Research on Ecological Environment of Green Building Based on Sustainable Development

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Abstract. Comfort refers to the subjective feeling of a person. The corresponding uncomfortable terms, is the psychological satisfaction of people in the hot environment. From individual differences, it is difficult to give accurate definitions of thermal comfort. Humidity directly and indirectly affects the thermal comfort. In summer, most southern China is humid. The traditional PMV model cannot accurately predict the thermal comfort of human body at high humidity. This allows for a concrete study of the relationship between humidity and thermal comfort and makes it necessary to build a suitable predictive model. Want to make more reasonable air-conditioning design parameters we can use the thermal comfort of the study, not only to meet the basic comfort requirements, but also to expand the scope of the relative humidity. Expand the application of new technologies, thrifty use of air conditioning to reduce energy consumption. This will ultimately be achieved by providing humankind with a comfortable and healthy artificial environment.

Introduction

According to the ANSI/ASHRAE Standard 55–2013 [1], thermal comfort is ‘that condition of mind that expresses satisfaction with the thermal environment and is assessed by subjective evaluation’. Indoor thermal comfort is among the most important factors affecting occupant well-being, health and productivity in buildings [2]. In addition, the humidity importance in determining physiological thermal comfort is well documented [3]. Early US air-conditioning projects, people urgently need the impact of humidity on comfort information. This issue prompted the American Association of HVAC Engineers in 1919 to create a new laboratory, one of its first batch of research topics is the effective temperature indicator ET. Later in 1967 ASHRAE manual still use this indicator. Effective temperature ET is an arbitrary indicator of the effect of air velocity, dry bulb temperature, or humidity on a human's cold or warmth, summarized as a single value. Its value is equivalent to the temperature of saturated air that forms the same sense of rest. After being replaced by the new effective temperature ET *, Gagge et al. [4] introduced the concept of skin moistenability to ET * to provide a comfort indicator that is suitable for dress code and for sitting people. This indicator is presented in the ASHRAE Comfort Standard 55-7 and ASHRAE's 1977 Handbook Fundamentals. Later, there are many scholars in-depth study of the type of impact of humidity on the comfort. It is known, for example, that high indoor humidity impairs sweat-induced evaporative cooling, which is the principal physiological mechanism by which the body rejects heat, particularly in warm environments [5–9]. De Dear, R. et al.[10]studied the effect of humidity on thermal comfort under non-static conditions. After the conclusion: the change of humidity in long-term sitting subjects, the impact is not obvious, on the contrary, changes in humidity for subjects in exercise conditions have different effects. When greater than 1.6met (1met is equivalent to the activity of restful adults), the body will not have a satisfactory percentage below 25% regardless of the humidity level. Jorn Toftum et al. [11] suggested that the upper limit of the heat and humidity comfort zone should be defined by the sense of humidity of the human respiratory system. But also through experiments to create a mathematical model that can be used to evaluate comfort. There are many factors that affect comfort, and the energy exchange between the human body and the
environment is continuously carried out. Therefore, environmental and meteorological conditions, hygiene, physiological adjustment and psychological impact are the factors that affect the human thermal sensation. Therefore, thermal comfort is the result of a comprehensive effect. At present, we have achieved good results in this respect. The following is a brief analysis of the mechanism of its impact. There are many factors that affect comfort, and the energy exchange between the human body and the environment is continuously carried out. Therefore, environmental and meteorological conditions, hygiene, physiological adjustment and psychological impact are the factors that affect the human thermal sensation. Therefore, thermal comfort is the result of a comprehensive effect.

Thermal Comfort Factors

Different evaluation criteria are proposed before and after Thermal Comfort Indices, There are two aspects to consider about the thermal comfort of human body: 1) Environmental parameters: humidity, average radiation temperature, air velocity and air temperature; 2) body parameters, including the level and clothing. In addition to this, there are other uncomfortable environmental parameters that can cause localized irritation in the human body, such as hair, relatively large temperature gradient between the ankles and the head, and uneven temperature radiation.

Environmental Parameters

1) Air temperature is a major contributor to thermal comfort and it directly affects the body's sensible heat exchange with respect to flow and radiation. 2) Radiation temperature. The average radiant temperature depends on the surface temperature of the surrounding area. Radiant heat source is only on the side of the human body, etc. 3) Air velocity. Placed in a hot environment, the air flow can supply fresh air to the human body, but also to some extent, the human body evaporative cooling and convection cooling, providing a cooling effect, so that the body to achieve thermal comfort, at the same time, the air flow speed larger may also lead to the risk of a sense of hair, so the size of the air flow rate is also an inevitable contradiction. 4) Environmental humidity. Humidity affects the thermal comfort of the human body and is an important factor in the tactile sensation of indoor materials. The main impact of ambient humidity on human thermal comfort is its effect on evaporative heat loss from human skin to the environment. With the relative humidity maintained within the 40% -70% range, the body ensures a stable evaporation process and the air flow rate at this time is very important. The same indoor environment slightly humidifier than the general assembly to form a building wet, and sometimes there will be condensation phenomenon, on the contrary, if the humidity is less than 30%, not only can cause the body's thermal discomfort, may also lead to respiratory disease. The Chinese humidity index distribution is shown in Figure 1.

![Figure 1 China humidity index distribution.](image)

Human Parameters

The body has only limited physical means to maintain a comfortable temperature. If the new effective temperature (ET *) is used as a comprehensive thermal indicator in environmental conditions, it will be found that ET *, which relies simply on physiologic thermoregulation. The
temperature range is only between 25-40 °C [12]. According to objective facts, the body's heat is mostly distributed through the skin to the environment using the skin and vice versa. Therefore, the primary consideration should be given to the role of garments in heat exchange. We discuss whether the exclusion of thermal conditions has a significant impact on human comfort.

The heat transfer between the outer surface of the human body and the skin is not as simple as the heat transfer resistance of the textile itself and the internal convective nuclear radiation of the air layer between the textile layers and the sewing and Taiwan body also has an impact on the transmission resistance. For example, loose clothes, can reflect the "chimney effect." In contrast, wet clothes, the heat transfer resistance will be significantly reduced.

Other Factors

1) psychological factors. Relevant research shows that when people are adequately mentally prepared, the expectation of treating the degree of hot and cold of the environment will be relatively lower and more easily met.

In 1988, the tests conducted by GE Sciller [13] showed that the summer neutral temperature was 22.6 degrees and the winter neutral temperature was 22 degrees. However, in winter and summer, the neutral temperature was exactly 0.4 degrees higher than the expected average temperature. 2) gender factors. Many scholars have conducted in-depth studies and discussions on the issue of the impact of gender on human comfort, and the conclusions are all different. Tanabe [14] conducted a project test in Japan that showed that in cold environments, women are more sensitive to environmental changes than men. Finally, in Moderate's test in 1993, the skin temperature of men and women was the same at low activity levels. Conversely, at high activity levels, men's optimal skin temperature 1.2 °C higher than women. 3) regional differences. There is also a discussion of the impact of regional differences on human comfort. As Shin-ichip [14] tested in 1994, he concluded that people living in the tropics are less moisturized than those in relatively cold areas when the temperature is less than a certain temperature.

Humidity

Relative Humidity on the Human Comfort

1) The effect of humidity on heat balance

People must maintain the balance of heat and heat. The body's thermal balance can be expressed as follows (Eq.1)[15]:

\[ S = M - W - C - R - E \]  

(1)

Where \( S \) - human thermal storage rate, \( W / m^2 \); \( M \) - the body's energy metabolism rate, determined by the size of the body's activity, \( W / m^2 \); \( W \) - mechanical work done by the human body, \( W / m^2 \); \( C \) - body surface to the surrounding environment by convection in the form of heat, \( W / m^2 \); \( R \) - body surface to the surrounding environment by radiation in the form of heat, \( W / m^2 \); \( E \) - sweat evaporation and expiration of the heat taken by the steam, \( W / m^2 \); When the human body heat storage \( S \) is zero, the body can maintain the energy balance. \( E \) is to some extent affected by the indoor relative humidity.

The evaporation of moisture in the sweat and mucus on the skin surface is affected by the humidity in the air, that is, the outward diffusion of moisture in the skin, which then affects the energy balance of the human body and eventually affects the human body temperature and comfort. When the evaporation of the skin surface is intensified or slowed down, the temperature of the skin will change, which directly senses the temperature receptors in the skin. Although people who are often seated do not primarily use perspiration to maintain their body's thermal balance as compared to people with greater activity, humidity still has a direct impact on them.

The difference between the partial pressure of water vapor in the human skin and the pressure of the surrounding water vapor will determine the size of the water vapor loss. The loss of water and energy will be accompanied by the loss, bringing some changes to the questions. For example, a
person at rest can reduce the relative humidity of the environment from 50% to 20% at room temperature of 24 °C, while the total body water evaporation increases to 40 mL/s. Take the latent heat of 26W (originally should be 21W), accounting for 25% of the total energy consumption (105W). The increase in water evaporation reduces the sensible heat loss to 79W (originally 84W), resulting in a slight decrease of 0.3 °C in the skin temperature. At this point people will feel slightly cool, if you want to maintain the original relative humidity of 50% when the heat feeling, the ambient temperature is about to rise 1 °C.

2) Humidity on the impact of skin moisture

Humidity in addition to the impact on the thermal balance, but also through other means affect the comfort of the human body. RH\(_{sk}\) is used to describe this effect more accurately than using skin wetness. The skin relative humidity (RH\(_{sk}\)) is the ratio of the partial pressure of water vapor on the skin surface to the partial pressure of saturated water vapor at the corresponding temperature (Eq. 2).

\[
\text{RH}_{sk} = \frac{P_m}{P_{s,sk}} \quad (2)
\]

Where \(P_m\) - average water vapor partial pressure of the skin, Pa. Skin relative humidity and skin moisture can be expressed using the following formula (Eq. 3):

\[
\text{RH}_{sk} = \frac{w+(1-w)}{P_a} \quad (3)
\]

The formula clearly shows that the value of skin wetness (w) is always less than the skin relative humidity (RH\(_{sk}\)) under the condition of \(w \neq 1\). Humidity on the human health and comfort played a role that cannot be ignored.

**Study of High Humidity on the Impact of Thermal Comfort Significance**

Humidity can affect comfort in all aspects. Humidity in the following areas as an important factor: 1. Thermal comfort 2. Air quality 3. Body heat balance

1) The most significant temperature control function in the human body is the evaporation and generation of sweat, and the cooling effect is achieved by the body's evaporation through sweat. Ambient temperature at 20 ~ 40 °C changes, the humidity in the body using sweat evaporation to maintain the thermal comfort of energy, has a very significant impact.

2) The rate of water evaporation is proportional to the pressure difference between the surface of the skin and the surrounding air, and the moisture of the skin can better respond to the degree of discomfort. In short, the humidity directly and indirectly affect the thermal comfort of the human body, especially when the humidity is above 70%, this effect cannot be ignored. In sitting subjects, a 30% drop in humidity equates to a 2 °C drop in temperature. Both of these changes have the same effect on thermal balance and thermal sensation.

3) Water environment means water element is the main part in space. The water-based environment that surrounds people and living space and can directly or indirectly affect human life, social development and biological survival is the building water environment. It is the totality of all kinds of natural factors and related social factors. It is not simply a natural form of water and artificial water.

The city's rivers and waters have always given birth to the rich history and culture of the city. They are also an important carrier of the unique style and pleasing beauty of the modern city. They are also the basis for the survival of the city. Cities like Waterfront in the South, Watercity in Venice, and Fort Lauderdale, the world's yachting capital, all feature water and buildings perfectly. Generally speaking, the basic structure of the city will be preserved as long as there are water areas and rivers. Similarly, those old blocks and residential buildings cannot be stopped in development. In terms of construction value, three values of the building water environment: ecological value, social value and cultural value are in practice mutually reinforcing and interrelated, not independent. The requirement of improving the external environment of people's lives to make them feel better and improving their quality of life makes them ecologically valuable as well.
Conclusion

The essence of building is to meet the various needs of people and to adapt and reform the environment to the outside world in order to protect its own survival and development. Environment is a general term for everything that affects the living and development of the individual or group of creatures in a certain spatial range or area. The spatial extent and geographical area outside the building also refer to the external environment of the building. If people were comfortable with the air temperature at that time, the humidity had no obvious effect, so there were few studies and experiments on the humidity in the past. In the past, the upper limit of humidity did not take into account the influence of humidity on thermal comfort, but only moldiness, condensation and other humidity-related phenomena. In this way, these standards not only failed to directly affect human comfort, but also greatly limit the application of direct evaporative cooling technology. Therefore, it is necessary for us to make use of the thermal comfort experiment to confirm the establishment of the upper humidity limit. Furthermore, when the temperature is high and humid in summer, the air velocity can be increased. Under the condition of constant temperature, the upper limit of the comfortable humidity is increased or the air temperature is raised while the humidity is not changed. Therefore, effective air conditioning can be achieved Energy saving. Therefore, if the water element can be used more and more to create some building water environment, the instinctive needs of people to enjoy water and water will be satisfied, which will also reflect the pleasant environment created by contemporary architecture.

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