials, looking for materials that can be either repurposed, or harvested locally or located locally, these kind of things are very much a part of our things when we design a high-rise building.” (Architect 12, interviewed 22/06/2016).

The notion “place-based design” relates to location’s natural features and resources taken into consideration during the design of buildings and environments. Sustainable design encompasses all location related factors such as analysis of the site and region context, ecology, biology,

geological conditions, anthropology and climate. Profound analysis of the site will help optimize buildings' form and size; their orientation for maximum natural light and ventilation; the windows location, orientation and the size promoting passive design. Location of opening for natural ventilation are also crucial; materials and finishes protecting the users from the weather; landscape type, size, location and variation; low-maintenance strategy (Ali and Armstrong, 2008).

“On the far end as I mentioned starts with how the building is situated on the site, relative to natural features or elements in the city or solar and wind orientation, in terms of the massing of the building. And then on a more fine level, the distribution of the program within the building to respond light, air, views, breezes, etc. and then decisions relative to construction methodology, whether the structure is concrete or steel, often depends upon where the building is located, whether these resources are easily accessible, certainly the design in details, enclosure to create a high-performance perimeter skin, whether incorporating sun shades, high-performance glass, balconies for shading.” (Architect 12, interviewed 22/06/2016).

Considering today's energy-economic crises, the role of passive controls improving the energy consumption have become more articulated. Natural ventilation is now considered to be an energy-efficient solution to minimize the operational costs in buildings, gain thermal comfort as well as support healthy indoor conditions (Wong et. al, 2002). Some architects are looking forward to technologies that are not developed yet. Other are implementing passive design strategies. Context also matters: the availability of mass transit makes people less reliant on the cars. A study by Norman, MacLean and Kennedy (2006) demonstrates that the most strategic steps to reduce GHG emissions in an urban development context should be oriented at transportation emissions, while the most strategic steps to reduce energy usage should focus on building operations. The findings also illustrate that low-density suburbs are not energy and GHG sustainable compared to high-density compact developments for a certain population.

The next question is how to reduce energy consumption in residential high-rise buildings. Globally, buildings are accountable for nearly 40% of the total world annual energy consumption.

This energy is used for the needs for lighting, heating, cooling, and air conditioning. Concerns about the environmental impact of CO₂ and NO_x emissions and CFCs provoked a new interest in green cooling, and heating technologies (Omer, 2008). Energy consumption in the residential buildings is significantly high in developed countries. The potential for energy savings in this sectors is great. Energy conservation measures exist for newly constructed buildings and for refurbished buildings. Anyway, to get a significant reduction in energy consumption different from the existing energy-efficiency methods, innovative technologies should be implemented, with renewable energy included (Chwieduk, 2003).

“We use a lot of glass, some of the projects are a combination of exposed concrete and glass, to try to reduce the amount of glass we have.” (Architect 4, interviewed 19/04/2016)

The rising cost of energy and negative impact on the environment by energy production facilities are all among the reasons for the need to address wasteful energy consumption. Buildings heating and cooling is a top energy user worldwide. The utilization of special building materials, thermal insulation, as well as implementing successful design practices should turn this tendency around (Al-Sanea, Zedan and Hussain, 2012).

“Well there are a few ways to do it, one way that we focused on is the building envelope design, so better insulation in the walls, better insulation in the roof, low-e glass, thermo broken windows as efficient as possible, it’s not always possible on every project because not every project has the budget for it. And then we look at different kinds of mechanical systems as well. We have seen the adoption of newer technologies that were more expensive and now because they are becoming more widespread, the cost is coming down and people are more willing to purchase them and install them in the building.” (Architect 9, interviewed 13/06/2016)

“Being very thoughtful about the orientation of the building, the massing of the building, being thoughtful about the enclosure of the building, and then in collaboration with our other teammates like mechanical engineers and sustainability consultants we are always looking for the best

mechanical system, for the local environment. And looking for ways to use the top technology in terms of what will be the best HVAC system, so in many of our projects we are looking at chill beams, we are looking at heat recovery, design that tries to reduce the cooling load, and in northern climates for the enclosure as well as the mechanical system.” (Architect 12, interviewed 22/06/2016).

“Two things: efficiency of the HVAC systems, second is the efficiency of the envelope. Typically we provide high insulation levels of the roof and the walls. For example, our walls are minimum R19, code typically requires R11, but we provided R19, which is basically very high. What’s typically required for a roof is R19, our is R30. So we do increase R, we provide efficient building through providing efficient HVAC systems, through insulating the roof, the walls, the windows, it’s provided clear double glazing, but also energy efficient appliances, the refrigerator, any of appliances, provided within the units. In addition to efficient fixtures that reduce water consumption.” (Architect 3, interviewed 25/08/2016)

The most common advice from the architects is energy efficient HVAC system and building envelope, with high levels of insulation and a reduced amount of visual glass. In recent years thermal resistance of building envelope increased significantly. New buildings are considerably more energy efficient than the old ones but still, a large part of the dwellings still consists of low thermal resistance buildings. The most environmentally friendly approach could be the thermal renovation of the low resistance dwellings (Juodis, Jaraminiene and Dudkiewicz, 2009). Research suggests that high thermal inertia walls improves the energy demands for heating and cooling. Additionally, the study showed that the role of the thermal inertia becomes more important when the inertia is combined with other energy savings approaches and with an efficient and thoughtful use of the building (Aste, Angelotti and Buzzetti, 2009). Without affordable heating, tenants cannot meet minimum comfort requirements; this results in condensation, mould growth, a lack maintenance of the property and contributes to the negative attitude of the occupiers for their surroundings. This promotes decay that is often observed and which adversely influences the

capital value of the property. Energy costs to provide thermal comfort in these towers have been indicated as a principal cause of many problems. Therefore it is very important, for designers to deal actively with the energy problems, as they are likely to have a crucial impact on design, management, real-estate issues. (Gorgolewski, Grindley and Probert, 1996). The architects suggest that good solar orientation is also important and passive design strategies have their place in the reduction of energy consumption.

“Overheating is a big problem, so passive ways of mitigating against this are worth investigating – solar shading, light shelves, louvres etc.” (Architect 8, interviewed 28/01/2016)

“We primarily do that through the building envelope which is how the windows, walls, etc. perform. You can achieve some very major reductions by really being smart about the envelope but that also requires upfront money, upfront expense in order to use the best materials.” (Architect 1, interviewed 16/05/2016)

A feasible measure in the constructions of high-rises and other buildings, minimising the energy consumption, is using less energy through passive solutions, mainly natural or hybrid ventilation (Xia, Zhu and Lin, 2008). Water management, energy saving appliances and light are also mentioned as successful strategies. Energy efficient windows are also a solution that has been pointed out.

The next question is what envelope should have the sustainable high-rise building. The building envelope has a particular influence on the thermal performance of the building; a failed design of the envelopes may end with unsuccessful thermal insulation due to the thermal bridge, which is largely unknown designers. Sills with cold bridge may result in more than 50% heat load in winter, even with otherwise heavily insulated building envelope (Zhu and Lin, 2004). Higher energy consumption in high-rise residential buildings is due to the fact that envelopes are not airtight, and the walls are not thermally efficient. Air leakage rates in high-rise buildings significantly exceed those in low-rise buildings. Typically, high-rises are not well insulated, have

poorer windows, and more thermal bridging than low-rise residential buildings. As well, their ventilation systems mainly work without the advantages of heat recovery (CMHC). The architects talk about highly efficient glass, low-e on the window, low conductivity, shading and durable materials. Buildings that want to provide views logically have more glass which has to have a lower impact on the energy consumption, both for heating and cooling.

“One aspect of living in a high rise building as opposed to other types of housing in an urban centre is the importance of views. People are drawn, in part, to a high rise building to have views. To take in the ever-changing landscape of a city. As a result of this highly efficient glass is an important aspect of the envelope. There have been experiments in developing Photovoltaic panels that are transparent that could clad a building as well as being a power source.” (Architect 4, interviewed 19/04/2016)

“It is too expensive to implement a lot of the time energy efficient envelopes, you obviously have windows, you try to use low-e on your window, you try to use window that performs well, if it is darker you get less light, there is a balance, low conductivity is pretty good, gives you pretty good energy savings, also not that bad looking.” (Architect 5, interviewed 19/04/2016)

“Most of our buildings tend to be all glass, they are not all vision glass, so the biggest impact is the U-value of the window systems, our projects they are all high-rises, they are very sensitive to cost of the external wall, so you don't see things like triple glazing in most of our projects, we try to use good, slightly better than the market frames, and we use very high-performance glass. One issue is when you don't have vision glass, it's hard to stick a lot of insulation behind it because it creates moisture problems, so we are working on a wall system that is inexpensive but will allow us to use more insulation, in the plain with the glass.” (Architect 6, 05/04/2016)

Recyclability is another important trend. Prefabrication could be a useful part of the process. There is no consensus among the architects what is the best solution, except on the efficiency of the glass that is preferable for good envelope performance. Besides recyclability, some architects

look at prefabrication as a way to increase quality and productivity. The building envelope has to cost less, be robust, energy-efficient, green, healthy and comfortable, intelligent (Haase and Amato, 2006). To end with sustainable envelope, there have to be a relation between sustainable energy performance indicators suggested. According to a relevant survey, the following sustainable energy performance indicators were cited for building envelope sustainable performance assessment: energy efficiency, environmental impact, cost, social benefit, material efficiency and robustness (Mwasha, Williams and Iwaro, 2011). The necessity for insulation in winter and the influence of solar radiation in summer must be taken into consideration when designing energy-efficient buildings (Feng, 2004).

“When we can and when the budget and the local construction industry supports it, we like to use a unitized system, we like to have enclosures that are fabricated and assembled as units offsite, we find that gives us a better enclosure and better weatherproof, well-sealed enclosures, if we can we like to use a unitized system, also the prefabrication of the units makes the site construction more efficient, less waste, when units are fabricated offsite, the waste can be recycled in safer manner and it makes the system more air tight, we are trying stay up to date on the latest technologies on relative on coding and glass so many of our buildings are using the state of the art coding on the glass and then in addition to that we are also always looking for a way to the enclosure to have elements that provide the appropriate shading based on its orientation. So, you will notice in many of our high-rise buildings we have a series of shading or elements that help cut the solar gain on appropriate façade.” (Architect 12, interviewed 22/06/2016).

“Some things here are obvious – low maintenance, high thermal and air tight performance etc. Others perhaps not so obvious. The robustness of materials is important. Many cladding materials can rapidly deteriorate with weather and UV exposure, so the choice of materials that “wear in rather than wear out” is critical. Pre-fabrication is a potential area to be investigated to ease construction. Winter gardens also worth mentioning as more useful outdoor space that is

protected from wind and rain. Self-cleaning surface finishes can be useful.” (Architect 8, interviewed 28/01/2016)

The thermal performance of the envelope is the essential part in the creation of an efficient and sustainable result. Cladding systems of high-rises must be a simple and sustainable solution. Therefore, façade system integration with the structure in designing a sustainable tall building is crucial (Elnimeiri and Gupta, 2008). The double skin system utilizes natural ventilation as a basic facility to improve energy efficiency and is considered to be a healthy solution. Besides it is very economical-initial construction increase by 8.5 percent but during exploitation, the energy consumption is less by 40 percent (low life-cycle cost) (Ng, 2010). The long-term research indicates that a double facade improves ventilation in high-rise buildings and buildings exposed to outside noise. The pluses of double facades in the buildings researched are: sun shading elements (louvers) protected from the wind in the facade space; reduced noise; opportunity for ventilation during the night; independence from all wind conditions with no negative thermal effect on the room temperature (Pasquay, 2004). High-rise envelopes present an opportunity to act as energy production units by implementing energy production systems into their façade systems. Hence, modern buildings can produce over 30% of their total energy demand on-site. This will contribute to the global and national share of clean energy production, reduce adverse environmental impacts of energy production and keep fossil fuels available for the future (Leeuw, 2016). The architects did not discuss these valuable aspects of the building envelope, mostly because in real business situations the cost curbs the enthusiasm.

The next question is are geothermal energy and solar panels applicable for residential high-rises. In general, exploring renewable energy sources is crucial. This refers mainly to high-rise buildings, which offer significant possibilities for using sustainable sources such as solar energy, because of their extensive facades, which provide a great area to utilize (Lotfabadi, 2013). Space heating is accountable for the largest share of household energy. Carbon-intensive energy

consumption in the UK must be decreased as a way to mitigate climate change. This is especially valid for electricity, considering the UK's high part of coal-fired power stations. To decrease UK dependence on imports, gas consumption should be minimised. In this context local resources of renewable energy (solar, wind, biomass, waste and micro-hydro) provide alternative in a long-term. (Roberts, 2008). Photovoltaics are environmentally friendly mean for electricity generation which proves even more benefits when it is implemented in buildings. The building actually can act as a support structure for the modules, and simultaneously PV modules can be an integral part of the building, as a weatherproof roof or façade element or as a shading device. With these benefits, it can be predicted that PV will become a frequent element in newly erected as well as refurbished buildings (Sick and Erge, 1996).

“Geothermal power and solar panels are absolutely suitable for high-rise residential buildings, like I said earlier, if we 99,9% of energy of everything on earth it comes from the sun, it goes to the plants, the plants turn it into fossil fuels, you know, when they decompose or animals eat the plants and then turn it into fossil fuel, but everything is coming from the sun, so if we can skip all those middle sources and get it to the building directly, that’s great. Solar panels today are not as efficient as they will be, but ultimately I think that’s absolutely true.” (Architect 2, interviewed 07/05/2016)

“Our buildings tend to be skinny so they don’t have enough roof area and it is very expensive to integrate it into the façade, but we just finished a building in San Francisco that has solar power, two water collectors on top of it, but it is a fairly small percentage of the energy used, for geothermal, we haven’t done it for high-rise residences, because of the first costs are high, but we did look at it in one project, I thought it is really interesting, we looked into integrating foundation and geothermal, these are very tall buildings, usually piling foundations, it means you already drilling down, to the ground which is what you do with geothermal, and that’s actually expensive part of geothermal, so we were looking at integrating the geothermal into the piling but it is complicated because all of a sudden you have to pour concrete and you have to

put pipes, but I think it is an interesting idea because you are using something you already spending money on.” (Architect 6, 05/04/2016)

Some architects, however, see obstacles in front of implementing these technologies.

“We have looked at solar panels and geothermal energy in certain projects, the expense is such that it makes no sense of using it in a high-rise building.” (Architect 4, interviewed 19/04/2016)

Geothermal energy is the energy produced as heat inside the Earth. The energy source originates from the planet structure and the physical processes observed there. No matter the large amount of this energy, in literally unlimited quantities in the Earth’s crust, and even more in the deeper parts of our planet, it is unevenly distributed, rarely concentrated, and often in industrially non-obtainable depths (Barbier, 2002). Only a small part of the geothermal potential has been used till nowadays, and there are great possibilities for an accelerated use of geothermal energy both for electricity generation and direct applications (Fridleifsson, 2001). Geothermal energy is usually regarded as a renewable source of energy and as such is compared with solar, wind and biomass as alternative energy options, in resources promoting geothermal energy. It is also considered environmentally friendly, because it is associated with negligible amounts of greenhouse gases (Rybach, 2003). Altogether, the architects agree that geothermal and solar panels are viable options, but often they are not implemented due to initial cost or lack of roof space. Particularly problematic for incorporating geothermal energy is the need for a large area for the installations.

Summarizing the answers of the architects, some important issues emerge. For the environmental sustainability of the high-rise buildings it is important to have energy efficient envelope, and efficient mechanical system, to make an effort to reduce energy consumption through good insulation and low-e glass, energy saving windows or simply by using less glass. Some other interventions are water use management, electrical car chargers in the building and use materials that are recyclable and harvested locally. Geothermal energy and solar panels implementation

depend on the features of the project and how economically viable is to use them, but they are definitely applicable for residential high-rises. These points answer the research question what are the principles of a sustainable high-rise.

7.3. Design features ensuring high quality of life

The next question is what design features provide residents with high-quality of life. Simultaneous tendencies for residential centralisation and decentralisation show that people's perception of their quality of life seems to be dependant by complex and sometimes contradictory factors. Without a doubt, quality of life factors affect different structures of population movements. To assess these variables the objective conditions and subjective perception of urban quality must be considered, and the related amount of satisfaction or dissatisfaction. An effective appraisal of the quality of life cannot be achieved simply in terms of the physical factors of the built environment. It also requires taking into account the social, psychological and cultural factors of the environment, such as identity, safety and social inclusion and representation (Fadda, Jiron and Allen, 2000). Incorporating amenities for more social life and accommodating different lifestyles increase the satisfaction of the residents with their lives. This helps developing a sense of identity and social inclusion.

“I think that roof terraces are great amenity as well as winter gardens, I think that they can be fabulous sustainability features, it helps the building breath and recycle air, but are they a solution for creating the informal neighbourhood feel that you get stepping outside in a neighbourhood. I don't think so. Because you have to choose to go to that destination to the park. And so I think having those resources is key and I think they do add to a quality of life, but what I think what we haven't solved is something you feel every time you walk down a hallway in a residential building which is that hallways are alien.” (Architect 2, interviewed 07/05/2016)

“There is a number of features that characterize the high quality of life within a high rise building: As discussed above, access to light and views is critical. Amenities for social interaction, exercise and entertainment; Well-designed units that can accommodate different lifestyles; Location, Location, Location; Access to transportation, work, green spaces, groceries, entertainment, cultural activities, etc.; Concierge services; Providing a connection with nature with exterior spaces and landscape elements.” (Architect 4, interviewed 19/04/2016)

Quality of life" is related to life satisfaction, largely subjective factor that might vary, multidimensional components that can be physical health, psychological state, level of independence, family, education, wealth, religious beliefs, a sense of optimism, local services and transport, employment, social relationships, housing and the environment, cultural perspectives, values, personal expectations and goals of what we want from life" (IESE Business School). So it is a struggle to relate the influences of the high-rise building to these various life factors. One of the biggest problems the architects mention is the isolation and the need for balance between public and private.

Public spaces such as cafeteria or dining room can mitigate the effects of living far over the street and support interactions between neighbours. A lounge, swimming pool are also amenities that can enhance the quality of life of the residents. Roof terraces introduce nature into the building with its well-known therapeutic effect on the mental health. Sky gardens related to ecology unite greenery space with the built environment. The sky gardens usually fulfil landscape areas role for public recreational uses. Nevertheless, it should consider if the wind speed are too high on that building altitude. Available solutions include addressing high pedestrian wind speed, producing discomfort, by the implementation of compact or porous windbreaks or wind guards. (Yau, 2002).

“There is a number of things, one is the layout of the apartment, we used to see a lot of subdivided space, a lot of no windows, now we really focus on the view of exposures, views and lights, and try to maximize windows where the cost will let us do it. We used to do a lot about the ventilation of the apartments, used to be above the norm, now the code has caught up with us so now it is a

pretty standard for kitchens and things like that. Everyone wants flexibility for every sort of new technology, that comes by, so everyone wants to be able to control their systems with their phone, so in one of our projects you will be able to control your thermostat with a telephone app, pretty soon your fridge will talk on your phone, we have one project where instead of shades on the windows there are electrochromic glass so those windows if you have an app on your phone you can darken the glass. And if you don't do it manually, the building will take over and optimize it, so if you are on a really sunny side of the building in the afternoon and you are not home, and you don't control with your app, the building will take over to darken the window and save energy.” (Architect 9, interviewed 13/06/2016)

“Balconies or sky gardens, or public spaces that allow the inhabitants of the building and even the inhabitants of the surrounding environment to have access to light, air and views, so that maybe balconies, sky gardens, things like that.” (Architect 12, interviewed 22/06/2016).

“So in terms of comfort of residents, lifestyle of young persons, is really changing in terms of not necessarily have a big house, a big apartment, it's really about where you live and the things that are connected near you, so the idea the city itself be your living room, and when you go out you meet up with people, things like that are very important, so location of the building plus the idea of supporting certain lifestyle that gets more young people into the centre of the city.” (Architect 10, interviewed 23/06/2016)

The benefits for the public health are numerous from the inclusion of greenery, natural light, and visual and physical access to open space in different types of buildings. Landscaping role should include measures for conserving water and protecting wildlife habitat (Jackson, 2003). Another factor for providing comfort and subsequently high-quality of life is access to light, view and air. Planners should find chances to give residents control over the indoor environment (temperature, air flow, lighting) as much as they can to increase comfort, satisfaction, and productivity as well as interior conditions flexibility (Wener and Carmalt, 2006). The design of façade, glazing and ventilation of the building can contribute to improved comfort and more

sustainability. The behaviour of the occupants is also accountable for the thermal comfort in the unit. There is technology available to reduce the vulnerability to the thermal discomfort of the residents, it is only a matter of policy and planning to realize its implementation (Smith and Levermore, 2008). Some of the architects anticipate this technological advances.

The architects help answer one of the research questions: what are the principles of sustainable residential high-rise in connection with quality of life. They talk about roof terraces winter gardens access to green spaces and entertainment as ways to enhance the quality of life. Also important are a concierge, windows that provide great views, proper ventilation, a location that can support a certain lifestyle with proper facilities, issues already mentioned as sustainable.

7.4. Residential high-rises and the placemaking process

The next question is what is the way to include residential high-rises into the placemaking process. In general, the large scale and visual impact within the urban settings of the high-rise buildings interact negatively with the cultural context and the vernacular character of the place. Nevertheless, well designed, properly located towers can arguably assist placemaking and act as focal points that promote new urban developments around them and enhance economic growth and social life (Al-Kodmany and Ali, 2012).

“And the way that placemaking through residential buildings, larger multifamily residential buildings today is really created through what happens on that first floor and frankly time and time again that placemaking is created through retail experience or through another kind of program. It’s really enlightening that that ground floor it’s creating the type of destination or environment that people will typically go.” (Architect 2, interviewed 07/05/2016)

“There are few aspects. First is we are creating a tall building in an environment that is the edge of the city centre. So we wanted to create a building that has a presence and is visible in the skyline and expand the city centre. The building is a real marker that brings people to come and

then go to the city centre. On a more local, level we made connections on the ground level. If you are on your way to somewhere you can pass through the building which is an interesting experience. So the building is really very opened.” (Architect 7, interviewed 28/01/2016)

Placemaking is the process of developing urban settings that support pride and ownership of both physical and social environment. The sense of place is the mental reaction that stems from comfort, satisfaction and attachment with a well-designed area. The immense size of the towers often leads to placelessness. Furthermore, the mono-culture of North-American design has been promoting similar universal design templates world-wide ((Al-Kodmany, 2013). The architects stress the importance of active ground floor, where people participate and experience the sense of place. This means that generic designs will not fulfil the requirements for considerate design and the contexts and the needs of the whole neighbourhood must be observed in combination with features that enhance the functionality, the levels of satisfaction in the users and the identity of the place. The process involves the creation of interesting public spaces, the location of the lobby and the responses to the functional gaps in the urban fabric. Access to tall buildings should emphasise on ground floor connectivity, and the entryway should be clearly visible (Al-Kodmany, 2013). The building might have a retail or a business centre, often coffee shop is quite useful, but it has to complement what already exists in the area. Reunification with nature, pocket parks, promenade if there is a water body, are very helpful in creating meaningful places. Massing, dividing the mass into chunks is a viable approach for reducing the impact of one large solid form.

“An urban residential high-rise must take into account the scale, texture and demographics of its context. In this way it can contribute to the history of the place. We are currently working on a new residential high-rise on an infill site in Old City Philadelphia. There is an existing mural on one of the party walls that we are preserving as part of the lobby and automated carpark. The people have walked past this mural for many years and we felt it important to preserve. At 35+ stories, this will be a large building compared to its 3-5 story immediate context, so we are dividing the mass into “chunks” that are similar in size to the surrounding buildings. We are then

inserting the amenity and social spaces between these volumes. We see the socialization of the building as the glue holding together the masses.” (Architect 10, interviewed 23/06/2016)

Placemaking is enhanced directly by the social life of the tall building. A place without social life is useless, participation and social interaction are crucial for the sense of place of the building. Social life and economic viability are closely related: services attract people and produce crowds that foster liveliness. It creates a negative impact to consider only automobile access for high-rises because less people will use the street level and the social life of the building will be diminished. The convenience for car users from drive-through high-rises is at the expense of social life and fulfilling human interactions (Al-Kodmany, 2013). One of the architects give for example a building in Florida which ground floor is a parking garage. It causes placemaking problems and this is the reason like they suggest the implementation of robotic garages for high-rise buildings with all the implication for placemaking. Amenities help activate the streetscape.

“In Florida until very recently we had issues with the base of the building. It’s a garage, parking garage. That doesn’t make for a pleasant social environment or a street pedestrian environment, and so what we have done recently is robotic garages which largely compress the reasons for the garages to be there. That allows for the removal of the garages for the ground which then start to answer the question of placemaking. Because then you can have pedestrian use and amenity spaces and all the kind of uses on the ground where before you had a big garage.” (Architect 11, interviewed 22/06/2016)

“The base of the building and how it meets the street and the type of uses located at grade level are critical to creating better places. The building has to participate in activating the street and adjacent side walk. For example, Enough setback to provide outdoor activities, a Retail Base, if possible with outdoor seating, Open Lobby, Amenities such as the Gym, Party room and other around the clock activities to help activate the street. This puts eyes on the street and assists in creating a secure and active environment that enhances the place. The type of Architecture, in many cases Contextual Architecture, where the new building weaves itself into the fabric of the

neighbourhood typically enriches the place and neighbourhood.” (Architect 3, interviewed 25/08/2016)

Placemaking includes several highly interdependent dimensions such as physical, psychological and social. Physical dimension strongly depends on the mere nature of the environments. Cultural references are interesting because of the historical meaning and the identity they evoke. Psychological dimension integrates the perceptions, along with the unconscious and conscious emotions supported by experiencing the surroundings in time and space. Social dimension resides in the emotions, experiences and memory created through the history and culture of the environment along with the social interactions. Physical objects can symbolize and reflect cultural and historical references inherent for the area, fostering pride or attachment to place. With good design and connection to the context, high-rises can lead to an imageable or legible city that enhances civic life, create citizen’s pride, and assists navigation and orientation of residents and visitors (Al-Kodmany, 2013). The architects note the ability of the high-rises to act as a landmark, for which purposes the architecture doesn’t need to be outstanding, the building just needs certain civic dignity.

“Placemaking is important at the base of the building, we also try to consider placemaking relative to the tower itself, and how the tower meets the sky, looking for a way the tower to improve the overall silhouette and overall character of the city view. And what the profile the city and the city scape look like. In urban conditions, we are also thinking very deliberately about how to preserve to the best of our ability the views that exist for the neighbouring buildings and also to create wonderful views for the new buildings. So, often the form and the places of a building is very much informed by its neighbours and adjacent towers.” (Architect 12, interviewed 22/06/2016).

Their role in enhancing the city silhouette and skyline is also an important part of the placemaking and their physical and social dimension since it affects the general perception of the citizens of their environment and creates objects of attachment and stronger identity.

The architects talk about different means to include residential high-rise buildings in the placemaking process, which is ultimately sustainable because satisfies the need of the residents of the various and functional environment and in the same time enhances their quality of life by supporting an interesting and diverse lifestyle. So it answers what are the principles of sustainable high-rise buildings.

7.5. Barriers in front of including sustainability into residential high-rises

The next question is what barriers are preventing from integrating sustainability into high-rise buildings designs. The popularity of sustainable buildings has been obstructed by certain issues. The building industry is fragmented and with negligible vertical integration. The industry is very conservative concerned with the long life of the product and liability. There is a misconception that more energy-efficient buildings are less comfortable, which is often opposite of the true: a prominent sustainable building provides better ventilation, increased comfort in all seasons, better daylighting and more individual control. (Glicksman, 2006). The architects also mention the industry and some speculative players that are more concerned with profit than with sustainability. Integration of function in one element can be a solution for a small budget. The more affordable the units are, and with more sustainability features the more attractive the life in a high-rise becomes.

“It is the cost. And it’s because the industry is very slow to respond, there has been a lot of things happening the change that but building buildings is a very expensive proposition that’s right up the edge, you know, it has to be profitable enough for the person who’s putting the money down for him to be worth risking, and what I think would be interesting today creating sustainability in the developer’s mind is putting more money in, and as the building codes are incorporating more of those elements, becoming required, and what is the risk of this projector is that as the cost of the sustainable elements goes up, the ability for the buildings to include some of the amenities

spaces like roof terraces, winter gardens and building common spaces that don't collect rent directly, are at risk because the more money that it takes to build the box, the less money there is to spend on things that make the box interesting.” (Architect 2, interviewed 07/05/2016)

“Well, I think some of the biggest barriers are always cost. You know, when we design the building we never have a situation where we have an unlimited budget. High-rise residential and office buildings always have a performance that they have to meet in an established budget, so you know, part of the trick is just try to find a way to accomplish some of the things we have spoken about, in a cost-effective way. Often times that means having design elements or design components which serve multiple functions. You ought to be very thoughtful about how to develop and assemble to make them cost-effective.” (Architect 12, interviewed 22/06/2016).

“Putting every single amenity that we want in the building really has to do with cost and space, there is a limit to what we can do and we look at each project differently and decide what is best, sort of maximize what are efficient mechanical systems, efficient windows, or whether it's an amenity that's important to people like a place to wash your dog or a place to repair your bike. We just face limited space and limited funds and we just have to choose those very carefully.” (Architect 9, interviewed 13/06/2016)

The architects agree irrevocably that the biggest barrier in front of implementing sustainability in residential high-rises is the cost. The attitude of the developers towards the size of the investment defines how much amenities and new technologies will be presented and often there are trade-offs to save money. However, the situation is improving and nowadays many green solutions are actually cheaper due to increased competition and experience in manufacturing them. There is a number of barriers to integrating one sustainability feature in high-rise buildings: a green roof that architects did not mention and we can suggest they are not so important. They are lack of governmental incentives towards owners and developers, technical difficulty for designers and contractors, the old age of the existing buildings, problems with withstanding wind load, weak

structural loading, poor utilities management, lack of awareness and promotions. (Zhang et al., 2012). These barriers can be well accurate for sustainability in high-rise buildings in general.

One of the problems the architects unite about is the cost, which has to be overcome by the sustainable design responses. This answers the question what problems the sustainable design responses need to address in residential high-rise buildings.

7.6. Weaknesses to learn from

The next question is are there some weaknesses we can learn from. Architects do not discuss some well-known weaknesses, which indicates that in socially and environmentally sustainable high-rises the problems are less severe. As it is a high building it is away from nature, and people may feel isolated. Separation from nature can especially affect young children. High-rises researched in the literature are known to be associated with behavioural problems (Gillis, 1974; Ineichen & Hooper, 1974; Richman, 1977; Saegert, 1982 as cited by Wells, 2000), less outdoor play (Churchman & Ginsburg, 1984; BDOE, 1973; Gittus, 1976 as cited by Wells, 2000), and poor physical health (Fanning, 1967; Goodman, 1974 as cited by Wells, 2000) among children. It is highly probable that these negative results are an outcome from being removed from the ground which deprives the residents of the recreational effects of the natural surroundings. Research on the action of nature proves that this is the case.

There is plenty well-supported evidence that contact with nature has positive effect on the well-being (R. Kaplan, 1973; R. Kaplan & S. Kaplan, 1989; R. Kaplan & Talbot, 1988 as cited by Wells, 2000), physical (Moore, 1981; Ulrich, 1984; Verderber & Reuman, 1987; West, 1986 as cited by Wells, 2000), and cognitive aspects (Cimprich, 1990; Hartig et al., 1991; Tennessen & Cimprich, 1995 as cited by Wells, 2000). In addition, the abundance of trees is discovered to cause promotion of children's play and access to adults (Taylor et al., 1998 as cited by Wells,

2000). In addition, interaction with nature is connected to better motor coordination and attentional capacities among preschool children (Grahn et al., 1997 as cited by Wells, 2000).

However, there is a problem with the proliferation of generic high-rise architecture that does not allow for the creation of strong identity and civic pride. These sentiments are important for the creation of place attachment and the feeling of being home, which greatly affect the quality of life. They are also crucial for the enhancement of the sense of community which comes with the feeling of belonging to a significant entity defined by strong unique attributes, not necessarily unique architecture, but arguably memorable environment.

“I think that somebody always wants to know, or be on the point that’s my house, there is a challenge in creating good civic architecture that, you know, not every building wants to be a squiggle, they all want to be a certain rhythm and fabric to a city, but everybody still want to be able to identify where they are and have a sense of place, and I think that most high-rise residential today, in particular, there is a real challenge to be able to have these landmarks within the architecture or within the experience that lets somebody to point and say that particular group of windows are my windows. And I think that that would help, being able to do that, having the architecture respond that kind of way would help somebody to feel more connected with the architecture with the environment, will be able to understand their relationship from the inside and the outside.” (Architects 2, interviewed 07/05/2016)

Another downside is the lack of long-term perspective in terms of choosing high-quality for a higher cost, but instead cheaper solutions are preferred and this affects negatively liveability and consequently the quality of life. It is not even cost effective because people often remodel the flats for an additional cost to get better quality. Poor materials and craftsmanship are long-term problems that negatively affect the quality of life.

“So cutting down on cost like that and choosing the cheaper roof, cheaper windows or less expensive mechanical systems, just has a long-term cost for the value of the building, for the

environmental performance, for liveability. And when people are so sort of driven by the market and what is important in order to make people rent or buy and live there you find if you are so fashion-driven you can ripping out flooring are repainting, and replacing finishes just to keep up with fashion. And that's a little bit wasteful.” (Architect 9, interviewed 13/06/2016)

Another problem can be the small apartments that are not orientated to families with children which greatly affects the social climate in the building and thus ruin the variety of social interactions that one can have within the building, negatively affecting the quality of life of the residents.

“The apartments are quite small and it was designed just before the recession and it was the market, what the agencies said the people wanted. Also, the city centre does not have many infrastructures for families, so it would be unrealistic to imagine that we could have families living there, but definitely we do not have any family units and the apartments are quite small. So it is limited to single professionals and people retiring.” (Architect 7, interviewed 28/01/2016)

Another problem is that the neighbourhood relations may vanish. High-rises worsen social and psychosocial issues, especially frequency of contacts with neighbours and control and recovery at home (Kearns et al., 2011). However, the interviewed architects are designing buildings with plenty of public space so this problem does not seem to be present in their buildings. The architects comment overload of the infrastructure and disturbance from the neighbours which can be avoided by considerate design features and location. However, it is frequently asked is there a sense in further densification, while the densities are already high, and associated exactly with infrastructure overload, overcrowding, congestion, air pollution, health hazards, lack of public and green spaces and deteriorating environment (Hardoy et al., 1990, as cited by Burgess, 2000).

There is not much common ground on this question, the answers vary from excessive parking to problems with the security. One architect criticizes the small corridors and suggests building with direct access. This will allow for utilization of the public space for spaces for interactions and

other amenities. He is supported by a colleague who thinks common areas should be replaced with amenities. The third architect also criticizes the small hallways and repetitive floor plans which do not allow for social interactions. The lack of social interaction seriously damages the social life of the residents and their quality of life.

These weaknesses answer the question what problems the sustainable design responses need to be addressed in residential high-rises.

7.7. Social values and residential high-rise design

The next questions is what social values the designed high-rises support. Architecture performs certain functions for the society and as such inevitably supports certain social values if properly executed. It creates memories and fosters communication, but also represents values and expresses the sense of place. High-rises are very specific, they often constitute one large structure where a proliferation of small buildings won't work. As such, they are in the position to affect the lives of a large number of people and solve existing social problems which makes it very important that they incorporate certain social values. Metaphors such as openness and transparency as an expression of freedom and democracy are in the palette of the architects with great potential to be used and to be appreciated by the public. Size is by itself a powerful conductor of the idea of togetherness. Architecture is a response to the human needs, but we live in a society so these needs are shaped and expressed through social values that allow us to exist together. There are many concepts on what the perfect human habitat should look like, some of them were successful and endured, and some did not.

However, in the rapidly urbanizing world, high-rises become more and more ubiquitous building typology and that puts the architects under pressure: they need to design pleasantly looking, comfortable buildings but they also need to harmonize their work with the traits in the society. For example, demolishing slums and replacing them with high-rise complexes should be done

sensitively, with a percentage of affordable housing implemented so a mix of different income families to be able to occupy them thus creating a multifaceted society where people can learn from each other and thrive together. A project like this can lead to sharing of different tradition and erase the division lines in the society. Such an approach also promotes respect, tolerance, inclusivity and humanity, all important social values. The architects are talking about mixing affordable and high-class housing for mutual benefits. This way social inclusion and equality are supported.

“If you have an entire development of just low-income housing, we found that it does not work. But when you mix, the mixes of income, in a building or in a neighbourhood, that’s when it works, because learn from each other and everybody grows together and I think it is the biggest part of it is housing equality and social justice.” (Architect 3, interviewed 25/08/2016)

“I think that the best that we can do is create an environment where people want to be, where people are happy, healthy, and excited to be there and make people excited about participating in whatever environment that is, so you know if it’s a park to make them want to be a part of the park, if it’s a high-rise building, it makes the want to be a part of the community that also lives in that building. The ways to do that, the architecture can only provide a small part of that, how the building is managed, who are the faces, the individuals, so it is all part of a big puzzle. I think everybody wants to be able to know, nobody wants to live in something totally generic. They want to be a sense of place, a sense of identity.” (Architect 2, interviewed 07/05/2016)

Another example is the cherished connection with nature, by green surroundings, winter or roof gardens. Being close to nature is a basic human aspiration that not many tall buildings recognise. Or providing a number of lounges through the building, that will work towards social interactions and good neighbouring relations, these are all social values that can be supported by the design of a high-rise which should also account for the young, elderly and the disabled with comprehensive spaces and programs. It is not a good testimony that the high-rises are still

regarded as unsuitable for families with children. Optimizing the opportunities for interaction can positively affect the quality of life.

“In a case like this what we wanted to do was maximize the opportunity for interaction, sure you know an anthropologist named Robin Dunbar. So Robin Dunbar has this concept on interaction like how many people can you know, how many friends can you have, how many real friends you have versus just acquaintances, and he talks about these models of numbers like there are groupings of people that create good neighbourhood groups, friendship groups. What we try to do with the layout of the floor is series of apartments or public spaces we try to map those as best as we can and aim at those numbers. If fifty people on a floor is really a maximum number of people that really interact and know each other so there is the social psychology, social engineering of how many friends can you actually have, versus how can the building support those groups of people, it is what we looked to in terms of when we are designing the building.”
(Architect 10, interviewed 23/06/2016)

“The roof decks, in Chicago we have short summers, the roof deck really get used by people. That’s definitely a place where you can meet someone, interact with someone. You see people in the lobbies but everybody just walking by, but specifically in the outdoor spaces people will seek something else because they don’t have these things in their units, so these can be really valuable spaces. The design has created opportunities for them to do that. I mean, it is not just the pool with a bunch of deck chairs, there are different kinds of spaces. We see on a lot of these decks which are usually pretty big, we see spaces like smaller seating spaces and areas with grills, they are better connected to the indoor spaces, so I have indoor space that has a kitchen, catering. The result is that you create spaces where is more likely to interact with your neighbours. It doesn’t happen on the floor where you live because the corridors are so narrow, and people feel uncomfortable, nor in the lobby or the parking garage, so those amenity floors are really the only opportunity for that.” (Architect 6, 05/04/2016)

The interviewed architects talk about the environment that the end users enjoy, or as some architects unite around that notion: building sustainable building type for many people to experience. High-rises are often located in well-developed neighbourhoods where living in a high-rise should give you walking access to great restaurants, places of social interactions, public transportation and possibly the place of employment, thus reducing dependence on cars. They should enhance and improve this environment both by appearance and mix of functions, and provide the urban structure with a large number of people to make it work. If done properly, residential high-rises can foster social interactions or even create wealth. They can also contribute to the sense of place and enhance the feeling of community. A place can be understood as the environmental experience which affects the behaviours and the cognition of people experiencing it. Like the place, the community has many definitions, such as a place inhabited by people with common interests, values and culture.

“So I think the key is benefiting all the users and the location, the community. Encouraging interactions, and feel like one single community. But our different projects have different focus really, about what is important for that project in that stage, and the client, so we really like to think that we think of the project from all aspects, and then make the most of it. Each building is very different.” (Architect 7, interviewed 28/01/2016)

Residential high-rises are intrinsically prone to affect the community since they usually create a strong image and put people together, but more is needed to be done by the architects: working for attributing a strong identity to them and capitalize on the great number of people by fostering communication and face-to-face interactions. It also allows people to fulfil their basic aspirations such as having a view. The architects say in many places it can be difficult to address all these issues that is why in the UK, for example, high-rises are not a favourable choice, but everywhere certain measures can be taken to improve quality of life if a sound design philosophy is in place. All these mean that there are a lot of social benefits from building high residences.

This question discusses the socially sustainable aspects of the design of high-rises and in the same time by commenting amenities, mixed-use and affordable housing draw a connection to the quality of life, so it connects principles and solutions in high-rise buildings.

7.8. Milestones in the design philosophy of residential high-rises

The next question is what the milestone of the design philosophy of urban design with high-rises are. The design philosophy is a concept formed by the architects' education and work experience that captures the general attitude of the architects towards a project. It encompasses factors such as aesthetics, functions and economics, without which the architecture cannot fulfil its primary goal: to create timeless, liberating, delightful spaces for the activities of life. It is guiding a complex discipline such as the architecture that integrates multiple skills such as mathematics, science, art, technology, history and philosophy. Exactly the philosophy of the practice is what defines the rationale by which problems are solved. Rationalism, empiricism, structuralism, post-modernism, deconstructivism and phenomenology are all philosophic notions influencing the architecture. The process is going beyond the simple appearance and must define priorities that will lead to the satisfaction of the various needs of the people who use it.

To end with enticing architecture, a holistic approach must be adopted. It includes sensitivity to the context, to the requirements of the placemaking, meticulous study of the materials used for rich and fulfilling visionary experience, exploration and experimentation with different ideas. The thoughtful making of place requires the application of tested and proven principles, which every architect invents for his work. The design philosophy is requiring subjecting the architects' creativity to certain outlooks and principles that will result in comprehensive and functional final outcome. Relevant themes are sustainable solutions, thought-provoking design and dialogue between the vernacular and the innovative. These ground points can lead to the creation of architecture that reflects our time, is environmentally healthy both for the inhabitants and the

surroundings and expresses the power of architecture to contribute to the daily experience. Functional requirements are of utmost importance along with climatic parameters, especially the indoor climate, ventilation and natural light are of crucial importance.

“We used to be really good at it, in the 19th century, when we had freezes that told stories and things like that, now the stories are more subdued, they are more about gesture and more about an idea. I think what we are about to see as we move forward we are starting to see it already is that story start to become more expressive again, maybe more literal as they talk themselves through, but I think our design philosophy is about who’s going to use the building, who’s going to use the space, how do they experience, how is a really core idea, a big picture concept help tie these experiences together so there is one cohesive idea. The connection with nature is absolutely important, our best work is in collaboration with, we collaborate with landscape architects a lot.”
(Architect 2, interviewed 07/05/2016)

With the inevitable depletion of energy resources, holistic design in urban centres is needed. It means the reuse of water, possible utilisation of grey water for irrigation, looking for opportunities for urban farming, alternative energy resources and so on. For a comprehensive design philosophy to be elaborated, certain goals must be fulfilled: solid understanding of the Client’s requirements and vision, and their amplification; responsible attitude towards our environment; creation of a contemporary architectural design that will last and utilises sophisticated building technology. Such approaches must be applied to the very essence of the buildings, incorporated into the building program and affecting the massing and materiality. Clearly defined design philosophy can produce buildings for our time, but respecting their historical context and environment; buildings which will provide service for several generations.

“So that’s what we do in early stages and once we had that information we go back to the site and figure what can fit there, what deficiencies is there now, we consider the shape of the building, we always consider the views and adjacency very carefully, we don’t like designing buildings that

have bad exposures, or if there are bad exposures, how can we make them better. And a pleasant place to live in. And from there we consider all sorts of a building matrix that affect the efficiencies of the building, so sometimes it makes sense to make a smaller plate to go higher, other times it really makes sense to build not as tall, make the building a little bit bigger on each floor.”
(Architects 9, interviewed 13/06/2016)

There is a great variety in the ways the interviewed architects design a project. They are considering who is going to use the building, how and what the clients' goals are. These are absolutely imperative objectives that ensure the functionality of the project and the fulfilment of social purpose. It is not embracing the Functionalism entirely, the aesthetics can still dictate many aspects of the building design, but simply ensuring that the needs of the users are met and the goals of the client are fulfilled. Most functional programming procedures simply define the quantitative amounts of space needed and some relationships between program elements. This is not enough for a comprehensive space program. For inspiring architecture, the inclusion of the qualitative aspect of the space program is needed: the character of the place is as crucial as its dimensions.

“So, in this case 850 residents, so in this particular case we grouped the smaller apartments together, and the larger apartments together, because we felt that all the students will probably be in a smaller apartments where one bedroom apartment or a studio apartment, for someone that is younger, and just started, so with less affordability. So we grouped those because we felt that those social grouping were important. So this is one milestone in the design. And then that coupled with this idea of these lounge spaces so you can imagine these 75-50 people that live in this surrounding area so they are very close to this particular lounge which gives them views to the south and also to the north, so even if you live in apartment always looking out through the window to the south you come to this space you can really get a better view to the city, because you can see both directions, so that I think was a milestone. The milestone of creating this place

so on a roof, 35 storey in the air, it really frames the city, so the idea of connecting those residences to the city, I think it was another milestone.” (Architect 10, interviewed 23/06/2016)

“So the idea is to what I referred is how do you stitch the fabric of the neighbourhood together. How do you yourself walking from your house to your job you are not worried, you see people, you see jobs, you see activities. You are enjoying yourself, you are not bored, while you walk. As you walk you can pick up your dry cleaning, grab a soda, so you try to design a building that contributes to the fabric of the city. You have the roads, you have your car, you have the utilities, how do you now start to fill in the missing pieces. And complete the city and complete this puzzle that the city is.” (Architect 3, interviewed 25/08/2016)

“We always start with the neighbourhood that we are going to build in, as well as the type of users that are going to use it. What sort of the demographic or the type of the people that are going to use the project. And then also we are trying to think about what kind of an impact the building will have on the skylines, try to think of the broad picture and keep all those things in mind when you start working on problematic elements like how many units are there going to be, how many two bedrooms, three bedrooms, the sizes of the units, that kind of stuff, sort of dictate the specifics of the project, but we always kind of start with the bigger idea. What you ultimately want to have, in terms of the form and the massing of the building. And the budget has a big impact on ultimately what the exterior of the building is going to be, how much glass going to be, how much concrete, all these nuts and bolts of what you can and cannot do. Even down to what kind of glass you will have on the building.” (Architect 4, interviewed 19/04/2016)

Some architects mention landscaping and active ground floor as equally important. Poor designs separate the nature from the urban settings seeing nature as something isolated from us. Obesity, autism, a decline in creativity—these the results of a lack of connection with natural environment. Because the evidence of diverse benefits is so obvious, contact with nature of our homes has become a vital element in the design of healthy housing. Connection with the nature may not only be represented by properly design surroundings, but by building elements such as roof or

winter garden. As for active ground floors, it is the way buildings reassert the importance of social, civic and economic encounter at street level.

“Here in Washington we are not doing a lot of high-rises, we are actually doing some in the suburbs, again for us, whether it is a high rise or a mid-rise building it starts with placemaking we like to work on interconnecting green spaces, around the site and a high-rise can be a very effective visual marker in a project here in the office we put the high-rise against the highway which makes perfect sense.” (Architect 1, interviewed 16/05/2016)

The comfort of the residents is another crucial issue. The notion represents the ultimate synthesis between design and use, leading to personal satisfaction. Even though the notion of comfort stays relatively subjective, there are certain factors that define it. Views, daylight, flat layout, materiality, sound, thermal control are all milestones that need to be carefully considered when creating a building that will shelter a great number of people. It may also mean prioritizing interactions between residents and design in a way to achieve it. The provision of comfort is closely related to ensuring high quality of life.

“Generally, we create a vision for the client and then the second step is convincing the authorities that the design is responsible and meet their rules. And then the viability of the construction comes after that, and then it goes for sale if it is residential or if it is rental building it goes to the construction with the drawings. We find in our firm that every building is different and nothing ever repeats. It has a lot to do with where the site is, there are so many variables, on the site itself, the rules and the topography, the position and what is it looking at, so in all those years, we have been doing this for forty and more years, none of our buildings is the same.” (Architect 11, interviewed 22/06/2016)

Finally, an important milestone is the sustainability of the project and mainly the energy performance. Minimal energy consumption is not only cost effective but also environmentally sound. This is why it is important architects to incorporate sustainable design practices

minimizing energy performance into their design philosophy. It is largely accepted that sustainability cost additional money and is not always compatible with comfort. This is exactly why the architects must find new means to achieve it that defy these misconceptions.

“Well, I think it is general over the last say twenty years sharpen attention to sustainability. And the progress in the profession and our firm has made there has been a tremendous amount of progress made on that front. It is definitely one of the key drivers of the design of that building type, it was the key drivers in terms of what one has to do to build in the curbed market, whether it is just in terms of what people are looking for in housing or in terms of what local government is looking for in terms of their approval of a high-rise project. The stipulations of energy performance are becoming more and more stringent every year, which is a good thing. It is driving the whole profession and the whole building industry towards more sustainable approach.” (Architect 12, interviewed 22/06/2016)

These approaches reveal how the architects create design that is intrinsically socially sustainable because they change the environment into lively and functional living settings, and in the same time enhance the residents’ quality of life meeting their needs, so this answers the question what are the principles of sustainable high-rise buildings.

7.9. Spatial program for the design of residential high-rises

The next question is what spatial program is viable for the creation of meaningful places around high-rises. The answers to this question encompass a large scale of solutions. Creating zones is important for harmonizing different activities without creating a conflict. It will allow people of all ages, abilities, and socio-economic backgrounds to access and enjoy a place, and take an important part in its identity, functioning, and maintenance. This is what makes a project viable. For example, the noisy and hectic places for children play should be separated by appropriate design means from the quiet retreats for the elderly. If there are busy streets around, a pedestrian

zone must be designed, with incorporated amenities, such as green spaces and seating. Zones increase the control and enhance the independent coexistence of function that otherwise will disturb each other.

“Try to landscape around it, create zones, but I think understanding, trying to understand the best you can what are the types of spaces that you are creating, and be very deliberate about them, the problem in the 50’s and 60’s with the towers in the park is that they were both these very abstract things that were sort of devoid of the reality of the world, there was a tower, situated into this kind of golf course and it didn’t really have any hierarchy or sense of place, but it was a very good architectural model, and I think we are all learning lessons from that. “(Architect 2, interviewed 07/05/2016)

“I think the landscape is critical, we had very good landscape architect, helping us on this, and essentially by creating a little pocket park there, it gives the building an identity at ground level. But also the spaces we have created at the fifth floor, and on the top floor with the roof terraces. About infrastructure for families with children, we have created a nursery and a crèche, so nursery for slightly older children and a crèche for babies. They have internal and external spaces, up at that roof terrace level on the fifth floor, we have also created a community space so it is essentially just a multipurpose for residents who would be able to use for community meetings or talks or discussions.” (Architect 8, interviewed 28/01/2016)

Another important point, made by the architects is responding to the needs of the neighbourhood. This will help integrate the building into the existing urban fabric and enrich the context. Their role as influential architectural objects is naturally to satisfy the physical, social and aesthetic needs of the society. Due to their size, high-rises make excellent focal points that can contribute to the legibility and orientation of the place. They can evoke the notion of power and prestige, helping a neighbourhood to develop a higher status. Tall buildings intrinsically stem from the necessity for higher density that provides opportunities to control urban sprawl and concentrate

activities. Understanding the activities needed in the neighbourhood is the key to establishing a healthy and vibrant community.

“That has to do with the context of the buildings we design vary from urban condition to less urban situation. And each one is very specific. Maybe the best way to talk about that is to provide you with two examples, I mentioned earlier the project that we did in Chicago, there it was adjacent to the river and so one of the responses was to set the tower back to create a south-facing public green space right by the river that steps down several levels to allow access to the river, to improve the river edge. So all that has to do with responding to specific conditions of the city, also to provide some pedestrian uses within the base of the building.” (Architect 12, interviewed 22/06/2016)

“So we worked with the grocery store to flip their activities. So we brought the coffee shop to the front. So when you walk by the grocery store you see a coffee shop. You see the bakery, you see the things that you really are street activities, you go in, grab a cup of tea, and a sandwich and walk out. The idea is, the sidewalks are wide, we have outdoor seating, all these restaurants have outdoor seating. Again people are seating outside, it's safer, you see people, people are seeing you, we used some art feature at the corner, which is sculpture, we created a plaza, a corner plaza with an art feature there. But we also, on the other hand, we created an alley between the two buildings.” (Architect 3, interviewed 25/08/2016)

Another claim of the architects is that the spaces around the high-rise need to accommodate different functions that everyone can enjoy. Functional diversity is related to satisfying a wider range of different needs and reaching for a greater number of social groups, enhancing the quality of life and strengthening the community. When culture, society and economics are taken into consideration, the functions of the spaces around the high-rises can establish a proper ground for the very existence of the building. In recent years, the connection with the context tends to be only visual: high-rises perform either as vertical extrusion of one-floor plan or as urban sculpture. This must be changed by a proper examination of the functional requirements of the place and

appropriate design intents. Another claim of the architects is that they often propose a green space. Urban green spaces are an important amenity with great value providing leisure possibilities and aesthetic enjoyment but has no market value which is why it is often neglected and underestimated as a need (Kong, Haiwei and Nakagoshi, 2007).

“The area between the base of the building and the curb. We try to maximize the usability and the enjoyability of those spaces. So we try to take the services, hide them as best as we can and then create great spaces for thing like cafes. Some of our buildings have direct entrances right off the street, so often we have like little yards for people just at the ground floor. We look at all those tools that we have whether it’s a dedicating entrance for people riding bicycles so they are not riding on the back or riding down the garage is safe, you know there is no safe way to put your bike in and out of the building you not going to want to use your bike.” (Architect 9, interviewed 13/06/2016)

Green space enriches the area by providing features such as fresh air and retreat spaces, which are basic human needs. This is why the architects claim the landscaping is crucial to the success of a high-rise project. To provide the building with a proper amenity, a variable such as the type of green space, the distance from the property to the nearest green space, and the size of the nearest green space should be evaluated and the proper solution applied.

“I tend to be pretty obsessed with taking these landscape places and actually moving them up through the building so they are not just on the bottom, but also on the top. That creates a lot of waterproofing issues so I spend a lot of my time doing that, but trying to distribute these spaces up the building rather than that obelisk tower, these terraces that we can walk through, break down the scale and create environments that people can occupy. And I think the biggest challenge for landscape particularly around the base of a building is really understanding microclimate, where is the sun, where is the wind, where are the places that people want to be, make it easy for the places that are going to be habitable or hospitable, make those really nice and then try, focus

energy on those spaces, the spaces that do have whether it is microclimate issues or other things.”
(Architect 2, interviewed 07/05/2016)

“So I think making a place has more to do with a blank space, it has to do with what interaction that space has to do with the tower and what happens in that space. Lots of people do parks and nobody goes to them at least in this country and then sometimes there become viable shopping areas, restaurants, etc. the ground plane in making a space a place within the environment of high-rises is really difficult task because that’s what creates the lifestyle of the residents beyond the building.” (Architect 11, interviewed 22/06/2016)

Another approach mentioned by the architects is creating green amenities, vertically. Such an amenity can be a green roof with the advantage of the proximity and provision of a great view over the city, a basic human aspiration. A green roof can mitigate the heat island effect, improve air quality, increase amenity spaces, contribute to energy efficiency, reduce noise and increase biodiversity. The architects pay special attention to the base of the buildings, maximizing the usability and enjoyability of these spaces. They can be south-facing parks, open spaces, a pocket park or any other service, interacting with the building, which is important for the active frontage of the building. Streetscapes are vital for the placemaking and community quality of life by providing spaces for social interactions. Understanding the types of spaces that you are creating, and be very deliberate about them, studying the microclimate, it is a question of comfort, tall buildings always cast shadows and change the patterns of air movement around them, these are some of the issues capturing the attention of the architects.

These approaches are related to the social sustainability of the places which evoke pride and pleasure in the users enhancing their quality of life so this answers the question what are the principles of sustainable high-rise buildings.

7.10. Placemaking design features for the design of residential high-rise

The next question is what features of the design of the high-rises address the creation of meaningful places in the city. According to the architects, it starts with the massing. It has to take into account the basic site features: places where people want to congregate, approaches to the site, where the cars are, to create massing that is cohesive under a concept. Massing strategies help to avoid monolithic building bulks. It also helps the microclimate, if massing is designed to limit shadowing of parks and other major public spaces. Proper massing can also visually support and promote the context for public spaces, enhancing the experience of the users and the quality of life. It can also provide eyes-on-the-street to streetscapes and public spaces.

“I think it obviously starts with the massing, and before that, I think it’s even is understanding what are the forces that exist on the site already. Where the people coming from, where cars are coming from, trains and tracks, you know, how the people are going to approach the site and understanding where are the relevant places people want to congregate or another thing. And then you know, the massing reacts to that, and the articulation that follows hopefully if the analysis of the site and the massing are cohesive under the concept, then all the other pieces will start to fill into place under that same concept with small refinements.” (Architect 2, interviewed 07/05/2016)

Then it comes to creating interesting public spaces for the people, possibly a lobby or a café, a restaurant, a grocery. The comprehensive design of the ground floor makes it inviting for the public. It can provide places to linger, work and think in public, satisfying the needs of the people living in the building or in the vicinity. Lacking ground floor uses, aggressive and alienating building at ground level and excessive parking lots can really harm the by-foot connectivity of the neighbourhoods. An attractive area at a ground level does exactly the opposite: it connects people with different backgrounds. For the sake of more permeable spaces, designers need to reconsider radically what happens at ground level and make the ground floor function as a true public amenity. It is related to another common point of the architects: participation in the existing urban fabric and is responding to the surroundings. Such a perspective can give the community a

heart and inspire it to reimagine and reinvent itself and its public spaces and the buildings that define them. Bicycle friendly buildings is another viable point: it promotes green movement and convenience for the users of the building. Having a bicycle path through a building is a great approach to green design, permeability and neighbourhood connectivity. These aspects of placemaking are closely related to the quality of life because they introduce handiness and opportunities for the residents and the citizens.

“We try to maximize the usability and the enjoyability of those spaces. So we try to take the services, hide them as best as we can and then create great spaces for thing like cafes.” (Architect 9, interviewed 13/06/2016)

“What is surrounding the site and what is the path from place to place. And how the building kind of participate in that urban experience. We had a, we designed a building that has a bicycle path that rides right through the building and connects the major bike paths in Washington. So, the bike path actually goes through the building. That’s a sort of interesting example.” (Architect 1, interviewed 16/05/2016)

“That really has to do, in the beginning talking about program elements or uses that can help invite the public in, and on the top of that thoughtful design of the bases the right proportion of glass, the amount visibility, the design of that edge between the building and the cityscape to make sure it is inviting and it will function as a true public amenity. And then beyond that how you create canopies to shelter people from the sun and rain.” (Architect 12, interviewed 22/06/2016)

Meaningful places have a great impact on the quality of life of the residents and citizens. The perception of the building is always in connection with its context, so a building that defies the existing will always create conflict, not a solution. What does emerge from the context-sensitive approach are places with different things to do, local stores, public spaces, and walkable streets. To have shade and also enough sunlight is another point: it refers to the basic human comfort and the high-rises have an enormous impact on the quality of life of many people. Infrastructure for

families with children can reconcile the typology with that demographics, so indoor play spaces can be a valuable solution. Actively involved into youth-friendly spaces, young people can feel that their community values them and they can develop a strong sense of ownership for these places.

“In my opinion, and it is personal opinion, is to create a building that fits, in the neighbourhood. Meaning a building that is sensitive to what is around it, and my opinion is you want to bring in a building that feels it has been there a long time, it is not just built, new. It is a building that is timeless.” (Architect 3, interviewed 25/08/2016)

Buildings that do not promote care or pride in their young people can receive the same lack of interest from the people who use it. The urban environment that dramatically enhances its opportunities for young people and children can undergo a change from something considered locally as a ‘no-go’ area into a busy pedestrian thoroughfare.

These replies also connect sustainability and quality of life, answering the question what are the principles of sustainable high-rise.

7.11. Defining space with residential high-rises

The next question is how to design a building that defines space rather than a building that sits in the space. The architects claim that defining space is not always obligatory if the site already is complete and space is defined. In such case, the task in front of the building is not to affect negatively the arrangement and the character of the space. There are codes and planning applying: in a predominantly high-rise environment a new tall building can successfully blend in or even create a new landmark, but for example on a historical square with dominating historical tower a new high-rise building sounds preposterous. However, there are cases where space must be well defined: the materiality, the form and the relationships on site must clearly differentiate one place from another for better viewer experience. To achieve this the architects have to analyse the

situation and define from where the people will be viewing the building. Their aim is the buildings to have a presence on the site.

“It’s case by case, and I think and what’s important is that not every high-rise building needs to define a place. Sometimes the place is very well defined before the building is there. And the role of the building that you are working on is really to contribute to that larger story. If I was building a building in Piazza Navona in Rome, the story will not be how do I make a place here, it’s already a place, how do you not ruin it, how do you add something to the dialogue, how do you participate in that conversation.” (Architect 2, interviewed 07/05/2016)

“I think that it is again going down to context: where the people will have a view out of the building as well as where are the neighbours, how are they going to be viewing the building. Try to design buildings in such a way that essentially there are no bad units, that there are no units that suffer because of restricted view or a lack of sunlight, or some other aspect that makes some part of the building to be less desirable than other. It’s really going down to the context and how the building seats on the site. What kind of things can we take advantage of on the site that allows the building to have a presence and be comfortable on its site.” (Architect 4, interviewed 19/04/2016)

Skilful massing can be the answer to a complex and problematic site definition. In this context, the arrangement of the ground floor is crucial. Some of the architects create a plinth for the tower, thus reducing the sense of overbearing height. U-shaped configuration of building forms and have the intrinsic ability to capture and define outdoor space. The principle of hierarchy means that in the prevailing number of architectural compositions, real difference exists among their form and space, defining the importance of form and space, as well as their functional, formal, and symbolic role in the composition. Due to their size, if a high-rise stands alone, it will inevitably become a dominant element in the organisation. In a high-rise environment, there are multiple factors that define the role of a single high-rise, such as location, size, massing and details.

“Something like Colburn does both. It sort of functions as an object, because it is a tower, it’s a high-rise among other high-rises. So when it wasn’t there was a void in the surrounding high-rises, and now it fills that space as an object. But then alternatively if you look at Colburn the tower is broken up into three masses and the three masses sort of cradle interior, the towers are kind of broken into three pieces so they kind of align with the street edge on the outer edge curved the way in the inner edge, so on the outside they kind of make up the feeling of the mass, and on the inside they kind of define space.” (Architect 5, interviewed 19/04/2016)

“A lot of it is dictated by zoning and code and shape of each site, you know, some of our buildings, for example, sit on larger plinths and fill out the entire site, and provide nice big plates for retail. So it works not just for the apartments, but for retail. And then as we get on above that plinth, we may use a smaller floor plate because it makes much more sense for residential units, you don’t want to be boxy. So we create spaces on top of the retail base, so it’s attractive to people to have these options.” (Architect 9, interviewed 13/06/2016)

Another way to define space is to create a courtyard. It can accommodate mixed-use development. The benefits of such an arrangement are small distances between housing, offices, retail, and other amenities and activities; a stronger sense of place; walkable neighbourhoods. These benefits can greatly improve quality of life of the high-rise residents. A common ground for the architects is that the defining of the space depends on the context, it is very site specific. Harmonizing the heights is a major issue. When there are big differences, massing and façade treatment can be used to complement the site.

“It is related to what I said before, our buildings tend to be up to the site line, but we think a lot of how the building relates to the ground, there are places where we have pedestrian traffic, it is almost possible to walk through our building, so we think a lot of how you walk and how you approach the building, we are trying to think more about bikes, but also you think of the façade as a street wall, not many buildings have that, this tends to be where the public gets involved,

with the design of the base of the building, because again it has an impact on the street.”
(Architect 6, 05/04/2016)

The architects are also trying to create a tranquil area for child play. Play enhances the quality and longevity of people's lives, enriches communities and makes better the perceptions and value of the urban areas. Architecture for childhood is allowing to engage children with their built and natural environments and to make every day spaces vibrant places for play.

“It goes back to where are you designing, what is your surrounding environment, what it looks like, how it reacts with the people, and what you can do, what you can still that space, so you have children that live in the building, families, obviously you want to have a children’s play area and then it is another situation with designing for children as well, and then you have issues of just tranquillity outside of the building as well as tranquillity inside so that can be affected by noise from the building or from the surrounding area.” (Architect 11, interviewed 22/06/2016)

Spaces for children must have the possibilities for creative play, encourage the children to be more active, offer an interesting natural environment for exploring, learning and for enjoyment by children of all ages, meet children with wildlife and have social spaces for better interaction. It is especially vital how building activates the street, activities help make streets vibrant and social, so a building that defines space should take that into account.

“The third is the street level, how the building meets the street. What’s happening, how does the building activates the street and contributes to the community, what type of the retail is there, what type of neighbourhood serving retail in terms of smaller restaurants, the grocery store, the hardware store, places that serve the neighbourhood and create a neighbourhood and encourages walkability.” (Architect 3, interviewed 25/08/2016)

Defining space is a case by case requirement but often it is a powerful approach for the placemaking, which is good for sustainability and quality of life so these answers reveal what are the principles of a sustainable residential high-rise building.

7.12. Problems imposed by residential high-rise buildings

The next question is what are the contemporary problems that high-rises placemaking imposes on the society. The architects point out lack of spaces for social interactions, where the absence of shared resources diminishes the sense of community.

“There are lots of horrible buildings. Isolated, there is no community space, buildings that are built today have very small apartments, tiny balconies, tiny public stairways, there is no space for encounters, expansion. So I think high-rises need to work really hard for more community space rather than individually themselves.” (Architect 7, interviewed 28/01/2016)

“There is also the issue of alienation, it’s becoming very isolated because it is very easy, you know a high-rise to be very anonymous, which is in terms of the city to appeal is dangerous from kind of a social stand point.” (Architect 2, interviewed 07/05/2016)

There are no examples in England that incorporate a decent set of amenities to enrich the life of the residents, even though new buildings such as Skyline Central in Manchester can satisfy some requirements. But there are pivotal projects in the world. The Pinnacle@Duxton in Singapore is an award-winning 50-storey public housing development in Singapore, with a different approach: the seven towers are linked by “sky bridges” at the 26th and 50th floors, places for a children’s playground, open-air gym and running track. The physical features of the design can contribute up to improved levels of social interaction between residents, which is only one side of the sense of community but is closely related to the quality of life. Man is a social creature. Society is an important factor in determining physical, psychological, behavioural and attitudinal factors. Cognition is also strongly influenced by the society that shelters the individual. The importance of social support becomes particularly important in case of disablement, pain, anxiety and loss of income of a person. It reflects on the person’s various sides of quality of life. (Debalina, Datta and Majumdar, 2015). In this context amenities for social interactions are a prerequisite not always present in recent high-rises which pose a great problem on the society. Another problem

is context disruption. In England, it is a common practice to have a high-rise situated in a low-rise context, which is a disturbing picture due to the difference in height and materiality. A frequent disruption is caused by these buildings since many of them are out of scale, out of context and out of place. Since they are extremely high, they dwarf the surrounding buildings and ignore the human scale. In these cases, the high-rises pose a problem for placemaking. It is recommendable a better arrangement achieved through height transition where the buildings rise gradually to create a pleasing skyline rather than an abrupt and radical change (Al-Kodmany, 2013). Another problem is the fine line between higher density and overcrowding. There is public scepticism of higher density housing schemes, often based on the view that too many residents will create overcrowding and related shortcomings.

“A lot of the problems that we see with density and overcrowding, have to do not only with the construction of a tall building but with the construction of a lot of buildings. And the infrastructure needs to keep up with it and it definitely doesn’t always do that. Although in some cases it is not true, we have areas where huge transit infrastructure is being built on the outskirts of the city and it’s waiting for the density. So, we are working in those areas too. I think a lot of the issues just have to do with the design of the buildings, with the effects on views, lights, air, just how the city starts to feel walking down around street level, light and views are one of the most important and sensitive impacts we deal with.” (Architect 9, interviewed 13/06/2016)

Demand for parking space is one of the main matters, but the general belief is that more people living in the same space will surely reduce the quality of life for existing residents (CABE). However, some of the architects do not think the typology is problematic, they find it a sustainable land use especially when it is situated next to mass transit, it fills the gaps of the city.

“I do not think high-rises are a problematic typology, they raise density, people in that particular part of the city. The advantage to that is public transportation, services, all those things are much more accessible and there is much greater opportunity for social interaction among people on the street.” (Architect 10, interviewed 23/06/2016)

“It depends on where are they located, in the city higher density city, there is more and more acceptance of it, clearly when you go out to the suburbs, there is resistance, because they think it brings more traffic, it’s too dense, so in a way, I do not think high-rise buildings bring problems, I think they refine the cities in filling the gaps, in many of the cities in the US and around the world, it is very important for the success of the cities.” (Architect 3, interviewed 25/08/2016)

Higher density packed with community services can provide walkable neighbourhoods, higher satisfaction with the living conditions and subsequently high quality of life. The amenities areas in the building can help with the feeling of isolation and alienation. However, only a limited recent buildings in England have amenities that mitigate the problems of alienation and loneliness. The prevailing high-rises from the sixties and the seventies are concrete boxes with tiny communal areas and no amenities, where the quality of life is questionable. In the modern buildings, there is another problem: they are designed with tiny apartments unsuitable for families with children and thus the social mixture in them is not various which damages the connections the residents have, squeeze them in small flats and decreases the quality of life. It is an interesting discourse among the professionals on the impact these buildings have on the society.

These answers reveal issues with contemporary and inherited high-rises and are directed to the question what problems sustainable design responses need to address in residential high-rises.

7.13. Planning and residential high-rises

The next question is if there is a planning desire to change the city form by high-rises and what are the dangers of this (ways to accommodate growth)?

The architects think there is no danger in growing vertically, as long as this is done in thoughtful and sustainable manner. Density is a good thing in terms of carbon footprint, but sometimes it doesn’t allow for light and view, which is seen as a problem of the planning with the typology. The high-rise layout is associated with large areas of open land, where the communal facilities can be situated: libraries, sports grounds and community centres. However, without smart

planning, these spaces might be underused, mismanaged and produce problems (Cheng, 2010). There are issues with planning aims and reality of land use in a high-rise environment. Often, places surrounding the city's infrastructure are inactive, empty spaces. The aim is to utilise the spaces in a manner, which, serves multiple uses and users. Developing vibrant, mixed-use neighbourhoods increases the social sustainability of the development and contributes to the quality of life.

"I absolutely believe that we should. It is alternative to sprawl. The green surroundings, the farmland, I mean it is just the best we think we should do. And we should make really high-quality high-rise where people would quite like to live. Because the alternative is just not sustainable, just wasting what we have." (Architect 7, interviewed 28/01/2016)

"I think density is a good thing, people, if you have a city and you have seen the change in Washington DC, in the last 15 years you will be surprised, so there is no danger as long as it is not overwhelming the existing infrastructure, and it is a building that fits with what is surrounding." (Architect 3, interviewed 25/08/2016)

"In terms of world view, I think density is actually a good thing. Now, it is not a good thing if it is not done properly, but if it is done fairly responsibly which I think most architects like to do, I think in terms of carbon footprint and sustainability it is been proven that cities are low on carbon footprint because you can walk and no cars, etc. the infrastructure is there so I think increasing density is a good thing actually." (Architect 11, interviewed 22/06/2016)

However, urban density understood as the concentration of built area, the rate of occupancy and intensity of user activity, has proved as one of the most significant advantages that allow us to manage with important opportunities and challenges in the modern city. The abilities from the high efficiency of land use, energy consumption, and personal time suggest the advantages of denser downtown districts (Klemperer, 2015).

There are many incentives for growing vertically and some architects find it is prevailing in the modern world. But the architects agree the high-rises that are built must be of high quality. There shouldn't be problems with light and views, or building visually uninteresting examples. There is the problem when the city becomes too dense and over-developed. For example, tall towers need extra energy for ventilation and elevators, they cast shadows over the environment, obstruct other buildings' access to daylight and solar energy, are expensive and difficult to maintain, have a high area of circulation and technical space, can generate unpleasant microclimates and enhance the urban heat island effect (Lehmann, 2016).

“There is nothing worse than an established pattern in the city that creates series of buildings that aren't visually interesting, don't allow for access to the outdoors, access to light. And in some way buildings that become via either zoning or some other forces in the market too repetitive in nature, we have all seen the urges of cities that either developed too quickly, developed along a long set of parameters. And you end up with kind of repetitive boxes in a city that lacks texture and inner beauty at all. So I do think in this discussion how to make building more sustainable, there must be a piece of it left to create beauty, the least sustainable building is a building that people want to tear down in a few years because they find it unappealing in some fashion.”
(Architect 12, interviewed 22/06/2016)

A recent tendency for a high-density urban living is enhancing the significance of natural features within the urban fabric. Living in a high-rise with a view means maintained contact with the environment (Bishop, 2004). This can improve quality of life, eliminate one of the downsides of the high-rise living: separation from the ground. However, there are doubts if the proliferation of high-rise buildings is conducted in a sustainable manner, which leaves a space for future research. Another benefit of high density is the increase in both activity and people, controlled by building regulations that create passive surveillance that leads to less crime and increases safety (Betanzo, 2007). This can provide people with a better environment to raise children, relax or participate in the urban life, thus increasing their well-being. Higher residential density affects urban and

suburban sprawl and, with the provision of a different easily accessible facilities and services, is considered to increase opportunities for easier trips to work or leisure activities, and provides for greater equality for people who do not use a car (Croucher, Wallace and Duffy, 2012).

These replies do not target a specific research question but are more applicable to the need for this research in general. Since the architects are affirmative of the need for vertical growth as an alternative to sprawl it is relevant to research the sustainability of residential high-rise buildings and the levels of quality of life they provide.

7.14. Residential high-rises in cultural context

The next question is how the residential high-rises respect the cultural context (for example building near historical buildings)? The architects talk about sensitive materiality and detailing, colour schemes, and setting the new building as a background of the old building, it is definitely not recommended to replicate the style of the historic building, and each building should represent its own time and construction technology.

“That’s always tricky because, in a lot of times historical buildings, you don’t want them to get overshadowed, simply by someone who is taller than them, that’s a tough one, because by nature high-rise is just in a different scale, exterior, particularly the materials in high-rise might be more modern by nature, you see glass and steel, and the historical building might be brick or stone. I think one of the things if you are looking into respect the context more will probably be if the high-rise is already a different form than the other buildings, you can use materials to make it feel like it belongs, like it is a part of the fabric of the city.” (Architect 5, interviewed 19/04/2016)

“This kind of thing do not come often, we have done buildings around low-rise buildings that used to be historical, we try to relate to the scale and the texture of it, but if you are asked to put a very tall building next to a smaller building, it is always going to be problematic. It is more of

a question for the city, the village or the state. It is a zoning question. (Architect 6, interviewed 05/04/2016)

It is a complicated task to place high-rise next to historic building but there are techniques that can help. Some of the architects find it is a matter of zoning and regulations. The approach of the architects and planners to the preservation of valuable old buildings, neighbourhoods and patterns of use, and at the same time inserting new buildings, is a complicated question. Without comprehensive planning and zoning, there is a force to build taller, larger buildings, seriously affecting the historical context. These tendencies have a detrimental effect on the physical and social environment. The historic heritage of picturesque cities must be preserved while introducing stunning new architecture. These issues are difficult and the historical planning cannot address them without high-rise buildings in mind (Sev, Ozgen and Basarir, 2011). However, a harmonious coexistence of old and new architecture creates a sense of pride in the citizens and ultimately provides them with high-quality of life. The promising way encompasses examining the context of any new construction in certain detail and connecting the new building to its context through an informed character appraisal. There is no guarantee however that any architectural approach is, naturally, more applicable than any other. Failure is possible, whether that solution is based on contrast or similarity. A successful project will connect fine to the geography and history of the place of the land, respecting patterns and routes. It will also relate well to important views, relate well to the scale of neighbouring buildings, use careful selection of materials and building methods, enhance views and contrasting effects to improve the urban fabric (CABE). This is close to what architects say. Creating a historical reference such as the case with the Cube is one way to reunite history and architecture.

“If we did a building that tries to replicate the limestone façade and all that it would actually devalue the historical building. So I think as architects we have to be very careful not to create buildings that try to mimic the context because I think that devalues the real historical buildings.”
(Architect 10, interviewed 23/06/2016)

The difficulty comes from the fact that the architects need to respect the cultural differences with a form that is exactly the opposite of the historic buildings. Another successful strategy is to shape the new building in a way to be a background of the historic structure or provide a lot of glass to reflect it. High-rises can be dreamy structures of steel and glass, bringing out the best of the old structure by providing high-quality surroundings and vibrancy to the site. Building tall has captured the human imagination for centuries and this aspiration, answered with simple, attractive exterior can successfully relate the tall building to the historical context, in order to have cultural essence and iconic architecture on a small area.

This question is especially relevant for the British context since there are numerous listed buildings in prime locations and the combination of old and new is always problematic for the designers. The replies reveal principles of designing sustainable high-rises in their quality to enhance the context.

7.15. Residential high-rises affecting users' emotions

The last question for the architects is how their architecture engages the users' emotions in the modern culture?

The architects are talking about sound functional integrity, good distribution of functions on the site. High-rises create new types of lifestyle, change the quality of living conditions and increase the demand for a pleasant living environment. The way to fulfil these requirements in a high-density development is to pay more attention to public realm and amenities. A new concept of relaxing spaces, community sharing facilities and cultural functions is needed (Shim, Park and Park, 2004). Numerous functions that coexist can meet the different needs of people and provide friendly activities space to attract more kinds of people (Zuo, 2015). This enhances the quality of life of the users through social inclusion and a better mix of occupations.

“There are two things, you have to fulfil the functional piece like they have to know where everything is, but there also have to be kind of an intuitive excitement, there have to be something

about it that gives someone a feeling is it a cultural history, evoke a positive reaction. And I think it's very hard to do universally, but I think there are certain things and certain ideas and gestures that engage with people. In my office there is the market project, that is not built yet but it resonates very well with people. People get excited about it, they kind of want to be a part of it, when they see it. I think there are, two or three points that we already talked about the first is focused on creating a sense of place in a suburban area where there really was not, and then the building by working with the landscape architect tried to create a really great plaza.” (Architect 2, interviewed 07/05/2016)

Some architects talk about intuitive excitement, a reference to the cultural history that addresses the need for emotional connection to the built environment. They try to respond to the cultural context of the place. Architecture, is supposed to emotionally affect people, to evoke certain emotional response. Like music, architecture possesses the ability to provoke mood, however, a lot of the foreground to the streets lacks emotional sensibility (Pert, 2014). It is becoming obvious that all cities stopped deferring from one another, which can damage local growth and wages. But there is something else different from an economic or nostalgic toll to bland retail and high-rise construction: boring architecture may emotionally ruin the people forced to live in and around it (Urist, 2016). According to the architects, it is important that the building is physically appealing, interesting, aesthetic, but more importantly, to have an identity, to be shaped around the aspirations of the different groups of people that are going to use it: families with children, elderly, professionals. Sometimes it simply means providing thermal comfort, acoustics, daylight, security and friendly interior materials to make it feel like home: an important emotion that according to the architects separates the successful architecture from the mute one. Accommodating comfortably the residents is one way to evoke emotions of ownership, pride and attachment. Liveability is an important factor for the feeling of home within the community. Interior design seems to be an important aspect of it. Providing a view, no matter if it is towards a city landmark or natural feature, is in many cases what leads the design in order to end with an

enticing architecture. The architects must overcome one prevailing attitude towards high-rises in UK and Europe: Europe doesn't much like them. There, tall buildings – a ubiquitous American architecture form – are mostly considered in a negative light, bad products of rapacious corporate speculators intrinsically destroying the urban fabric and cultural heritage of old European cities (Dupré 1996). This is why it is so important that new high-rises relate to the cultural context of the city the way the Cube in Birmingham does to the industrial heritage of the city.

“We try to respond to the cultural context. With the Cube, we got really inspired by Birmingham industrial heritage, metallic and very strong, which refers to Birmingham metal industry, and then the courtyard is related to watchmaking Birmingham big industrial legacy. So whether people feel that from our building, so we are very careful creating something that belongs there people don't think oh this building could be anywhere. So they see it as a little bit enrichment of their culture, some people love it and some people absolutely hate it, but at least there is discussion and they are thinking about architecture. It is challenging than being just a background, even though sometimes it is appropriate, but at least they are talking about architecture.” (Architect 7, interviewed 28/01/2016)

Reuniting the city with the high-rises demands a collaborative methodology that puts an accent on knowledge transfer and integration through a modern holistic design. The integration of cities and the tall buildings is the only way that the collective functioning of both can be improved, which will lead to better air quality, resource conservation, waste reduction, lower operating costs, lesser impact on local infrastructure, but mainly a better urban life (Ali and Aksamija, 2008).

These replies outline some of the principles of a sustainable residential high-rise in their quality to meet the emotional needs of the users and thus enhance their quality of life.

7.16. Summary of the chapter

The interviews with the twelve architects answered some very important questions about enhancing the quality of life in residential high-rises by sustainable design responses. It was investigated how they achieve environmental and social sustainability in these buildings going into detail explaining how they design for social interactions; increase the energy efficiency and what building envelope they find advantageous. They also discuss directly design features that ensure high quality of life. The role of the residential high-rises in the placemaking process is discussed. Barriers in front of sustainability in these buildings and observed weaknesses are also investigated. The architects also share how social values are manifested by the design and what are the milestones of their design philosophy. Some problems imposed by residential high-rises are mentioned along with the impact they have on the cultural context and the way these buildings to engage the users' emotions by the design.

There is a correlation between the answers of the architects and the residents. Both groups of respondents are in favour of the amenities, implemented in the design of residential high-rises. In regards to some amenities, the residents state that their availability will help build a community, and the architects are positive that this is ultimately socially sustainable. Roof gardens are an example of amenity that the both groups find desirable since it restores the lost contact with nature. Access to daylight, views, connection to nature, thermal comfort, air quality, and spaces for social interaction, have positive psychological and social benefits, such as reduced stress, better emotional state, increased communication, and a stronger sense of belonging. The benefits of amenities can be physical: use of recreational area for the benefits of the health of the occupants, and social: in terms of improved social life in the building. In this regard, both residents and professionals point large windows, amenities, security and connection with the context as vital elements of the design for better quality of life. The negative opinions of the residents can be explained with emotional stress and other negative psychological conditions due to fear of undesirable social interaction among tenants because of sharing floors and amenities , that can create tensions (Prezza, et al., 2001 as cited by Al-Kodmany, 2018). However, when a significant

number of people are confined at a limited floor-area, with problematic access to the outdoors, the “city as your living room” becomes a powerful concept for the provision of lounges and rooftop amenities that encompass the panoramic views that are one of the great advantages of building tall.

The architects are clearly in favour of mixed use high-rises. It can be explained with the fact that residential buildings are dependent on proximity to education, shopping, and other functions. Mixed-use is the modern interpretation of the concept of the vertical city, where people can live, work and relax in the same building. Obviously, not always a proper balance between “privacy” and “openness” is present which leads to cautiousness among the residents. However, mixed-use towers can help eliminate the vacuum space phenomena of the city at night-time, caused by excessive density of office functions. It creates more efficient use of available land and leads to 24 hour occupancy of the space, in the same time shortening the commuting distances (Shim, Parka and Park, 2004). Along with the easy access to local employment opportunities, offices can serve as a buffer between the commercial activities on the ground floor and the residential floors. However, the opinions of the residents matter, and the design must carefully consider how to isolate the residential from the other functions, since noise and strangers were the major concerns of the residents. According to Rabianski et al. (2009), mixed use supports the need for a strong local economy. However, they claim market analysis is necessary to determine demand and supply for each use, along with trends and forecasts to reflect the influence of changing economic, demographic and psychographic factors of demand.

Chapter 8 Simulation analysis

8.1. Introduction

Modern technologies and strategies have been introduced for the design of buildings “in performance considerations, such as energy, comfort, cost, aesthetics, and environmental impact.” Simulations are appreciated in the design stage because they facilitate testing hypotheses and examine the parameters of solutions of designers “especially in terms of energy consumption and the environment” (Strand et al, 2004 as cited by Rilling, Siang and Siang, 2007).

Even though qualitative methods were found more relevant to the nature of this research, the literature review and the interviews with the residents revealed a margin for the implementation of quantitative approach to thermal comfort, energy efficiency and cost effectiveness. The literature review suggests that the energy performance of the buildings is influenced by the glazing system and the increase of insulations is not cost effective after a certain amount (Dowd and Mourshed, 2015), statements that needed to be tested in the UK context via dynamic simulations. The residential satisfaction with thermal comfort was controversial, stating that through the year, some flats are too cold or too hot, and the simulations intended to detect a possibility to improve the existing Building Regulations for U-values of the building envelope elements and to battle overheating. This is the reason to run dynamic simulations for a building with similar characteristics as one of the problematic high-rises in London. The professionals find geothermal energy applicable for high-rises and a simulation scenario was developed to investigate this opinion.

For the past 50 years, different building energy simulation programs were made available, improved and utilized by the construction industry. Some of them are BLAST, BSim, DeST, DOE-2.1E, ECOTECT, Ener-Win, Energy Express, Energy-10, EnergyPlus, eQUEST, ESP-r, IDA ICE, IES 〈VE〉 , HAP, HEED, PowerDomus, SUNREL, Tas, TRACE and TRNSYS (Crawley, et al., 2008).

DesignBuilder (DB) was selected to perform the dynamic thermal and energy simulation for three variations of external wall construction of a proposed high-rise model to compare their energy and environmental performance.

“The DesignBuilder is the most comprehensive interface for EnergyPlus available today. Its current version (1.4.0.031 beta) includes a simplified CAD interface, templates, wizards, and most compact air system configurations of EnergyPlus.” (Maile, Fischer and Bazjanac, 2007).

“DesignBuilder is approved by the UK government to generate an Energy Performance Certificate (EPC2) and its database is based on the UK’s National Calculation Method (NCM) for construction, activity and schedule data.” (Kim and Altan, 2013).

Additional reasons why the study has chosen the DesignBuilder tool to test the energy efficiency of the typical U-values for high-rise designs is that the software has high capability to calculate energy usage with use of latest EnergyPlus tool allowing easy modelling of different building geometries.

8.1.1 Location, orientation and building characteristics

The 26-storey high-rise model shown on Fig. 8.1. is a subject of this energy simulation. The design is similar to Eddystone Tower, where the residents declared it is too hot during the summer and too cold during the winter. Its shape is rectangular, with a total area of 11 270.8 m², located at London Gatwick, with South-North orientation with a considerable number of activity zones. The flats are organized around a circulation area containing lifts, stairs and corridors with a total area of 90.73 m². On the ground floor are accommodated café and a shop. Since this is a relatively large building, an effort was made to simplify the data entry. Construction and facades are common for the whole building so these data were entered at building level.

For lighting is chosen LED. Heating is radiator-heating, boiler, with natural ventilation and heating system seasonal coefficient of performance CoP 0,850.

There are various residential activities in the flats encompassing living rooms, bedrooms, kitchens and baths, each entered with a related density (people/m²)

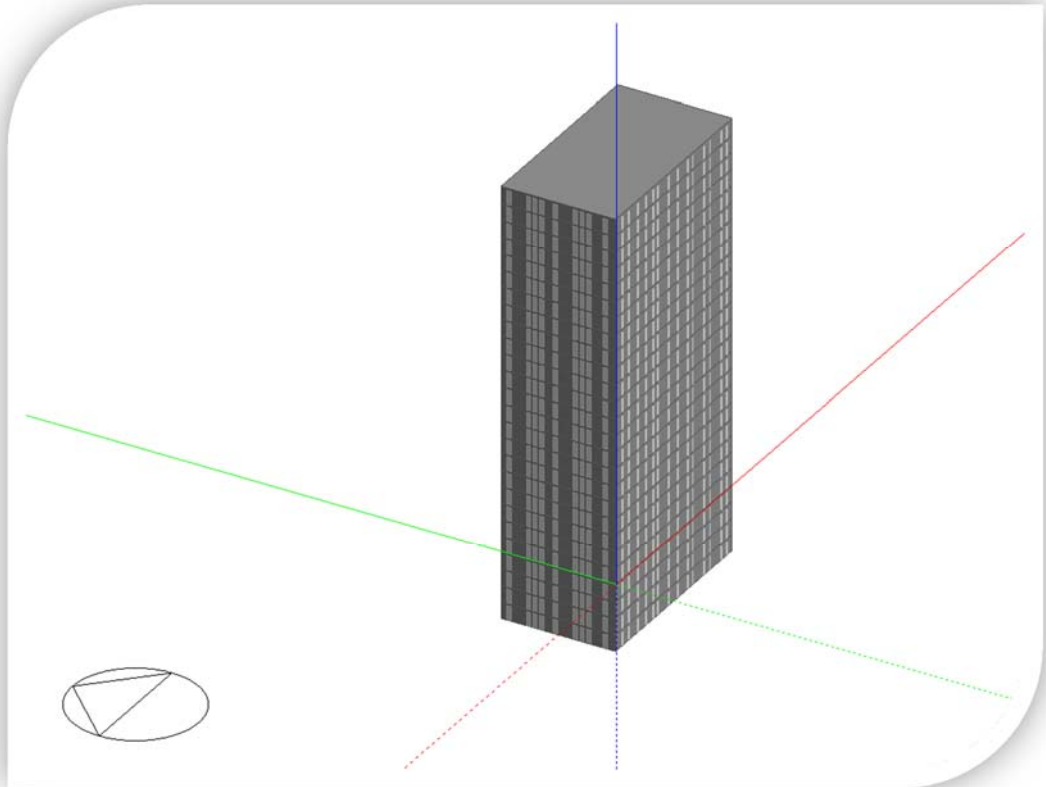


Fig. 8.1. Energy model 3D view of a residential high-rise

8.2. Flats layout and construction of the building envelope elements

The construction utilizes typical for UK concrete cladding for the external walls, mineral wool insulation, and steel frame load bearing construction.

Each floor comprises four studio flats suitable for elderly people and single professionals, two two-bedrooms flats suitable for families with one child and two three –bedroom flats suitable for families with two children.

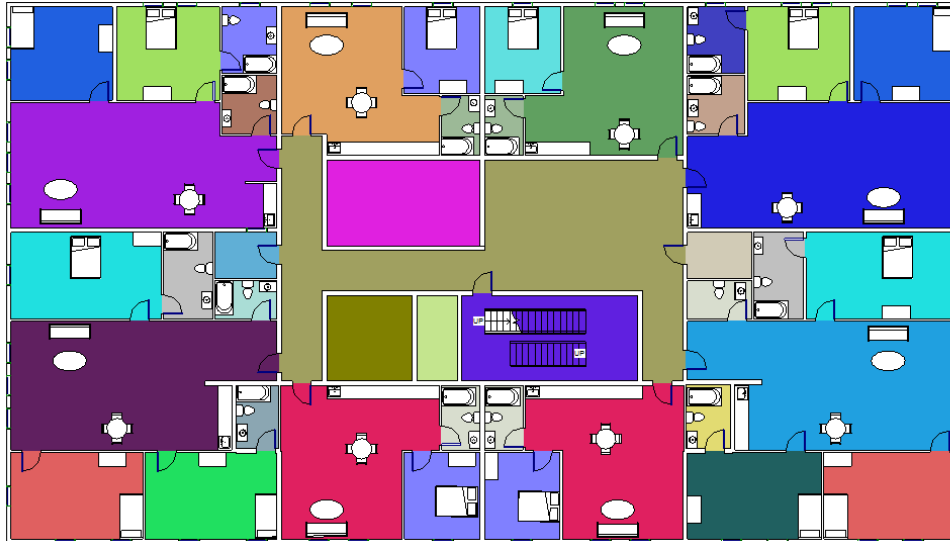


Fig. 8.2. Proposed flats layouts: Typical floor without amenities

There are several scenarios for energy efficiency implemented in the simulation:

1. Existing building Insulation for the building envelope
2. New Building insulation for the building envelope
3. Optimized building insulation for the building envelope
4. Optimized building with energy efficient windows
5. Optimized building boiler replaced by a Ground Source heat pump.

The area average U-values were taken from National Dwelling specification and are shown in Table 8.1.

8.2.1. Existing building scenario

The existing building is constructed as a steel frame with mineral wool insulation. Thin layers providing damp insulation are omitted. The materials are presented as follows.

Table 8. 1. Average U-values for an existing and new buildings construction elements.

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	Flat roofs	External walls	Ground floors
Existing buildings	0.18	0.30	0.25
New Buildings	0.18	0.126	0.22

- Ground floor construction

Table 8.2. GROUND FLOOR CONSTRUCTION	
Material	Thickness (m)
Metal framing/Expanded polystyrene	0.125
Floor screed	0.07
Timber flooring	0.03
U-Value (W/m²-K) 0.243	

- External walls construction

Table 8.3. EXTERNAL WALLS CONSTRUCTION	
Material	Thickness (m)
Concrete Cladding	0.05
Metal framing/Mineral wool	0.12
Gypsum plasterboard	0.025
U-Value (W/m²-K) 0.283	

- Flat roof construction

Table 8.4. FLAT ROOF CONSTRUCTION	
Material	Thickness (m)
Asphalt	0.01
Concrete slabs	0.05
Metal framing/Mineral wool	0.20
Air gap	0.20
Gypsum plasterboard	0.025
U-Value (W/m²-K) 0.163	

- Internal partitions construction

Table 8.5. INTERNAL PARTITIONS CONSTRUCTION	
Material	Thickness (m)
Gypsum Plasterboard	0.025
Metal framing/Mineral wool	0.10
Gypsum Plasterboard	0.025
U-Value (W/m²-K)	0.305

- Floor partitions

Table 8.6. FLOOR PARTITIONS CONSTRUCTION	
Material	Thickness (m)
Timber flooring	0.03
Gypsum Plasterboard	0.025
Metal framing/Mineral wool	0.10
Gypsum Plasterboard	0.025
U-Value (W/m²-K)	0.302

- Energy consumption existing building scenario

First, a simulation without heating or cooling was conducted. Table 8.7. demonstrates that the building needs heating, since the comfort levels are unsatisfactory during the cold months.

Table 8.7 Comfort Existing building: no heating or cooling

	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
Air temperature °C	11.41	10.89	14.92	17.90	21.72	23.33	24.95	24.32	22.03	18.58	14.95	11.53
Radiant temperature °C	11.77	11.22	15.42	18.60	22.55	24.18	25.99	25.25	22.75	19.10	15.33	11.80
Operative temperature °C	11.59	11.05	15.17	18.25	22.14	23.75	25.47	24.78	22.39	18.84	15.14	11.66
Relative humidity %	53.05	55.03	47.98	42.91	42.40	43.34	47.54	47.82	46.90	54.03	57.29	59.72

Table 8.8 Energy consumption existing building	Consumption (kWh)
Heating (gas)	772961.64
Water systems (gas)	319730.23
Interior lighting (electricity)	216652.90
Interior equipment (electricity)	243585.63

For the purposes of the cost calculation are used only the heating consumption, which accounts for 772961.64 kWh.

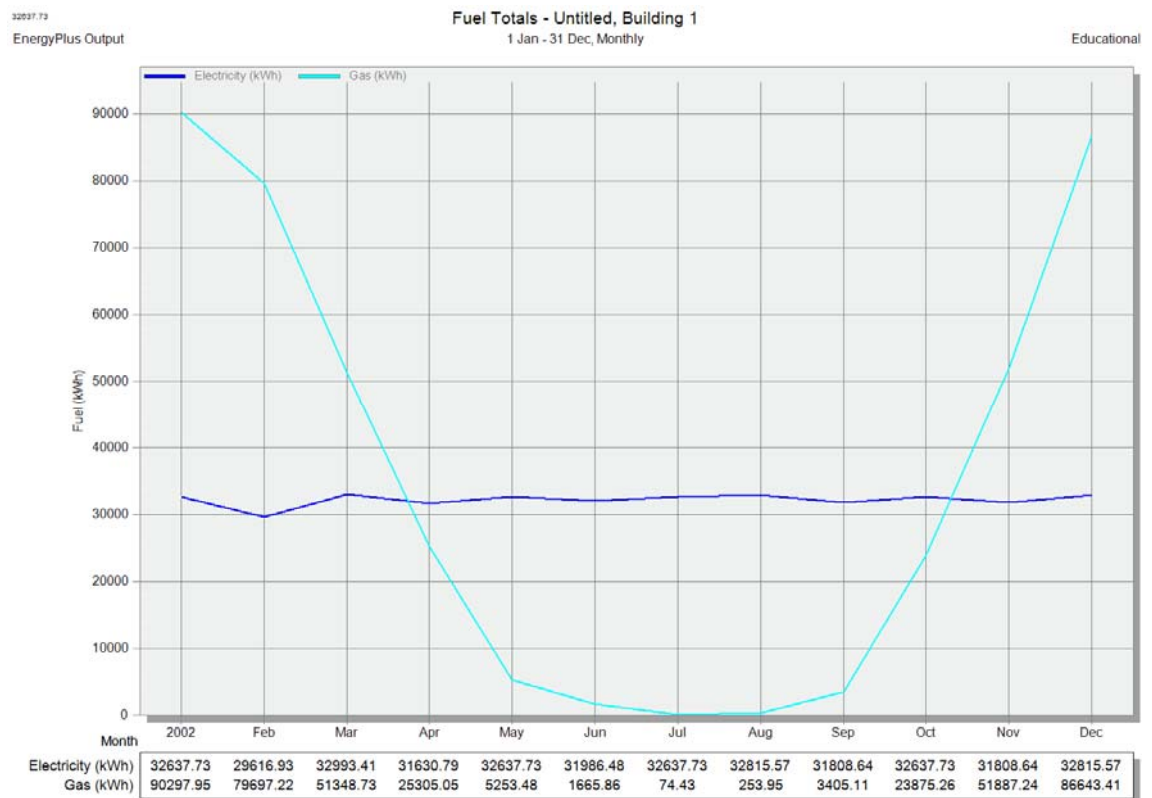


Fig. 8.3. Fuels totals from the simulation for an existing building: first 12 storeys

- **Comfort:** the World Health Organization recognizes temperatures between 18-21 °C as comfortable. However, CISBE Guide A, Environmental criteria as cited by Zero Carbon

Hub, states that benchmark summer peak temperatures are 28 °C for living areas and 26 °C for bedrooms with 1% annual occupied hours over an operative temperature of 28 °C and 26 °C, respectively, qualified as overheating. As seen from the table 8.9 between May and September are observed the peak temperatures and the building is not overheating, providing quite a pleasant environment, while in January, February and December the temperature is slightly below 18 °C.

Table 8.9. Comfort for an existing building

	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
Air temperature °C	17.38	17.43	16.26	19.19	21.44	22.75	24.27	23.68	21.52	19.41	18.23	17.46
Radiant temperature °C	17.28	17.39	18.43	19.68	22.17	23.50	25.16	24.48	22.09	19.69	18.26	17.31
Operative temperature °C	17.33	17.41	18.35	19.43	21.80	23.12	24.73	24.08	21.81	19.55	18.25	17.38
Relative humidity %	37.89	37.72	40.05	40.16	43.32	45.02	49.68	50.05	49.56	51.68	47.60	42.67

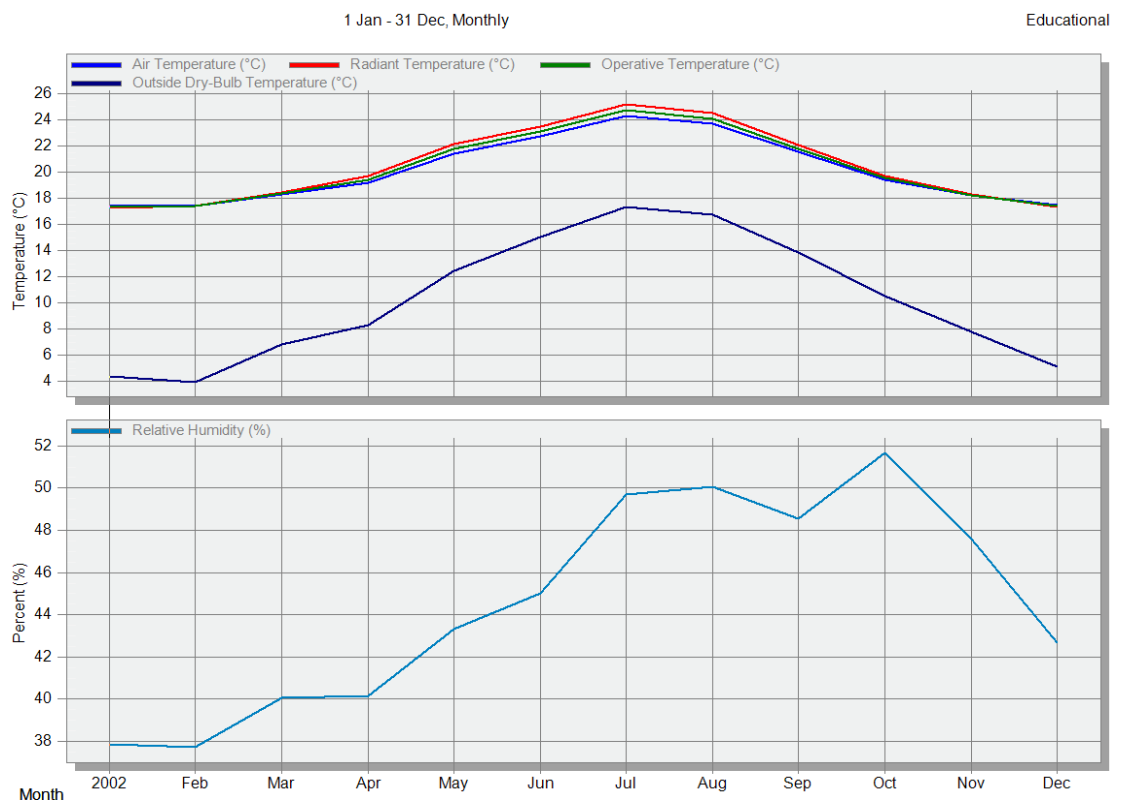


Fig. 8.4. Comfort for an existing building

8.2.2. New building scenario

The new building that was used for this simulation is characterized by improved U-values achieved through better insulation levels of the building envelope as follows:

- Ground floor construction

Table 8.10 GROUND FLOOR CONSTRUCTION: New	
Material	Thickness (m)
Metal framing/Expanded polystyrene	0.15
Floor screed	0.07
Timber flooring	0.03
U-Value (W/m²-K)	0.207

- External wall construction

Table 8.11 EXTERNAL WALLS CONSTRUCTION: new	
Material	Thickness (m)
Concrete Cladding	0.05
Metal framing/Mineral wool	0.30
Gypsum plasterboard	0.025
U-Value (W/m²-K)	0.124

- Flat roof construction

Table 8.12 FLAT ROOF CONSTRUCTION: new	
Material	Thickness (m)
Asphalt	0.01
Concrete slabs	0.05
Metal framing/Mineral wool	0.20
Air gap	0.20
Gypsum plasterboard	0.025
U-Value (W/m²-K)	0.163

- Internal partitions construction

Table 8.13 INTERNAL PARTITIONS CONSTRUCTION: new	
Material	Thickness (m)
Gypsum Plasterboard	0.025
Metal framing/Mineral wool	0.10
Gypsum Plasterboard	0.025
U-Value (W/m²-K)	0.305

- Floor partitions

Table 8.14 FLOOR PARTITIONS CONSTRUCTION: new	
Material	Thickness (m)
Timber flooring	0.03
Gypsum Plasterboard	0.025
Metal framing/Mineral wool	0.10
Gypsum Plasterboard	0.025
U-Value (W/m²-K)	0.302

- Energy consumption new building scenario

The results from the energy consumption simulation for a new building are presented in table 8.17. For the purposes of cost savings calculation due to increased levels of insulation, only the heating consumption is taken into account. The energy consumption decreases to 701422.80 kWh from 772961.64 kWh for the existing building.

Table 8.15 Consumption: new	Consumption (kWh)
Heating (gas)	701422.80
Water systems (gas)	311045.36
Interior lighting (electricity)	212371.12
Interior equipment (electricity)	237052.11

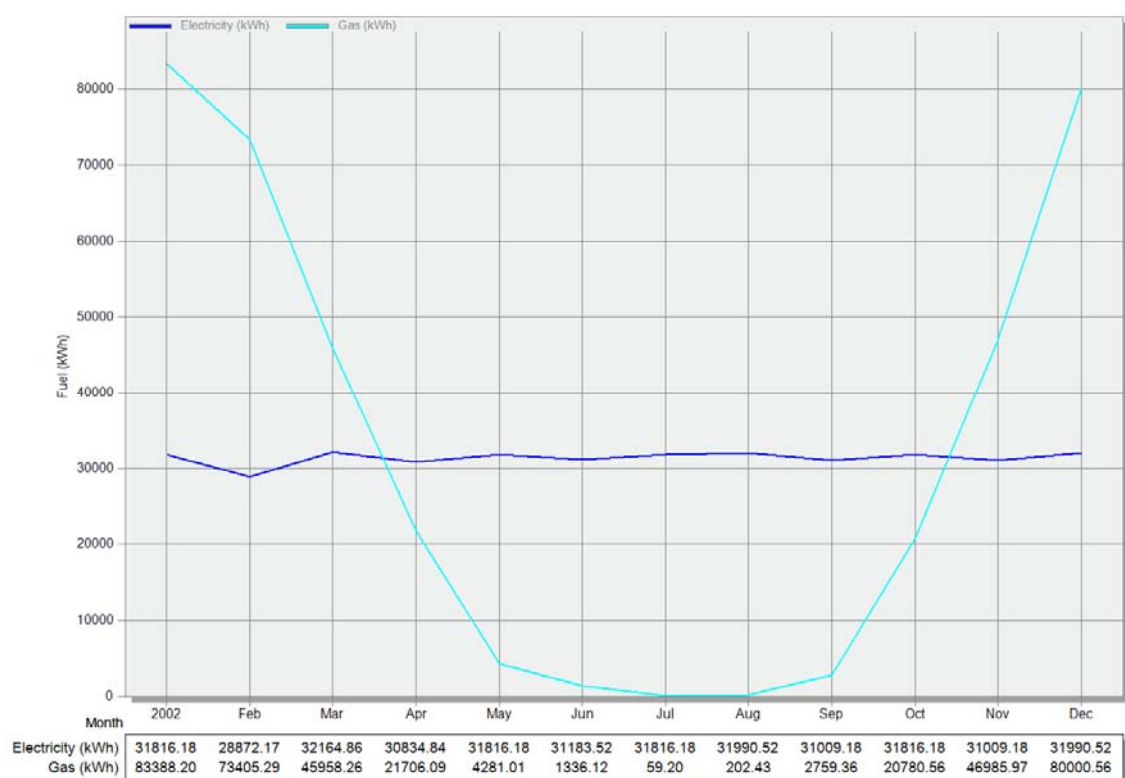


Fig. 8.5. Fuels totals from the simulation for a new building: first 12 storeys

- **Comfort:** the operative temperatures show slight improvement both during the winter months where the temperatures go up and during the summer when the building ensures a good level of comfort

Table 8.16 Comfort for a new building

	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
<i>Air temperature °C</i>	17.51	17.55	18.39	19.36	21.65	22.94	24.38	23.83	21.72	19.57	18.34	17.57
<i>Radiant temperature °C</i>	17.48	17.58	18.63	19.92	22.43	23.71	25.32	24.65	22.33	19.91	18.43	17.49
<i>Operative temperature °C</i>	17.49	17.56	18.51	19.64	22.04	23.32	24.85	24.24	22.03	19.74	18.39	17.53
<i>Relative humidity %</i>	37.59	37.46	39.75	39.75	42.81	44.53	49.38	49.61	47.99	51.23	47.30	42.41

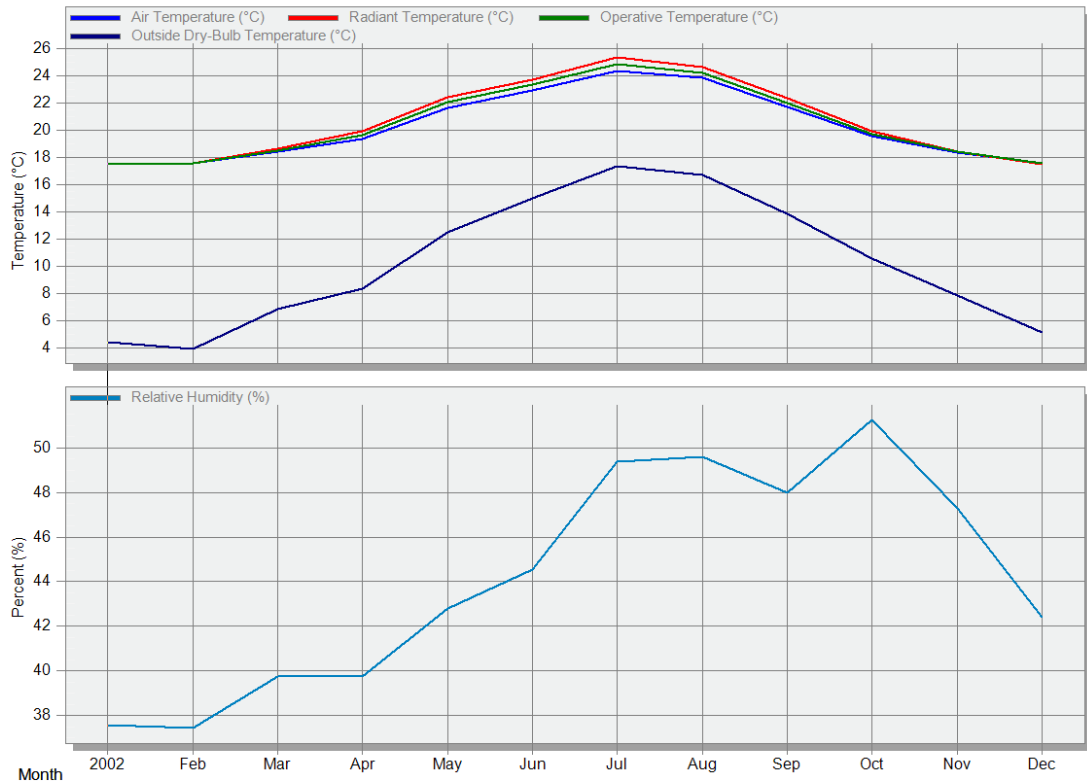


Fig. 8.6. Comfort for a new building

8.2.3. Optimized building scenario

The optimized building has even better levels of insulation to inspect the effect on heating loads and then it will be used as a basis for the building with energy-efficient windows and heat pump HVAC. The constructions of the building elements are as follows:

- Ground floor construction

Table 8.17 GROUND FLOOR CONSTRUCTION: optimized	
Material	Thickness (m)
Metal framing/Expanded polystyrene	0.25
Floor screed	0.07
Timber flooring	0.03
U-Value (W/m²-K)	0.131

- External wall construction

Table 8.18 EXTERNAL WALLS CONSTRUCTION: optimized	
Material	Thickness (m)
Concrete Cladding	0.05
Metal Framing/Mineral wool	0.40
Gypsum plasterboard	0.025
U-Value (W/m2-K)	
0.095	

- Flat roof construction

Table 8.19 FLAT ROOF CONSTRUCTION: optimized	
Material	Thickness (m)
Asphalt	0.01
Concrete slabs	0.05
Metal framing/Mineral wool	0.30
Air gap	0.20
Gypsum plasterboard	0.025
U-Value (W/m2-K)	
0.112	

- Internal partitions construction

Table 8.20 INTERNAL PARTITIONS CONSTRUCTION: optimized	
Material	Thickness (m)
Gypsum Plasterboard	0.025
Metal framing/Mineral wool	0.10
Gypsum Plasterboard	0.025
U-Value (W/m2-K)	
0.305	

- Floor partitions

Table 8.21 FLOOR PARTITIONS CONSTRUCTION: optimized	
Material	Thickness (m)
Timber flooring	0.03
Gypsum Plasterboard	0.025
Metal framing/Mineral wool	0.10
Gypsum Plasterboard	0.025
U-Value (W/m2-K)	
0.302	

- Energy consumption optimized building scenario

The results from the energy consumption simulation for the optimized building are presented in Table 8.24. For the purposes of cost savings calculations due to increased levels of insulation, only the heating consumption is taken into account. The energy consumption decreases from 701422.80 kWh to 677443.34 kWh for the optimized building.

Table 8.22 Consumption optimized	Consumption (kWh)
Heating (gas)	677443.34
Water systems (gas)	141348,63
Interior lighting (electricity)	96926,43
Interior equipment (electricity)	107747,76

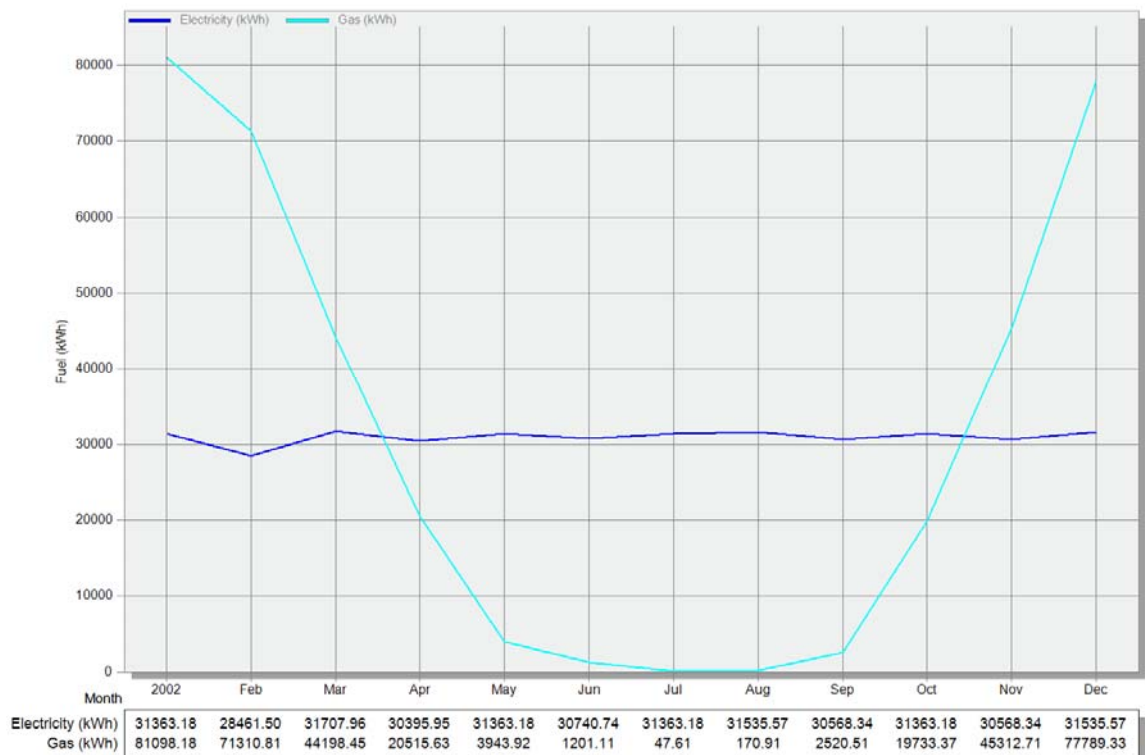


Fig. 8.7. Fuels totals from the simulation for an optimized building: first 12 storeys

- **Comfort:** the operative temperatures during the cold months slightly increase, as shown in Table 8.25 and during the summer the temperatures are quite pleasant.

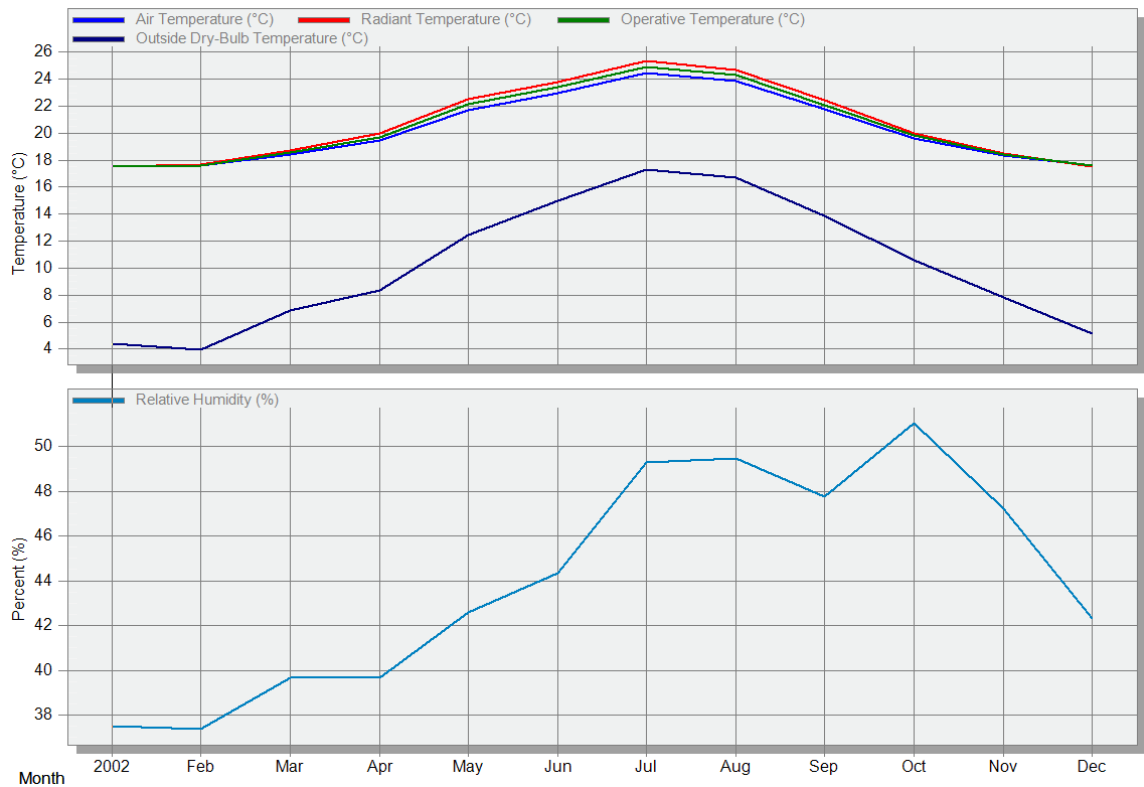


Fig. 8.8. Comfort for an optimized building

Table 8.23 Comfort for an optimized building

	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
Air temperature °C	17.55	17.59	18.43	19.43	21.73	23.00	24.42	23.88	21.79	19.63	18.38	17.61
Radiant temperature °C	17.54	17.64	18.69	19.99	22.51	23.79	25.37	24.72	22.42	19.98	18.49	17.55
Operative temperature °C	17.54	17.62	18.61	19.71	22.12	23.40	24.85	24.30	22.11	19.80	18.44	17.58
Relative humidity %	37.51	37.36	39.67	39.66	42.61	44.36	49.27	49.27	47.46	51.05	47.21	42.31

8.2.4. Optimized building with energy-efficient fenestration scenario

Energy-efficient windows affect two possible problems: overheating during the warm periods of the year and wasteful heat losses through the building envelope. For this simulation were used quadruple windows with krypton fill, with U-value 0,781 W/m²-K. Additionally, switchable

electrochromic absorptive film 6 mm is applied with inside air temperature set point of 19 °C to ensure even more comfort during the hottest months.

- Energy consumption optimized building scenario with energy efficient windows

The results from the energy consumption simulation for an optimized building with energy-efficient windows are presented in Table 8.26. For the purposes of cost savings calculations due to increased levels of insulation, only the heating consumption is taken into account. The energy consumption decreases from 677443.34 kWh for the optimized building to 609804.41 kWh for building with energy-efficient windows.

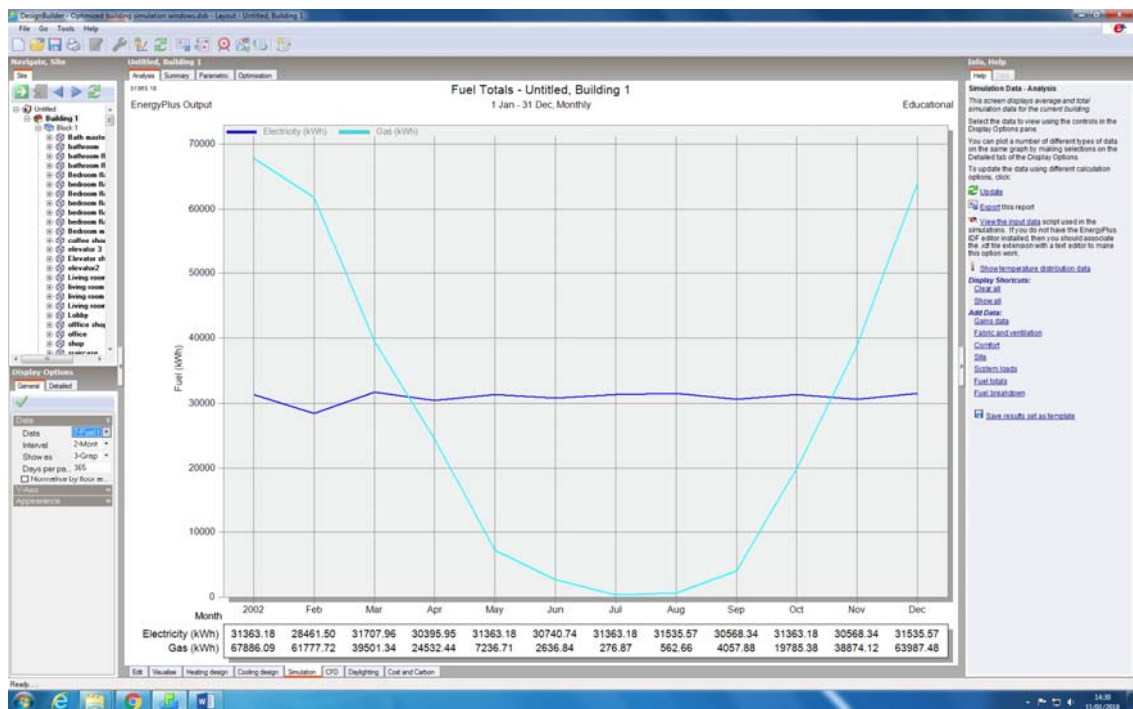


Fig. 8.9. Fuels total for a building with energy-efficient windows: first 12 storeys

Table 8.24 Consumption: Energy efficient windows	Consumption (kWh)
Heating (gas)	609804.41
Water systems (gas)	306255.36
Interior lighting (electricity)	210007.26
Interior equipment (electricity)	233453.48

Comfort: the operative temperatures show significant improvement. In June, July and August the operative temperatures are slightly over 21°C, but below 24 °C, a threshold over which negative impacts on the health such as cardiovascular risks occur.

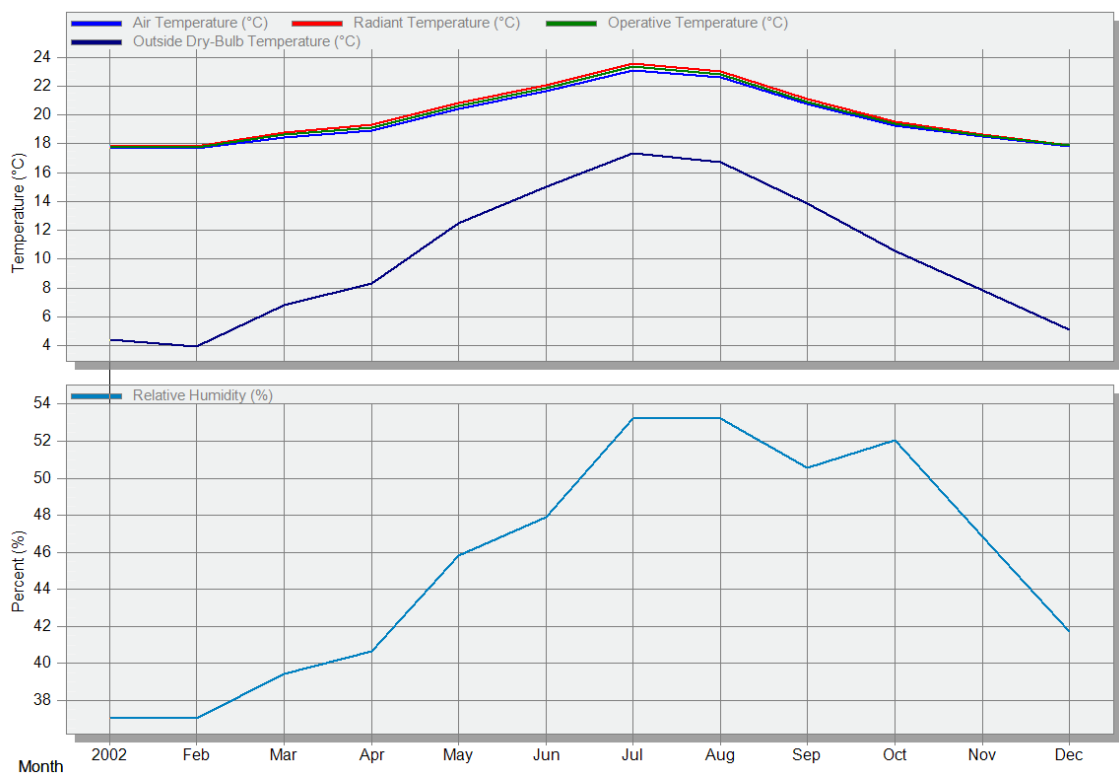


Fig. 8.10. Comfort for an optimized building with energy-efficient windows

Table 8.25 Comfort for an optimized building with energy-efficient windows

	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
Air temperature °C	17.73	17.70	18.46	18.94	20.44	21.76	23.08	22.58	20.73	19.28	18.47	17.82
Radiant temperature °C	17.86	17.85	18.76	19.35	20.85	22.08	23.57	23.00	21.07	19.55	18.66	17.92
Operative temperature °C	17.80	17.78	18.61	19.14	20.65	21.87	23.33	22.79	20.90	19.41	18.57	17.87
Relative humidity %	37.02	37.04	39.45	40.67	45.82	47.94	53.26	53.26	50.60	52.06	46.85	41.72

8.2.5. Optimized building with energy-efficient fenestration and Ground source heat pump scenario

Water-to-water heat pumps are a smart measure that can save money and reduce carbon emissions in a properly designed building. The major indicator of the efficiency of a heat pump is the Coefficient of Performance: the “CoP”: ground source heat pump CoP varies from northern to southern locations between 4.3 and 5.1. The design characteristics of the simulated water-to-water heat pump are: CoP is 3.5, using electricity from the grid, with radiant floor heating heat distribution.

- Energy consumption optimized building scenario with energy-efficient fenestration and water-to-water heat pump

Total energy consumption with the Ground source heat pump system is 529197.21 kWh. It is dissatisfying that the distribution of the heat by the means of fans is so energy-intensive. This might indicate that it will be more beneficial if only the lower floors of a high-rise building are supplied with heat from such a system. Considering the significant difference in the cost of electricity and gas in the UK it might not be cost-effective to rely on such a system, using the

expensive electricity just yet. The feasibility of the system is even more doubtful regarding the results of the simulation for comfort.



Fig. 8.11. Fuels total for a building with energy-efficient windows and ground source heat pump: first 12 storeys

Table 8.26 Consumption with a heat pump	Consumption (kWh)
Heating (electricity)	107175.85
Fans (electricity)	413225.15
Pumps (electricity)	8796.21
Interior lighting (electricity)	210007.265
Interior equipment (electricity)	233453.48

- Comfort:** it is dissatisfying that during the cold months the system cannot provide comfortable operative temperatures between 18-21 °C. It means that additional heat sources should be applied and as a result, the energy consumption with the water-to-water system might actually increase to the levels of a building heated with a gas boiler already presented.

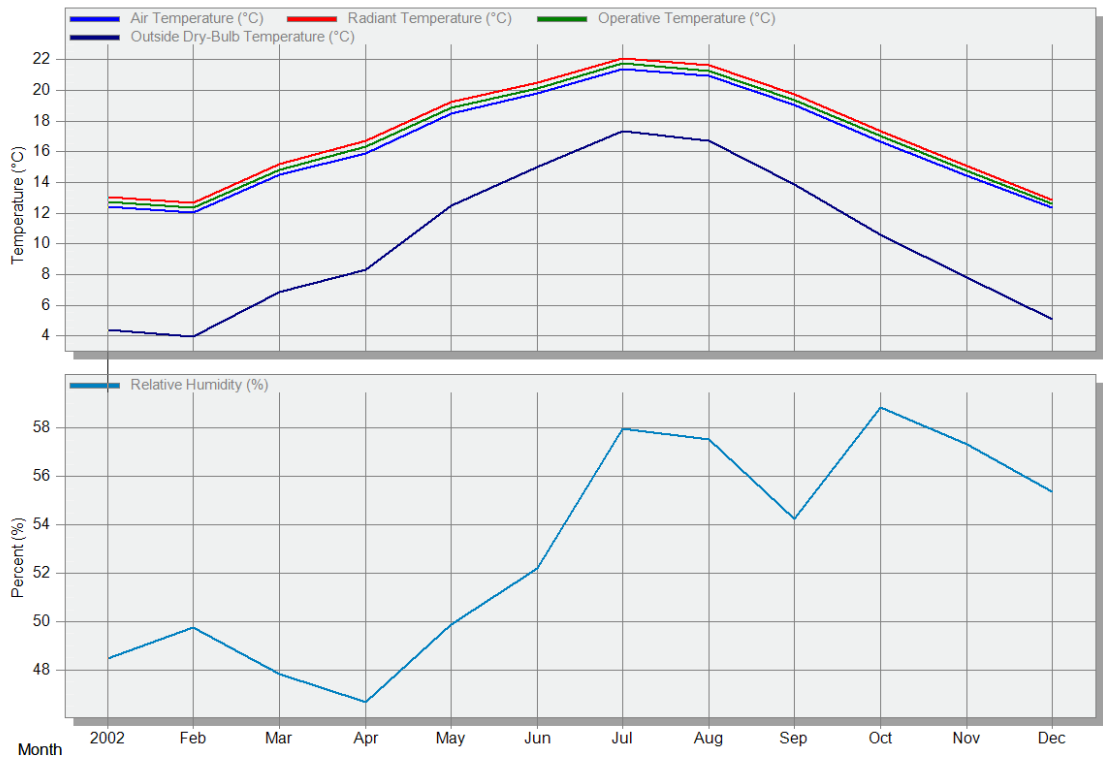


Fig. 8.12. Comfort for an optimized building with energy-efficient windows and GSHP

Table 8.27 Comfort with energy-efficient windows and ground-source heat pump

	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
Air temperature °C	12.42	12.05	14.48	15.92	18.46	19.81	21.42	20.97	19.06	16.67	14.45	12.33
Radiant temperature °C	13.06	12.67	15.21	16.74	19.22	20.49	22.09	21.62	19.72	17.33	15.06	12.87
Operative temperature °C	12.74	12.36	14.85	16.33	18.84	20.15	21.76	21.29	19.39	17.00	14.75	12.60
Relative humidity %	48.46	49.76	47.85	46.66	49.89	52.19	57.99	57.52	54.24	58.87	57.32	55.38

8.3. Cost comparison between the different scenarios

8.3.1. Cost of heating for an existing building

The annual energy consumption for an existing building is 772961.64 kWh which is equal to 15459.23 British Pounds. A detailed consumption for different flats located on the fourth floor of the building is presented in Table 8.30

<u>Table 8.28 Cost Existing</u>	<u>Annual Consumption (kWh)</u>	<u>Cost (£) ex. VAT</u>
<u>Studio flat</u>	<u>1667.07</u>	<u>46.67</u>
<u>Two-bedroom flat</u>	<u>4692.91</u>	<u>131.40</u>
<u>Three-bedroom flat</u>	<u>5124.45</u>	<u>143.48</u>

8.3.2. Cost of heating for a new building

The annual energy consumption for a new building is 701422.80 kWh which is equal to 14028.45 British Pounds. A detailed consumption for different flats located on the fourth floor of the building is presented in Table 8.31

<u>Table 8.29 Cost New</u>	<u>Annual Consumption (kWh)</u>	<u>Cost (£) ex. VAT</u>
<u>Studio flat</u>	<u>1491.21</u>	<u>41.75</u>
<u>Two-bedroom flat</u>	<u>4205.33</u>	<u>117.75</u>
<u>Three-bedroom flat</u>	<u>4432.63</u>	<u>124.11</u>

8.3.3. Cost of heating for an optimized building

The annual energy consumption for an optimized building is 677443.34 kWh which is equal to 13546.86 British Pounds. A detailed consumption for different flats located on the fourth floor of the building is presented in Table 8.32

Table 8.30 Cost Optimized	Annual Consumption (kWh)	Cost (£) ex. VAT
Studio flat	1450.93	40.62
Two-bedroom flat	4079.21	114.22
Three-bedroom flat	4285.26	119.99

8.3.4. Cost of heating for an optimized building with energy-efficient windows

The annual energy consumption for an optimized building with energy efficient windows is 609804.41 kWh which is equal to 12196.08 British Pounds. A detailed consumption for different flats located on the fourth floor of the building is presented in Table 8.33

Table 8.31 Cost EEW	Annual Consumption (kWh)	Cost (£) ex. VAT
Studio flat	1166.83	32.67
Two-bedroom flat	3407.60	95.41
Three-bedroom flat	3964.83	111.01

8.3.4. Cost of heating for an optimized building with energy-efficient windows and a heat pump

Total energy consumption with the Ground source heat pump system is 529197.21 kWh, but it is using electricity which is considerably more expensive than gas in the UK and equals 63503.66

British Pounds. For example, the cost of heating using a gas boiler in the existing building with the worst case scenario building envelope characteristics are only 15459.23 British Pounds.

8.4. Conclusion

The simulations of five different scenarios revealed there is no margin for improvement regarding the insulation of the building envelope in connection with the existing Building Regulations. To illustrate this the annual cost of heating for a three bedroom flat is 124.11 British Pounds in a new building, and 111.01 British Pounds in a building with energy-efficient windows and better walls insulation. Such a difference in the cost will not have a major impact on the budget of the residents, and considering the price of energy-efficient windows and the additional information, it will pay back very slowly.

Regarding the use of geothermal energy, the simulation showed that it indeed reduces the energy consumption, but because the electricity is more expensive than gas in the UK, it is still not a feasible solution and it also cannot provide the required comfort levels on its own.

The results of these simulations are taken into account when producing the theoretical framework.

Chapter 9 The Theoretical framework

9.1. Introduction

This framework seeks to combine the views of architects and residents of high-rise buildings in a practical vision for the future of the typology. Physical and spatial projects that follow this vision will be able to transform the urban environment in the UK cities.

There is a plan for achieving the objectives of the study: actions for energy efficiency, actions for the inclusion of amenities for enhanced quality of life and actions for architectural qualities for enhanced quality of life of the residents in high-rise buildings.

9.1.1. Framework context

Tower blocks, now accounting for 20 percent of the housing stock, were perceived as a salvation from poor living conditions. Therefore the designers always struggle to adapt the high-rises characteristic to the features of the social capital and the social needs. Mixed development required that councils build a mixture of housing forms – flats, maisonettes and houses – at a range of heights (Municipal Dreams in Birmingham, Housing, 2015). Post-war buildings, however, showed little response to the social dimensions and were soon rejected as inhabitable. They were not suitable for families with children, the private space was inadequate, concrete quickly became shabby, there was fear of crime, they soon started representing the slams of the future, and on the top of it, they did not really cost less. High-rise living is associated with social breakdown, crime and misery. This is decisively not just the situation in Britain and is due to various economic and historical factors (Smith, 2012).

A new, more adequate response to the specific features, characteristics and demands of the social groups inhabiting the high-rise buildings is required. This response can be synthesised from theory and practice, emphasising the working solutions integrated into existing buildings and into

theoretical constructs. The development of UK specific standards that extract experience from the world's best examples with the failures of the past and mindful of the unique nature of UK society would lay firmer foundations for sustainable future high rise developments in this country (Watts et al., 2015.). The research on the process shows that most of these buildings are built in carefully designed clusters. The focus will be on architectural qualities and placemaking process with high-rises. However, the observation of a significant number of high-rises, old and new, reveals disturbing shortcoming about the urban texture these buildings form. The buildings are often lacking any useful design intervention on street level or in addition to the ground floor to make the passer-by experience strong. Very often they are in sharp contrast with the surrounding buildings both as for size and style. Often outdoor amenities such as canopies, seating areas, planting are not implemented. The old high-rises are with simple and unattractive architectural design.

A disadvantage of the high-rise buildings is that they tend to stand alone, following a standard rectilinear model and rejecting hundreds of years of the urban fabric. They are usually a difficult type of building to design and integrate sensitively into the landscape. Apartments may cause problems such as a disappearing sense of neighbourhood or community, and finally, there are the problems of common poor construction, design and visual appearance, which might not work well with the promotion of healthy and safe communities. Tall buildings need to comply with topography, existing urban scale, height, transport infrastructure and land values to be sustainable.

9.2. Role of the framework

The framework provides a guidance for the development of the urban environment with high-rises over the next 20 years. New research, inventions and knowledge can continue shaping the context. It defines design principles to govern architectural change by sustainable design responses and answers questions such as:

- What type of high-rises should occur in connection with liveability and quality of life
- Which features need to be implemented in connection with sustainability and energy efficiency
- What placemaking changes must be promoted

The framework gains credibility after the objectives of the research has been fulfilled and two research questions have been answered through analysis of interviews with residents of old and new buildings, and architects with experience with residential high-rises. The connection between quality of life and sustainable design responses, outlined after the analysis of the interviews, results in the promotion of certain suggestions for future buildings. The clarification of the principles of the sustainable residential high-rise further supports some design solutions, listed in this framework. The problems, clearly addressed in the literature and explored through primary data sources, provide the basis from which the framework stems.

STRATEGY: it refers to the strategy of the framework, not the research strategy and objectives, outlined in the methodology. The strategy defines the direction for success, prioritizes the actions needed and simplifies the decision-making. It is reduced to objectives, steps that are related to the significance of the research and its contribution to knowledge; and plan: the actions, needed to meet the framework objectives.

1. OBJECTIVES

- Help people to live in more environmentally friendly buildings and surroundings.
- Improve the social and psychological effects in high-rises, mainly gathering people together to maintain a healthy social climate

- Create a sense of place with residential high-rises, not only save land

2. PLAN

- Learn how to improve the physical dimensions of the residential high-rise stock by following the energy efficiency recommendations of the research
- Provide guidance what design can accommodate the residents of the high-rises better, responding to manifested and anticipated needs
- Explore architectural and urban design devices to link together the users' affections to the physical settings of the environment, comprising high-rises.

There are some implications from the research that are the guiding points of the framework.

The framework is designed to help planners, developers, architects and the community when implementing planning and design directions, providing clarity and certainty.

9.3. Need for the framework

The need for this framework is dictated by the high numbers of high-rises in the United Kingdom, about 3500, housing around 800 000 residents (Buxton, 2013). Most of these high-rises are in severe need of refurbishing, displaying energy inefficient envelope making them highly energy-consuming at a time of growing fuel poverty (Buxton, 2013). The secondary data also confirms raising numbers of new high-rises in construction especially in the capital (Frearson, 2016). There is a need for a shift in the vision for the design of these buildings, especially because:

- In the UK, the enthusiasm about the fast and omnipresent construction of high-rise residential towers in the 1960s was quickly tempered by some technical and social issues. (Jacobs, Cairns and Strebel, 2007)
- Social and psychosocial effects are frequently poor in a high-rise, mainly social interactions with neighbours and a number of aspects of control and recuperation at home. More analysis demonstrates that neighbourhood satisfaction and some social issues are better (or ameliorated) for people on upper floors (Kearns et al., 2011)
- In addition, there is a connection between people and the place of the built form which is quantified by levels of participation, both mentally and physically. However, the main task of high-rise solutions was saving land, but they mostly caused placelessness (Zahiri, Dezhdar and Foroutan, 2016)

9.4. Implications of the case study

The case study provided information for the development of sustainable design approaches that will increase the quality of life of the residents in high-rise buildings. The framework has been divided into five categories with respective subcategories addressing the considerations derived from the case study, professional interviews and the main findings of the literature review.

The framework is based on the generated general understanding of the conditions under which residents of high-rise buildings live at present investigated through interviews with some of them. Those conditions are analysed and a strategy is designed to improve them. It starts with measures to increase social interactions and improve the flats layout in order to accommodate different lifestyles; the second stage is assessing which amenities will improve the quality of life of the residents. The third stage is to improve the thermal and aural comfort by addressing the energy efficiency and the design of the walls and slabs. The next stage reflects the applicability of mixed

use in these buildings and the last stage discuss which architectural qualities will affect the quality of life of the residents in a positive direction.

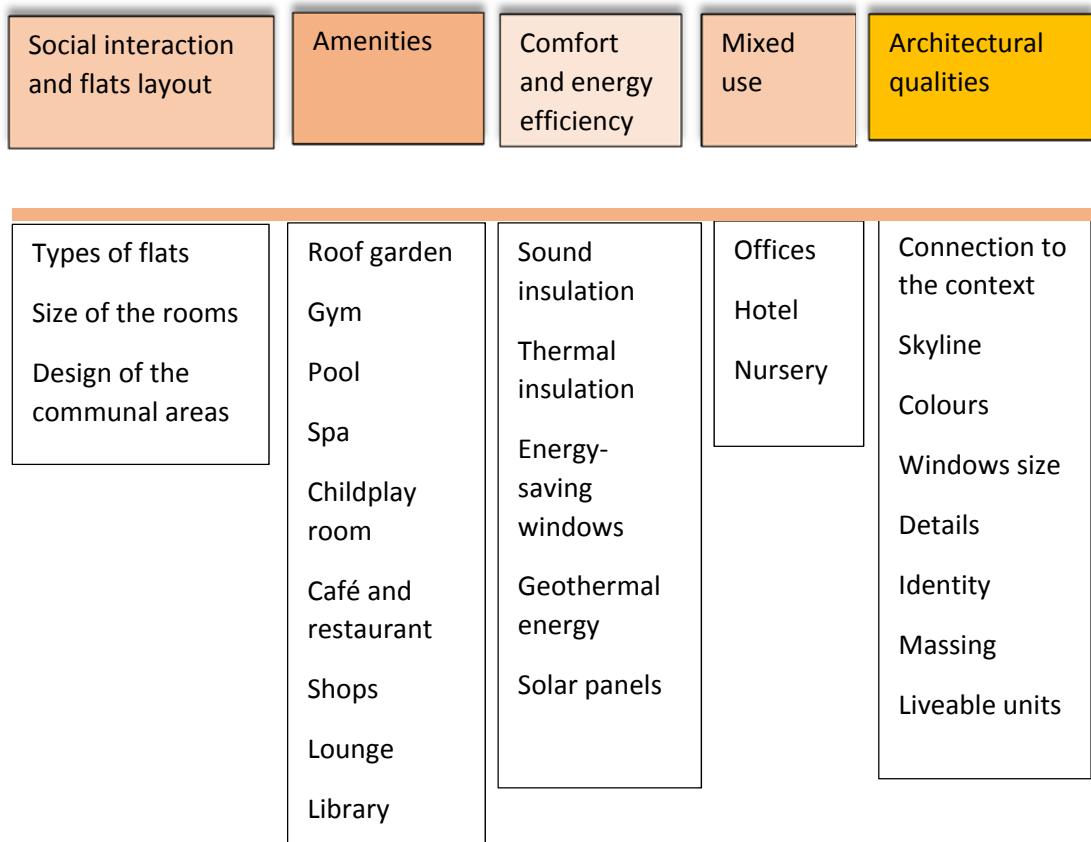


Fig. 9.1. Theoretical Framework Content

Theoretical framework for better quality of life in residential high-rises



Fig. 9.2. Theoretical Framework Summary

9.4.1. An overview of the recommendations from the framework

9.4.1.1. Social interaction and flats layout

- It is recommended a greater variety of flats layouts to accommodate a mix of tenants such as elderly people living alone, professionals living alone and families with one, two or three children. From the literature review, it is a gap of knowledge to what extent the demographic characteristics of a group are related to the quality of life. From the researcher experience with David Lee Point, where there were not observed any elderly people, the pride from living there comes from a sense of ownership, there is no pride or it is not clear what evokes it, but definitely, no one mentions healthy day to day contact with the experienced members of the society. Figure 9.3 shows a proposal for a typical floor plan, comprising two three bedrooms, four one bedroom and two bedroom flats per floor which will provide opportunities for greater social mixture in the building. The smaller flats are suitable for elderly people, living alone, but the building needs amenities if their family wants to visit with young children.



Fig. 9.3. Proposed flats layout

- **Flats layout proposal**

A certain improvement of the sizes of the rooms is recommended. Figure 9.4 shows a typical flat in a high-rise from the 60s' (David Lee Point). The proposed sizes are based on research by design.

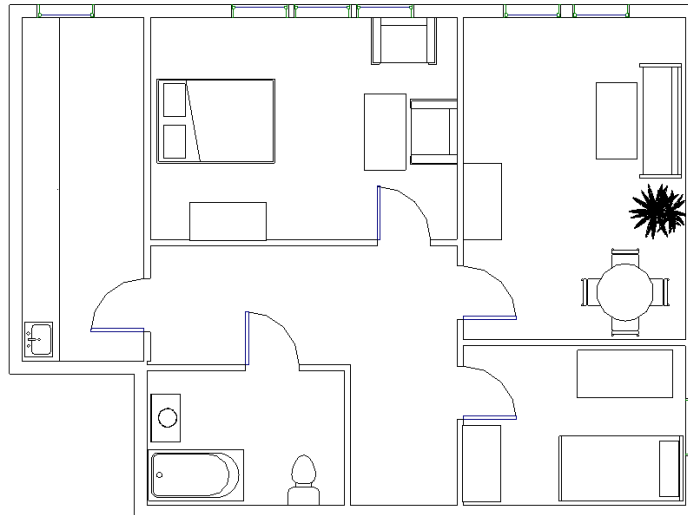


Fig. 9.4. David Lee Point flat layout

SIZES OF THE ROOMS IN THE TYPICAL FLAT:

Bedroom 1: 20,7m²

Bedroom 2: 10,3 m²

Lounge with dining room: 22 m²

Kitchen: 13,6 m²

Bathroom: 8,3 m²

PROPOSED SIZES OF THE ROOMS

1. Studio Flat

Living room united with kitchen and dining: 23 m²

Bedroom: 14 m²

Bathroom: 5m²

2. Three bedroom apartment

Bedroom 1: 23 m²

Bedroom 2: 23 m²

Master Bedroom: 27 m²

Living room, dining room, bathroom and kitchen: 70m²

Bathroom master bedroom: 8,5 m²

Bathroom: 5 m²

3. Two bedroom apartment

Bedroom 1: 23 m²

Master Bedroom: 27 m²

Master bathroom: 7 m²

Bathroom: 7m²

Living room, kitchen, dining and bathroom: 65m²

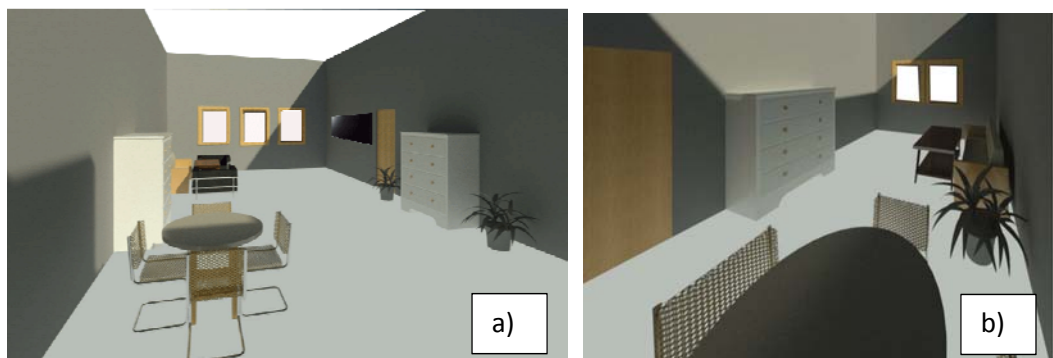


Fig. 9.5. Living rooms: proposed (a) and typical (b)



Fig. 9.6 Examples of more spacious living rooms, suitable for gatherings with friends and experiencing peaceful time at home

Fig. 9.5. shows the 3D model of David Lee Point living room (b) and proposed sizes for high-rise flats (a). It is revealing that the David Lee Point living room is quite a space restricted and unsuitable for accommodating many people.



Fig. 9.7. Child room: typical (a) and proposed (b)



Fig. 9.8. Examples of more spacious child rooms with all the furniture a child needs

This is why this framework proposes a bigger living room, considering the fact that some residents admit they are having their social interactions in their flats.

Fig. 9.7 (a). demonstrates the lack of comfort in David Lee child room; this is why the framework proposes more space to be dedicated to this part of the flat.

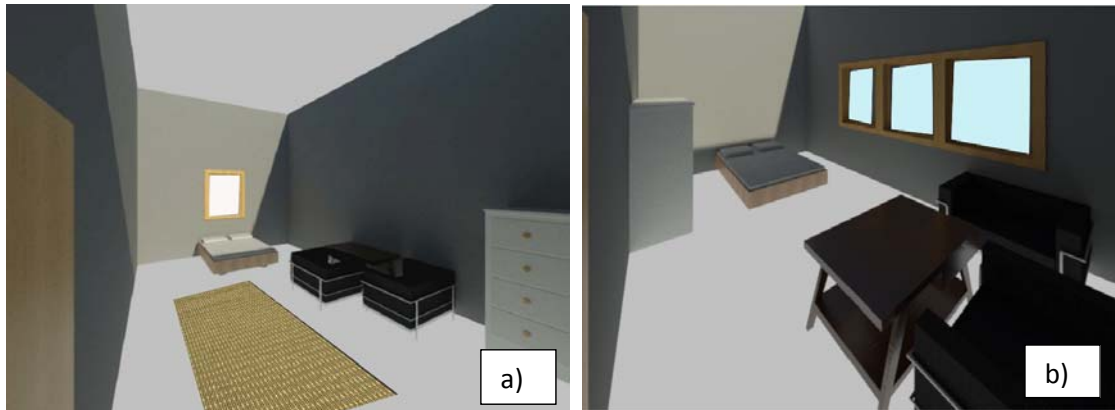


Fig. 9.9. Master bedroom: proposed (a) and typical (b)

The situation with the master bedroom in David Lee Point is slightly better, however bigger master bedrooms with their bathrooms are recommended for accommodating more furniture without restricting the movement in the room for better quality of life.



Fig. 9.10. Examples of more spacious master bedrooms that can be casual, but functional

Since some social interactions take place in the communal areas, it is recommended the building to be provided with corridors and lobby of sensible size. Fig. 9.11 shows a ground floor plan with corridor width of 1.8m and lobby size 6,45m/12,60m



Fig. 9.11. Ground floor with restaurant, café and shops

9.4.1.2. Amenities

According to best practices examined through interviews with prominent high-rise architects and case study with high-rise residents the following design principles and recommendations are:

- Implementation of **roof garden with modular seating** is highly recommended. However, attention should be focused on safety, especially that of small children. It is logical to assume that the roof garden is an appropriate place for the elderly to spend some of their spare time. In that connection, it is important to provide them with some activities such as gardening in which they can be involved. For passive recreation, there must be provided comfortable seating and viewing

opportunities. For more meaningful experience, there must be provided secluded “reflective” niches. Reflection is an important psychological approach crucial for the mental well-being of the people. Spaces where people can peacefully observe their past experiences can be very beneficial for their health.



Fig. 9.12. Reflective niche on a rooftop

- Introduction of a **gym** in the building. The gym should be designed in such a manner that people of different ages and abilities to be able to use it. Even though training in a park is ideal, when there is no access to suitable natural settings, or it is unsafe, a gym can provide a healthy alternative.
- **Pool** in the building will make a useful addition to the gym for more active and healthy lifestyle. Swimming is a great sport, and in the UK cities, there are pools provided for the people. Pool in the building can suit the lifestyle of a busy professional or can be a nice place to socialize with the children.

- Implementation of a **spa** in the building to improve the quality of life of the residents. This is a luxury amenity meaning it is not a first life necessity, though the sweating is proven to be very beneficial for the health. A regular visit to the spa provides the benefits of a mild exercise since the heat of the sauna dilates the capillaries and improves the blood flow.
- Even if there are suitable childplay facilities outside the building, in very bad weather, so frequent in the UK, it is reasonable to have **childplay room**, properly designed for children of different ages and interests. A slide and other climbing facilities must be provided for the development of gross motor skills, as well as elements that develop the fine motor skills. The equipment must be in different colours, shapes and textures for maximum sensory stimulation. The gross motor play areas should be separated from the from quieter cognitive play areas. There must be adequate provision for watching others play-places and to hang out and observe, as well as a variety of activities.
- Provision of a **café and/or restaurant** on the ground floor of the building will greatly improve the social atmosphere in the building and will contribute to the neighbourhood connections and the sense of place. It, however, depends on other factors, building strong community sense in the building, making the residents want to gather in their restaurant or a café and some of them depend on the design. For example, if they socialise around the children in the childplay room or at the rooftop garden, it is very likely for them to want to start their day together in the morning or have a meal together in a familiar, friendly environment.
- It recommended providing **shops** on the ground floor of the high-rise to better connect the building with its neighbourhood. Shops are beneficial for the whole neighbourhood, they are needed, and they must meet a great variety of demands, so it is often a challenge to locate them conveniently, and every space suitable for the purpose must be used wisely.

- A **lounge** in the building is highly recommended since the lack of spaces for social interactions badly affects the quality of life of the residents. It might or might not improve the social climate in the building, but its availability suggests opportunities to know your neighbours, thus feel safer and accepted, which is a pleasant mental state.
- A **library** is highly recommended amenity which will provide an area for peaceful and useful time especially in between the elderly and the children.

Since the architects point out lack of space and funding as the major barrier in front of the sustainability, it is realistic to suppose that not all the amenities should be incorporated at once, but choose certain combinations. For example, since library suggests more sedentary time, it can be combined with pool and spa. Or a childplay room can be combined with a lounge for further capitalizing on the established social connections. A lounge can be coupled with a roof garden for any weather circumstances, and to provide access to nature and larger view than the flats are doing. This is all directed towards the difficult task to bring people living in high-rises together because it is important for a healthy social life to maintain a good relationship with your neighbours. From the literature review, it is found that making available more participation chances will raise the interest to community activities, and there is a margin for exploring the high or low interest in a particular initiative after the recommendation of this framework are implemented.

9.4.1.3. Comfort and energy efficiency

- Sound comfort

The UK building regulations Approved Document E has a comprehensive set of suggested solutions which should be implemented in new buildings. Since the interviews with the residents

in the new buildings demonstrate better aural comfort than in the old ones, it should be enough to follow the prescriptions for constructions in the building regulations and apply it to old high-rises.

- Thermal Comfort:

The simulations demonstrated minimal cost savings from implementing more insulation or energy-efficient windows. The electricity for a water-to-water heat pump is even much more expensive than heating with a gas boiler, so it is enough to follow the Building Regulations regarding energy efficiency, the simulations demonstrated that a good level of comfort is achieved with the prescribed U-values for the building envelope elements for different scenarios. Experiments with solar panels are recommended since there are found desirable by the residents and professionals.

9.5.1.4. Mixed use

The combination of offices or a hotel with the residential areas is not approved from the majority of the residents, so even though some of the architects think that it is socially sustainable, the framework cannot recommend the combination. A nursery in a residential building is found feasible from the majority of the residents and some of the architects so this is a solution that can improve the quality of life of the residents and is recommended by the framework.

9.4.1.5. Architectural qualities

- **The building needs to be connected to the landscape and the urban context**

There are two sides of such a connection: functional and visual. The functional connection has been discussed when reviewing amenities on the ground floor. The visual connection can be achieved by correspondence to human scale on the ground level, either by properly scaled

architectural elements such as columns and walls or by adding a lower mass at the base of the building. If there are landscape features around the building, greenery and architecture could be united for mutual enhancement of their visual effect.

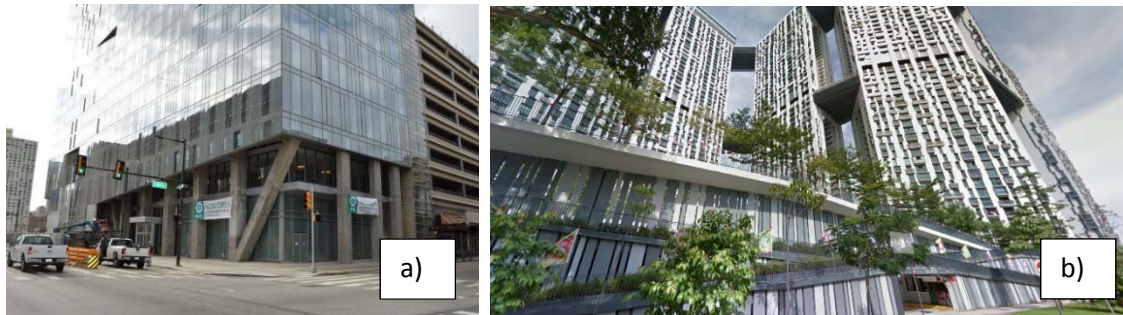


Fig. 9.13. Connection with the context a) Evo, Philadelphia, Designed by Erdy McHenry and b) The Pinnacle@Duxton, Singapore

The interviewed architects, when discussing the sense of place with residential high-rises have recommended these approaches. Trancik (1986) also finds a connection between regionalism, contextualism and liveability, related to the user's identification and control over the personal space. Gehl Architects claim, "There are universal elements of spatial form that achieve liveability standards that are oriented around people's needs, for example, human scale. However, these elements are not always copy and paste, and should be tailored to a local and cultural context" (Danish TM, 2016). Brolin (1981) disagrees with modernism's context disruption, the disregard for the past, and the "spirit of the times" doctrine, and stresses on the significance of visual continuity, bringing it on the top of the agenda architects, planners, and developers. In his work, the form, scale, ornament, materials, and details for accommodating architecture to its contexts are a high priority. Groat (1983) provides a guide on how to connect new buildings to old neighbourhoods. The focus is on using elements extracted from the surrounding façades. "A highly liveable city respects its natural setting and builds on its landscape qualities as well as on its history, providing visible connections with its past" (Southworth, 2016, p.570).

- **The overall silhouette and overall character of the city skyline must be improved.**

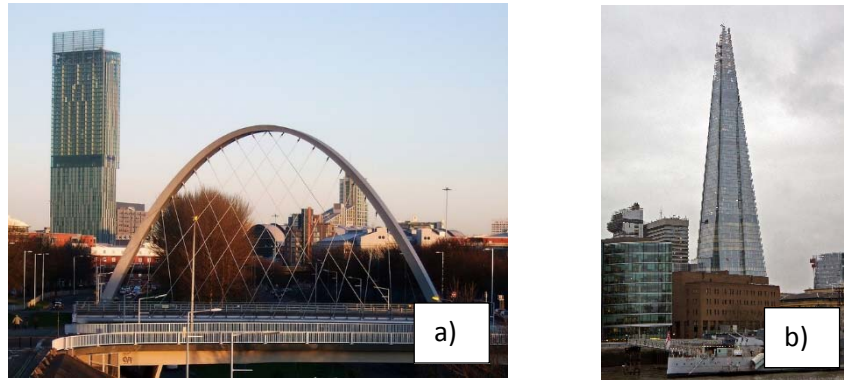


Fig. 9.14 a) The Beetham Tower, Manchester and b) The Shard, London

The shape of the building and the façade treatment can add quality to the city skyline and overall appearance if it is interesting and non-conforming. The architects must choose such colours, materials and patterns that will make a great impression viewed from near or from a big distance and will distinct the building from more traditional context or unite it with its neighbours in a cluster of new high-rises. Ali and Aksamija (2008) claim that better city life is based on a holistic design methodology, taking into consideration factors such as contextual aspects and urban character and skyline. For the successful integration of the tall buildings in the cities, they must be aesthetically pleasing and in balance with their environment. A well-designed tall building can add positive elements to the skyline and cityscape, being attractive and acceptable for the citizens. Researchers are positive that certain skylines can evoke pleasure and interest, after all the city skyline is the ultimate manifestation of prestige and power. Stamps et al. (2005) as cited by Al-Kodmany (2017), points out that this is depending on three variables: variance of building attributes; the number of turns of the roofs; skyline's overall shape. According to these findings, urban designers must carefully consider variations in heights, widths, setbacks and step backs.

- **The high-rises have to create landmarks within the architecture of the place where appropriate.** If there is no conflict with a historical building that is already a landmark, using their size and with the ambitious design the high-rise buildings can make great

landmarks. Landmarks give face and identity of the city and the place, enhance the civic pride of the residents and that is why they are so important. “Focal buildings should represent society and need to re-establish their symbolism. At the same time, a new shared architectural language based on specific localities must be devised for contextual buildings to return to a subordinate role. Places can and should enhance their communities by providing landmarks in time and space that are perceived as touchstones for the past and present. There is little doubt that a community uplifted by its environment is more socially adjusted, more economically prosperous and more optimistic about the future (Giddings, 2007). Clerici and Mironowicz (2009), p.23, claim that the quality of landmarks is a crucial and powerful factor of successful urban realm related not only to sense of place but also to “essential values basic both in economic development and in public involvement. In consequence, landmarks might be considered as a key factor the quality of urban life.”

- **Wonderful views must be created.** Some architects recommend shaping the building around the views and carefully design the windows. The views from amenities such as roof deck or lounge are equally important to the views from the units, in a way they complement sometimes restricted possibilities the architects have with the design of the units.

From an environmental point of view, climatic factors and the availability of healthy, pleasant indoor and outdoor spaces are crucial for liveability. There are some vital questions related to liveability: provision of adequate contact with the outside (view) and does the resident benefit from the natural agents (daylight, sunlight, & natural ventilation) (NG and Wong, 2003). Mentioned by numerous authors, the most appealing features of high-rise living are the good views, breeziness, and air quality (Chew, 2005; Housing & Development Board, 2005; Yuen et al., 2006 as cited by Yuen, 2009).



Fig. 9.15. Evo, Philadelphia, rooftop pool

People also like the big windows; they are relevant for providing light, air and view, so it is recommended whenever possible to use large panes. The architects repeatedly talk about the importance of lights and views in the interviews. In the future advanced ventilation systems can provide high-quality of air through control over the openings, but this is a technology for residential buildings that was not mentioned by the architects or found on the Internet. Such a technology can bring peace of mind.

- **A sense of place must be created with the high-rise buildings.**

For cognitive interaction with the place, the building must provide environmental elements that help people navigate their way and assist their spatial perception. For behavioural aspects of the interaction between people and places, there must be implemented possibilities for activities and different functions of the high-rise buildings. And for emotional interaction the building must create attachment and satisfaction with the place, the place must have some meaning. It can be achieved by a special form of the space and the building, different functions on the ground floor and

turning the space into a centre of community interaction or simply providing a landmark. In the UK, the Department for Communities and Local Government defined that liveability deals with the quality of space and the built environment.



Fig. 9.16. NV buildings, Salford Quays

The easiness with which a place is used and the safe feeling is crucial. It is important to create and maintain a sense of place through an environment that is both inviting and delightful (Li, Sun, Jones, 2012). “To reduce the liveability of cities to their material or economic wealth is to miss the social relations needed for what Peattie (1998) puts forth as the highest pursuit of a liveable city, which is its social conviviality. In the same light, in giving meaning and a sense of shared community life, the interaction of people with the built environment through place-making is fundamental to the conviviality, and thus the liveability, of any city” (Ho and Douglass, 2008, p.200).

- **The architecture of the new high-rise buildings must stand out and be unique, thus conducting a sense of identity.** “Identity is the basis of perception, experience and appreciation of the environment. It allows people to develop effective bonds to place, as well as a sense of belonging that brings people together around shared values, issues and

localities (Manzo, 2003; Tua, 1980). Place identity contributes to forging the image of an environment, as well as vitality, liveability and performance.” (Casakin, n.d., p. iii)

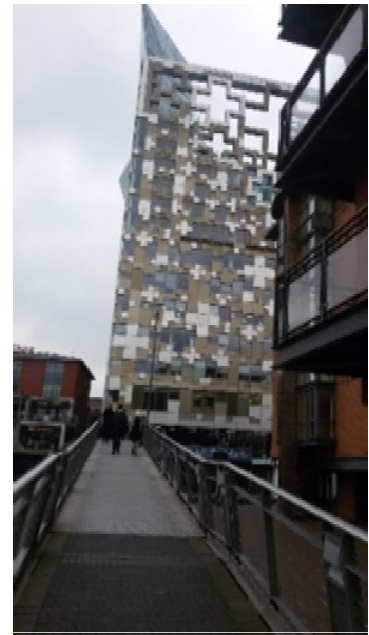


Fig. 9.17. The Cube, Birmingham, unique architecture

- **Proper security must be provided, including access control and monitoring in the lobby.** Newman (1972) explored a concept known as “defensible space” where citizens of a location engage with a place and care for it as their own, leading to less crime and enhanced liveability. “A neighbourhood with a high crime rate will result in an unsafe environment that imparts fear and worry among its residents. It is impossible to bring about a good quality of life in an area with a high crime rate, even if other living conditions are satisfactory” (Leby and Hashim, 2010, p.76).
- People are more attracted to **light colours**, they make the building stand out, so it is recommended to use them for new buildings.
- **It is recommended to put an effort into developing memorable shape and great architectural detail to distinguish the buildings from the rest of similar constructions.** Fig 9.18 shows all these points implemented into a local landmark.

- It is recommended to study the area of construction and work for a **variety of architectural styles, enrichment of the surroundings**. Diversity encompasses a lot of issues. It refers to physical space (building density, housing types and size, architectural styles) as well as variety in social, cultural and economic terms (household sizes, ages, cultures and income). Diversity, supports creating a common identity, for more attractive places, thus encouraging walking and social interaction. (Okutuku and Kilic, 2007).

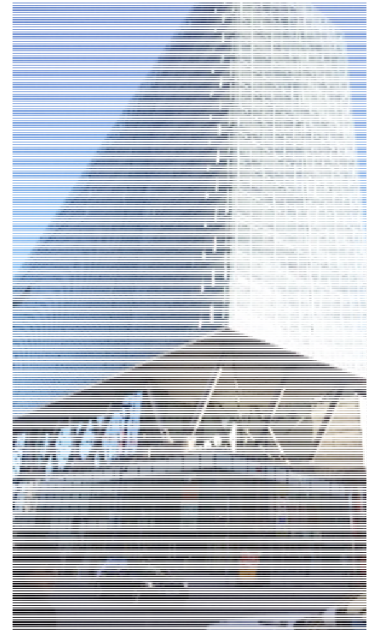


Fig. 9.18 1 Deansgate memorable shape and light colours



Fig. 9.19. Example of diversity: Salford Quays high-rises

- **The massing must react to how the people are going to approach the site and understanding where are the relevant places people want to congregate.** “Aesthetically, the whole form of the compound or the neighbourhood can enhance liveability on several levels; site organization, massing, and façade features, in which site organization includes size and heights of masses, and their composite fittingness. Massing includes shape, volume and scale, while façade features include colour, texture, materials, style, openings, and overall details that are in facades. Availability of matching and fittingness in the whole urban built environment leads to contextual compatibility which leads to liveability” (Momtaz and Elsemary, 2015, p. 78). A successful trend from the interviewed architects’ projects is to include lower volumes by the tower and incorporate natural features on their tops, very feasible in the hearts of the cities, where such features are scarce.
- **The units must be Liveable units:** they must provide a sense of satisfaction with good materials and attractive interior design.

9.5. Discussion of the implications in the framework

The theoretical framework encompasses recommendations that through sustainable design responses will enhance the quality of life of residents in high-rise buildings. It starts with the proposition of different flats layouts of different sizes that will better accommodate the needs and the lifestyle of the residents. These parameters directly influence the activities that can be deployed in the flat and thus are of great importance for the quality of life if the designers want the residents to be liberated to have guests or accommodate the children games, or other space demanding activities. Regarding amenities, it was found that the implementation of certain amenities, not all at once, but combinations, are highly desirable. It can directly affect the social life of the residents, their health, their comfort and the sense of place in the buildings. The thermal

comfort was not found problematic in the new buildings, however it is an issue in the old buildings, however the energy bill cannot be significantly reduced by increasing the U-value of the external walls or by introducing energy-saving windows. Aural comfort can be improved by following the prescriptions of the building regulations. Finally, to improve the attachment of the residents to their homes, a number of architectural features must be taken into consideration in order to appeal to the sense of pride in the residents.

Chapter 10 Summary, recommendations, areas of future research and conclusion

The last chapter discusses the main findings of the thesis to illustrate how the theoretical and empirical research is related to the outcomes. The answers to the research questions are also presented, along with a link between the findings and the research objectives and the overall aim of this research. Finally, recommendations are synthesised, and areas for further research are proposed.

10.1. Summary

The problems with liveability and energy efficiency of the residential high-rises have been a subject of active discussion in the literature. There is extensive research on programs and measures applicable for residential high-rises, but not much has been done in connection with the quality of life as discovered when exploring the literature.

This research aimed at developing a theoretical framework that informs designers, academics and users on how to apply sustainable design responses to the architecture of the towers for enhancing the quality of life in contexts such as the UK or close as urban planning, textures and functions embedded in it, climate and built environment. The research was guided by the research objectives and answers to two research questions as well. Connection between sustainable design responses and quality of life in residential high-rises was investigated via interviews with professionals (objective 1). Liveability was evaluated via interviews with high-rise residents (objective 2). Energy-efficient solutions' applicability was investigated through dynamic simulations in DesignBuilder with a focus on thermal comfort related (affecting quality of life) after different energy-efficient solutions were implemented in a model (objective 3). A theoretical framework was produced based on the main outcomes of the research (objective 4). Principles of the sustainable high-rises were formulated based on the interviews with the professionals (first research question). Problems, mentioned in the literature review, were investigated for the British context, listed and addressed (second research question). A mixed interpretivist (access to reality

through language, consciousness, shared meaning), and realist (Objective true, independent of human thoughts and believes or knowledge of their existence, measurable and testable) philosophical view determined the research direction and a mixed method methodology as justified in chapter three was implemented to gather useful data. An exploratory study of a number of high-rises in Manchester and London was carried out April 2016-July 2017 in order to provide answers to the research problems. The qualitative interviews with residents in new and old high-rises were complemented by an observational survey carried out two times: April 2016 and July 2017. Interviews with twelve architects were conducted January-July 2016 to apply triangulation of the findings. To complete the study with a comprehensive set of data the methodology included data from dynamic computer modelling programme namely DesignBuilder used to evaluate the energy performance of a proposed high-rise building depending on different characteristics of its envelope. The framework is developed to have an impact on the residents' quality of life and will guide professionals about their approach to one or another sustainable design response and will fill the gap in knowledge concerning this typology.

10.1.1. Occupants' needs

Cho and Lee (2011) discover that it is needed to design according to age and generation in adequately meet needs. Li, Sun and Jones (2012) share similar views. Carstens (1998) offers guidelines based on the older people's social and psychological needs, directions for garden plots, social interactions, sensory details and enjoying nature, allowing for independence and security. Francis (1998) discusses educational philosophy and child development, stressing on the correlation between the quality of space and the children's behaviour. This is why elderly residents and families with children were interviewed. It was discovered that childplay provisions vary in quality around new and old buildings, which affects the life of the residents and there is a need for quality childplay amenities. Provisions for elderly also vary in quality and size around new and old buildings sometimes with a negative impact on quality of life and there must be

implemented amenities in and around the buildings that reflect the needs of the elderly. These findings imply that the new high-rises must encompass more age appropriate features than at present. Mohit and Lee (2011) state that the demands of the residents are crucial, and point out some options for communal spaces such as gym, saunas or study rooms. Cho and Lin (2011) conclude that attractive communal spaces increase life satisfaction. However, they do not state what functions in particular could increase quality of life this is why the study investigated the availability of such spaces in residential high-rises and their attitudes to particular amenities. Both old and new buildings suffer from lack of specially designated places where neighbours can communicate. A number of amenities such as pool, spa, gym, childplay room, café, shops, lounge and library are desirable in both selections of buildings. For the future it means that the demand and the needs of the residents must be reflected by adequate design after serious preliminary surveys of the context and the affordability. Better variety of rooms and their appropriate sizes must be considered since there is a general dissatisfaction with the layouts both in new and old buildings. There are some problems reported regarding thermal comfort in the old buildings, the new buildings seem to be satisfactory, but the simulations demonstrated that following the Building regulations leads to good results.

Kearns et al., (2011) describe dissatisfaction with noise and security. Noise is a problem also according to Lai and Yik (2009) in residential high-rises for a different context. The research investigate the issue. Aural comfort is problematic in the old buildings but is all right in the new buildings. Following the existing building regulations also successfully addresses this problem. The residents in most of the old and new buildings are satisfied with their double-glazing and do not wish to switch to energy saving-windows. The simulations also demonstrated there is little to be achieved cost-wise with advanced fenestration. Gill (2008) stresses on the importance of greenery, daylight and renewable energy technologies so the attitudes of the residents were investigated. Chong et al. (2011) demonstrates energy savings by application of solar panels. When familiar with the concept, the residents in both selections of buildings approve the implementation of geothermal energy. However, the simulations demonstrated it is a very

expensive option. Solar panels are a desirable solution in both selections of buildings. For the future it does not mean that these technologies are not applicable, but better economic conditions must arise. Architectural features such as big windows, views, security are highly appreciated in both selections of buildings.

Lee, Je and Byen (2011) state that clean facilities and good indoor air quality are the most important for the crucial factor for well-being: health. However, the psychological aspects of living in an environment with a sense of place, community spirit, pride evoking features are underestimated and the research studied them. There is no feeling of community in both selections of buildings and steps to gather people together in communal spaces are recommended. A strong identity is achieved mainly with the new buildings' design. Green features and seating and viewing opportunities are more accessible around the new buildings, and even there are not abundant. For the future, it means that the high-rises and the surroundings need to be designed to the highest standards available in order to secure psychological as well as physical comfort, standards that will probably will need to be developed after further research.

10.1.2. Practice and professional recommendations

Social climate can be improved by introducing better communal areas and amenities into the design of residential high-rises. Architects find mixed use socially sustainable. Energy efficient envelope, proper solar orientation and efficient HVAC systems can improve the environmental sustainability of the residential high-rises. Geothermal energy and solar panels are absolutely suitable for residential high-rises provided that there is enough service area on the roof or around the building. Jackson, (2003) states out that according to the literature, successful design provides the inhabitants with plenty of natural light and air, views of natural elements and provision of beautiful landscapes around. The architects agree that Quality of life in residential high-rises can be enhanced by access to light and view, amenities for social interactions, exercise and

entertainment, well-designed units, access to transportation, work and green features. Thus the existing research is complemented as the role of the social spaces and variety of functions is stressed by the architects along with the provision of natural agents. Placemaking is directly enhanced by the social life of the building. Architects agree that the barrier creating the most difficulties to implementing sustainability into residential high-rise buildings is the cost. Weaknesses like small units, unattractive architecture, cheap materials and craftsmanship with worse performance, parking problems, security issues seriously diminish the popularity of the typology. High-rises accommodating people with different income through affordability programs can contribute to equality and social justice. An environment that the users enjoy because of appearance and mix of functions has a great social value. For the future implementation of such programs may lead to a shift in the profile of the residents and people with different incomes might live at prestigious locations. Tu and Lee (2008) stress on the importance of the ground floor. Gill (2008) state the importance of the connection with the context. This existing research led to investigation of the design philosophy and the placemaking techniques of the architects. Design milestones include studying the context and its deficiencies, considering the number of amenity users, stitching the fabric of the neighbourhood together, attention to sustainability. Skilful massing can solve complex issues of the site definition. Problems with high-rises include isolation and alienation of the buildings and the users, no communal areas, small units. The architects are affirmative of the need for vertical growth as an alternative to sprawl. There are several successful strategies when designing in rich cultural context: design the high-rise as a background (forming a setting) building, answer with simple, attractive exterior, do not mimic the context, design the high-rise as a part of the fabric through massing to mitigate the effect of the height difference, or as a simple, unobstructive form. Affecting the users' emotions can be achieved through sound functional integrity and responding to the cultural context. For the future, these approaches might be helpful when creating a high-rise environment that is uplifting and memorable.

10.1.3. Architecture quality and sense of place

The old buildings are characterized by worn out, uninteresting facades. The architectural design of the new buildings is very attractive due to transparent materials evoking the feeling of lightness, or harder surfaces where water features are abundant, order, the play of volumes creating shades. Smooth transitions in height are not achieved either with the old nor the new buildings presented in this case study. A good example are the buildings around the Cobalt Point at Isle of the Dogs, where a good effect was achieved. Public realm around the old buildings has less functional and visual significance than around the new buildings. People are more active around the new buildings than around the old ones that look abandoned. The new buildings manage to contribute to the sense of place with their advanced appearance, unlike the old ones that only dominated the context there, so the new areas represent a more meaningful location.

10.1.4. Energy efficiency and cost sustainability

- Three factors influence the envelope performance: the facade design factors including glazing type, window area and shading. Secondly, the building material properties including the thermal mass, insulation and airtightness are crucial for the efficiency of the envelope. Finally, and site factors including building orientation and climatic features are important (Raji, Tenpierik and Dobbelsteen (2015)). This is why scenarios with different insulations thicknesses and windows were investigated. Dowd and Mourshed, (2015) investigate building envelope and the results illustrate that wall construction and window size mostly determine the thermal behaviour of the building. They conclude that 20% glazing level resulted in minimal energy consumption for all with the exception of the concrete wall without insulation. These types of walls can benefit if glazed up to 30%, meeting the heat losses with solar heat gains. However, small savings are possible for insulation beyond 50 mm, negatively affecting the payback period. The simulations demonstrated minimal cost savings from expanding the insulation layer of the building

envelopes and the introduction of energy-saving windows. There is no margin for improving the existing building regulations since increasing the thickness of the insulation layer results in very small energy savings and long payback period. For the future it means that energy savings must be achieved through better orientation and optimum glazing amount, not heavily insulated walls.

- Total energy consumption with the Ground source heat pump system is 529197.21 kWh, which equals 63503.66 British Pounds related to the price of the electricity in the UK. However, the cost of heating using a gas boiler in the existing building with the worst case scenario building envelope characteristics is only 15459.23 British Pounds. This suggests that at this point geothermal energy is not money saving technology in the UK, even though it is environmentally sustainable.

The main aim of this thesis was to develop a framework that suggests a number of sustainable design responses in order to enhance the quality of life of residential high-rises in the UK context. The outcomes from this study can help architects and engineers in their decision-making process in order to produce more successful designs.

1. The first objective was to evaluate the connection between sustainability and quality of life indicators in high-rise buildings. This objective has been met by interviews with architects which made a clear connection between quality of life and possible features of the designs that were described as sustainable.
2. The second objective was to analyse liveability of high-rise buildings for a better quality of life. It has been met through interviews with residents in new and old high-rises in Manchester and London, who built a comprehensive picture of what their life in these buildings is looking like.
3. The third objective was to analyse energy-efficient solutions and their impact on comfort enhancing the quality of life. It has been met through dynamic simulations of a proposed

high-rise as well as through questions what energy-efficient measures seem feasible with residents and architects.

4. The fourth objective was to produce a theoretical framework for designing sustainable high-rise residential buildings. The interviews and the simulations informed the author on what suggestion to make in order to enhance the quality of life in residential high-rises with sustainable design interventions.

10.2. Potential, limitations, challenges and gaps

1. The literature on sustainability of the high-rises and the quality of life in them in the UK context is limited
2. The demographics of the residents in the new high-rises and the difficulties to convince elderly and families with children to participate in the interviews ended in an insufficient number of respondents from these groups. An effort was made to include people from different cultures in the research, however, if they were elderly or family with children, they were included with little regard of their ethnicity or culture due to the difficulties to find these particular type of participants. A contact person from some buildings was asked to contact neighbours from this demographics in order to overcome this challenge. Case studies focused on the needs of these groups have a great potential for a better future design of residential high-rises in the UK.
3. It was impossible to obtain original construction drawings for a simulation of an existing building. Such simulations are recommended in order to better understand the problems of the building envelope of the existing high-rise stock in the UK. A cross reference-between such a simulation and the data from the interviews with the residents could bring this thesis further.

4. A limitation imposed by the nature of a single case study method is the difficulty to arrive at a generalising conclusion (Tellis, 1997) as cited by Zainal. (2007). Yin (1993) as cited by Zainal. (2007) describes this type of methodology as ‘microscopic’ since it relies on limited samples. The research cannot recommend following the framework without further broad discussion with residents in the cities in question even in the UK.

10.3. Contribution to knowledge

The research can serve as architects and planners guide, thus bridging the gap of knowledge in the areas covered. The contribution can be summarized as follows:

10.3.1. Theoretical contribution

- It bridges a gap in the literature concerning the quality of life in residential high-rises for the UK context. There was found limited proof of quality of life in the literature for the UK context that need to be controlled, that the quality of life in the UK context is low, or it needs improvement. The questions were based on the theory of the architecture, urban design and healthy lifestyle inspired by the literature for other contexts, an experience that could be applied in the British context.
- The suggestion to include a certain number of amenities in the residential high-rises is directly addressing some of the weaknesses of the typology stated in the interviews with the architects. For example, Architect 7 comments that it would be unrealistic to imagine that families will be living in the city centre since there are no facilities for children there and if the apartments are quite small; which can be avoided by considerate design features and a mixture of flats layouts.

The research developed a framework that can be of interest (with some limitations) for planning authorities not only in the UK but in similar contexts, as it can be another

developed European Country willing to densify its city centres and preserve its architectural heritage in the same time.

10.3.2. Empirical contribution

- Some findings were published in conferences and journals raising the awareness of possible solutions of quality of life in residential high-rise problems
- The outcomes could also be a teaching tool clarifying often neglected problems in residential high-rise buildings
- Areas for future research and recommendations include wider population to be included in the research thus for a study gaining more validity and dynamic simulations of solar panels on the roof and the façade.

10.4. Suggestion for future research

The major contribution of this research is purely theoretical. It will be interesting future research if the framework is implemented in a real-life project and the satisfaction of the residents is measured. Special interest might be the focus on the amenities: how they changed the quality of life, how much are they used, which are the most helpful. Also, the architectural qualities are a vast area for suggestions, experimentation and research in terms of architectural detail shape, massing and materials. Due to the challenge to include more family with children and elderly, it is suggested that the needs of these demographics are further studied. Mixed-use was a controversial issue, more research on the demand and the applicability as well as the benefits of this solution is needed.

10.5. Conclusion

Quality of life in residential high-rise buildings through better human comfort conditions while optimising energy efficiency and reducing the impact on the environment is an important and challenging topic. The users' awareness on the subject has been found problematic and the research aimed at linking the knowledge of the professionals to the sensations and the opinions of the residents. The research recognised the various needs for a framework developed through interviews and dynamic simulations to bridge the gap in knowledge regarding sustainability solutions in the UK context. The research aims at improving the housing conditions in residential high-rises and to solve social and environmental issues. The approach concerns the solutions that highly influence the design in order to produce more energy-efficient homes with better social parameters.

The research methodology of this study is based on the combined interpretivist and realist philosophical view applied to case study to fully address social and environmental issues. The research has developed a framework to propose design strategies for better quality of life in residential high-rises. It could be a useful guidance for stakeholders (designers, planners and authorities) to help approaching design decisions, techniques and strategies. The framework is based on an empirical and theoretical study to clarify the main principle of sustainable high-rise enhancing the quality of life of the residents. The analysis of the subjective views and the design simulations was implemented in order to evaluate the applicability of different measures in order to achieve the overall aim. The findings of the study show minimal money savings from increasing the U-value of a high-rises' building envelope and implementing energy-saving windows, however introducing combinations of amenities is proven to be highly desirable from the residents and recommended by the professionals. Finally, this work aims to contribute to knowledge towards socially and environmentally sustainable residential high-rises and to become a source of information to direct future studies to improve residents' quality of life.

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Appendixes

Appendix 1 Interview Protocols: residents

Interview Protocol: families with children

I. Is there a child play facilities for the building?

>Yes

1. Is there provision for the children physical development-gross motor activities such as running, jumping and climbing?
2. Are there opportunities to manipulate elements in the environment to develop fine motor control?
3. Are the spaces created with appropriate size?
4. Have the colours, textures and shapes of design elements been chosen to provide a range of sensory experience?
5. Are gross motor play areas separated from quieter cognitive play areas?
6. Is one third to one-half of the space open: containing no equipment?
7. Is there adequate provision for watching others play-places to hang out and observe?
8. Is there a good relation between play settings: visual connection, clear paths, adequate separation?
9. Is there some natural area for exploration?
10. Is there provision for a variety of activities?

>No

1. Is it important for you to have a provision for the children physical development-gross motor activities such as running, jumping and climbing?
2. Is it important for you to have opportunities to manipulate elements in the environment to develop fine motor control?
3. Do you demand the spaces to be created with appropriate size?
4. Do you demand colours, textures and shapes of design elements to be chosen to provide a range of sensory experience?
5. Do you want gross motor play areas to be separated from quieter cognitive play areas?
6. Do you approve one third to one half of the space to be open-containing no equipment?
7. Do you demand adequate provision for watching others play-places to hang out and observe?
8. Do you require a good relation between play settings: visual connection, clear paths, adequate separation?
9. Do you require there some natural area for exploration?
10. Do you require provision for a variety of activities?

II. Where in the building are you having your social interactions?

III. Is the flat layout satisfying yours and your family needs? What rooms do you need?

IV. Thermal comfort

1. Is the air temperature pleasant?
2. Do you have unpleasant sources of radiant temperature (solar gain, equipment)?

3. How do you evaluate the humidity in the apartment(too high/too low)?
4. Do you have to wear too much or too little clothes?
5. How do you perceive the air movement in the flat: too little/too much?

V. Are there pollutants (outdoor/indoor) in the air?

VI. Aural comfort:

1. Is there step noise in the flat?
2. Is there air-born noise in the flat?

VII. Energy efficiency

1. Would you like energy saving windows instead of double glazing?
2. Do you fancy geothermal energy?
3. Do you fancy biofuel equipment?
4. Do you fancy solar panels on the roof?

VIII. Amenities

1. Do you fancy Roof garden with Modular Seating and Dining Areas?
2. Do you fancy gym in the building?
3. Do you fancy pool in the building?
4. Do you fancy spa in the building?
5. Do you fancy childplay room in the building?
6. Do you fancy café and restaurant in the building?
7. Do you fancy shops in the building?
8. Do you fancy Living room lounge with billiards and TV
9. Do you fancy library with 24 hours business centre in the building?

IX. Mixed use

1. Do you fancy offices in the building?
2. Do you fancy a hotel in the building?
3. Do you fancy shops in the building?
4. Do you fancy a nursery in the building?

X. Architectural qualities

1. What architectural qualities of the building do you like the most?
2. Is there a feeling of community?
3. Do you think the building has a strong identity?
4. Do you feel proud of living in that building?
5. Do you have enough green spaces in and around the building?
6. Do you have enough seating and scenic views around the building?

Interview protocol-elderly

I. Activities

1. Is there a provision of a range of activities/spaces for active and passive recreation?
2. Are there active 'doing' spaces?

3. Is there a provision of appropriate viewing and observation areas so people can easily see landmarks, significant landscaping, recreation and activity areas, eg. fountains, bird feeders, gardens, picnic area etc.;
4. Is there a provision of a garden-like setting with trees to stroll through;
5. Is it Promoting and supporting socialising and game playing through the design of appropriate facilities and spaces;
6. is there a provision of comfortable sitting and socialising areas;
7. Is there a provision of secluded 'retreats' and reflective niches
8. Is there a provision of seating for two people and group of people
9. Is a variety of exercise opportunities available for people of all ability levels?
10. Have seating arrangements been avoided that force people into eye contact?

II. Where in the building are you having your social interactions?

III. Is the flat layout satisfying yours and your family needs? What rooms do you need?

IV. Thermal comfort

6. Is the air temperature pleasant?
7. Do you have unpleasant sources of radiant temperature (solar gain, equipment)?
8. How do you evaluate the humidity in the apartment(too high/too low)?
9. Do you have to wear too much or too little clothes?
10. How do you perceive the air movement in the flat: too little/too much?

V. Are there pollutants (outdoor/indoor) in the air?

VI. Aural comfort:

3. Is there step noise in the flat?
4. Is there air-born noise in the flat?

VII. Energy efficiency

5. Would you like energy saving windows instead of double glazing?
6. Do you fancy geothermal energy?
7. Do you fancy biofuel equipment?
8. Do you fancy solar panels on the roof?

VIII. Amenities

10. Do you fancy Roof garden with Modular Seating and Dining Areas?
11. Do you fancy gym in the building?
12. Do you fancy pool in the building?
13. Do you fancy spa in the building?
14. Do you fancy childplay room in the building?
15. Do you fancy café and restaurant in the building?
16. Do you fancy shops in the building?
17. Do you fancy Living room lounge with billiards and TV
18. Do you fancy library with 24 hours business centre in the building?

IX. Mixed use

5. Do you fancy offices in the building?
6. Do you fancy a hotel in the building?
7. Do you fancy shops in the building?
8. Do you fancy a nursery in the building?

X. Architectural qualities

1. What architectural qualities of the building do you like the most?
2. Is there a feeling of community?
3. Do you think the building has a strong identity?
4. Do you feel proud of living in that building?
5. Do you have enough green spaces in and around the building?
6. Do you have enough seating and scenic views around the building?

Interview protocol-young professionals

I. Where in the building are you having your social interactions?

II. Is the flat layout satisfying yours and your family needs? What rooms do you need?

III. Thermal comfort

11. Is the air temperature pleasant?
12. Do you have unpleasant sources of radiant temperature (solar gain, equipment)?
13. How do you evaluate the humidity in the apartment(too high/too low)?
14. Do you have to wear too much or too little clothes?
15. How do you perceive the air movement in the flat: too little/too much?

IV. Are there pollutants (outdoor/indoor) in the air?

V. Aural comfort:

5. Is there step noise in the flat?
6. Is there air-born noise in the flat?

VI. Energy efficiency

9. Would you like energy saving windows instead of double glazing?
10. Do you fancy geothermal energy?
11. Do you fancy biofuel equipment?
12. Do you fancy solar panels on the roof?

VII. Amenities

19. Do you fancy Roof garden with Modular Seating and Dining Areas?
20. Do you fancy gym in the building?
21. Do you fancy pool in the building?
22. Do you fancy spa in the building?
23. Do you fancy childplay room in the building?
24. Do you fancy café and restaurant in the building?
25. Do you fancy shops in the building?
26. Do you fancy Living room lounge with billiards and TV
27. Do you fancy library with 24 hours business centre in the building?

VIII. Mixed use

9. Do you fancy offices in the building?

10. Do you fancy a hotel in the building?
 11. Do you fancy shops in the building?
 12. Do you fancy a nursery in the building?
- IX. **Architectural qualities**
- I. What architectural qualities of the building do you like the most?
 - II. Is there a feeling of community?
 - III. Do you think the building has a strong identity?
 - IV. Do you feel proud of living in that building?
 - V. Do you have enough green spaces in and around the building?
 - VI. Do you have enough seating and scenic views around the building?

Appendix 2 Interview Protocols: Professionals

1. What design features ensure the social sustainability of the high-rise buildings?
 - 1.1. How to design in order to ensure more social interaction?
2. What design features ensure the environmental sustainability of high-rise buildings?
 - 2.1. What are the efficient ways to reduce energy consumption in residential high-rise buildings?
 - 2.2. What envelope should have the sustainable high-rise building?
 - 2.3. How to ensure good thermal comfort, air quality, aural comfort and visual comfort in residential high-rises?
 - 2.4. What technology should be implemented for a higher quality of life in residential high-rises?
3. What design features provide the residents of high-rise buildings with high a quality of life?
4. What is the way to include residential high-rises into the placemaking process?
5. What are the barriers preventing from integrating sustainability into high-rise buildings?
6. Are there some weaknesses we can learn from?
7. What are the social values your design with high-rises aims to support?
8. What are the milestones of your design philosophy when designing of high-rises?
9. What spatial program is viable for the creation of meaningful places around high-rises?
10. What features of the design of the high-rises address the creation of meaningful places in the city?
11. How can the design provide a building that defines space rather than a building that sits in the space?

12. What are the contemporary problems that high-rises placemaking imposes on the society?
13. Is there a planning desire to change the city form by high-rises and what are the dangers of this?
14. How the residential high-rises respect the cultural context (for example building near historical buildings)?
15. How your architecture engages with the users addressing their emotionality in the modern culture?