A Study on Preliminary Architectural Orientation Design Methodologies for Sustainability

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Abstract: The objective of this study is to present and to analyze preliminary orientation design factors in the design stage of sustainable architecture in the viewpoint of technocentrism. Typically people interpret solar energy system architecture as simply being part of a mechanical system. Yet, even before considering energy-consuming physical systems in buildings, it is very important to consider the outer parameters of sustainable design factors and the design process itself for the effective and suitable energy-saving design methodology. By analyzing the evolving phases and history of technocentrism and solar energy systems in sustainable architecture through examples and case studies, this paper focuses on and proposes preliminary orientation design factors that should be considered when starting the architectural design process in the viewpoint of technocentrism.

Key Words: Orientation, Sustainability, Solar-Energy, Preliminary Design Factor, Technocentrism

1. Introduction

When we think of heating, ventilation, and air-conditioning (HVAC) systems, we generally think of them as automatic energy input systems, with their technologies being integrally combined with their facilities. We take it for granted that these systems need a certain amount of energy to create comfortable environment. While, solar radiation in the form of light can replace electricity, in reality much of the energy used to power buildings is still generated inefficiently, and unsustainably using nuclear energy and fossil fuels. At the level of architectural planning, designers need to increase their awareness and employment of sustainable design processes when approaching a project in the viewpoint of technocentrism.

We can find the sustainable architecture case of wisdom from the past and nature. Before using energy and energy-consuming technology, designers should consider preliminary architectural level design processes that stem from other examples...
of sustainable architecture.

We can find cases of sustainable architectural practice from the past as well as from nature. This approach will save considerably more energy from the very beginning of a building’s life span. The focus should be on preliminary orientation design methodologies that adopt building–mass manipulation and creative design solutions without artificial energy-consuming technology, creating year-round comfortable spaces as naturally as possible. Comparing the technocentric philosophy of sustainable architectural design with alternative thinking, how sustainable architectural design concepts have evolved with environmental knowledge throughout history is presented here. More specifically, this study highlights natural-orientation methodologies which can be used and considered at a preliminary level of design process, avoiding energy-consuming artificial means. These are primarily connected with the building envelope utilizing convection currents. In this paper, Park Hoon’s analysis for technocentrism philosophy is important to understand how we can adapt architectural orientation methodology into metaphysical level of technocentrism. Collin Porteous’s analysis and case studies for so called Eco-architecture are also good examples for combining technocentric philosophy and architectural cases together.

2. The Concept of Technocentrism

Ecocentrism is an expression used to indicate a nature-centered, as opposed to a human-centered (socio-human centrisim), system of values as shown in Table 1. Ecocentric beliefs might arise out of persuasion on ethical grounds. Technocentrism, on the other hand, is a value system that is centered on technology and its ability to control and protect the environment. Technocentrics have a strong belief in technology and industry, and are of the viewpoint that humans have control over nature.

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<th>Environment</th>
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The characteristics of each concept are described in more detail here. Firstly, ecocentrism
is based on a philosophy of natural ecology. Its political base is anarchism. The social objective of it is its coexistence with the natural environment. On the contrary, technocentrism is based on the open-market economy and liberalism. (table. 1) Naturally, the social objective of spirit is overcome by the development of technology leading to continual wealth for economic growth. The pursuit of urban-level adaptation contributes to growth-management policy. At a complex level, it focuses on high-density development, energy saving technology, and the bigger development of the economy. At an architectural level, it adapts new technology, and new material for more economic value gain. Eco-friendly products and personal consumption is the life pattern of technocentrism. Next, we examine the technocentric preliminary design methodology at the architectural level, which is based on the orientation for energy-saving in the first level of design stage.

3. Sustainable Architecture Methodology for Technocentrism

There have been numerous approaches throughout architectural history to create sustainable architecture in order to save energy. Such approaches include allowing for natural heating and using the natural flow of convection currents.

One case of natural heating and ventilation is found in the former assembly hall of Glasgow School of Art in Scotland, designed by Charles Rennie Mackintosh. Its design adopted what has been found among Roman remains, showing that similar natural heating and ventilation strategies have long since been known.

Modern warm-air HVAC systems arose from the refurbishment of the temporary House of Commons building in 1836 in London, England. Such a system involves natural displacement, in which relatively cool air flows from low-level introduction and meets warm air as it rises (Fig. 1). The combined air flows together upward into a plume for exhaustion. Solar energy can and should help to both reduce CO₂ emissions by reducing the energy loads of buildings, and supplement natural supplies of fresh air by means of preliminary design techniques. The main methodologies for preliminary design consideration in the design level stage is as follows.

Firstly, using natural convection currents.
There is also the technique of using a wind-load canopy, using the double skin envelope for convection currents, and using a water space for cool convection currents flow in front of the building. This can include inducing water inside the building and using mass manipulation to trace the trajectory of the sun’s path. In the case of the Malaysian architect, Ken Yeang, he often uses building mass-cutting and planting tracing the trajectory of the sun’s path. Yeang is discussed further in Section 4.

Secondly, a 35-degree slanted glazing system combined with a passive louver is one of the easiest ways to achieve energy gain in the winter time and avoidance from the sun in the summer time (Fig. 2). A double skin combined with a balcony (sun space) is a universal energy saving solution that has been used from ancient times in architecture. More famously in modern times, Le Corbusier used the brise soleil to shield interiors from strong sun.

Thirdly, studying louver reflection plate angles and reflection material would be useful and effective in energy saving. These days, angled glazing and convection currents chimney effects combined with solar energy photovoltaic (PV) panel design is one of the more challenging areas when making energy saving with low cost. Artificial approaches are not a priority for architectural solutions but should be considered for sustainable design. The Photonics Center in Adlershof, Berlin, Germany (1995), designed by Sauerbruch Hutton, is a good example with respect to double-skin envelope performance. It has an amoeba-shaped plan with a double skin of alternate narrow sections for exhaust air, and wider ones for intake. This section can be changeable according to the amount of sunlight. The R&D center by Uwe Kiessler, Gelsenkirchen, Germany, C. 1996 is another strong example of a natural solution for energy-saving preliminary design. It involves raising large sections of the facade to allow cool, evaporating air to enter at the ground level, and then, after accumulating heat, to leave through a window at roof level (Fig. 3).

4. Sustainable Architecture Orientation for Technocenrism

One of the easiest and cheapest approaches for energy gain from natural resources is
sun-orientation.

One such case where this was included from the preliminary design state is in the design competition of the Nursery School in Sessenheim, Frankfurt, Germany, designed by Arup Associates (Fig. 4). In 1992 Arup Associates were selected as one of six European practices to participate in an international design competition sponsored by the City of Frankfurt to design a school and daycare center. The design focused on low entropy, minimizing the energy that would be required to build, operate, maintain, and eventually demolish the building which is situated within a residential area.

The proposed plan with buildings and outdoor play areas optimizes the southern sun condition accompanying the trajectory of sun’s path. The daycare center is conceived as a brightly illuminated, climate-controlled glass envelope containing a series of classrooms and enclosed by a curving masonry wall.

One further notable example comes from architect Ken Yeang. Yeang is a pioneer of ecology-based sustainable design and master planning, placing preliminary architectural solutions before energy-consuming technology. He utilized a preliminary design methodology for a bioclimatic sustainable energy skyscraper, in which a number of passive low-energy features are incorporated which do not use energy-consuming facilities.

In the case of Yeang’s headquarters for IBM, the building applies a bioclimatic design with both internal and external features to create a low-energy consuming building (Fig. 5).

The building contains some core preliminary ideas, such as a smooth building skin, cooling-fins (engine cylinder cooling fins), and terraces to reduce wind vertexes (Fig. 6).
As part of the preliminary design process, Yeang made plectrum-shaped floor plates and rotated alternate floors. He created stepped terraces and planters (gardens and sky courts). Vertical landscaping (planting) is incorporated heavily in the building facade and in the "sky courts".

Yeang additionally created a service track with mobile cherry pickers that spirals up around the building. There are also wind flues with adjustable dampers to bring wind into the inner parts of the building (Fig. 7). Finally, there are rotating, moveable sun shades and wind shields. These allow natural ventilation with cool air, and the additional vegetation increases both the level of shade and oxygen supply.

5. Conclusions

Modern HVAC systems that were developed from the end of the 19th century, have
largely become questionable because of the mass-consumption of energy and fossil fuel. Nowadays, there is need to return to using solar energy and natural ventilation and circulation systems. Such sustainable design methodologies show various manifestations depending on regions and cultures. The main solution for preliminary architectural level design methodologies include double-skin wall/window solutions, slanted glazing, louver usage, PV panel usage, natural ventilation and circulation. Sun-orientation is one of the most important considerations for easy energy gain and energy saving from the first stage of architectural design. Despite more energy consumption and costs in the early stage, the importance of combination between philosophy and sustainable design in the viewpoint of technocentrism would be more and more increasing in the future. For more energy-saving, technocentric preliminary design methodologies should be developed with existing knowledge and new technology together.

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References