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THE INTEGRATION OF TALL BUILDINGS IN URBAN ENVIRONMENT: CONSIDERING THE KEY SUSTAINABILITY CONCEPTS (1)

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INTRODUCTION

Tall buildings can create negative or positive impacts on urban environment both physically and socially. They should be designed with a consideration on basic parameters that satisfy both structural requirements and requirements of an ideal sustainable built environment. The harmony between a tall building and its environment is an important point that should be discussed together. Research in the field of tall buildings and their sustainable capabilities determine important design issues in different scales from urban scale to architectural scale. Location, site organization, transportation, urban skyline, material selection and façade design, entrance floor design, vertical design and the urban microclimate may be listed as fundamental concepts that should be taken into consideration in order to define the boundaries and intersection points of a tall building with the city. These key concepts should be used in examining the negative and positive impacts of a tall building on its environment. Thus, the most important and robust aim of a tall building design should be minimizing the damage on existing built environment while expanding the usable space which is provided by its current physical footprint on the site.

Even if a tall building is designed with a totally holistic sustainable design approach, its impacts may still not always be positive. Architectural benefits should not be provided only for the tall building itself. Making the building more livable and giving it a better current and future harmony with its urban environment should be taken into account as well. Kind of an environment-friendly approach will provide a sustainable built environment for city dwellers and all other users by means of a healthy urban environment. It is conceivable that positive impacts can be achieved via the correct strategy of design and suitable construction of a tall building on the existing urban texture. Also, tall buildings in particular have the largest potential of becoming landmarks. They are the structures that are most commonly used for shaping a city image. When designed with a

wholly sustainable perspective including the fundamental key conceptual analyses, tall buildings may become iconic symbols of the financial and technological power, and give the impression of modernization to the city as a whole. Well-organized design and well-planned construction phases through key sustainability concepts are necessary for a tall building to make a positive impact on its surrounding urban environment. Examining physical and social intersection points of a tall building and its urban environment and can be simplified with a well-defined sustainable design strategy.

As this study discusses the social integration of the building with people, it also focuses on the interfaces of the physical and social environment with a better definition of the needs of a building and its users. By observing the usage of a tall building and its surrounding area, the balance of the social and physical necessities must be identified. Questions such as; 'How can people access to the area? Which transportation facilities are available? Are there any public places within the tall building zone? Do people spend time around the building? How many people use the building? What is the main purpose of the building?' should be answered. Similar questions or ideas can be added also by taking the social concepts into account besides the architectural/concrete physical needs. Also, discussion of such topics strengthens the architectural and sustainable design value of the building.

From urban scale to architectural scale, architectural design details are another important point of discussion.

Doing an analysis on tall buildings according to key sustainability concepts enables us to internalize the issue of 'sustainable and environment friendly tall buildings'. An empirical observation platform is introduced for comparing the tall buildings and revealing out their urban environmental impacts. Finding more relevant key sustainability concepts may further help to develop this method for observing and understanding these impacts. By developing this observational platform, it may be possible to provide a universal and a holistic concept design tool for buildings and their surroundings for further studies.

In order to draw a better understanding of the key sustainability concepts, this study includes some case studies.

In this context, two tall buildings located in London are selected in order to analyze the environmental and social impacts related with a sustainable design strategy. The case study buildings are 30 St Mary Axe and The Shard, which have similarities such as being powerful landmarks of London, their architectural appearance and strong environmental influences. However, they also have different characteristics. While 30 St Mary Axe is entirely an office building and not open for public users, The Shard is multi-functional and helps creating a mixed-use environment for public and building users. Moreover, 30 St Mary Axe is located in a district where there are only office buildings, whereas The Shard is located in the central area of London, being almost the only tall building around its environment. Also the height difference is observable as 30 St Mary Axe is 180 meters while The Shard is 310 meters. Within the study, this comparison becomes a tool for defining the negative and positive nature of the impacts of a tall building on the existing built environment. Users can be more effective for the transformation of a tall building from a solid concrete structure to an active city element; this is directly related with the usage of the building in social manners. Investigating a wider range of tall

building cases by using key sustainability concepts presented in this study provides a deeper understanding on social impacts of high-rise buildings.

Providing various observational and experimental results might create a more robust pattern for revealing the physical and social impacts of tall buildings on their surroundings. A better understanding of this pattern may shape the thinking of sustainability for existing or newly built tall buildings. This pattern highlights critical design strategies which strengthen the sustainable integration of tall building design with the existing urban texture.

Over the key sustainability concepts, a necessary perspective is inevitably the green building and green environmental standards. The best known standards 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 standards of buildings regarding: location, transportation, materials and resources, water efficiency, energy and atmosphere, indoor environmental quality, neighborhood pattern and design, infrastructure, renewable energy systems, health and well-being, waste management, pollution. These criteria are generally physical requirements but a sustainable building has to address social concerns as well. In **Figure 1**, Larsson (2009) clarifies the difference between a green building and sustainable building; "Currently the emphasis is on 'green', focusing mainly on environmental performance and often defined in operational terms. Sustainable approach is operationally defined as including social and economic factors" (Larsson, 2009, 5). From this point of view, the balance of a tall building and its environment gains importance in catching the intersection points.

The green design indicators of key sustainability concepts for this study, have been comprised of by considering both LEED and BREEAM requirements. Moreover, when dealing with design logistics of both a green and a sustainable building, it is inevitable to concentrate both on physical and social points in designing a tall building. As a result, location, site organization, transportation, urban skyline, material selection and façade design, entrance floor design, vertical design and the urban microclimate are the key concepts of sustainability which will be used for this research study. These main key sustainability standards define the boundary of both physical and social parts of sustainable design for tall buildings in this research. These concepts are determined for this study in order to define

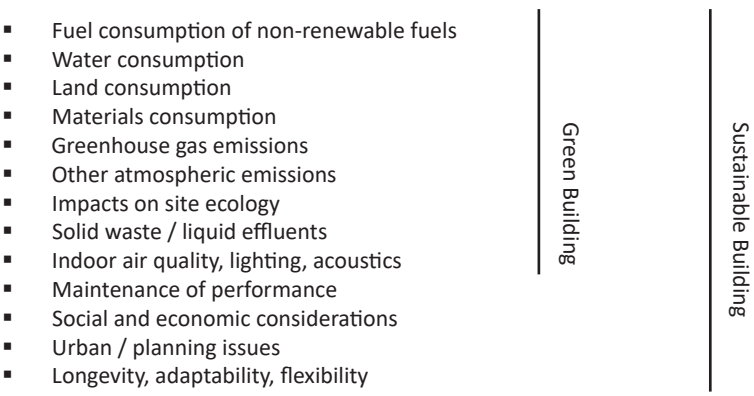

Figure 1. Different issues addressed by each approach: green building and sustainable building (Larsson, 2009)

the impacts of a tall building the urban environment in an acceptable manner.

SURVEY OF LITERATURE

The Definition of Tall Building and its Necessity in the Urban Environment

There is no precise definition of a tall building. It can be mentioned that tall buildings are structures with more floors than other buildings and are buildings that have the power of giving an identity to a city and keep reshaping the city skyline. Tall buildings are different than other structures or buildings in their environment by their height, proportion and shape. Tall buildings are classified as; very tall buildings, super-tall, mega structures, skyscrapers. In general, structures higher than 300 meters are called as "super-tall" and above 600 meters height these buildings are officially called as "megatall" (CTBUH, 2011).

The rise of tall buildings in cities is related to several kinds of necessities such as social, cultural and economic. Within a city, tall buildings are attention-grabbing and their solid appearances add a power to the city. Given their scale and visibility, the form and orientation of tall buildings can have a dramatic impact on the urban prospect, both positively and negatively (Strelitz, 2011). Besides their impacts on urban environment, their functions are also very important in delivery of some certain urban functions. According to Ali et al. (2007, 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. The physical urban environment makes it possible to build such tall structures if there is an appropriate ground (topographic and infrastructural base) for the construction of a tall building, designers and engineers would be able to easily think about designing tall buildings. In each phase of urban design (renovation, restoration, rehabilitation, renewal or gentrification) construction of a building is always a newness image for a city. Planning and determining the design principles together at the initial phase is important by means of integration with the city.

The Harmony of Tall Buildings in the Urban Environment

The harmony between a building and its environment is an important architectural dialogue that should be assessed and evaluated together when trying to find solutions through sustainable architectural design considerations. There are a lot of important factors to consider during a design process of a tall building which need to be examined from a wider urban scale to a narrower architectural scale. Examples that may be given for these factors are location and site selection, land-use, integration of landscape elements, the use of natural energy resources (wind, sun, vegetation.), the livable urban areas and building areas and nodes (plazas, inner-outer courtyards of the building, service floors), transportation, façade design, material usage. It can be seen that, it is a must to discuss the building with other landscape parameters, in order to create healthy environments. The harmony of all these factors enables us to better define the relationship between tall buildings and the urban texture.

The correct decision on location of a tall building supports convenient sustainable urban places by physical and social considerations where the relation between the building and the environment strengthens.

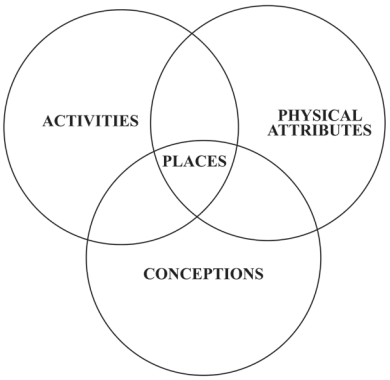

Figure 2. A visual metaphor for the nature of places (Canter, 1977 cited in Montgomery, 1998)

Montgomery (1998) puts forward the importance of a good city; as one that is the best designed, managed and developed. He also states that these situations create a legible city within a complexity. Thus, the location of a tall building can become a very important point by means of supporting the image-able mind in thinking of a city. According to Lynch (1960), a legible city makes one to feel comfortable within his/her own living space because of being conscious of where he/she should go and to which direction. Being comfortable and relaxed within a city can be provided with correct and balanced physical arrangements of urban elements such as; buildings, streets, landscape patterns, landmarks. Tall buildings can be involved within this idea by being constructed on suitable sites because of the potential of becoming a reference point for people.

As indicated by Montgomery (1998), social and cultural theories should also be investigated for harmony of tall buildings with the urban environment. 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 is given by Montgomery (1998) regarding nature of places;

Not only physical structures provide well quality of urban places, but also a harmony of physical and social attractions both create the urban environment; as shown in **Figure 2**, physical attributes, perceptions of human beings and activities altogether create places. From this point of view, the relationship between a tall building and the urban environment is an extension of the relationship between human (as the city dweller) and the building. Where city dwellers do not accept the idea of a tall building within their routine life cycles, this issue may become a problem due to their everyday use of urban places.

The City Elements

Lynch (1960), defines 5 elements of a city with their relationship with each other; paths, edges, districts, nodes and landmarks. According to him, 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 landmarks. They may also be the desire of people in finding their ways within a city. A tall building can be a very attractive landmark as a single building. A well-defined district with a group of tall buildings can act as a well-defined edge when Lynch's city elements are taken into consideration. The city must let its dweller to be able to build up their relationship with the environment, as Lynch (1960) defines getting lost in a city as a disaster. 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 to the relationship between a human and the urban environment, tall buildings have the potential of becoming an environmental image (Lynch, 1960) in one's mind.

A remarkable answer to the question of "Why environmental impacts and 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 which have impacts on 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). Gonçalves (2010) determines all of the inputs of tall buildings in order to define the impacts on the urban environment. Also she supports these ideas with different examples of these kind of buildings. The urban-skyline views, micro climatic conditions, bioclimatic approaches, the urban quality of ground arrangements, ventilation and impacts on their surroundings make a finer point on designing tall buildings. Nevertheless, according to her, these approaches should be implemented carefully for achieving better climatic conditions. The comfort of pedestrians on street level is important by means of urban livability. Design strategies that enhance permeability, connectivity and legibility, make cities walkable, 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 cannot interact with the building, the social connection of the surrounding area will lose attention. The tall building feeds from the social environment which keeps its vivacity alive. This disregard is not in a physical domain; it is totally within a social frame as it creates economic, politics and public reasons and effects. Rhythm of the relationship between people and tall buildings can change in time depending on the physical and social needs and variations in the living urban texture. The most secured way to cope with this situation is again the harmonic design of the building with the social environment. The building must never lose the social livability around. In addition, urban functions, social and economic needs, urban policies, planning criteria, places/spaces, communication ways of city dwellers may show differentiations in time, therefore both physical and social impacts on the urban environment of tall buildings can also change in parallel with this situation.

A Sustainable Perspective: The Environmental Impacts of Tall Buildings

In our modern day, sustainable design became a method for tall buildings to perform well in present time and future. Sustainability is handled for a long term and this situation is usually associated with the buildings' physical requirements such as; energy efficiency (energy consumption, material usage). However, the main matter is beyond technology and smart design. Sustainability, the creation of sustainable tall buildings, goes far beyond just energy use and even broader environmental considerations (Oldfield, 2012, 6). Meeting the needs of environmental, economic and social concerns are separate objectives, however all should be jointly satisfied through a sustainable approach. For better urban environments, tall buildings should adapt to both physical and social environment. Although it is very difficult to meet all physical and social requirements of a tall building design, the harmony between a building and the urban environment should be configured according to specific common principles of sustainable urban and architectural designs. 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.

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 criteria 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 a necessary to work with such design principles that achieve a healthy balance between the building and the

environment. Whereby buildings have to be evaluated according to their environmental performance which have been designed and constructed according to appropriate city planning formations. Tall buildings can accommodate more people than low rise buildings on the same footprint on the site. Constructing a high or low rise building is still a choice depending on the designer and requirements given by employer, function of the building and pleasures of the architect. According to Aksamija and Ali (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.

MATERIAL AND METHOD

The Key Sustainability Concepts

Reflecting on a comprehensive research made for sustainability key concepts, it is important to establish a relationship between these key concepts when evaluating the impact on the urban environment of tall buildings in both architectural and urban scales. The important point of view is to find the most reliable intersection points of a tall building design with its environment in order to define the boundaries and interfaces of architectural points and outside areas. Also, the key sustainability concepts are compatible with each other and must be taken into consideration as a complete system with examining the details one by one.

Site Organization:

Key points:

- The integration of a tall building with physical and social urban environment and street life (contribution to physical and social facilities),
- The relationship of a new tall building with the surrounding physical structures (height, form and mass),
- Public access through the site and existence of the pedestrian areas,
- The connection between public spaces with the surrounding urban places existing within the tall building site,
- The visual impact of a tall building on the surrounding historical views or landmarks (considering settlement of the building),
- Vehicle services.
- Site analysis,
- The connection of a new tall building with the surrounding physical structures (height, form and mass),
- The relation of a new tall building with the surrounding context (historical heritage, open areas, public spaces).

Transportation:

Key points:

- Contribution of a tall building on transportation network system,
- Existence of underground subway stations,
- Ease of pedestrian accessibility through the site,
- The variety of the functions of a tall building and its effects on public transportation usage.

Urban Skyline:

Key points:

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

Façade Design:

Key points:

- Providing a social screen on the street level,
- Transparency (indoor and outdoor areas of usage),
- The usage of natural sources by façade materials,
- The building as an intersection pattern between the indoor and outdoor areas.

Entrance Floor:

Key points:

- Height balance of the entrance floor of a tall building with the surrounding existing built environment,
- Relation with façade design,
- A transition pattern between indoor and outdoor areas of a tall building (a sense of connection),
- Welcoming people by creating public areas on entrance floors (increasing the sociality and physical usage),
- Necessity of creating wide open areas around the entrance floor (plaza, parks, green areas),
- Architectural contributions (columnar design, levelling) to strengthen the connection of a tall building and the urban environment,
- Providing several entrances for the building (variety of functions).

Vertical Design:

Key points:

- Indoor circulation,
- Atrium and inner garden designs within a tall building,
- The usage of green elements within a tall building,
- The vertical green connection between inside and outside areas of a tall building.

Urban Microclimate:

Key points:

- A comfortable usable area around the building,
- Sunlight access on the site; whether the building blocks the sunlight or not,
- Creation of wind corridors that affect the human comfort,
- Effect of the building on climatic conditions on the ground level

Selection of Case Study Buildings

Generally, tall buildings in London are located in different districts which are mainly financial and commercial zones. Because tall buildings are directly built into the urban heritage texture, it is easy to see and experience tall buildings near historical structures. London is continuously rejuvenating itself with design and construction of new, modern buildings. The density and number of tall buildings in London increase and these financial and commercial zones are already rising up to the sky. After an intensive research study on tall buildings in different locations, districts, function and stationary populations, The Shard and 30 St Mary Axe buildings were selected to be used as the case studies for this research. The Shard and 30 St Mary Axe buildings are located in different functional zones. These districts contain opportunities for satisfying needs (commercial, educational, health care, offices) of city dwellers. Furthermore, The Shard and 30 St Mary Axe buildings differentiate from each other by their architectural appearance, design approach, function, material selection, project area, district and design aim. These consequences of differentiation and common points make it more interesting to analyze different buildings and see how key sustainability concepts act on the observation platform of this study. 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 two buildings,
- Two buildings' architectural, environmental, functional and social contrasts,
- This selection may enable one to derive different results although the buildings belong to the same city,
- This selection may allow one to configure separated empirical observation platform to discuss,
- The variable usage of different population groups,
- The differentiation of zones,
- Different usage and profiles at different times.

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

The Shard is a multi-functional tall building with 310 meters height. Offices, residential floors, a hotel (Shangri-La), restaurants and viewing galleries (London view) are located in separated floors within the building. The London city skyline has been redefined with construction of The Shard building. The building is located in the central area of London (London Bridge). Architecturally, a sustainable approach remains at the forefront of the design considerations; The Shard is designed through environmental and sustainable criteria. Especially when the unconventional architectural design of this tall building is taken into account, design requirements of The Shard have been provided with advanced technological methods in both architecture and construction phases.

Figure 3. The Shard, London (archived by Author)

The architect of the building Renzo Piano has an interesting approach about sustainability which he defines that: "when buildings close down at 6 pm., everybody leaves the building and it becomes dead within the city, a building must be alive for 24 hours" (Interview: Renzo Piano, 2012). This point of view may be the beginning of combining the building as a physical urban element with the social side of the city where Piano (2012) defines The Shard as "a vertical city". While the building is extremely high, Piano says that it is small in its footprint and it has a variety of uses,

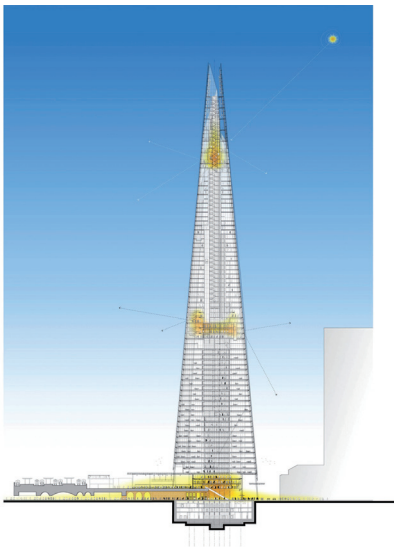

Figure 4. The Shard Building, Drawing (http://www.rpbw.com)

open to public. The sustainability concepts both include the physical and social issues in order to define a sustainable urban area. Renzo Piano also includes the energy use in his design as: "while The Shard building starts to get a smaller floor space from the bottom to top (related with its shape), the use of energy decreases" (Interview: Renzo Piano, 2012). This is one of the most important points for Piano in order to break down the general idea of 'tall buildings using more energy'. Piano mentioned as:

> "Designing such a building is playing with an orchestra. Every classic building is modern at one time and cities are great places because they are made by layers: Every built layer is built on the old layer. At one condition we did not destroy anything where the ground came from railways. This building will be full of life and not shut down at 6 pm. Also people will enjoy the building because it is a public building where everyone can access" (Interview: Renzo Piano, 2012)

Furthermore, Piano defines the sound of the building as a social sound where the area is very close to the river and this is very important for Londoners. Piano (2012) says that London, as a city, starts from this project area and with this project he believes that they have brought back the energy of London. Piano says that the façade of The Shard is like a mirror of the weather, human and the city. Also, he claims that London's skyline never remains the same and The Shard building has changed the skyline. When The Shard building changes in colour depending on the colour of the sky, this reflects the sense of mobility (The Shard – Press Conference with Renzo Piano, 2012).

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

Commonly called as the "Gherkin", 30 St Mary Axe is an office building which is located in the central financial zone in London. The building is surrounded by many other tall office buildings and public activity areas which are within walking distance. 30 St. Mary Axe is 180 meters in height.

Figure 5. 30 St Mary Axe (Gherkin), London (http://www.fosterandpartners.com)

Offices, a restaurant and bar at the top floor on the building with a 360 degree view of London (only open to building users), private dining rooms and a lobby floor are located in separated floors within the building. The building is located in the Bank district of London.

The sustainability concept is a basic theme for the architect of the building, Norman Foster, where the principles of sustainability are integrated in his works. Foster has an approach of designing sustainable buildings which run at a fraction of current energy requirements, or urban quarters that can support thriving communities, improving the quality of life in a city for all (Foster & Partners, 2004). The most important point for this research is to investigate both the physical and social quality manners of a tall building within urban life which are the basic considerations of sustainability. Foster also mentions that 30 St Mary Axe is the building that defines the city.

30 St Mary Axe is a very important building for London because of its monumental design. The building has a recognizable architecture in the city skyline and it is the first ecological tall building in London). According to Foster, 30 St Mary Axe creates a good harmony between the nature and workplaces because the building should have developed the technological and architectural ideas" (Foster & Partners, 2004). On the entrance level, 30 St Mary Axe presents an open public plaza which integrates the building users with outsiders. This distinctive form responds to the constraints of the site: the building appears more slender than a rectangular block of equivalent size and the slimming of its profile towards the base maximizes the public realm at street level (Foster & Partners, 2004). Also, the atria's on each floor of the building are the meeting areas while they can be described as the "social focus" points.

Method

Two methods have been used while conducting the study: an analysis and survey methods. The results have been obtained by an observational site analysis and a survey questionnaire. Observation points and routes were mapped onto observation maps in order to create an image of the case study building sites within the city. All results were obtained from site analysis, are primary qualitative observational sources: the tall building sites were visited and observed first-hand for each of the tall building separately.

Site Analysis:

The site analysis was carried out over the key sustainability concepts (site organization, transportation, urban skyline, façade design, entrance floor, vertical design and urban microclimate). These architectural, urban and environmental features were taken into consideration during observation. Firstly, architectural features were determined which include investigations about architectural form/shape, height, function, façade design and material selection, vertical design, modern and technological appearance of the tall building. Secondly, urban features were defined which consist of include the examination of: urban skyline, location, plazas/open areas, transportation facilities, vehicle/pedestrian cycle, urban parks/green areas and urban microclimatic effects of the tall buildings.

Finally, the environmental features were decided which include observations concerning: land use, entrance floor design, pedestrian realm, creation of public spaces and social interaction of users. This method was necessary for making a complete analysis about the conditions of these

buildings with their location in London and gave qualitative data about the case studies. The surveys were conducted and resulted in accordance with site analysis.

Survey:

The survey questions were composed in order to determine the physical and social impacts of The Shard and 30 St Mary Axe buildings. A survey questionnaire was prepared with the minimum number of survey participants obtained via a calculation with using Power and Sample Size Program (PS). In order to achieve a reliable comparison and valuable results of the two different case studies, 40 questionnaires were completed by participants shown in **Table 1**. More participants were able to answer questions about The Shard than 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)

Most of the surveyors were people who have lived in London at some point but some of them were still living in London. Shortly the surveyors were;

- People who were working within the building itself as security guards or as building staff,
- Young people who completed their university education in London,
- People spontaneously passing by the buildings,
- The waiting staff in nearby restaurants,
- People working around and using only the transportation facilities.

The basic distribution of the surveyors was as;

- Female and male contributors (% 45 male and %55 female),
- Age range: 15-24, 25-34, 35-44, 55-64 and 65+
- Occupation (agro-industries, communications and media, education, energy and utilities, banking and financial institutions, public sector and other
- Years living in London: 0-4, 5-14, 15-24, 25-34

People who filled out the survey questionnaire on site also had the chance of giving their own qualitative feedback regarding to the question topics. People who filled out the survey questionnaire online entered their demographic data and then answered the questions without making comments.

Case Study Building	Online Surveys	On Site Surveys
The Shard	13	12
30 St Mary Axe	5	10
Both for The Shard and 30 St Mary Axe	5	5
TOTAL	**18**	**22**

Table 1. Total number of surveys answered

Observation Checklist	The Shard	30 St Mary Axe
Contribution towards the physical and social facilities	**5**	**2**
The physical relationship of the building with the existing environment (height/ form)	**3**	**5**
The existence of pedestrian areas within the site	**5**	**5**
The proximity of the site to public places	**5**	**2**
The usability of the public places provided by the site by people	**5**	**3**
Existence of car parking areas within the site	–	–
Separated service roads for vehicle entrances	**1**	**1**
Existence of public places within or near the site (restaurants, cafes, shops, urban squares, meeting points)	**5**	**3**
Existence of other tall buildings within the surrounding area	**2**	**5**
Existence of historical heritage within the surrounding area	**4**	**2**
Accessibility for pedestrians to the area	**5**	**4**
Visual impact of the building on any historical sites or buildings nearby	**5**	**3**
The accessibility to the Thames River from the site for people	**5**	**3**
Height harmony of the building with the surrounding built environment	**1**	**3**

Table 2. Site organization; the site analysis comparison of The Shard and 30 St Mary Axe

RESULTS AND DISCUSSION

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

A comparison table has been achieved for every key sustainability concept 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 observation checklist of **Table 2**) for each key concept was selected. In this study, observational site analysis were made in order to support the survey results. The comparison of the two buildings is conducted with numbers from 0 (none) to 5 (strong) points; 1 (less), 2 (below average), 3 (average), 4 (adequate), 5 (strong).

The comparison tables are given below:

Site Analysis Comparison Tables:

The Shard building is more successful in contributing to the existing environmental facilities of the area and improving the needs of users with new pedestrian routes, public plaza and different leveling on site: The Shard building allows people to use all of the opportunities of the site. Both of the buildings do not have car parking areas but 30 St Mary Axe has a separated entrance for car parking area (only for building users) which is located under the ground. Also, both The Shard and 30 St Mary Axe support pedestrian circulation. Sustainable cities or areas do encourage designers to create pedestrian friendly zones.

The Shard is located in an area where there are many social and public facilities within the site and also in surrounding zone. This case is

Observation Checklist	The Shard	30 St Mary Axe
Transportation facilities provided within the site	5	
Accessibility to the underground subway	5	2
Approximate walking time to nearest subway station	0-5 mins.	5-10 mins.
Subway stations adjacent to the building	5	
Pedestrian accessibility	5	3
Connectivity between pedestrian routes and the open areas around the building	5	3
Usage of the building when accessing nearby public transportation	4	–

Table 3. Transportation; the site analysis comparison of The Shard and 30 St Mary Axe

supported by strong pedestrian circulations around the area. The distance to the River Thames is very short and the access through the riverside is more comfortable for pedestrians when compared with 30 St Mary Axe. Neighbor environment of The Shard building has a historical heritage. The heights of the buildings are in a balance with surrounding height of structures/buildings near 30 St Mary Axe; when compared to The Shard building, 30 St Mary Axe is directly located within a tall building zone. The Shard is totally a new and modern building by means of height, form and social contributions within its zone.

The Shard efficiently contributes to the public transportation network with the existence and development of London Bridge Station. Correspondingly, this arrangement makes the area more convenient and attractive for all people who are also not directly the users of the building as transportation facilities make the area more livable with creating social circulation. Both of the buildings are in a walking distance to underground subway stations. In addition, the pedestrian route connections are much stronger for The Shard's site than 30 St Mary Axe; public places within the site strengthen this situation for The Shard. Further, The Shard's site selection and multifunctional purpose make it a stronger social hub for Londoners. So, The Shard's zone is always in service and the existence of London Bridge Station within the zone is very effective for this case.

The height and the shape of both buildings include modern and unconventional architectural and technological challenges. Although The Shard is higher than 30 St Mary Axe, both buildings create nearly the same effect on the city skyline: both buildings have affected and improved the skyline. The Shard is located in an area where there are critical viewpoints of historical buildings. 30 St Mary Axe is not in a location of harming the historical skyline. Although The Shard's location near historical heritage creates a more sensitive situation about the impact on the skyline when compared to 30 St Mary Axe, the observation results show that, despite this arguable disadvantage, The Shard has succeeded in being a positive potential landmark.

The Shard gives the sense of transparency better than 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 building envelope. Additionally, the transparent interior effect of the first floors of The Shard makes it act as being within the city and

Observation Checklist	The Shard	30 St Mary Axe
Height of the building	**310 m**	**180 m**
Effect of the height/shape on the skyline	**5**	**5**
Potential of the building being a landmark of London	**5**	**5**
Existence of viewing galleries or terrace for watching the city skyline	**5**	**Only for occupants**
Power of its visuality in affecting the historical city skyline	**5**	**4**
Existence of any important historical landmarks on the nearby city skyline	**5**	**3**
Contribution of the building to the city skyline (view from the top of the building)	**5**	**5**
Contribution of the building to the city skyline (view from street level)	**3**	**3**

Table 4. Urban Skyline; the site analysis comparison of The Shard and 30 St Mary Axe

Observation Checklist	The Shard	30 St Mary Axe
The sense of transparency of the building depending on its material usage	**5**	**2**
Façade material selection considering a sustainable approach	**5**	**5**
Transmission of natural light through the building	**5**	**5**
Use of transparent material on the façade covering the first floor and giving a sense of continuity between the interior and exterior of the building	**4**	**3**

Table 5. Façade Design; the site analysis comparison of The Shard and 30 St Mary Axe

interpenetrating 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 has been located amongst tall buildings and this situation is a disadvantage in receiving natural sunlight. The glass material used on the skin of The Shard, gives a better sense of lightness and reflects light onto the piazza; the physical impacts of which is caused by the building façade is more perceivable than 30 St Mary Axe. Furthermore, The Shard has a differentiation on its façade material usage at the first 4 floors; people are able to see the inside workplaces from the completely transparent facade where 30 St Mary Axe does not provide this kind of a transparency and likewise a relation with the outside area.

Both The Shard and 30 St Mary Axe have separate entrances for entering the different parts of the building.

However, The Shard is directly connected with public facilities on the ground level when compared to 30 St Mary Axe. Where 30 St Mary Axe building contains several doors, which belong to restaurants and cafés at the plaza, the Shard building provides a public circulation via several entrances from different sides depending on functional purposes.

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 outdoor environment	**5**	**2**
Height of the base building in comparison with nearby buildings	–	–
Separation of public and service entrances	**5**	**3**
Availability of public spaces within the entrance area	**5**	**3**
Entrances on different topographical levels	**5**	–
Architectural contribution to the entrance level (usage of columns, bridges)	**5**	**1**

Table 6. Entrance Floor; the site analysis comparison of The Shard and 30 St Mary Axe

Observation Checklist	The Shard	30 St Mary Axe
Public usage of the floors	**5**	**Only for restaurants on entrance floor**
Facilities for users to have effective accessibility within the building	**5**	**5**
Existence of atrium or inner gardens	**Yes**	**Yes**
Suitable green usage between floors	**4**	**4**
Perceivable green usage within the building and its connection with the outdoor environment	–	–

Table 7. Vertical Design; the site analysis comparison of The Shard and 30 St Mary Axe

During the site analysis observation, this situation has been evaluated as supporting the physical circulation around the building. Correspondingly, The Shard presents open areas for people and this is an important necessity for social sustainability. Also, The Shard has columnar design on different levels which creates semi open areas for people. 30 St Mary Axe has an architectural design which extends straight through the sky upon a circular plaza.

Both The Shard and 30 St Mary Axe supply the necessities for a vertical transportation system in a tall building within a technical manner. But still, The Shard building transports people more quickly to upper floors (it can be noted that The Shard is constructed with newer technology). They are both designed in accordance with creating inner gardens and atriums as breathtaking spaces in the building. This situation is very important for sustainability criteria such as accessing the sunlight or natural ventilation. Further, no green connection was observed between the vertical green line (inside of the building) and the exterior green environment or with the entrance level. Also, no green areas are placed around both building. This can be an explanation for why the vertical circulation system is only considered with only technical solutions without a vertical green corridor. .

There are very noticeable wind transitions around The Shard. Within the frame of the comfort zone of the pedestrians, angle and reflection of the sunlight decreases the uncomfortable effect of the wind. Around 30 St

Observation Checklist	The Shard	30 St Mary Axe
Sunlight access through the public places around the building	4	3
Shadows on the surrounding public spaces	3	4
Strong wind corridor effects within the district	4	4
The effect of the variation of microclimatic conditions around the building for pedestrians	5	5

Table 8. Urban Microclimate; the site analysis comparison of The Shard and 30 St Mary Axe

Mary Axe, the area receives less daylight because of the surrounding tall building zone, and also the use of darker materials on the façade creates darker environmental sense. On the other hand, the wind corridor effect is perceived more on the site of The Shard than 30 St Mary Axe; this can be related with surrounding buildings and their height. 30 St Mary Axe is located in a more compact and dense tall building zone and distance between neighbor buildings are narrower. Even though 30 St Mary Axe's circular shape is effective on reducing wind turbulences, the building is exposed to more negative microclimatic conditions as a result of the distribution of the tall buildings within the zone.

Comparison of Survey Results for the Shard and 30 St Mary Axe

The surveys were made with 25 contributors for The Shard building and 15 contributors for 30 St Mary Axe building. During the survey, excess data sets were taken for The Shard because 30 St Mary Axe is a secured and non-residential building. Furthermore, higher scores dataset entries for The Shard via online survey platform infers that The Shard building has been more successful in creating general awareness and has been more accessible to inhabitants due to its location and site/architectural design. In any case, analysis of datasets have been averaged, hence the 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 surveyors. The data was collected in one table for each building and were distributed according to the demographic information of the surveyors for determining an accurate classification of the results.

The Shard: According to survey results, the general opinion for this building by demographic distribution is given as:

Data Results in Relation to the Demographic Information of Sex: 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 similarities between the answers of males and females.

Variation in opinions between male and females separated more for design related questions 9-12, for which males had slightly higher opinions.

Data Results in Relation to the Demographic Information of Age: All age groups were mostly scored in the higher end of the scale for transportation key concept for The Shard building, particularly 35-44 and 15-24 age groups 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 in the below end of

the scale, both individually and altogether. Although there is not enough data to make a full analysis on the impact of age about 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, were slightly in the below end of the scale for design related questions 7-12 (ignoring age group 45-54 as only one participant for this age group was found for The Shard building).

Data Results in Relation to the Demographic Information of Years Living in London: Generally, all participants had the highest opinion for the urban skyline' and transportation key concept. Again, these group participants also have almost the same positive opinion on the site organization key concept. The other positive opinion was given for the entrance Floor of the age group 15-24. Yet, again all age groups found the urban microclimatic conditions least effective.

30 St Mary Axe: According to survey results, the general opinion for this building by demographic distribution is given as:

Data Results in Relation to the Demographic Information of Sex: Amongst females, urban skyline key concept was scored almost with the highest rating and urban microclimate was least favored. Males similarly favored urban skyline and least favored urban microclimate for 30 St Mary Axe and façade design was scored higher. In general, there was a similarity between answers of males and females. Variation in opinions between males and females separated in design related questions, 11-13, for which males had slightly higher opinions.

Data Results in Relation to the Demographic Information of Age: All age groups were scored in the higher end of the scale for site 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 the age group 25-34 is visiting, and spending more time within the financial zone regarding their business lives and intensive work programs/meetings. Urban microclimate was in the below end of the scale for all age groups, except the correspondents aged 55-64.

Data Results in Relation to the Demographic Information of Years Living in London: Generally, all participants were ranking highly throughout all questions. Only urban microclimate key concept questions were highly favoured. The 5-14 age group had the highest opinions for all apart from the transportation key concept and this group particularly scored urban skyline high too.

Comparison Graphs of the Survey Results

A histogram graphic showing the distribution of the results was created for each question, with the results which have been derived for both of the case study buildings. As the number of correspondents for The Shard and 30 St Mary Axe building was not the same, the quantity of particular histogram graphics is not directly the frequency of hits for a certain result. Instead of this 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.

Examples for the Survey Result Comparison Graphs:

- Result showed that the survey correspondents greatly preferred the visual impact of the building.
- Furthermore, **Figure 6** shows that, survey correspondents were 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 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.

- People had higher opinion for the choice of being in 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.
- 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 the advantage of using the open areas around (participants also agreed with this situation).

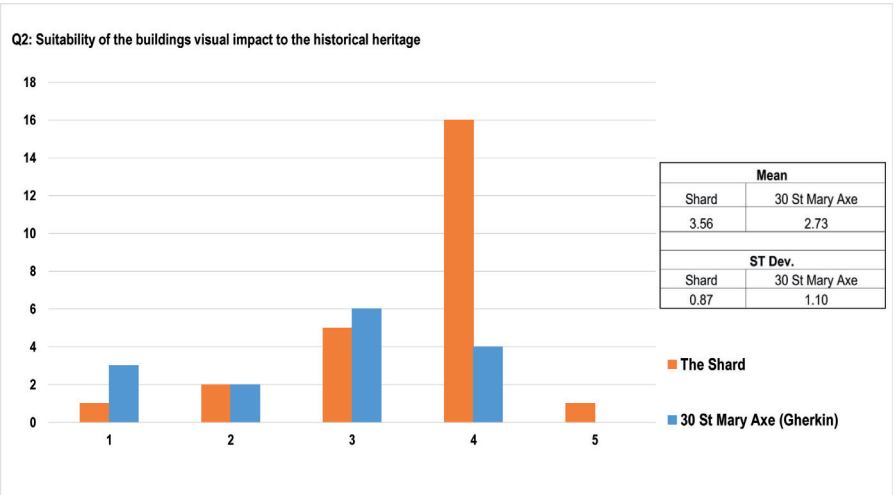

Figure 6. The survey result comparison graph of The Shard and 30 St Mary Axe: Site Organization (drawn by Author)

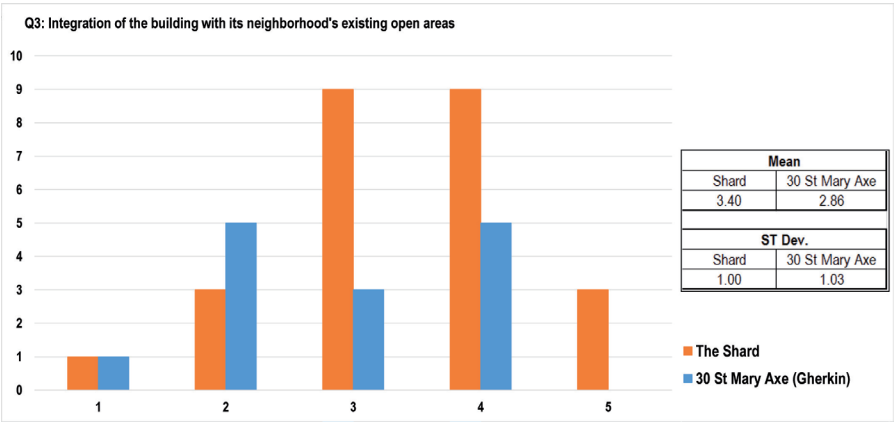

Figure 7. The survey result comparison graph of The Shard and 30 St Mary Axe: Site Organization (drawn by Author)

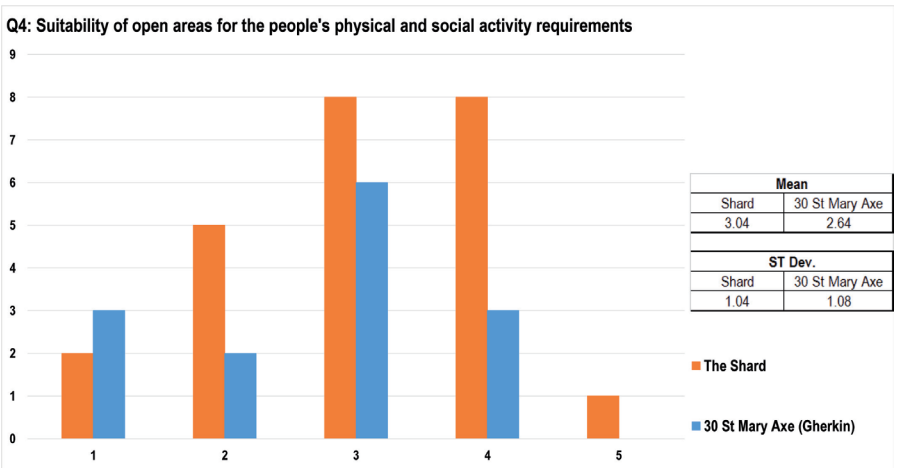

Figure 8. The survey result comparison graph of The Shard and 30 St Mary Axe: Site Organization (drawn by Author)

- 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.

CONCLUSION

Tall buildings in particular are the most powerful and distinctive players in the urban texture. Due to this distinctive impact, tall buildings immediately become an important part of the urban environment and therefore it must be needed to pay particular attention into issues concerning their integration with the surrounding environment. This study shows that even when two tall buildings are located in the central districts of the same city (London), The Shard building may be defined as a more appropriate tall building design example when investigated with the key sustainability concepts of this study. Two buildings had both similarities and differences with each other.

Indeed, one of the building (30 St Mary Axe) was located in the business center while the other building (The Shard) was located in the heart of the city; it has been seen that the characterization of the districts were the basic differentiation points for these buildings by means of their functionality and user profile.

The key sustainability concepts chosen in this study provide us an empirical observation platform for the evaluation of tall buildings and their urban environment. The universal sustainability concepts have been limited for this research study in order to combine both the physical and social sustainability concerns which have impacts on the urban area and are visible enough to be explored on the site. The evaluation of the two selected buildings have been made by the selected and limited key sustainability concepts. It was important to investigate whether these key concepts are implemented in these tall buildings or not. Observation on the site helped to reach adequate solutions of these qualitatively visible key concepts and get the opinions of the users. Far away from calculations about wind, energy usage and daylight, the key sustainability concepts have been limited according to the intersection points of social and physical attributions of the tall building design. Selected key sustainability concepts within this research study may be implemented through different tall buildings from every part of the world and also more key concepts can be selected and applied depending on the case buildings.

This situation would no doubt expand the library of key concepts used to evaluate tall buildings and hence make the system even more robust. The empirical observation platform introduced a comparison tool, to highlight the design strategies for defining better the negative and 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 can 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 city dwellers. Furthermore, designers should not only concentrate on physical sustainability considerations, social integration in living urban complexity is just as (or sometimes even more) important in securing the sustainability of tall buildings.

Providing users with suitable interaction facilities can enable the people themselves to unknowingly integrate the tall building into the urban livability. This study enabled users to transform their perception of a building as a ‘solid structure’ to an active city element.

In summary, in a world with a developing future on technology which integrates us virtually with each other both in social and physical situations, , makes us evolve and adapt with the buildings and herwith the urban environment. Furthermore, with rapid development and population growth, people face future challenges to maintain a cultivated social interaction between people to keep the urban environment alive and interconnected. With well-developed and suitable design practices, tall buildings can play an important role in satisfying both physical and social needs of this expansion in strengthening the harmonic urban vitality.

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Anahtar Sözcükler: Sürdürülebilir yüksek binalar; çevresel uyum; sürdürülebilirlik kavramları; mimari ölçek; kentsel ölçek.

SÜRDÜRÜLEBİLİRLİK KAVRAMLARI ÇERÇEVESİNDE YÜKSEK BİNALARIN KENTSEL ÇEVRE İLE BÜTÜNLEŞMESİ

Yüksek binalar; insanların fiziksel, sosyal ve ekonomik gerekliliklerine bağlı olarak artmaktadır. Yüksek binalar, ağır strüktürlerinden dolayı kentsel çevre üzerinde güçlü etkilere sahiptir ve kentsel çevre ile uyumlarına göre ele alınacak tasarımları sayesinde, bulundukları çevrenin kalitesini artırmah potansiyelleri mevcuttur. Alçak binalar ile karşılaştırıldıklarında, yüksek binalar mimari tasarım ve mühendislik detayları açısından daha zorlayıcı olabilmektedir. Buna bağlı olarak, çevre üzerindeki etkileri de hem fiziksel hem de psikolojik açıdan çok kuvvetli hale gelebilmektedir. Geniş kentsel alanlara yayılan etkileri göz önünde bulundurulduğunda, yüksek binaların çevrelerine pozitif etki sağlamaları için sürdürülebilirlik ve çevresel uyum ile örtüşen tasarım kriterleri diğer geleneksel binalara göre daha titiz bir şekilde ele alınmalıdır.

Bu çalışma, yüksek binaların fiziksel ve sosyal çevre etkilerini, belirli sürdürülebilirlik kavramları üzerinden tartışmaktadır. Bu kavramlar, yüksek binaların kentsel çevre üzerindeki fiziksel ve sosyal etkilerini negatif veya pozitif yönden ortaya çıkarmayı kolaylaştırarak, mevcut veya yapılmakta olan yüksek binaların hem mimari hem de kentsel ölçekten incelenmelerini sağlayan bir analiz aracı olmuştur. Bu çalışma için Londra'da bulunan iki yüksek bina, The Shard ve 30 St Mary Axe (Gherkin), bulundukları kentsel çevre üzerinde yarattıkları etkilerin incelenmesi için seçilmişlerdir. Bu binalar, analiz ve anket yöntemleri kullanılarak sürdürülebilirlik kavramları üzerinden birbirleri ile karşılaştırılmışlardır. Bu çalışma ile yüksek binaların hem mimari hem de

kentsel ölçekte yaratabilecekleri pozitif ya da negatif etkileri, fiziksel ve sosyal sürdürülebilir bir yaklaşım üzerinden ortaya konulmuştur.

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

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 urban environment, tall buildings, , have the potential to improve the quality around them through careful design and urban integration. When compared with lower buildings, tall buildings can be more challenging by means of architectural design and engineering details. 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 other conventional buildings in order to provide the most positive impact.

This research focuses on physical and social environmental impacts of tall buildings where these impacts are examined through determined 'key sustainability concepts'. The identified relevant 'key sustainability concepts' support revealing out the physical and social environmental impacts of tall buildings as positive or negative. As conducted in this study, these key sustainability concepts are proved to be analytical and observational tools to evaluate existing or new tall buildings, from architectural scale to urban scale. As a demonstration of its effectiveness on urban environment, two tall buildings located in London, 'The Shard' and '30 St Mary Axe (Gherkin)' were selected and compared through site analysis and survey methods over key sustainability concepts. 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.

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