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Research

Friendly and Beautiful: Environmental Aesthetics in Twenty-First-Century Architecture

Abstract. Until recently, environmental control systems have been more often suppressed than expressed, hidden from casual observers and building users, rarely featured as architectural design elements, or considered aesthetically. While the impact of the overall form of a building on its thermal environmental performance may not always be apparent, the mutual influences of shape, form and orientation should be evident to – if not a basic activity of – a well-informed professional. A primary aim of this paper is to encourage a new aesthetic sensibility for the 21st century; one that conceives architectural form with respect to environmental context and ecological efficiency. Toward this end, I propose a method of comparative analysis, using several recently completed and speculative architectural projects.

1 Introduction

Over time, humans have cultivated a wealth of knowledge about living in harmony with a variety of environmental conditions. This accrued wisdom has produced many ingenious and commonsense building methods, optimizing local resources and site conditions, while evolving spaces to support and promote human activities. Whether by vernacular tradition or professional training, this has been accomplished with a very high degree of artistic expression [Fathy 1994]. The multiple influences of architectural form – pragmatic, social, aesthetic – are essential to assessing the validity of an architectural solution. Originating from the Greek term *aisthetikos*, aesthetics represents the study of beauty, an open-ended field of inquiry that continues to evolve as social, political, technological and ecological developments contribute to new views on art, architecture, design and their manifestations in the built environment [Baird 2001:3-4].

2 Research problem, aim and methodology

The main aim of this study is to address formal geometry as qualitative criteria for a more integrated approach to conceiving environmental control systems in buildings. Specifically, how might aesthetics enhance their quantitative, functional and scientific dimensions? Architectural design is dependent on a satisfactory reconciliation of the intuitive with the rational; "A building has to be both poem and machine" [Jones 1998]; [Baird 2001: 4]. All applied technologies – complex or simple, active or passive – should be part of an architectural language where building envelopes generously and advantageously embrace site geometries and orientation. We will briefly address the aesthetic potential of environmental control systems and offer an initial sketch of a larger program to focus on the following issues:

- being environmentally friendly and creatively expressing environmental control systems, opening up a wide range of potential design solutions;
- integration of building services and passive environmental control systems as inherent to the design solution;

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– identifying examples of fruitful collaborations among disciplines and design professionals for further study.

3 Expression in architecture: the issue of environmental systems

3.1 Historical contribution

Thermal environmental control systems in buildings range from fully active, through hybrid, to fully passive. Most buildings represent hybrid solutions. For pre-industrial man, including the ancient Greeks and Romans, passive environmental control systems were openly expressed in the building forms and materials selection, in response to ambient climate conditions. Despite the visual exaggeration of early features of environmental control, the tendency for the mid-nineteenth century was to incorporate newly developed systems unobtrusively into the building fabric [Baird 2001: 13]. Until recently, then, environmental control systems were typically implicit rather than explicit.

3.2 Environmental control systems: potential for expression

Vertical and horizontal transportation, exploited as major service systems with expressive potential, includes the full range of the thermal environmental control systems; active, passive and in between. Passive systems are expressible externally through form, the solar and polar orientation of the building, the geometries of site and exposure to the elements, as well as in the detailing of the exterior envelope. The building façade or external envelope is a primary thermal environmental control system; composition of the façade influences the rate and degree of heat gain and loss to the building through thermal radiation, convection and conduction. To make use of the ambient energies of sun, wind and outside air temperature, the building skin is concerned with the admission/rejection of solar radiation, fresh air and heat gains/losses due to temperature differences. The main design features here include proportion and disposition of glass to solid, and techniques of solar shading, including extensions and fins, which augment pressure differentials on the various windows, and the horizontal and vertical orientation of the envelope surfaces. The main concern in the building interior, on the other hand, is provision of thermal comfort and air movement by natural forces. Table 1 (below) sums up the different approaches and types of the thermal control systems in relation to their potential expression [Baird 2001: 10-17].

4 Creation of theory : aesthetics in architecture

4.1 Aesthetics and perception in architecture

Etymologically, *aesthetics* relates to perception. Modern use of the term was coined by Alexander Blaumgarten in 1750 to denote the study of taste in fine arts. During the last century, there has been a search for a positive science of aesthetics, while the field of empirical aesthetics has grown substantially. These studies have sought to identify and understand factors that contribute to the perception of an object or a process as "beautiful" or as a "pleasurable" experience, and to better appreciate the human desire and ability to create and enjoy creating displays that are aesthetically pleasing. Here, George Santayana's distinctions among sensory, formal and symbolic aesthetics (see Table 2 below) are still useful [Lang 1987: 179-204].

Active systems	Passive systems
−Usually designed by engineers. −Consist of heating, ventilating and air conditioning systems.	−Traditionally the role of the architect. −Are dependent on the building form, construction methods and material selection.

Banham's three modes of Environmental Management [Banham 1969: 23]**:**		
Conservative	**Selective**	**Regenerative**
Involves relatively massive construction to isolate internal and external temperatures.	Uses external fabric of the building to admit desirable environmental effects and reduce the undesirable.	Implies the use of energy to control the internal environment.

Hawkes reworked Banham's terms to make a clear difference between [Baird 2001: 10-11]:	
Exclusive	**Selective**
Use ambient energy sources in creating natural environments.	Rely predominantly upon mechanical plants to create controlled artificial environments.

Levels of Rush's visible integration scale [Baird 2001: 15-17]:		
Level 1	**Levels 2 and 3**	**Levels 4 and 5**
Not visible, no change.	−Handle them simply and forthrightly. −Visible, but little or no surface change.	−Treating systems as design opportunity. −Visible with size or shape change or with location or orientation change.

Table 1. Types of thermal environmental control systems involved in relation to their expressive potential

Whether or not one pursues profound studies of aesthetics, what makes one building or place beautiful or not remains open to a considerable amount of personal interpretation. Furthermore, the aesthetics of a given architectonic language selected and/or developed by the architect, design professional, and/or client is influenced by many factors, including context, program, and construction materials and methods, as well as personal or cultural predispositions. Bearing in mind that there is by no means a single solution for any given architectural design problem, it is incumbent on responsible designers to explore widely for sources of inspiration at various scales, to contribute to the whole concept as well as its parts.

4.2 Normative environmental design theory

A friendly built environment depends on a variety of factors, including the need for design professionals to advance ecological and humanitarian ideals and not only their own skills and knowledge. New and available building and system technologies should be tuned to site conditions, allowing local climate and geometries of site topography to exert predominant influence on the shapes and forms of buildings and cities. Many architects have designed multiple buildings in the same cities, for similar purposes, yet their designs may be startlingly different from one project to next. Analyses of these differences have long been central to architectural theory, providing case studies for professionals and academics. Many practitioners urge that a responsive and healthy environment stimulates an individual's physical, mental and spiritual development, providing a sense of security, pride, privacy, community, and vitality, at a scale in keeping with human needs rather than dictated by machines or computer-compiled statistics. They hold that harmony among site and climate, the built environment, and occupants will further encourage conservation of energy and natural resources [Lang 1987: 217-32].

	Sensory Aesthetics	Formal Aesthetics	Symbolic Aesthetics
Background and Field of Concern	-We know very little about sensory aesthetics. Speculations on the topic [for instance, Rasmussen 1959 and Heschong 1979] are based largely on highly subjective and fascinating introspective analyses.	-Concerned with the appreciation of shapes and structures of the environment in response to certain patterns, proportions or shapes that are not biologically based, but are based rather on self conscious and intellectual reasoning. -Based on the Gestalt Theory of Perception.	-Concerned with associational meanings of the patterns of the environment that give people pleasure through significance, meaning and feelings.
Aesthetic Values	-Sensory values are those generated by pleasurable sensations. -They are obtained from the textures, smells, tastes, sounds and sights of the world. Here, we are more concerned with sight and hearing.	-Formal values arise from the order of sensory material, perception of the system and relationships that exist in the patterns, proportions and ordering principles.	-Expression or associated values as: *Unity and Rhythm*.

	Formal Aesthetics	Symbolic Aesthetics
Aesthetic Variables	-The shapes, proportions, rhythms, scale, degree of complexity, colour harmony, illumination and shadowing effects of the built and natural worlds. -Elements of design: dots, lines, planes and volumes -Principles of Composition: simple or complex. -Order and disorder: Perceptual Order and Proportional Schemata.	-Image, sign and symbol. -Variables in the built environment that carry meanings are: ▪ Building configuration ▪ Spatial configuration ▪ Materials ▪ Nature of illumination ▪ Colour

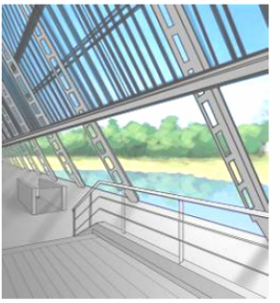
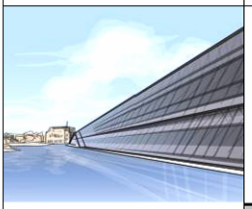
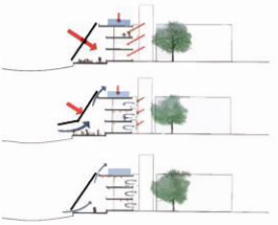
Table 2. Santayana: Study of Sensory, Formal and Symbolic Aesthetics

5 The green manifesto: the new link and paradigm

In *The New Paradigm in Architecture*, Charles Jencks considers the new aesthetics of environmentally conscious buildings in the late twentieth and twenty-first centuries [Jencks 2002: 228-34], describing the landform, blob and topological surface as new metaphors of nature and methods of dealing with complexity: "A computer is not a brain, an ecology is not a body, but these are all analogies of each other" [2002: 228]. For Jencks, metaphor offers a vital agency of expression in the new paradigm of twenty-first-century multiplicity, grafting ecological principles with cybernetic technologies. For example, such high-tech architects as Norman Foster, Richard Rogers, Renzo Piano, Dominique Perrault, and Jean Nouvel now routinely incorporate growing plants in their structures, creating self-sustaining systems supported by, but not limited to, computer-centered technologies [Wines 2000: 8-15].

The five case studies shown below provide an overview of analyzed examples of late-twentieth-century environmentally conscious buildings.

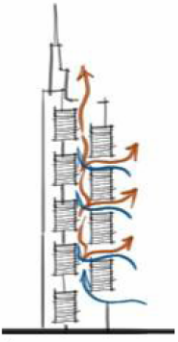
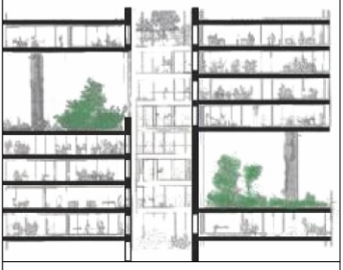
<table>
<tr><th>Case Study/ Building</th><th colspan="2">Architectural/ Environmental Treatments</th></tr>
<tr><td rowspan="5">1. SCIENCE AND TECHNOLOGY PARK:

Gelsenkirchen, Germany, 1989-1995, by Kiessler + Partner, Munich. [Baird 2001, 68-75] & [Herzog 1996, 98-99]</td><th>Geometries of Site</th><th>Geometries of Form</th></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>  </td><td>A 300m elongated glazed comb-like gallery is placed on a north-south axis overlooking an artificial lake; part of an urban park.</td><td>-Nine pavilions lead from the three-storey triangular cross- section glazed arcade forming a linear comb-like form.
-The linear façade slopes skywards facing west forming a funnel towards the sun.</td></tr>
<tr><td></td><th>Geometries of Design Elements</th><th>Environmental Control Details</th></tr>
<tr><td></td><td> 
a. Winter day
b. Summer day
c. Summer Night

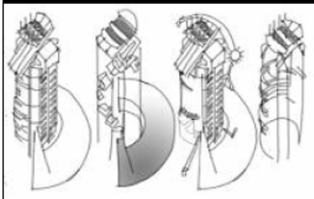
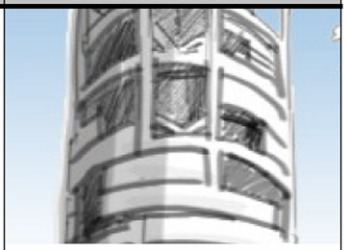
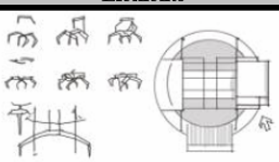
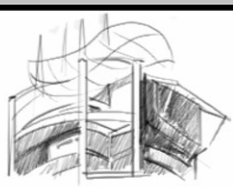
The rectangular lower third of the long glass façade may be opened electronically to create a walkway to the public to make use of the cooling potential of the lake water.</td><td>-Passive systems: in summer the boundary between inside and outside is blurred, extending the building's arcade to the park, allowing for natural ventilation and night cooling, avoiding need for mechanical systems. Large openings in the west façade and appropriate construction materials are influenced by sound conditions.

-Active systems: a photovoltaic solar panel system is installed on the roof. Control of the environmental system is via a bus system that facilitates energy management.</td></tr>
</table>

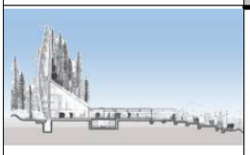
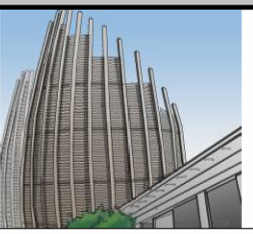
Case Study 1. Analyzed examples of late twentieth-century new architecture: environmentally conscious buildings: Science and Technology Park

Case Study/ Building	Architectural/ Environmental Treatments	
	Geometries of Site	**Geometries of Form**
2. COMMERZBANK HEADQUARTERS: Frankfurt, Germany, 1991-97, by Foster and Partners. [Herzog 1996, 108-9]		 
	The world's first ecological high-rise tower whose plan is triangular in form, each side being curved to maximize space efficiency. The triangular form is integrated in the trapezium shaped site to fit in its corner.	Lifts, staircases and services are placed in the three corners of the triangular floor plate. The lifting pattern is designed through vertical masts enclosing the corner cores and supporting eight-storey vierendeel beams which in turn support clear span office floors and gardens enabling all to be totally free of structure.
	Geometries of Design Elements	**Environmental Control Details**
		 a. Atrium b. Garden c. Terrace
	The sixty-storey skyscraper is cut open and turned inside out forming a hollow shaft around which spiral a series of sky gardens; through which natural light and fresh air enter the hollow core and spaces that face-in on it.	Natural Ventilation with opening windows is applied. Winter gardens spiral up the tower to become the visual and social focus for four-storey clusters of offices. These gardens are linked to a central atrium, throughout the full height of the building, acting as a natural ventilation chimney for the inward looking offices.

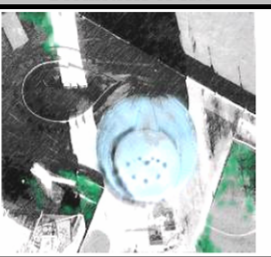
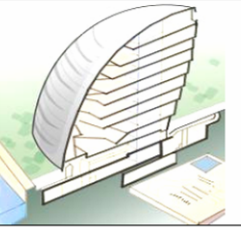
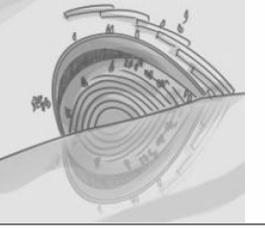
Case Study 2. Analyzed examples of late twentieth-century new architecture: environmentally conscious buildings: Commerzbank Headquarters

Case Study/ Building	Architectural/ Environmental Treatments	
	Geometries of Site	**Geometries of Form**
3. MENARA MESINIAGA: IBM Malaysia, 1992, by Ken Yeang. [Herzog 1996: 160-1], [Daniels 1997: 28] & [Mostafa 2008: 192-7]	 a. Built form- b. Planting & terraces- c. Orientation- d. Glazing & shading	
	An example of a sound environmental filter with vertical landscaping that transforms the impact of high-rise buildings in the ecosystem of a city. Its tri-partite structure consists of a raised green base responding in plan and form to the tropical climate, orientation and location, and creatively integrating with the site.	The circular spiraling fabric of the tall building with landscaped sky courts allows vertical relief for office users, in addition to providing continuity of spaces through connecting the land with the building. The sloping landscape base shifts in each floor to connect the land with the vertical of the building.
	Geometries of Design Elements	**Environmental Control Details**
		
	-Sky gardens that serve as villages. -Spiral vertical landscape. -Recessed and shaded windows in the east and west. -Curtain wall glazing in the north and south. -Single core service on the hot eastern side. -Naturally ventilated and sunlit services. -Spiral balconies on the exterior with full height sliding doors opening up on interior offices.	-At lower three levels artificial landscape was created to shelter and insulate the building from the morning sun. -A sun screen structure, made of steel and equipped with terraced garden balconies, holds aluminum panels and external louvers to reduce solar gain and provide shade. -A sun-roof arching across the top-floor pool and installed solar panels reduce energy consumption of the building cooled by natural ventilation, sun screens and air conditioning.

Case Study 3. Analyzed examples of late twentieth-century new architecture: environmentally conscious buildings: Menara Mesiniaga: IBM

Case Study/ Building	Architectural/ Environmental Treatments	
	Geometries of Site	**Geometries of Form**
4. JEAN-MARIE TJIBAOU CULTURAL CENTER: New Caledonia, 1998, by Renzo Piano. [Wines 2000:130-1] [Herzog 1996: 160] [Mostafa 2008: 213-23]	 A contemporary architecture in harmony with the natural context and human values of the *Kanak*'s community integrates and sinks into the topography of the natural site. Inspired from the traditional Kanak house, with an additional unfinished look, the center consists of 10 buildings with three different sizes creating a symbiosis of: nature, Kanakan tradition and modern architecture. The location is characterized by bold natural contrasts: rich vegetation, tranquility of the lagoon and strong prevailing winds.	 The shell-shaped structures set facing the prevailing strong winds is self-reflective to its function and creates a suction effect on the leeward side, drawing out the warm air that collects in the interior ensuring an adequate air exchange. The design is characterized by its great sensitivity to site and increased use of terrestrial materials and vegetation. Piano refined his design with the help of the local people in a site of remarkable significance, using advanced technology with careful aesthetic consideration.
	**Geometries of Design Elements**	**Environmental Control Details**
	-Use of prevailing trade winds to obtain natural cross ventilation. -Ribs and slats with modifying effects to high winds. -Louvers open and close according to wind direction allowing breezes through spaces while air is expelled from the highest roof points; passive ventilation. -Double skinned façade provides large air spaces between woodwork and glass forming the stack-effect where cool air replaces hot air during the day. -The African rot-resistant *Iroko* wood turns silvery grey overtime due to weather effects, harmonizing and blending its color with the coconut palm trunks in site.	 -Computer-operated climate control system in the whole complex. -Manipulation of the region's bio-climatic typology achieving high level of human comfort using passive cooling where the entire buildings are dictated by wind and sun orientation

Case Study 4. Analyzed examples of late twentieth-century new architecture: environmentally conscious buildings: Jean-Marie Tjibaou Cultural Center

Case Study/ Building	Architectural/ Environmental Treatments	
	Geometries of Site	**Geometries of Form**
5. CITY HALL: London, UK, 2002, by Norman Foster and Ken Shuttleworth. [Mostafa 2008: 188-92]		
	A deliberately iconic distorted glass sphere projects out of the flat geometry of the natural site and landscape. Yet through its original transparency, it integrates to all its surrounding. This transparent offset inclined form is designed around a magnificent interior ramp down which the people can symbolically walk above the debating chamber, embodying the democratic process and promoting an image of the modern city.	The naturally ventilated glass egg-like form reduces both the solar gain and heat loss through the building skin. The minimization of building's surface area also results in increasing its energy conservation efficiency. The leaning shape also provides natural shading from intense direct sunlight.
	Geometries of Design Elements	**Environmental Control Details**
		
	On floor and roof levels and vertical landscape creates a microclimate at the façade on each floor level. It acts as a windbreaker that absorbs CO_2, generates O_2 and counterbalances the huge use of artificial materials with natural plants and soil.	-Solar panels are installed on roof to provide solar power. -Heat generated by computers and lights is recycled, so no chillers are needed. -Cold ground water is used to air condition the building then reused in services and for irrigation in attempt to minimize water use. -The whole building works on quarter of the energy consumed by a comparably sized office building.

Case Study 5. Analyzed examples of late twentieth-century new architecture: environmentally conscious buildings: London City Hall

6 Synopsis: Twenty-first-century environmental aesthetics: an initial sketch

Examining the efficacy of environmental control systems and their aesthetic potential for architectural expression reveals new opportunities to join scientific and artistic facets of architectural practice, two modes often considered to be at odds. Whether active, passive or hybrid, architectural environmental controls can effectively and beautifully express a commonsense attitude toward environmental and cultural resources. This paper, it is hoped, offers an *initial sketch* for assessing formal and symbolic values through aesthetic analysis (table 2) in relation to the environmental friendliness of a building (tables 1 and 3). This sketch is intended to stimulate the development of new research tools to obtain finer-grained feedback regarding quantifiable and qualifiable building assessments, using questionnaires, opinion polls or similar methods. By mindfully integrating the multiple forces that give rise to a building – cultural, topographical, technological – aspects that are often considered separately may be harnessed to enhance a building's experiential measure of pleasure, as well as its longer term sustainability and performance.

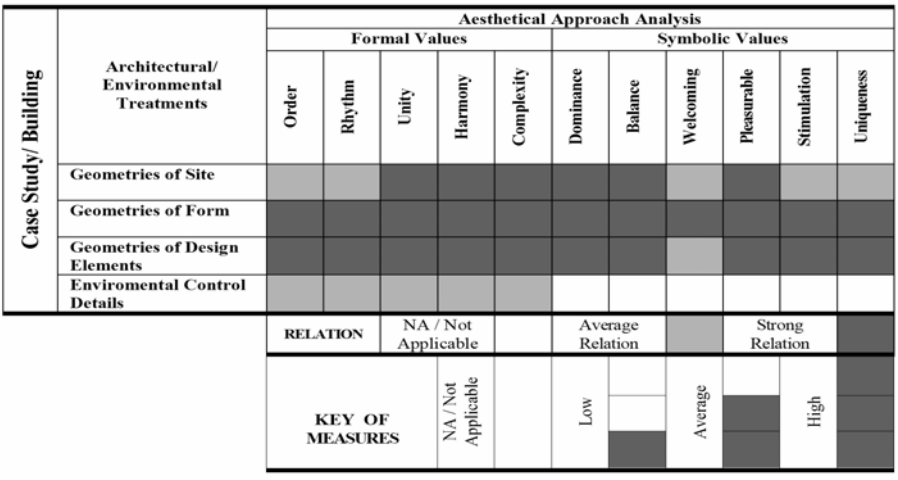


Table 4. Sketch/relation measuring aesthetical values - in relation to - environmental friendliness

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