THE INTEGRATION OF TALL BUILDINGS WITH THE URBAN ENVIRONMENT: CONSIDERING THE KEY SUSTAINABILITY CONCEPTS

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ABSTRACT

THE INTEGRATION OF TALL BUILDINGS WITH THE URBAN ENVIRONMENT: CONSIDERING THE KEY SUSTAINABILITY CONCEPTS

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As a result of physical, social and economic needs, demand for tall buildings is increasing worldwide. Due to their great size and large impacts on the urban environment, tall buildings, through careful design and urban integration, have the potential to improve the quality around them. Also, depending on their large area of influence, design considerations regarding sustainability and environmental integration of tall buildings need to be handled with more care than with other conventional buildings to provide the most positive impact.

This study focuses on the physical and social environmental impacts of tall buildings where these impacts are examined through determined 'key sustainability concepts'. The identified relevant 'key sustainability concepts' reveal the positive or negative, physical and social environmental impacts of tall buildings. These key sustainability concepts provided to be an observational tool to conduct a study on existing or new tall buildings, from the architectural scale to the urban scale.

As a demonstration of its effectiveness on the urban environment, the defined key sustainability concepts of two tall buildings located in London, 'The Shard' and '30 St Mary Axe (Gherkin)' were selected and compared through site analysis and survey methods. With this study, the possible negative and positive effects of tall buildings both on architectural and urban scale have been revealed through a physical and social sustainable approach.

Keywords: Sustainable Tall Buildings, London, Environmental Harmony, Sustainability Concepts, Architectural Scale, Urban Scale, The Shard, 30 St Mary Axe

ÖZ

YÜKSEK BİNALARIN KENTSEL ÇEVRE İLE UYUMU:
SÜRDÜRÜLEBİLİRLİK KAVRAMLARI ÜZERİNE

Tohumcu, Tulû
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Yüksek bina sayısı fiziksel, sosyal ve ekonomik gerekliliklere bağlı olarak artmaktadır. Ağır strüktürlerinin kentsel çevre üzerindeki güçlü etkilerine bağlı olarak, yüksek binaların kentsel çevre ile uyumlarına göre ele alınacak tasarımları sayesinde bulundukları çevrenin kalitesini artırma potansiyelleri mevcuttur. Geniş kentsel alanlara yayılan etkileri göz önünde bulundurulduğunda, yüksek binaların çevrelerine pozitif etki sağlamaları için, sürdürülebilirlik ve çevresel uyumu ilgilendiren tasarım kriterleri diğer geleneksel binalara göre daha titiz bir şekilde ele alınmalıdır.

Bu çalışma, yüksek binaların fiziksel ve sosyal çevre etkilerini belirlenen ‘sürdürülebilirlik kavramları’ üzerinden tartışmaktadır. Çalışma içerisinde belirlenmiş olan bu kavramlar, yüksek binaların kentsel çevre üzerindeki negatif ya da pozitif, fiziksel ve sosyal etkilerini ortaya çıkarmayı kolaylaştırmaktadır. Ayrıca bu çalışmada yer alan ‘sürdürülebilirlik kavramları', yapılmakta olan veya mevcut yüksek binaların hem mimari hem de kentsel ölçekten incelenmelerini sağlayan bir analiz aracı olmuştur.

Londra'da bulunan iki yüksek bina, 'The Shard' ve '30 St Mary Axe (Gherkin)', bulundukları kentsel çevre üzerinde yarattıkları etkilerin incelenmesi için seçilmiştir. Bu binalar analiz ve anket metot yöntemleri kullanılarak birbirleri ile belirlenen 'sürdürülebilirlik kavramları' üzerinden karşılaştırılmışlardır. Bu çalışma ile yüksek binaların hem mimari hem de kentsel ölçekte yaratabilecekleri pozitif ya da negatif etkiler, fiziksel ve sosyal sürdürülebilir bir yaklaşım üzerinden ortaya konulmuştur.

Anahtar Kelimeler: Sürdürülebilir Yüksek Binalar, Londra, Çevresel Uyum, Sürdürülebilirlik Kavramları, Mimari Ölçek, Kentsel Ölçek, The Shard, 30 St Mary Axe

To My Beloved Family;

My Father İsmail Tohumcu and *My Mother Fiğre Tohumcu*

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Also, I would like to express my love and thanks to my precious fiancé Tolga Ahıska, for his valuable love and endless support. Tolga is definitely not an urban designer or architect, but I may have turned him into one during this study.

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LIST OF ABBREVIATIONS

AVG:	Average
BREEAM:	Building Research Establishment Environmental Assessment Method
CBD:	Central Business District
CTBUH:	Council on Tall Buildings and Urban Habitat
F:	Female
LEED:	Leadership in Energy & Environmental Design
M:	Male
UDP:	The City of London Unitary Development Plan
UK:	United Kingdom
PS:	Power and Sample Size Program
STDEV:	Standard Deviation
Q:	Question

CHAPTER 1

INTRODUCTION

This study investigates the environmental impact of tall buildings on their urban environment through selected key sustainability concepts. This chapter briefly explains the main statement of this study, also including background information about the topic.

1.1 Argument

Tall building design has significant design principles regarding sustainable processes. Tall buildings can have both negative and positive impacts on the urban environment both physically and socially. Tall buildings should be designed with consideration of basic parameters that satisfy both their structural requirements and ideally the requirements of the existing built environment. Harmony between a tall building and its environment is an important concern that should be handled together.

Research in the field of tall buildings and their sustainable capabilities identify important design issues from the urban scale to architectural scale. The relationship between certain factors can show impact on the urban environment of tall buildings at different scales. Location, site organization, transportation, urban skyline, material selection and façade design, entrance floor design, vertical design and the urban microclimate are some of the fundamental concepts that should be considered in order to define the boundaries and intersection points of a tall building design and the city. The above fundamental “key concepts” should be used when identifying the negative and positive impacts of a tall building and level of harmony with their environment.

A sustainable design approach of a tall building may not always give it positive impact results, if key concepts mentioned above are not implemented properly. Benefits are not just provided for a tall building itself, they are also make them more livable, and give them better current and future harmony with their urban environment. With this kind of an ecological approach, a sustainably built environment can be presented to city dwellers and all other users as a healthy urban environment.

It is important to identify that tall buildings are not always elements which negatively affect the physical and social urban environment. Positive impact can be achieved via the correct strategy of design and construction of a suitable tall building on the existing urban texture. In summary, tall buildings in particularly have the largest potential of becoming landmarks and are powerful signatures in a city; they are the structures that most easily used for shaping a city image. When designed according to several key sustainability concepts, tall buildings can be beneficial iconic symbols of the financial and technological power, and give the impression of modernization to the city as a whole.

1.2 Aim and Objectives

The aim of this study is to examine the negative and positive impacts of tall buildings on the urban environment through determined key sustainability concepts for design of tall buildings. This study reveals the impacts of tall buildings from the design and construction phases to the already built environment using an approach sensitive to sustainability. Furthermore, a comparison of selected tall buildings from the same region identifies;

- their individual negative/positive effects on the city,
- a pattern for describing the position of the tall building within a city.

The aim of a tall building design should be; minimizing damage to the existing built environment and expanding the usable space provided by its current physical footprint on the site. In order for a tall building to positively impact its urban environment, well organized design and well planned construction phases through with attention to key sustainability concepts are necessary.

One objective of this study is to use the defined key sustainability concepts to examine tall building and urban environment designs to find their physical and social intersection points. Furthermore, the integration of physical and social requirements of tall building design is discussed by creating pattern of key sustainability concepts.

The other objective of this study is the comparison of selected tall buildings from the same region (London) using the identified key sustainability concepts. This study examines a sustainability pattern of how tall buildings are planned, designed, constructed and used on the existing urban texture.

1.3 Procedure

The first stage of this study consists of a literature survey chapter. This chapter includes information derived from various external references and studies (articles, journals, books, web sites, architectural drawings, photographs and other documentations) in the field of this research study. Tall building design policies and reports are particularly used to gather the most correct information to determine suitable case studies in London to examine. After the selection of case studies, the whole information on the selected tall buildings are given in the ‘Material and Method’ Chapter. The data for both cases are directly collected via site analysis/observation and a survey. ‘PS’ software is used to formulate the optimum minimum number of people that are required to participate in the survey. Later, ‘Microsoft Excel’ is used to analyze the raw numerical data in the site surveys in graphic form.

The next stage of this study includes the results and discussions. Site analysis results are considered through determined key sustainability concepts where the survey results are gathered and presented in graphs with including the demographic information. Within the discussion section, the comparison of both analysis and survey results are taken into consideration by charts and observational review on case studies. Final stage of this study includes a conclusion and evaluations.

1.4 Disposition

This study is consisted of five chapters. Chapter 1 is the introduction chapter that includes the background information regarding tall building design within an urban environment. The mentioned key sustainability concepts through sustainable approach highlight the importance of integrated design strategies. Thereafter, the aim and objectives of this study are given.

Chapter 2 includes a brief literature study of this research study. Information and definition about tall building design is given with regarding to their necessities in the architectural world. Furthermore, the urban impacts of tall building on urban environment are explained from both physical and social perspectives. Additionally, regarding a sustainable approach, key concepts are determined for designing tall buildings in cities where these key parameters help to identify the impacts on the urban environment.

In Chapter 3, the material and method of this study are explained. The materials of this research are the two selected buildings (The Shard and 30 St Mary Axe) which both of them are located in London/UK, PS Software and the survey questionnaire. There are two methods used while conducting the study which are the ‘analysis’ and the ‘survey’ methods.

Chapter 4 is the results and discussion section of the whole study which examines the site analysis, observations and surveys conducted. This chapter puts forward the results by tables and graphs for revealing both the different and common points for two buildings through the determined key sustainability concepts.

In Chapter 5, there is a summary of the whole research study from the initial part to the ideas on tall building design and their impacts on urban environment from a sustainable perspective and platform.

1.5 Contribution

The key sustainability concepts provided to be a successful tool to conduct a study on tall buildings. The study presents realistic approaches to examine the influences of tall and powerful buildings on the city. This study investigates important details through an integrated design approach of a tall building with the urban environment, from urban scale to the architectural scale.

The analysis of key sustainability concepts on the selected buildings’ local physical and social environment, enable us to conceptualize the topic of ‘sustainable and environment friendly tall buildings’. Using this method, an empirical observation platform has been introduced for comparing tall buildings and their urban environmental impacts. Finding more relevant key sustainability concepts can further develop this method for observing and understanding these impacts. However, it is important to find suitable parameters regarding to the intersection points of the urban environment and tall buildings. By developing this observational platform, it should be possible to further the work conducted in this study to provide a universal and whole concept design tool for buildings and their surroundings.

In order to gain a better understanding of key sustainability concepts, this study uses selected case studies to review the differences and common points of the impacts of the design of tall buildings. Within the study, this comparison becomes a tool for better defining the negative/positive nature of the impacts of a tall building design on the existing built environment. Thus, users transform the building's perception from a solid concrete structure to an active city element with social considerations. This study could also be furthered developed by using the key concepts presented in this study to investigate a wider sample of tall building case studies. Investigating a wider range of tall building cases, and hence providing a wider range/variation of results, would provide a more robust pattern for revealing the physical and social impacts of tall buildings on their surroundings. A better understanding of this pattern can shape the way that we think of sustainability for existing or new tall buildings on their urban environment. Additionally, the study of this pattern highlights critical design strategies that can strengthen the sustainable integration of tall building design within the existing urban fabric.

CHAPTER 2

LITERATURE SURVEY

This chapter reviews and summarizes existing theory, research and methodological contributions in relation to this study, in order to better understand the needs of this study's aim. The first part of the literature survey, discusses the definition and necessity for tall building design, to establish a foundation for our understanding of tall buildings. The following part examines the physical and social relationship and harmony of a tall building design and existing urban environment. Followed, an examination of an existing sustainable design approach using the key concepts outlined in this study. All of the material within the literature survey is assessed by the physical and social effects of tall buildings on the urban environment.

2.1 The Definition of Tall Building and its Necessity within the Urban Environment

There is no precise definition of a tall building. It can be said that, tall buildings are structures with more story than other building types and are buildings that have the power of giving an 'identity' to a city and reshaping its skyline. Tall buildings are differentiated from other structures or buildings in their surrounding environment by their height, proportion and shape. There are many names given to tall buildings such as; very tall buildings, super-tall, mega structures, skyscrapers and etc. In general, structures higher than 300 meters are called as 'super-tall' and above 600 meters height these buildings are called as 'skyscrapers'.

The reason for constructing tall buildings and their rise in cities came into being due to several kinds of requirements, such as social, cultural and economic. Tall buildings are usually very noticeable in their environments, and their solid appearance can add a powerful reflection onto the city. Due to the magnitude of their visual power, they can either be charismatic or undesirable. Given their scale and visibility, tall buildings’ form and orientation can have a dramatic impact on the urban prospect, both positively and negatively (Strelitz, 2011: 264). Besides their impacts on the urban environment, their functions are also very important for satisfying urban needs. According to Beedle, Ali and Armstrong (2007: 394-395), tall buildings have important functions in meeting specific urban needs as follows; commercial business, residential, industrial, institutional, public assembly, special purpose and multi-use.

Generally, tall buildings are known as disadvantageous when compared with low rise buildings due to their large and forceful footprint on the environment. On the other hand Maunsell (2012) expresses that, tall buildings may be advantageous when compared to low rise structures by means of; economic products (cheaper costs for more product, environment friendly material selection), land use (allowing more public urban places) and floor plans (narrow floor plans enable to use daylight more). However, in comparison with low-rise building design, tall buildings require more careful structural design and construction with strict safety protocol, structural framework, mechanical complexities and integration issues with their wide impact areas on urban ground.

Sev (2009: 86) examines that the reasons for the necessity of tall buildings can be both social and economic; the increase in population in cities and the wide spectrum of business that shows variations in time, the reason for using the urban areas more efficiently can be the items for the necessity of tall buildings design. Cities are getting more and more over-crowded and within this, the knowledge of tall building design begins to be a different concept; a solution for minimum land-use and maximum use of capacity of the building for inhabitants. The city alike has a requirement to provide and sustain this social growth and development of needs. Tall buildings provide a life style that leads the power symbol of the city and also enables provide new livable areas by growing upwards. Money, as ‘the economic power’, creates a distance in different opportunities used in cities, and cities become more expensive in view.

According to Ali and Al-Kodmany (2012: 391), iconic tall buildings enhance the global image of the city; they are likely to put the city on the world map, thereby signaling and promoting its significant economic progress and development. In other words, tall building construction sets the idea of being an evidence for the city which it does not have economic problems so that every situation was ready for construction where architectural and engineering workloads need high expenses for built process.

Besides the socio-economic effects, cultural formations of the city and inhabitants are issued in tall building design. Sev (2009), points out the transformations in social structure and increasing social needs have forced high rise residential buildings, and the contribution of technology are reducing the obstacles of constructing higher structures. Tall buildings need more delicate and sensitive action towards architectural design and definite decisions on how to use the technology. These actions have to fit in harmony with the urban environment and its principles, in order to maximize its positive effect on its surrounding.

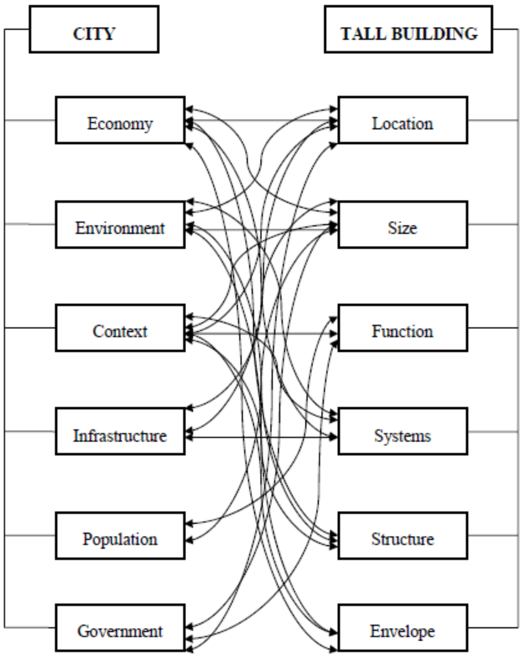

Figure 2.1. Integration factors for tall buildings and cities (Source: Ali and Aksamija, 2008)

All physical, social, cultural and economic formations of a city better define the necessity of a tall building within a city with a specific location. As shown in Figure 2.1, the harmonization of these concepts is a necessity when designing a tall building.

The physical urban environment makes it possible to build such structures; if there was not any a suitable ground for constructing, designers and engineers would not be able to easily construct but also 'think' about designing tall buildings. In each phase of urban design (renovation, restoration, rehabilitation, renewal or gentrification and etc.) construction of a building is always a new additive on the city. The implications must be considered for which tall building might reveal within a city after conceptual framework (Sev, 2009: 87). Together with planning and determining the design principles at the initial phase comes the focal point of its integration with the city and a new tall building design.

Every architectural design includes basic principles which shape the ideas; for example, constructing a house and a hotel contain very different approaches and hard to resemble to each other by means of design criteria. Whereupon every architectural product varies depending on the planning and design principles within the urban environment, tall buildings are the special buildings that include wide range of complexities and comprehensive design approaches. Sev (2009: 87) determines some principles guiding for tall building design;

- The structure must not damage the natural topography, should not negatively affect the street order and city structure with regarding urban scale and density,
- The structure must not give harm to fields which ranked as world heritage, it should protect; registered memorials and structures, protected areas, historical parks, gardens, landscape areas and water roads,
- It should be constructed where the infrastructure is efficient enough,
- It should be in a harmony with its surrounding environment and buildings by means of the materials that are used on the façade and its form,
- The entrance floor design must be adapted with the public life order and pedestrian cycle where the structure must support the social life and create the sense of ‘space’,
- The structure should not change the microclimatic conditions of its environment,
- The structure should be based on technological developments.

According to Sev (2009) these principles must be considered with an advanced level of sustainability issues regarding all environmentally, socially and economically concerns.

The number of tall buildings is increasing from day to day and, if not designed with these principles in mind, these situations/problems start to become a threat for the urban environment, the importance of collaboration for tall building design - especially when considered under the title of ‘sustainable and eco-friendly’ buildings - has gained precedence. Today, the number of tall buildings that are under construction or planned to be constructed is imposing. Answering some questions may be helpful in order to gain positive results as; whether having enough time, authorized person and urban areas for constructing new tall buildings.

2.2 The Harmony of Tall Buildings with the Urban Environment

The harmony between a building and its environment is an important dialogue that should be assessed, evaluated and calculated together when having specific solutions through sustainable oriented architectural design considerations. There are a lot of important factors to consider during design process of a tall building which need to be examined from the wide urban-scale down to the narrower architectural-scale, such as; location/site selection, land-use, integration of landscape elements, the use of natural/energy resources (wind, sun, vegetation and etc.), the urban environment (plazas, inner-outer courtyards of the building, service floors and etc.), transportation, façade design and the material use. It is not possible to create healthy urban environments without considering the surrounding and the tall building as two separated concerns. This is why the harmonization of all of these factors enables us to better define the relationship between tall buildings and their urban places on different scales.

Montgomery (1998: 97) classifies ‘the principles of space making’ under three categories; he identifies the combination of his urban design scheme elements (or qualities or characteristics) that produce good spaces. The city has to contain a strategic development plan issued by local government and the city must grow within a planned process of urbanization. The needs of a city for being adaptable to further processes can be easily read by the figure below.

(A) Activity	Principle 1:	Generating pedestrian flows and vitality
	Principle 2:	Seeding people attractors
	Principle 3:	Achieving a diversity of primary and secondary uses
	Principle 4:	Developing a density of population
	Principle 5:	Varying opening hours and stimulating the evening economy
	Principle 6:	Promoting street life and people-watching
	Principle 7:	Growing a fine-grained economy
(B) Image	Principle 8:	Legibility
	Principle 9:	Imageability
	Principle 10:	Symbolism and memory
	Principle 11:	Psychological access
	Principle 12:	Receptivity
	Principle 13:	Knowledgeability
(C) Form	Principle 14:	Achieving development intensity
	Principle 15:	Zoning for mixed use
	Principle 16:	Building for a fine grain
	Principle 17:	Adaptability of the built stock
	Principle 18:	Scale
	Principle 19:	City blocks and permeability
	Principle 20:	Streets: contact, visibility and horizontal grain
	Principle 21:	The public realm
	Principle 22:	Movement
	Principle 23:	Green space and water space
	Principle 24:	Landmarks, visual stimulation and attention to detail
	Principle 25:	Architectural style as image

Figure 2.2. Principles for achieving urbanity (Source: Montgomery, 1998)

As shown in Figure 2.2, there are issues to take into consideration for the evaluation method of tall building design principles in every category (A, B, C). For example, tall building designs have to satisfy the needs about the Principles 9 (Imageability), 10 (Symbolism and memory), 11 (Psychological access) and 12 (Receptivity) within the urban environment because of their ability and power that they have regarding to their physical appearances. Thereto, Principles 15 (Zoning for mixed use), 18 (Scale), 19 (City blocks and permeability), 21 (The public realm), 22 (Movement), 24 (Landmarks, visual stimulation and attention to detail) and 25 (Architectural style as image) are identified under the parameter of ‘form’ by Montgomery (1998) which they can directly be reconciled with the design principles of tall buildings for healthy urban environment.

According to the study of made on ‘The City of Cape Town’ (2012), a strategic scheme on tall building design is composed under six approaches as shown in Figure 2.3. Response at the scale of the Precinct, Response at the scale of the Site, Response at the scale of the Buildings, Impact on the Public Realm, Sustainable Building Design and Social responsibility contributions.

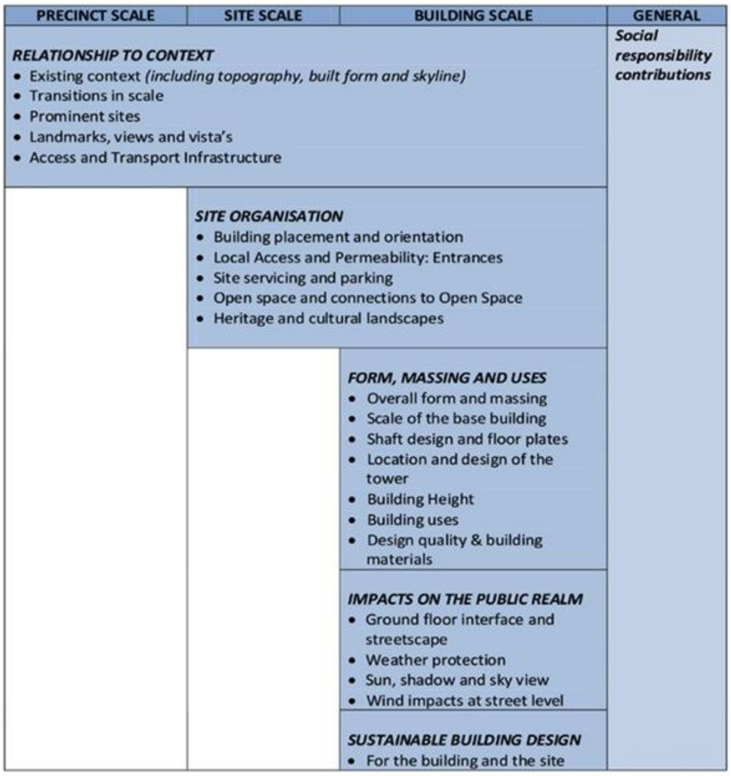

Figure 2.3. Design scheme (Source: Draft Urban Design Guidelines for Tall Buildings, 2012)

'Relationship to Context' is evaluated at the precinct scale; 'Site Organization' is another considered in the under site scale; 'Form, massing and uses', 'Impacts on the Public Realm' and 'Sustainable Building Design' are other categorized in the building scale. Generally, all of the building and site principles, which give different results, refer to a common title that is its 'Social responsibility contributions'.

Additionally, suitable location can create more convenient and sustainable urban places on the ground for buildings as well as it can strengthen the relation between the building and the environment. Montgomery (1998) puts forward the importance of a good city; as one that is the best designed, managed and developed. The author also states that, these situations create a legible city within a complexity. In order not to lose the urban rhythm, the city has to have a good city form. A legible city makes anybody feel comfortable with their living space as they are conscious of where they are going and to which direction within urban areas. The natural desire for human beings to be comfortable and relaxed can be put into the middle of this idea. This comfort can be provided only with correct and balanced physical arrangements of urban materials such as; buildings, streets, landscape patterns, landmarks and etc. Tall buildings can be involved within this idea by being constructed and conditions on correct site locations with right decisions of architecture; so, tall buildings can become a reference for people living in the city.

Correspondingly, social and cultural theories can be discussed; "The urban quality must be considered in much wider terms than the physical attributes of buildings, spaces and street patterns" (Montgomery, 1998: 95). A conceptual diagram by Canter (1977) is referenced by Montgomery (1998) regarding on nature of places;

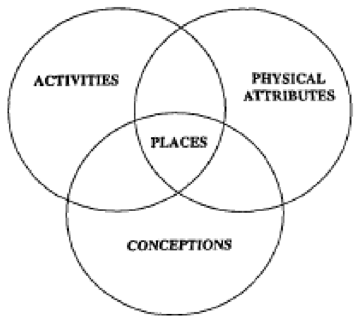

Figure 2.4. A visual metaphor for the nature of places - Canter, 1977 (Source: Montgomery, 1998)

It can be said that, not only physical structures provide and present well quality of urban places. The harmony of both physical and social actions should flow in urban environment; as shown in Figure 2.4, 'physical attributes', 'perceptions' of human beings and 'activities' altogether work together to create 'places'. From this point of view, the relationship between a tall building and the urban environment is an extension of the relationship between the human (as the city dweller) and the building. Where city dwellers do not accept the idea of a tall building within their ecosystem this issue may become the most important problem due to their everyday use of the urban environment every day. The city must be legible for inhabitants in order to live in a harmony.

Kevin Lynch (1960), defines 5 elements of a city and their relationship; paths, edges, districts, nodes and landmarks. According to Lynch (1960), legibility is not the most important characteristic of the city but it has a special importance for large and complex cities. Tall buildings may have the ability to make the city become more legible depending on their physical powers as a landmark. They may be also the desire of people in finding their ways within a city.

A tall building can be a very attractive landmark as a whole single building, a very well defined district with a group of tall buildings or even a well-defined edge with referring to Lynchs' city elements. The city must let its dweller to be able to build up their relationship with the environment as Lynch (1960) defines getting lost in the city a 'disaster' in a city. In the process of way-finding, the strategic link is the environmental image, the generalized mental picture of the exterior physical world that is held by an individual (Lynch, 1960: 4). Regarding the relationship between a person and the urban environment, tall buildings have the capacity for becoming an 'environmental image' in one's mind in all ways of thinking through the city elements.

A remarkable answer to the question of 'Why the environmental impacts and the urban sustainability concepts of a tall building should be considered' is given by Gonçalves (2010). Because of rapid population growth, tall buildings have risen in urban centers with the pressure of high densities and globalization causing another effect that have impacts on the urban areas (Gonçalves, 2010: 1). Tall buildings represent the modernization and the economic growth within cities especially related with their construction phases (Gonçalves, 2010: 27).
Goncalves (2010) determines all of the inputs of tall buildings in order to define the impacts on the urban environment. Goncalves (2010) supports these ideas with different examples of these buildings about the urban-skyline views,

micro climatic conditions, bioclimatic approaches, the urban quality of ground conditions, ventilation and impacts on their surroundings make the picture get clearer. Nevertheless according to the author, these issues surrounding the tall buildings should be designed carefully for achieving good climatic conditions. The comfort of the pedestrians walking on the street level is important by means of the harmony with their urban lifestyle. Design strategies that enhance permeability, connectivity and legibility, help make cities walk-able, safe and productive, contributing to sustainable urban living (Strelitz, 2011: 65).

Even if the physical attraction of a tall building is strong, if city dwellers do not connect with the building, the social connection with the building can begin to sever, cutting the life source that provides its vivacity. This disregard is not in physical domain; it is totally within a social frame as it creates economic, politics and public reasons and effects. The relationship between the city dwellers and the buildings must always be open to change and innovation that depend on the adapting needs and variations of the city. Urban functions, social and economic needs, urban policies, urban planning criteria, urban places/spaces, communication ways of city dwellers, etc… may show differentiations in time, therefore both physical and social impacts on the urban environment of tall buildings may change in parallel.

The Case of London

Tovernor (2007) puts forward a study of the city London, which investigates the impacts of tall buildings both visually and culturally by means of a sustainable environment. An analysis regarding tall buildings in the city of London is made from the perspective of urban characterization, historical background of the city, urban design considerations of London, protected locations/areas, environmental effects and transportation strategies, monumental and local views of London, geographical conditions and the skyline of the city (City of London Tall buildings Evidence Paper, 2010: 2). "The City of London Unitary Development Plan (UDP) defines tall buildings as; those which significantly exceed the height of their surroundings”. This definition shows us that tall building design within a city may be a ‘threatening’ architectural process. An approach is determined regarding to the locations of tall buildings in London whether the structure is suitable and sensitive to the environment.

The harmony of a tall building with its surrounding can be evaluated from different perspectives. One of the most important of these perspectives is the design policies and local character of London. This study has undertaken by three basic methods of study as shown in Figure 2.5 as; Evaluation of Historic Context, Urban characterization, and Evaluation of the City’s Local Character. The building and its social and physical balance with the historical context of the environment must be taken into control at the initial design phase. The City of London Evidence Paper (2010) points out this importance by focusing on the historical issues before all other considerations;

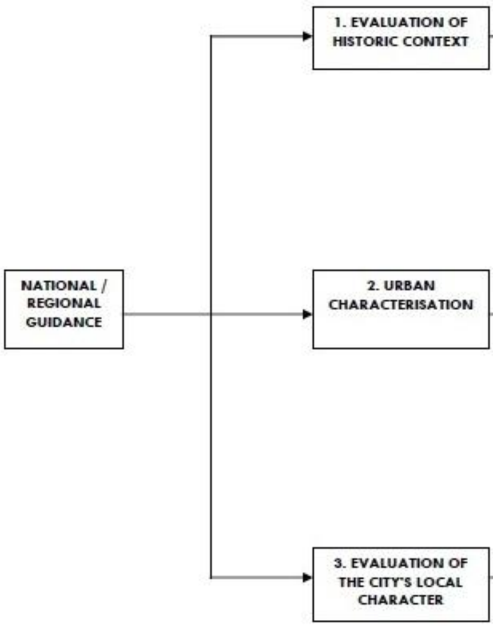

Figure 2.5. The methodology for identifying suitable locations for tall buildings (Source: City of London Tall Buildings Evidence Paper, 2010)

While it is expressed that, designing innovative facades at different heights of a building, this approach may not be suitable for the lower floor designs, as these floors are the buildings interaction with the urban street texture (City of London Tall buildings Evidence Paper 2010: 24). Regarding/Concerning the importance of the locations of tall buildings, a map has been introduced depending on their situations whether they are under construction or completed as shown in Figure 2.6:

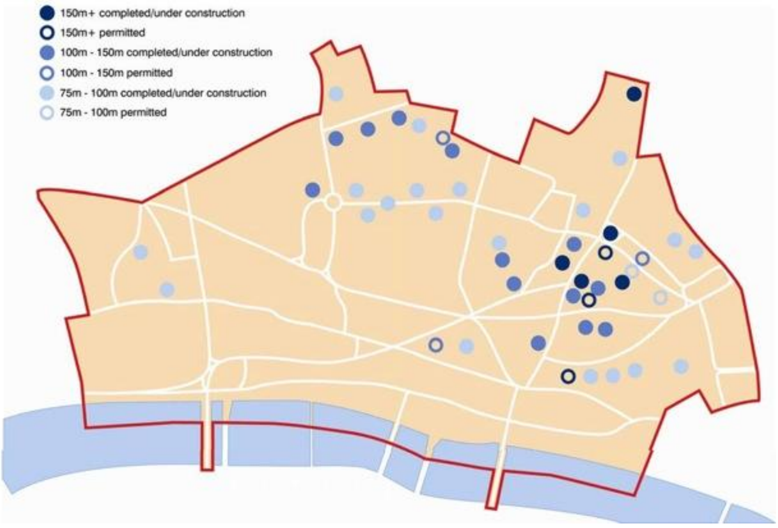

Figure 2.6. Tall building distribution in the city (Source: City of London Tall Buildings Evidence Paper, 2010)

2.3 A Sustainable Perspective: The Environmental Impacts of Tall Buildings

In our modern day, sustainable design became a method for building tall buildings that are perform well even in the future. When we consider long-term sustainability in buildings we usually associate with its physical energy sustainability (energy consumption, material usage and etc). However we must look beyond this and assess the buildings harmony and integration with the environment. Further, besides physical considerations of a tall building sustainability also needs to be viewed from the social harmony perspective. Sustainability, and the creation of sustainable tall buildings, goes far beyond just energy use and even broader environmental considerations (Oldfield, 2012: 6). In general sustainably designed buildings are best suited to resolving the current and future physical, social and economic concerns. As this study focuses on environmental balance, a sustainable building is “one in which the design team have struck a balance between environmental, economic and social issues at all stages – design, construction, operation and change of use/end of life” (Crompton and Wilson, 3). Meeting the needs of environmental, economic and social concerns are separate objectives, however are all jointly satisfied through a sustainable approach. Sustainability is “about improving quality of life” (Sutton, 2000). For better urban environments the social side of the perspective must be issued; tall buildings can adapt to both physical and social environment.

As it is very difficult to meet all of the physical and social requirements of a tall building’s design, the harmony between a building and the urban environment should be configured according to specific mutually-supporting principles of sustainable urban and architectural designs. The critical point is that the absence of a single strategy (physical or social) can expose undesirable results. In addition to these design strategies need to be handled with determinations on both and social criteria. Therefore it can be said that, successful sustainable approaches require the fulfillment of high expectations of all design strategies both in physical and social phases in order not to lose its reliability towards future. In order to create a stable socio-economic balance with their physical appearances on the urban environment, social impacts of tall buildings must be also considered organized.

2.3.1 The Physical Impacts

In the scope of ‘urban environment’, tall buildings have a certain physical function; a symbolic landmark for the city by expressing the power of socio-economic issues. Physical systems of a city include; streets, parks, pedestrian ways, public squares, public/private open spaces and buildings. Form, massing and core positioning are key to the urban views and vistas that a tall building can allow or occlude (Strelitz, 2011: 264). A tall building generates a new ‘urban zone’ on the existing urban texture. The new urban zone of a tall building can be considered as its critical impact on the urban environment.

> “Physically, tall buildings have a concentration of built space placed on a small site area. Functionally, it enables usable floor spaces to be stacked vertically. Commercially, it enables its owner to make more profit from the land and to put more goods, more people, and more rents in one place” (Beedle, Ali and Armstrong, 2007: 367).

Meeting all of the design needs (physical, functional and commercial) of a tall building does not necessarily mean that the building is efficient enough to integrate with the physical city. Tall buildings have the potential to damage the existing urban settlement because of their height and mass. Also Tavernor (2007) expresses the importance of the ‘height’ parameter when a tall building rises up in a low storey built environment. In such cases, tall buildings directly affect the image of the city; therefore the locations of tall buildings are important for a sustainable future too.

Designers should always be aware of the change in ‘urban city image’, due to the before and after construction effect on city frames. At the initial design phase, regarding to the ‘urban location’ of a tall building, height of the structure must be considered by means of the urban context and the balance with its surrounding built environment. Tall buildings should also meet the aesthetic concerns with their scale and designs while trying to find their suitable locations within the urban environment. As an example; Tavernor (2007) analyses the present and future effects of tall buildings Brighton & Hove (a city that is located in the South-East of England). Analytical photographs taken from different sites, streets, districts and etc. of the city are used to demonstrate this effect. In order to understand the main roles and services of the existing tall buildings photographs of different sea front views, strategic point views, historical protections, street views and etc. are considered within photographs. The photographs shown in in Figure 2.8 - 2.11 show the importance of protecting the existing urban character within the whole city and the city views. This kind of a study can be used to minimize the negative impacts of new tall buildings on its urban environment.

Figure 2.8. Strategic view – Palace Pier (Source: Gillespies and GVA Grimley, 2003)

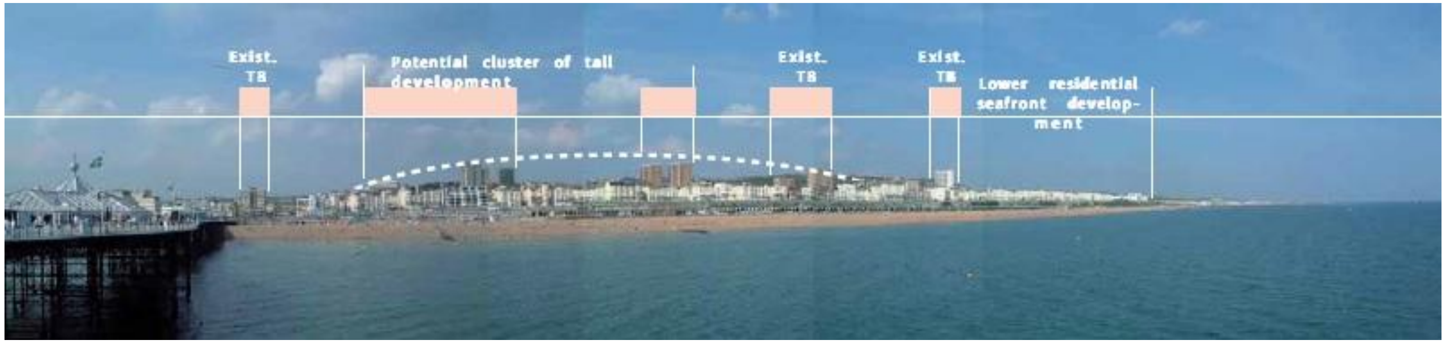

Figure 2.7. Strategic view – Palace Pier (Source: Gillespies and GVA Grimley, 2003)

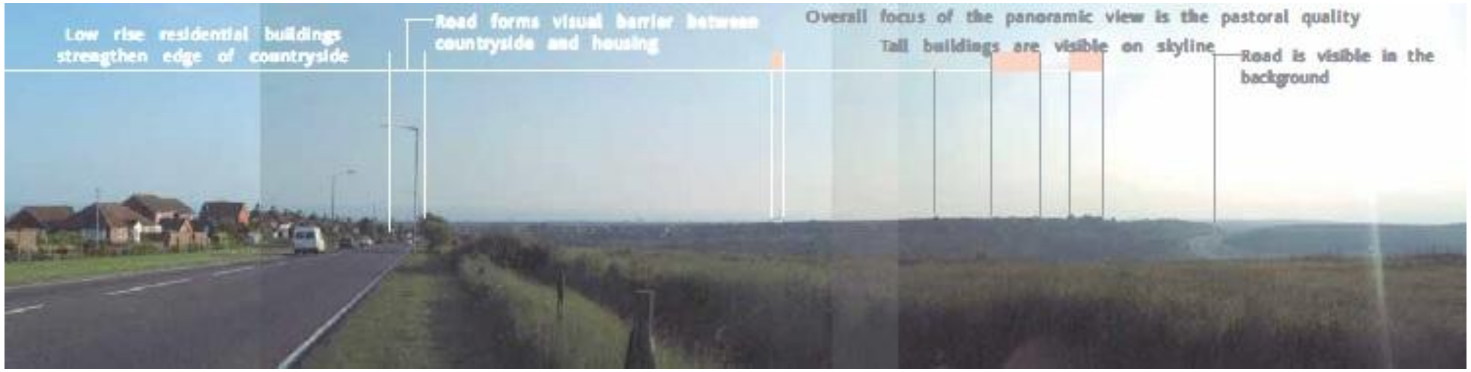

Figure 2.9. Trans European route – 'Impressions of Brighton' (Source: Gillespies and GVA Grimley, 2003)

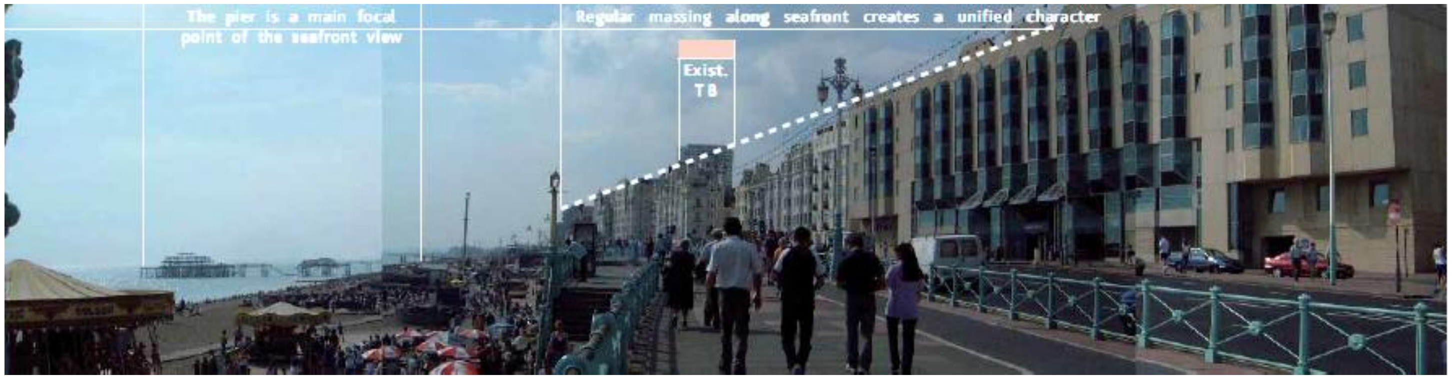

Figure 2.10. Sea front visual experience (Source: Gillespies and GVA Grimley, 2003)

When the number of tall building blocks increase within a certain area, it is inevitable for these huge building blocks to affect urban perspectives and images. If a tall building is located within a low rise settlement, it can be a significant positive landmark for its district or an urban public place as long as it is in a harmony with its design concepts such as material use, entrance floor plan design and street life harmony, urban micro-climatic balance, transportation facilities, urban skyline effect and ecological conditions. The final height of a tall building will have significant impacts on the character of the local texture as well as contribute to the creation of a memorable skyline (Draft Urban Design Guidelines for Tall Buildings, 2012: 18). As, it is important not to settle a tall building as an urban wall because the height; it may block the original city view and image at that point of location.

Figure 2.11 - 2.14 shows examples of different cases that of the physical impacts of tall buildings related with their height and scale through the urban context;

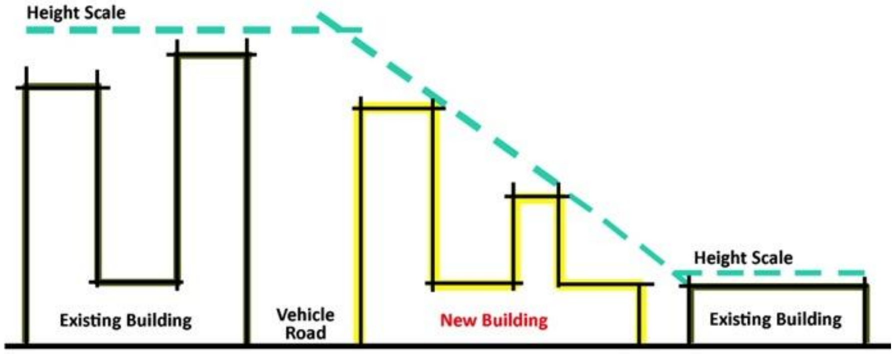

Figure 2.11. A conceptual illustration of a progressive transition in the height and scale of tall buildings from the centre of a growth area down to a lower-scale area (Adapted and Re-drawn; Tall Building Design Guidelines, 2013)

As shown in Figure 2.11, new buildings are located between the existing higher-scaled and lower-scaled buildings. The relation is supported with a gradual height dynamic from high to low; supporting both the higher-scaled and lower-scaled existing urban context.

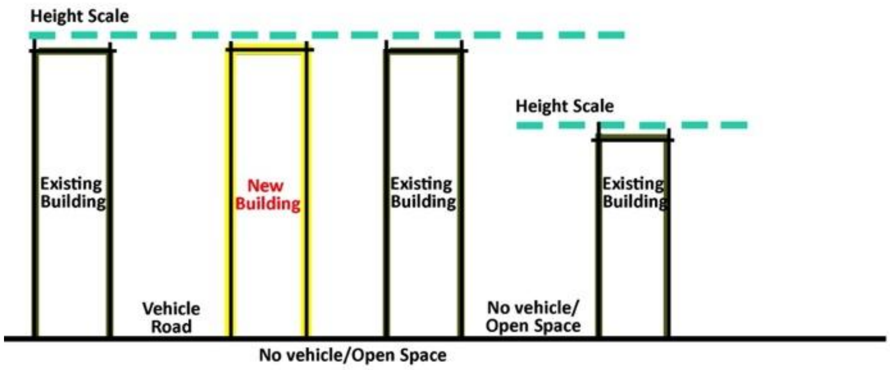

Figure 2.12. A conceptual illustration of a new tall building fitting within an existing context of other tall buildings of consistent height (Adapted and Re-drawn; Tall Building Design Guidelines, 2013)

As shown in Figure 2.12, tall buildings are located on an urban area which existing context of built environment is composed by high rise buildings. Open areas between buildings present transition sites for public use; the distance depends on the height of new and existing tall buildings.

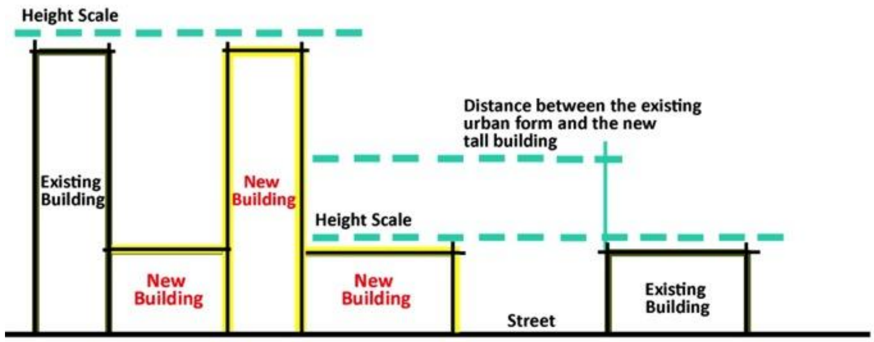

Figure 2.13. A conceptual illustration of horizontal separation distance and a change in base building height and form to support tall building transition down to a lower-scale area (Adapted and Re-drawn; Tall Building Design Guidelines, 2013)

As shown in Figure 2.13, a new tall building is physically connected with the existing urban context, whereby there is a large height difference between the neighborhood settlements. The distance between the lower-scaled and higher-scaled buildings creates a physical balance. So, the new building is designed with a height dynamic that is balanced with the lower-scaled neighborhood area.

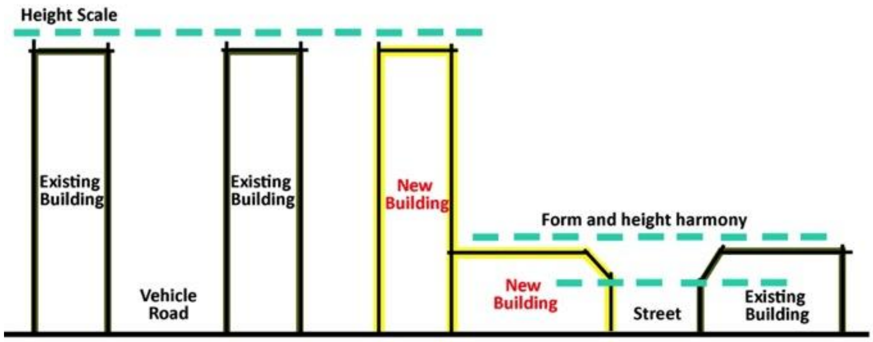

Figure 2.14. A conceptual illustration of an angular plane and direct relationship in base building height and form to support tall building transition down to a lower-scale area (Adapted and Re-drawn; Tall Building Design Guidelines, 2013)

As shown in Figure 2.14, a new tall building is settled within the existing urban context, again by designing the new building with a height dynamic in base building design (similar to the Figure 2.13) that is balanced with the lower-scaled neighborhood area. The form of the base building corners creates a similar design between the existing and new buildings, for a more fluid integration.

Depending on the distances between buildings, a tall building can impact the site, historical monuments or structures within the urban area. It is important that this impact does not negatively affect the environment. Designers or engineers should “ensure that the heritage of the city and its cultural landscapes are protected and that all new tall building developments are sensitively integrated in a manner that preserves their setting, character and integrity”

(Draft Urban Design Guidelines for Tall Buildings, 2012: 12). Cities develop with time but the fundamental rule in planning sites or landscape designs remains; if there is a protection zone at the design area, design criteria of the structure or urban area change depending on the level of conservation degree of the historical site or building. Regarding built heritage, tall building proposals often are challenging and problematic because of their inevitable impact on the historic urban fabric (Ali and Al-Kodmany, 2012: 389). The analysis and initial projects of tall buildings must be regulated according to these situations so that it will satisfy the most important rule of planning.

Several studies have been conducted on the physical tall building effects of the urban environment from the historical protection perspective for the London city image because "London has played an instructive role in shaping sustainable tall building responses" (Strelitz, 2011: 251).

Figure 2.15. Arial view of city of London conveying its complexity, Kathleen Tyler Conklin (Source: Strelitz, 2011)

Tavernor (2007) draws attention to the historical importance of London and the effects of such buildings within a typical geographical condition in London. He describes; London topography where it is surrounded by low hills and this is why tall buildings can be seen from any distance "and do have a visual impact on the capital's most major historic monuments" (Tovernor, 2007: 3). The St.

Paul’s cathedral sits on the hill of ‘Ludgate’ within the city center of London and especially tall building designs in London are designed and planned regarding to the view points from this historically valuable cathedral. London’s historic narrative is legible in its numerous commercial, civic, cultural and religious buildings, among which St Paul’s Cathedral has been vested with strong pre-eminence (Strelitz, 251).

Canary Wharf is a district in London where a majority of the tall buildings are located. It can be said that; it is the place where financial and commercial power of London is reflected in architecture using high rise building block settlements. According to Strelitz (2011: 253), in previous times, tall building settlement in Canary Wharf has started to become unfettered because of the construction process of such buildings with large scales and creating very ‘big spaces’ for interior plans. As the author mentions that this situation promoted Canary Wharf turning into a competition platform for occupiers regarding financial issues. The City then developed a more facilitative approach to tall buildings, alongside its continued custodianship of heritage and urban character (Strelitz, 2011: 253).

Figure 2.16. Competition to the city of London: vertically extruded large orthogonal footprints at Canary Wharf, Peter Pearson (Source: Strelitz, 2011)

In this context Tovernor (2007) delicately compares and identifies the regulations and policies regarding tall building design considerations in

London and their impacts of on the protected views of London. Tovernor (2007: 9) defines three categories; panoramas (general views from high points), visual cones (views of large scale elements) and visual corridors (views of an identifiable feature – e.g. St. Paul's). The importance of the physical impact of tall buildings on the urban vision is very apparent, and more accentuated if historical points are included. The city of London's 'view management plans' or 'policies' that are always being updated, provides tall buildings to grow 'limited' and in a beneficial way within the physical urban environment.

The urban silhouette is the other issue to consider when examining the importance of the tall buildings and their physical impacts on the city. It accepted that tall buildings do affect the urban perceptual frame and contribute to the existing urban nature. Heath, Smith and Lim (2000), express that tall buildings have a strong effect on defining the urban skyline view, greatly determined by the facade design and the height of a tall building. Also, aesthetic quality is an important point as it is addressed towards environmental concerns. The image of the city begins to become clear when the buildings start to shape their surroundings with their heights. Skylines dominated by tall buildings are inherently highly ordered; increasing the perceptual complexity of the buildings would increase preference" (Heath, Smith and Lim, 2000: 543).

Figure 2.17. The skyline of Chicago, Erica Mitie Umakoshi (Source: Gonçalves, 2010)

Figure 2.18. New York skyline as seen from the Circle Line Ferry, Manhattan, New York

(Source:http://www.flickr.com/photos/26782864@N00/2229937103)

The perception we create, imagine and see through the city, are critically related with the building height, the complexity of their design strategies and locations within the built environment when picturing the urban skyline.

Additionally, the physical impact of a tall building on pedestrian ways, streets and slightly so on open areas can increase depending on their mass. For example, if we consider an area where tall buildings are located, the buildings obstructed there potential receive sunlight to their interiors and their surrounding open areas, due to shadow obstruction.

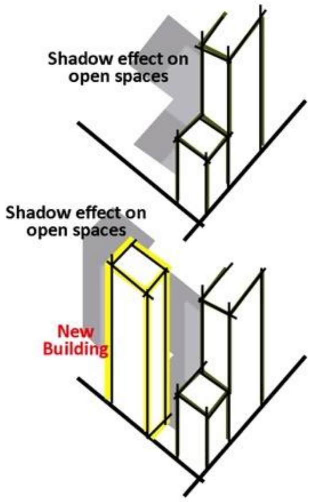

Figure 2.19.Illustrate, through oblique shadow studies, the resultant shadow patterns on vertical and horizontal surfaces (Adapted and Re-drawn; Draft Urban Design Guidelines for Tall Buildings, 2012)

As shown in the Figure 2.19, a single tall building located within the area shown has radically increased the size of the shadowed area on the surrounding urban area. As the size and/or number of tall buildings rises within a city, the shadow area becomes larger as the barrier effect of sunlight on the city grows with the expanding built environment. In addition, as tall buildings inevitably create shadows, properly planned design considerations can ensure that the negative impacts on the environment caused by sunlight obstruction is minimized.

Figure 2.20. Tall buildings designed to protect sunlight and sky view in a public park (Source: Tall Building Design Guidelines, 2013)

It is important to have sunlight access where sunlight provides warmer usable outdoor spaces. Through landscape design outdoor spaces can be used for vegetation. Plant types can be selected to suite open areas depending on the sunlight they receive; for example trees with wide canopies are most likely not required for sunlight protection in highly shadowed areas. The same can be said for the material selections for streets or other urban elements such as, benches, lightening, pavement and etc. For example, sunlight may harm certain materials, so if a tall building is preventing an area from sunlight, the materials used do not have to be sunlight resistive. Due to sunlight obstruction, these design selections may be more cost-effective; for example; as sunlight resistive materials are generally more expensive and more difficult to use, and also wider trees are can expensive than smaller ones.

Furthermore, the higher a building(s) is/are, the more easily and effectively defined the identification of the skyline will be within the city. Figure 2.21 shows a building that is divided into three main sections; the top, middle/shaft and base/podium. By dividing a tall building into sections a design can design each section depending on its interaction with the environment on its height level. The impact each section increases as the scale of the building gets larger on the urban scale.

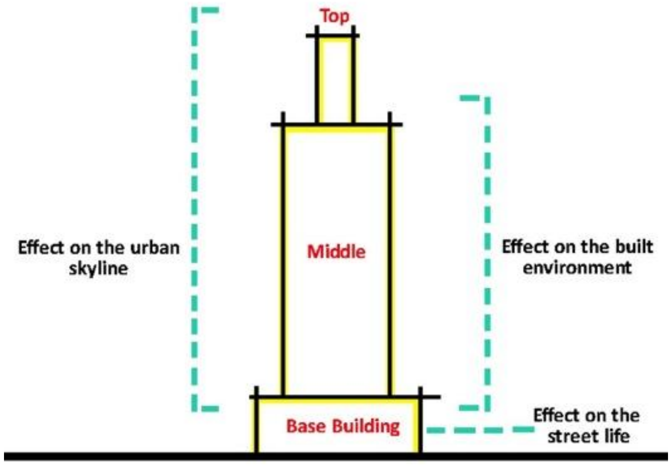

Figure 2.21. Response at the scale of the building; overall form and massing (Adapted and Re-drawn; Draft Urban Design Guidelines for Tall Buildings, 2012)

Topographic and natural considerations are very important items of tall buildings in determining the urban skyline. Topography, imposed by natural landscape features, can be a powerful force in shaping a skyline (Beedle, Ali and Armstrong, 2007: 375). Topography may be a problematic issue; for example slopes and high and/or small hills may need to be excavated. Constructing a tall building on a high land will cause it to be higher and hence more powerful on the urban silhouette. The topography of an area should be organized and re-planned according to the height and scale of a proposed tall building, much the same way that we consider the harmony of height between buildings on flat areas.

It should not be forgotten that a single tall building cannot generate a powerful skyline itself alone. A group of tall buildings can create a selective urban silhouette where other building types and city elements contribute to this perceptual frame. The figures below show examples of urban skylines with different silhouette complexities. Even though these buildings are in the same area and have the same façade articulation, change in silhouette complexities can have an impressive effect and contribution to the city skyline.

Figure 2.22. Image of Singapore’s skyline illustrating that clusters of tall buildings are able to create a much stronger skyline than single towers scattered across the city - Abel, 2003 (Source: Gillespies and GVA Grimley, 2003)

Figure 2.23. A skyline image with low silhouette complexity and low façade articulation (Source: Heath, Lim and Smith, 2000)

Figure 2.24. A Skyline image with medium silhouette complexity and low façade articulation (Source: Heath, Lim and Smith, 2000)

Urban vision is also about 'picturing' or 'imaging' the city. The powerful physical appearance of tall buildings easily captures the line of being 'image' of a city. Lynch (1960), defines 'imageability' as the characteristics of physical objects that can create strong image on any observer. In addition, a single impressive tall building or a group of tall building blocks create a powerful city image in one's mind. Observing from a far distance, the heights and sizes of these buildings define our urban images. Also, a city image may not be stable because cities change with time. Finally, change in the image can be changed huge land transformations or radical decisions made on the city. As Lynch (1960), points out that, the metropolitan region is a functional unit that occurs fast and this unit should have a city image belongs to it. For example; a park transformed into a street, an empty space filled with high rise residential buildings, a building construction on an urban plaza removing all open spaces. These changes have the possibility to develop and create a different city image of the district or urban environment. Due to their large impacts on the environment transformative change can be more effective with tall buildings. Destruction of a tall building within urban context totally erases not only the symbolic image, but also, it destroys the urban vision along with the urban social life.

Alternatively, construction of new tall building can add a new symbolic view into the urban culture. Whether the aim is to create a landmark or not, a new 'symbolic element' is identified.

2.3.2 The Social Impacts

In urban design, every stage of strategies has to turn into advantages for city dwellers in order to provide long term good quality of urban life standards. Depending on its function, the social environment may change with a new building construction within a specified area. It reveals out as a difficult situation if the building is located in an area where inhabitants are strongly adopted to their daily urban life. For example, the construction of a new tall building on an existing area may require the destruction of urban places used every day by many people such as parks, shops, or cafes. This kind situation a can have a negative impact and can unwilling force people re-adopt to the new urban environment. This may clearly point out an important part of social factors that affect the strategic planning ideas of tall building design.

Where tall buildings exist as the 'socio-economic power' symbols of cities, these have to be socially sustainable. This depends on how carefully and delicately the social factors of the urban environment and correspondingly the building's impact on the social environment is presumed and handled. The most important items that need to be identified are; why and where the building will be located. Sensitivity to the local customs and traditions of a society where the tall building will be built is essential for the success of the project that involves a large amount of investment (Beedle, Ali and Armstrong, 2007: 63). The process of tall building construction will continuously affect the environment during the process of. Accordingly, social habits of local public and environment should be determined carefully before tall building construction. It is obvious that, these kind of powerful buildings make an alteration in social activities within the area.

Social health and well-being is very important for the city. The psychology which an area creates in one's mind is directly related with the usage of that area. If an urban place (park, urban square or any other landscape areas) loses its value in the city, this situation may cause negative problems physically. For example, if there is no one using a park, street or even a public square within a city, these places begin to transform into empty spaces in time. This fact can also be reconciled for buildings and their space intersections with the urban environment. Moreover, the city begins to lose interest through these critical points socio-economically. As it is unnecessary to keep the empty spaces which no one use; commercial areas that surround these kind of places begin to lose money, no one takes a step to buy or hire a flat within the building, less people pass by the street and all of these cases draws a dead urban environment image in minds. Therefore, it is very important to choose the correct location of a tall building and assign the best meaning for public health and neighborhood. Especially, the intersection point of a tall building with the street life under it is the critical point by means of altering the social life.

The function of a tall building must be identified clearly. The facilities in the building also must supply the needs of people. These needs may change according to the location and use of building such as; office, residential or multi-use building types. For example; if the building is located within a 'Central Business District' (CBD), it must include commercial facilities such as banks, markets, cafes and etc. Numbers of health, safety and security issues can be raised, appropriate both for occupants, visitors and neighbors (Ali and Aksamija, 2008:8). In addition to this, the building will also serve to its district where it belongs. If this location is in a city center, then including public activities within will be an advantage as the city centers are always crowd. Thus, multi-use functional tall buildings have the capacity to shelter various activity types for people in order to provide public interaction with livable urban places near the building. Providing banks, retail, recreation facilities, etc. in the same complex facilitates interaction people in a community (Ali and Aksamija, 2008:8).

Figure 2.25. Active retail and commercial uses and upper storey windows animate the base building and provide natural surveillance for the street (Source: Tall Building Design Guidelines, 2013)

Social integrations strengthen the ability of a tall building to control its socio-environment. But these kinds of implementations should be the solutions of wide range of brainstorming exercises on tall buildings in their initial design phases. Since the location of the tall building is very important for including similar activities but different solutions may occur depending on different social and physical neighborhood settlements.

> “If the building is already in a well-developed community with similar functions, a portion of the services can come from the surrounding area. But if it is an underdeveloped area, greater care must be taken” (Beedle, Ali and Armstrong, 2007: 175).

In fact, tall buildings create a variety by means of ‘space’. For example, the designer can design an office floor in another suitable floor area for leaving the entrance floor just for public usage. This can become an advantage for when integrating the building with the urban environment socially. Also this type of functionalities can even enhance communication and interaction between people who are in and out of the building. According to Ali and Al-Kodmany (2012), if structures grow taller, the users get far away from the city level under as they become untouched with the street life. As the building gets taller, it can still include social activity spaces on the ground floor which will interest the public. So it can be a great advantage for taller buildings to develop a communication pattern with the urban environment.

In order to design sustainable urban places supported by tall buildings, the surrounding urban culture is also important. The new tall building should be designed, built and oriented towards the needs of close urban places. Settling on the existing urban fabric will bring out a new social and cultural attention; “any new high-rise development provides an opportunity to offer facilities and economic benefits for the surrounding community” (Ali and Aksamija, 2008:8). If a new social ambiance can be brought within the urban environment with a newly built structure, constructed tall buildings may also adapt their social goals in time related with social and public needs of the area. For example; the entrance floor of a tall building that is used for commercial needs, may need a train station to support developing transportation needs of the district or even to support the general public transport. Design for occupational flexibility is important to promote sustainable building use, with shorter and longer-term horizons both relevant (Strelitz, 2011: 261). . This ‘flexible’ condition of tall buildings is very important for becoming a multi-functional building for public well-being. Social design ideas should be re-considered to suite not only current needs but also the envisaged future needs of its people and environment.

Living or working in tall buildings can in time become a cultural factor for a society. People who are accustomed to work in low-rise buildings may refuse or overwhelmed by new tall buildings. Whereas, if tall buildings are already in use in a given area, the construction of a new tall building would not create such a change in culture and habit for the people, hence it would be easier to into the existing urban environment. As Ali and Al-Kodmany (2012) mention that, as societies get used to living and working in tall buildings, then this lifestyle can become a norm. Therefore so the local culture will not have problems adopting new tall buildings joining on site. On the other hand, a new tall building could upset an accustomed way of life, if the new tall building prevents with or destroys the people's social activity areas. Due to their large impacts, tall buildings can have more complex and destabilizing social effects than most buildings.

For social health during the construction or destruction phases of tall buildings, some precautions need to be considered. Compared with low-rise buildings, these stages are more difficult for both inhabitants and employees because the risk and danger potentials are very high. Disasters, both natural and accidental as well as by deliberate human acts, often result in loss of lives, destruction and chaos (Beedle, Ali and Armstrong, 2007: 568). As tall buildings are high structures, they generally have a higher threat potential than other conventional buildings during construction phases. The majority of construction accidents occur as a result of debris falling from a building and onto someone. Precautions against fire safety or injuries that may appear depending on the work and construction need to be thought; appropriate construction apparatus should be established on the site. Additionally, natural disasters as earthquakes, floods, tsunamis and etc. should be more important items in public safety for tall buildings. Tall buildings should stay resilient during their life cycle and endure such weather disasters where there could be life-threatening consequences. Similar life saver rules affect the public safety and social well-being; it is hard for engineers or architects to say something about the construction or destruction processes of tall buildings.

2.4 Key Sustainability Concepts for Tall Buildings

For achieving a truly sustainable building tall building need to meet difficult criteria for high quality of architectural work. The general requirements of sustainable design can be considered as an "ecological balance" (Ali and Armstrong, 2008: 2). The physical and social requirements of sustainability create a balance between the building and the environment. To achieve a degree of sustainability in a building, the following critical concepts are important to consider; “site context, environment, structure and use of materials, energy consumption, use of water, ecological balance, community development” (Ali and Armstrong, 2008: 3). It is necessary to have design principles that achieve a healthy balance between the building and the environment. Whereby buildings have to be evaluated according to their environmental performance, and be designed and constructed according to city planning regulations and urban design considerations. Moreover, within a sustainable approach, tall building design needs appropriate parameters that should be taken into consideration in order to positively influence the surrounding environment. As a result, tall building design and construction requirements have to be much stricter and target oriented in comparison to other conventional architectural buildings.

Tall buildings can host more people than low rise buildings for the same footprint area on the site. Constructing a high or low rise building is still a choice depending on designer, requirements given by employer and function of the building. According to Ali and Aksamija (2008), a suitable choice can be made by considering various factors; the availability of land, balance between public and private transport, population pressures, planning and development regulations, the availability of urban services, existing infrastructure, future plans. These factors are in a harmony with each other; transportation systems and existing infrastructure affect the site organization and land use where urban services are provided by transportation facilities.

Consequently sustainability becomes a fundamental concept, for the integration of tall buildings with the urban environment. The most known concepts for sustainable building design are listed by ‘US Green Building Council – LEED (Leadership in Energy and Environmental Design) certificate’ and ‘UK Green Building Council – BREAM (Building Research Establishment Environmental Assessment Methodology)’. LEED and BREEAM certificates generally insist on sustainability concepts in buildings regarding; Location, Transportation, Materials & Resources, Water efficiency, Energy & Atmosphere, Indoor environmental quality, Neighborhood pattern & design, Infrastructure, Renewable energy systems, Health and wellbeing, Waste management, Pollution and etc. However these criteria are mainly physical requirements and a sustainable building has social needs as well. As Larsson (2009) clarifies the difference between 'green building' and 'sustainable building'; "Currently the emphasis is on 'green', focusing mainly on environmental performance and often defined in operational terms. Sustainable approach, operationally defined as including social and economic factors" (Larsson, 2009: 5). Through this point, the harmony of the building and its environment gains importance whereby getting the intersection points.

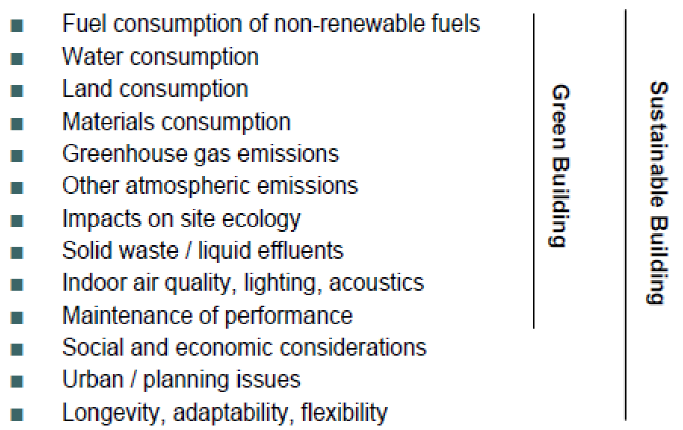

Figure 2.26. The difference in the types of issues addressed by each approach: green building and sustainable building (Source: Larsson, 2009)

For this research study, the selected key sustainability concepts for the physical and social integration of the urban environment and a tall building are; site selection, site organization, transportation, urban skyline, façade design, entrance floor, vertical design and urban microclimate.

2.4.1 Site Selection

Key concept points:

- Site analysis,
- The relation of the new tall building with the surrounding physical structures (height, form and mass),
- The relation of the new tall building with the surrounding context (historical heritage, open areas, public spaces and etc.)

Site selection is a deterministic factor for the physical and social sustainable future life of a building. Improper site selection can cause significant damaging effects on the buildings itself and its relation with its environment. The integration of a tall building with the existing urban character must be strongly secured. In order to provide the best site and valuable facilities, the selected location must be well analyzed and the surrounding must be investigated as a whole. The analysis adhere to several urban design criteria; for example, traffic, pedestrian circulation, integration of open areas, building density, existence of parks and landscaped areas and etc. Correspondingly, the context of site analysis should include design criteria that are thought to be implemented on new tall building as height concerns, shape and form, mass scale of the building when compared with surrounding built environment.

A master plan includes strategies regarding the needs of a district. Analysis and observations made on a specific place within a city and a master plan provides more beneficial urban developments for present and future time. Previsions within a master plan help to support existing urban facilities and the new urban context that a new tall building will introduce. This is further supported with a master plan consisting of parcel areas; these urban places should include the predicted building heights and general mass dimensions of the structure by means of the general physical impacts of tall buildings. The relationship between a single tall building and a group of tall buildings will be determined depending on the site and neighborhood area. As shown in Figure 2.27, the development phase of the environment is certain and the integration of new buildings with existing urban environment is evaluated.

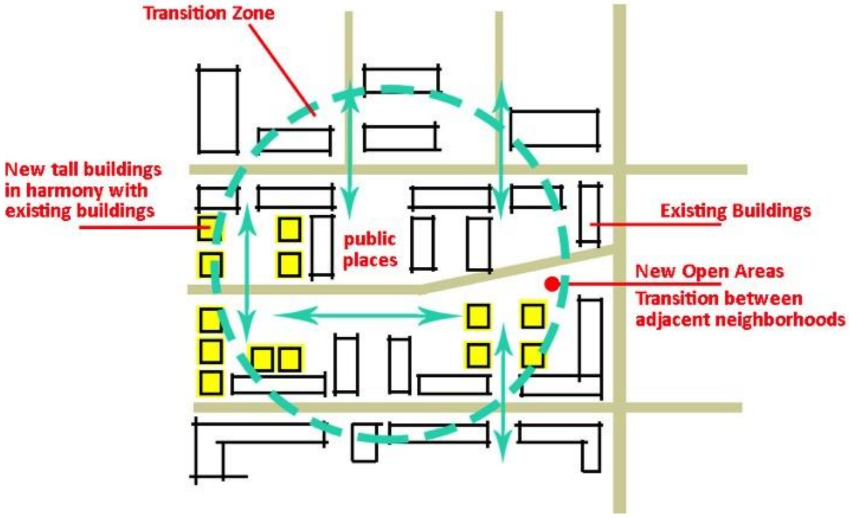

Figure 2.27. An illustration of a conceptual Master Plan for a larger development area containing multiple tall buildings, new streets and parks (Adapted and Re-drawn; Tall Building Design Guidelines, 2013)

Another important issue regard site selection is the function of the building and its functional relation with the surrounding context. For example, if the building placement will be near heritage area, tall building location should be strictly oriented with respecting to conserve these elements (buildings, parks, streets, urban squares and etc.). Any building located very near by a heritage site, should follow more sensitive and carefully selected design strategies than with a standard approach. So, the function of the architectural building is parallel with the location of a tall building where such situations may reveal as historical conserved areas.

Figure 2.28. The historic streetwall context is respected with a generous tower stepback and referenced through an appropriately scaled and articulated base building (Source: Tall Building Design Guidelines, 2013)

Figure 2.29. New base buildings with contemporary expression relate to the heritage buildings preserved on-site (Source: Tall Building Design Guidelines 2013)

2.4.2 Site Organization

Key concept points:

- The integration of the building with the physical, social urban environment and street life (contribution on physical and social facilities),
- Public access to the site and existence of pedestrian areas,

- The relation of the public spaces within the site with the surrounding urban places,
- The visual impact of the tall building on the surrounding historical views or landmarks in considering its settlement within the site,
- Vehicle services

The site planning and organization step follows site selection step for tall building design. Placement of the structure within the site should not be needs to be carefully determined for successful integration. The aim of this step must be to integrate the tall building project with the urban environment, both physically and socially. Further, the site should be planned to use every space for maximum benefit. For example; entrances of the building should be oriented towards the most crowded streets and must be visible enough for people by means of the public access of the building.

While creating urban places within a defined site, a tall building should also be capable of supporting other public areas that are not included in land as private gardens, green spaces, inner plaza or gardens as shown in Figure 2.30. In this way, there will be a sustainably social interaction between the site in that tall building will be settled, and the site which belongs to public. Also, the variety of activities within urban places will increase. Since, open space site organization may differ depending on building height, width, use and natural land characteristics.

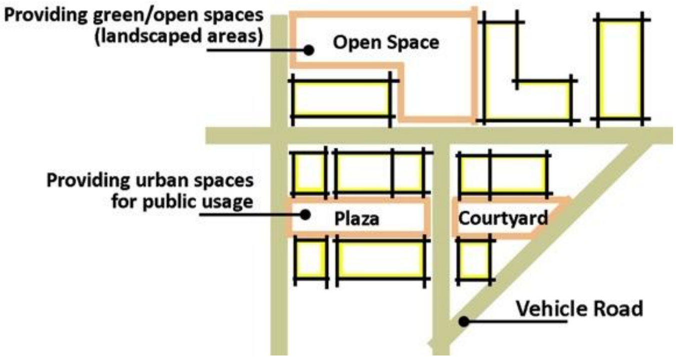

Figure 2.30.Tall building sites offer a broad range of publically accessible open space opportunities (Adapted and Re-drawn; Tall Building Design Guidelines, 2013)

Figure 2.31. A plaza with seating and shade (Source: Tall Building Design Guidelines, 2013)

Besides public spaces, tall buildings may also create private spaces for building occupants or employees. This kind of a situation mostly appears in the middle of a group of tall building clusters and with this approach site organization totally changes.

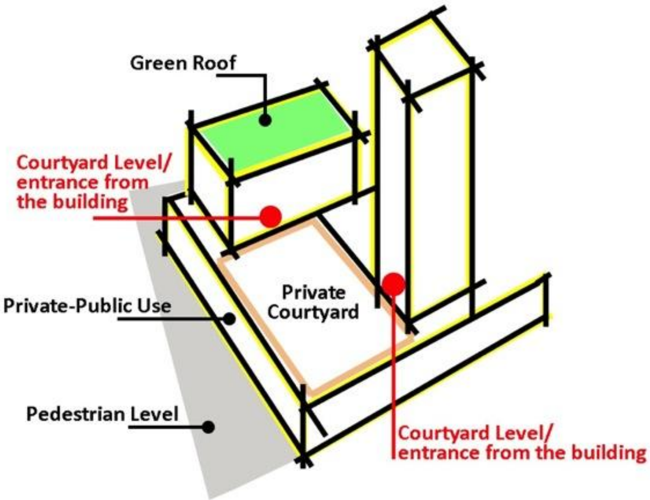

Figure 2.32. Tall buildings require a broad range of private open spaces to meet the needs of building occupants (Adapted and Re-drawn; Tall Building Design Guidelines, 2013)

With an integration of a structure in this manner, with public spaces created between buildings as shown in Figure 2.32, the separation of private and public spaces the relation between the street life and the building will be less strict. It is not correct to perceive this kind of a planning system as negative because depending on design strategies the type of a site plan and usage may differentiate by means of fitting with the urban environment. Soft transitions of public and private setbacks will surely provide a sustainable harmony and balance between the tall building and its street life.

Another issue about tall building placement within a site is whether the structure will be a barrier for existing urban view and visibility. This perceptual frame can be consisted of a landmark, urban park, street or any other constructions.

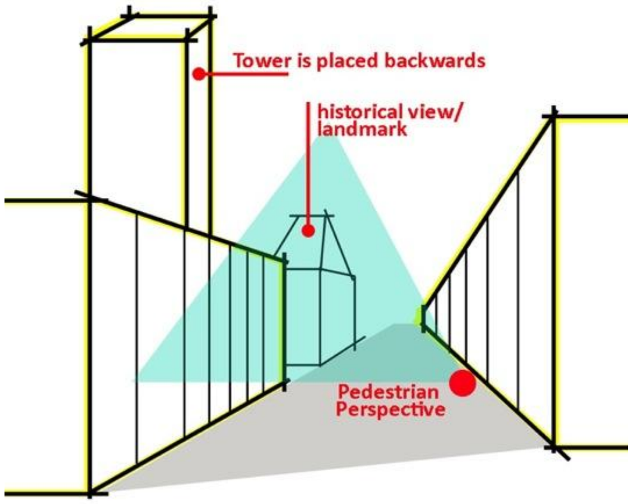

Figure 2.33. The tall building steps back to protect an important view from the public realm (Adapted and Re-drawn; Tall Building Design Guidelines, 2013)

Site organization can be oriented towards visual protection but on the other hand “well-designed tall buildings on prominent sites can become recognizable landmarks, providing points of orientation and visual interest within the city” (Tall Building Design Guidelines, 2013: 22). However, critical vistas and viewpoints should be identified in site analysis so that a tall building’s placement can be suitably identified for its physical environment in order to best maintain its environment. Hence social and physical sustainability is achieved without interference.

Furthermore, site servicing for tall buildings is a necessary process which supports urban transportation besides its own service cycle. Tall buildings may require more than one entrance for open or closed parking areas. However there are many elements beyond car park areas that should not be overlooked; such as, garbage and waste loading areas, drop-off areas, public transportation stops and etc. Generally, vehicle entrances designed for big trucks or service requirements are recommended to be at the back of tall buildings in order not to disturb surroundings.

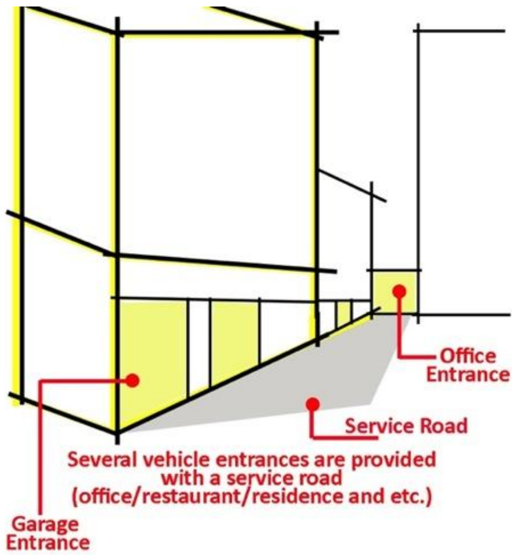

Figure 2.34. Site servicing and vehicular access provided within and behind the building (Adapted and Re-drawn; Tall Building Design Guidelines, 2013)

Providing service roads or car entrances from the back or another side that does not block the pedestrian flow may be more preferable. This is an important design plan decision for tall building location selection because not in all sites may be able to facilitate this kind of an implementation, due to factors such as the natural topography.

2.4.3 Transportation

Key concept points:

- Contribution of the building on the transportation network system,
- Existence of underground subway stations within the site,
- Easy pedestrian accessibility to the site,
- The usage of the building for transportation systems

In many countries transportation facilities are being developed for city dwellers to use public transportation in order to reduce rise in number of personal vehicles. Sustainable urban environments promote the use of public transportation as opposed instead of cars or any other similar vehicles because of air / noise pollution and carbon emissions. Tall buildings can contribute to the development of transportation facilities by acting as a transportation hub, by including several stop points, train stations or transition pathways that combine transportation spots. Also “a concentration of multi-story development reduces costs and energy involved in transportation and urban services” (Ali and Al-Kodmany, 2012: 395). People generally tend to use tall buildings for commercial and social needs because tall buildings are structures capable of containing different functional services that enable them to use their time for efficiently; such as, to complete daily tasks during rush hours, going to food market, tailor or even using the transit links to other areas (subway stations).

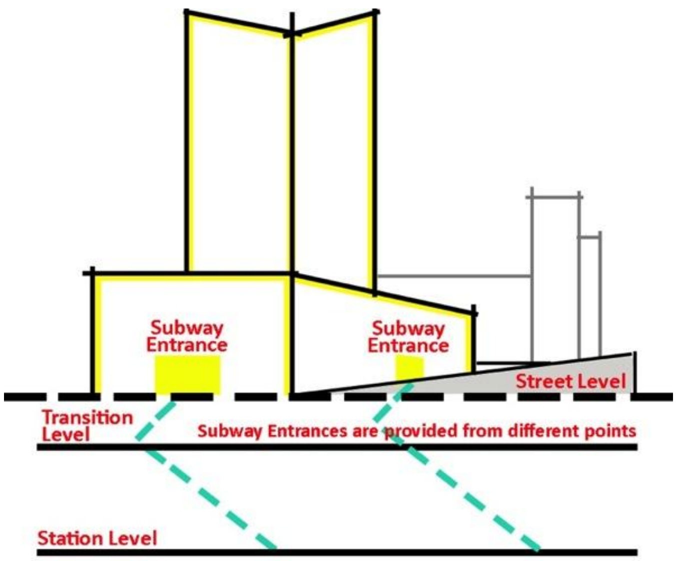

Figure 2.35. Connections at-grade, as well as those above-and below- grade promote walking cycling and transit (Adapted and Re-drawn; Tall Building Design Guidelines, 2013)

All of these activities can be provided in or near tall building settlement areas. Therefore, as a number of activities can be integrated into a centralized location, the usage of transportation vehicles can be minimized. Tall buildings in a compact urban core can reduce the per capita carbon footprint of a city with respect to suburbia (Ali and Al-Kodmany, 2012: 396). That is why walkable cities are preferred instead of transportation usage. If we think beyond the architectural scale, we can to some extent include the energy loss due to transportation when considering the total energy loss of the tall building; for example by minimizing transportation use, tall buildings can save on their energy footprint on the urban area.

Compact city form is a planning concept where a it contains short distances between different functional areas. Walking or cycling is preferred in such city forms; low energy consumption is provided and also supports the social life of the city with exposing pedestrian friendly urban places. Sustainable transportation can contribute to sustainable development of the city by constructing more tall buildings and containing urban sprawl; that is to say, by building compact city (Beedle, Ali and Armstrong, 2007: 675). Infrastructural concerns are also easier managed because walkable cities cause roads to carry smaller traffic loads. So, a group of tall building can compose public or private urban places with rich social activities in it. In the same way, they can support vertical transportation systems within the buildings and activity areas can be located at the upper levels of the city.

2.4.4 Urban Skyline

Key concept points:

- The importance of the height,
- The improvement on the urban skyline,
- The impact of a tall building on historical structures, sites or buildings within the skyline,
- A different approach; becoming a district composed of tall buildings within a city,
- A new view from the tall building or a new view through the new tall building? (Contribution on the existing skyline)

'Tall buildings', as the title states, have inherent physical impacts on drawing the picturesque frame of the city. Tall buildings greatly increase the visibility of the city and make it a more memorable image; the urban skyline can directly be seen by almost every point of view. The height of the buildings is a direct specification for capturing an image of tall buildings within a city. Besides buildings, city skylines can be also composed with different urban elements as trees, roads, urban squares, public places and etc. But a single building is capable of affecting the whole frame by itself; this is why tall buildings are directly related with the urban skyline. As well as this, city skylines can always change because the city is a creation that always develops itself with adding new structures, buildings and urban elements on the existing form. Where every city has its own urban skyline, every interventions made will be different within a city with consideration of specific physical, social and economic criteria.

Historical views and built heritage conservation are critical issues to consider, as they should be protected as much as possible. Besides creating a competitive scene with the new and existing buildings, tall buildings should be designed to give an additive component to the already built heritage in the established city's frame. Selecting a suitable site location can ensure that the building is situated in a location which best integrates its appearance with the city's significant heritage, vistas and views for better sustainability.

Figure 2.36. Skyline of Cairo, where Mosques of Sultan Hassan and Al Rifaii is seen, 1995 (Source: Abu-Ghazalah, 2007)

Figure 2.36 shows a skyline with dominant historical structures, the mosques, as its focal point. In this kind of a built environment, tall buildings can be threatening if not designed to suite the surrounding environment.

The design of a tall building and its height is greatly defined by the style of the district they will belong to within a city. It is obvious that height is a deterministic item for these kinds of buildings when discussing on urban skylines. Depending on the impact of a new tall building, the new building can divide the city's districts into areas of newly defined activities and social places; for example according to their physical or social situations they can be divided into historical, commercial or residential districts or even it can depend on the height levels of buildings in it as, high-rise building districts. These areas that are specified by kind of a land-zoning approach will enable the city to become more future oriented. As, there may be more defined urban skylines and more properly constructed tall buildings.

Additionally, there may be two different viewpoints for the urban skyline; the first is the view from the top of the tall building out towards the city, the other one is the view from the ground or other buildings up towards the tall building.

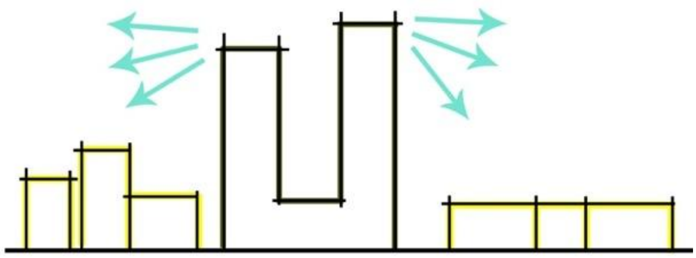

Figure 2.37. View of the city skyline from the top of the building (Drawn by Author)

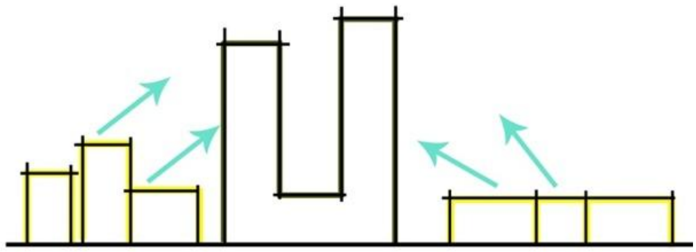

Figure 2.38. View of the city skyline through the building from street level (Drawn by Author)

The magnitude of a tall building's impact on the urban skyline may differ depending on this situation. For example, important landmarks or historical views may be visible from the top of a building, but the tall building may block important landmarks or historical views when viewed from the street towards the tall building. Moreover, when thinking about the effect of a tall building on the skyline, the impacts should also be discovered through these two different viewpoints.

2.4.5 Façade Design

Key concept points:

- Providing a social screen on the street level,
- Transparency,
- Providing energy from natural sources,
- Intersection pattern between the outside and inside environment of the building

Façade is the interface between building and the urban environment. A building's external appearance defines how the building exposes itself to the city: it is a way of architectural expression. Human perception approves existence of a tall building firstly with its architectural appearance within existing urban environment. Besides structural systems, a building must be approved with its form and physical appearance that is promoted by means of façade design. From its contemplation to its integration with the city a tall building needs; "a high degree of visual and physical connection, including multiple entrances and 'storefront' windows, supports active, street-related commercial and retail uses" (Tall Building Design Guidelines, 2013: 43). This integration can satisfy the needs of a livable street. When a building has integrates itself with needs of the city at the pedestrian scale, the buildings creates an enduring relationship with the city dweller. Moreover, the transparency of the entrance floors of a tall building, via façade material selection, can enable it expose itself more to the pedestrian life. The integration with the living urban environment can shaped with this transparency by creating a suitable balance and fluidity between the interior and exterior life.

One of the main aims of sustainable design is to build up environmentally friendly buildings with low energy, especially if the building has a long life cycle. This can be achieved with efficient material/resource use on the façade. According to Sev (2009), for bioclimatic tall building design, façade materials should;

- provide energy conservation,
- alternatives for texture and endings,
- be in a harmony with façade cleaning systems,
- be coherently balanced with heat differentiations and wind effects,
- be weightless enough in order not to make load on structural system,
- be easy and economic with its maintenance and repair.

Through careful selection of materials, façade design has the potential to minimize the inevitable energy losses of a building. One such example is the ability for tall buildings to capture large quantities of natural light as a result of their large physical proportions; "the fabric of the façade and the area given to windows, their height and width, are of ultimate concern in gathering light" (Maunsell, 2012: 38). By capturing more sunlight energy, a building can reduce its dependence on electrical light, improve its heating performance and potentially have significant physiological benefits to its users.

Figure 2.39. Daylight, external aspect and fine spatial quality between the blocks: The Minerva Tower, Grimshaw Architects LLP/Smooth (Source: Strelitz, 2011)

As the material selections for the façade of tall buildings inevitably depend on the form and design, costs, function and integrated engineering technologies, and systems that are going to be processed to the building. Before the selection of the façade materials, a detailed research has to be conducted to decide whether it meets the requirements the tall building design and its physical impacts on the surrounding environment. It must be reminded that sustainably concerns all of the buildings phases including the demolition, therefore using recyclable materials can significantly improve a building’s sustainability. Natural air conditioning can be an advantage for tall building design for reducing energy consumption and also achieving healthier indoor air. For example, accessing sunlight has to be managed properly in order to use natural daylight within the building at daytime.

Figure 2.40. The Heron Tower, London (Source: http://photography.jfranklin.com)

The Heron Tower shown in Figure 2.40 is an example of a tall building that demosntrates sustainable façade design. The interactive façade is triple glazed – with a single-glazed outer pane, double-glazed inner pane and cavity mounted blind for shading (Strelitz, 2011: 257-258). Also, the Heron Tower has a transparent view and is designed towards reducing energy use with using different materials that support energy efficiency on facades as photovoltaic panels (East and West sides).

The ultimate goal in using energy-efficient materials is to reduce the amount of generated energy that must be brought to a building site (Kim and Rigdon, 1998: 16). As almost a building's entire exterior is composed of external facades, façade design has is a potentially large contributor to energy efficiency. Both internal and external air conditions can benefit from materials used on external side of a tall building; thus, this situation approves that façade is the intersection point between inside and outside environment. Also, by means of an intersection point, the façade may be reflective through the outside environment. The material on the façade can reflect the sunlight on the surrounding outdoor spaces.

A successfully implement façade design can benefit from a tall buildings large surface area in order to minimize energy lost from the building, give it an aesthetic quality and integrate it with the urban environment outside, while also provided the needed mechanical requirements.

2.4.6 Entrance Floor

Key concept points:

- Height balance of the entrance floors with the surrounding built environment,
- Relation with façade design,
- A transition pattern between the inside and outside environment (a connection sense),
- Welcoming people by creating public spaces on entrance floors (increasing the sociality and physical usage)
- Necessity of creating wide open areas around the entrance floor,
- Architectural contributions to strengthen the connection of the building and the urban environment,
- Providing several entrances for different functions

The entrance floor of a tall building is the complementary part of fitting harmoniously with neighbor buildings. Height consideration, façade design, social attributions, transportation facilities can be the supporting tools of this relationship which is necessary for socially and physically sustainable urban environment. Moreover, entrance floor design has to be well proportioned in scale through surrounding built environment.

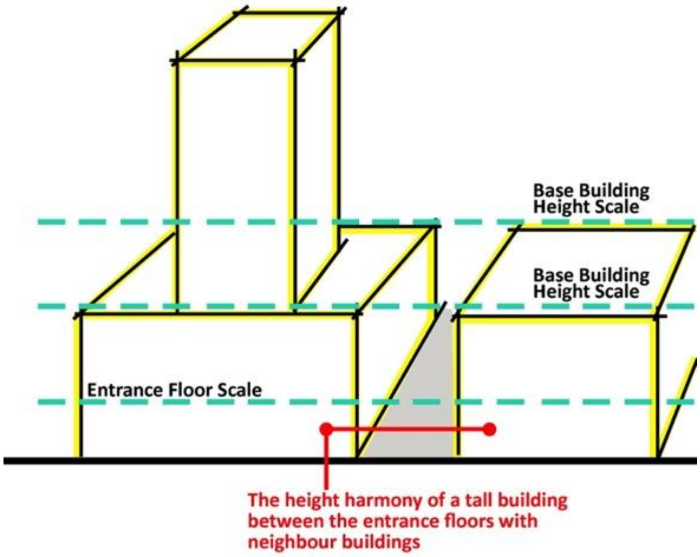

Figure 2.41. The height and scale of the base building respond to the scale of neighboring buildings and street proportions (Adapted and Re-drawn; Tall Building Design Guidelines, 2013)

Façade and entrance floor design are mutually complementary items. Together they create a visual balance together; this can be provided by using same material types from the ground surface to a determined height on the façade surface of the tall building. The façade material selection should be environment friendly and sustainably suitable in design phases of tall buildings. Besides the considerations on energy usage, transparent materials used on entrance floor façades, contribute on the transition between the interior and exterior places of the building. It is possible to provide visual continuity with a harmonious relationship between entrance floor-façade design and the existing building context.

In some situations, it is important to allow space for urban places at the front to achieve a more effective ground floor design. Urban squares have the potential to welcome people inside of the building. These plazas give the chance to provide breathing spaces for people within densely built environment. Figure

2.42 shows an example of an open space at the front of the tall building that gives the opportunity of an urban place for people to use.

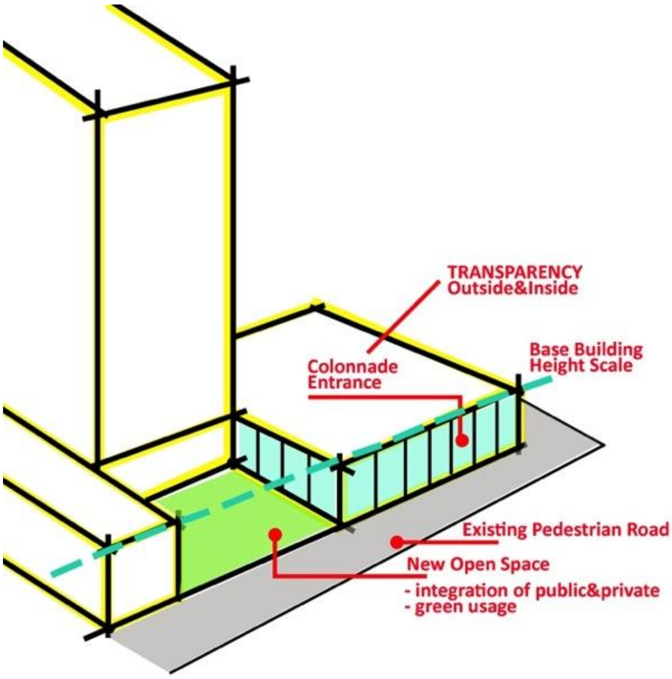

Figure 2.42. Define public open space by appropriately massing and orientating the base building (Adapted and Re-drawn; Draft Urban Design Guidelines for Tall Buildings, 2012)

Entrance floor designs are very critical points for defining urban places around the building. This opportunity to provide new urban places is an advantage for tall buildings within a city, because in some conditions tall buildings can make use of narrow urban places to give people a psychological cure for the claustrophobic effect of growing cities. On the other hand, “the tall building can also create a sterile urban environment, isolating its internal functions from street life” (Gonçalves, 2010: 50). This may create a barrier between the building and pedestrians that may decrease the usage of the building, and hence negatively impact the ground level conditions. Designing open spaces around tall buildings facilitates their usage and livability by including social life in the entrance floors. Thus, columns or other architectural contributions to entrance floor designs connect the building and the urban environment.

Figure 2.43. The ground floor of Ministry of Culture and Education in Rio de Janeiro and the open public space created by the podium and the *pilotis*[1] through which pedestrians can cross the urban block (Source: Gonçalves, 2010)

As an entrance can welcome people, the iteration of the building with the public is possible through several entrances. The use of suitably selected entrance areas or separated entrances can aid the building to become more socially sustainable. The building shown in the Figure 2.44 has different entrances that generate multiple urban places; in multi- functional buildings, variety of entrances can be much better choice than a single.

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[1] A way of architectural configuration to lift the whole building mass off from the ground level, usually columns are used as supportatives.

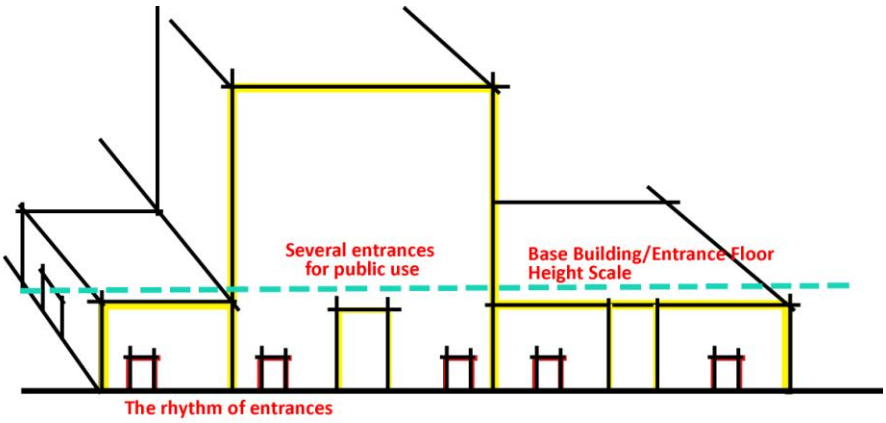


Figure 2.44. A series of street-related entrances promote interaction between the building interior and adjacent public realm (Adapted and Re-drawn; Tall Building Design Guidelines, 2013)

2.4.7 Vertical Design

Key concept points:

- Indoor circulation,
- Atrium and inner garden designs within the building,
- The usage of green within the building,
- The vertical connection between the inside and outside environment

By considering all living facilities within a tall building, tall buildings can be considered as communities embracing ‘a vertical life’. Due to their height, movement within tall buildings has to be supported with elevators. Besides benefits of pedestrian movement, integral transportation systems (escalators, elevators, etc…) need to contribute on the energy efficiency requirements of a tall building. Tall buildings with more suitably designed vertical circulation will create a success in design of integrated building systems. This transportation can be supported by various kind of vertical designs called atriums (‘spaces’ that are not used between the floors) supported by vertical landscape. Designing atriums between floors contribute on sustainability considerations of a tall building because they are mostly designed as green areas, or landscape elements are used within these empty spaces. Much like the importance of open areas outside a tall building at the ground levels for the public's social use and physiological benefit, these open common areas inside the buildings give benefit to the internal users. Also, atriums are important because they can contribute to the indoor environmental conditions with wind circulation and to the ventilation services of the building.

Floors designed according to the usage of the energy from sunlight and air, can show different forms within design; for example, a floor extending out from the side of outward side of a tall building can gain energy from sunlight. These types of building spaces can be used to support by green atriums where and also be used as social common spaces. Different types of atrium designs can be created depending on the vertical circulation and form of a tall building. .If we consider a vertical circulation of a tall building as vertical line through the buildings core, then we can place all of the points, nodes, places along this line, together with the building's transportation systems (such as, stairs and elevators). These connection points along the said vertical line can be connected to urban environment depending on the building function and design strategy.

Figure 2.45. Menara Mesiniaga, a bioclimatic building in Kuala Lumpur
(Source: www.solaripedia.com)

The example of Menara Mesiniaga, the building provides natural daylight and ventilation throughout the building by connecting its exterior façade directly to its core. According to Sev (2009), landscape areas that take place on the façade of this building surround the structure and integrate this green with the entrance floor landscape areas. In the case of Menara Mesiniaga, the building has connected planting within floors, sky courts and terraces directly to the vertical. In this example the usage of from the inside of the building to its exterior gives it a fluidic sense of transition from the outside urban environment to its interior.

The mechanical part of vertical design is consisted of building support, escalators, elevators and stairs. The taller a building is, the more important of the usage of these integral vertical transportation systems becomes. This point raises the question of 'how these design configurations can contribute within a sustainable approach'. According to Strelitz (2011), irrespective of the potential for regenerative power solutions, numerous strategies are now available to achieve efficient lifting, enabling a reduction in elevator numbers and an increase in building population. Whereas, the number of mechanical service systems increase within a building, the electricity usage and energy consumption also increase in parallel. The taller a building is the more it depends on a transportation system. Strelitz (2011) mentions that new strategies are established; shuttle elevators providing access to sky courts, local elevators for determined floors, a single shaft having twin lifts and etc. In the example of the Heron Tower in London, stairs and atriums facing different directions can be seen from the outside through its transparent façade design. The design affords scope for stairs to interlink the set of floors grouped around each atrium (Strelitz, 2011: 256). This gives the choice for users to use the options of stairs rather than elevators to travel between floors. If vertical transportation services are arranged suitably, a comfortable circulation will be provided for people.

Figure 2.46. Heron Tower: animating the city through its vertical circulation by Hayes Davidson (Source: Strelitz, 2011)

2.4.8 Urban Microclimate

Key concept points:

- Sunlight access on the site (a barrier or reflective?),
- Creating wind corridors/tunnels,
- Effect of the building on climatic conditions on the ground level

When discussing the impacts of a tall building on microclimatic conditions, geographical and seasonal conditions have to be considered. The direction and position of a tall building directly affects its exposure to wind and sunlight energy. Depending on its form and position, tall buildings can act as wind funnels to the street level, and also shading on urban environment. Tall buildings produce adverse effects on the microclimate, due to wind funneling and turbulence around them at their base causing inconvenience for pedestrians (Ali and Al-Kodmany, 2012: 387).

Figure 2.47. Strong pedestrian level wind makes street-level conditions uncomfortable and in some cases hazardous (Source: Tall Building Design Guidelines, 2013)

Wind effects can vary and negatively change regarding to the position of a base building.

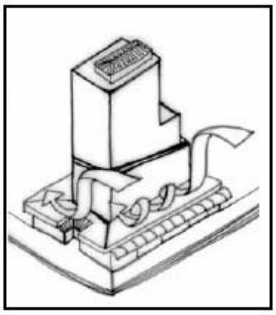


Figure 2.48. Use of horizontal canopies (Source: Draft Urban Design Guidelines for Tall Buildings, 2012)

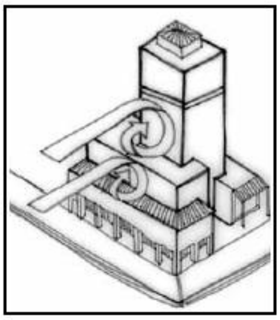


Figure 2.49. Stepped back base buildings (Source: Draft Urban Design Guidelines for Tall Buildings, 2012)

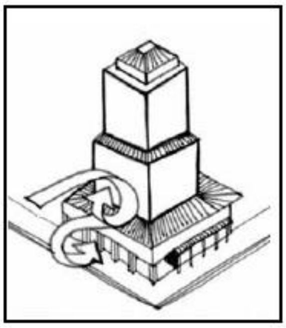


Figure 2.50. Use of colonnaded base (Source: Draft Urban Design Guidelines for Tall Buildings, 2012)

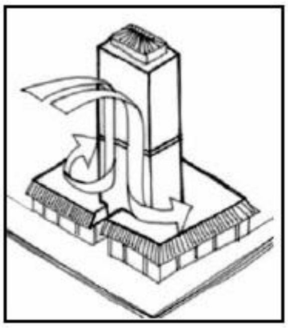


Figure 2.51. Using roof areas on base building (Source: Draft Urban Design Guidelines for Tall Buildings, 2012)

Figure 2.48 - 2.51 show solutions as creating a barrier against undesirable wind flows on pedestrian level. As well as neighboring built environment also is a deterministic factor, these strategies must be considered by creating the connection with the surrounding.

Microclimatic effects of tall buildings need to be considered in their design. Walking through windy streets is not a comfortable for city dwellers. Further, tall buildings block a large amount of sunlight on pedestrian level, making the effect on the pedestrians more noticeable.

CHAPTER 3

MATERIAL AND METHOD

This chapter is consisted of two sections; firstly the 'material' section that includes selected case studies, the program tool used to achieve reliable results out of the research inputs, and the survey questionnaire. Secondly there is the 'method' section which includes the information of how the study was conducted with site analysis and survey methods.

3.1 Material

The following materials were used in this study are; two case study buildings which are 'The Shard' (London Bridge Tower) and '30 St Mary Axe (Gherkin)', the 'Power and Sample Size Calculation (PS)' Program, and a survey questionnaire. Case studies enable us to apply a thought pattern onto different real word examples in order to examine different architectural and environmental features related with their social, physical and environmental conditions.

Tall buildings in London are generally located in different clusters in separate districts, mainly in financial and commercial districts. These tall buildings are directly built into the urban heritage texture, making it possible to see tall buildings populated near historical structures. London is continuously rejuvenating itself with design and construction of new, modern buildings. The density of tall buildings in London increases when one gets closer to financial/commercial districts.

In the Canary Wharf and Bank districts, tall buildings are constructed side by side with narrow pedestrian ways in between. The tall buildings in each district generally have a similar appearance by means of their material usage on their envelope. Especially tall buildings located in Canary Wharf area (i.e. Citigroup Centre, 8 Canada Square, One Churchill Place, 25 Bank Street, 1 West India Quay buildings and etc.) almost hold nearly the same visual appearances. Due to the similar transparent façade designs used on the envelope skins of tall buildings in Canary Wharf, all the buildings reflect a similar dark grey color. As tall buildings in Canary Wharf have similar architectural expressions and form a cluster area, these buildings were not selected for a case study. As these buildings form a cluster, there is not as much definition or contrast in the integration strategies with their given environment, to make them a rich enough case to study.

Figure 3.1. Tall buildings in 'Canary Wharf' (Source: www.londonlovesbusiness.com)

After an intensive study and comparison of tall buildings with different location, district, function and stationary population; The Shard and 30 St Mary Axe buildings were be used as case studies for comparison.

The Shard and 30 St Mary Axe are located in districts that are used by a heavy flow of people due to their functional purposes. These areas support the many needs of the people (commercial, educational, health care, offices and etc.) Thus, the reasons for selecting The Shard and 30 St Mary Axe can be listed as;

- The intensive usage of the area by people,
- The functional differentiation of the two buildings,
- The contrast of the two buildings' architectural, environmental, functional and social considerations,
- This selection may enable one to derive different results although the buildings belong to the same city,
- This selection may enable to configure separated empirical observation platform to discuss,
- The variable usage of different population groups,
- The differentiation of districts,
- Different usage in different hours in day

3.1.1 Case Study Building 1: The Shard (London Bridge Tower)

The Shard is a multi-functional building 310 m. in height, which includes offices, residential apartments, hotel (Shangri-La), restaurants and observatory view floors of London. The building has been constructed on the site previously occupied by the 'Southwark Towers'. The Shard is the tallest building in Western Europe as it is the highest building in London (The Shard – London Bridge Quarter, 2013). The building offers 360 degrees view of the city with different perspectives from North, South, East and West directions.

Figure 3.2. The Shard (Archived by Author)

London city skyline has been redefined with construction of The Shard building. There are some disagreements whether it has negatively impacted the nearby historical buildings (i.e. St. Paul's Cathedral). Whether or not it has positively or negatively impacted the skyline, it is generally accepted that The Shard has added a fresh new and modern silhouette to London's skyline.

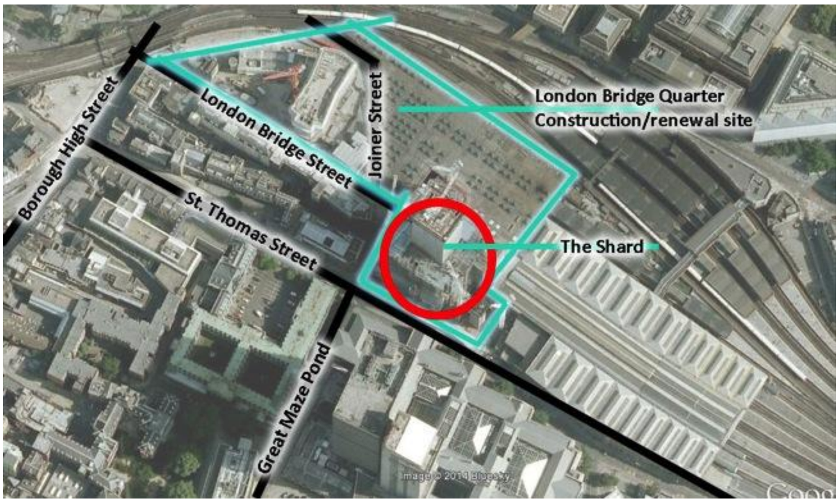


Figure 3.3. Location of The Shard (Drawn by Author)

The building is located in the central area of London (London Bridge). Because of its central location, and integrating and design strategies, The Shard has an important contribution on London’s transportation facilities; underground, bus and taxi stations, well-connected pedestrian routes. Also, as a concept of this study, sustainable approaches are taken into hand with this building; The Shard is designed through environmental and sustainable criteria. Sustainability requirements of this tall building have been provided with advanced technological methods in construction.

3.1.2 Case Study Building 2: 30 St Mary Axe (Gherkin)

Commonly referred to as the “Gherkin”, the 30 St Mary Axe is an office building that is located in the central financial district area in London. It is surrounded by several office buildings where public activity areas are in a walking distance. 30 St Mary Axe is 180 meters in height with including offices, a restaurant & bar at the top roof floor with a 360 degrees view of London, private dining rooms and a lobby floor for members only. But for public use, there are a few restaurants at the ground level.

Figure 3.4.30 St Mary Axe (Archived by Author)

The outstanding circular architectural shape of 30 St Mary Axe that is visible from afar, has an important impact both on the city skyline and the surrounding environment. Because of its shape and uncommon architectural design, 30 St

Mary Axe has changed the historical city silhouette of London a lot. Besides its impacts on the environment, the building contains sustainable credentials and energy saving methods regarding to the use of natural sources (i.e. daylight, wind and ventilation), the use of materials used on the façade and the use of other design strategies aimed at reducing energy consumption.

Figure 3.5. Location of 30 St Mary Axe (Drawn by Author)

The building is in the Bank district of London where lots of office buildings (tall and low rise buildings) are located. Several transportation facilities are located near the building. Nearby 30 St Mary Axe, a new tall building construction site (100 Bishopsgate) takes place. Due to the functional nature of its district, 30 St Mary Axe is surrounded mostly with tall buildings.

3.1.3 Power and Sample Size Calculation (PS) Program and Microsoft Excel

Power and Sample Size Calculation (PS) Program: For the survey, PS program was used to determine the required minimal sample size of survey correspondents need to achieve reliable results. According to Suresh and Chandrashekara (2012), the use of an agreeable sample size, with correct a suitable collection process provides more reliable and valid. For this study, the PS Program calculated a necessary minimum target sample size (people) that were required to accurately compare each group (the two cases buildings as in this study) for the hypothesis to be reliable enough for conducting the study.

Microsoft Excel: Excel spreadsheets were used to plot the data and demographic information gathered from the survey into graphs and tables. Also Excel provided to draw the comparison graphs for the range of scoring points given for each question between two case study buildings.

3.1.4 Survey Questionnaire

A survey questionnaire was prepared with questions that are composed according to the research aim, which are based on the key concepts of sustainability. 'Vertical Design' key concept is not considered within the survey because it was believed that people would not be able to answer questions about the buildings' interior circulation, due to prohibition to enter the buildings. The survey questionnaire has been prepared through key sustainability concepts, as follows;

Site Selection:

- **Number of questions:** 2
- **Aim:** To determine the relation between the location for the building and its suitability with the historical heritage.

Site Organization:

- **Number of questions:** 2
- **Aim:** To determine the nature of the buildings integration with the nearby existing open areas and whether people are available to use these open areas for their physical and social needs.

Transportation:

- **Number of questions:** 2
- **Aim:** To determine the people's accessibility to the local public transportation system from the building and impact of the on the local public transportation system.

Urban Skyline:

- **Number of questions:** 5
- **Aim:** To determine the degree of suitability of the buildings as a new landmark for London, and its contribution to the urban skyline, and the existing historical skyline. Furthermore, the impact of the buildings' height and shape on its surrounding built environment and urban skyline is the other consideration.

Façade Design:

- **Number of questions:** 2
- **Aim:** To determine the whether buildings' façade material matches its surrounding buildings in appearance. Also to determine whether the façade design gave the impression that it was designed to aesthetical concerns or for physical concerns suc as mechanical structural and energy efficiency.

Entrance Floor:

- **Number of questions:** 2
- **Aim:** To determine the fluidity between the interior and exterior and its success in making people feel comfortable entering the building or just passing by. Also the number and type of the entrance door/doors are important because of whether providing a public sense or not as welcoming people inside.

Urban Microclimate:

- **Number of questions:** 1

- **Aim:** To determine how much the buildings' microclimatic condition affect people when they are passing by. It is important to learn how they can feel differences in temperature or not and how near the building because of the wind, shadow or sun reflections.

Sex	
Age	
Years living in London	

*Please do not fill - This section is for Administrator	
Date	
Location	

	Poor	Below Average	Average	Good	Excellent
Site Selection	*1*	*2*	*3*	*4*	*5*
Q1: Location of the building is a correct decision	○	○	○	○	○
Q2: Suitability of the buildings visual impact to the historical heritage	○	○	○	○	○
Site Organization					
Q3: Integration of the building with its neighborhood's existing open areas	○	○	○	○	○
Q4: Suitability of open areas for the people's physical and social activity requirements	○	○	○	○	○
Transportation					
Q5: Accessibility to the London's transportation network	○	○	○	○	○
Q6: Effect of the building on Public Transport accessibility	○	○	○	○	○
Urban Skyline					
Q7: Potential of being a powerful landmark for London	○	○	○	○	○
Q8: Contribution towards "Improving" the Urban Skyline	○	○	○	○	○
Q9: Effect of the building on the "Historical" Urban Skyline	○	○	○	○	○
Q10: Visual effect of the building's height on surrounding built environment	○	○	○	○	○
Q11: Visual effect of the building's shape on surrounding built environment	○	○	○	○	○
Façade Design					
Q12: Harmony of building's facade with those of the surrounding buildings	○	○	○	○	○
Q13: Importance of a buildings façade for it aesthetic "looks" rather than a solution for energy efficiency	○	○	○	○	○
Entrance Floor					
Q14: Design of the ground floor providing a sense continuance (from outside to inside) for pedestrians.	○	○	○	○	○
Q15: Design and locations of building entrances/exits for pedestrians.	○	○	○	○	○
Urban Microclimate					
Q16: Effect of building's micro climate conditions (wind, shadow, reflections, etc...) your comfort when passing by?	○	○	○	○	○

Figure 3.6. Sample survey questionnaire of The Shard and 30 St Mary Axe

3.2 Method

The negative and positive impacts related with the architectural form, function and environmental concerns of tall buildings, and impacts on the built environment are investigated better by comparing two different tall buildings within the same region. The methods used in this study are site analysis and survey.

3.2.1 Analysis

The analysis through observation for selected tall buildings were made with regards to the key sustainability concepts (Site Selection, Site Organization, Transportation, Urban Skyline, Façade Design, Entrance Floor, Vertical Design and Urban Microclimate), as determined in Literature Survey (Chapter 2). The examined 'key sustainability concepts' in Part "Key Sustainability Concepts for Tall Buildings" are the basic features for site analysis. Site analysis includes architectural, urban and environmental features. Architectural features include investigations on architectural form and shape, height, function, façade design and material selection, vertical design, modern and technological appearance of the tall building. Secondly the urban features include examination of; urban skyline, location, transportation and urban microclimatic effects of the tall buildings. Finally, the environmental features include observations concerning; land use, entrance floor design (the integration with the outside open area), pedestrian realm, creation of public spaces and social interaction of users. This method is necessary for making a complete analysis about the conditions of these buildings within their locations in London and will give qualitative data about the case studies. The surveys are conducted and resulted in accordance with site analysis.

3.2.2 Survey

The second method is the survey. The survey questions were composed in order to determine the physical and social impacts of The Shard and 30 St Mary Axe buildings. As it was mentioned earlier, in Part 'Power and Sample Size Calculation (PS) Program and Microsoft Excel', the number of people contributed to the survey, has been determined depending on the data which PS program has given, and the results were analyzed in Microsoft Excel.

Survey questionnaire was prepared with the minimum number of survey participants obtained via calculation using PS. It was calculated that in order to detect 1 unit difference between the mean responses of matched pairs, 15 pairs of subjects needed to be studied to be able to reject the null hypothesis that this response difference is zero with probability (power) 0.95. The Type I error probability associated with this test of this null hypothesis is 0.05. In order to achieve a reliable comparison and valuable results for two different case studies. 40 questionnaires were completed by participants.

More participants were able to answer questions about The Shard and 30 St Mary Axe.

- All of the 25 participants (of which 12 were onsite and 13 online) answered questions for the Shard.
- 15 of the 25 participants (of which 10 were onsite and 5 online) answered questions for the 30 St Mary Axe.
- Therefore the 25 participants answered a total of 40 questionnaires (22 of them on site and 18 online)

People who filled the survey questionnaire on site also had the chance to give five their own qualitative feedback regarding the question topics. People who filled the survey questionnaire online (via a free service provided by http://kwiksurveys.com/) entered their demographic data and then answered the questions without giving comments.

CHAPTER 4

RESULTS AND DISCUSSION

This chapter is consisted of two sections; firstly the 'analysis and survey results' section that includes the analysis of the results obtained during the survey for the two selected case studies, and secondly the 'discussions and comparisons' section which includes an comparative evaluation between the cases based on all results obtained during the study.

4.1 Results

The following results have been obtained by both observational sinte analysis and survey questionnaire. Observations of the site analysis regards to the buildings connection with its surrounding environment were mapped onto observation maps, to create image of the site. All results obtained from the analysis are primary qualitative observational sources as the site location was visited and observed first-hand for each building separately. The results contain qualitative data concerning; height, function, façade designs and material selections, vertical design and circulation, modern and technological appearances within their neighborhood, locations, transportation on site, their microclimatic effects, land uses, the design of their entrance floors (by means of creating physical and social urban areas), their impacts on the pedestrian life, public spaces around and social interaction facilities.

4.1.1 The Results of the Observational Site Analysis

As general information, London occupies many physical and social activities, keeping the city alive and livable. London can be considered as a leading city in terms of livability, with its mixed culture and wide range of facilities; such as educational, entertainment, financial, media, sports, touristic and etc. The site analysis on the selected two case study buildings are given below:

Case Study Building 1: The Shard (London Bridge Tower):

Height: 310 meters (87 stories)

Function: Mixed Use (Office, restaurants, hotel, residence, public viewing gallery)

Location: London Bridge Quarter

Opening date: 2012

Architect: Renzo Piano

Client: Sellar Property Group

Sustainable Approach: As it is mentioned in the 'London Bridge Quarter' Project's brochure and homepage, The Shard building has; BREEAM certificate (Excellent); 95% of materials from demolition recycled, 50% of all steelwork from recycled sources, saving 10% CO_2 on the whole site with combined heat and power, solar gain effects, maximum use of natural light, naturally ventilated workspaces, a plot ratio of 32.1% ensuring land is used efficiently.

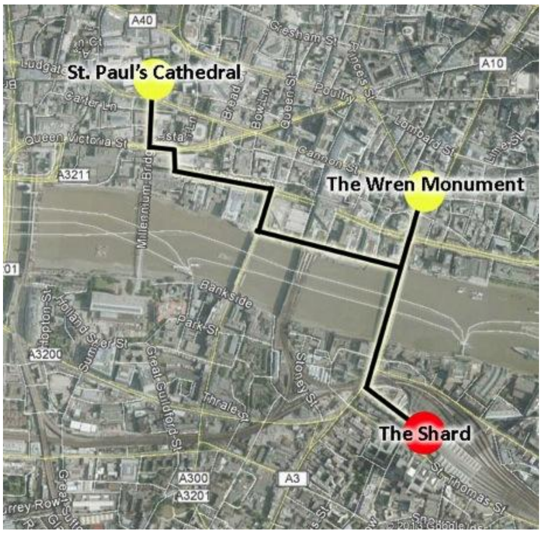


Figure 4.1. Observation map for The Shard (Drawn by Author)

The site analysis for The Shard was conducted with regards to the key sustainability concepts;

Site Selection Observations: The Shard is one part of a larger project for the 'London Bridge Quarter', located in London Bridge. The London Bridge Quarter area provides many open spaces with physical and social facilities for people to interact. The most important item about the location of The Shard is that it is directly adjacent to the very busy 'London Bridge Station' underground subway station, which acts as a hub connecting South East London to the South East over-ground railway. Thus, the station supports huge traffic flows of people, particularly from commuters outside of the city. The many pedestrian routs round The Shard take pedestrians through many different routes connected to different functional areas. Pedestrian routes intersect at 'Great Maze Pond' Street is a pedestrian road directly connecting with The Shard. Also the building is located very close to the River Thames where lots of public facilities and places are served for people, particularly on the riverbank.

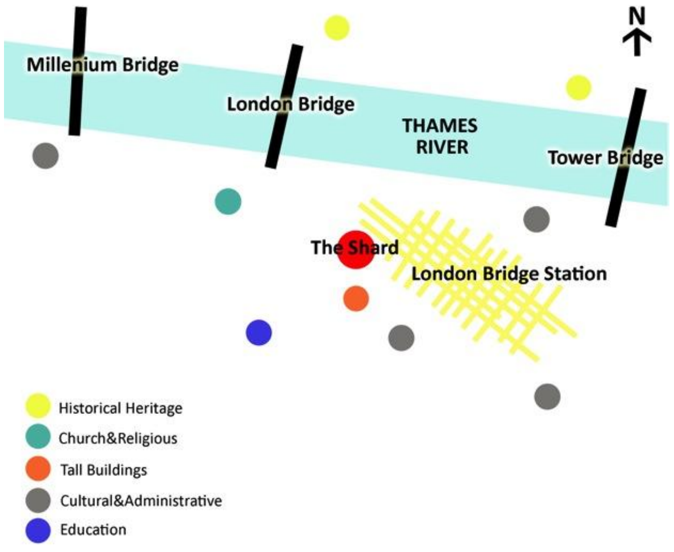


Figure 4.2. Illustration of surrounding buildings and places near The Shard (Drawn by Author)

At the time of these observations, The Shard building was built and open for use but various components of the London Bridge Quarter Project were still in their construction phases; including ‘The Place’ building (a new office building), landscape areas and a piazza for public use, a new bus station with public open areas.

It was observed that, The Shard has a very strong impact on the visual appearance of the existing city. One of the most important issues with The Shards’ location is its sensitivity to visually impact London’s historical heritage. Most of the buildings surrounding the modern The Shard building are historic. However it was observed that, these historic buildings were still able to keep their strong visual status, and hence remain as the important buildings on the site. It was noticed that, the use of public open spaces significantly lowered the impact the new buildings in this area had on the historic heritage.

The Shard has a very noticeable and obvious height different with its surrounding buildings. The completion of the high rise building, ‘The Place’, which is the next piece in the London Bridge Quarter Project, will most likely give more balance to the contrast in height that The Shard currently has on the visual appearance of the built environment within the district.

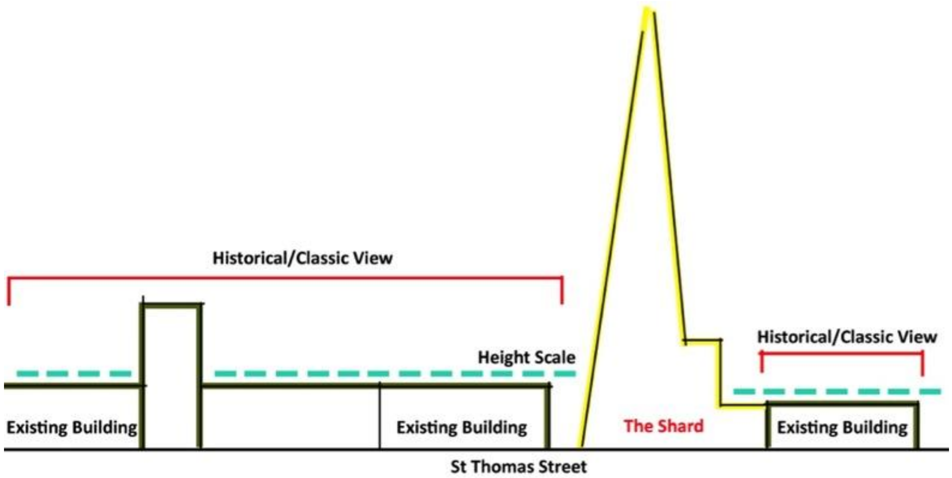


Figure 4.3. Height consideration of The Shard relative to surrounding buildings; a view from St. Thomas Street (Drawn by Author) *Figure is not scaled*

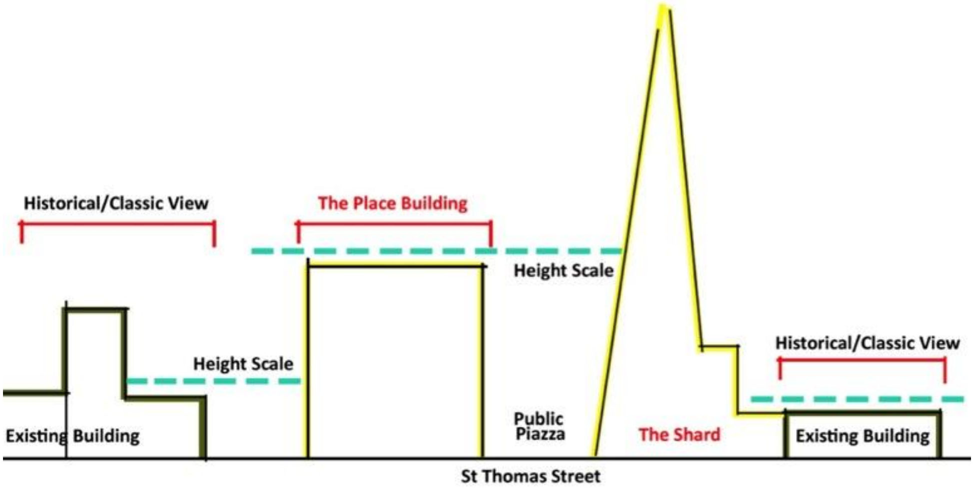


Figure 4.4. Height consideration of the Shard relative to surrounding buildings; after the construction of The Place building; a view from St. Thomas Street (Drawn by Author) *Figure is not scaled*

Site Organization Observations: It should to be noted that the site organization of London Bridge Quarter area was not completed at the time of this observational analysis. Although the area was not completed it was observed that the site has been organized with the purpose of providing physical and social facilities for as shown in the illustrated site map in Figure 4.5;

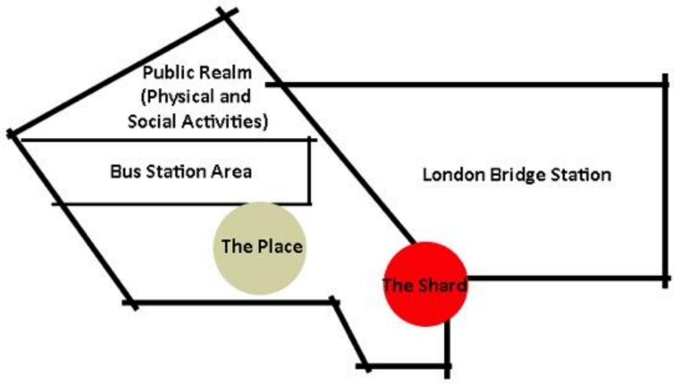


Figure 4.5. Illustrated scheme of London Bridge Quarter (Drawn by Author)

No car parking areas were seen around The Shard building, however it was learnt that 47 car parking spaces are provided under the ground. The Shard is located on Southern side of the London Bridge Quarter project area. A leveling has been created, where the southern side entrance to St. Thomas Street is below the piazza. Each of these levels has entrances into the building.

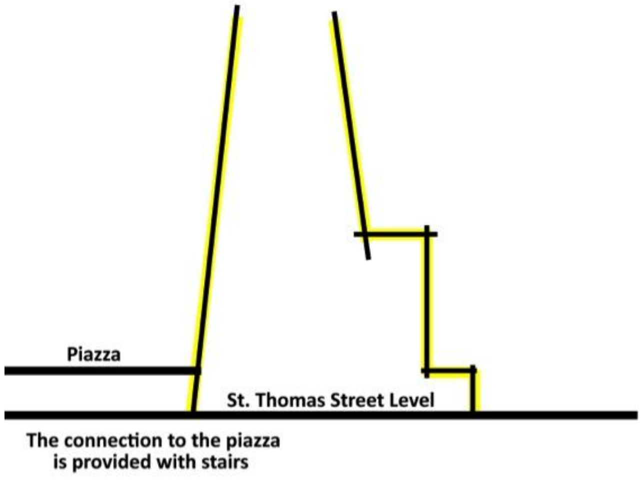


Figure 4.6. Site leveling (Drawn by Author) *Figure is not scaled*

The location of The Shard and the preparation of the site around the building enable it to be accessed from all directions. This has appeared to make the building more ‘discoverable’ and hence enhance its potential in becoming a landmark for people. It was observed that the open spaces coming from The Shard were connected to many of the surrounding facilities, making it easier for people to use the areas together.

From observation, it can be inferred that as London Bridge station is a busy station, many public places have developed around the station in order to facilitate the needs of its users, hence enhancing the possibility of the users to prefer spending their time in the area. It can be said that, as the construction finishes on site, more pedestrian and open areas will be provided for people. Therefore, the area will be more connected with the surrounding and existing public areas, especially with the River Thames. However the site is very near to River Thames, the pedestrian route is not very comfortable to walk. There are a few interruptions regarding the open area connections of providing pedestrian flow through riverside. According to the site analysis, this situation depends on the ongoing construction although all precautions are taken within the site.

Transportation Observations: The Shard has the potential for being a more important transportation hub for London because it is well connected with the city transportation network and with the outer city over ground rail. As well as this the building is designed as a part of a whole concept including the station, hence The Shard and the station are mutually supporting. During the site analysis, it was noted that, people were using the building (visiting the viewing gallery and exploring) and then easily accessing the transportation network. Additionally, a new bus station area was also still under development at the site. It was observed that; Mansion House, Bank, Cannon Street, Monument, Tower Hill, and Southwark station points are easily accessible by walking or short-distance underground subway to each other.

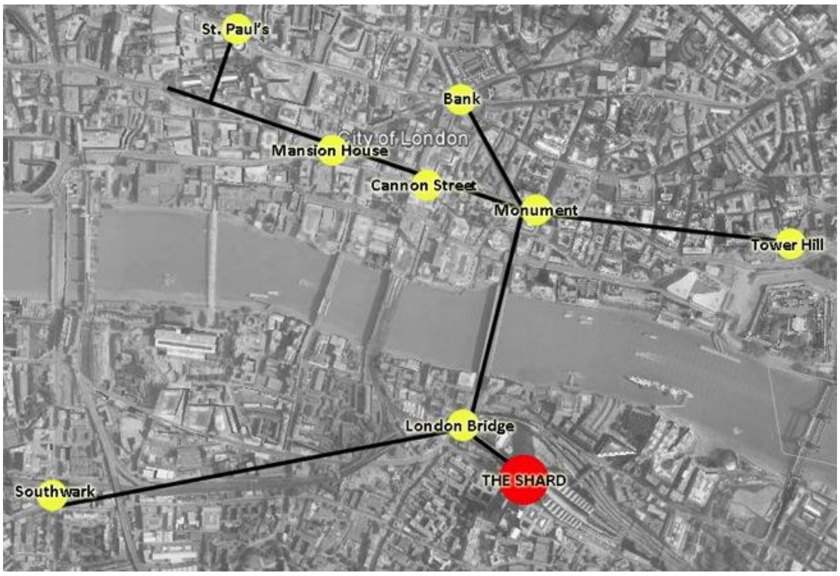


Figure 4.7. Underground transportation stations (Drawn by Author)

From several routes social, cultural (such as theatres, museums and etc.) and commercial activities are within approximately 5-15 minutes walking distance away. During the analysis, it has been walked along the River Thames passing by many café's, restaurants, resting places, open areas and etc. On the other hand, vehicle access (car, bus, taxi and etc.) is provided from St. Thomas, Joiner and London Bridge Street. Busses use the Joiner Street and connect to the main Borough High Street with London Bridge Street. There are also vehicle access ways within the site area although the area is totally designed for pedestrians.

Urban Skyline Observations: The building has a very powerful stance within the site area and the surrounding built environment. It is 310 meters in height and has a very powerful in design with its verticality within the site. The building owns a technological and modern appearance within the historical low rise building settlement. The view from the top viewing gallery reminds the user of how significant The Shard's impact is on the city. The photograph in Figure 4.8 below shows a view from the viewing gallery and it helps us to draw a small part of the urban silhouette. Even the shadow cast by the Shard on the city signifies a sense of gigantic proportions as it stretches across another district all the way to the other side of the River Thames.

Figure 4.8. Shadow of The Shard on River Thames; photograph taken from the viewing gallery at the top level of The Shard (Archived by Author)

Some of the most important architectural city images of London are visible from the viewing gallery of The Shard; including, St. Paul's Cathedral, London Bridge, Monument, 30 St Mary Axe, Heron Tower, Lloyd's Building are visible from the North side; Tower of London, Tower Bridge, City Hall on the Northeast; Tate Modern on the Northwest, London eye, Buckingham palace and Waterloo Bridge on the West; the Canary Wharf area on the East; Battersea power station and Big Ben on the Southwest side. Moreover, the height and shape of the building separates itself from its surrounding. In comparison to the sometimes-intimidating appearance of conventional square block tall buildings, the triangular form of the Shard makes it more comfortable and less intimidating to view up from ground level Furthermore, the contemporary triangular appearance of The Shard creates a contrast to the familiar (block and historic) London skyline.

Façade Design Observations: The material that is used on the envelope of the building is semi-transparent white glass and gives the building, as it is very ‘light’ both physically and psychologically from human perspective. The selected materials’ color is almost the same shade with the sky and also controls the use of light within a sustainable approach.

Figure 4.9. Picture showing The Shard’s façade material usage; extra white glass (Archived by Author)

Natural ventilation and heat control is provided with the material used on the façade. A technical solution was founded for this mechanical operation; “double-skin, naturally ventilated facade by internal blinds that respond automatically to changes in light levels was developed” (The Shard - London Bridge Quarter, 2013). The sunlight also passes through inside of the building and sometimes reflection occurs when looking up to the building. Besides architectural and mechanical concerns, the total ambience of the building created within the surrounding built environment, is provided with the material selection on its outside skin; creating a transparent design from the inside to outside of the building where people are not disturbed from its existence. Especially, on the façade surface of the first 4-5 floors on the side of St.

Thomas Street, the outer surface of the building , composed of transparent glass (fractional use of frosted glass can also be seen) is used where one can directly see inside of the building.

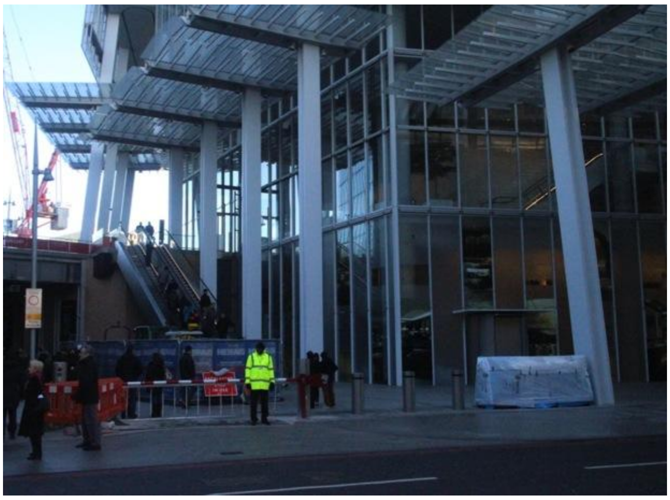


Figure 4.10. Façade material usage on the entrance floors of The Shard: transparent and frosted glass. (Archived by Author)

Entrance Floor Observations: The Shard has 5 entrances as shown in Figure 4.11. Two entrances are located on the St. Thomas Street, one of which is exclusively for hotel and residences (1), the other one is for restaurants (2). Another entrance is viewing gallery on 'The Cloudscape' level 68, and retail services access point from Joiner Street, on the intersection with St Thomas Street (3). Another entrance is from the piazza for the offices that is closed for public use (4). Finally there is a set of escalators that are located in the middle of the piazza to the building (5), however at the time of the observation only the exit side of the escalators was in use. Also, another escalator going under to the station is located at the other side of the piazza (next to London Bridge Street) but has not opened yet.

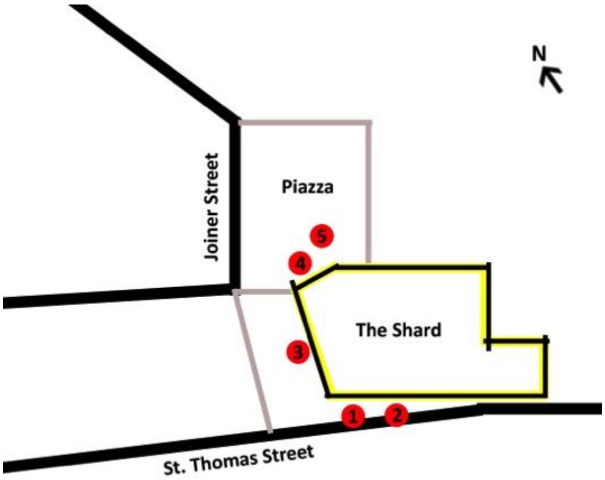


Figure 4.11. Illustrated plan of the entrances (Drawn by Author) **Figure is not scaled*

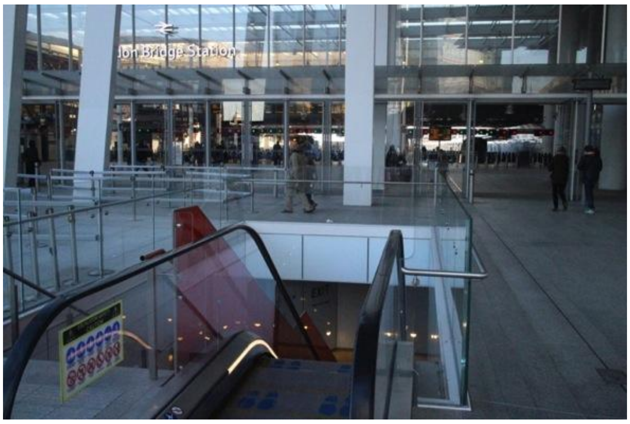


Figure 4.12. Escalator access from The Shard to the Piazza level (Archived by Author)

As the building intersects with the station, people are able to see the feet of the columns and upper floors through the transparent façade of the station and the building. Also, the entrance floor design of the building is in a harmony with the public both physically and socially. The building is always intersecting with its outside areas; the colonnade and transparent façade design of the building gives the sense of continuity between the inside and outside of the building.

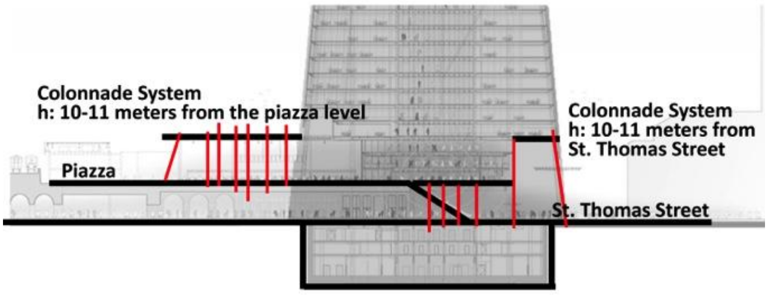


Figure 4.13. Colonnade design on the levels of; Piazza and St. Thomas Street (Adapted and Re-drawn; www.rpbw.com) **Figure is not scaled*

As shown in Figure 4.13, the height of the columns is different on both sides, due to the difference in street level height. The columns on the piazza level piazza level, are approximately 10-11 meters high, and determine the station and building entrance's appearance. Similarly on the side of St. Thomas Street, the columns are higher; approximately 18-20 meters from the ground level, again highlighting the building entrance floor. Moreover, people are able to see the building from every perspective (outside piazza, inside of the station, streets and etc.).

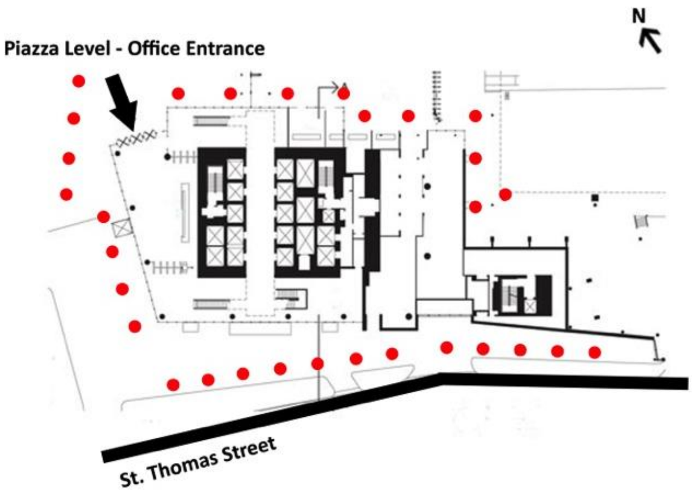


Figure 4.14. Exterior colonnade design plan of The Shard (Adapted and Re-drawn; www.designalmic.com) **Figure is not scaled*

As in Figure 4.14, the colonnade design continues along from St Thomas Street side and to the piazza level. The relation of the building with the environment is strengthened by this architectural form of design of columns. The columns create the sense of an artificial wall; although they are spaces apart by air they still give the feeling of providing shelter. They create semi-open spaces acting as a buffer zone or transition space.

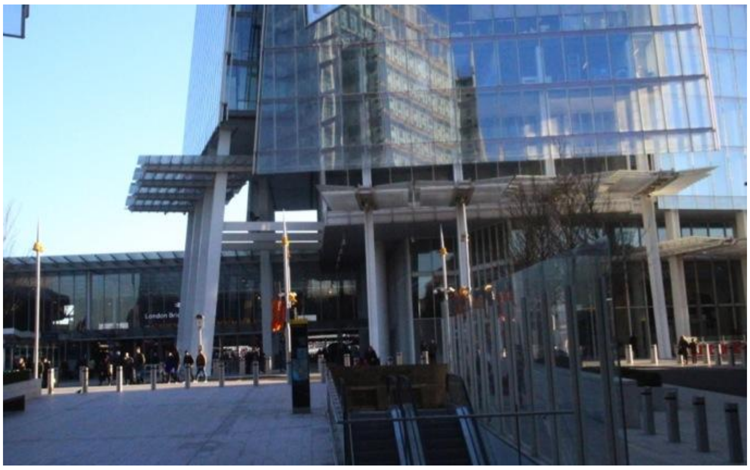


Figure 4.15. Exterior colonnade design of The Shard - entrance floors (Archived by Author)

As mentioned earlier, the inside of the first 4 floors can be seen from St. Thomas Street (transparent façade material). . Even though it is not possible to see the upper floors of the building and internal functions are isolated, the building creates an intersection between the outside and inside area. It is still possible to feel a transparency about the whole building, even when viewin from the ground floor.

Vertical Design Observations: The Shard building has 72 floors. At first 0-3 levels the reception, public and entrance parts; at 4-28 levels the offices; at 29-33 levels the bars and restaurants (not opened at the time of observation), at 34-52 levels the famous ‘Shangri-La hotel’ (not opened at the time of observation), at 53-65 residences and 68-72nd floors the viewing gallery is located. Furthermore, the levels of 75 to 95 are the spire.

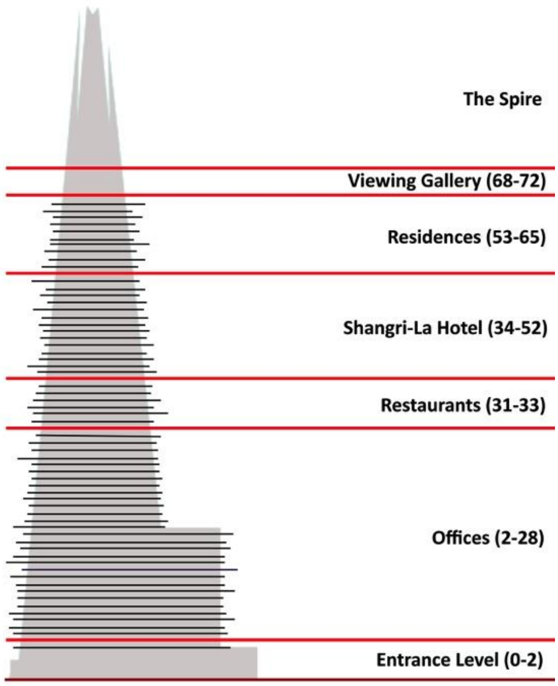


Figure 4.16. Floor functions (Drawn by Author) **Figure is not scaled*

The highest floor accessible to the users with elevator is the 68th floor, and further to the 72nd floor with additional stairs. Also, there are two elevators working separately from each other; the first elevator travels from the 1st floor, to the 33rd floor, the second elevator travels form the 33rd floor to the 68th floor, followed by the stair cases in order to reach the viewing gallery on floors 69th-72nd floors.

It was learnt that The Shard has winter gardens through the inner vertical space of office floors for natural ventilation. These gardens are located between the gaps of floors and they are designed as atriums which combine minimum two floors together. However these gardens were not observed first hand, as they are prohibited areas to the public.

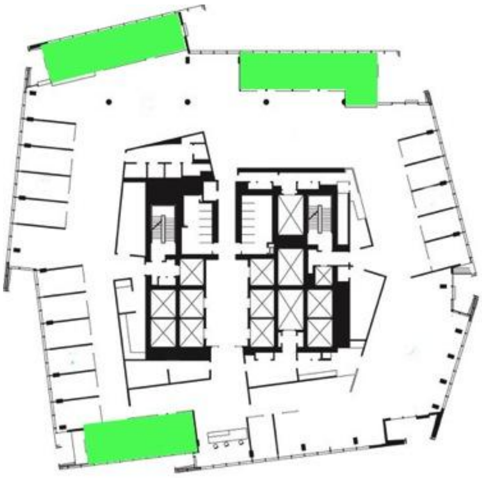


Figure 4.17. Office floor plan and the winter gardens (Adapted and Re-drawn; www.designalmic.com) **Figure is not scaled*

Urban Microclimate Observations: Due to the transparent appearance and usage of white glass on its windows, The Shard causes people to not perceive it as a solid element as it does not block the sunlight. However of course it does still block some sunlight and casts a large shadow on the piazza, inflicting cold weather to by-passers. The building also creates air turbines and strong wind flows that can be felt on the Piazza level. The wind effect is very noticeable. Wind corridors make people feel the effects of wind circulation around the building.

The building changes the area's micro climatic conditions due to sun and wind effects. The surrounding built environment of The Shard is consisted of low-rise buildings, so these microclimate effects are created by The Shard building. For example, there is no other tall building that can block the sun. It has been observed that micro climatic conditions originate from the western side (the piazza) of the building.

Site Analysis Regarding 'Social Integration' Observations: It has been observed that there is a highly efficient usage of the surrounding public spaces. The Shard arranges several social activity places within the site. The building is directly connected with the St Thomas Street life and with the piazza square at the upper level. The building is designed with a connection to neighboring social places (café’s, shops, restaurants, transportation stations and etc.). It can be seen that not only does The Shard not create an obstacle to people’s daily routines, but also that the development and use of public spaces provided by The Shard’s construction help enhance their usage. Furthermore, through discussion with onsite survey participants, it was generally believed The Shard efficiently and positively affected their daily routines via their enhanced accessibility to the public transportation system. They also generally mentioned that the London Bridge Quarter creates a pleasant platform to spend time for social activities together with friends or family, some of whom may have travelled from long distances due to the availability of the public transportation systems. It was observed that, the café’s or restaurants highly utilized and crowded in most of the hours of the day. The contribution to the transportation network is really essential system for keeping this site live; the area will always have the potential of being socially sustainable.

It was notices that there were no ‘empty’ or ‘unoccupied’ urban places around the building (other than planned open public spaces). There are many functional and social places around the building’s entrances creating a continuous activity circle around the building. As the different functions inside the building have been separated with different entrances, it is possible to notice the function differentiation within the building reflects itself to the urban environment. Furthermore, The Shard building is a multi-functional building that serves to both public and private needs, with effective social separation using, floor separation, and function orientated entrances and vertical transportation.

It is important to note that a large area of the London Bridge Quarter area was closed at the time of the site analysis. The west side of the building that was under construction had a barrier with temporary artificial walls and warning signs. The construction barriers on the site had been organized in a manner that did not obstruct pedestrian flow, particularly towards the River Thames and the transportation station locations.

Figure 4.18. Construction site and precautions (Archived and Drawn by Author)

Case Study Building 2: 30 St Mary Axe (Gherkin)

Height: 180 meters (40 stories)
Function: Office
Location: Financial District/Bank Area
Opening date: 2004
Architect: Norman Foster
Client: Swiss-Re
Sustainable Approach: London's first ecological tall building with; heating systems, air conditioning systems, energy efficient lighting systems and light sources, ventilation systems with reducing energy consumption and carbon dioxide emissions, controlling systems for mechanical issues and management.

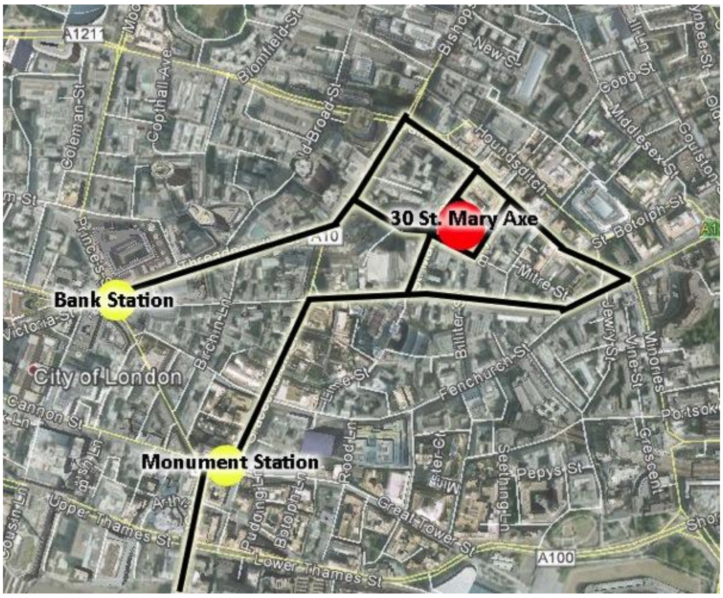


Figure 4.19. Observation map for 30 St Mary Axe (Drawn by Author)

The site analysis for 30 St Mary Axe was conducted with regards to the key sustainability concepts;

Site Selection Observations: 30 St Mary Axe is located at the center of the 'Bank' financial district. It is clear from observation that the main driver for locating the building in its site was due to functional requirements, as the 30 St Mary Axe is a commercial building. Due to its centralized location, the building is only 5-10 minute walking distance away from the Bank, Monument, Fenchurch Street, Cannon Street and Liverpool Street subway stations. There are several restaurants, shopping centers and hotels located again within a 10 minute walking distance to the building. The building is constructed very close to its neighboring buildings in different heights and functions; low-rise, high-rise and historical buildings. On the west side of the building there is St. Mary Axe Street, on the east side there is Bury Street; on the North and South sides both there are pedestrian ways and parking garage entrances.

Within the area there were not much open areas observed. An area open to the public called as the 'Plaza' is located at the ground level and surrounds the entire circular shaped building. The Plaza contains three restaurant-bars takes place within this Plaza where they are the part of the building (located at the entrance floor). As there are not many open areas in the existing neighborhood area, 30 St Mary Axe has created one of its own, the Plaza.

Figure 4.20. The Plaza (Source: www.30stmaryaxe.com)

Near the 30 St Mary Axe, there are historical buildings such as churches, monuments and several buildings that can be shown in Figure 4.21. As, The Wren Monument (built in 1671-1677), is very important when considering location of the 30 St Mary Axe because of its historical importance. Mansion House (built in1939-1952) is another important historical building that is located to the South West side of 30 St Mary Axe. Additionally, The Bank of England (built in 1694) is another historical point that can be found near the site.

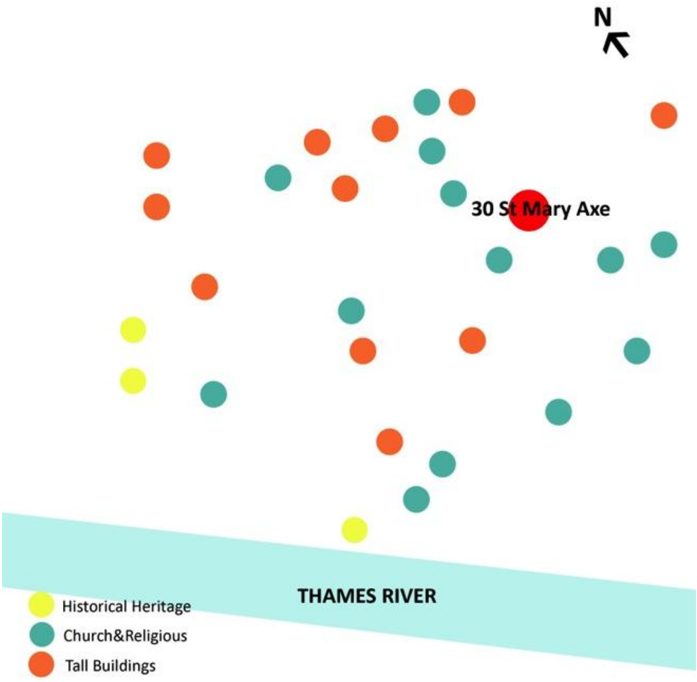


Figure 4.21. Illustration of surrounding buildings and places near 30 St Mary Axe (Drawn by Author)

It was observed that, the physical appearances of tall structures at the surrounding area, that there was a lot of contrast in building era, in that modern and historic buildings are diffused together. Furthermore, while designing 30 St Mary Axe, Foster & Partners believed that the construction of this modern building will strengthen the skyline within completing the cluster of tall buildings shown in Figure 4.22.

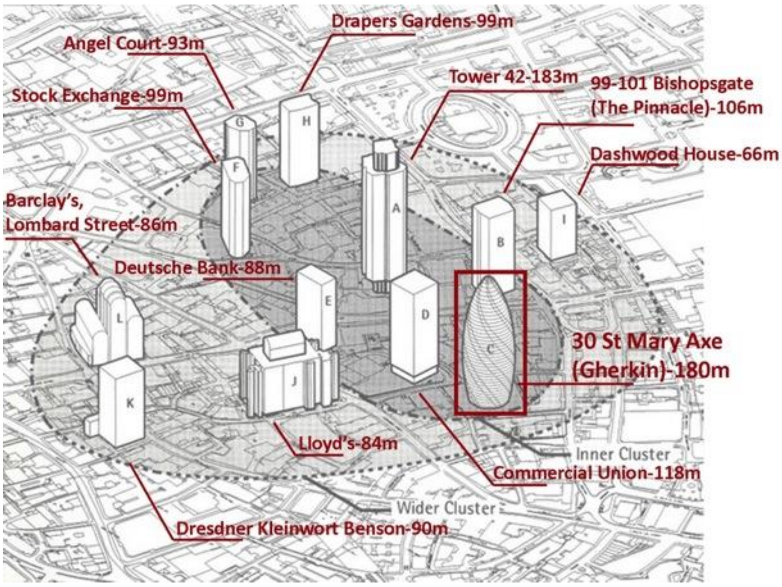


Figure 4.22. Consolidation of the city cluster of high buildings (Adapted and Re-drawn; www.archdaily.com, Record Set Presentation, Foster + Partners, 1998)

The completion dates of the shown buildings in Figure 4.22 above, are mostly at 1960's and 1980's (i.e. Lloyd's/ 1986, Drapers Gardens/ 1960, 99-101 Bishopsgate/ 1976 and etc.). Moreover, there are other tall buildings surrounding 30 St Mary Axe as, Leadenhall Building (225m), The Pinnacle (288m), Heron Tower (230m), The Walkie-Talkie Building (160m), and Petticoat Tower (82m). Whereas the existing buildings that are directly located nearby 30 St Mary Axe, are not so tall. Also, two church buildings (historical) are located very closely, one of which is located directly on St Mary Axe Street, and the other directly on the West (front) side as shown in Figure 4.24 below. It can be said that, although there is a balance in height within the zone of 30 St Mary Axe building, very close buildings are still lower and 30 St Mary Axe directly gets the focus by means of height and shape.

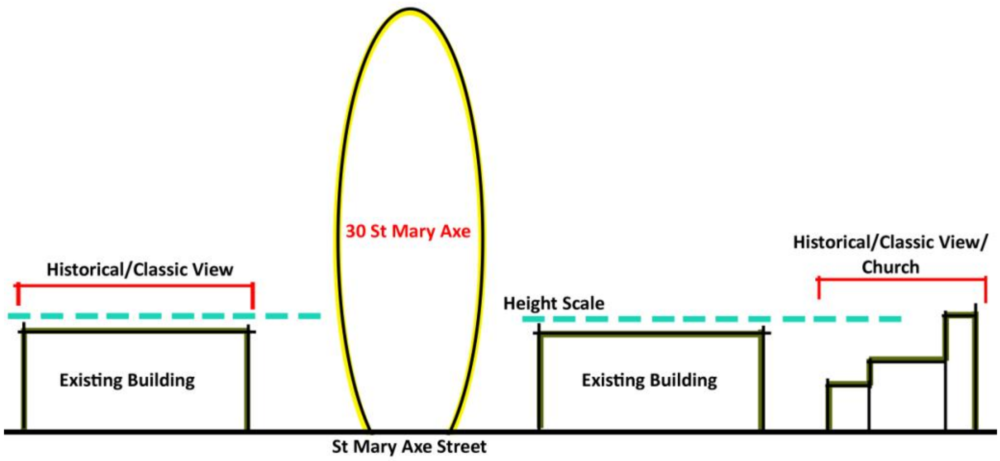


Figure 4.23. Height consideration of 30 St Mary Axe relative to surrounding buildings; a view from St Mary Axe Street (Drawn by Author) **Figure is not scaled*

Figure 4.24. Height consideration of 30 St Mary Axe relative to surrounding buildings; a view from Bury Street (Drawn by Author) **Figure is not scaled*

Site Organization Observations: It was observed that 30 St Mary Axe building stands alone by its architectural configuration; the building has only been designed together with the plaza around its entrance floor. The building and Plaza's perimeter was surrounded with short walls, as shown in Figure 4.25, that define the site but do not prevent access to it (maximum height approximately, 1.50m). The outer side of these walls is not included to the project area; the inner side is the plaza including a wide open space with sitting benches and restaurant-bar's open places. The plaza is wide enough to for people to rest, meet, and have something to eat, etc… However, the open Plaza area is not always used for social reasons by people, due to the specific business function of 30 St Mary Axe and its surrounding buildings (offices).

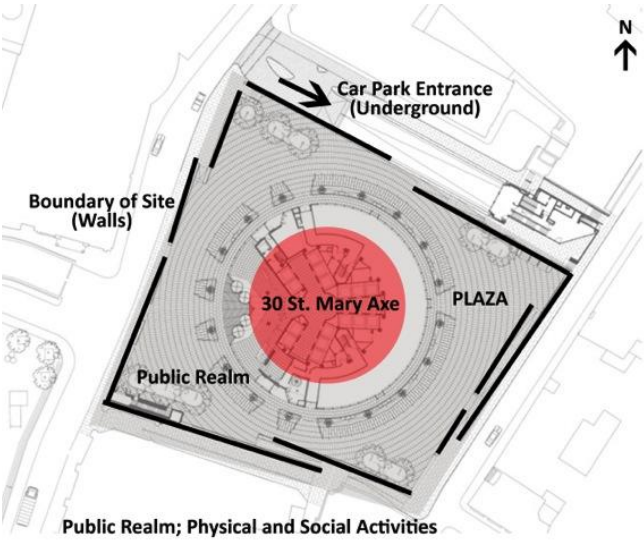


Figure 4.25. 30 St Mary Axe project area (Adapted and Re-drawn; www.fosterandpartners.com) **Figure is not scaled*

The building has only one car parking entrance under the ground from North. As there is a single basement that is used as a car parking area for users of the building, not for public parking; public transportation is supported.

If you visit the area during working hours, it is possible to see lots of people in the Plaza within their daily routine. However during after work hours, such as end of shift, weekends or holidays, the building and the general site area is scarcely populated, and few visiting people (mostly tourists) can be seen.

Figure 4.26. Plaza after work hours (Archived by Author)

Transportation Observations: The building is within 5-10 minutes of walking distance of key underground subway and over ground railway stations; Monument, Bank, Liverpool Street, Fenchurch, Cannon Street, Aldgate, Tower Hill, Monument, Bank, Liverpool street, Cannon Street, Frenchurch. The building is on the North side of River Thames and it is not much close to the river and its facilities.

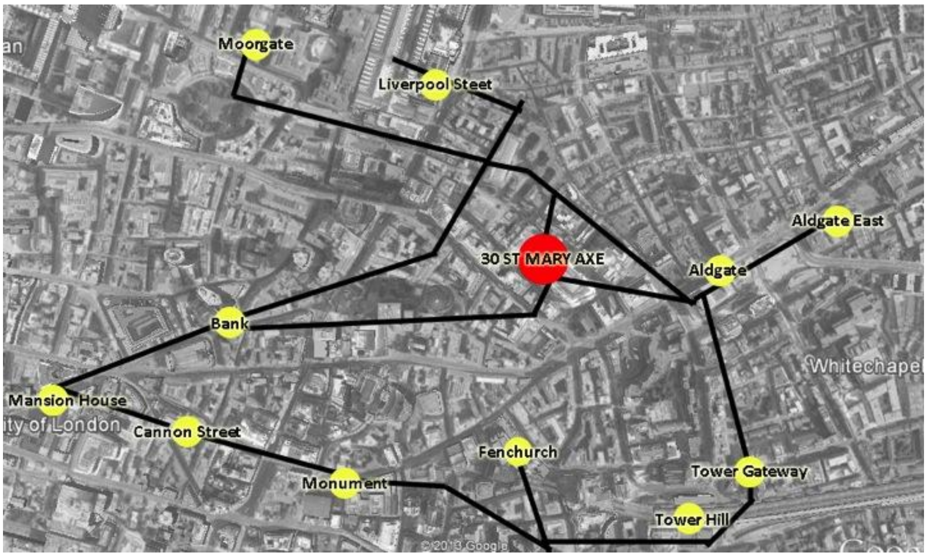


Figure 4.27. Underground transportation stations (Drawn by Author)

According to site observations, 30 St Mary Axe does not have a concept design strategy to change the surrounding area as a whole, it instead is designed to make use of already existing facilities without influencing them; for example, transportation systems.

Besides transportation systems, there are narrow open areas that are used only by pedestrians near 30 St Mary Axe; for example, the outside area of St. Helen's Church. These types of pedestrian areas directly transit pedestrians through the site. The surrounding roads do not carry much traffic, and pedestrians mostly use them (believed to be due to London's existing complex underground subway system). As mainly pedestrian used roads surround the building, the Plaza appears to have been designed to integrate the existing roads with it.

Urban Skyline Observations: Due to its contemporary design and extraordinary architectural shape, the 30 St Mary Axe's positive or negative impact on London's urban skyline has always been under discussion. The building is designed as an elliptical structure that makes it equally viewable 360° from London. Furthermore the round building provides a 360° view of London, particularly from the panoramic view restaurant. From an observer's perspective, the building appears much taller than 180 m height and much wider in diameter.

Figure 4.28. The view from the top floor of the Gherkin towards the Tower, Tower Bridge and the Armadillo (Source: http://herrylaw.blogspot.com.tr/2010/03/gherkin.html)

Heron Tower, Broadgate Tower are visible from the North side; BT Tower on Northwest; the Olympic Park Avenue, and Westfield Stratford area (wooded) on the Northeast; Greenwich Park, Battersea Power Station and Old Royal Naval College on the Southwest; Tower of London and Tower Bridge on the Southeast the new One New Change complex, City Tower, Bank of England, Angel Court and No 1 Poultry building on the West; the Canary Wharf area on the East; Monument, and finally on the South side; The Shard, and maybe the most important one the meandering River Thames located.

30 St Mary Axe has a very distinctive appearance in the urban silhouette, as it is a tall building with a contemporary design, in a location with many historical structures.

Figure 4.29. Skyline view - photograph taken from The Shard (Archived by Author)

Façade Design Observations: With its extraordinary shape and façade design, 30 St Mary Axe has a very different position in the district. The building's façade has a circular architectural shape featuring upwards-spiraling façade segments around the entire building. A double-wall system is used where the outer façade is made of double-glazed glass wall, with single-glazed wall with a sun-screen in the inner façade. The windows are triangular shaped where these triangles can obviously be perceived from inside and outside of the building. According to the researches, this shape has been used for including ventilation flaps within the triangular façade for hot air to leave the building.

Figure 4.30. Triangular form of the windows (Source: www.fosterandpartners.com)

Figure 4.31. The color and triangular forms of 30 St Mary Axe (Archived by Author)

Designers of the building have developed several systems to satisfy sustainability issues; one of them is about the façade design which serves as a natural ventilation within the building. As there are opening panels on the façade, the building provides fresh air; thus reducing its dependency on air conditioning systems. On the other hand, the glass façade also provides natural lighting within the building with its transparency.

The same façade design continues along from the ground floor through the top of the building. The dome of the building is also consisted of dark colored double glazed glasses with triangular units. The triangular shaped windows are settled on the envelope of the building on the entrance floor where triangular columns are also constructed on the ground. This transparent design provides a visual integration between the inside and outside of the building.

Figure 4.32. Façade design on entrance level (Archived by Author)

Entrance Floor Observations: The building has 4 entrances on the ground floor which, as shown in Figure 4.33. The main entrance (1) facing pedestrian Plaza on St. Mary Axe Street, for its users. Inside the entrance floor there is a wide opening lobby and reception. The other 3 entrances are for the restaurants; The Sterling Wine Bar (2), Bridges Newsagents (3), and Konditor and Cook (4).

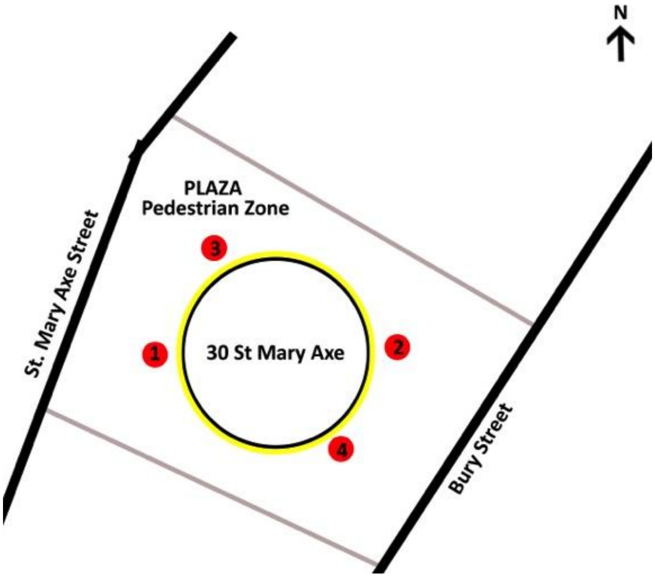


Figure 4.33. Illustrated plan of the entrances (Drawn by Author) **Figure is not scaled*

The architectural design of 30 St Mary Axe is very solid on the ground floor. Only on the side of the main entrance, triangular columns are based on the ground for emphasizing the building entrance. It has been observed that this creates and introverted design that is not inviting people.

Figure 4.34. Triangular column design above the main entrance (Source: www.30stmaryaxe.com)

The 30 St Mary Axe has no base building, and is a singular structure, which rises directly from the ground, that grows in diameter until mid-height and then contracts. Thus, all of the entrances are provided from a single circular plaza from the same level. The pedestrian entrances from the Plaza can be found on all sides of the building, as shown in Figure 4.35.

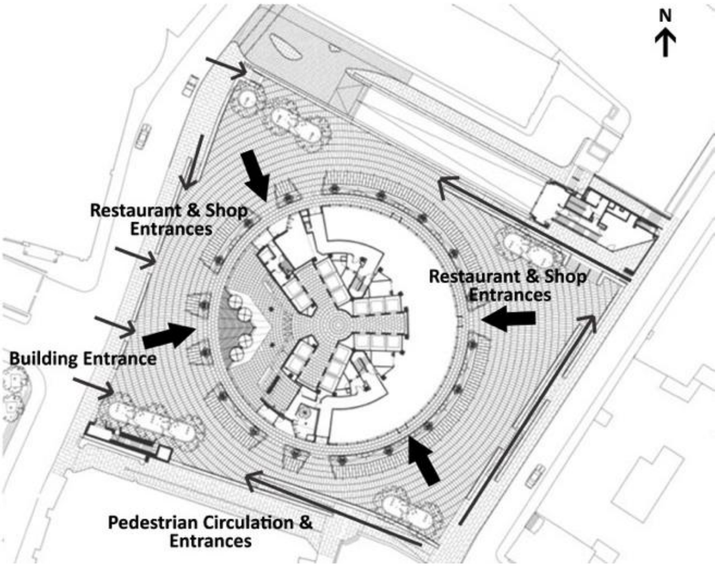


Figure 4.35. Entrance level: Plaza and the environmental relation (Adapted and Re-drawn; www.fosterandpartners.com) **Figure is not scaled*

The only sense of continuity between the inside and outside areas comes along with the use of glass windows on the façade which does not change till the top of the building in visual. It is able to see through into the first few floors from the plaza or near streets. Also as mentioned earlier, the site area is well defined with the use of landscape-urban elements such as walls, sitting benches and some art works that the plaza gains more a rich appearance physically. These design strategies can add a positive element to provide the connectivity between the building and social life outside.

Vertical Design Observations: The building has 40 floors. The first 16 floors are occupied by Swiss Re Insurance Company. Floors 17-37, are used for other commercial purposes with several different company offices. On floors 38-39 there are hospitality services and private dining rooms for guests. At the top of the building (39-40th floor) there is a 360° restaurant named Searcy's, serving for users and guests are able to enter. The building has 18 elevators that serve only to 34th floor, after which 2 shuttle lifts operate up to the 39th floor, where the restaurant is. Further, there is a separated elevator that is used for going under the basement (car parking) level.

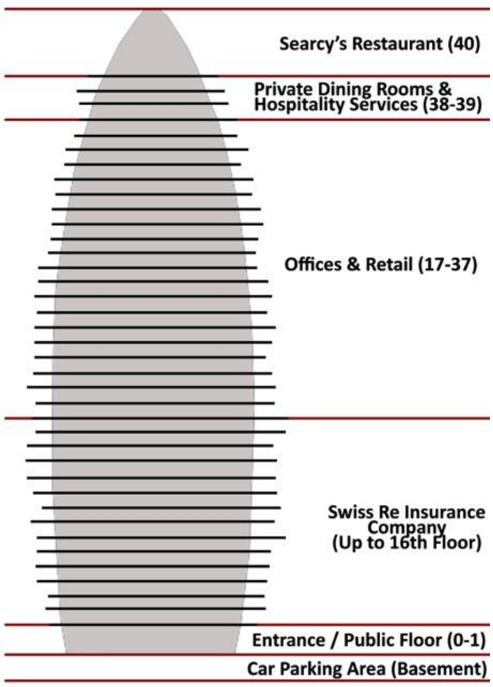


Figure 4.36. Floor functions (Drawn by Author) **Figure is not scaled*

Due to its elliptical cross-section, floor size varies depending varies along the vertical axis. The widest and largest floor is along the middle of the building at the 17th floor. Having a smaller diameter at the ground level provides more space for the plaza. The largest floors are reserved for offices spaces. Finally the building design takes advantage of the very narrow top floors to provide a 360^{o} view for the restaurants and catering levels.

Furthermore, there is a visual continuity in vertical circulation with the usage of a spiral form. Every floor is 5° clockwise to the floor below, as shown

Figure 4.37 and Figure 4.38. As one views the edge railings on each floor gaps, this creates a turning perspective, and visual vertical continuity.

Figure 4.37. Visibility of spiral floors (Source: www.archinomy.com)

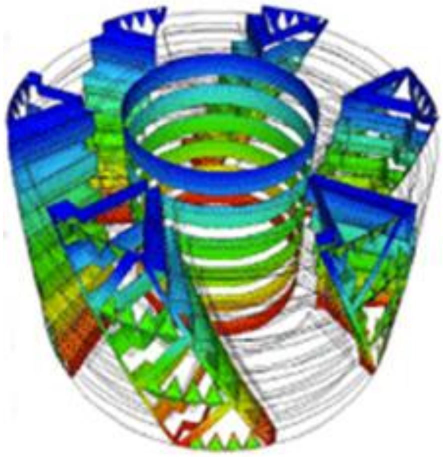


Figure 4.38. Spiral floors (Source: www.chapmanbdsp.com/our-work/commercial/30-st-marys-axe.html#.U4s5QZSSwbY)

The turning floor gaps provide natural ventilation and sunlight access is provided through the building. Also, there are six petals (gaps) on each floor (as shown in Figures 4.39 and 4.40) that maximizes daylight usage within the building.

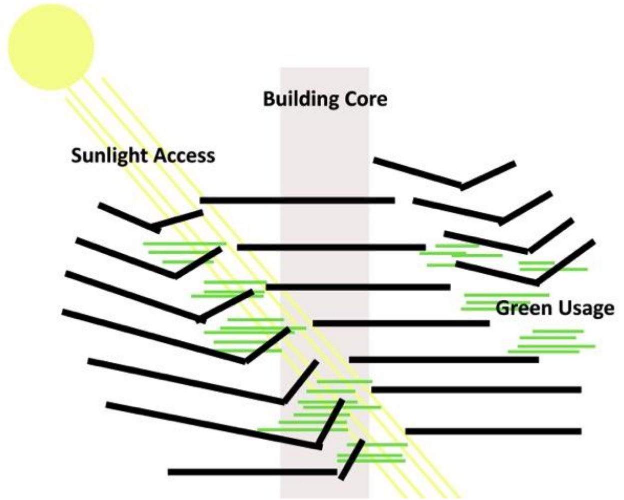


Figure 4.39. Sunlight Access through the building (Adapted and Re-drawn: www.fosterandpartners.com)

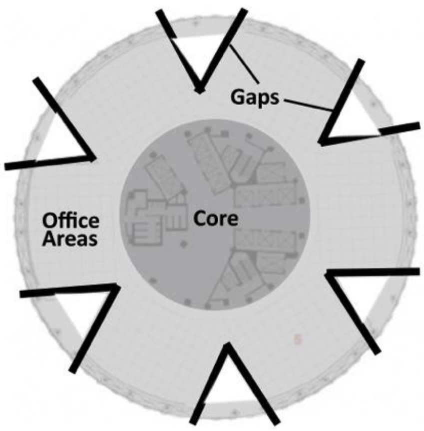


Figure 4.40. Office floor plan and 6 Gaps between the floors (Adapted and Re-drawn: www.fosterandpartners.com)

Urban Microclimate Observations: Besides architectural strategies, 30 St Mary Axe has been designed in a cylindrical to soften the wind movement around the building. According to site observations, this is certainly considered with a sustainable approach such as natural ventilation usage through inside of the building.

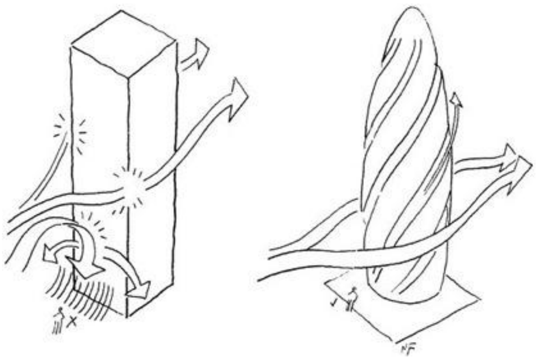


Figure 4.41. Wind effect diagram for 30 St Mary Axe (Source: www.fosterandpartners.com)

30 St Mary Axe's aerodynamic design helps to minimize turbulence of wind on its exit path from the building. If the building had a more conventional rectangular shape then more wind turbulence would be created, thus creating more discomfort for pedestrians. However, as 30 St Mary Axe is already located in an area densely populated by tall buildings, the wind turbulence generated by buildings in the district in general already have a difficult to cure Moreover, the site area directly gets the sunlight on the plaza from the Bury Street side. The side of the plaza where the main entrance of the building is (west) gets directly the sunlight access too. After sunset, the area gets quickly darker and cold because of the surrounding buildings that give the sense of enclosure.

Site Analysis Regarding 'Social Integration': It has been observed that there are no public spaces that are used by people except the Plaza. The circular Plaza surrounds 30 St Mary Axe, but this public area is not frequently used except during working hours. Being an office building in a commercial district does affect this situation. Some cafés, restaurants and shops are located around (on St Mary Axe Street and Bury Street) but they are often used in rush hours or lunch breaks. 30 St Mary Axe does not have an effective contribution on the social life of the district as there is no physical relation of the building with the public life except the circular Plaza on the ground level. It has been observed that this condition creates a disconnection between the building and the urban environment as social sustainability requirements arise from the supplied needs of physical requirements of an area or building. However, it should be noted that the buildings function does not necessarily require it to need to provide any more open space than that of the Plaza used already.

An entrance floor provides an opportunity to create a connection between a tall building and the urban environment. This connection is an intersection surface that supports social sustainability. If we examine the entrances of the 30 St Mary Axe with this in mind, 3 of the buildings entrances are used for cafe and restaurant entrances, and can also be used by the public. According to thoughts of people who live in London, places near 30 St Mary Axe or its café's at the entrance level, are not attractive areas to spend social time. So it can be said that, although it has several entrances created or café's located within the plaza, city dwellers do not prefer using them. Only there are tourists who visit 30 St Mary Axe and they may prefer to sit within these café's.

Furthermore, 30 St Mary Axe does not have a transportation system which neither contributes nor improves the city transportation systems. However it makes use of already existing nearby public transportation stations, that can be found at a walking distance (5-10 minutes). This makes the location of the building get slightly more desolated as there are no common meeting points around the building. On the other hand, the pedestrian access to the site is very easy and comfortable enough to walk. Subway or bus stations are close enough to encourage people visiting 30 St Mary Axe. Also, 30 St Mary Axe is an office building and the proximity of the stations or other transportation places is very important. It can be said that employees do not have difficulty in getting to their work in time.

4.1.2 Survey Results

Surveys include demographic data (sex, age and years living in London) given in Figure 4.42.

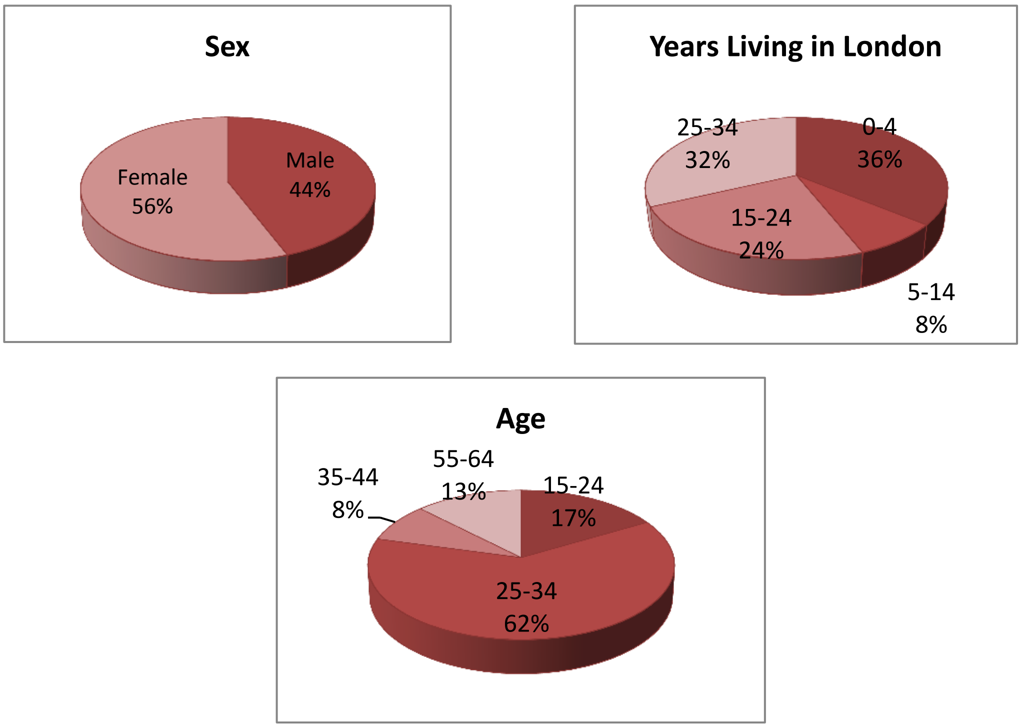


Figure 4.42. Demographic information of survey participants

The survey results are conducted with 25 contributors for The Shard building and 15 contributors for 30 St Mary Axe building. 25 data sets were taken for The Shard and 15 data sets were taken for the 30 St Mary Axe. During survey questioning, excess data sets were taken for The Shard as the 30 St Mary Axe is a more secured and non-residence based building. Further, higher entries of datasets for The Shard via online survey platform may infer that The Shard has been more successful in creating general awareness or that has been more accessible to inhabitants of the city due to location and/or site design.

In any case the analysis of the datasets have been averaged, hence difference in size of data set has not affected the qualitative outcome of the survey. Also, analysis of individual data entries from the survey questionnaires shows a strong correlation of opinions from the entrants. The data was collected into one table for each case building (Table 4.1 and Table 4.2). The data in the tables were separated into the survey correspondent's demographics in order to determine a better trend in the results. The mean and standard deviation average for both all questions were calculated in order to provide a number for general comparison and measure of the variance of opinions, respectively.

Table 4.1. The Shard - survey results

The Shard	Sex				Age										Years living in London							
	Female		Male		15-24		25-34		35-44		45-54		55-64		0-4		5-14		15-24		25-34	
	AVG	STDEV	AVG	STDEV	AVG	STDEV	AVG	STDEV	AVG	STDEV	AVG	STDEV	AVG	STDEV	AVG	STDEV	AVG	STDEV	AVG	STDEV	AVG	STDEV
Site Selection																						
Q1: Location of the building is a correct decision	3.71	1.14	4.27	0.79	4.50	1.00	4.13	0.83	4.00	0.00	1.00	*	3.33	0.58	4.22	0.67	3.00	0.00	4.50	0.84	3.50	1.31
Q2: Suitability of the buildings visual impact to the historical heritage	3.29	1.07	3.91	0.30	3.75	0.50	3.67	0.82	4.00	0.00	1.00	*	3.33	0.58	3.78	0.67	3.00	1.41	3.67	0.52	3.38	1.19
Site Organization																						
Q3: Integration of the building with its neighborhood's existing open areas	3.29	0.99	3.55	1.04	3.50	1.29	3.53	0.92	4.00	0.00	1.00	*	3.00	0.00	3.56	0.73	3.50	0.71	3.50	1.22	3.13	1.25
Q4: Suitability of open areas for the people's physical and social activity requirements	3.08	1.46	3.00	0.77	3.25	0.96	3.40	0.83	2.00	0.00	1.00	*	2.00	1.53	3.44	1.01	3.00	1.41	2.67	0.52	2.86	1.60
Transportation																						
Q5: Accessibility to the London's transportation network	4.43	0.76	4.73	0.65	5.00	0.00	4.60	0.74	5.00	0.00	4.00	*	3.67	0.58	4.78	0.67	3.50	0.71	4.83	0.41	4.38	0.74
Q6: Effect of the building on Public Transport accessibility	3.38	1.35	3.64	1.29	4.00	1.41	3.71	1.36	2.50	2.12	3.00	*	2.67	0.58	3.50	1.76	3.50	0.71	3.67	1.37	3.38	0.92
Urban Skyline																						
Q7: Potential of being a powerful landmark for London	3.86	1.29	4.27	1.01	4.25	1.50	4.27	0.80	5.00	0.00	4.00	*	2.00	1.00	4.22	1.09	4.00	1.41	4.50	0.84	3.50	1.41
Q8: Contribution towards "Improving" the Urban Skyline	3.79	1.48	3.91	0.83	4.25	1.50	4.13	0.64	4.50	0.71	1.00	*	2.33	1.53	4.11	0.93	4.00	1.41	4.33	0.52	3.13	1.64
Q9: Effect of the building on the "Historical" Urban Skyline	2.92	1.49	3.73	1.01	4.00	0.00	3.43	1.37	4.50	0.71	1.00	*	1.67	0.58	3.63	1.64	3.50	0.71	3.67	1.03	2.63	1.41
Q10: Visual effect of the building's height on surrounding built environment	3.43	1.22	4.09	1.04	4.50	1.00	3.80	0.77	5.00	0.00	1.00	*	2.33	1.15	4.33	1.12	4.00	0.00	3.67	0.82	3.00	1.31
Q11: Visual effect of the building's shape on surrounding built environment	3.50	1.22	4.27	0.65	4.50	0.58	4.07	0.70	4.50	0.71	1.00	*	2.33	0.58	4.22	0.83	3.50	0.71	4.00	1.10	3.38	1.30
Façade Design																						
Q12: Harmony of building's facade with those of the surrounding buildings	3.00	1.37	3.82	0.75	4.50	0.58	3.57	1.11	3.00	0.00	1.00	*	2.00	1.00	3.44	0.73	3.00	2.12	3.67	1.03	3.13	1.46
Q13: Importance of a buildings façade for it aesthetic "looks" rather than a solution for energy efficiency	3.62	1.45	3.73	0.79	4.00	0.82	3.67	0.82	4.50	0.71	1.00	*	3.50	2.08	3.67	0.87	4.00	0.00	3.50	0.84	3.71	1.83
Entrance Floor																						
Q14: Design of the ground floor providing a sense continuance (from outside to inside) for pedestrians.	3.82	1.71	3.60	1.42	4.25	0.96	3.62	1.46	3.50	0.71	3.00	*	4.00	2.31	3.63	1.48	3.50	0.71	4.00	2.16	3.71	1.49
Q15: Design and locations of building entrances/exits for pedestrians.	3.45	1.59	3.70	1.36	4.00	0.82	3.46	1.36	3.00	1.41	4.00	*	4.00	2.31	3.63	1.56	3.50	0.71	3.50	1.86	3.57	1.36
Urban Microclimate																						
Q16: Effect of building's micro climate conditions (wind, shadow, reflections, etc...) your comfort when passing by?	2.00	1.45	2.27	1.42	3.00	1.83	1.79	1.23	2.50	0.71	4.00	4.00	1.00	0.58	2.75	1.74	1.50	0.71	2.20	1.47	1.57	1.19

* - Standard deviation of this data set cannot be calculated as only one data set fits this particular criteria

Table 4.2. 30 St Mary Axe - survey results

30 St Mary Axe (Gherkin)	Sex				Age										Years living in London							
	Female		Male		15-24		25-34		35-44		45-54		55-64		0-4		5-14		15-24		25-34	
	AVG	STDEV	AVG	STDEV	AVG	STDEV	AVG	STDEV	AVG	STDEV	AVG	STDEV	AVG	STDEV	AVG	STDEV	AVG	STDEV	AVG	STDEV	AVG	STDEV
Site Selection																						
Q1: Location of the building is a correct decision	3.44	1.93	3.33	1.83	3.00	1.50	3.60	1.88	*	0.00	3.00	*	3.00	1.73	3.67	1.99	3.50	0.71	3.50	1.86	3.17	1.77
Q2: Suitability of the buildings visual impact to the historical heritage	2.67	1.68	2.83	1.57	2.00	1.00	3.00	1.65	*	0.00	1.00	*	2.67	1.53	2.33	1.30	4.00	0.00	2.50	1.37	2.67	1.69
Site Organization																						
Q3: Integration of the building with its neighborhood's existing open areas	2.88	1.69	2.83	1.63	2.00	1.00	3.10	1.67	*	0.00	2.00	*	2.50	2.08	2.33	1.20	3.50	0.71	2.67	1.63	3.00	1.75
Q4: Suitability of open areas for the people's physical and social activity requirements	2.63	1.61	2.67	1.57	2.00	1.00	2.80	1.64	*	0.00	3.00	*	2.00	1.53	2.00	1.12	4.00	0.00	2.00	1.26	2.83	1.55
Transportation																						
Q5: Accessibility to the London's transportation network	3.44	1.85	3.33	1.83	3.00	1.50	3.20	1.68	*	0.00	5.00	*	3.67	0.58	2.67	1.36	3.00	0.00	3.25	1.83	4.00	1.93
Q6: Effect of the building on Public Transport accessibility	2.56	1.45	2.83	1.69	2.00	1.00	2.80	1.60	*	0.00	3.00	*	2.33	1.15	2.33	1.30	3.00	0.00	2.50	1.63	2.83	1.55
Urban Skyline																						
Q7: Potential of being a powerful landmark for London	3.33	2.03	3.50	1.87	3.00	1.50	3.80	1.96	*	0.00	1.00	*	3.00	1.73	3.67	1.92	4.00	1.41	3.50	1.86	3.00	1.91
Q8: Contribution towards "Improving" the Urban Skyline	3.13	1.97	3.17	1.90	3.00	1.50	3.50	1.99	*	0.00	1.00	*	2.50	2.08	3.67	1.92	4.00	1.41	3.00	2.07	2.67	1.69
Q9: Effect of the building on the "Historical" Urban Skyline	2.89	1.75	2.67	1.63	2.00	1.00	3.10	1.75	*	0.00	1.00	*	2.67	1.53	3.00	1.58	3.50	0.71	2.50	1.63	2.67	1.77
Q10: Visual effect of the building's height on surrounding built environment	3.22	1.90	3.50	1.87	3.00	1.50	3.70	1.92	*	0.00	2.00	*	2.67	1.53	4.00	2.06	4.00	1.41	3.25	1.72	2.83	1.64
Q11: Visual effect of the building's shape on surrounding built environment	3.00	1.86	3.50	1.97	3.00	1.50	3.70	1.96	*	0.00	1.00	*	2.33	1.53	3.67	1.86	4.00	1.41	3.00	1.90	2.83	1.81
Façade Design																						
Q12: Harmony of building's facade with those of the surrounding buildings	3.00	1.86	3.50	1.87	3.00	1.50	3.80	1.92	*	0.00	1.00	*	2.00	1.00	4.00	2.06	3.50	0.71	3.00	1.67	2.83	1.81
Q13: Importance of a buildings façade for it aesthetic "looks" rather than a solution for energy efficiency	2.57	1.59	3.50	1.87	3.00	1.50	3.40	1.75	*	0.00	1.00	*	1.00	0.58	3.00	1.58	3.50	0.71	3.33	1.86	2.60	1.77
Entrance Floor																						
Q14: Design of the ground floor providing a sense continuance (from outside to inside) for pedestrians.	2.86	1.60	3.17	1.74	3.00	1.50	3.00	1.65	*	0.00	3.00	*	3.00	1.73	3.00	1.73	3.00	0.00	2.67	1.51	3.20	1.69
Q15: Design and locations of building entrances/exits for pedestrians.	3.00	1.69	3.00	1.75	3.00	1.50	2.90	1.67	*	0.00	4.00	*	3.00	1.00	3.00	1.73	3.00	0.00	2.25	1.38	3.50	1.69
Urban Microclimate																						
Q16: Effect of building's micro climate conditions (wind, shadow, reflections, etc...) your comfort when passing by?	2.00	1.51	1.17	0.67	1.00	0.50	1.30	0.83	*	0.00	1.00	*	4.00	2.52	1.67	1.01	1.00	0.00	1.75	1.17	1.80	1.64

* - Standard deviation of this data set cannot be calculated as only one data set fits this particular criteria

The Shard: According to the survey results the general opinions for this building by demographic are given as;

If we look at The Shard results data in relation to the Sex demographic: Amongst males, ‘Urban Skyline’ and ‘Transportation’ key concepts were most scored equally the highest opinion rating and ‘Urban Microclimate’ was least favored. The females also favored ‘Transportation’ for The Shard and again least favored ‘Urban Microclimate’. In general there was a lot of similarity between the answers of males and females. Variation in opinions between males and females separated more for design related questions 9-12, for which males had slightly higher opinions.

If we look at The Shard results data in relation to the Age demographic: All ages groups had high opinions for ‘Transportation’ key concept in The Shard, particularly ‘35-44’ and ’15-24, age groups who scored a maximum 5 rating for ‘Transportation’. ‘Urban Skyline’ also appears to have been very highly favored amongst all age groups. As with the Sex demographic “Urban Microclimate’ scored the lowest opinion ratings, both individually and altogether. Although there is not enough data to make a full analysis on the impact of age on the impression of The Shard’s key concept, the younger ’15-24’ age group generally had the highest opinions of the key concepts, and although all age group scored relatively similar results, the highest age group ’55-64’ had slightly lower opinions for design related questions 7-12 (ignoring age group ’45-54’as only one participant for this age group was found for The Shard).

If we look at The Shard results data in relation to the Years Living in London demographic: Generally all participants had the highest opinions ratings for the ‘Urban Skyline’ and ‘Transportation’ key concept. Again these group participants also have almost the same positive opinion on the ‘Site Selection’ key concept. The other positive opinion is for the ‘Entrance Floor’ which ’15-

24' years group had gave. Yet, again all age groups found the 'Urban Microclimatic' conditions least effective.

30 St Mary Axe: According to the survey results the general opinions for this building by demographic are given as

If we look at 30 St Mary Axe results data in relation to the Sex demographic: Amongst females, 'Urban Skyline' key concepts were most scored almost equally the highest opinion rating and 'Urban Microclimate' was least favored. The males similarly favored 'Urban Skyline' and least favored 'Urban Microclimate' for 30 St Mary Axe, they also scored highly for 'Façade Design'. In general there was a lot of similarity between the answers of males and females. Variation in opinions between males and females separated more for design related questions 11-13, for which males had slightly higher opinions.

If we look at 30 St Mary Axe results data in relation to the Age demographic: All ages groups had high opinions for 'Sight Selection' and 'Transportation' key concepts. All age groups appeared to score similar results, apart from the '25-34' age group that generally scored higher for all questions apart from question 4. Perhaps because age group '25-34' is the financial districts target demographic age group. As with the Sex demographic "Urban Microclimate' scored the lowest opinion ratings for all age groups, except the correspondents aged '55-64'.

If we look at 30 St Mary Axe results data in relation to the Years Living in London demographic: Generally all participants had the high opinions throughout all question apart from 'Urban Microclimate' that scored low. The people living in London '5-14' generally had the highest opinions for all apart from the 'Transportation' key concept, this group particularly had a high opinion of 'Urban Skyline'.

4.2 Discussions

Within the discussions, the site analysis results of The Shard and 30 St Mary Axe buildings are compared with each other via tables. Following, the survey results of these two case study buildings also are compared by graphs including opinion ratings for all contributors and a basic average and variance comparison. The environmental impacts of the two selected tall buildings are pointed out with a general frame.

4.2.1 Comparison of Observational Site Analysis Results of 'The Shard' and '30 St Mary Axe'

A table has been drawn for every key sustainability concepts (Site Selection, Site Organization, Transportation, Urban Skyline, Façade Design, Entrance Floor, Vertical Design and Urban Microclimate) separately depending on the considerations and analysis made on site. In order to achieve a full observation of each key sustainability concept a set of criteria (as shown in the in the observation checklist column of Table 4.3.) for each key concept were selected. The comparisons are expressed with a scoring scheme from 1 (poor) to 5 (excellent) points expressed with dots; 1 (poor), 2 (below average), 3 (average), 4 (good), 5 (excellent).

Table 4.3. Site selection; the site analysis comparison of The Shard and 30 St Mary Axe

Site Selection

Observation Checklist	The Shard	30 St Mary Axe
Existence of public places within or near the site (restaurants, cafés, shops, urban squares, meeting points, etc…)	●●●●●	●●●
Existence of other tall buildings within the surrounding area	●●	●●●●●
Existence of historical heritage within the surrounding area	●●●●	●●
Accessibility for pedestrians to the area	●●●●●	●●●●
Visual impact of the building on any historical sites or buildings nearby	●●●●●	●●●
The accessibility of the Thames River from the site for people	●●●●●	●●●
Height harmony of the building with the surrounding built environment	●	●●●

Site Selection: The Shard building is located in an area where social and public facilities can be brought in to the site. This case is also supported by strong pedestrian circulation through the site. As long as the River Thames is very near and the access to the river is comfortable enough when compared with 30 St Mary Axe. Both of the two buildings have visual impacts on the surrounding historical buildings. However the neighboring environment of The Shard contains more historic heritage. A height balance can be more observed near 30 St Mary Axe because of the surrounding tall building zone. It can be said that, The Shard is a totally new and modern building by means of height, form and social contributions within the district.

Table 4.4 Site organization; the site analysis comparison of The Shard and 30 St Mary Axe

Site Organization

Observation Checklist	The Shard	30 St Mary Axe
Contribution towards the physical and social facilities	●●●●●	●●
The physical relationship of the building with the existing environment (height/form)	●●●	●●●●●
The existence of pedestrian areas within the site	●●●●●	●●●●●
The proximity of the site to public places	●●●●●	●●
The usability of the public places provided by the site by people	●●●●●	●●●
Existence of car parking areas within the site	—	—
Separated service roads for vehicle entrances	●	●

Site organization: As mentioned before, contributing on both physical and social activities is very important for to achieve sustainability, particularly in this particular key sustainability concept. According to site analysis, The Shard is more successful in contributing and improving the existing needs of the urban environment with its new pedestrian routes, public piazza and different levels which let people to explore the building by using the opportunities of the site. Both buildings do not have car parking areas but 30 St Mary Axe has a separated entrance for car parking area which is located under the ground level. Therefore, it can be said that both buildings are supporting pedestrian circulation as sustainable cities and areas do encourage designers to create pedestrian friendly zones.

Table 4.5 Transportation; the site analysis comparison of The Shard and 30 St Mary Axe

Transportation

Observation Checklist	The Shard	30 St Mary Axe
Transportation facilities provided within the site	●●●●●	—
Accessibility to the underground subway	●●●●●	●●
Approximate walking time to nearest subway station	0-5 mins.	5-10 mins.
Subway stations adjacent to the building	●●●●●	—
Pedestrian accessibility	●●●●●	●●●
Connectivity between pedestrian routes and the open areas around the building	●●●●●	●●●
Usage of the building when accessing nearby public transportation	●●●●	—

Transportation: Improving and contributing to the public transportation system is one of the most important criteria of creating the frame of sustainable design, in this study. It has been analyzed that, The Shard building is efficiently contributing on the public transportation network with the development of the 'London Bridge Station'. Correspondingly, this makes the area more usable for the public and holds the area lively with a social circulation. Both buildings are within a walking distance of underground subway stations. As long as, the pedestrian route connections are much stronger for The Shard project area than 30 St Mary Axe zone; the existence and creation of public places within the site strengthen this situation. Further, The Shard's site selection and multifunctional purpose make it a stronger of a social hub for the people. So, The Shard building area is always used by people and the effect of the existence of London Bridge Station on this case is effective.

Table 4.6. Urban skyline; the site analysis comparison of The Shard and 30 St Mary Axe

Urban Skyline

Observation Checklist	The Shard	30 St Mary Axe
Height of the building	310 m	180 m
Effect of the height/shape on the skyline	●●●●●	●●●●●
Potential of the building being a landmark of London	●●●●●	●●●●●
Existence of viewing galleries or terraces for watching the city skyline	●●●●●	Only for occupants
Power of its visuality in affecting the historical city skyline	●●●●●	●●●●
Existence of any important historical landmarks on the nearby city skyline	●●●●●	●●●
Contribution of the building on the city skyline (view from the top of the building)	●●●●●	●●●●●
Contribution of this building on the city skyline (view from street level)	●●●	●●●

Urban Skyline: the height and the shape of both buildings include architectural and technological challenges. Although The Shard building is significantly higher than 30 St Mary Axe, the urban skyline key concept was equally investigated for both buildings, as they both affect and improved the urban silhouette. The Shard building is located in an area which has a critical viewpoint on historical buildings. For example; The Shard is standing as a potential threat for the St. Paul's Cathedral by its height and shape within the urban skyline for this historical structure. 30 St Mary Axe is not in a location for being a harmful structure on historical urban skyline. Although The Shard's location near historic heritage makes its impact on the urban skyline a more sensitive issue than with 30 St Mary Axe, the observations show that The Shard as succeeded in being a positive potential landmark, despite this arguable disadvantage.

Table 4.7. Façade design; the site analysis comparison of The Shard and 30 St Mary Axe

Façade Design

Observation Checklist	The Shard	30 St Mary Axe
The sense of transparency of the building depending on its material usage	●●●●●	●●
Façade material selection in considering a sustainable approach	●●●●●	●●●●●
Transmission of natural light through the building	●●●●●	●●●●●
Use of transparent material on the façade covering the first floor floors and giving a sense of continuity between the interior and exterior of the building	●●●●	●●●

Façade Design: The most critical point of this key sustainability concept was determined as 'establishing continuity between the inside and outside environment'. The Shard building gives better sense of transparency when compared to 30 St Mary Axe. Also, the transition of the sunlight within the building is more perceptible within The Shard building because of the usage of transparent glass on the envelope. Additionally, the visibility of the first floors from outside makes The Shard be 'in' the city and collaborate with the street life; this situation could not have been observed for 30 St Mary Axe. However, it must be noted that, 30 St Mary axe having been located amongst tall buildings has a disadvantage in its ability to receive natural sunlight, in comparison to The Shard. As the glass used on the skin of The Shard building, gives a better the sense of lightness and reflects light onto its piazza, the physical effects of the building's façade is felt more than with 30 St Mary Axe. Furthermore, The Shard building has a differentiation at the first 4 floors which people are able to see the interior of the building where 30 St Mary Axe do not provide this kind of a transparency and so a relation with the outside area.

Table 4.8. Entrance floor; the site analysis comparison of The Shard and 30 St Mary Axe

Entrance Floor

Observation Checklist	The Shard	30 St Mary Axe
Number of entrances	5	4
Number of entrances for the public	3	3
Sense of connectivity of the building with the outside environment	•••••	••
Height of the base building in comparison with nearby buildings	—	—
Separation of public and service entrances	•••••	•••
Availability of public spaces within the entrance area	•••••	•••
Entrances on different topographical levels	•••••	—
Architectural contribution on the entrance level (usage of columns, bridges and etc...)	•••••	•

Entrance Floor: Both of the buildings do provide separated entrances for different functions. However, The Shard building is directly connected with public facilities at the ground level. Where 30 St Mary Axe has separated doors to enter its social facilities such as restaurants and cafés. The Shard building provides a public circulation with via several functional entrances from different sides (St Thomas Street, Piazza and Joiner Street). During site analysis, this situation has been evaluated as supporting a physical circulation around the building. Correspondingly, the building offers many open areas for people and this is one of the necessities for social sustainability. Another point is that, The Shard building has architectural columns on different levels and this also creates semi open spaces for people where 30 St Mary Axe is a straight building through the sky on a circular plaza.

Table 4.9. Vertical design; the site analysis comparison of The Shard and 30 St Mary Axe

Vertical Design

Observation Checklist	The Shard	30 St Mary Axe
Proportion of floors open to the public	●●●●●	Only for restaurants on entrance floor
Facilities for users to have effective accessibility within the building	●●●●●	●●●●●
Existence of atrium or inner gardens	●●●	●●●
Contribution of landscaped floors and hardens on suitability concerns within the building	●●●●	●●●●
Perceivable green usage within the building and its connection with the outside environment	—	—

Vertical Design: Both of the buildings supply the needs for a vertical transportation system of a tall building in a technical manner. But still, The Shard building provides getting people quicker to higher floors and in a comfortable way. For both of the buildings it can be said that they are designed for creating inner gardens and atriums as breath-taking spaces for sustainability criteria such as accessing the sunlight or natural ventilation. Further, no green connection was observed along the vertical line and connected to the exterior environment or to the entrance level. Both of the buildings stand as; a creation of technical systems far away from a ‘green’ perspective. Additionally, no green areas are observed around the buildings and vertical circulation systems are considered only by their technical solutions.

Table 4.10. Urban microclimate; the site analysis comparison of The Shard and 30 St Mary Axe

Urban Microclimate

Observation Checklist	The Shard	30 St Mary Axe
Sunlight access through the public places around the building	••••	•••
Shadows on the surrounding public places	•••	••••
Strong wind corridor effects within the district	••••	••••
Variation of microclimatic conditions on pedestrians	•••••	•••••

Urban Microclimate: There are noticeable wind transitions within the site of The Shard. The degree and reflection of the sunlight decreases the uncomfortable impact of the wind. 30 St Mary Axe site takes less light through itself because of the lower levels of sunlight due to obstruction from surrounding tall building zone, and because of the use of darker materials on the façade. On the other hand, wind corridor effect is much more perceived at The Shard building site than 30 St Mary Axe; this can be related with the surrounding building heights. As it is expressed before; 30 St Mary Axe has a more compact building zone where the distances between neighbor buildings are narrower. Even though 30 St Mary Axe's circular shape is effective and reduce wind turbulence, it must be noted that the building is exposed to more negative microclimatic conductions to start with as a results of the diffusion of tall buildings in its neighborhood.

4.2.2 Comparison of Survey Results of 'The Shard' and '30 St Mary Axe'

A histogram showing the distribution of results was created for each question, with results for both case study buildings. As the number of correspondents for The Shard and 30 St Mary Axe was not the same, the quantity of particular histograms should not be directly frequency of hits for a certain result. Instead the general distribution of results should be compared. The x-axis of each histogram shows 0-1 options for each survey question, and the y-axis shows the frequency of each choice.

- The mean results graphs enabled a quick relative comparison of generalized opinions for each case, per question.
- The standard deviation provides further understanding into the distribution of these opinions for each case, per question; for example, a low standard deviation signifies more concession between user opinions.

The comparison graphs are given below:

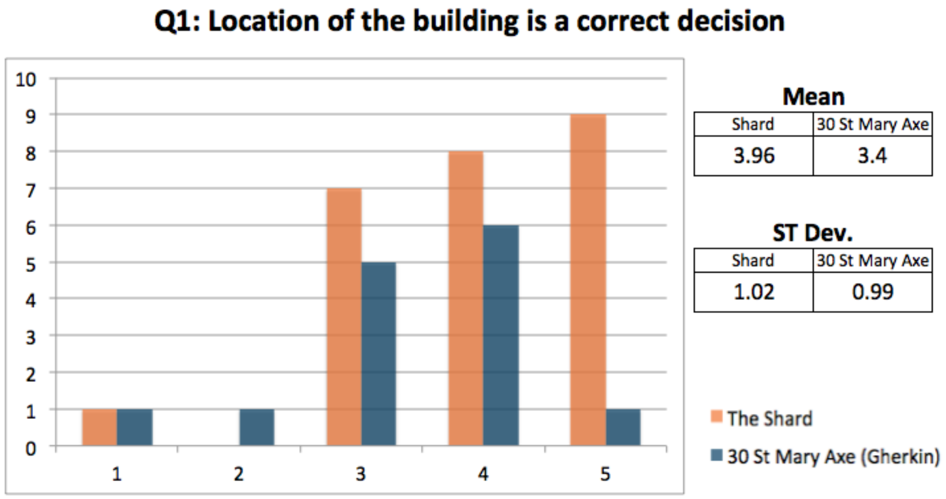


Figure 4.43. The survey result comparison graph of The Shard and 30 St Mary Axe: Site Selection

- People had a higher opinion of the choice of location for The Shard building than 30 St Mary Axe.
- Variation of results amongst survey correspondents was almost identical.
- It can be inferred that finding the suitable location for The Shard building was a much more complex issue than 30 St Mary Axe. This is because The Shard building is a multipurpose concept design project whereas 30 St Mary

Axe is a single financial building that requires being in a financial district. It can be said that not only was The Shard preferred but that more thought and planning had been required to deserve each ranking point.

- Preference of the location of The Shard may have been affected highly due to its proximity to the River Thames and its surrounding activity areas as observed during the analysis.

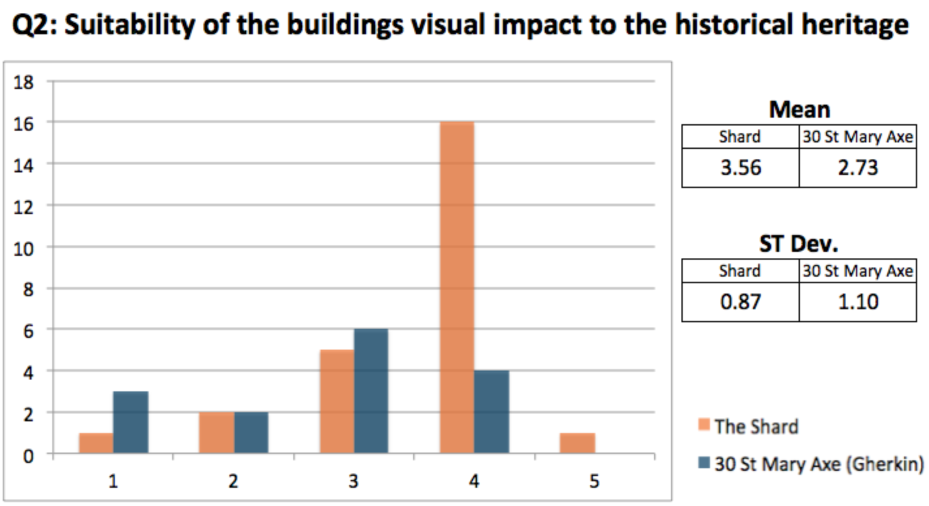


Figure 4.44. The survey result comparison graph of The Shard and 30 St Mary Axe: Site Selection

- Result showed that the survey correspondents greatly preferred the visual impact of the building. Furthermore, Figure 4.44 shows that, survey correspondents were a lot more definite in their beliefs as there was less variation in their answers.
- The importance of the visual impact to the historical heritage of The Shard was a lot more sensitive, being a project in the historical 'Tower Bridge' district. Because of this, during the design phase of The Shard not obstructing the surrounding historical heritage was one of its primary specifications. The preference towards the Shard in the results above could indicate that the design is successful in meeting these criteria.

- Furthermore, some correspondents also believed that the location of the modern building within the historical heritage gave it a complementary contrast.

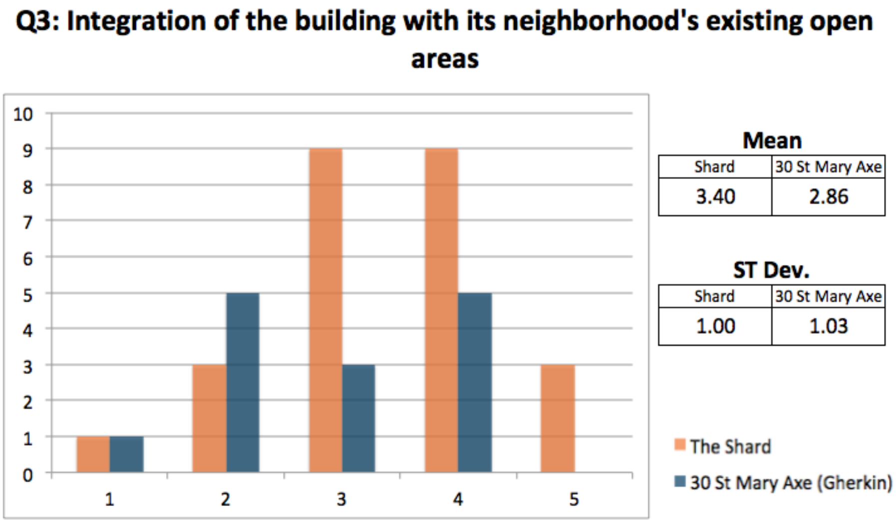


Figure 4.45. The survey result comparison graph of The Shard and 30 St Mary Axe: Site Organization

- People had a greater opinion of the choice of being in a harmony with the surrounding open area system for The Shard building than 30 St Mary Axe.
- Variation of results amongst survey correspondents was almost identical.
- As noticed during the site analysis, The Shard is exposed to more open areas within its neighborhood than 30 St Mary Axe. Related with the survey results, it can be said that The Shard's design has successfully taken advantage of the use of these open areas that people also agreed with this situation.

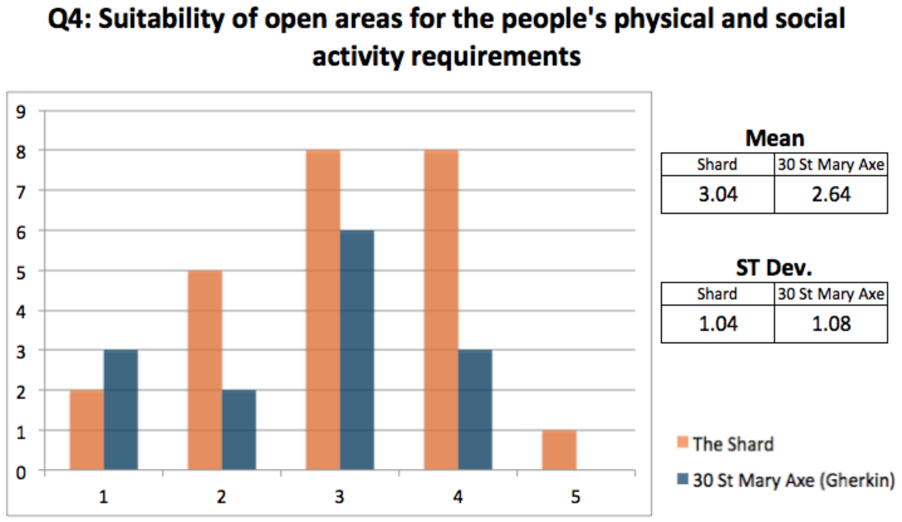


Figure 4.46. The survey result comparison graph of The Shard and 30 St Mary Axe: Site Organization

- People had a slightly greater opinion on providing social and physical places for The Shard building than 30 St Mary Axe.
- This result appears to support the observation during site analysis; people spend more time within the places around The Shard with the purpose of using social facilities than 30 St Mary Axe.
- In addition, the physical and social activity places were still in developing during the time of the survey whereas 30 St Mary Axe social facilities have been established years earlier.

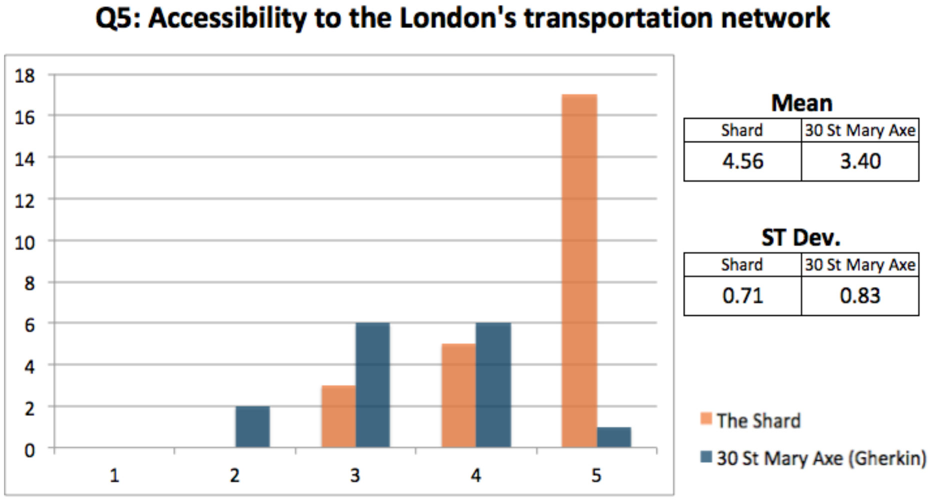


Figure 4.47. The survey result comparison graph of The Shard and 30 St Mary Axe: Transportation

- This criteria is one of the biggest differentiators between the two cases.
- People had a much greater opinion on the accessibility to the transportation network for The Shard building than 30 St Mary Axe.
- Furthermore, as shown in the graph above in Figure 4.47, the survey correspondents were a lot more definite in their beliefs as there was less variation in their answers.
- As observed during the site analysis the location of The Shard building is directly built on the train station and the bus station is located on the piazza, as can be seen in the analysis in Figure 4.5 (*see section "The Results of the Observational Site Analysis"*).

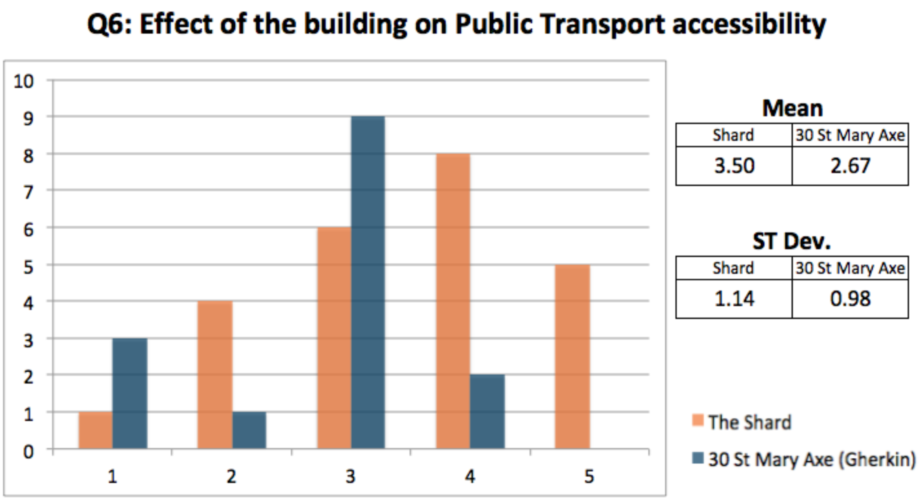


Figure 4. 48. The survey result comparison graph of The Shard and 30 St Mary Axe: Transportation

- People had a slightly greater opinion on providing social and physical places for The Shard building than 30 St Mary Axe.
- The London Bridge Quarter Project includes a central bus station and 'London Bridge' Station. Thus it can be said that The Shard (together with the rest of the London Bridge Quarter Project) is the driving force for the renovation of the areas public transportability infrastructure. In comparison 30 St Mary Axe's design made use of the available public transportation without the aim to significantly improve it. As observed during the site analysis the facilities provided by The Shard building provide the people with both a transportation hub and a point to meet and spend their time.

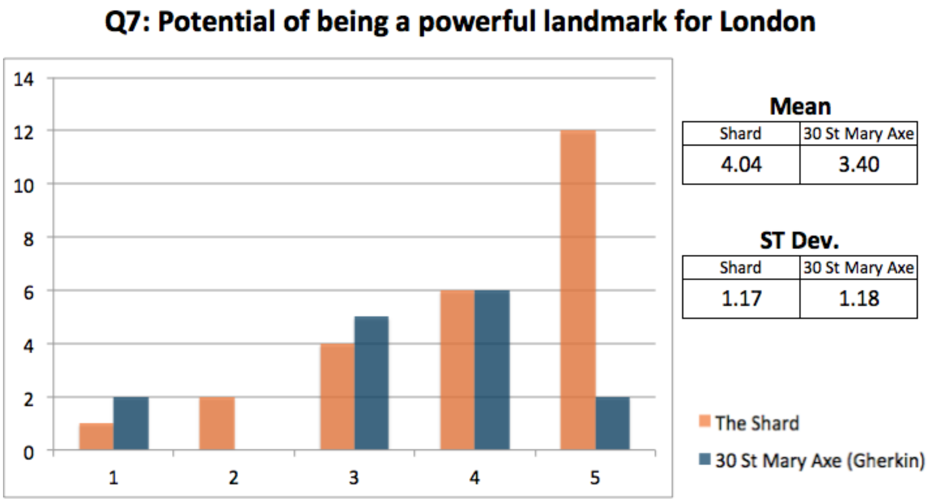


Figure 4.49. The survey result comparison graph of The Shard and 30 St Mary Axe: Urban Skyline

- Variation of results amongst survey correspondents was almost identical.
- Time is a critical factor for a building to become established as an icon. Despite the fact that 30 St Mary Axe was completed far earlier than The Shard, it has succeeded to be more recognized due to its conceptual project design, height and striking architectural ambiance.

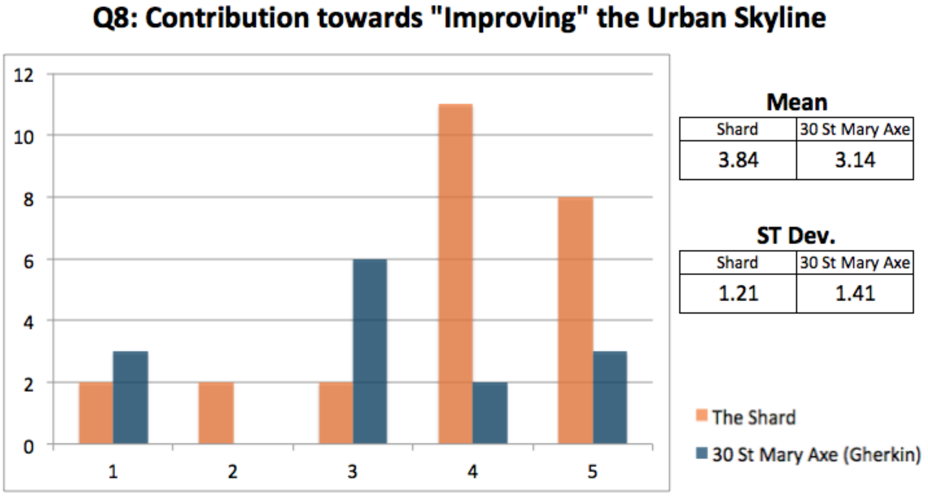


Figure 4.50. The survey result comparison graph of The Shard and 30 St Mary Axe: Urban Skyline

- The survey correspondents had a greater opinion on improving the urban skyline for The Shard building than 30 St Mary Axe with less variance.
- Both case studies are designed to play a major role for being an icon building for London and they have both succeeded in this strategy.

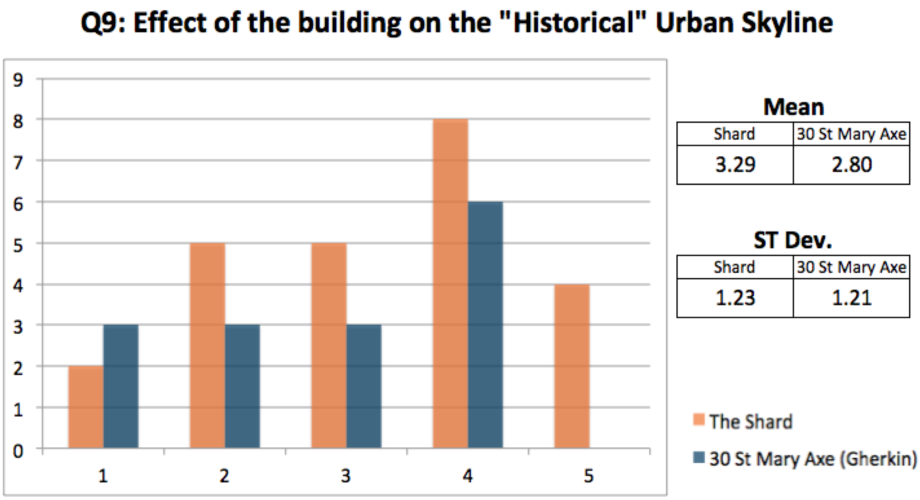
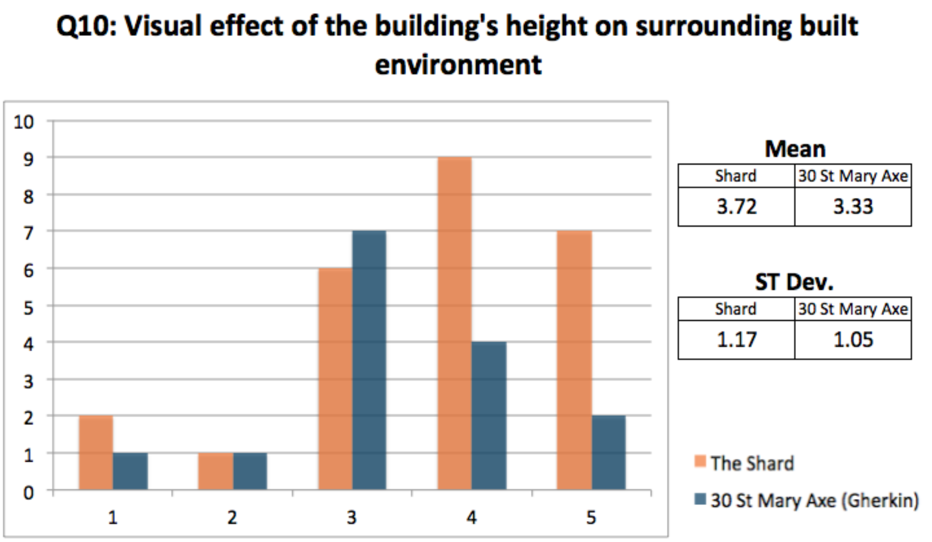


Figure 4.51. The survey result comparison graph of The Shard and 30 St Mary Axe: Urban Skyline

- Variation of results amongst survey correspondents was almost identical.
- Related with the site analysis, both of the cases have a modern design that takes London's historical urban skyline into the future. Many of the correspondents to the survey believed that the contrasting of the modern and historical skyline in fact created a complementary effect.
- Furthermore, as shown in the graph above in Figure 4.51, The Shard building has a stronger effect on the historical skyline. This can be related with the more modern and technologic appearance of the building or other influencers including its preferred iconic status and impact on the urban skyline.



Shard	30 St Mary Axe
3.72	3.33

Shard	30 St Mary Axe
1.17	1.05

Figure 4.52. The survey result comparison graph of The Shard and 30 St Mary Axe: Urban Skyline

- The survey shows very similar results for the visual effect of the height of the building in both cases on their respective surrounding built environment.
- Some of the survey correspondents displayed mixed thoughts on whether the visual impact on the surrounding environment of the significantly taller The Shard building. The greater variance in opinion on the preference of The Shard building's height on the built environment could be due to its more contemporary and distinctive features in regarding height.

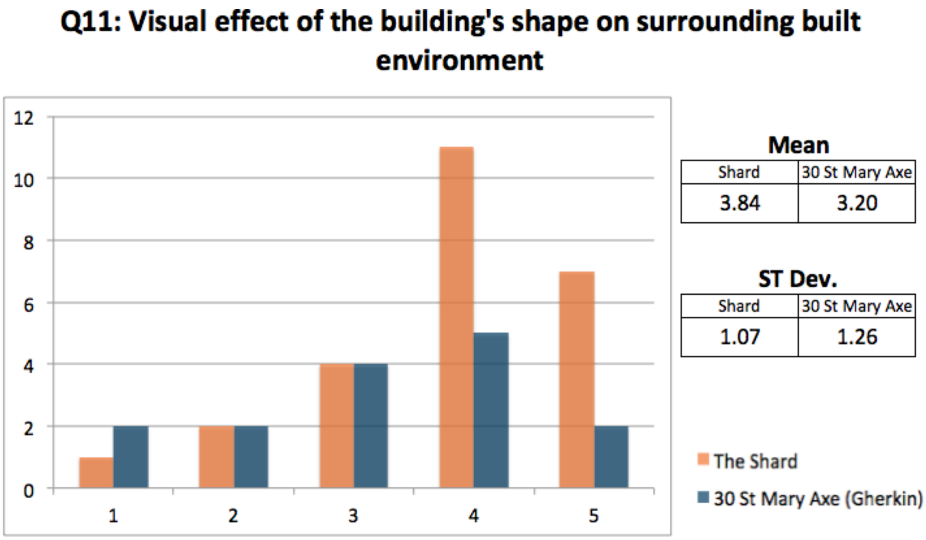


Figure 4.53. The survey result comparison graph of The Shard and 30 St Mary Axe: Urban Skyline

- Results of the survey show that the shape of The Shard has a preferred effect on its surrounding environment than the 30 St Mary Axe.
- As noticed during site analysis, both cases are designed with distinctive and unconventional shape. Furthermore, in both cases the shape of the building is significantly defined by the physical sustainability concerns.

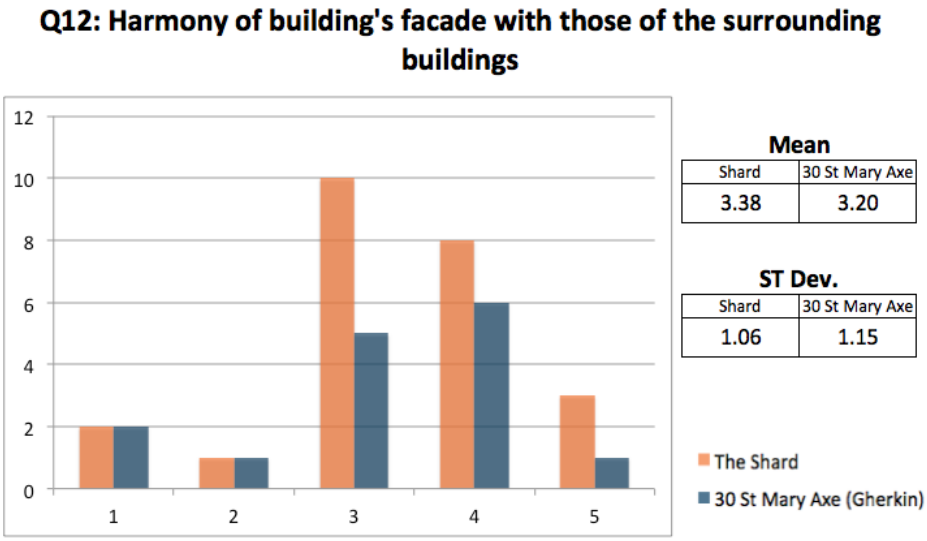


Figure 4.54. The survey result comparison graph of The Shard and 30 St Mary Axe: Façade Design

- Results of the survey showed very similar results for the harmony of each building's facades with their surrounding buildings.
- One would expect that the 30 St Mary Axe has an advantage over The Shard building with regards to façade harmony, as it is located in financial district populated by tall buildings with similar façade material usage. On the other hand The Shard building creates a sharper contrast with its façade design in relation to its surrounding buildings and becomes a positive feature for its visual acceptance.

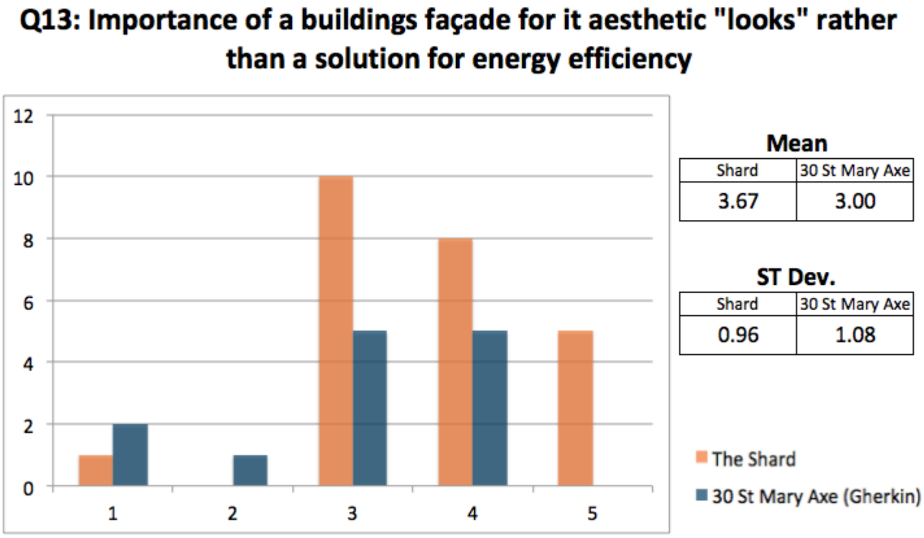


Figure 4.55. The survey result comparison graph of The Shard and 30 St Mary Axe: Façade Design

- Both cases show an inclination that they are designed for aesthetical appeal rather than a mechanical solution for energy efficiency.
- Both buildings were in fact definitely built with a sustainable approach on energy efficiency via façade material usage before aesthetic appeal. Using the form of design this energy solution was shaped to give unique aesthetical properties. Above average results for both cases and the site analysis observations show that the design of each building was successful in not conveying this mechanical design approach.

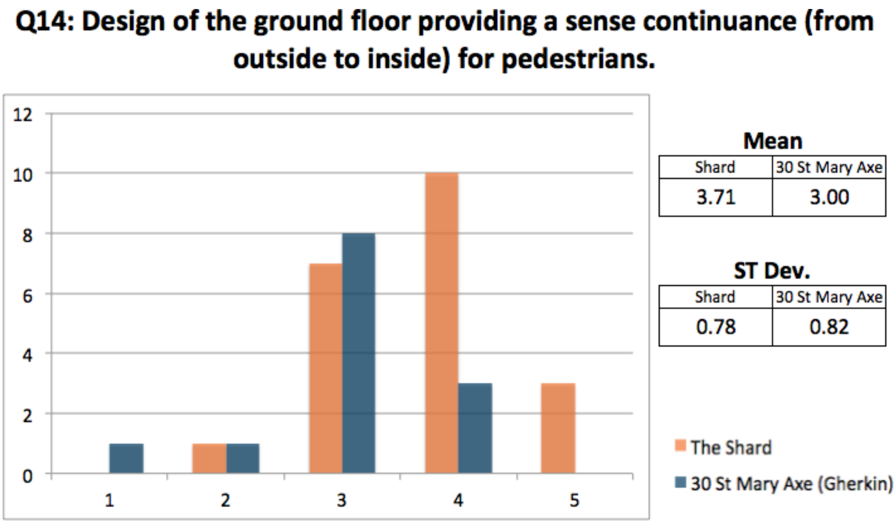


Figure 4. 56. The survey result comparison graph of The Shard and 30 St Mary Axe: Entrance Floor

- Variation of results amongst survey correspondents was almost identical.
- Although variation of results amongst survey correspondents was almost identical, survey correspondents generally preferred The Shard.
- According to site analysis, The Shard building is much more transparent in façade design in whole and on ground floor than 30 St Mary Axe. Probably related with this situation, survey correspondents also agreed on that The Shard building had the sense of continuance.
- Also being a multi-purpose building within the mixed London Bridge Quarter, The Shard designed for a greater pedestrian flow whereas the predominantly business oriented 30 St Mary Axe is designed to admit certain particular selected/invited people.

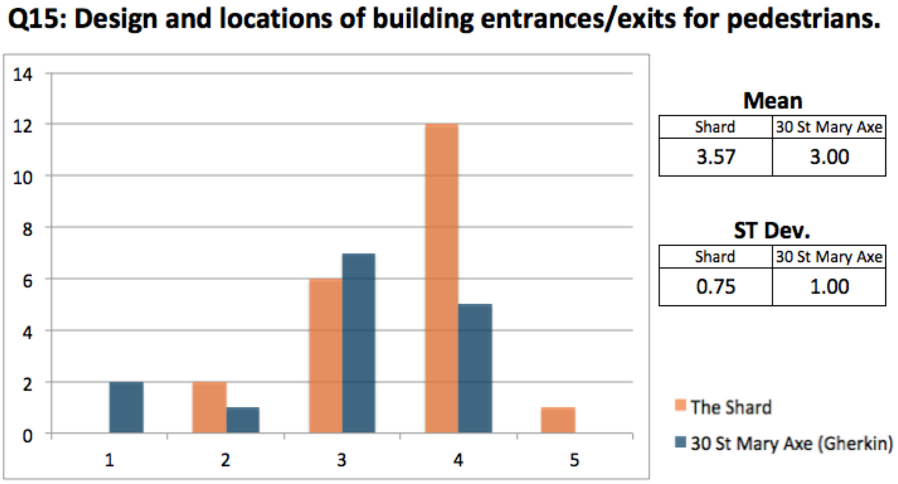


Figure 4.57. The survey result comparison graph of The Shard and 30 St Mary Axe: Entrance Floor

- The results show that survey correspondents generally preferred the location of the entrances/exists of The Shard and, this seems to be agreed by a higher density of values.
- It can be inferred from the results that; as 30 St Mary Axe predominantly designed for a single purpose, the public is prohibited from entering into the building and are only allowed to enter/exit the café's on the ground floor. On the other hand, as observed in the site analysis The Shard building provides a pedestrian flow for both occupants and public users which the building is designed more as a hub.

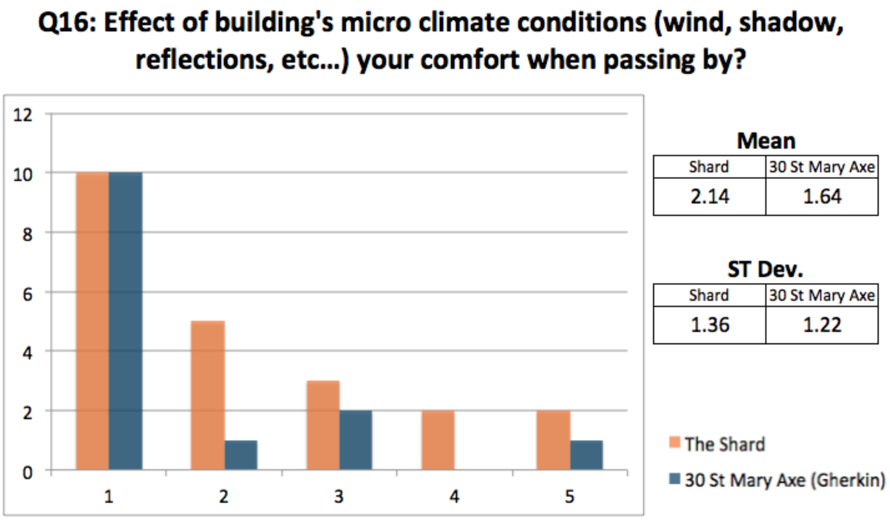


Figure 4.58. The survey result comparison graph of The Shard and 30 St Mary Axe: Urban Microclimate

- The results showed that both buildings had a negative (below average - 2.5) microclimatic comfort to users. The Shard was generally the favored of the two cases.
- The negative microclimatic impact is expected as effects such as wind/shadow/etc. are inherited by products of tall buildings.
- During the survey feedback, survey correspondents mentioned that, as 30 St Mary Axe is located in a district populated by other tall buildings which already cause a shadow the plaza of 30 St Mary Axe, hence they are already acclimatized to the negative effects of tall buildings. The Shard on the other hand, as observed during the site analysis, is a tall building amongst low rise buildings and has a semi-transparent facade material usage which enables transmission of heat/light through the building, which could explain the difference in the results.

CHAPTER 5

CONCLUSION

Buildings are one of the main physical elements of a city. Tall buildings in particular are the most powerful and distinctive players in the city texture. Due to this distinctive impact tall buildings immediately become an important part of the cities texture and therefore we must pay particular attention into issues concerning their integration with the surrounding environment. The key sustainability concepts chosen in this study provide us an empirical observation platform for the evaluation of tall buildings and their urban environment.

In this thesis, two tall buildings have been evaluated by using these key sustainability concepts, through observation/site analysis and survey. This study shows even though both cases are located in central districts of the same city, the case with the more positive implementation of these key sustainability concepts (The Shard building), has a more user friendly and a more attractive integration with environment. The study showed that, key concepts can be implemented on every 'tall building' with different architectural and environmental considerations. With an empirical observation platform which introduces a comparison 'tool', highlighted design strategies in order to define better the negative/positive nature of the impacts of tall buildings.

It is important to maintain an objective and unbiased approach when studying the negative and positive influences of tall buildings on the urban environment. Every tall building could be designed through varied sustainability concepts. Instead perhaps designers should use a platform that evaluates the tall building from an all-around perspective, satisfying the needs of all stakeholders including 'public' users or city dwellers. Furthermore designers should not only concentrate towards physical sustainability considerations, as social integration in living urban complexity is just as (or sometimes even more) important to securing a tall buildings sustainability. Providing the people with suitable interaction facilities can enable the people themselves to unknowingly integrate the tall building into the urban texture. This study enabled users to transform their perception of a building as a 'solid structure' to an active city element. The selected key sustainability concepts within this research study can be implemented through different 'tall buildings' from every part of the world as more key concepts can be developed and used depending on the case building.

As mentioned within this study, tall building construction is increasing rapidly around the world. It is a designer's goal to design the most suitable tall building for its given area. This study can help serve as a tool to help designers achieve this goal. The selected key sustainability concepts within this research study can applied to any 'tall building' from anywhere in the world. The study and application of these key concepts on different cases would no doubt expand the library of key concepts used to evaluate tall buildings and hence make the system even more robust. Turkey is an interesting example of a country with this type of rapid growth in the number of tall building constructions, particularly in cities Ankara and Istanbul. Growing too quickly can sometimes have negative effects, as tall building designs can take on a more mechanistic approach, focusing more on features such as the function in the location rather and focusing on the sustainability approach in this study. Having a ready tool to more easily and efficiently evaluate sustainability can make it easier to integrate sustainability concerns in design projects in an environment of rapid development, such as Turkey. Therefore the empirical observation platform that this study presents could be of much benefit to areas such as Turkey, particularly for the much needed initial site analysis. Perhaps also for countries like Turkey, this platform could also act as a guideline reference for departments within municipalities of each city.

In a world with developing future of social technology that virtually integrates us with each other and our physical surroundings, we will no doubt have to evolve and adapt the way that we integrated the buildings with the urban environment. Furthermore, with rapid development and population growth we face future challenges to maintaining a cultivated social interaction between people to keep the urban environment alive and interconnected. With well-developed suitability design practices tall buildings can doubt play an important role to satisfying both of the needs of this expansion and while strengthening the harmonic urban vitality.

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APPENDIX A

COMPARISON GRAPHS OF AVERAGED RESPONSES IN SURVEY QUESTIONNAIRE

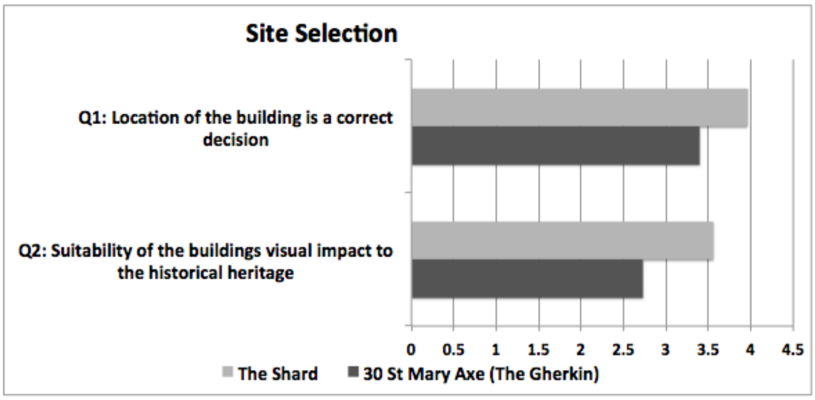

Figure A.1. Survey results for Site Selection

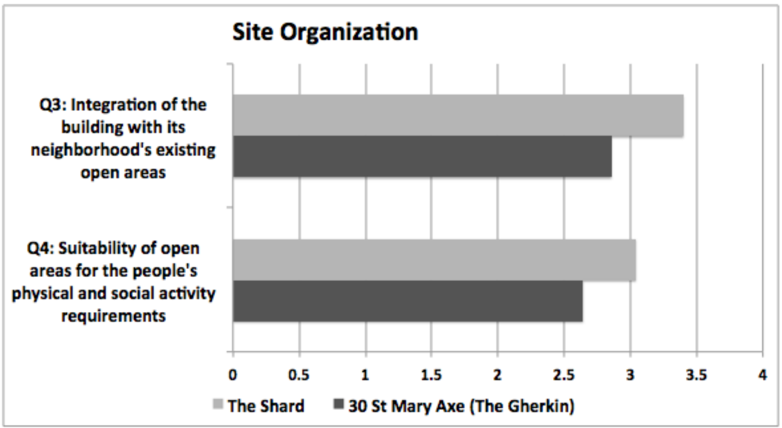

Figure A.2. Survey results for Site Organization

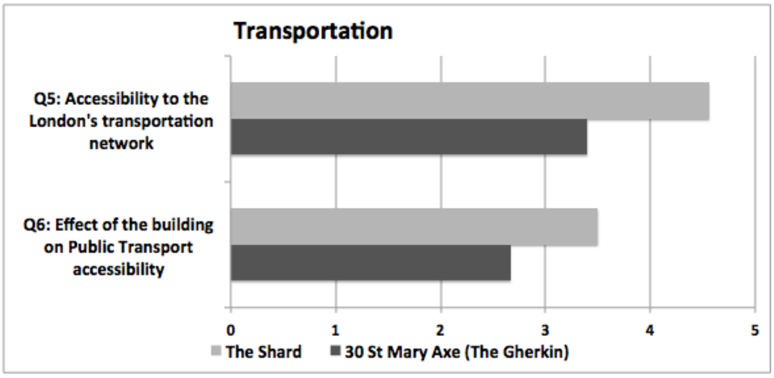

Figure A.3. Survey results for Transportation

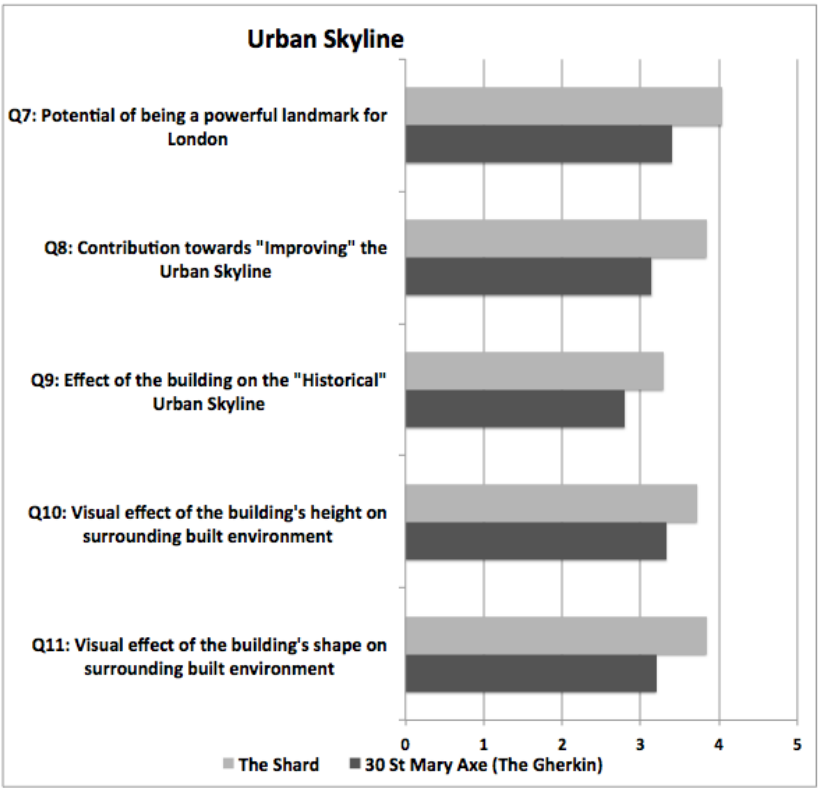

Figure A.4. Survey results for Urban Skyline

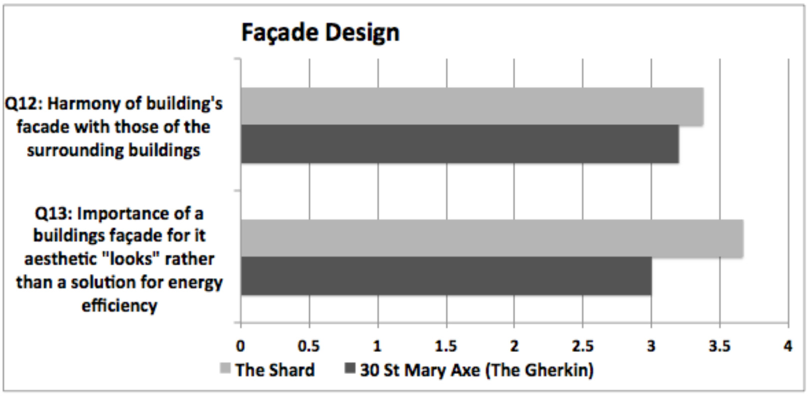

Figure A.5. Survey results for Façade Design

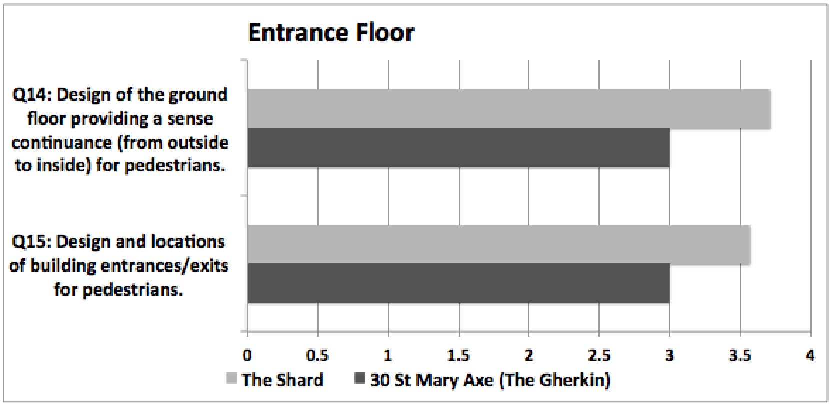

Figure A.6. Survey results for Entrance Floor

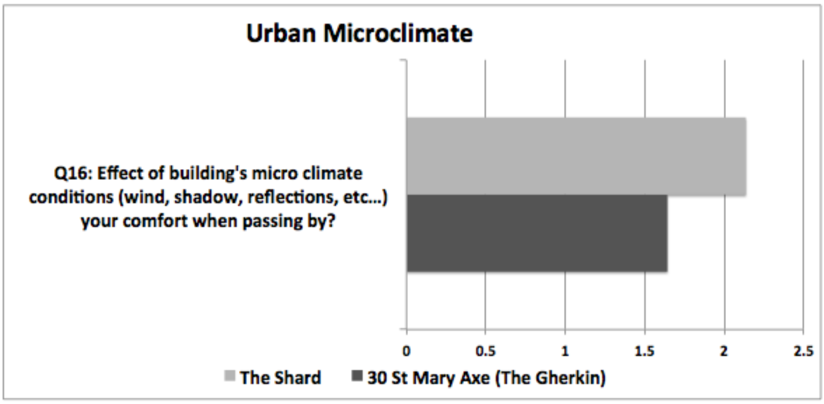

Figure A.7. Survey results for Urban Microclimate