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Bioclimatic Design Strategy in Hot Summer and Cold Winter Region of China

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Abstract: The building of ecological harmony with the environment is not only concern in the field of architecture, when we do architectural design, we must respect nature promote the process of natural humanization, and obtain good natural, economic, and ecological comprehensive benefits. The bioclimatic design method can provide the basic direction for the development of building technology. To a certain extent, it is helpful for Chinese architects to objectively analyze the environment of a particular area in the light of their own economic and technological level, the purpose of this study is to provide architects with a macro concept of climate and to summarize practical, experienced and technical methods for the bioclimatic design of buildings and urban spaces. Analyzing domestic and foreign research trends, we can see that the following problems exist in the development of bioclimatic design theory in China. Clarify the concept, clarify the definition and connotation of bioclimate architecture and its related concepts, as well as its connection and difference with concepts such as ecological architecture, and establish a complete and well-organized theoretical system. In the light of the study of regional Bio climate design strategies, a Bio climate design strategy suitable for the hot summer and cold winter regions is studied for the special climatic characteristics of the hot summer and cold winter regions, and so on. The main conclusions of this study are: Buildings should provide effective feedback to the environment like living creatures when choosing forms, compare the comprehensive understanding of historical bioclimatic analysis methods, and make use of buildings themselves to organize ventilation, passive Cooling, and Dehumidification, bio-climate building to maximize indoor comfort environment, thus saving energy and protecting the environment, clear the dynamic relationship between climate factors and site Human Comfort; The climate adaptability of regional buildings should be considered as heat preservation and insulation, sunshade, and ventilation, and the design of heat preservation and insulation should be strengthened to reduce heat loss.
Keywords: Bioclimatic, Architectural Design, Environment, Ecological benefit, Sustainable Design

I. INTRODUCTION

In a rapidly changing world where climate change, environmental degradation, and the growing concern for over-dependence on non-renewable energy are becoming key environmental issues, it is argued that it is necessary to redefine the environmental and architectural attitudes to an environmentally-friendly approach [1]. As the Earth faces a major international problem, re-thinking systems in various areas is necessary. In the energy field, the housing sector is a key focus, as buildings are now considered not just designed housing objects but also in terms of comfort, consumption, and environmental impacts. Thermal behavior is increasingly important, alongside architectural and structural issues. Energy savings are becoming a top concern, and energy consumption has become a major ecumenical concern. Research has focused on ecological studies to provide better approaches and strategies. Building construction is the largest energy consumer, accounting for about one-third of global final energy use. [2]. On this basis; the sustainability spirit in architecture engaged with the manifestation of "more efficient energy use", where an allied relationship through the external and internal environment is adjusted to be asserted. Architects and planners increasingly focus on designing harmony with the environment to minimize interference with the natural environment, reduce natural support costs, and improve the environment through reasonable construction. They are actively promoting natural humanization while achieving benefits from nature, economy, and ecology. The architectural profession is resurging the integration of passive and hybrid environmental strategies in building design to mitigate ecosystem impacts and promote adaptation to climate changes [3]. Since the Industrial Revolution, the world has increasingly depended on high-quality energy resources like natural oil, gas, coal, and nuclear power. Buildings account for around half of global energy consumption, contributing to global warming. Architecture was once crucial for climate and energy, but with the advent of the industrial age, it became more mechanized and resource-intensive.

The construction industry, which was once extravagant and wasteful, recognized the importance of energy-saving design. Commercial buildings and offices' energy consumption is largely linked to architectural elements, with final uses like lighting and air conditioning directly linked to the type of architecture and space occupation [4]. Buildings contribute 54% of national energy consumption and 32% of global warming through carbon dioxide and CFC emissions. Most architecture focuses on price, function, aesthetics, and building problems, but correct strategies can save 2-3/4 of energy consumption [5]. Human understanding of sustainable development has led to a shift in energy conservation towards renewable energy, particularly climate energy. Climate energy is the most primitive and primary energy on Earth, offering a clean, non-polluting, and ubiquitous source, making it a crucial part of human sustainable energy strategy.

A. Background introduction of hot summer and cold winter zone

1) Geographical range of hot summer and cold winter area

Located in the middle of China, the Yangtze River valley and its surrounding areas are a "hot summer and cold winter" region. The area is roughly south of the Longhai Line, north of the Nanling Mountains, and east of the Sichuan Basin. It includes two municipalities directly under the Central Government: Chongqing and Shanghai; Hubei, Hunan, Anhui, Zhejiang, and Jiangxi provinces; the eastern half of Sichuan and Guizhou provinces; the southern half of Jiangsu and Henan provinces; the northern half of Fujian Province; and the southern end of Shaanxi and Gansu provinces Guangdong and Guangxi provinces and regions, covering a total of 16 provinces, municipalities and autonomous regions. This area, with an area of 1.8 million square kilometers and a gross domestic product (GDP) of 48%, is an economically and culturally developed area of China [6].

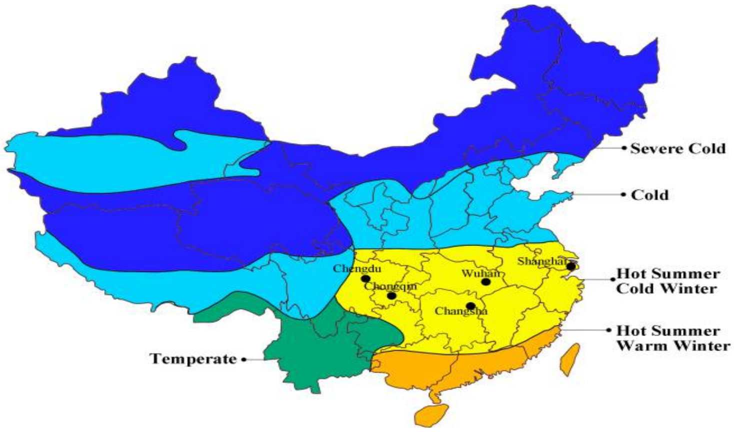

Fig. 1 Major cities in China′s hot summer and cold winter region. Edited and drawn by authors; Resource from National Geomatics Center and National Public Service Platform for Standards Information of China (http://www.ngcc.cn and http://www.std.gov.cn).

Most of Central China is within the hot summer and cold winter region, which is also located within the warm temperate zone. The landscape in this region is a mix of plain and mountains, and the dominant climate is a long period of hot humid summer and a short and cool winter [7].

2) The Topography of hot Summer and Cold Winter Zone

The natural environment of the hot summer and cold winter zone is complex and varied in topography, including rivers, mountains, hills, basins and plains. Most of the Yangtze River valley is hot in summer and cold in winter. The upper reaches of the Yangtze are high in mountains and deep in valleys and the middle reaches stretch from Yichang to Hukou. In the Jingjiang reach, the river is especially curved, the water flow is slow, sediment deposition, easy to cause disasters [8]. Along the rivers and lakes dense, many tributaries, the lower reaches of the river wide water depth, water flow flat, water-rich, many sandbanks. Hot summer and cold winter zone between Qin Mountains and Nanling Mountains, mountain area is vast, during which the main mountains are Mt. Wu, Xuefeng Mountain, Wuyishan and so on. The hills south of the Yangtze Plain are the largest in China. The southeastern part of Zhejiang Province, together with the mountains of Fujian Province, is known as the mountains of Fujian and Zhejiang [9]. Located in the eastern part of Sichuan Province, the northern part of Sichuan Basin has the qin-ba mountain to block the cold, warm climate, fertile land, known as the "land of abundance". The Yangtze Plain consists mainly of the Jianghan Plain, the Dongting Lake Plain, the Poyang Lake Plains and the Yangtze River Delta. Low-lying flat, rivers, known as the "Water Township" said. China's five major freshwater lakes (Poyang Lake, Dongting Lake, Tai Lake, Hongze Lake, Chao Lake) are also in the region.

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3) Climatic Characteristics

The climate in hot summer and cold winter areas is the same latitude in the world climate conditions worse areas. High extreme maximum temperatures are a feature of hot summer and cold winter regions, and are the hottest areas in this latitude except for arid desert regions. It is also cold in winter in this region, and the temperature in January is 8 ° 10 °C lower than that in other areas of the same latitude, which is the coldest winter area in the world at the same latitude [10].

Table 1 Temperature parameters of nine cities in hot winter and cold summer

Project	Shanghai	Hangzhou	Nanjing	Hefei	Nanchang	Wuhan	Changsha	Chongqing	Chengdu
Average monthly temperature in the hottest month/ °C	27.8	22.6	28.0	28.3	29.6	29.8	29.3	28.1	25.6
Extreme maximum temperature/ °C	38.9	39.9	40.7	41.0	40.6	39.4	40.6	40.2	37.3
The average temperature at 14:00 in the hottest month/ °C	32	33	32	32	33	33	33	33	29
Days with a daily maximum temperature of no less than 35 °C in a year	8.7	22	15.8	15.8	27.7	21	30		1
Average relative humidity of the hottest month %	83	80	81	81	75	79	75	71	85

B. Energy Consumption in hot Summer and Cold Winter Regions and Solar Energy Resources

1) Energy Consumption in Hot Summer and Cold Winter Regions

Hot summer and cold winter regions are relatively serious energy consumption areas in China, the energy consumption of air-conditioning and winter heating in the region is growing rapidly and will increase substantially. The main reasons are as follows: 1 the Environment is humid, the requirement for ventilation is very high, the energy consumption of ventilation is big; 2 the summer is very hot, the winter is cold, the building needs the mechanical refrigeration and the heating time is very long, about half a year altogether, the energy consumption of the refrigeration and heating is big; There is no central heating in this area, so the residents solve the problem of indoor thermal environment by themselves [11] [12]. Due to the low energy efficiency of the current equipment, combined with people's living habits and awareness level lead to improper, resulting in high energy consumption and the effect is not ideal.

2) The Status of Solar Energy Resources in hot Summer and Cold Winter Regions.

Based on the measurements of the total amount of solar energy radiation over the years, China can be divided into four solar radiation resource regions: resource-rich regions, resource-rich regions and resource-usable regions, as can be seen from the chart, most of the hot summer and cold winter areas in China are in the resource-poor areas, and a few are in the resource-poor areas, especially in Sichuan Basin, where there are more rain, more fog and fewer sunny days, it's a solar-energy-poor area [8] [13]. The adequacy of solar energy resources in a region is mainly measured by the number of hours of sunshine and the percentage of sunshine in the region. By comparing the sunshine hours and percentage of sunshine between hot summer and cold winter in 6 cities of north China and 6 cities of North China, the relationship between hot summer and cold winter in summer and the solar energy resources in northern China was found. In addition, the solar radiation resource in hot summer and cold winter is almost the same as that in the north and west of China in summer, but much lower in winter [14]. Solar energy resources in summer are generally higher than that in winter, which brings a problem for passive solar energy application in hot summer and cold winter regions: In summer, we need to keep the solar radiation out to the maximum extent, solar radiation is relatively abundant this season; in winter we need to maximize the solar radiation into the indoor, and this season the solar radiation energy is relatively poor.

Table 2 distribution of solar radiation resources in China MJ/(m^2·a)- Mega coke /(Square meter · year). drive from [15] [16]

Resource code	Name	Index
I	Resource rich area	≥6700 MJ/(m^2·a)
II	General resource rich area	5400-6700 MJ/(m^2·a)
III	Resource availability area	4200-5400 MJ/(m^2·a)
IV	Resource poor area	<4200 MJ/(m^2·a)

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Throughout the year, buildings in the hot summer and cold winter zone have no direct solar radiation on the north; thus, no solar heat gain was obtained through the north window. However, the rise in the window-wall ratio will lead to the expansion of thermal transmission by various temperatures, and therefore the bedroom's annual demand for heating energy rises. The increase in the bedroom's window-wall ratio leads to greater gain in solar radiation power through the exterior window than the heat loss through the window. Nevertheless, if the window-wall ratio increases above a critical amount, the heat loss through the window will be greater than the gain in heat from the solar radiation [17]. Consequently, at first the annual demand for heating energy declines with the rise of the window-wall ratio and then increases, but without a clear pattern. The rate of change in annual demand for cooling energy and overall energy consumption with the ratio of the window-wall is greater than the annual demand for heating energy. This is largely because the disparity in indoor and outdoor temperatures as well as solar radiation influences the heat gain in summer. The increase in the window-wall ratio contributes to a significant rise in heat gain resulting from a different temperature and solar radiation transfer. The effect of thermal transfer heat gain by varying temperature, however, counteracts that of winter solar radiation. As a result, the varying rate of annual demand for cooling energy is higher than that of annual demand for heating energy [18]. Meanwhile, the absolute value of annual cooling energy demand in hot summer and cold winter zones is far higher than that of yearly heating energy demand. Changing the window-wall ratio thus has a greater effect on the annual demand for cooling energy as well as the overall consumption of electricity. Windows facing east and west lead to the highest overall energy consumption, followed by South and North facing glass. In Chongqing the solar radiation is mainly characterized by scattering, where the amount of direct sunlight is comparatively lower. Consequently, it has some effect on window orientations. By comparison, in Shanghai and Wuhan, the amount of direct solar radiation is greater than in Chongqing. And the window-wall ratio of external windows reveals a strong difference in different orientations in Shanghai and Wuhan: The impacts are higher with the east or west face the window than the north or south side [19]. In addition, the solar radiation in the east and west during the summer becomes more intense for all three cities than in the winter, which raises the cooling load through the outside window in the summer. In addition, the inside wall and the floor will absorb the solar radiation through the glass facing the west, and then release it later at night. During winter, the solar radiation in the glass facing the south is greater than that in summer, and the increase in solar radiation heat in winter is comparatively higher, which is a benefit in reducing the annual demand for heating energy, whereas the increase in solar radiation heat in summer is relatively smaller, which is a benefit in reducing the annual demand for cooling energy.

II. BIOCLIMATIC DESIGN ANALYSIS OF HOT SUMMER AND COLD WINTER REGIONS

A. Architecture of major cities in hot summer and cold winter regions

A comprehensive analysis of hot summer and cold winter regions according to bioclimatic design procedures, a system analysis method from thermal comfort to design strategy can be established to facilitate architects to select a suitable passive design method based on the analysis results in the scheme design stage, from the beginning of the program, the building can consider its self-adjusting function to its environment and climate, thus achieving indoor comfort and energy conservation. Attia 2019 [20] used neutral temperature comfort zones combined with intuitive air temperature and humidity charts and urban meteorological data from various regions of China; it is the first time to construct the architecture climate design analysis tool. The effective use time of building design strategies for urban thermal environment control is analyzed by climate analysis chart, and the applicable range of various strategies is proposed according to the effective value of time [21]. This method takes into account the environmental conditions of different temperature amplitudes and water vapor pressures, all the data can be visualized by directly marking the scope of application of natural ventilation or night ventilation, reduction of room temperature, evaporation and heat dissipation, and solar energy utilization or heating and air conditioning.

1) Nanjing Bioclimatic Analysis

Architecture bioclimatic analysis of Nanjing shows that passive solar design cannot solve the heating problem for most of January and about half of December, about 22% of the year. For the rest of the winter, which is mainly in November and February, passive solar design is the ideal way to achieve thermal comfort, about 39% of the year is devoted to passive solar design for Indoor Comfort [22]. August there are uncomfortable problems caused by hot and humid climate, using natural ventilation can get one half of the summer heat comfort, accounting for 18% of the year, still have to rely on air conditioning cooling 7% of the time. Therefore, it is the key to solve the problem of indoor thermal comfort and save energy to make full use of solar energy in winter in Nanjing area.

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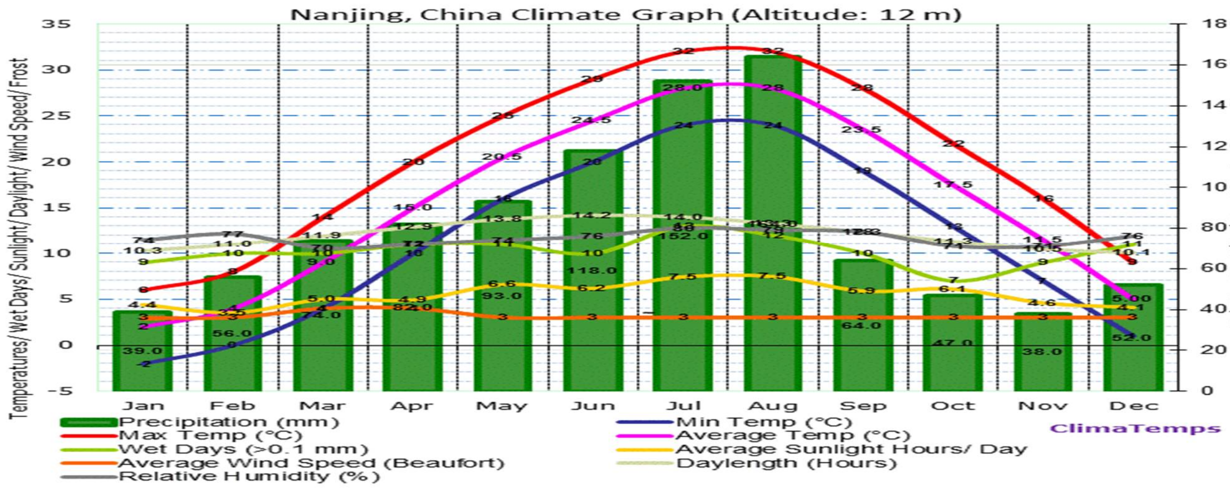

Fig. 2 Nanjing climate and temperature graph http://www.nanjing.climatemps.com/nanjing-climate-graph.gif

The Jiangsu Province's and historic Chinese capital Nanjing's (or Nanking's) climate is moderate, with frigid winters and hot, humid, and wet summers. The Yangtze (or Blue River) passes through Nanjing, which is in eastern China and is about 205 kilometres (130 miles) from the coast. With nighttime lows of -0.3°C in the winter, the average temperature is 7.7°C. Springtime highs are 19.7°C, with 10°C afternoon lows. Summertime lows are 22.7°C and highs are 31°C, with highs reaching 87.8°F. Fall temperatures drop to lows of 13°C and highs of 22°C (71.6°F). The annual rainfall is 979 mm, and there are 2059 hours of sunlight. The section on light and sunlight contains monthly information.

2) Shanghai bioclimatic analysis

About half of the time in December - February in Shanghai is still not completely dependent on passive solar energy to solve the heating problem, accounting for 23% of the whole year. For the rest of the winter, passive solar design is the ideal way to achieve thermal comfort, and about 37% of the year, passive solar design can be used to solve indoor thermal comfort. The heat and humidity problems occurred in summer for four months, from June to September [7]. Natural ventilation can be used to solve the problem of overheating two thirds of the time in summer, making up a total of 18% of the year. Still have to rely on air conditioning for 7% of the time. 15% of the year is spent in your comfort zone [7] [23]. It can be seen that the full use of solar energy in winter is the key to solve the problem of indoor thermal comfort and energy conservation in Shanghai area; due to the simultaneous existence of high temperature and high humidity in summer, due to the full consideration of building natural ventilation design, can reduce the use of air conditioning time.

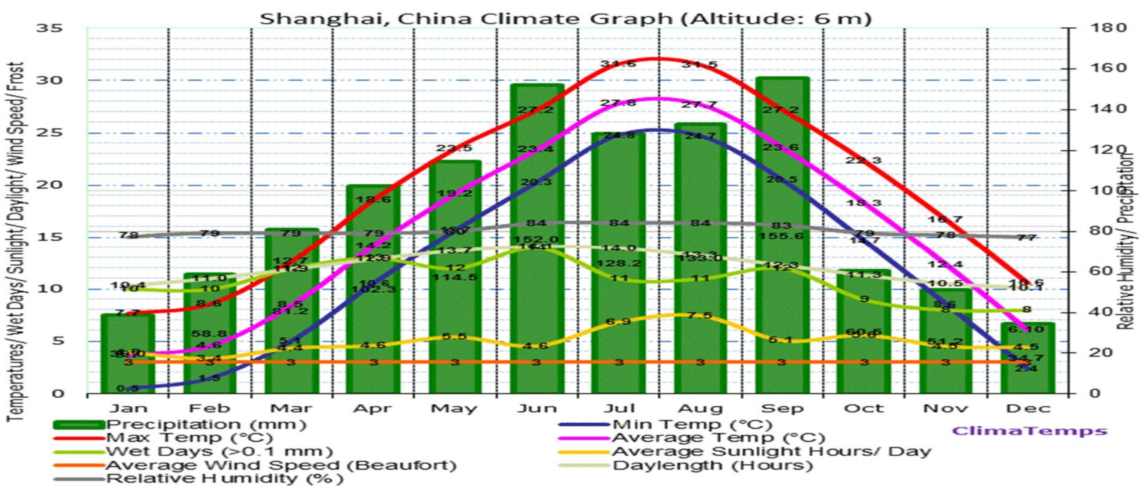

Fig. 3 Shanghai climate and temperature graph http://www.shanghai.climatemps.com/shanghai-climate-graph.giffig

Shanghai has a moderate climate with hot, steamy summers and comparatively frigid winters. China's largest metropolis, Shanghai, is situated in the Yangtze (or Blue River) Delta in the east of the nation. Wintertime lows are 1.5°C (34.6°F) while wintertime highs are an average of 9°C (48.1°F). With nightly lows of 10.5°C (50.8°F), springtime temperatures can reach 18.3°C (64.9°F). With average highs of 23.3°C (73.9°F), summertime temperatures can reach 30.1°C (86.2°F). Fall temperatures drop to lows of 14.6°C (58.3°F) and highs of 22.1°C (71.7°F). 1874 hours of sunlight and 1111 mm (43.7 inches) of precipitation are experienced in the area annually.

3) Bioclimatic Analysis of Chengdu

An architectural bioclimatic analysis of Chengdu shows that Chengdu is cold in winter and still cannot rely entirely on passive solar energy for heating 6% of the year. Passive solar design for most of the winter is the ideal means of thermal comfort, accounting for 45% of the year. Heat and humidity problems are more serious in summer, with natural ventilation taking up 28% of the time. Four percent of the summer must be cooled by air conditioning, mainly in July and August. 17% of the year is spent in the comfort zone [24] . Therefore, due to the high temperature and humidity in summer in Chengdu, the natural ventilation design in summer should be paid attention to in climate design. Making full use of solar energy in winter is the key to solve the problem of indoor thermal comfort and energy conservation.

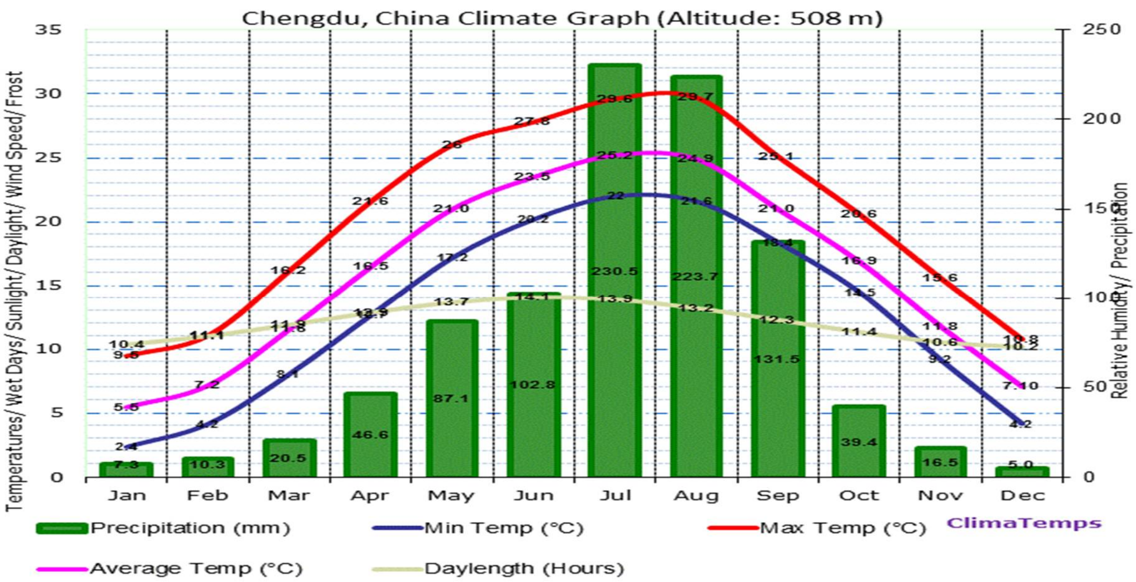

Fig. 4 Chengdu climate and temperature graph http://www.chengdu.climatemps.com/chengdu-climate-graph.gif

Chengdu, the capital of Sichuan Province, has a temperate climate with cold winters and hot, muggy summers. Located in southwestern China, it is situated in a vast continental zone, 1,100 kilometers away from the sea and 500 meters above sea level. The climate is cold in winter but not as hot as nearby Chongqing. With barely 7 mm of precipitation, December is unusually dry. With an average rainfall of 306 mm, July receives the most precipitation. The hottest month is July, with a high of 26.3 °C. January shows a noticeable decline. The variation in precipitation is 299 mm. With 19.27 rainy days, August has the highest relative humidity, while December has the fewest rainy days (1.77).

4) Bioclimatic analysis of Wuhan

The bioclimatic analysis of architecture in Wuhan shows that the time of heating is about 58% of the whole year, and the passive solar energy design can solve 45% of the time, the heat and humidity problems are more serious in summer, with natural ventilation taking up 18% of the time. Air conditioning is used 12% of the time in summer, mainly in June, July and August. 12% of the year is spent in the comfort zone [25]. Thus, the climate design strategy in Wuhan is to combine passive solar energy with active solar energy in winter to solve the need for heating; the problem of hot and humid in summer is serious, make use of natural ventilation as far as possible to reduce the use of air conditioning time.

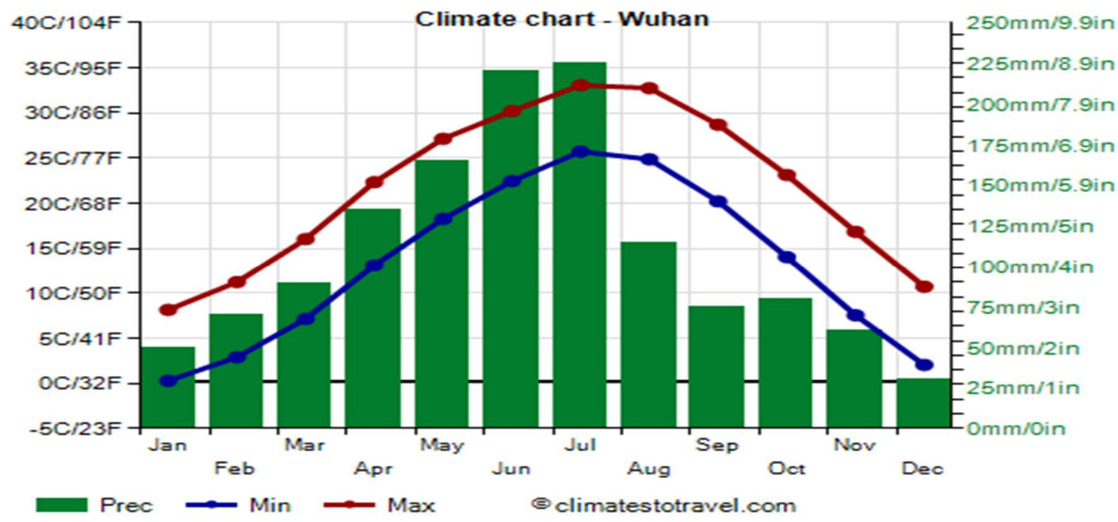

Fig. 5 Chengdu climate and temperature graph https://www.climatestotravel.com/images/charts/Wuhan-China.png

Wuhan, the capital of Hubei Province, has a temperate climate with cold winters and hot, muggy summers. Located at the Han and Yangtze River confluence, it is 630 kilometers away from the sea. Despite its millennia-old history, Wuhan is with intense summer heat and stagnant cold air in winter. Wuhan experiences cold winters from December to February, with an average January temperature of 4°C. The city is slightly colder than Nanchang due to its location further north. Nocturnal frosts are frequent but not intense. Winters are hot and muggy, with July and August being the rainiest months. Wuhan is considered one of the "three furnaces" of China, along with Chongqing and Nanjing. Precipitation is abundant, with a minimum between autumn and early winter and a maximum between spring and summer.

5) Nanchang bioclimatic analysis

Nanchang bioclimatic Chart Analysis results show that Nanchang winter is milder than Wuhan, need heating time is 52% of the whole year. The passive solar design can meet 40% of the heating needs. The problem of heat and humidity is more serious in summer than in Wuhan. The time of using natural ventilation is increased to 20%. Summer has 15% of the time must rely on air-conditioning cooling, mainly concentrated in June to September. 14% of the year is spent in the comfort zone [10].

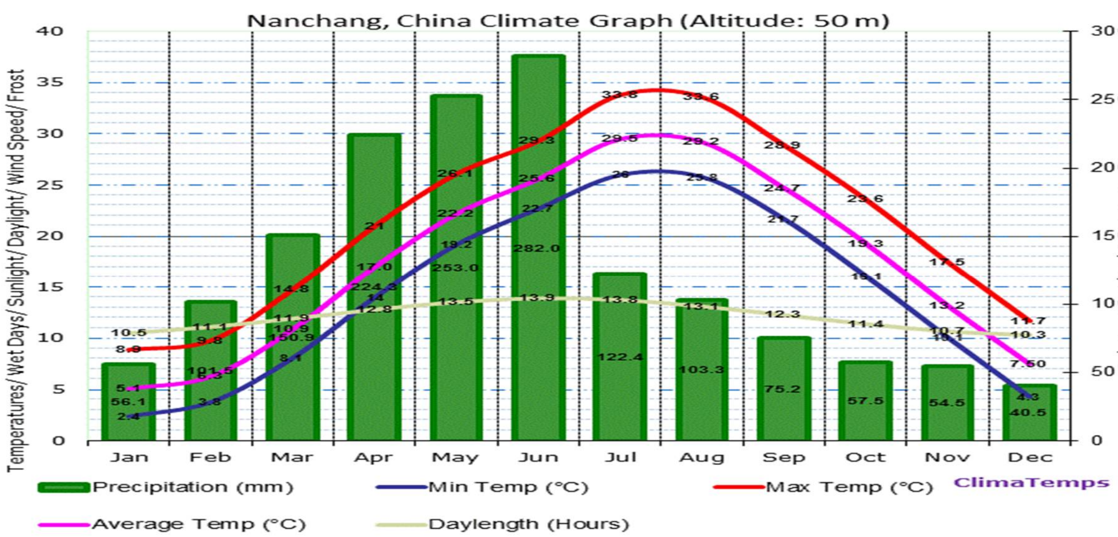

Fig. 6 Nanchnag climate and temperature graph http://www.nanchang.climatemps.com/nanchang-climate-graph.gif

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Nanchang, the capital of Jiangxi Province, has a temperate climate with cold winters and hot, muggy summers. Located in southeastern China, it is situated at a low latitude and 450 miles away from the sea, making summer heat intense. Despite its millennia-old history, Nanchang is now a metropolis, often polluted like other large Chinese cities. The average wintertime temperature is 10.1°C (50.2°F), while the nighttime low is 3.5°C (38.3°F). Springtime lows are 13.8 °C and highs are 20.6 °C (69.1 °F). Highs in the summertime average 24.8°C (76.7°F) and reach 32.2°C (90°F). Fall time highs are 23.3 °C (74 °F) during the day and 16 °C (60.7 °F) at dawn. There are 1521.2 mm (59.9 inches) of rain each year.

6) Chongqing Bioclimatic Analysis

Chongqing is a high humidity area Known as one of the "Three Furnaces" of the Yangtze River, along with Wuhan and Nanjing, the city of Chongqing experiences long, hot summers with highs of 28.3 degrees Celsius, while winters are short but mild at average of 10 degrees Celsius, and an average annual rainfall of 70%-80% and an annual sunshine time of 1000-1400 hours, with only 25%-35% sunshine [26] [27]. Due to its location in the Sichuan Basin, it has one of the lowest annual sunshine totals in China.

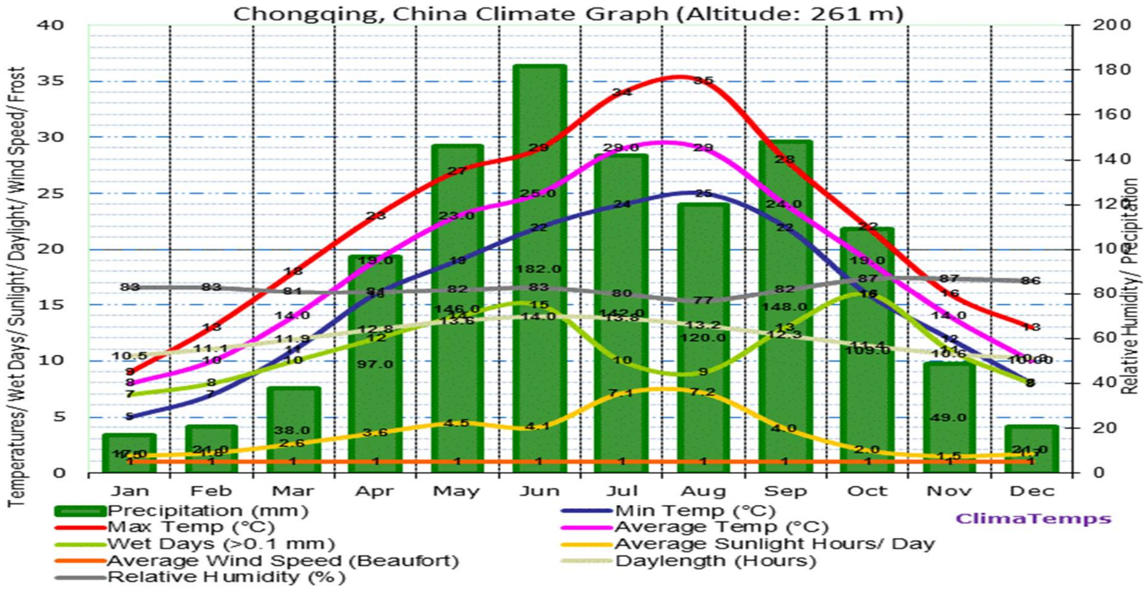

Fig. 7 chongqing climate and temperature graph http://www.chongqing.climatemps.com/chongqing-climate-graph.gif

Chongqing, a temperate city in south-central China, has a long history and is now a megalopolis. Located at an altitude of 250 meters (820 feet) at the meeting point between the Jialing and Yangtze rivers, it is one of the hottest cities in China due to its position in a plain surrounded by mountains. However, it is also known for its cloudy and foggy weather in other seasons. Winter temperatures average 11.7°C (53°F) with a drop to 6.7°C (44°F) overnight. Spring temperatures reach 22.7°C (72.8°F) with lows of 15.3°C (59.6°F). Summer temperatures reach 32.7°C (90.8°F) with highs of 23.7°C (74.6°F). Fall temperatures decrease to 22°C (71.6°F) with lows of 16.7°C (62°F). Annual precipitation is 1090 mm (42.9 inches).

B. Summary

From the above analysis, we can get the proportion of each strategy according to the current situation of each city in hot summer and cold winter area. This paper analyzes the effective use time of the building design strategy of each city thermal environment control, and puts forward the building design strategy suitable for each city climate characteristic according to the effective degree of the time. 1 The thermal comfort time is very short in hot summer and cold winter zone. It is an important method to meet the thermal comfort demand of human body in this area by other means of heating and cooling. The passive strategy can solve the heating demand most of the time, which is of great significance for energy saving in hot summer and cold winter regions. Natural ventilation is an effective means to reduce the temperature in hot summer and cold winter zone in summer, and it can meet the demand in most cases. 4. You should see the differences between cities. The uncomfortable humidity index in Chengdu is the highest, the coldest in winter in Nanjing and the lowest in. Therefore, the architectural design stage needs to aim at the different characteristic, has the emphasis. Chengdu focuses on dehumidification and ventilation, in addition to the heat and humidity problem.

Table 3 Time utilization of climate strategies of cities in hot summer and cold winter regions unit：%

Heating time required	Passive solar heating	39	37	45	45	40
	Traditional heating (active)	22	23	6	13	12
Cooling time	Natural ventilation	18	18	28	18	20
	Air conditioner	7	7	4	12	15
Comfort time		14	15	17	12	14

Nanjing and shanghai need to consider winter insulation which belong to the real transition region compound climate, is also the most difficult to co-ordinate the design of the region. To sum up the key problem of passive design of building in hot summer and cold winter zone is to prevent the adverse effect of extreme weather condition of indoor human comfort, for example, solar radiation in summer and cold and windy weather in winter; reducing the consumption of non-renewable energy and material materials during the operation of building systems; making full use of Knowledge in relevant disciplines; Promote the exchange of energy and materials required between the internal and external ecosystems of the building system. Therefore, the climate adaptability of the buildings in this area should be considered as heat preservation and insulation, shading and ventilation. The bioclimatic design principles are: 1, the Passive Cooling and dehumidification are carried out by using the ventilation of the building itself. 2 passive heating is carried out in winter by using the precious solar radiation resource to prevent the violent fluctuation of indoor temperature, reduce the indoor temperature by the sunlight irradiation, and strengthen the heat insulation design to reduce the heat loss.

C. Reflections on the use of bioclImatic Design in Buildings in Hot Summer and Cold Winter Regions

Reflections on "cold" and "hot" regions cold is an obstacle to survival and hot is an obstacle to comfort:

For most climate types, the difference between the low temperature of the climate and that of the human body is much greater than the difference between the high temperature and that of the human body. Therefore, the cold in winter is a greater threat to human survival than the hot in summer. Human beings need to survive, the first is to have the ability and means to resist the cold, cold is the first human survival needs. Therefore, early human in the long-term survival gradually formed a response to the cold means, such as increasing clothing, building houses, fire and so on [13]. These basic tools were first developed for survival, and to a large extent, people's creativity has enabled these tools to gradually make the living environment more comfortable. Cooling and expelling heat are important aspects of comfort, but there is only so much that can be done by natural means such as ventilation [28]. Therefore, for the ancients, the comfort of summer is difficult to get an effective guarantee, and become the biggest obstacle to comfort. Cold is an insurmountable obstacle, and heat is an insurmountable one: In hot summer and cold winter regions, the cold of winter is less severe than in cold climates, and basic needs can be maintained in a general way. In ancient agricultural societies, winter did not need to work, so can largely avoided the cold outdoors, and could add clothing, quilt, and fire [27] [29]. Therefore, the winter cold is hot in summer, and cold in winter regions can overcome the obstacles. But the region has very high summer temperatures, a calm long time, and a large number of water bodies leading to humid air, high temperatures, and humid weather, muggy. At the same time to carry out outdoor work, the heat is difficult to avoid. At this time clothing and other means cannot form a response to the effective means, compared to the cold winter-summer heat more unbearable. In the low-tech situation at that time, the hope placed in the building itself, placed in the choice and creation of the micro-climate environment, to a certain extent, to alleviate the summer heat. Generally speaking, in hot summer and cold winter areas, hot summer is an insurmountable obstacle.

III. BIOCLIMATIC DESIGN PRINCIPLES IN HOT SUMMER AND COLD WINTER REGIONS

Based on the above analysis, we find that for extreme climatic conditions in hot summer and cold winter regions, unipolar climate design strategies fail to cater to winter and Summer Comfort needs, to this, can seek the solution from two trains of thought, namely conformity train of thought and change train of thought. The idea of integration is to find a strategy that can solve both passive heating and passive cooling potential, that is to find the intersection of passive Heating Strategy and Passive Cooling Strategy. The idea is to use a variable approach, using a passive heating strategy when heating is needed and a passive cooling strategy when cooling is needed, that is, to sum up, the collection of available passive Heating Strategies and passive cooling strategies under the hot summer and cold winter conditions, due to the cyclical contradiction between climate and comfort needs, the integrated approach cannot meet all climatic conditions, so we advocate a design strategy that can be changed [30].

The adaptation of trees to climate in hot summer and cold winter regions is manifested in the adaptability of their morphology to climate change in different seasons, i.e., the dynamics in time dimension. In summer there is a continuous and dense canopy, and in winter all leaves are lost [30]. The adaptability of trees to climate inspires us those buildings should also respond to changes in the environment, especially in hot summer and cold winter areas, and flexible measures should be taken to solve the contradiction between winter and summer. In short, the concept of change is very meaningful for hot summer and cold winter regions, since the climate characteristics of hot summer and cold winter regions are extreme changes, then, flexible "variable" measures to deal with the multi-"variable" climate is much better than "constant response" [31]. The following principles should be followed in order to find a changeable design strategy: the principle of overall balance: the ecological architecture view of sustainable development is based on the comprehensive comparative analysis of Environmental cost-benefit, in order to minimize the cost of the environment to achieve a comfortable artificial climate, so the overall benefits of ecological architecture is an important principle of bioclimatic architecture [31]. In order to comply with the principle of overall equilibrium, it is necessary to analyze the interaction between the various parts, for example, when the summer ventilation and the winter heating and heat preservation have almost contradictory requirements on the building's shape and interface, to achieve the overall comfort of the full cycle and energy-saving, it is necessary to carry out an overall analysis of different situations, to make a balance [28]. The principle of dynamic openness: any organic life system needs to keep its character of openness in the face of the change of environmental conditions, which is the basis for the coordination and communication between all life and the environment, in order to adapt to the extreme climate conditions, the architecture must have flexible and changeable adaptive system, so it must be open [32]. Open architecture is such an adaptive architecture system that makes buildings flexible and changeable in the face of changing external conditions, in the hot summer and cold winter zone, the principle of dynamic opening is more fully displayed as the extreme changing climate conditions require the building's strong adaptability to climate change throughout its life cycle [23]. Principle of high efficiency and intelligence: The ideal building climate regulation should be like the stress behavior of living things, an adaptive control process which collects the outside climate information completely autonomously, and then causes the internal environment and the equipment to react accordingly, the architectural design in hot summer and cold winter zone should embody the similar life characteristics of architecture. Bipolar control principle: the extreme changes of climate in hot summer and cold winter regions require timely adjustment of the bipolar control of buildings [20]. Bipolar control, that is, the control system can actively control the control parameters (such as temperature, humidity, etc.) in both directions between its fluctuating poles, as the outside climate is always around the human body's ability to adapt to the acceptance of the scope of sitting bipolar swing, from uncomfortable to comfortable, from comfortable to the other pole of uncomfortable. Therefore, the building should have the ability to adjust each climate element in both directions, which is especially important in hot summer and cold winter areas.

A. Analysis of Climate Strategy of rural Buildings in hot Summer and cold Winter Areas in China

Hot summer and cold winter areas are the earliest areas of agricultural social development in China. During the Tang, song and five dynasties, with the war in the north, a large number of residents moved south, the Yangtze River Basin economy to develop. By the Southern Song Dynasty, China's economic center was obviously moved to the Yangtze River valley. As a result, a variety of architectural form has developed in hot summer and cold winter zones. Such as the south of the Yangtze River White Wall Gray tile water village pattern, the southern Anhui horse head wall form, the city lane layout [33].

The emphasis of vernacular architecture is not on the technical means of creating an artificial microenvironment within the larger environment, but rather on creating a "filter" between the indoor and outdoor environments, allowing people to integrate into the overall environment. In particular, it should be pointed out that the transitional grey spaces in rural buildings, such as courtyards, porches, balconies and awnings, often have climatic functions and at the same time express the emotional consciousness of the owners, with a strong symbolic meaning, these spaces offer the possibility of more functions for specific spaces that are not available within the building [27] [12].

However, the great wealth of Vernacular Architecture does not lay in its form itself, but more in its attitude to the environment and climate and flexible adaptive strategies. It is difficult to solve the problem of summer shading, ventilation and winter heating at the same time for low-tech vernacular buildings, but more decisive factors can often be found. In the hot summer and cold winter area, people's life in traditional agricultural society is restricted by the natural condition because of the severe climate condition, and the local architecture in this area has produced the rich form adapting to the climate [34]. Due to the limitation of technology, the local architecture in hot summer and cold winter area tends to deal with hot summer, and tends to select and create microclimate environment.

B. Microclimate Selection for Adaptation to Regional Climate

1) Settlement Site Selection: from the Macro Level

The site selection and layout of traditional vernacular buildings are often a comprehensive consideration of multiple climatic factors, making full use of favorable conditions, the process of deterring predation by adverse factors. In hot summer and cold winter zone, the problem of hot summer and heat preservation should be solved simultaneously [9] [4]. The village site is chosen on the relatively open sunny slope in the valley or the gentle slope on the south side of the inter-mountain basin. 'for example, the southern Anhui Province is located in the mountainous and hilly area, making full use of the characteristics of land and water breeze in the planning and layout, and through a reasonable architectural layout, introducing the cool wind from the water surface through the streets, so that the buildings can achieve a good ventilation effect, to cool the summer air. In practical function, the village located in the south of the slope land can get enough natural sunshine and open view, and can avoid flood invasion and facilitate natural drainage [35]. This pattern forms a more closed regional settlement environment, which can not only make the villages avoid the strong mountain wind, the cold moist air current erosion, but also can absorb the cool wind passing by the water in summer. In hot summer and cold winter regions, due to the complexity of topography, various climatic factors play different roles in site selection, and various regions often combine regional and national cultural forms to form diversified architectural features, for example, in Enshi Tujia and Miao Autonomous Prefecture and northern Guangxi, dry-landed houses are suitable for mountain area, in southern Anhui, in the form of Matou Wall to meet the need of fire prevention, and in the large-area courtyard layout in the south of Yangtze River Plain [36].

2) Settlement Layout and wind Environment

Wind Treatment in rural buildings can only be carried out in two ways: preventing adverse wind effects and making full use of effective natural ventilation. Taking as an example the main traditional residential area in Wuhan, Florida, the existing main part is located in Jiang'an District. The arrangement of fish ribs along the Hankou River is both in line with the river's movement and allows the river's winds to flow straight into it. Dozens of streets which are not wide and perpendicular to the river face the open river directly, forming the so-called narrow pipe effect. This is not only a form of planning, but also an aspect of climate adaptation [37].

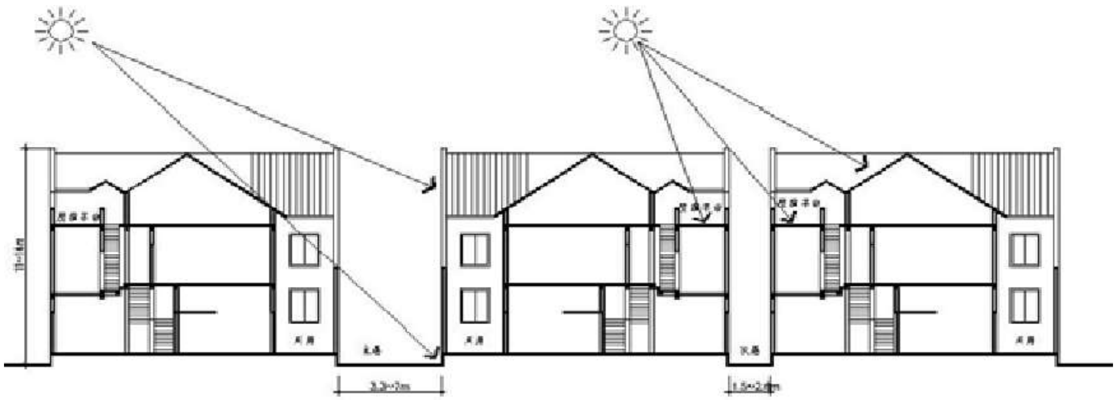

Fig. 8 Analysis of sunshine in the outdoor space of Lilong House

The laneways of the Lilong House are perpendicular to the river [38], The Shi-ku-men houses in China, originating from London's row-housing pattern, feature a two-storied front building body with a central courtyard and a rear one-storied body connected by a light-well, reflecting traditional Chinese dwelling models. The Old Shi-ku-men Lilongs house features courtyards, enclosed by a brick wall at the front, allowing for controlled light and ventilation. The courtyards moderate sunlight on internal walls, while the hotter temperature of outside open space traps wind draught, ensuring a comfortable living environment in narrow lots [39]. Futhermore, Hanzhengjie in Wuhan, which runs parallel to Han River, and the west section is close to Han River. The laneway is perpendicular to Hanzhengjie and Han River, and connects to Hanzhengjie and Yanjiang Boulevard [40]. The prevailing wind direction in Wuhan in summer is West or east of the South Wind, and in winter the prevailing wind direction is about 15 east of the North Wind. Hanzheng Street is roughly parallel to Han River Street, and the laneway is perpendicular to Hanzheng Street, making the laneway in the western section parallel to the prevailing wind direction in summer, it is beneficial to the ventilation in the tunnel in summer and avoids the influence of the dominant wind in winter.

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3) Dense Buildings Layout and Narrow Street Space

Hot summer and cold winter areas due to hot summer, solar radiation intensity. The buildings tend to be compact in layout, reducing the effect of solar radiation and helping to slow the heat loss in winter. For example, Wuhan, the adoption of Long Street narrow lane overall layout, lane spacing is very small, residential use of row layout, reduce the exposed area of the outer wall, while increasing the shadow of the roadway. At the same time, the building density and the utilization ratio are improved. Sunshine in the main lane is better than sunshine in the Secondary Lane [41]. The outer wall of the patio is not high, making the outdoor space of the Patio (main lane) the most sunshine. In summer, the walls on both sides of the main lane block the morning and afternoon sunlight, and receive direct sunlight only at noon, ensuring a shaded outdoor space in the morning and afternoon

4) Settlement Layout and Water Greening

There are many rivers and lakes in hot summer and cold winter area. Settlement layout is usually parallel to the river according to the characteristics of water system, forming the residential pattern of" Qianchaohoujiezhenhe" [42]. The shape of the total plane of the settlement is different from that of the river, such as belt shape, radial shape, nuclear shape, saddle shape, trumpet shape and arc shape. Band-shaped settlements are generally small in scale; radial settlements are large in scale and extend along rivers; nuclear settlements are located in river ring, which is a moat and used to serve as a defense; saddle-shaped settlements are located at the end of rivers, the scale increases with the discharge at the end of the river, the trumpet-shaped settlement develops along the river, and the arc-shaped settlement is arranged along the contour line [35]. The river bank of the building line with the river, space façade colorful, intimate small scale. In order to meet the boat clearance, the construction of tall arch bridge, the river crossing, at the intersection of the river channel group, forming a unique water feature. Ancient residents were good at transforming water bodies in the environment and diverting water into villages. Village water mouth and internal water Shenzhen, ditches and other interconnected to form a natural village water supply, drainage network [43]. The construction of gardens at Shui Hau, such as the Nanhu, not only provides the village with abundant water, but also prevents the damage caused by floods. In addition, the village of Shuikou Gardens more built in the village entrance where many water convergence, where a wide variety of trees, building pavilions, water pavilion, pleasant scenery [44] [45]. The village water mouth forest can make the village resident winter screen cold wind, summer shade Sun, and can contain the water source, adsorb the dust and sand and purify the air. In the traditional Lilong residential area of Shanghai, there are many considerations for greening. Lilong House to the east-west-oriented will cause the problem of indoor summer Western Sun, residential in order to block the sun, in addition to the addition of shutters, but also the use of plant shading. And planted Tall Sycamore trees on both sides of the street outside the Lilong residential building, so that the temperature around the Lilong residential building decreased, played a good role in temperature control [43].

C. Building units Adapted to Regional Climate

1) Spatial Layout of Buildings

Spatial layout of traditional Vernacular buildings in hot summer and cold winter areas, using Patios, open rooms and verandas as links, doors and windows facing each other, open halls, indoor and outdoor connections, it forms a complete ventilation system with vertical and horizontal ventilation [9]. The wind is blown in by the main door or side door, and can be reached in both south and east-west rooms. Dense building layout, so that the building's doors and windows and wall length in the shadow, while the room into a greater depth, is conducive to reducing the level of heat radiation. Taking Wuhan as an example, the unit has a compact plane layout and complete functions. It is arranged around a small central courtyard with functions of day lighting and ventilation [42]. Each House has an organic transition between the inner and outer courtyards, this compact layout reduces direct heat loss and heat gain to the outside world. So that the summer day lighting to a certain extent to meet and reduce the impact of strong light on the indoor heat. Lane residential more for two or three floors, and clearance height, into the deep, generally a layer 4.2 meters, 23.9 meters, 3.3 meters [9]. This large layer height setting facilitates the formation of vertical temperature zones 192. Most of the residential buildings in Huizhou are rectangular in plan, with a column net size close to the modern Modulus, a small opening space and a large depth of penetration. This leads to low heat transfer, low heat consumption, low energy consumption, and a large indoor space.

2) Organization of Courtyards and Patios

The patios serve as a well-defined focal point for vernacular architecture, as a tower like space that can sense the weather, the weather, the heat, the cold and the warmth of the natural world [4]. In hot summer and cold winter area, the local buildings are mostly organized by courtyard and courtyard, which adjust the micro-climate environment of the whole residence and have the

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function of climate buffer layer. There are four ways to deal with the courtyard in the traditional vernacular architecture in hot summer and cold winter zone: the former courtyard, the middle courtyard, the latter courtyard and the side courtyard. The former patio is to make use of the shady corridor and the ventilation wall to obtain the air inlet, the latter patio is to solve the air outlet, the Middle Patio and the side patio are not very big in scale, basically is the north-south into the depth short, the east-west narrow, in favor of blocking the summer sun [48]. At the same time, all the patios are connected with each other to make the air flow smoothly and connect with the roadway to form a complete ventilation and heat-proof system. For example, the natural ventilation system of the courtyards and deep laneways in Huizhou residential quarters can improve the indoor air circulation and solve the problems of heat dissipation and moisture prevention [49]. In addition, Suzhou folk houses have a small and narrow courtyard, width only 1.82 M193, commonly known as "wall-hole courtyard. ". From the adaptation of the climate, the wall-hole Patio has a unique feature: effective prevention of the Western Sun and the invasion of winter north wind, summer induced convection ventilation and so on [50]. In the Qing Dynasty houses in Shangtang town, Nancheng County, Jiangsu Province, there is an even more variant of this traditional form of courtyard. The results of the open-and-close courtyard can indirectly prove the climate adaptability of the open-and-close courtyard to hot summer and cold winter areas [50]. The lilong-style buildings in Shanghai also tend to have a former courtyard and rear courtyard two types. The Organization of the Front and Rear Patios promotes the formation of cross ventilation, and the Organization of the front and Rear Patios has similar functions of day lighting and ventilation in the Lilong residence in Wuhan, in Wuhan Lilong House, the function of ventilation is small, because the summer in Wuhan is calm, it is difficult to form cross-ventilation, and the function of pulling out wind is also very small [43].

D. Building Elements Adapted to Regional Climate

1) Walls for Ventilation and Thermal Insulation

Walls that are conducive to ventilation and heat insulation are enclosed mainly by inward-facing walls in hot summer and cold winter areas in order to reduce heat exchange inside and outside the building. From the view of the houses in southern Anhui Province, the outer wall has few windows or no windows, the area of windows is not large, and the time of direct heat exposure is little [51]. The initial structure of Lilong residence in Wuhan is mostly brick-wood structure, brick-wall load-bearing, wall thickness is mostly 240 ~ 490 mm, brick is mostly used for brick kiln, reinforced concrete beam-plate is adopted in the later period, still brick-wall load-bearing, with 370 mm wall and 500 mm wall mostly, the thick and heavy wall is favorable for heat preservation and insulation, which conforms to the climate characteristics of hot summer and cold winter in Wuhan and Tianjin area [52] [53]. Some of the houses have shutters. The material of shutter is woodiness commonly, most have perpendicular tie rod to adjust, also have a few do not have tie Rod. The measured results show that the form of the louvers meets the strain needs of day lighting and ventilation in hot summer and cold winter areas. It is a form which is worth popularizing in this area. As far as residential buildings are concerned, in the heat insulation and ventilation problems in summer, it focuses on insulation. Because, in the lower temperature of 28 °C, the human body visible sweat less, the skin almost no sweat condensation, so in the lower wind speed, the human body can achieve thermal comfort. In order to reduce the heat exchange between inside and outside buildings in hot summer and cold winter zone, the enclosed wall is the main wall. From the view of the houses in southern Anhui Province, the outer wall has few windows or no windows, the area of windows is not large, and the time of direct heat exposure is little [51]. Some of the houses have shutters. The material of shutter is woodiness commonly, most have perpendicular tie rod to adjust, also have a few do not have tie Rod. The measured results show that the form of the louvers meets the strain needs of day lighting and ventilation in hot summer and cold winter areas. It is a form which is worth popularizing in this area. As far as residential buildings are concerned, in the heat insulation and ventilation problems in summer, it focuses on insulation [52]. Because, in the lower temperature of 28 °C, the human body visible sweat less, the skin almost no sweat condensation, so in the lower wind speed, the human body can achieve thermal comfort.

2) For the Maintenance of Rain Protection Structure.

Hot summer and cold winter areas of rural buildings are mostly slope roof, which is mainly affected by the size of precipitation. Generally speaking, the local building in the precipitation more places, the roof slope, to water, on the contrary, the roof slope is small. In the coastal areas of China due to the impact of typhoons, the roof generally has a small slope, and the roof is not even out of eaves or sealed eaves etc. [29]. This form helps to attenuate the damaging effects of the wind. Secondly, the amount of precipitation in hot summer and cold winter area has a great influence on the construction and protection of Exterior Wall. In the protection of exterior walls in rainy areas, the commonly used component forms are deep overhanging eaves, overhanging eaves, waist eaves, sloping eaves and heavy eaves, etc.

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These different treatment methods, but also formed a rainy area unique to some of the building forms in summary, Architecture cannot exist without nature, and folk artisans in hot summer and cold winter regions have created various houses adapted to the terrain and local climate under limited material and technical conditions, traditional vernacular architecture is to rely on the attitude of cooperation with nature, and has accumulated a lot of architectural experience in line with nature [35]. From many examples of traditional vernacular architecture, we can conclude how the ancients took advantage of nature to avoid natural hazards to the greatest extent.

E. Summary

In summary, the climate design of the traditional vernacular architecture has the following characteristics: 1 The building space is single and the function is comprehensive, the expectation value to the comfortable degree is low, therefore the building's total energy consumption is low, and the adjustment request is simple and primitive. Limited by the technical means, the response to the adverse climate depends on the building itself, mainly relying on the simple and directly accessible energy, such as firewood and other materials. 3 focus on the choice of micro-climate, such as winter nest summer and geomantic phase site selection. In some cases, choosing a natural climate is easier than creating an artificial one. 4 Monopole Control. The ancients were better at protecting against cold than against heat, because fire generates heat, and it was impossible for the ancients to artificially create low temperatures, as was the control of ventilation. Therefore, the relationship between traditional vernacular architecture and climate lies in the "prevention" of adverse climatic elements, but due to the limitation of technological means, the external surfaces of most buildings are characterized by "closed but not closed”, which makes it difficult to isolate the adverse climatic elements, and it is difficult to use the beneficial climatic factors, so the efficiency is low and the effect is bad [9]. Modern material technology and construction technology can make the exterior surface of the building not only more airtight and prevent the invasion of the bad weather, but also more open and flexible, and can "isolate" the beneficial climatic elements, and can better embody the "use" of the building to the climate, at the same time, it is possible to make timely conversion between "closed" and "open”. What the ancients saw as an adverse climatic factor to be guarded against could well become a useful factor to be used in modern architecture [20] [12] [23] [28]. Only in this way can the relationship between architecture and climate be transformed from "prevention" to "use", and architecture can be transformed from primitive "shelter" to "filter" of climate for comfort and psychological satisfaction. This is the building and the environment coexist the embodiment of the ecological character has been gradually strengthened.

F. Climate Design Strategy for Buildings in Exterior Space Scale.

From the previous analysis, it can be seen that the annual temperature difference is large in hot summer and cold winter zone, a two-season response needs to be considered. For this kind of climate characteristic, the architecture needs flexible and changeable measures to adapt to the climate, no matter from the space layout, the form processing, or the application of the structural material.

1) Heat Island effect, its Utilization and Improvement

Because most of the big cities in hot summer and cold winter regions are old industrial cities, the land application and the afforestation disposition have been unreasonable, the environmental damage is serious, the afforestation is insufficient, makes the heat island phenomenon more obvious [55]. On the other hand, because there are more lakes and rivers in this area, the urban distribution is obviously regionalized, which also provides the conditions for alleviating the heat island effect. Taking Wuhan as an example, the situation of heat island is closely related to the present situation of city layout. The characteristics of Wuhan Heat Island: 1971 the new city of Wuchang where the water body and green space are concentrated, the heat island effect is not obvious in most areas of Hanyang, and the high temperature area is scattered; 3 the distribution of urban heat island temperature field intensity is not uniform, and its distribution is closely related to human activities and economic development [56]. The urban temperature field in Wuhan presents a regular distribution, from high to low: Old Industrial Zone a new industrial zone an old urban area a new urban area a suburb. Based on this, we can put forward the strategy of using and improving urban heat island effect: Urban Heat Island double effect, urban heat island effect has positive and negative effects. On the one hand, for a city as cold and humid as Wuhan in winter, the Heat Island effect can raise the minimum temperature, benefits in terms of increased airflow exchange, reduction of environmental pollution, reduction of winter inversion, increased rainfall, beneficial winterization of urban flora and fauna, and the use of open corridors such as rivers to form urban ventilation corridors. Wuhan, on the other hand, is sweltering in the summer, and the heat island effect adds fuel to the fire [56] [57].

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The main solutions are: to adjust the irrational layout of urban areas, to transform the traditional industrial structure, to adjust the irrational layout of industrial enterprises and buildings in urban areas according to the characteristics and spatial distribution of the heat island effect in order to reduce the intensity of the Wuhan Heat Island effect, for such a strong heat island area as the eastern part of Qingshan, measures should be taken to divide and weaken the heat pollution. Expanding urban green space, a 1994 survey of the urban environment showed that the per capita public green space in Wuhan was only 2.9 m [58] [57] (Jiao et al., 2020). Therefore, it is necessary to strengthen urban greening, which can adjust local temperature and humidity, reduce urban central heat island effect and Clean Air. The fact that Nanjing, known as the "furnace”, has lowered its average summer temperature by 2 °C in july-august is a good example of how the city's vegetation coverage has increased as a result of Afforestation [59] [43]. Active Protection of water bodies, strengthening Lake Regulation, large-area water bodies to mitigate the heat island effect is the most obvious, but also an important way to create the cold island effect. Wuhan is rich in water resources, and its development and utilization are relatively early. However, due to inadequate protection, most of Wuhan's lakes are facing the problems of area reduction, water quality decline, and so on. The distribution of lakes is also concentrated in the suburbs of Wuchang and Hanyang, while the old urban area of Hankou, where the heat island effect is most concentrated, has almost no large water bodies [57]. Therefore, in the process of urban infrastructure planning, we should not only actively protect the existing water body from further damage, but more importantly, develop more artificial water bodies where the population is concentrated.

2) Layout and Ventilation of Buildings

In the hot summer and cold winter regions of China, only the average wind speed in Shanghai is higher than 3M / s in winter and summer, which are 3.1 m / s and 3.2 m / s respectively. The average wind speed in other major cities is less than 3M / S. The wind speed in Chongqing is 1.4 m / s in summer and 1.2 m / S in winter [6]. Therefore, in this area of the building group layout, hot summer and cold winter areas should be used in favor of building groups in summer natural ventilation layout. Staggered, oblique and free, better than determinant, peripheral, building each other less windproof, staggered equivalent to increase the distance between the front and rear buildings, favorable for ventilation; no wind, due to the role of heat pressure tunnel wind. Furthermore, the distance between the staggered front and rear buildings can be slightly reduced, saving building land. When limited by the terrain, can use oblique, staggered, can also use free according to the terrain, terrain and orientation and other conditions flexible layout. Because of the negative pressure in front and back of some buildings, poor ventilation, and part of the building in the East, west, so this area is not suitable for this layout. The height, length, and depth of the building also have a significant impact on natural ventilation [17]. Architectural layout should pay attention to "before low after high" and regular "High and low patchwork" treatment. This prevents the front and rear buildings from blocking each other's airflow. It can be concluded that the ground floor of the building can effectively reduce the obstruction to airflow movement and form good natural ventilation. To sum up, the wind-proof design in winter and natural ventilation design in summer should be taken into account in the layout of buildings in hot summer and cold winter areas. Natural Ventilation in summer requires that the group layout of the building should be as low as possible to block the wind, and should be open to the prevailing wind direction in summer to guide the air flow in. In contrast, winter windbreaks are designed to be tightly packed to keep the air out [61]. The opposite design requires careful examination of the dominant wind direction in winter and summer. Under the influence of the continental climate, the prevailing wind direction in the hot summer and cold winter regions is nearly opposite to that in the summer, and the prevailing wind is mainly southeasterly in the summer and northwest in the winter. Taking advantage of the difference between the dominant wind direction in winter and summer, combined with the layout of the building group, the wind-proof in winter and natural ventilation in summer can be achieved. The different height and length of the building group are arranged according to the different dominant wind direction. Facing the north-west direction of the group in winter, the tallest and longest buildings are arranged on the north side of the group, while the South side of the group is arranged with low and small buildings, which can not only block the north-facing wind in winter, but also form a ventilation opening facing south

IV. CONCLUSION

A. Conclusion

Based on the study of bioclimatic design theory and strategy, the study is further limited to hot summer and cold winter regions. The analysis and summary based on the theory of bioclimatic design are given to the local architecture in hot summer and cold winter regions, which provides a useful reading book for the current architectural practice in hot summer and cold winter regions. According to the climate situation in hot summer and cold winter regions, a series of strategies based on the regional climate were established from the bioclimatic analysis map of the region, it provides feasible guidance for design practice of paying attention to climate and saving energy in hot summer and cold winter zone.

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Ecological Architecture and sustainable development have become the focus of the industry. With the contradiction between man and the natural environment becoming more and more prominent, it is urgent to explore the methods and strategies of bioclimatic design. In particular, the design strategy for adapting to severe climate change in China, where continental climate features are evident, such as hot summer and cold winter regions, is extremely important. Firstly, this paper discusses the relationship between organism and climatic energy, and holds that the interaction between organism and climatic factors reflects the adaptability, and architecture is a compensation method for human's comfort requirement besides human's adaptability. The emergence of energy crisis makes the building have to find a new way out, climate, as an inexhaustible resource, can bring new vitality to architectural creation. Bioclimatic architecture design theory is based on the human understanding of this relationship, for the future of mankind, high concern, gradually formed in the integration of disciplines, a comprehensive and practical scientific theory. The characteristic of bioclimatic architecture is to take the adjustment of building "skin" as the key point, not the simple combination of material and component, it has the biological, organic characteristic, can adjust itself constantly, thus cause the change of building appearance form. Bioclimatic architecture advocates the use of low-tech, passive technology means to minimize energy consumption in the operation process, on the basis of reasonable, scientific, reflect the simple, efficient characteristics of biological adaptation to climate.

B. The Research Conclusion of This Paper

As the applied basic research of architectural climate design, based on the requirement of human comfort and the systematic analysis of bioclimatic design theory, this paper puts forward the general principles of bioclimatic architecture, on the basis of this, the bioclimatic design strategy of hot summer and cold winter region in China was studied. The main research work and conclusions are as follows: (1) firstly, this paper analyzes the relationship between bioclimatic architecture and ecological architecture from the perspective of history and design, and points out that from the perspective of the development history of ecological architecture, the theory of bioclimatic design is a stage of the development of ecological design theory, and the content of bioclimatic design is a part of ecological design from the point of view of design. Generally speaking, the standard of comfort is not determined by any one factor, including many aspects: Thermal Comfort, visual comfort and olfactory and auditory comfort, and often includes a combination of historical, geographical, cultural, ethnic and other reasons, thermal Comfort has the greatest impact on human body. According to the research on the area of Thermal Comfort, it is considered that the range of thermal comfort is a gradual and dynamic process as the change of various conditions (temperature, humidity, wind speed, etc. The human body responds to climate change in two ways. One is adaptation, which is mainly reflected in keeping the body at a nearly constant temperature by adjusting various parts of the body. The other is compensation, that is to say, the building is the main means to compensate the climate change in the region beyond the adaptive adjustment range. It also points out that the compensation methods mainly include: 1 Climate Compensation Based on human comfort demand 2 ecological compensation based on environmental sustainable development (4) starting with the life-like features of buildings, it is pointed out that the building should provide effective feedback to the environment like living beings when selecting forms, apply scientific and reasonable analytical methods as far as possible, use simple and efficient forms, and reduce as far as possible the equipment systems that maintain the building operation, minimize Energy Expenditure. (5) The design premise, target, cut-in point and means of bioclimatic architecture are discussed in general, and it is concluded that bioclimatic architecture is based on the principle of low energy consumption architecture design, emphasizing passive means, the principle of no or little equipment adjustment maximizes the indoor comfort environment, thus saving energy and protecting the environment. There are two basic premises of bioclimatic architecture: (1) the difference of indoor and outdoor climate and (2) the necessity of building's influence on environment.

Furthermore, General compensatory principles mainly includes: 1 Climate Compensation Based on Human Comfort demand 2 ecological compensation based on environmentally sustainable development, the starting point of bioclimatic architecture design is climate factor. The basic goals of bioclimatic architecture design: From the difference between indoor and outdoor: required climate control = outdoor actual climate conditions-thermal comfort environment conditions 2. From the technical mode of control: Required Climate Control = passive control of buildings (as much as possible) + active control of equipment (as little as possible)(6) through the comprehensive understanding and comparison of bioclimatic analysis methods in history, in view of the current situation of the design industry in China, this paper puts forward the steps of bioclimatic design based on some technical analysis: (1) the determination of the comfortable range of human body combined with the factors of site, history and culture, according to the relevant technology background knowledge, wind movement principle, Sundial and so on, the actual research on the site climate factors such as wind, temperature, solar radiation, humidity, etc. , the main factors are analyzed. 3 the gap between outdoor climate factors and users' comfort needs is determined.

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4 The distribution of climate strategies is determined by the bioclimatic chart of the climate region Based on the mastery of various strategies, the architect makes a reasonable choice among the strategies, and makes a choice by some means (such as experience, Computer Model Simulation) ; 6 The strategy choice and the form, the material and so on construction essential factor union, forms the complete design; 7 carries on the actual measurement analysis to the building, carries on the synthesis comparison with the anticipation, thus strengthens to the region climate characteristic understanding. 7 design strategies are firstly organized in three scales: The exterior spatial scale (macro scale), the individual scale (Meso scale) and the component scale (micro scale).
In the study of each scale, different design elements are classified, this paper discusses the use of natural resources such as lighting, ventilation, heating and so on. It provides the key points for architectural design practice. 8 through the analysis of the traditional vernacular architecture in the hot summer and cold winter area, it is considered that the hot summer and cold winter area tends to deal with the hot summer, on this basis, it is realized that the core of the bioclimatic design of buildings in hot summer and cold winter regions is the idea of "change" , that is, considering the heating and heat preservation in winter on the basis of satisfying the heat insulation and ventilation in summer as far as possible, this kind of change thought at the same time more confirmed the architectural similar life characteristic. Based on the analysis of traditional vernacular architecture in hot summer and cold winter zone, it is pointed out that the theory of bioclimatic architecture reflects the change of architecture from "preventing" to "using" climate. According to the climate condition of hot summer and cold winter area, the following conclusions are drawn from the bioclimatic analysis map: the climate adaptability of buildings in this area should be considered as heat preservation and heat insulation, shading and ventilation.

Table 4 The difference between bioclimatic design and ecological design

	Bioclimatic design	Ecological design
Discipline background	A focus on energy	A new understanding of the relationship between man, and nature
Design condition	The relationship between human body and climate	The relationship between the building and the whole ecosystem
Design goal	Create a comfortable microclimate	Comfortable microclimate/The whole ecosystem is balanced
Design Point Starting	An analysis of the effects of climate on people	Analysis of environmental energy and data
Design evaluation	Human comfort/ Energy consumption	Overall harmony of the environment

The bioclimatic design principles are as follows: (1) in summer, the excessive solar radiation is isolated from the outside by shading measures, and the passive cooling and dehumidification are carried out by using the ventilation of the building itself. 2 passive heating is carried out in winter by using the precious solar radiation resource to prevent the violent fluctuation of indoor temperature, reduce the indoor temperature by the sunlight irradiation, and strengthen the heat insulation design to reduce the heat loss. 10 combined with the work of the Huazhong University of Science and Technology over the years, a set of strategies has been developed to respond to the regional climate on the same scale, it provides reference for design practice of paying attention to climate and saving energy in hot summer and cold winter area.

C. Future Research Work

The research on bioclimatic architecture theory is a comprehensive and systematic project, which requires close coordination between disciplines. This paper focuses on the combing concept and the sorting strategy, the aim is to establish a complete theoretical framework and strategic system of bioclimatic architecture, and the analysis of the concrete data involved is less, but this is the basis of bioclimatic design theory, it is also an indispensable link in the theory of bioclimatic architecture. It is based on this, this paper can be carried out from the following aspects: 1 from the thermal sense, vision, hearing, smell and other aspects of Indoor Environment Comfort Research; (2) research on the "use" and "prevention" of microclimate factors in architecture; (3) research on the influence of climate factors on Human Comfort; (4) Comparative Research on the influence of design strategies on environmental microclimate.

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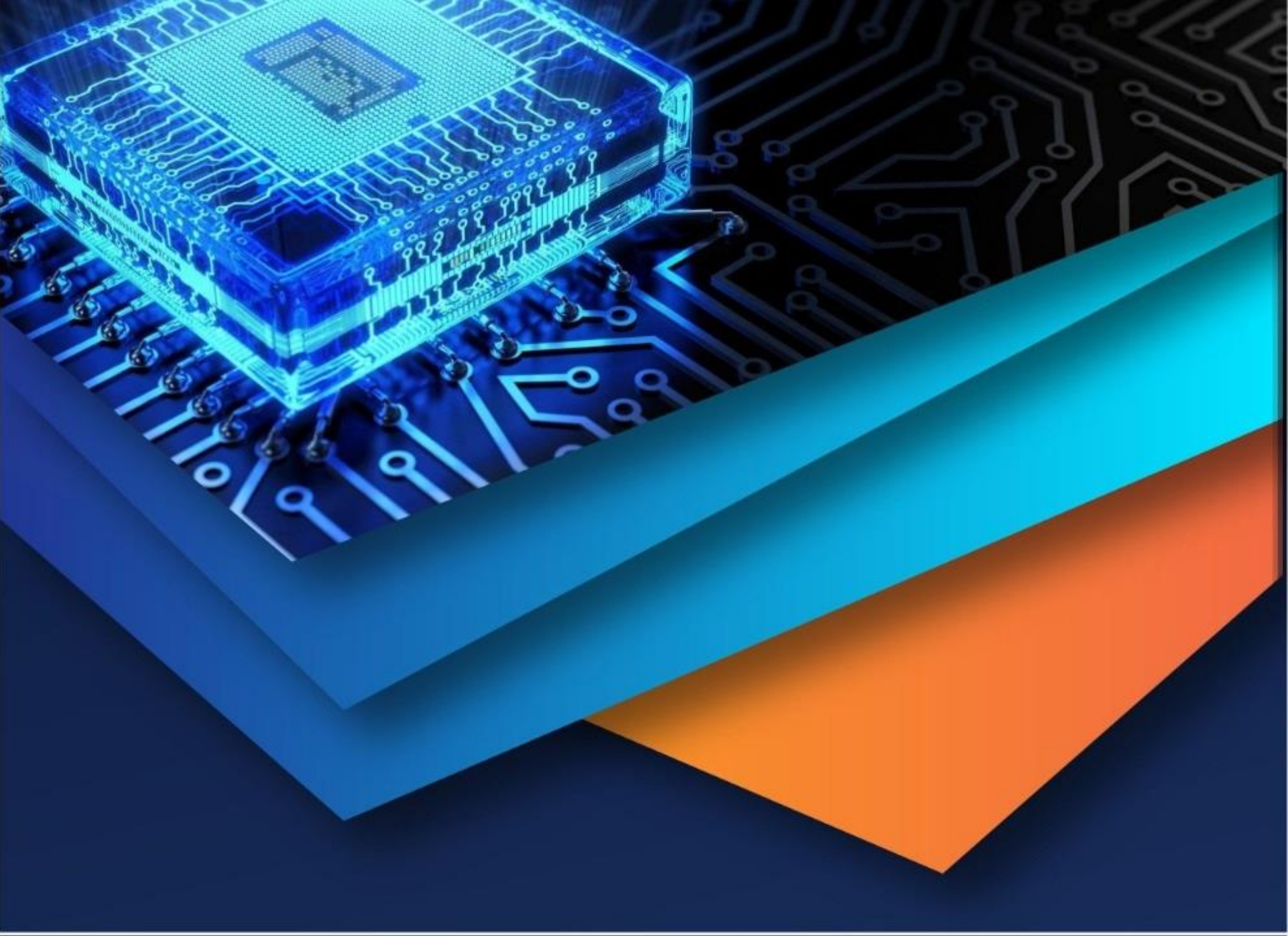

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