SUSTAINABLE URBAN DESIGN APPROACHES AN OVERVIEW

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ABSTRACT: This paper aims to examine the various approaches in urban planning handling environmental principles and it focuses on introduced design techniques. Sustainability refers in this sense primarily to smart and bioclimatic design aspects in terms of social, cultural, economical and technical contexts. Besides an historical overview, contemporary perspectives have been taken from different sections in the urban field. A strong shift has occurred over time in environmental design techniques from early practical methods to ideological prescriptive principles, culminating into a combination consisting of effective instrumental parameters and criteria. A second important change involves the visionary focus from final design product to design process.

KEYWORDS: environmental design strategies, design process, urban design techniques, integration.

1 INTRODUCTION

Environmental design techniques had early on their share in urban planning. In fact, it used to guide the building design and process substantially in early societies and continued to influence until the rise of the industrial era and the modern movement. Whereas previous historical time epochs had always managed to handle the cultural dimension in line with natural basics, this was not the case since ca. 1850 when firstly, machinery was introduced, and secondly, eclectic style fashions took the main stage, leaving hardly any attention for other values. Cultural considerations started to surpass natural logics in a radical way and its results are still visible at present, evidenced by the present building stock and its organizational and political systems. Although environmental concerns have clearly had an incredible boost within the urban domain, it is primarily expressed in technological matters and final touches instead of innovative design approaches.

This paper specifically focuses on design techniques used during the design process that are essential to its results, rather than emphasizing technical specifications, which is often the case within reflections on the environmental field. It generates the opportunity of a relatively neutral display of design approaches and gives the possibility to compare. Within the broad perspective of architectural and urban design history in general, three basic design techniques are to be distinguished: zoning, modeling and montage[1]. Zoning can be defined as the reciprocal positioning of elements in a three-dimensional setting, modeling as to plan or form after a pattern (Webster's Dictionary, 2002), and montage as an artistic composition made by combining heterogeneous elements (Webster's Dictionary, 2002). The purpose of this paper is to examine whether environmental design principles have been part of these basic design principles in an integrative way or that specific design solutions have been introduced as an extra element in the design process. It should lead to better insights into the basic structure of environmental designing during history.

Criteria to judge if environmental design standards are integrative or additional to the basic design method are based on the mentioned definitions: in case the environmental techniques seize respectively a spatial, sculptural or compositional dimension inherent to the overall design they are regarded as rather integrative; in case the environmental practice involves measures that are fairly independent of the main design it is conceived as additional. To disclose as much information as possible about the projects, this paper draws on references to the built work and, if existent, to written works.

[1] Fleurke, N., "Strategies in Architectural and Urban Design handling Complexity *On Techniques and Visions*", in: EAAE Conference Proceedings "The Urban Project", Delft, 2008.

Sustainability and environmental principles primarily refer in this study to smart and bioclimatic design aspects in terms of social, cultural, economical and technical contexts. It is interesting to examine sustainable design techniques applied in varying climatologically regions and especially geographical areas that have a long tradition coping with extreme climate and environmental conditions. This study of environmental design techniques is restricted to approaches and methods that explicitly address design principles.

2 HISTORICAL OVERVIEW

2.1 Context

The course of environmental movements is in writings typically described with a focus on a specific movement or area. Particularly the western development in respectively the US and Europe is extensively discussed in works. Other parts of the world are mainly analyzed for specific countries or continents and occasionally a reference is made (mostly to the US) in order to compare developments. Attempts to examine environmental movements at a global scale (in works as Doherty – 2002, Sinha – 1998, Carter – 2007) tend to concentrate on the political arena rather than on design and management aspects of ideas, opportunities and implementations. As a result, environmental movements are mainly explained as part of the social movement's framework and the debate concentrates on its position within the political scene.

The relatively few reviews on environmental movements that are fairly oriented on the urban planning, architecture and industrial design tend to be widely descriptive of character, setting the spotlight on the projects itself and not on the intentions. In case it discusses the designer's approach, it mostly involves a rather biographical description providing information about developments without explicit references to the exact designer's principles. Other reviews in the urban and architectural field document in a detailed way technical parameters of the projects in order to compare the most advanced projects and techniques and, consequently, do not mention older periods.

Within more detailed studies, although often forming an introduction to current environmental policies in the architectural field, a sharp distinction is made between vernacular and monumental architecture and its inherent intentions. In this perspective, environmental vernacular architecture is not considered as part of the early environmental discourse since it culminated as result of practical considerations and not on basis of ideological holistic worldviews (Jones, 1998). Instead, according to these writers, the roots of the environmental approach originated in the Age of Enlightenment when self-consciousness and ideals became basic elements in the strongly human-centered society. 'It was at this time, in the late eighteenth century, that ideas such as harmony with nature, care for the rights and well-being of the individual and the efficacy of technological development came to the fore.'[2]

Although these views provide insights into the advancement of social and political green movements, it omits large parts of the development of environmental design techniques. In effect, most environmental discourse reviews have been remarkably human-centered instead of world-environment centered and focus on the one-sided relationship how nature can serve human. I would argue it is essential to study the mutual relationship between human (including its built environment) and the state of the world-environment as single entity. It emphasizes not just the natural elements in human settings in this way, but fundamentally the effects of the two units on each other – instead of observing a static situation it examines a rather dynamic situation on basis of the earlier mentioned environmental design techniques.

2.2 Early Directives

For more than 5000 years, people benefited from environmental elements of the earth in its built settings. Local temperature, wind directions, earth materials and land structure have been major influences since the beginning and a huge variety in application can be found. I shall highlight a few significant contributions in order to illustrate the early understanding of the climatologically conditions of the world's environmental system.

One of the oldest major building structures concerns the ziggurat complex; a building consisting of temples and merely accessible for the priest. The first ziggurat complex dates from 2900 B.C. and the latest from 6 B.C, all built in old Mesopotamia, which is present-day Iraq and Iran.

[2] Jones, 1998, p.19

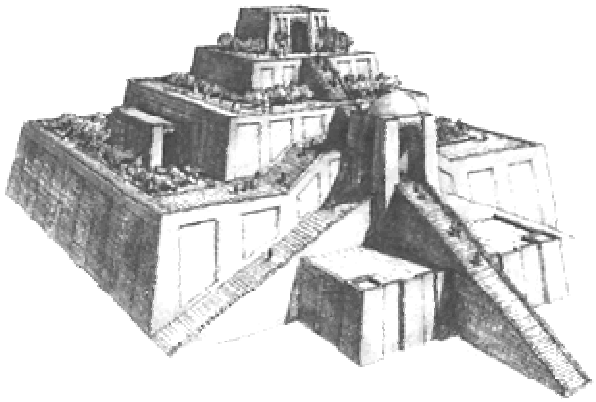

Figure 1 Drawing of ziggurat model as in Ur, 2900 B.C. (Source: ref. [3]).

Although the environmental aspects are basic, they mark the exterior in a noteworthy way: the sideways used to be vegetated along the terraces of each platform and were as important as the solid walls in its urban appearance next to the fact that they kept the inner rooms cool. Secondly, drainage water holes are built within the characteristic walls in order to drain the water from the rooms and the terraces and they break the firm wall by detailing it. Within the complex itself, often a water construction system was present and connected to long canals, usually supplied by a river. Purification took place in several basins that were mostly situated outside the ziggurat, but sometimes inside the complex. In modest addition, some ziggurats had sundials on top of the complex, making use of the sunlight. Considering the whole complex, the environmental design techniques have a sculptural (drainage holes, vegetation) and compositional (terraces, water supply system) dimension within the architectural and urban main approach and are therefore clearly integrated in the entity.

Land conditions and presence of water have always formed incredibly important parameters for the origin of cities and its built structures. This is especially the case in cities with an informal labyrinth pattern, responding directly to local circumstances. Many ancient city patterns in old Mesopotamia show an orthogonal grid as basis and, although environmental values were of concern for its foundation, it lasted long before environmental conditions became an important directive in the further city-layout of these cities. Originally in Mesopotamia, this model was grounded on religious and supremacy motives: a south-north street running from the royal kingdom and an east-west street to the temple cross each other at the central square and this naturally formed the centre of the city. In Asia, a light variation to this model is introduced from 15th century B.C. onwards: instead of two intersecting streets, it was known for nine crossing streets with the royal palace in the south, the market place in the north and the ancestral temple in the east. After further development of the grid in Greek and Roman cities on basis of the acropolis and military functional structures, cities finally also became planned according environmental principles in a deliberate way.

Vitruvius was the first one to write down important environmental principles in a clear way. He regarded it of high importance to plan the city lay-out of the Roman town according to the principles of protecting people against wind, heat and cold, while ensuring views from public places across the sea if possible or ‘with a view to general convenience and utility’ (Vitruvius, 25 B.C.). Hence, on basis of health and spatial/functional premises the cities were configured with great environmental precision and included zoning guide lines, important view lines, walking routes along colonnades and detailed recommendations for the use of materials, waste management and water systems. In this kind of approach, the environmental urban principles are integral part of the urban design as they have large influences on compositional and spatial zoning regulations.

A further reference forms the Chanchan complex in Peru (950 A.D. – 1470 A.D.), which shows both an extensive water drainage construction at the scale of an urban complex and environmental zoning principles. The city is founded in a triangular form and has no enclosement to the north side in order to block the sun. High walls on the south-western side provide protection against the winds from the coast, while the northern walls are lower. It consists of 10 citadels, small walled cities, and each city holds its own main water basin and distribution construction. A wide canal and purification system, built in brick and mud,

facilitates the complex in its water needs and is connected to the Pacific Ocean nearby.

Figure 2 Wind catchers in Yazd, Iran (photo taken by F. Fleurke)

An outstanding development in areas with a sharp temperature difference between day and night has been the wind catcher that was traditionally applied in Persia and later on in many desert-oases areas. Although it is mostly known for its architectural use, wind catchers have also been applied to large complexes and can generate cool air and water for entire city parts. In general, cold wind is let in at night and keeps the spaces cool on day time as it generates a ventilation stream. The wind catcher can be used in several ways and it is even used as a refrigerating device, often in combination with traditional water reservoirs. Both the environmental principles applied in the Chanchan complex and the wind catcher are integral part of the overall design, strongly manipulating its spatial, compositional and sculptural (in case of the wind catcher) facets.

2.3 Regained Interest: Environmental Pioneers

After a sincere interest in environmental techniques early on in all parts of the world, gradually, the reasonable advanced techniques became less common. Although basic principles were still in use, the focus shifted slightly to establish prestigious buildings with a strong attention for style icons. Typical building typologies of these times are churches, temples, palaces, town halls and market halls without many environmental principles incorporated. The human function had clearly become the centre of the attention and environmental elements had become secondary or redundant. Although Renaissance and Classicism in western countries obviously revealed old utilizations and standards of the Greek and Roman times, the environmental practices were almost left out. The modest attention was mainly restricted to water supply and sunlight manipulation.

Renewed interest in the classic period firstly focused on artistic ideas, and secondly, during the Age of Enlightenment, on political, social and organizational ideas. It led to a rearrangement of society and, in building terms, to a large amount of new typologies that were needed to accommodate its cultural rise: theatres, museums, libraries, universities, parliament buildings, stations, warehouses and stock exchanges. As environmental issues still had not been reintroduced in a principal way, it was rather the newly established social and political structures that stimulated the first modern environmental pioneers. Strongly influenced by the technological revolutions and its accompanying disadvantages, the environmental concerns were fairly ideological of character and could be defined as a counter-attack.

The first relevant writings about the environmental subject in this period were accomplished by a few individuals as William Morris and John Ruskin. Slowly, it led to early environmental movements of

which the most well-known is the Arts and Crafts movement. These visions were mostly expressed in a few broad 'rules' or described by some adjectives that could be widely interpreted. Ruskin, one of the most significant critics during the 19th century, supported the artistic group Pre-Raphaelite Brotherhood, which later on inspired the Arts and Crafts movement. A few general ideas were developed as set of rules, as Vitruvius had done before, and included amongst others the following: 'to have genuine ideas to express, to study Nature attentively, and to sympathize with what is direct and serious and heartfelt in previous art'[3]. Morris argued rather to focus on 'individuality, simplicity and usefulness'[4] of the design product and was the one who introduced the Arts and Crafts movement around the end of the 19th century, which endured a strong focus on the original 'natural' craftsmanship of the designer instead of modern industrial realizations or eclectic historic styles.

Figure 3 Wightwick Manor Houses in Wolverhampton, England, inspired by the Arts and Crafts movement. (Photo taken by F. Fleurke).

Both the Pre-Raphaelite group and the Arts and Crafts movement approached the environmental aspects from the perspective of tradition and ethics. It was explicitly a reaction upon the new modern techniques and diverse historic styles of their time and therefore not an independent movement of pure interest in environmental issues.

Within the rising scientific climate, new theories with a certain basis in environmental interests have been developed during the first half of the 20th century. Kevin Lynch has extensively researched the presence of history and time in the urban environment and the influence of the built environment on human with a strong focus on the psychological aspects. Lynch argued for a design technique based on human perceptions and the physical forms of urban environment. According to Lynch a good place is a place that easy can be remembered because of its spatial organization - the 'imageability' is determining for its environmental quality. He developed on basis of a normative theory five criteria and two 'meta-criteria' for performance dimensions of a city instead of rigid standards, which should be differently prioritized in each society: vitality, sense, fit, access, control and as meta-criteria: internal efficiency and justice. It is clear that his environmental interests focus rather on the human perception and psychological aspects than on building physical design techniques. Ruskin, Morris and Lynch all maintain a holistic view and stay unclear about the exact design techniques; the views are rather descriptive and ambiguous. It is consequently hard to judge whether the maintained design techniques are integral or additional of character. As in theory the formulated principles should be applied to every single design step, the design statements could be conceived as an integral part of its final design. Though, the design techniques are obviously just directed at the conditions of

[3] This set of rules was defined by William Michael Rossetti at the founding meeting of the Pre-Raphaelite Brotherhood in September 1848.
[4] Stansky, 1983, p. 67

the human, leaving the world conditions out, and therefore it could even be regarded as not specifically environmental from a building-physical perspective.

Since the 1960s Christopher Alexander worked on a design technique with roots in natural principles called 'A Pattern Language'. The main idea behind the theory is that every building complex should be built out of specific structural and classic patterns like a 'generative grammar' as is visible in nature. The mentioned patterns are based on long-standing examples of successful building traditions. Alexander defined 15 common features of successful structures, which are the following: levels of scale, strong centers, boundaries, alternating repetition, positive space, good shape, local symmetries, deep interlock and ambiguity, contrast, gradients, roughness, echoes, the void, simplicity and inner calm, and non-separateness. The different properties are described in an exact way and Alexander prescribes a rather strict way of designing architecture based on these principles, relating all scale levels to each other via detailed defined patterns. As a result, the structuring aspect heavily characterizes the design technique in an integral way. However, although this approach has a basis in natural environmental principles, it does not include the environmental state of the world and just focuses on human conditions.

2.4 Movements

As part of scientific and political discourse, the environmental movement became a significant and explicit sub discipline in the 1960s. During this time, platforms and groups were formed to discuss the architectural and urban possibilities, which continued on thoughts of the early pioneers. Examples of these formations are 'Principles of Intelligent Urbanism' (1960s), 'Permaculture' (1970s) and 'New Urbanism' (1980s).

‘Principles of Intelligent Urbanism’ (PIU) has its roots in Team Ten and the ‘Congresses International Architectura Modern’ (CIAM), which took place during the 1960s. Christopher Benninger is the most prominent practitioner of the movement and the principles focus on integration of different urban and management issues. Ten axioms of design principles have been formulated: environmental sustainability – balance with nature, heritage conservation – balance with tradition, appropriate technology, place making – conviviality, efficiency, human scale, opportunity matrix, regional integration, balanced movement – integrated transport and institutional integrity. Instead of approaches from one single discipline (tradition/ethics in Arts and Crafts movement, structural perspective of Alexander and psychological perspective of Lynch), PIU introduces an environmental integrated view. It covers the wide range of environmental issues from building technology to management ideals, social ideals, preservation theories and urban zoning strategies and clearly includes in this way the spatial and compositional dimension. A new interest in old environmental principles exposed during early civilizations and ancient periods is shown. PIU does not involve any architectural prescriptions, although it strongly focuses at a social hierarchy from the individual scale to the public scale by introducing different entities: individual domain, friendship domain, householder’s domain, neighborhood domain, community’s domain and city domain. The social component turns out to be the connecting principle within the integrated city structures and has therefore a strong emphasis.

Initiated by Bill Mollisson and David Holmgren in Australia during the mid 1970s, the term permaculture referred in its origin to permanent agriculture and was developed as an alternative for industrial agricultural practices. Later, the term permaculture also stood for permanent culture, since social aspects were regarded as a vital element of a sustainable system. Permaculture has a strong sustainable systematic focus since it evaluates the ins and outs and the properties of every transfer, object and process. The roots are based in ecological theory in which characteristics and relationships of natural systems are analyzed and applied to characteristics and potential relationships between design elements in order to coordinate an optimal sustainable system. Synergy should be achieved and complex systems can emerge; the organizational and connecting principles as spotted in nature are the central instruments in permaculture. David Holmgren has developed 12 main design principles for permaculture for all its applications of which are the most important: observe and interact, catch and store energy, apply self-regulation and accept feedback, use and value renewable resources and services, produce no waste, design from patterns to details, integrate rather than segregate. Permaculture clearly approaches the environmental design technique from a integrative relationship structure of intelligent linked processes in which it analyzes both the characteristics of the structure itself as the designed relationships and comprises the spatial, compositional and sculpturing dimension in its design results.

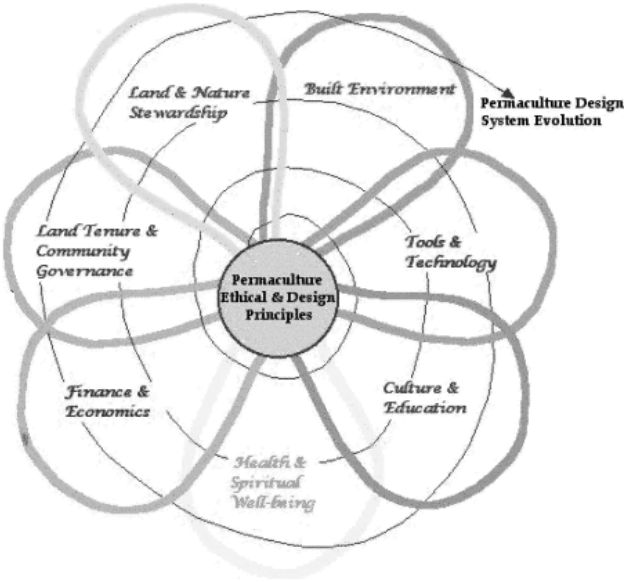

Figure 4 The Permaculture Flower developed by Holmgren in 2002. The loop goes around the key areas that require transformation in this order to create a sustainable culture; it reflects the evolutionary path.

The movement New Urbanism, originated in the United States during the 1980s, envisages designed urban area for pedestrians and considers the neighborhood as the basis of good urban design. It has a strong rooting in traditional concepts and gives the pedestrian a central place in the urban environment in opposition to the car-centered and sprawled cities in the US. In 1993, the first Congress for the New Urbanism was hold and in 1997, the Charter of New Urbanism was established. It contains different sections for the region (metropolis, city and town), the neighborhood (neighborhood, district and corridor) and the block (block, street and building). Each section has 9 design principles of which the most important elements are the following:

- Neighborhoods should be diverse in use and population
- Communities should be designed for the pedestrian and transit as well as for the car
- Cities and towns should be shaped by physically defined and universally accessible public spaces and community institutions
- Urban places should be framed by architecture and landscape design that celebrate local history, climate, ecology, and building practice

The New Urbanism movement focuses on traditional and social architectural concepts, leaving the environmental building physics aside. Although this movement prescribes functional, cultural and social aspects, it has not explicit spatial, compositional or sculptural implications for its design and can therefore be considered as an additional design technique.

3 THE CONTEMPORARY INSTRUMENTAL PERSPECTIVE

During the 90s, the environmental focus gradually shifted to the quantitative parameters, setting minimal limits to be reached within projects. The DCBA-method of Duijvestein is a clear example of this approach, in which building materials, energy and water cycling methods are divided into 4 categories. Variant A stands for the most sustainable alternative, while variant D is the less environmental orientated option. Also this technique is rather additional of character since it implies no spatial, compositional or sculptural parameters for its design.

Within the current domain, it is clearly the ambition to integrate and combine different

environmental perspectives and options shown during history with a strong emphasis on new technical techniques and possibilities. It does not focus any longer on just one scale, but covers the wide spectrum from micro-algae to large-scale urban planning. It has become the aim to use the environment in a smart way, and even more, to facilitate the world's complex climatologically environment and, if possible, to improve its conditions. The design process has taken a central place in this approach instead of the final design product, in which integration and balancing the different demands has become the main aspect.

Ken Yeang has shown a long tradition in combining a large amount of design parameters on large-scale building projects. His buildings feature amongst others vertical landscaping, zoning principles, stepped terraces, wind scoops usage, eco-land bridges, vertical linked enclosed atria and smart energy and water use. Yeang distinguishes four infrastructures which are key to defining a holistic approach towards urban planning and to repair ecosystem fragmentation: eco-infrastructure, engineering infrastructure, water infrastructure and human infrastructure.

Figure 5 Perspective drawing of plan for Zorlu Ecocity in Turkey by Ken Yeang. (Source: ref. [19]).

At the scale of an architectural building he defines as well four infrastructures: the red infrastructure of energy, the blue infrastructure of water, the grey infrastructure of installations and lastly, the available resources to actually make the building. It is the main task to find a balance between all these different and conflicting demands, in which strategies have become crucial. Interestingly, the urban scale approach shows a strong involvement on spatial, compositional and sculptural values and can therefore be regarded as integrative. The infrastructures on the architectural scale however, are rather independent of architectural and urban design parameters and can be regarded as additional in character.

4 CONCLUSION

Land zoning, wind - sun usage/blockage and facilitating water structures mark the early environmental design techniques. It clearly shows a focus on the physical building component of environmental design principles generating relatively convenient conditions for both the inhabitants and the world system. After the fall of the Roman Empire during the 5th century, environmental knowledge and applications are lost in a significant way and the attention turns to establishing communal places of economics and religion and private expressions of power without particularly environmental interest. For almost a millennium the environmental building qualities are reduced to facilitating water structures and sun usage/blockage.

Consequently, instead of a gradual evolution of early environmental techniques, a strong disruption is visible and almost a new start occurred in the second half of the 19th century with a main focus on the human conditions. Within this new approach, it is the social, political and organizational perspective that

gave attention to environmental issues and, as a result, an opposite vision is noticeable – holistic, ideological world views are predicted in sets of ideas, strongly stimulated by the present social, political and technical conditions in society.

During the 20th century, both perspectives merged and were significantly enriched in both its technical aspects as the social and political sides. An important addition was the quantification of design techniques, measures and results. Recently, it has become the aim to integrate the entire spectrum of environmental techniques varying in scale, discipline and management, which requires tactical strategies and improvisation. This approach has led to effective instrumental parameters and criteria, and secondly, to a shift of the visionary focus from final design product to design process.

Regarding the character of the environmental design techniques in general, it can be concluded that most ancient and pre-modern principles have integrative dimensions and influence to some extent the spatial, compositional or sculptural features of the design result. More precisely, these designs would have been fundamentally different if no environmental techniques were applied in its construction; the design and environmental aspects are inseparable related to each other. This relationship changes considerably within main design approaches in the last decades. In these cases the environmental techniques are rather technical in character and can exist independently of the architectural and urban main convictions. It would be interesting if environmental aspects and design techniques start again to influence the typological pattern of building settings in a noteworthy way.

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