

Exploring Human-Centered and Ecological Approaches in Architectural Design under the Healthy City Concept

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Abstract: In urban planning and health development, one of the principles fetching attention is the healthy city. When confronted with these two imperatives, architectural design must layer upon function the health of the individual and that of the planet. So, this paper investigates the possible routes to a human-centred and ecologically sustainable architectural design via the healthy city. The first is to study the new demand of healthy city on spatial structure of architecture; The second is to explore human-centered design practice in terms of Human spatial experience, community interaction and intelligent protection. The last one aims to look at ecological design from these angles: green building materials, natural energy comparison integration, low carbon regeneration. And linking and progressing these two approaches — human-centered and ecological, is one of the key directions in achieving healthy city development. This would not only benefit the health of residents physically and mentally, but also offer a benefits for ecological environments in urban areas and even sustainability development of architecture and cities. This discussion is theoretically meaningful and practically valuable for architectural innovation design and the healthy city development.

1. Introduction

Introduction Urbanization and betterment of living standards are causing major public health challenge for the society ^[1]. In fact, major urban problems such as air pollution, spatial congestion, resource depletion and ecological destruction not only threaten economic vitality and liveability, but also jeopardise physical and mental health of residents. Given this, "healthy cities" is now among the preferred global targets of urban planning and even development theories and practices for people-oriented development, attributing priority to ecological hinterlands, as well as promoting balanced development in social, economic and environmental fields. Buildings, as the constituent elements of urban form and physical vessels of city space, are pivotal to realizing healthy city objectives ^[2]. Architecture is not only a functional organization or formal; it governs the influence of humans over their environment ^[3]. Its values transcend simply economic necessity, and are increasingly based on human health, socialisation and ecological sustainability ^[4]. Sustainability represents an urgent precautionary endeavor in design today, where the welfare of humans is reconciled with the wellbeing of ecological and environmental ^[5]. Human-centered design aims to obtain an understanding of various behavioral patterns and social processes, as well as psychological phenomena that assist individuals or society in reaching a quality of life regarding spatial creation ^[6]. Ecological design: Not just building with sustainable sources but the invitation of a mutually beneficial model of building and ecological systems – utilizing eco-friendly construction materials, energy thumbing palettes and the organically harmonious fusion of manufacturing along with nature ^[7]. The convergence of method is not only requisite for healthy urbanation construction, but also the key direction for revolutionary walk on architectural innovation. Based on the theoretical basis of healing space, so as to provide a strong theoretical support and practical reference for the construction of healthy city, this article will analyze and explore the humanized ecological architectural design ^[8].

2. The Healthy City Concept and New Demands for Architectural Design

The idea of pay attention to healthy city is from the World Health Organization's Healthy Cities

scheme in last years [9]. These tenets aim to change the influence of urban and social contexts, through scientific planning and management, on the overall health of populations [10]. In the context of this paradigm, it cuts itself free from economic and spatial aggrandization to consider human well-being as its main aim. It is time for architecture to rethink design principles – through the lens of how it can respond to health, one of the elements of the urban environment and in doing so reinforce its agency in addressing a variety of environmental, social and individual needs. Energy Consumption of a Building

$$E_{\text{tot}} = \sum_{i=1}^n (E_{\text{heating},i} + E_{\text{cooling},i} + E_{\text{lighting},i} + E_{\text{appliance},i}) \quad (1)$$

At the level of building design, Healthy city is not only to meet functional and safety needs; but it demands that spatial environments be shaped with considerations in human physiology and psychology. Good natural light, proper ventilation, scale and the acoustic and visual Environ all impact on physical and mental health. Design has to be responsive to people i.e. children, elderly and handicapped in a way that it becomes an inclusive factor which tends to create equal public space providing true human oriented care as shown in fig 1 :

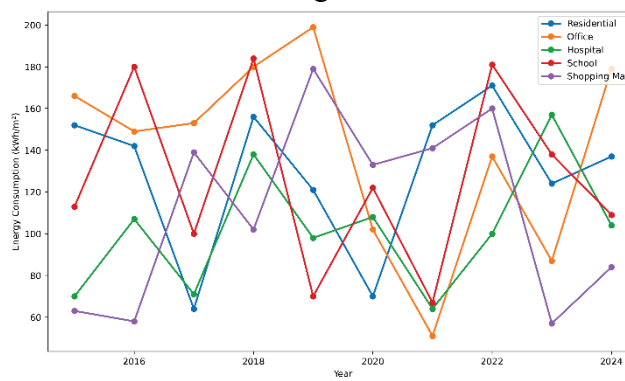


Figure 1 Energy consumption of different building types

Healthy cities are more about creating social relations and community strength. Architecture should be much more than just a physical space — this was the premise to exert influence as means for social interaction and cultural manifestation.

Amidst growing ecological and resources crises, the sanity of healthy cities imposes a condition: architectures must operate at an (bio)ecological scale. Energy saving and renewable energy tech application, rainwater collection, decay as well as recycling become needed in constructing materials being the essential foundation of architecture design. This design concept creates larger spaces without the need to escape human ecologies and ultimately generate a more reciprocal nature with it. The idea on healthy cities not only sets the bar higher for architects to shoot towards but also paves a route along human-centered and ecological values.

3. Human-Centered Exploration in Architectural Design

Thus the concept of human-centric character in architectural design has got traction as human habitation expanded. It emphasizes the fact that buildings are not merely physical constructions but spatial exchanges impacting the health and comfort of users and socialization. Human-centered design is architecture that optimizes physical experiences with social relationships by integrating smart technology to create a highly interactive and emotional connection with people, focusing on human needs. Healthy Cities on the perspective of Human-centered exploration, mainly has three parts: First, spatial organisation and environmental design in a way to impacts positively users' physical and mental well-being. Secondly, to promote social interaction and a sense of belonging by creating spaces for community exchange. Third, this is about utilising smart as tech and service approaches of looking after buildings in a more convenient way for the occupier. The three dimensions, which complement each other completely, together give rise to a whole new paradigm of human-centered healthy architecture.

3.1 Spatial Experience and Mental Health

It goes without saying that architectural spaces are not just material environments, they structuring its all-important infrastructure of human psychology and behavior. Over the past few decades, a fair amount of research has been conducted showing that how we experience our space may be strongly correlated to mental health. 1: IntroductionAs one of the most important research trends, healthy city encourages “people-centeredness” and necessitates that architectural design explore how multidimensional sensory dimensions (space syntax, lighting conditions, air quality and material texture) correlate with psychological state from the perspective of physical and mental health for users. However, using science-based design to build with these concepts can result in environments that reduce stress, elevate mood and assist mental well-being. Daylight Factor (DF)

$$DF = \frac{E_{in}}{E_{out}} \times 100\% \quad (2)$$

These qualities afforded by nature are one-of-a-kind. Natural light also regulates circadian rhythms and enhances mood, reducing incidence of depression and anxiety disorders. With good ventilation and air circulation, living comfort increases and the risk of infectious respiratory diseases decreases. Bringing Natural Media Components including Greenery, Courtyards and Water Elements that advance observable leisure which fortifies Biophilia and deepens the human-nature connection showing a psychological influence supported by health restore significances displayed presenting Figure 2 :

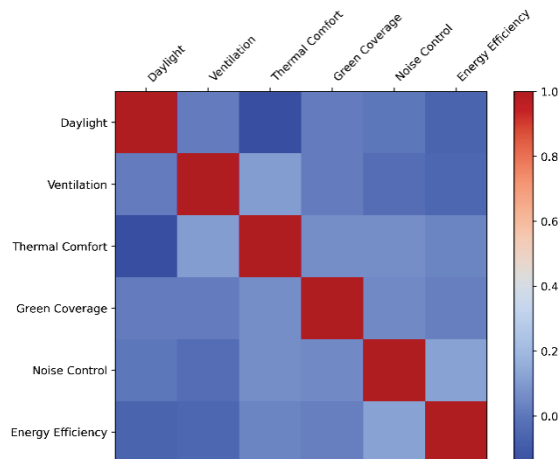


Figure 2 Correlation heatmap of environmental factors

The rationality of spatial scale and functional layout directly affects psychological perception. In the opposite direction, relationships between spaces in a permanent building that appear too stifling or refrained create repression and can cause anxiety while areas that miss out on some kind of zoning get as wide as to isolate indenture their inhabitants. Functionality is flexible, and measurements are appropriate to ensure that a person meets its particular security and privacy needs, offering contact as well as communication. Comfort & approachability in the space Specifically, depending on the types of buildings (residential, hospitals or education),spatial comfort and approachability plays a profound role on how occupants mental state is.

Details and style values for an architecture aspect of a space is likewise vital. Whether it is the design of hues, material systems, acoustic habitats, or even olfactory backdrops — this has a subtle part in the individual public awareness and reasoning. Soft colors evoke warmth and calmness, natural materials provide an intimacy of space, and good sound control reduces noise-related stress. This elevates quality of space, while at the same time provides quiet, protective shields of wellbeing. So, experience-is by featuring some spatial architectural concept to optimise the environment to foster human psyche health, which is instanced in healthy cities concept.

3.2 Community Interaction and Social Engagement

While the individual health of citizens is personal, at its core healthy cities are about the well-being and interconnectedness of people in their search for harmonious relationships. Buildings define the communication and social interaction spaces of a community in no uncertain terms as they are simply the basic space-bound elements of community life on which our daily grind depends. Human-centered architectural design is not just a theory in regard to individual experiences, because it also advocates for and suppresses group interactions. Space and functions when rationally designed make building rational mediators for neighborliness networks along with social cohesion having positive physics of public health. This is what PMV:

$$PMV=(0.303e^{-0.036M}+0.028) \cdot (M-W-H) \quad (3)$$

Space to share form the great stretch of modern life. Open courtyards & community activity plazas, leisure promenades and multipurpose public halls naturally evolve as hotspots of residential congregating and sociality. Creating and designing such spaces can be difficult, since they have to fulfill multitudes of functional requirements while also creating comfort and accessibility to generate peoples nodes where people linger embrace or engage. Common areas help to turn neighborhood relations into common bonds, and these together form webs that strengthen the attachment in communities of residence.

The building layout is also important, because its architecture is meant to-guide social interaction. Open floor plans of circulation patterns, semi-open transitional spaces and well-placed public vs private zones yield greater opportunities for an impromptu chit chat while respecting personal privacy. For example, internal pedestrian walkways and landscape features not only serve as transportation and visual assets, but also stimulate conversations with neighbors and daily interactions. Architecture serves a role via this “passive socialization,” an extension of social networks itself. Ventilation Rate Requirement

$$Q = V \cdot ACH \quad (4)$$

It also means that architectural spaces have to cater to social activities and community governance functions. Healthy cities are based on the assumption that communities are not just a place to reside; they are the heart of social culture and public services. They provide various solutions for individual cultural needs of residents and systematic use in local community and public participation by including multifunctional activity rooms, community libraries, cultural galleries or exhibition spaces as part of building designs. This design where space allows for social interaction changed the pattern of social engagement among residents which in turn had a positive effect on public health and accumulation of community's social capital.

3.3 Smart Technology and Human-Centered Care

When information technologies and intelligent solutions are being developed at a concerning rapid pace, architectural spaces become not only physical environments, but digital or smart worlds based on software. The intelligent technology integration under the guidance of healthy city philosophy can continuously optimize city operation efficiency, management level and bring more humanistic experience and service. Conceptual smart buildings take you beyond the traditional technology by and for people, with technologies there as tools to achieve flexibility, customization and pampering.

Thus, Smart technologies play a very fundamental role in the creation of healthy environments. Intelligent monitoring systems monitor indoor air quality, temperature, humidity and noise in real time and automatically increase ventilation, lighting and HVAC systems by going up when needed. This continuous patching not only dramatically improves comfort but helps reduce some of the possible health hazards from nearby harmful environmental substances. At the same time these sensor based smart lighting and shading systems also adapts to changes in natural light and upon the pattern of occupant activities simply by thus providing settings conducive to natural rhythms of living which is a critical support to Mental Health.

Smart technology enables personalized services. A "one size fits all" approach is not enough when we have different kinds of users: elders need easy access systems, security should be guaranteed, children want spaces that enhance fun and interactivity and sensory experience and people with disabilities request to be supportively catered about. Buildings can autonomously learn and play roles, according to the learned behavior patterns or preferences of users by leveraging AI and big data thereby enabling them to offer differentiated services and assistance. This brings cooperative environments to architectural spaces that can "read people really well."

Smart technologies are creating spaces for more humanistic care and societal wellbeing in architecture. After ward, smart city using interactive platform and well community application that allows residents to communicate with each other and help one another for support in need. And also the self-healthcare and remote health monitoring are providing more convenience channel for individual manage their health condition. In addition, the smart security systems help protect home and VR/AR technology will offer a unique experience for education, culture and recreation needs. In combination these applications protect the fact that not only do smart buildings work effectively to satisfy human needs, but also respond in human values consistent with those highlighted by healthy cities on an emotional and caring level. Carbon Emission of Building Lifecycl

$$C_{\text{total}} = \sum_{j=1}^m (C_{\text{material},j} + C_{\text{construction},j} + C_{\text{operation},j} + C_{\text{demolition},j}) \quad (5)$$

4. Ecological Practices in Architectural Design

In healthy city concepts, architectural design should not only focus on humans' physiological and psychological health but also give considerable consideration to ecological protection and sustainable development. The ecological transformation of buildings as the predominant energy consumers and carbon emissions contributors is particularly important in reducing the pressures on the environment and fostering environmental sustainability in urban development. Ecological design is more than just singular technological solutions or technology integration; it provides healthy cohabitation between architecture and landscape by implementing strategies such as material choice, energy use, blending/complementing the environment, and circular regeneration.

Ecological design (Green building) depends on green building materials and energy-saving technologies. Green materials are designed to minimize the environmental impacts associated with building production, use, and recycling needs while providing a healthy indoor environment. Energy-efficient technologies artfully reduce operational energy consumption through passive high-performance enclosure systems, low-energy HVAC and lighting device types, and renewable power usage. They can be energy self-sufficient, whilst avoiding fossil fuels by integrating solar photovoltaic panels and geothermal heat pumps; they set a benchmark for low-carbon buildings in healthy cities.

This nexus of architecture and nature is one of the cornerstone features of ecological design. It also embraces nature into buildings via green roofs vertical greening and ecological courtyards. This not only improves global microclimates and air quality, but allows for residents to connect with their natural environment. At the same time, using rain gardens, constructed wetlands and permeable paving can also effectively address urban stormwater issues as well as working to enhance self-repairing capacities of urban ecosystems. The adaptation of the built environment to the natural one, ie buildings become living organisms in a healthy city. Water Recycling Efficiency

$$\eta_{\text{water}} = \frac{V_{\text{recycled}}}{V_{\text{total}}} \times 100\% \quad (6)$$

Another major direction of ecological practice is regeneration (ic) and renovation in the concept value of circulating economy and low carbon. Ironically the biggest yet most immediate design challenge for architects towards longer building lifetimes in cities are green retrofits that will help improve traditional buildings performance during their new life. By recycling materials, reducing waste & reusing construction works modularization and prefabrication can save resources as well as enhance productivity in construction. Smart management platforms that leverage big data analytics to monitor and optimize building lifecycle performance, enable better use of energy, low carbon

operations, and sustainability objectives.

The ecological principles of architecture include various aspects: environmentally friendly material, renewable energy, environmental quality and competitive management. Essentially, this strategy employs technology and science in order to achieve harmony within the coexistence of buildings with nature. Ecological architecture is not simply about minimizing man's imprint on Earth, however; it can also complement anthropocentric design; together they inform the productive cultivation of our vision for healthy cities.

5. Conclusion

Healthy city Theory provides architectural design with a new direction and program of development after modernism. This ideology gives a foundation for viewing buildings not merely as walls and roofs, but rather as mediators of humans to their habitat — social continuum or ecological network. This paper explores the challenges for architecture in the healthy city, and considers human-centered ways of designing spatial experience, social connections and intelligent caring systems that work synergically with ecological design strategies including green construction material use, natural environmental integration patterns or circular renewal provisions. Therefore, both human-centered and ecological perspectives are complementary but not mutually exclusive; they will be the two indispensable pillars of a healthy city – the first focuses on individual health needs and social relationships (need for positive interaction) and nature-oriented focus emphasizes harmonious coexistence between man with Nature. Besides benefiting the physical and mental health of urban dwellers, their congenial established urban environments will propel greening transformation and sustainable development of construction industry. As smart technologies continue to evolve and ecological concepts mature, architectural design has a broader range of roles it can fulfill in the evolution of healthy cities. The building will show its human-centered main properties, emphasizing its ecological identity as never before giving an impulse to harmonious coexistence of man and building, city and nature.

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