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Abstract

In architecture, design begins by generating ideas and continues by transforming them to concrete spatial formations. Architects learn about the design problem by creating alternatives and testing them in order to gain desired spatial formations. A comprehensive architectural knowledge helps architects in this process. This knowledge is a synthesis of practice and theory, in other words mystery and certainty, intuition and science, experience and research. Architects must proceed in two ways and bring all components together in a creative way. This paper aims to explore contribution of a scientific, and research based approach, namely space syntax, in the design process. Space syntax is based on configurational theory of space and attempts to decode spatial formations and their impacts on human activity. By the development of new techniques for representing and analysing space, space syntax appears as a tool for architects to explore their design ideas and understand possible effects of their proposals. By illustrating a link between research and design, this study attempts to create new horizons for those professionals in architectural practice as well as academics in architectural education.

Introduction

In architecture, design is a kind of activity that is learned by doing and experience and architects discover much about design problem by evaluating their solutions. A comprehensive architectural knowledge helps architects in this process. Critical questions arise at this point: How does an architect evaluate his/her ideas? How does an architect test the spaces that s/he has created? What kind of architectural knowledge leads to this process? Does this knowledge include intuition, feelings, and experiences or does it consist of theory, science and research? Similar to Vitruvius' (1990) definition, architectural knowledge is a synthesis of practice and theory. During the design process, the architect has to bring intuitive and rational ways of thinking together, in other words mystery and certainty, intuition and science, practice and research. By linking these two ends together, this paper aims to focus on the configurational theory of

space, namely space syntax, and to explore its contribution to architectural design process.

This paper investigates the research theme by focusing on:

1. Design activity itself, its nature and architectural design process,
2. Space syntax itself, its main idea and its role in architectural practice.

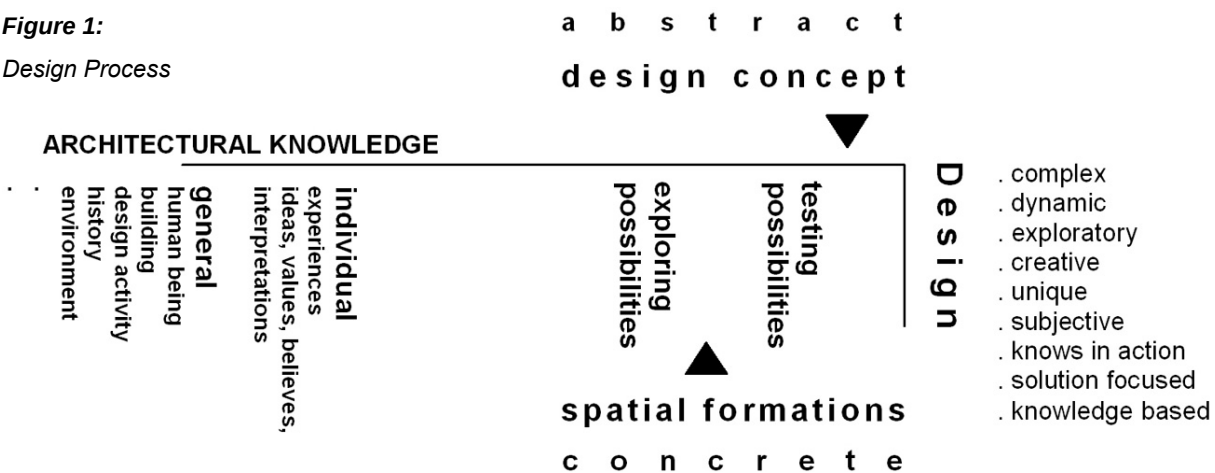
Three case studies, from architectural education (Principle Project in British Museum, MSC Course, UCL), and practice (Proposal for Extension to Tate Britain and Urban Design Project for Trafalgar Square) are explored to illuminate the discussion.

Design Activity

Design is a sophisticated cognitive activity. In architecture, this activity begins by generating an abstract idea and continues by transforming it to concrete spatial formations. Whether it is called as “image” (Alexander, 1964), “primary generator” (Darke, 1984), “conjecture” (Hillier, et al., 1984), “organising principle” (Rowe, 1987) or concept (Lawson, 2003) all refers to the same: the idea that makes an architectural design unique or different from all others. Finding a unique way in which spaces are formulated to reflect these ideas constitutes the next step of design activity; in other words to find a way to transform these abstract ideas into spatial formations, which are occupied and experienced. By generating different proposals and testing them, the architect consolidates his/her ideas or re-defines them in order to gain satisfied spatial formations.

Design is not a procedural or systematic activity as design methodologists have expressed (Alexander, 1964, Jones, 1984, Archer, 1984) in which designer must carry out sequential activities such as problem definition, analysis, synthesis, decision making and evaluation, in a definite order in order to attain a final solution. Design is a process in which problem and solution emerge together (Lawson, 2003). There is no definite direction of flow from one activity to another; each activity can be seen as a reflection of the other. Rather than producing optimal solutions (Simon, 1996), design is about experimenting and probing. Experiments lead architects to discover something, and then these help them to redefine their underlying concepts (Figure 1).

Figure 1:
Design Process



This idea is well clarified by Schön's statement on design. Schön saw designing as a kind of “making” (Schön, 1987), which is largely learned and practiced through “action and reflection”:

“Designing in its broader sense involves complexity and synthesis. In contrast to analysts or critics, designers put things together and bring

new things into being, dealing in the process with many variables and constraints, some initially known and some discovered through designing. Almost always, designers' moves have consequences other than those intended for them. Designers juggle variables, reconcile conflicting values and manoeuvre around constraints- a process in which, although some design products may be superior to others, there are no unique right answers.....Beginning with the situations that are at least in part uncertain, ill defined, complex and incoherent, designers construct and impose a coherence of their own. Subsequently they discover consequences and implications of their constructions – some unintended – which they appreciate and evaluate. Analysis and criticism play critical roles within their larger process. Their designing is a web of projected moves and discovered consequences and implications, sometimes leading to the reconstruction of initial coherence – a reflective conversation with the materials of a situation.” (Schön, 1987).

Lawson's experimental work has supported the idea, the idea of thinking and learning by doing, by introducing two types strategy in design: problem focused strategy and solution focused strategy (Lawson, 2003). He observed two different groups, architects and psychologists, under the given design task. Based on the findings Lawson showed that while scientists focused their attention on understanding the underlying rules, architects were obsessed with achieving the desired result. According to him architects learned about the problem through attempts to create solutions rather than through deliberate and separate study of the problem itself. In other words, architects as well as designers discover much more about the design problem as they critically evaluate their own solutions.

Then, we come across the questions of, how does an architect evaluate his/her ideas, in terms of spaces that s/he creates and what are the constituent elements of his/her architectural knowledge leading to this process? Does this knowledge include intuition, feeling, and experiences or should it be based on a theory, science and research? Answer is simple: Both. Architect on one hand has variety of scientific or research based knowledge related with the human being, building, environment, history, design activity, etc. On the other hand s/he has intuitions and experiences, ideas, believes and values or guiding principles (Lawson, 2004). In the design process, by interpreting design constraints (user requirements, cost, technology, etc.) the architect brings two types of knowledge together, both to generate ideas and test them in a subjective way.

According to Ziesel (1984), design interconnects three constituent activities: imaging, presenting and testing. Appraisals, refutations, criticism, judgments, comparisons, reflections, reviews and confrontations are all types of tests. After presenting a design idea in whatever form, designer steps back with a critical eye and examines his/her product (Hillier and Leman, 1974). Design testing means comparing tentative presentations against an array of information like the designer's and the client's implicit images, explicit information about constraints or objectives, degrees of internal design consistency and performance criteria -economic, technical and sociological (Ziesel,1984).

Ziesel argues that designing works with two types of information: heuristic catalyst for imaging and a body of knowledge for testing. This means that designers rely on information to tell them how things might be, but also that they use information to tell them how well things might work (Lawson, 2003). By creating a link between research and design activity, the next step of this study focuses on an approach, namely space syntax, which attempts to produce a kind of knowledge

which helps architects to find out how well their designs might work, what their solution means, their implications and consequences.

Space Syntax

Space syntax is theory of space and a set of analytical, quantitative and descriptive tools for analysing the spatial formations in different forms: buildings, cities, interior spaces or landscapes (Hillier and Hanson, 1984, Hillier, 1996). Main interest of space syntax is the relation between human beings and their inhabited spaces. It is believed that distinctive characteristics of societies exist within spatial systems, and their knowledge is conveyed through space itself, and through the organisation of spaces (Dursun and Saglam, 2003). Space Syntax calls this relational characteristic of space as configuration and proposed the idea that it is this characteristic forms the human behaviour thus contains the social knowledge.

The aim of space syntax research is to develop strategies of description for configuring inhabited spaces in such a way that the underlying social meaning can be enunciated. This in turn can allow for secondary theories or often practical explanations to be developed regarding the effects of spatial configuration on various social or cultural variables. A related theme in space syntax research is to understand configured space itself, particularly its formative process and its social meaning (Bafna, 2003).

In brief, space syntax is an attempt to constitute a configurational theory in architecture by generating a theoretical understanding of how people make and use spatial configurations, in other words, an attempt to identify how spatial configurations express a social or cultural meaning and how spatial configurations generate the social interactions in built environments.

Great variety of research and publication shows that earliest space syntax works focused on real environments and tried to identify the intrinsic nature of man made environments. By developing consistent techniques for the representation and analysis of spatial patterns, recent space syntax works attempt to simulate spatial design proposals and arrive at a basis for predicting how they would work. "Space syntax research is reason based, and more rigorous than most, but it has effectively led to the study of architectural intuition through its creations. In practice, design proceeds by mixing intuition and reason. Space syntax makes the deployment of non-discursive intuition more rational and therefore more discursive" (Hillier and Hanson, 1997). Three case studies, both from architectural design practice and architectural education, are good examples to identify the role of space syntax in design process.

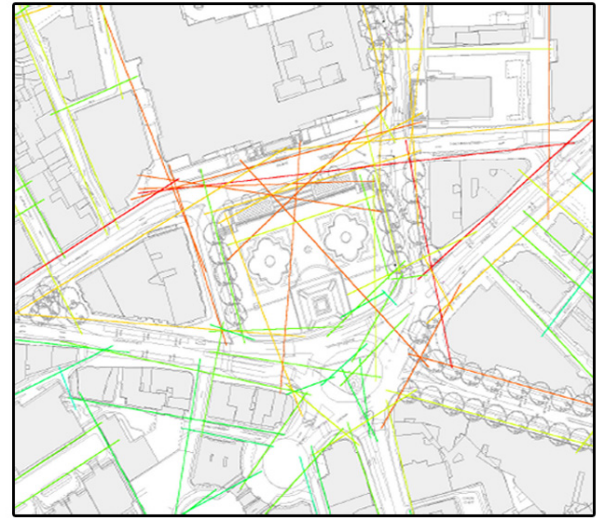
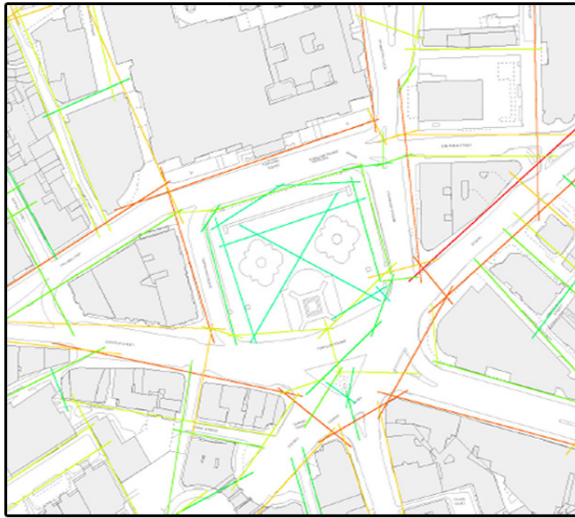
Space Syntax in Architectural Design and Education

Design Practice in Urban Context: Trafalgar Square

National government aimed to improve the network of public spaces in central London between Trafalgar Square and Parliament Square and a master plan for the area was commissioned in 1996, calling for improvements in the quality of the public realm which was perceived to be unpleasant, unsafe and dominated by traffic (Space Syntax, 2004). In this design competition, the works of space syntax have underpinned Norman Foster's proposal. Space Syntax Laboratory has contributed to design process both by diagnosing problems in the area with analyses of the existing space use and movement patterns in and around the square and helping design team to generate and evaluate their design solutions.

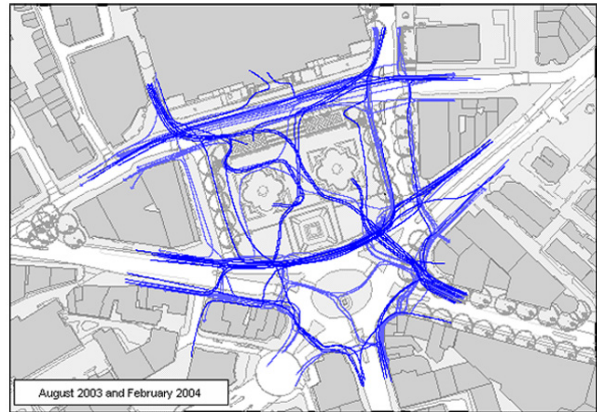
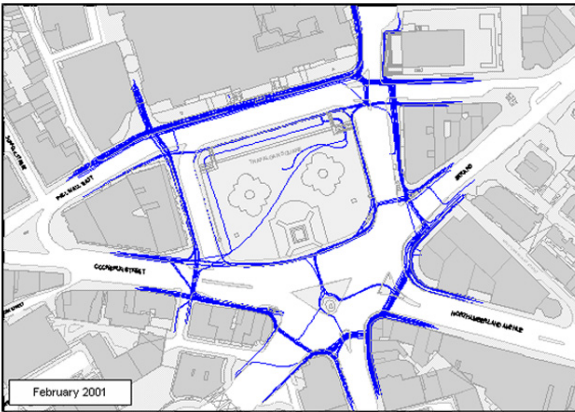
CASE 1

design practice in urban scale: trafalgar square



056-05

axial analyses before and after



movement traces before and after

During the project, Space Syntax Laboratory counted pedestrian movement in over 300 locations at different times of the day, on different days of the week, and in different seasons of the year. The result of the survey has shown the key features of space use in and around Trafalgar Square: Trafalgar Square appears to be cut off from its surrounding by dense traffic. Londoners avoid the centre of Trafalgar Square and leave this space to visitors. There is virtually no movement across the heart of the square especially because of existing design of corner stairs. Londoners prefer to move around the outside pavements and visitors chose to meander slowly within the square. There is much informal road crossing by visitors, especially from the south side of Trafalgar Square in order to get to the best views of the area (Hillier, 1998).

Figure 2 shows the detailed observation related to pedestrian movement and activity pattern in the area. In Figure 2, the most striking point is that the observed pedestrian activity in the area has totally been corresponded the computer model of the square which has been carried out by the space syntax software. In these simulations more accessible spaces are indicated by thin red lines.

The findings of these analyses have generated a number of key design ideas for Trafalgar Square. These included a new staircase

Figure 2:

Trafalgar Square (Space Syntax)

into Trafalgar Square, selective pedestrianisation of the public realm and the re-connection of Parliament Square to the wider area (Space Syntax, 2004). The designer of the project described the key resources for generating their design proposals as follows: "I would just mention that the sources of our proposals have an interactive relationship to each other. Many have emerged from these experiences; but they have also come out of the brief. They have resulted from our observations, but at the same time there is constant crosschecking between those findings and public consultation. It is this symbiosis which demonstrates to me what a very creative tool the space syntax theory is" (Foster, 1997).

In the World Square project space syntax has both shown designers the nature and problems of the area by analysing the existing spatial layout. When the characteristics of the area were underlined it then helped designers to generate design proposals as well as evaluate them by providing new generation computer software.

Design Practice in Building Context: Tate Britain

Administration department of Tate Britain has decided to improve museum layout by providing new exhibition spaces. The idea was to design a new wing with a sculpture courtyard as extension to existing gallery. Space Syntax has been commissioned by Tate Britain to assist Tate Britain and its architects Allies and Morrison.

Space Syntax Laboratory has contributed to the design process both by illuminating the social culture in the museum which was conveyed through the spatial configuration itself and helping architects, Allies and Morrison, to evaluate their three proposals (Figure 3). During the project, Space Syntax Laboratory counted pedestrian movement in over 300 locations at different times of the day, on different days of the week, and in different seasons of the year.

During the project, the routes of 100 people for the first ten minutes of their visits were recorded. The result of the survey has showed that some spaces in the museum are much more visited than others (Hillier, 2004, Hillier and Tzortzi, 2006) (Figure 3). Visitors tend to move along the central axis from the main entrance and intensify especially on the left side of the building. Visibility graph analysis confirmed this characteristic by simulating the observed visitor movement.

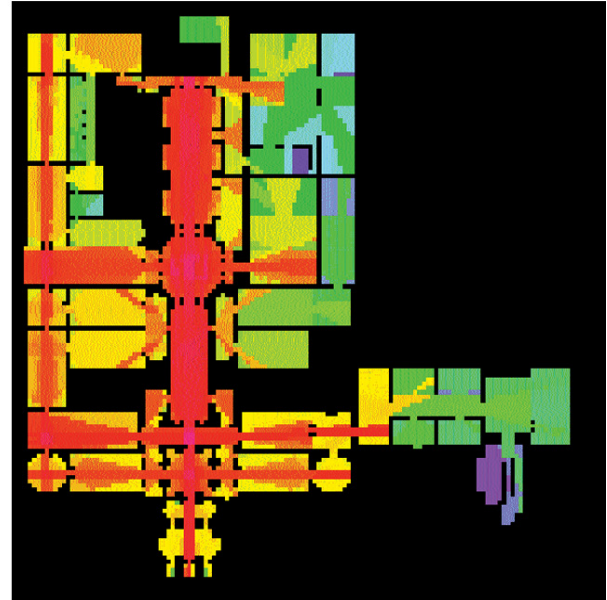
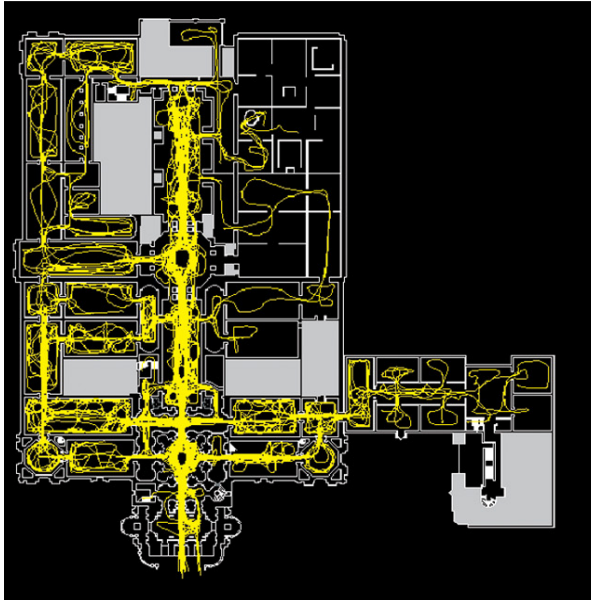
After being defined how the existing spatial layout works spatially, comparative analyses of proposals in term of their possible effects on the museum have been carried out. Among the proposals first one intended to create a new gallery wing for the permanent collection having a passage entrance through the Clore Gallery. An external sculpture court was planned at the back of this wing. In the second proposal, some of the new gallery spaces were added on the north side of the building linearly and the others were designed at the back of this as a separate wing shaping an open court at the centre. Third one introduced a new north wing that will be used as temporary exhibition space and the area which is currently used for temporary exhibition was designed to host the permanent collection. In this option, external sculpture court was formed between the new gallery wing and the Clore Gallery having a link to new café and bookshop space.

Based on the visibility graph analyses of proposals it has been shown that among the three proposals, third proposal provides the most intelligible layout by making the new temporary exhibition space well integrated and well connected to the core of the building (Space Syntax, 2002). By introducing a new link between the left side of the Gallery, the Clore Gallery and the new spaces, and by creating a new

route to Clore Gallery, this proposal also impacts positively on the existing building by giving the plan a strong global structure (Figure 3).

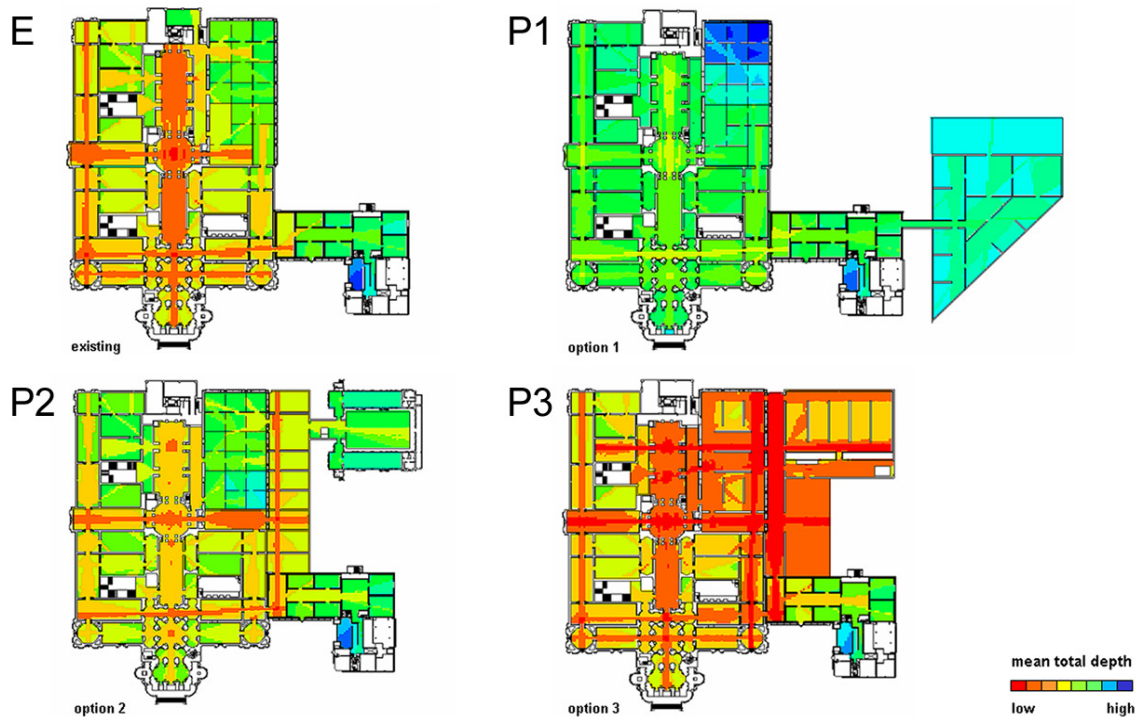
CASE 2

design practice in building scale : tate britain



056-07

movement traces and vga analyses in existing museum



t e s t i n g t h r e e d e s i g n p r o p o s a l s

This exploratory work on Tate Britain has both shown designers the social codes in the museum by analysing the existing spatial layout and helped them to test their design proposals during the design process. By simulating the possible effects of design decisions on existing plan layout, designers had a chance to evaluate and evolve their ideas in the light of scientific evidence.

Figure 3:

Tate Britain (Space Syntax, 2002)

Architectural Education:

Principle Project in MSc, Advance Architectural Studies Course, UCL, The Bartlett School of Graduate Studies

Space Syntax constitutes the main core of Advanced Architectural Studies (AAS) at the Bartlett School of Graduate Studies, University College London. The course is built around the idea that by studying buildings and cities as patterns of space, we can derive wholly new insights into the relations between them and the individuals, communities and organisations that inhabit them (Webpage of Bartlett, Faculty of the Built Environment, Graduate Studies, 2006). The modules in this course are mainly formed by a variety of researches as well as experiments related with the application of these researches to design through consultancy projects.

In the 2004-2005 academic year, British Museum was chosen as the theme of the Principle Project in MSc course. In this project the students were asked to investigate how British Museum is embedded in its urban context affects the way it functions, how the building operates as a social object, how people move around the building, how the spatial layout of the museum affects patterns of movement, how does the Great Court designed by N. Foster in 2000s figure as an open space at this scale (Penn, 2004).

One of the student works which is related with the theme of this study focused on the Great Court by underlining these following research questions: Can one influence the sequence of movement throughout the museum by reconfiguring the spatial morphology of the Great Court? To what degree does the spatial configuration of the Great Court effect the movement flow through the galleries? (Chicken, et.al, 2004). After defining the existing spatial functioning by observing visitors and implementing syntactic analyses which correlates with these observations, three different scenarios were compared by using the theory and the tools of space syntax.

Among these three scenarios, scenario A reflects the original layout of the museum before the Foster's intervention. Scenario B proposed to remove the reading room by providing bigger open court without any closed space inside. Scenario C reflects the idea of preserving Foster's proposal by opening new entrances from the great court towards the galleries. Figure 4 shows the axial line analyses of the museum in each particular scenario showing the intelligibility of spatial whole which means the degree which what we can see from the spaces that make up the museum (Hillier, 1996).

These analyses showed that the most intelligible spatial layout appears in scenario C. This scenario was the most well performed alternative among the three and this was also confirmed by visual graph simulations (Figure 4). The students reached to a conclusion that the significant factors increasing the "intelligibility" of the spatial arrangement seem to be a combination of long axial lines as well as ring structures that allow multiple choices for movement at key locations (Chicken, et al., 2004).

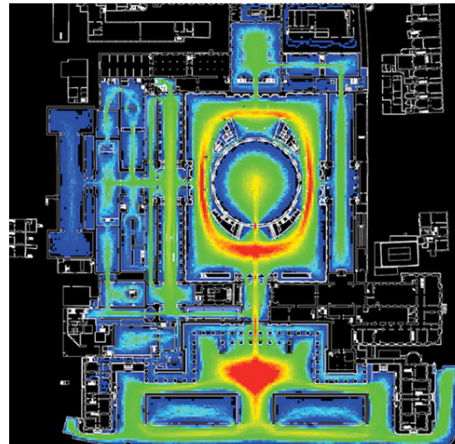
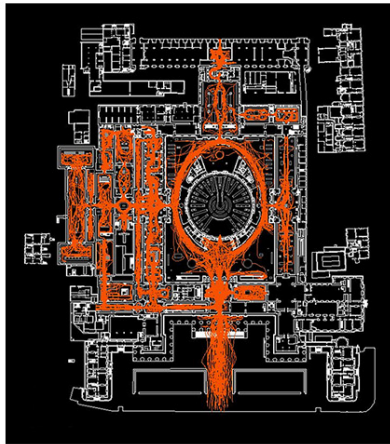
This study has illustrated that the space syntax provided a useful tool for students to think about space. By employing evidence based approach, first it became possible to capture the spatial characteristics of the museum and then different ideas were tested in terms of their effect on the whole spatial configuration to see how space will be used and experienced by their inhabitants. If design is a kind of activity that can be learned by doing and experiencing, this approach provides a useful tool for students to learn from their design decisions. This then can lead them in creating new ideas as well as developing and evolving their proposals.

CASE 3

design education : british museum

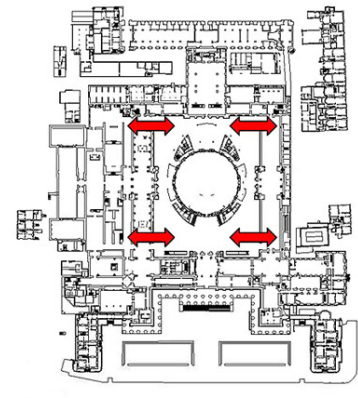
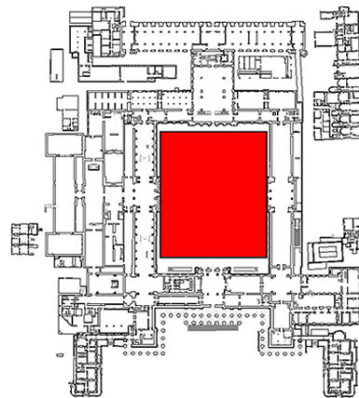
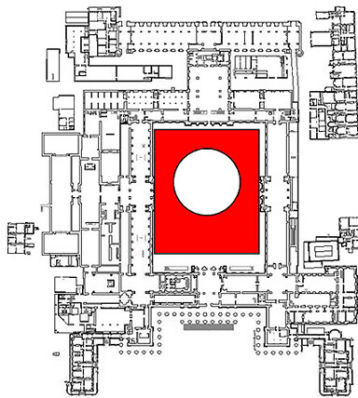
Figure 4:

British Museum (Chicken, et al., 2004)

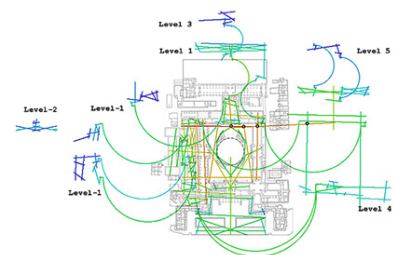
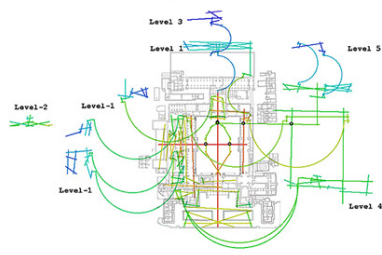
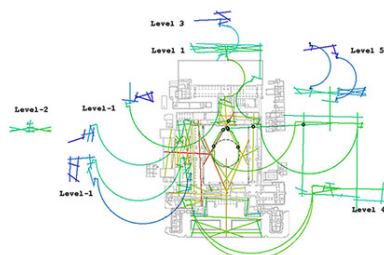


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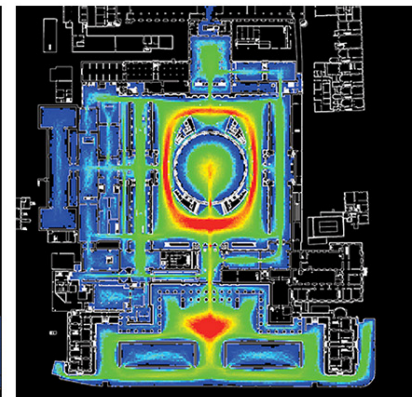
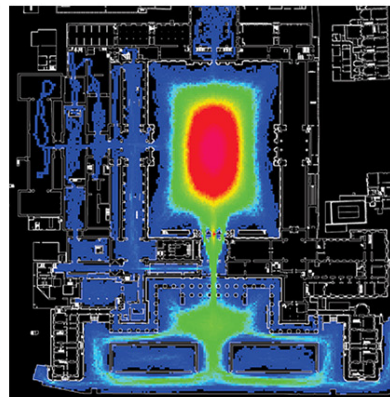
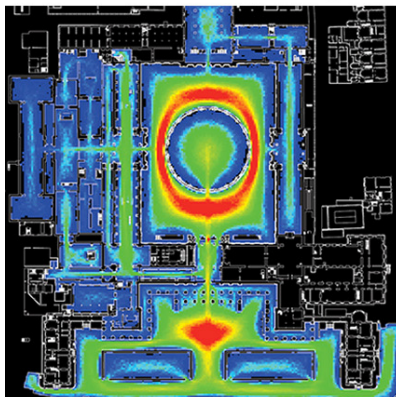
movement traces and vga analyses in existing museum



t h r e e d e s i g n s c e n a r i o s



t e s t i n g t h r e e s c e n a r i o s



t e s t i n g t h r e e s c e n a r i o s

Conclusion

Design process in architecture is not a systematic or procedural process. It is rather a making and discovery process which proceeds by creating and testing design ideas. By taking into account design constraints, architects use a great variety of science based knowledge as well as his/her individual experiences and beliefs in this process. The way how the architect brings these together or what are his/her priorities, or how s/he understands and evaluates them is totally subjective.

Space syntax which is the subject of this study is a scientific or research based approach for understanding and evaluating architectural space. In searching for the relation between space syntax and design activity, critical issues underlined with the three case studies can be reviewed as follows:

Case 1: Space syntax creates an alternative way to interpret and conceive an urban space, to clarify its potentials and exhibited living patterns. By making intangible aspects of urban performance more tangible, this way of understanding enriches the discussion on design of a public space: How it is possible to enhance the living quality in an urban space? How it is possible to integrate a public space with surrounding city in a successful way?

Case 2: This time the space is investigated in building scale. Space syntax provides the design team important data about gallery spaces. This data has emerged from the interaction between user and space. However it has never been revealed in a discursive way. By accepting gallery as context for socialisation and clarifying implicit aspects of its space and culture, it helps the designers to clarify their guiding principles for improving the existing built environment and tests their proposals in terms of their performance.

Case 3: Moving from abstract ideas to designed spaces, space syntax provides an informative tool for students both to conceive and criticize the space in design education.

Based on the three case studies which are examined in this study, the role of space syntax in architectural design can be summarised as follows:

1. In the dialogue between architect and designed space, space syntax presents a language for thinking and talking about space. This is a language which architects aren't familiar to use. It is more scientific, more mathematical. However it is important as it makes non-discursive characteristics of space discursive and puts the space into a more extensive debate.
2. Space syntax carries science based knowledge into design process. It establishes a link between research and design; in this way constitutes the core of "evidence based design" (Hanson, 2001).
3. If design is an activity which is learned by making and testing, space syntax contributes to this process by providing tools for architects to explore their ideas, to understand the possible effects of their proposals, as well as to show how their designs will work.
4. The striking point is that space syntax gives a chance to the architect to evaluate his/her designs not simply as a physical and static entity, but as a living organism, which is experienced by its inhabitants. This kind of evaluation which is based on the interaction between human beings and designed spaces is differentiated from those which only test or indicate the performance of the space against a number of criteria such as cost, energy consumption, level of light, etc.

Here, it must be clarified that space syntax is only one way of thinking about space by focusing on the organization of spaces, movement patterns and their social meanings. If we think that the architect is the person who has a comprehensive conception about human being and inhabited space, his/her duty must be to be aware of different tools and knowledge resources and to have a capability of using them to lead his/her design thinking.

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