



Space Syntax as an Operative Tool in "Pedestrianization" Process

Ashraf A. Elmokadem¹, Usama A. Nassar², Hosam S. El-samaty³ and Mostafa M. Elzeni⁴

ABSTRACT

Lately, a lot of studies focus on people behaviour and their relation with the built environment. This relation is studied in environment psychology science, which contains different theories as place theory. Place theory inquiries people presence or absence, and some attributes in such space to define how it raise to be a place for people. Hence, people are usually pedestrian in different times and situations. Moreover, the benefits of designing for pedestrian, and the calls of various urban theories to design for pedestrian and, so designing places is a critical and important issue. Accordingly, Space Syntax will be applied in this research as an efficient tool to be used for developing urban fabric of cities, and to design urban places for pedestrian.

1. INTRODUCTION

Space syntax, as a language to describe the urban space configuration, provides a powerful tool for researchers to characterizing the functional patterns of urban space. [1] Besides, Space syntax not only suggests an effective conceptual framework for investigating the man and built environment relation, but also a method for describing spatial configuration as collections of local elements and as an interrelated whole.[2] Moreover, Space Syntax is a theoretical, methodological and technical framework proposed by Hillier and Hanson. It studies the arrangement and interrelationship of spaces in a spatial configuration, by assuming that there is a social logic underlying the space organization. Why designing for the pedestrian? A number of studies in London, New York, and Sydney show that almost of traffic problems Cause by vehicle traffic. Although, the number of car drivers is far little than the pedestrian. [3]

According, different calls asked for pedestrianization as a term which solves traffic problem. Hence, Egyptian cities suffer from different traffic problems, so showing and analyzing other cities cases to investigate how they use space syntax in order two solve their traffic problem. The research deal with Trafalgar square as a successful cases in London.

2. "PEDESTRIANIZATION" DEFINITION

At the 1800s and starts of 1900 arched shopping area was built at European Countries it was a unique design for the pedestrian.4 Pedestrianization as a traffic policy is widely adopted in many cities and there has been a long history on the in Europe and UK. Moreover, the earliest Pedestrianization can be traced back to the 1960s. At 1975, the definition of pedestrianization was first suggested by Monheim. Who stated that pedestrianization can be a street only for pedestrian's usage. [5]

Pedestrianization means to remove and restrict vehicle from a specific area and to turn the area for pedestrians only.[6] Accordingly, Pedestrianization can be a necessary implementation in circumstances where a bothersome pedestrian-vehicle conflict is observed due to the centralization of a street; or where a revival of economic grain in a street is needed. Any successful Pedestrianization project will thus provide an attractive Street for pedestrians because of its vitality and quality.[7]

¹ Professor and Head of Architectural engineering and urban planning faculty of engineering Port Said University
Email: elmokadem1@gmail.com

² Associate. Professor at Architectural engineering and urban planning, Faculty of engineering Suez Canal University
Email: usama.a.nassar@gmail.com

³ Assistant. Professor at Architectural engineering and urban planning, faculty of engineering Port Said University
Email: hosamsamaty@gmail.com

⁴ Demonstrator at Architectural engineering and urban planning, faculty of engineering Port Said University
Email:mma.elzeni@gmail.com

3. PEDESTRIANISATION PLANNING STRATEGIES

3.1. Fulltime pedestrian streets

Accessibility of vehicles into street is fully forbidden, usually, services are in the back of street, and only emergency vehicles are allowed to enter.

3.2. Part time pedestrian streets

Accessibility is allowed only in specific periods, parking on-street spaces not allowed, only services vehicles can access.

3.3. Traffic Calming Streets

Traffic calming streets serve reducing car dominance and its speed. so, there are no restrictions to vehicle access, but footpaths are widened and parking spaces are reduced. Various traffic calming measures are used to slow down the speed of vehicles as speed tables, narrower traffic lanes, and different road textures and colours to remind driver.[8]

4. STRATEGIES AND STAGES OF PEDESTRIANIZATION PROCESS

Pedestrianization method can be categorized into three strategies as follows:

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Through these strategies, *AKIT, M.* stated that, Planning for pedestrians can be undertaken experimentally and in stages as follows [10]:

- Problem definition.
- Determination of the objectives.
- Collection and analysis of data.

- Identification of constraints and opportunities.
- Development of alternative solutions.
- Final design, and implementation.

It is obvious that, these stages have a group of integrated social and spatial characteristics; every stage is related to pedestrian behaviour and their social activities. Furthermore, it's also related to "place attachment" which can be defined as the development of the affective bond or link between people or individuals and specific places. [11] CIOLFI, L. mentioned that, constructing of the place means the dynamic relation between physical surrounding and human factors. [12]

It worth mentioning that, urban design is a concept familiar to everyone because it is closely bound up with people living. Otherwise, we don't completely understand the space we are living in. Hence, the need for a comprehensive analytical tool appears in order to fit in with the complexity of Pedestrianisation process.

Urban street network, which is generally regarded as a complexity system in urban space, has gained more attention as the rise of "Space Syntax". It has various applications at urban design field that used Space Syntax to solve a lot of problems which has a relation with people behaviour and movement.

5. SPACE SYNTAX

Space syntax, as a language to describe the urban space configuration, provides a powerful tool for researchers to characterize the functional patterns of urban space.[13] Space syntax not only suggests an effective conceptual framework for investigating the man and built environment relation, but also a method for describing spatial configuration as collections of local elements and as an interrelated whole.[14]

Space Syntax deals with spaces and their syntactic relations not as physical spatial configuration, but as a system includes social aspect with the physical one. Besides, it is interested in studying and analyzing the relation between spatial configuration and people behavior at architecture or urban design level.

6. METHOD OF INVESTIGATION

Former stages of Pedestrianisation process can be summarized in the following phases:

- Identifying and confirmation of problems. (Ph1)
- Proposing alternatives of solution. (Ph2)
- Best alternative evaluation & development. (Ph3)
- Detailed design and implementation. (Ph4)

Efficiency of the selected analytical tool "Space Syntax" will be evaluated in accordance with Pedestrianisation process through these four phases.

This will be operated through analyzing "Trafalgar Square, London" renovation process. Effectiveness of

Space Syntax will be observed at each phase of this project.

7. TRAFALGAR SQUARE", BACKGROUND.

Trafalgar square Renovation is a part of developing London central urban spaces by Westminster. The project established at 1996. The square is the first finished part at 2003, which aims to improve the quality of public realm, and keep its historic importance. Generally, the square has to be safe pleasant and solve traffic buzz. Nowadays, the square is animated and equipped with visitors and Londoners. [15]

7.1. Project Problem

The square was surrounded by a high-density traffic. As a result, a low people access to the square, pedestrians network avoid pedestrian to access. Generally, the usage of the square decreased because of the traffic. [16] Observation indicates that Londoners avoided center of the square, Visitors field to make a tour from the square to parliament square. [17]

7.2. Project objective

The project was assigned to team consist of Space Syntax laboratory and Sir Norman foster team. The main

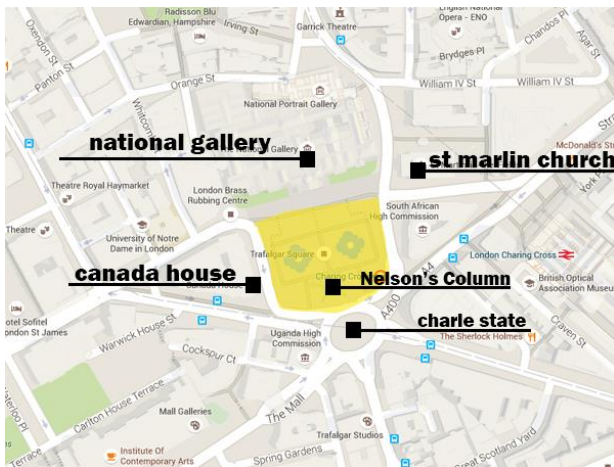


Figure 71 important location at the site

Source: Google map, adapted by researcher

objective was redesigning the square to be accessible and intelligible for all pedestrians with their different types, visitors, Londoners, and impaired people. Besides, well connection to national gallery and another surrounding. The key to the success of the scheme was to create a fairer balance than existing between pedestrians and vehicles. [18] Project aimed to convert this noise, polluted and crowded traffic area to be as pleasant, enjoyable and accessible area. Providing safe environment for cyclists and public transport, and improving facilities. [19]

7.3. Project phases

Renovation of Trafalgar square to achieve the final project depends on other four phases. The first one is manual observation. The second phase is analysis (1) which depends on Space Syntax analysis of existing spatial layout to explain people behavior through the square. The third phase depends on the urban planner to convert the urban problem into a solution. The fourth phase evaluates the new spatial layout using Space Syntax and takes new

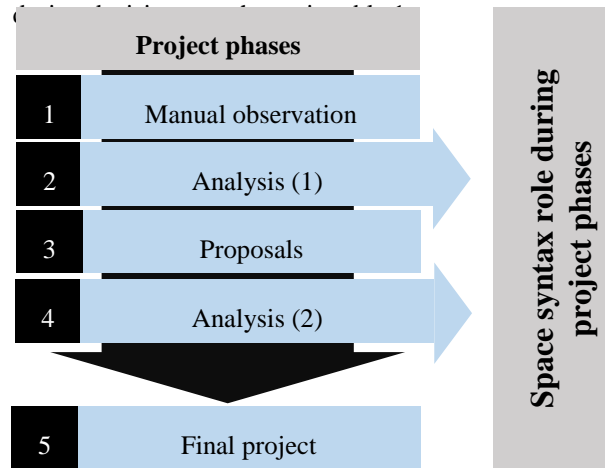


Table 1: Trafalgar square phases chart

Source: by researcher

A- Manual observation (Ph1)

The observation has been done at Space Syntax laboratory by trained observers, who used 300 gates at different hours during different days of the week. The north part of the square is virtually unused only for moving or static activity, as shown in Figure 2. Observation results showed that:

Visitors concentrated at the south-east of the square and left other locations at the space empty. Besides, the visitor used an informal road to cross the south side of the square to go through King Charles traffic island.

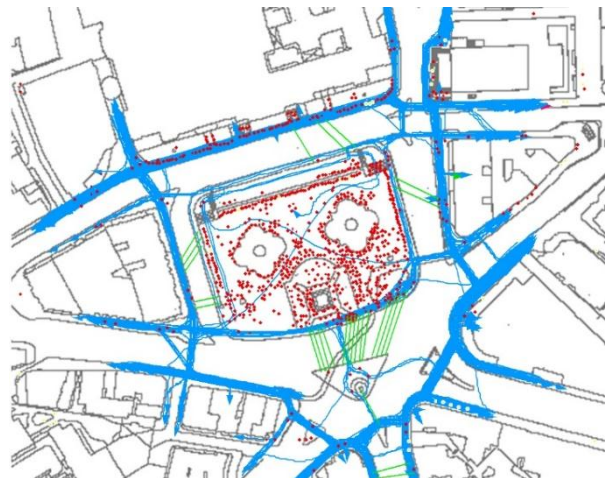


Figure 2: observation of existing

Source:Stonor, 2013

Londoners didn't access into the square but they preferred to move around its edges, except a small number of pedestrian.

B- Analysis (1) (Ph1)

This phase depends on space syntax by analyzing the existing spatial configuration to know how the spaces work as s shown in **Figure 3**. The analysis indicates low accessible values within the square and high accessible values outside. The red colored axial lines represents high value, green color represents low value. Isovist analysis has been done from two different points. The point from square center generates constricted field, unlike point from Charles Island, which was more spread and unconstructed, as shown in **Figure 74** and **Figure 5**. As a result, people attract to this island. Besides, its high



Figure 3: access analysis of existing situation
Source: Hillier, 1998



Figure 5: vision field from Charles Island
Source: : Hillier,1998

integration value, the analysis shows the low accessible value of the north side.[20]

C- Proposals (Ph2)

Norman foster team develop their proposal according to the previous analysis. They start to develop some strategies to renovate the square by attract people to access inside. The main strategy is to make changes in the spatial configuration to attract pedestrians instead of push pedestrians out the square. Spaces syntax analysis show that traffic isn't the problem, so removing the traffic isn't

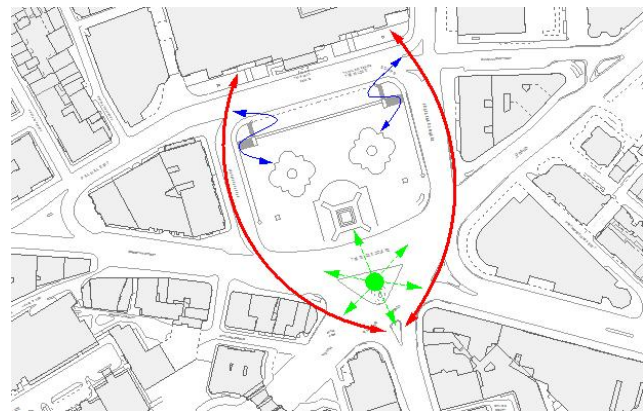


Figure 6: physical structure push people out.
Source: Stonor, 2013

the solution. Accordingly, good new design at the square has to provide a simple route from middle island to the secure, well connection to surrounding visually and

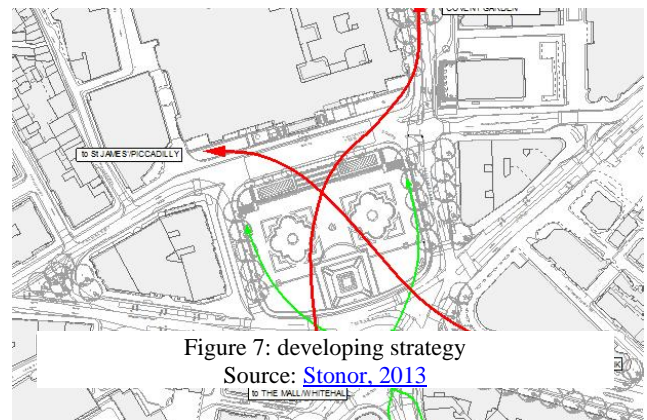


Figure 7: developing strategy
Source: Stonor, 2013

spatially. Besides, Provide facilities to eat, drink and rest.[21]

D- Analysis (2) (Ph3)

Analysing spatial configuration after redesigning shows that accessible value increased inside and outside the square. New decisions have been taken.

E- Final project (after implementation) (Ph4)

Streets and vehicle movement

- North side: close the north side street as Pedestrian Street.

- Eastside: converted to two lanes in two-way for traffic.
- Westside: provided two lanes one-way south for traffic.
- Southside: the square extends down and redesign the Charles Island and create a new two island at its two directions to decrease walking.

Pedestrian's movement

- Into the Square provide crosswalk at the square four corners.
- Pedestrian access to Charles Island is provided by crossings from the major island at the main street Whitehall to the new two island to access the square on pedestrian's desire lines also, the design takes a wheelchair into the count.

Cyclist and public transport

- Provide a bus lane and cycle only lane at east and west of the square Services.
- Provide cafes and toilets under the north terrace near new staircase

Planting

- **New trees was added to continue the space visual entertainment.**²²

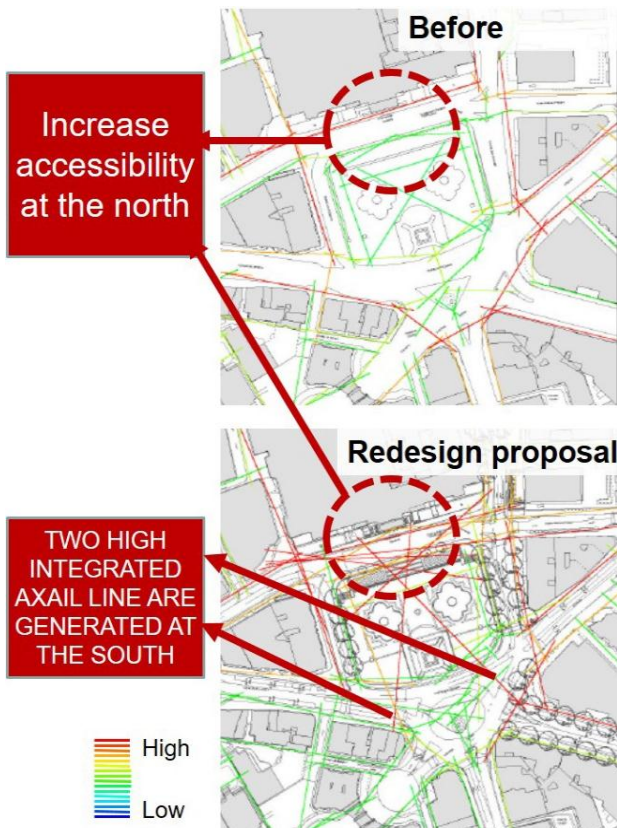


Figure 8: changing at analysis after spatial configuration developing
Source: Stonor, 2013 adapted by researcher

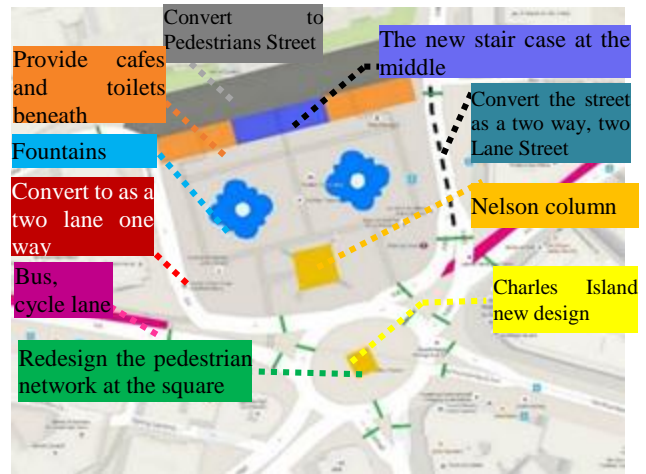


Figure 9: Decisions taken after spatial configuration analysis 2
Source: Google map adaptive by researcher

7.4. Investigation results

Space syntax was used clearly at two phases in different ways. The first phase integrated the first two stages (Manual observation – Analysis 1) together; it was used to clarify square problems and to propose its solutions. Additionally, it was used in the third phase (analysis 2) which has been handled in designing and evaluation of the final proposal.

A- Phase 1

This key point introduces how space syntax works at the first phase (Identifying and confirmation of problems). At first, space syntax indicates the problems. Then, the design team explained these problems according to previous analysis. Afterwards, design team made some decisions which aimed to solve the explained and indicated problem. Finally, the team proposed the design.

Problem (1)	Pedestrian attracted to Charles island instead of the square
Explanation	High integration value of the generated axial line inside and beside the island. The good visual location of the island as shown at the Isovist analysis.
Decision	Efficiently Redesign the island to be as a link between the surrounding and the square. Besides, the island will be as central location attract people then transport to the square.
Aim	Usage of the high accessibility and visual location of the island to be as the south entrance to the square.

Design	Design includes widening Charles island as the main and two small islands on its two sides.
Problem (2)	Pedestrian pushed out the square and they prefer to walk around the square instead of inside the square.
Explanation	Low integration value of the axial line inside the square. Moreover, high integrated axial line around the square
Decision	Reconnect the square with the surrounding to attract the pedestrian inside the square. Redesign a north entrance to the square.
Aim	Generate high integrated axial lines crossed the square, and connected with the surrounding.
Design	Close the north street for pedestrians, besides redesign the surrounding street for vehicle movement. Connect the north street with the square by a wide staircase.

B- Phase 3

This key point introduces how space syntax works at the third phase (Best alternative evaluation & development.). It was used to evaluate the final proposal. Besides, it helped in designing the square in detail.

Evaluate	New two axial line generated inside the square. As a result, people will go across the square. A composition of high integrated axial lines generated at the north entrance of the square. As a result, the north street and staircase will be a vital location.
Design in detail	Locate the staircase at the intersections of the axial line at the north entrance and provide services at its sides.
	Locate the bus and cycle lanes ant the south high integrated street.
	Usage the high integrated axial lines which crossed the square and the islands as a cross walk beside the four corner crosswalk.

8. RESULTS

The whole performance of Space Syntax in pedestrianization process can be summarized as shown in the next table:

No.	Phase Name	Included stages	Space Syntax Performance
1	Identifying & confirmation of problems.	Observation	-----
		Analysis 1	Explanation of former stage
2	Proposing alternatives of solution.	Proposals	Feedback
3	Best alternative evaluation & development	Analysis 2	Evaluation
4	Detailed design implementation.	Implementation	Feedback

- Space Syntax is an efficient tool in developing and designing urban places for Pedestrians. It helps in choosing Pedestrian Street, vehicle Street, and Shared Street. Space Syntax could be used to locate crosswalks, landscape desired paths, bicycles lanes, and public transportation network location.
- Space Syntax actually participated indirectly in making important decisions in phases 2 & 4.
- A new tools have to be added beside Space Syntax in the way of forming an integrated analytical approach in pedestrianization process. These tools will be related to unrecovered items in syntax analysis.

9. REFERENCES

- [1] **XIA, X.** 2013. *A Comparison Study on a Set of Space Syntax based Methods, Applying metric, topological and angular analysis to natural streets, axial lines and axial segments.* Master, faculty of engineering and sustainable development p1.
- [2] **KIM, Y. K.** 1999. *spatial configuration, spatial cognition and spatial behaviour: the role of architectural intelligibility in shaping spatial experience.* PHD in Architecture University College London.p4.
- [3] **GEHL, J. & ROGERS, R.** 2013. *Cities for People,* Island Press.p21.
- [4]**MOOSAJEE, N.** 2009. *An Investigation into the Pedestrianisation of City Streets: A move towards pedestrian friendly spaces and their economic effects in the City of Cape Town.* Masters in the Department of Civil Engineering, university of cape town.p2/17.

- [6] **HAN, L. Y.** 2009a. *An empirical study of the impact of a pedestrianisation scheme on retail rental values in the neighbourhood.* Bachelor of science in surveying, The university of hong kong.p7.
- [7] **SHAHIDEH, S.** 2013. *Analyzing the Quality of Pedestrian Street in the Case of Istiklal Street in Walled City of Famagusta.* Master of Science in Urban Design, Eastern Mediterranean University.p17-18
- [8] **AKIT, M.** 2004a. *Pedestrian experiences in bahÇevler 7th street: Setting the design criteria for the enhancement of urban public realm.* A thesis submitted to the graduate school of natural and applied sciences, The middle east technical university.p25.
- [9] **IRANMANESH, N.** 2008. *Pedestrianisation a great necessity in urban designing to create a sustainable city in developing countries.* 44th ISOCARP Congress .p3.
- [10] **IRANMANESH, N.** 2008. *Pedestrianisation a great necessity in urban designing to create a sustainable city in developing countries.* 44th ISOCARP Congress .p3.
- [11] **AKIT, M.** 2004a. *Pedestrian experiences in bahÇevler 7th street: Setting the design criteria for the enhancement of urban public realm.* A thesis submitted to the graduate school of natural and applied sciences, The middle east technical university.p25-26.
- [12] **UJANG, N.** 2009. *Place Attachment and Continuity of Urban Place Identity. 1 st National Conference on Environment-Behaviour Studies.* Faculty of Architecture, Planning & Surveying, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia.p157.
- [13] **CIOLFI, L.** 2004. *Situating "Place" in Interaction Design: Enhancing the User Experience in Interactive Environments.* PHD, University of Limerick.p54.
- [14] **XIA, X.** 2013. *A Comparison Study on a Set of Space Syntax based Methods, Applying metric, topological and angular analysis to natural streets, axial lines and axial segments.* Master, faculty of engineering and sustainable development p1.
- [15] **KIM, Y. K.** 1999. *spatial configuration, spatial cognition and spatial behaviour: the role of architectural intelligibility in shaping spatial experience.* PHD in Architecture University College London.p4.
- [16] **SPACE SYNTAX NETWORK** 2012. *space syntax general practice brochur.p1.*
- [17] **SPACE SYNTAX NETWORK** 2012. *space syntax general practice brochur.p1.*
- [18] **SPACE SYNTAX NETWORK** 2012. *space syntax general practice brochur.p1.*
- [19] **HILLIER, B., STONOR, T., MAJOR, M. D. & SPENDE, N.** 1998. *From research to design re-engineering the space of trafilgar square.* *Urban Design Quarterly* 68, 35-37.
- [20] **ATKINS, D. F. K. & EARL, T.** 2004. *The pedestrianisation of trafilgar square: How do we deliver a sustainable scheme at a world heritage site?* *Association for European Transport* p3.
- [21] **HILLIER, B., STONOR, T., MAJOR, M. D. & SPENDE, N.** 1998. *From research to design re-engineering the space of trafilgar square.* *Urban Design Quarterly* 68, 35-37.
- [22] **HILLIER, B., STONOR, T., MAJOR, M. D. & SPENDE, N.** 1998. *From research to design re-engineering the space of trafilgar square.* *Urban Design Quarterly* 68, 35-37.
- [23] **ATKINS, D. F. K. & EARL, T.** 2004. *The pedestrianisation of trafilgar square: How do we deliver a sustainable scheme at a world heritage site?* *Association for European Transport*
-
- ¹ **XIA, X.** 2013. *A Comparison Study on a Set of Space Syntax based Methods, Applying metric, topological and angular analysis to natural streets, axial lines and axial segments.* Master, faculty of engineering and sustainable development p1.
- ² **KIM, Y. K.** 1999. *spatial configuration, spatial cognition and spatial behaviour: the role of architectural intelligibility in shaping spatial experience.* PHD in Architecture University College London.p4.
- ³ **GEHL, J. & ROGERS, R.** 2013. *Cities for People,* Island Press.p21.
- ⁴ **MOOSAJEE, N.** 2009. *An Investigation into the Pedestrianisation of City Streets: A move towards pedestrian friendly spaces and their economic effects in the City of Cape Town.* Masters in the Department of Civil Engineering, university of cape town.p2/17.
- ⁵ **HAN, L. Y.** 2009a. *An empirical study of the impact of a pedestrianisation scheme on retail rental values in the neighbourhood.* Bachelor of science in surveying, The university of hong kong.p7.
- ⁶ **SHAHIDEH, S.** 2013. *Analyzing the Quality of Pedestrian Street in the Case of Istiklal Street in Walled City of Famagusta.* Master of Science in Urban Design, Eastern Mediterranean University.p17-18
- ⁷ **AKIT, M.** 2004a. *Pedestrian experiences in bahÇevler 7th street: Setting the design criteria for the enhancement of urban public realm.* A thesis submitted to the graduate school of natural and applied sciences, The middle east technical university.p25.
- ⁸ **IRANMANESH, N.** 2008. *Pedestrianisation a great necessity in urban designing to create a sustainable city in developing countries.* 44th ISOCARP Congress .p3.
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- ¹⁰ **AKIT, M.** 2004a. *Pedestrian experiences in bahÇevler 7th street: Setting the design criteria for the enhancement of urban public realm.* A thesis submitted to the graduate school

of natural and applied sciences, The middle east technical university.p25-26.

¹¹ **UJANG, N.** 2009. *Place Attachment and Continuity of Urban Place Identity. 1 st National Conference on Environment-Behaviour Studies.* Faculty of Architecture, Planning & Surveying, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia.p157.

¹² **CIOLFI, L.** 2004. *Situating "Place" in Interaction Design: Enhancing the User Experience in Interactive Environments.* PHD, University of Limerick.p54.

¹³ **XIA, X.** 2013. *A Comparison Study on a Set of Space Syntax based Methods, Applying metric, topological and angular analysis to natural streets, axial lines and axial segments.* Master, faculty of engineering and sustainable development p1.

¹⁴ **KIM, Y. K.** 1999. *spatial configuration, spatial cognition and spatial behaviour: the role of architectural intelligibility in shaping spatial experience.* PHD in Architecture University College London.p4.

¹⁵ **SPACE SYNTAX NETWORK** 2012. *space syntax general practice brochur.*p1.

¹⁶Ibid.

¹⁷ **SPACE SYNTAX NETWORK** 2012. *space syntax general practice brochur.*p1.

¹⁸ **HILLIER, B., STONOR, T., MAJOR, M. D. & SPENDE, N.** 1998. From research to design re-engineering the space of trafalgar square. *Urban Design Quarterly* 68, 35-37.

¹⁹ **ATKINS, D. F. K. & EARL, T.** 2004. The pedestrianisation of trafalgar square: How do we deliver a sustainable scheme at a world heritage site? *Association for European Transport* p3.

²⁰ **HILLIER, B., STONOR, T., MAJOR, M. D. & SPENDE, N.** 1998. From research to design re-engineering the space of trafalgar square. *Urban Design Quarterly* 68, 35-37.

²¹ **HILLIER, B., STONOR, T., MAJOR, M. D. & SPENDE, N.** 1998. From research to design re-engineering the space of trafalgar square. *Urban Design Quarterly* 68, 35-37.

²² **ATKINS, D. F. K. & EARL, T.** 2004. The pedestrianisation of trafalgar square: How do we deliver a sustainable scheme at a world heritage site? *Association for European Transport*