# Research on Design Indicators of Chinese Circular Healthy Building

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**Abstract.** A set of design principles for circular WELL buildings is proposed based on a combination of circular architecture and WELL building indicators that incorporate traditional Chinese health-preserving culture. Indicators were first collated through mind mapping. Supplementary indicators on spatial and health-preservation requirements were then identified through guided surveys. The weighting of each aspect and design indicator was calculated using the Eigenvector method to establish an evaluation model for circular architecture design indicators. On the hardware side, emphasis was on providing people with living spaces and environments with smart management that were safe, free from hazards, healthy, comfortable. On the health preservation side, knowledge on physical and mental care was incorporated into the metrics to define 33 design indicators in 6 aspects. The research findings can be applied to the design of buildings for all ages, and will also help to inspire new design approaches and innovative research on new forms of human habitation.

**Keywords:** Circular Building, Healthy Building, Health Preserving, All Age.

## 1 Introduction

In this study, the WELL Building Standard was combined with China's own Healthy Building Standard were combined before incorporating the essence of circular architecture. The traditional China health-preservation concept was also introduced to satisfy the contemporary requirements of "people-centric" living spaces and environments (The scope of application does not consider areas outside China). The term "Health-Preserving" is misunderstood by many people. Reading too much from the term can lead to inappropriate expectations that following health-preserving practices will increase longevity. In reality, how long or short a human life will be is uncertain. Maintaining the normal bodily functions as well as the practicing of proper protection and prevention is the right mindset to have. For this reason, the establishment of a safe and hazard-free living environment, comfortable and pleasant living spaces, fit and regular living habits, along with knowledge on routine physical and mental well-being are the true purpose of people-centric circular healthy building design.


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### 1.1 Healthy Building

Version 1 of the WELL Building Standard was issued by the International Well Building Institute (IWB) in 2014. Version 2 released in 2020 increased the number of design concepts from seven to ten (In v2, Thermal Comfort replaced Comfort from v1, while Sound and Materials & Community were added) [1]. The 105 feature were enhanced to become 121 evaluation standards [2]. WELL is considered to be the first building standard to focus on the health effects of the building environment as well as a proponent of "people-centric" healthy buildings [3]. WELL v2 divided healthy buildings into 10 design concepts that ensured the physical and mental wellbeing of people living in the building environment. The Healthy Building Standard issued by China in 2021 incorporated the WELL indicators to draw up 6 design indicators on air, water, comfort, fitness, culture, and service.

### 1.2 Circular Building

Circular Building (CB) is derived from the Circular Economy (CE) and is classified under the Green category. CE is currently considered to the best Turing model for sustainable development. In 2013, the Ellen MacArthur Foundation proposed an industrial and biological sustainable operating model that changed the legacy linear economic model to a circular model [4]. The design concept for circular architecture begins with the start of the life cycle. The circularity of the building at every stage must then be assessed [5]. Dr. Chang believed that the seven conditions were satisfied by CB, namely 1) Reduce the extraction of resources; 2) Improving the recycling of recycled materials; 3) Reduce the re-manufacturing of renewable resources that result in more waste and $CO_{2e}$ emissions; 4) Use co-sharing model to improve reuse of resources; 5) Extend product life through maintenance and maintenance management and maintain its effective operation, 6) Producer must bear social responsibility for deployment of reverse logistics, improving the recycling rate for renewable resources, and better recovery of recycled resources; and 7) Set up circular supply chain information platform [6].

### 1.3 Traditional Chinese Regimen

Traditional herbal medicine is a part of cultural renaissance and is gradually becoming a part of people's lives. All subheatlh caused by harm to bodily functions take place over time. Examples included unhealthy environmental conditions, poor living habits, inappropriate food & beverage, and improper exercise. When the human body is out of balance, it will start feeling signs of discomfort. The bodily functions are directly or indirected affected as well.

Health-Preserving should be taken to mean maintenance. Here it refers to how human beings must respond to the current natural and social environment in order to realize the goal of health [7]. Human bodily functions will gradually deteriorate over time. Personal habits and external environmental factors may also have an effect. Harmful substances that should not be left in the body are constantly accumulated. The philosophy of *Huang Di Nei Jing* suggested taking care of the body through living in

tune with the four seasons, staying calm, living in a safe place, and having sex in moderation. Fundamentally, regimen is about establishing healthy living habits and patterns [8].

## 2 Research Methodology

This study mainly made use of the three following methods:1. Guided interviews: These were divided into two parts. The first part focused on respondents with more than 10 years of hands-on experience in circular and healthy architecture. The second part looked at people advocating for rights related to health and regimen. Open, targeted interviews were conducted to obtain the real thoughts and suggestions of respondents. The information was used to reinforce the design indicators for circular healthy building design in this study. Respondents included specialists in green circular buildings, elders in the community, carers, and physiotherapists.2. Mind Mapping: Also known as a mind map, this method was used during this study for compilation of research literature and the design requirements after the interview. The needs indicators were also integrated based on their operational level.3. Eigenvector: This method is frequently used for calculation of weightings in the Analytic Hierarchy Process, and primarily for multi-criteria decision analysis (MCDA) [9]. In this study, the method was used to calculate the relative weighting between indicators on each tier.

## 3 Construction of a Model for Circular Healthy Building Design Indicators

### 3.1 Guided Interviews

Interviews started after all design indicators had been compiled. To ensure the validity of the design indicators, the respondents backgrounds included both professionals and community members related to healthy buildings, and the respondents were aged between 30 and 80 (Figure 1), sound mind and body, and possessed both communication and judgment skills. Guided interviews and communications were conducted on the requirements for circular healthy buildings with a particular emphasis on actual needs and expectations in everyday life. The interviews used service indicators as examples as shown in Table 1.

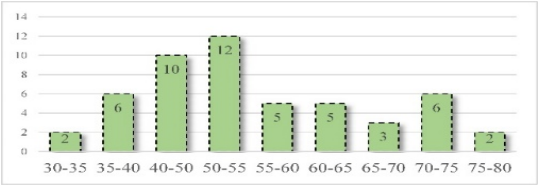


**Fig. 1.** Graph showing the age distribution of respondents. There were 51 respondents in total with 42% aged between 40 and 55.

**Table 1.** Hierarchy diagram of design indicators under the service dimensions

| Dimensions | Design Indicator | Design Element |
|---|---|---|
| Service | Public information display | Communication of public affairs, weather forecasts, temperature, humidity, wind force, early warning. |
| | Public resource management | Recycling and reuse of resources, sewage and reclaimed water, kitchen scraps. |
| | Operations management system | Resource circulation supply chain, facilities maintenance, renewable energy module, security and protection systems, fire and alarm systems. |
| | Public infrastructure | Medical green passage, smart grid, public ventilation system, common area power management. |
| | Public health management | Air quality testing, pest prevention, home emergency alarm, health examination, health education, healthcare and monitoring, water quality testing. |
| | Health-preserving knowledge | Chronic illness prevention, first-aid, self-treatment and self-care, functional health preservation, mental health and adaptation, food safety, health preservation, physical disease education, appropriate medication and scientific exercise. |

## 3.2 Calculation of Dimensions and Design Indicator Weightings

Table 2 is the dimension' level. The eigenvector weighting calculations for Table 3. Service design indicators are shown here as an example. As shown in Figure 2., the model used pairwise comparison of design indicators to define the weighting of the eigenvectors.

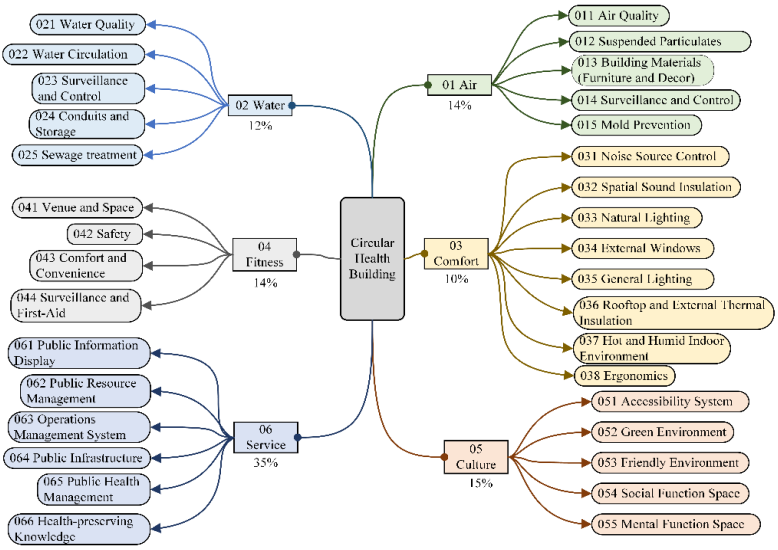


**Fig. 2.** Model for circular healthy building design indicators

**Table 2.** Calculation of eigenvector weightings for the Circular Healthy Buildings Dimensions showed that the Service aspect accounted for 35% of the weighting. People therefore want circular healthy buildings to provide more services.

| Dimensions | 01 | 02 | 03 | 04 | 05 | 06 | υ | |
|---|---|---|---|---|---|---|---|---|
| 01 | 1 | 1 | 1 | 3 | 1/3 | 1/3 | 14 | Air |
| 02 | 1 | 1 | 1 | 1 | 1 | 1/3 | 12 | Water |
| 03 | 1 | 1 | 1 | 1/3 | 1 | 1/3 | 10 | Comfort |
| 04 | 1/3 | 1 | 3 | 1 | 1 | 1/3 | 14 | Fitness |
| 05 | 3 | 1 | 1 | 1 | 1 | 1/3 | 15 | Culture |
| 06 | 3 | 3 | 3 | 3 | 3 | 1 | 35 | Service |

**Table 3.** Calculation of the eigenvector weightings for the Service design indicators showed that the Operations Management design indicator accounted for 31%. People therefore want a sound operations management system.

| 06 Service | 061 | 062 | 063 | 064 | 065 | 066 | υ | |
|---|---|---|---|---|---|---|---|---|
| 061 | 1 | 1/3 | 1/3 | 1 | 1 | 1 | 10 | Information display |
| 062 | 3 | 1 | 1/3 | 1 | 3 | 3 | 22 | Public resource management |
| 063 | 3 | 3 | 1 | 1 | 3 | 3 | 31 | Operations management system |
| 064 | 1 | 1 | 1 | 1 | 1 | 1 | 16 | Public infrastructure |
| 065 | 1 | 1/3 | 1/3 | 1 | 1 | 1 | 10 | Public health |
| 066 | 1 | 1/3 | 1/3 | 1 | 1 | 1 | 10 | Health-preserving knowledge |

## 4 Conclusion

"People-centricity" is the core view of this study. The integration of healthy buildings and circular design is aligned with the trend towards sustainable development and can provide people with the living space for healthy regimens with great precision. Circular healthy buildings offer people with a set of environmental hardware requirements that is safe, comfortable, healthy and eco-friendly. The requirements are aligned with the current strategy of curbing carbon emissions. This study combined green spaces, circular design, the effects of environmental elements with traditional Chinese regimen concepts. This study proposed that systematic approach should be adopted for nursing one's own physical health and fortifying personal mental fortitude. Assistance should be provided to boost the human metabolism and its immune function in order to resist unforeseen threats from the outside.

The 6 design dimensions and 33 design indicators established by the research results of Chinese circular healthy building are developed based on green building design and meet the current environmental needs. The construction of hardware is relatively easy to meet the requirements of actual use, but it is indeed challenging to meet the requirements of human psychological construction and training. Therefore, the main feature of this study is the addition of soft demands and design from "people" on their regimen

needs. The systematic regimen knowledge in Chinese medicine in particular has gained widespread public acceptance in the post-COVID era. People's needs should therefore be considered on a consciousness, emotional, mental, and physical level. Such an approach is different from Western medicine based mainly on suppression to trigger or boost the patient's immune system. The combining of both schools of health and incorporation of a circular health design indicator system was also what this study set out to describe and communicate. These research findings can be applied to the design of habitable buildings for all ages, and will also help to inspire new design approaches and innovative research on new forms of architecture.

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