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On the climate adaptability design of hot summer and cold winter regions-Taking the design works of Huzhai Sanjia Kindergarten in Lancao County as an example

Ye Wu^{1*}, Xiao Shao², Guozhu Chen³

¹College of Civil Engineering & Architecture, China Three Gorges University, Yichang, 443002, China. ²College of Medicine, China Three Gorges University, Yichang, 443002, China. ³College of Hydraulic & Environmental Engineering, China Three Gorges University, Yichang, 443002, China.

ABSTRACT

This article takes the example of the 8th China Dream Township-Product Creative Design Competition in 2019, the three-parent kindergarten in Huzhai Village, Lancao County, Kaifeng City as an example. According to the local climate characteristics, architectural forms, building materials and other aspects combined with ecological design means to create a suitable summer. Green kindergartens with climatic conditions in hot winter cold regions. The design mainly starts with the contradiction between kindergarten use and regional climate. Through the optimization design of environment design, layout optimization, lighting and ventilation optimization and material adoption, an ecological design method is proposed for rural kindergartens in hot summer and cold winter regions.

Keywords: Hot summer and cold winter area; Kindergarten; Climate; Ecology

*Correspondence to Author:

Ye Wu

College of Civil Engineering & Architecture, China Three Gorges University, Yichang, 443002, China.

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1. Introduction:

Due to the large population base of China's vast territory, the demand for buildings is large and energy consumption is large in this respect. The energy conservation and environmental protection of domestic buildings in this century is an important theme. Therefore, the construction industry should adhere to green as the main

part in the process of engineering construction, and apply green building design to the current architectural design. The hot summer and cold winter areas are the most challenging areas for green building design. Therefore, this paper aims to provide ideas for green building design in hot summer and cold winter areas through a competition case.

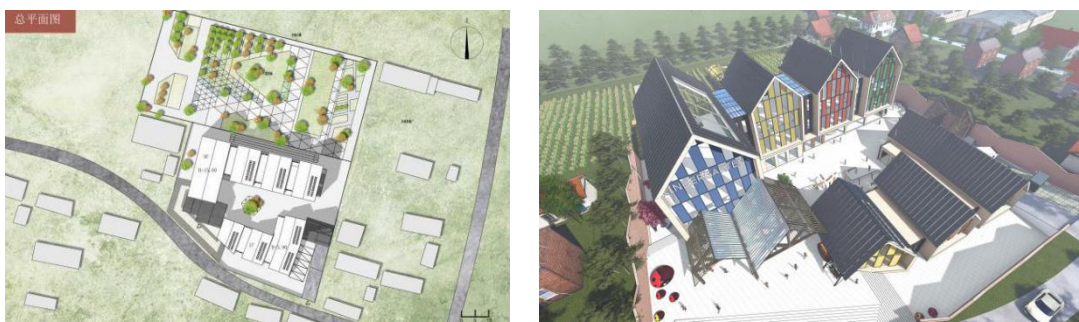


Figure 1 (plan view and first-phase renderings)

2. Base condition overview

2.1 overviews of base climatic conditions

Lankao County in Kaifeng City is a warm temperate continental monsoon climate with four distinct seasons and sufficient sunshine. The annual sunshine hours are 2529.7 hours. The base itself belongs to the hot summer and cold winter regions, with mild climate, annual average temperature of 14 degrees; moderate rainfall, average annual rainfall 678.2 mm. The most precipitation is in July and August, the wind is generally around 3-4, the summer wind is southwest wind, winter northeast wind. The hottest

month is July and August, and the coldest month is January (Figure 2).

The project site is located in Yifeng Township, Lankao County, Henan Province, six kilometers southeast of Yifeng Township, Lankao County, and borders Shangqiu Minquan County. The village has a population of 1,006, a cultivated area of 1,346 mu, and a per capita land of 1.3 mu. Huzhai Village is located at the ancient levee of the Yellow River. The soil has a large sediment concentration and is suitable for a variety of crops

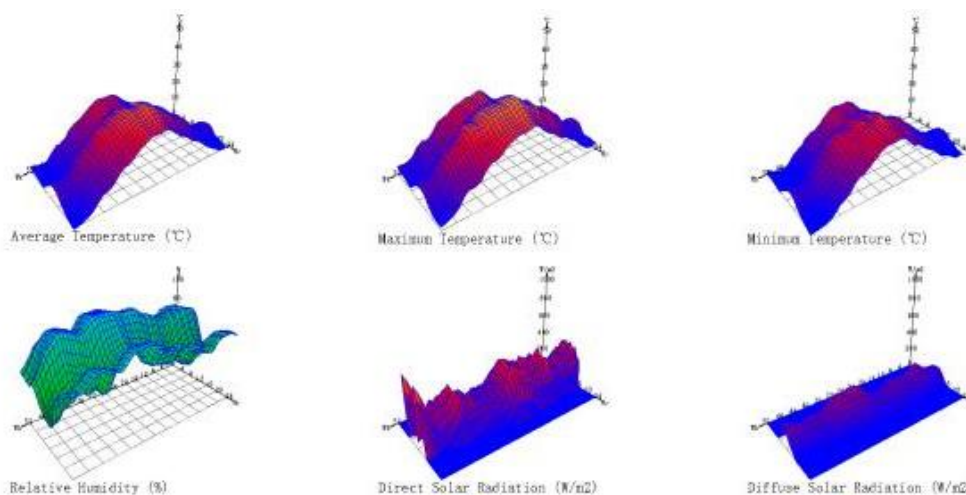


Figure 2 (climate analysis chart)

2.2 Project space layout and base conditions contradictory

Kindergarten needs many outdoor activities venues. Contact with nature is beneficial to children's physical and mental health. However, under certain extreme weather conditions, children are not allowed to carry out activities outdoors safely. In the many cases, teachers usually use music classrooms instead. However the way is not able to adapt to the long-standing climatic factors, so it is necessary to create a safe outdoor activity space.

The southeast corner of the project base has a

height difference from the other parts of the base (shown in Figure 3), and the location itself is adapted to the layout of the entrance and exit functions, so there is a problem between the functional requirements of the building itself and the height difference of the base.

The last point is that the project's own land use conditions are relatively tight, so it is difficult for us to arrange the activity room in a space that is relatively oriented and can be directly connected with the classroom, so it is necessary to rationally design the functional streamline.



Figure 3 (base analysis chart)

3. Environmental design and layout optimization

3.1 Planting

Only when combined with the local environment can the building produce a good atmosphere, and the greening of plants should respect the local natural conditions. By selecting native plants and introducing the native nature into the building, a natural green architectural landscape can be created. Lancao County, Kaifeng City has a variety of plants such as cedar, magnolia, osmanthus tree, ginkgo, acacia, paulownia, etc., but considering the cost of construction and the needs of the site and plant level, we choose paulownia, poplar, lobular, and abundance plants to carry out landscape plant-

ing.

As Kaifeng City belongs to the hot summer and cold winter regions, in order to get the high temperature of hot summer down and cold weather in winter regions, we combine the characteristic of winter leaves of the local characteristic plants-Paulownia and poplar, and the growth characteristics of the long leaves in summer. We plant it on the more severe side of the summer sun, so that when the sun is strong in the summer, we can create a cool space for the young children by using it to absorb the strong solar radiation on the west side, and in the winter it will naturally fall leaves so that it can introduce enough sunlight into the room.

And these two kinds of trees can form a good

landscape level with the shrubs such as the lobes, and they together can achieve good eco-

logical benefits (as shown in Figures 4, 5 and 6).



Figure 4 (paulownia)



Figure 5 (Poplar)



Figure 6 (Lobelia)

3.2 compost design

The ecological design of rural kindergartens is different from the ecological design of urban kindergartens. It is more inclined to combine ecological design with the geographical conditions of local characteristics.

Kindergarten needs organic production more. On the one hand, it is about children's health. On the other hand, it makes children feel that they are part of the ecosystem from an early age. So that they won't destroy it, won't want to endlessly ask for it. This is a seed in the heart of children.

According to statistical surveys, organic waste accounts for more than 80% of the waste in rural areas. Therefore, if these wastes can be disposed of, it is equivalent to treating 80% of domestic garbage in rural areas. Therefore, combined with the characteristics of local geographical conditions, we consider the use of environmentally friendly enzymes to decompose local organic waste. The advantage of this method is that the container is easy to obtain on the one hand, ordinary plastic buckets, unused cylinders and crucibles can be used for this method. On the one hand, the production method is simple and easy to operate, the kitchen dregs and peels used in the kitchen can be used as enzyme raw materials, and the other raw materials such as water and sugar are easily obtained in life, and the technical treatment of the method is compared with the composting of the

manure. The means are simple and convenient for local residents to operate.

3.3 Optimize the spatial layout design according to the nature of the base

We designed the main entrance as an overhead corridor in combination with the height difference of the site, and combined the height difference with the activity space required by the kindergarten. This solves the problem that the building shape will block the shadow of the low-lying children's activity venue, and the entrance space and the children's outdoor area are combined to create an interesting grey space. Naturally, the building block is divided into two parts, making it easy to place different building functions.

According to the summer wind direction, we hollow out the northward building block, which makes it easy to combine the hallway to guide the wind direction. At the same time, the activity room is placed on the first floor, so that the young children can directly reach the outdoor activity site from the indoor activity room. Place the activity space such as the sound room and classroom in the upper layer of the activity room, and give the classroom the best view of the land for the planting experience. At the same time, the two-three-level teaching area streamline will be directly led to the outdoor activity space through the straight staircase, enhancing the connection of the classroom and outdoor. (Figures 7, 8)

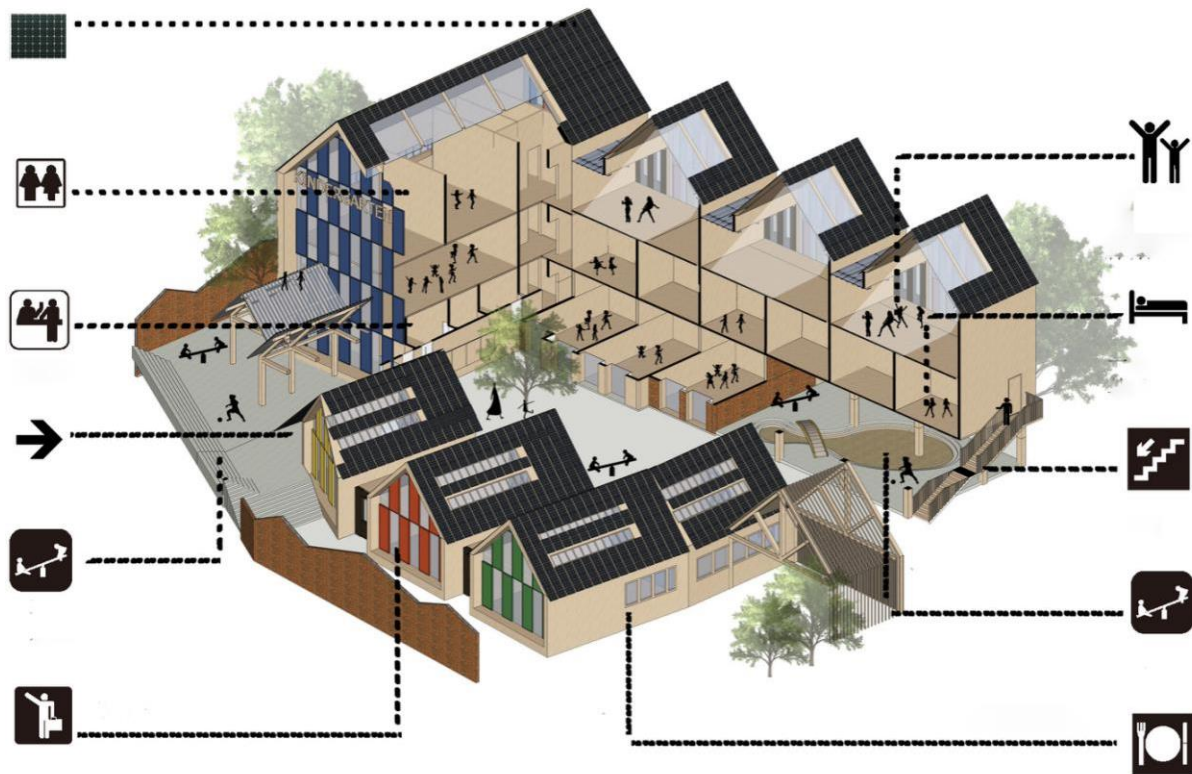


Figure 7 (cross-sectional perspective)

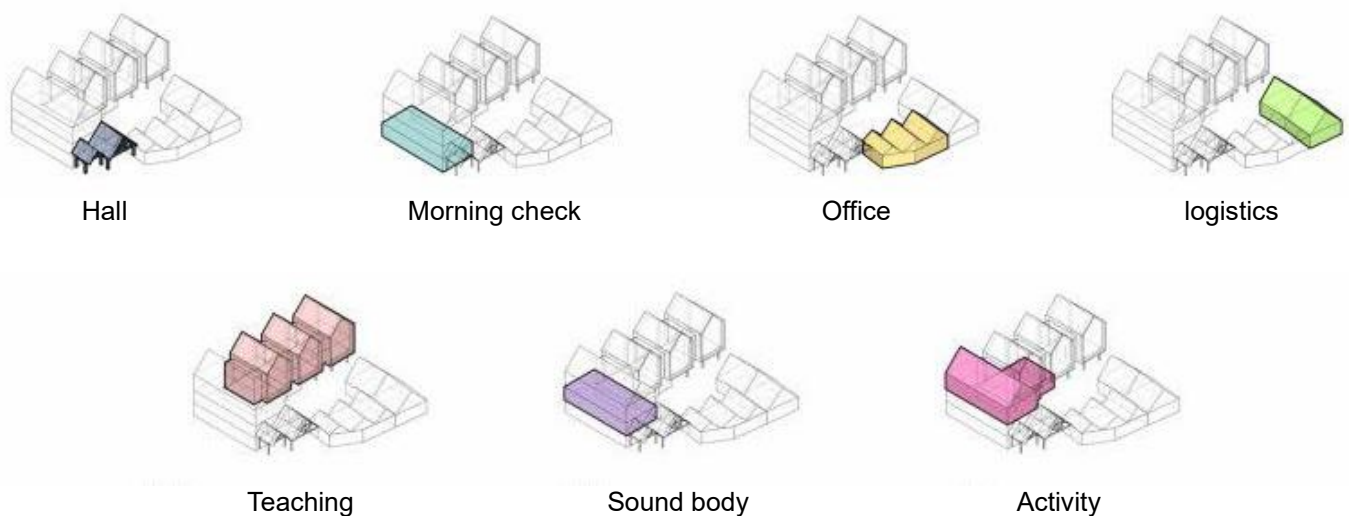


Figure 8 (function partition map)

4. Lighting and ventilation analysis

4.1 facade

The building façade not only affects the overall image of the building, but also directly relates to the building function and indoor comfort.

Therefore, it is considered that the façade design meets the psychological characteristics of the child, and adopts appropriate ecological design methods and means to achieve energy-sa-

ving design effects.

We use a sunshade louver combined with the façade design of the building (Fig. 9), which forms an adjustable building façade that fully introduces natural lighting and ventilation, through the adjustment of the louvers to achieve proper ventilation, while at the same time enriching the façade.

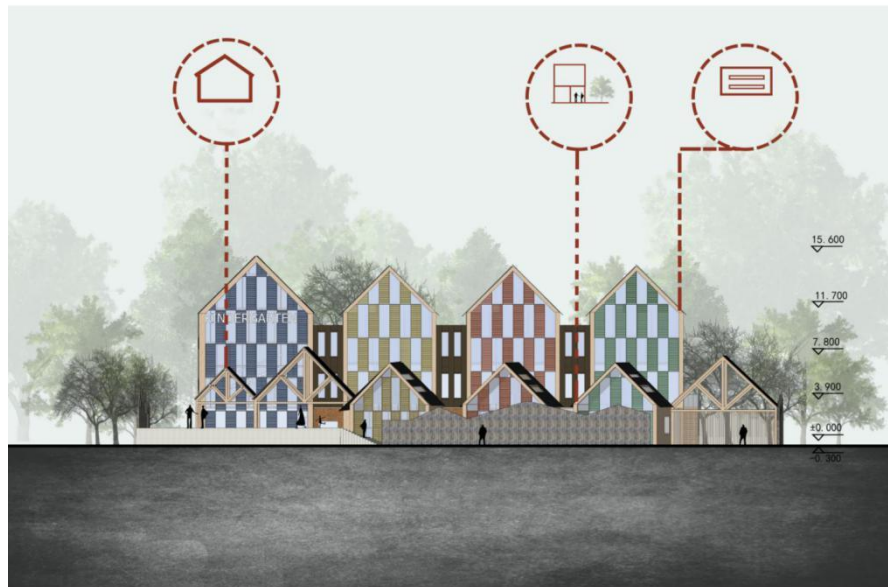


Figure 9 (elevation view)

4.2 section

Reasonable organization of indoor and outdoor air circulation is an important point to ensure the indoor air quality of kindergartens. Therefore, we have added the design of the skylight (Fig. 10) in this design, which can use the chimney effect to pass indoor hot air through the roof during the hot summer. The skylight is exhausted, and in the winter, the skylight is closed and natural light is introduced to form hot air. And this increases the indoor temperature in winter.

Due to the abundant rainfall in the base, we consider the combination of rainwater and medium water to form a wastewater recycling system. When it rains, we collect rainwater through the wall of the daughter's wall and the rainwater pipe, combined with the water system to carry out clarification and filtration of the wastewater, and the domestic water for the kindergarten. Recycling, so that clean water can be used for plant irrigation in the planting area, plant irrigation in the surrounding area, toilet flushing, etc.

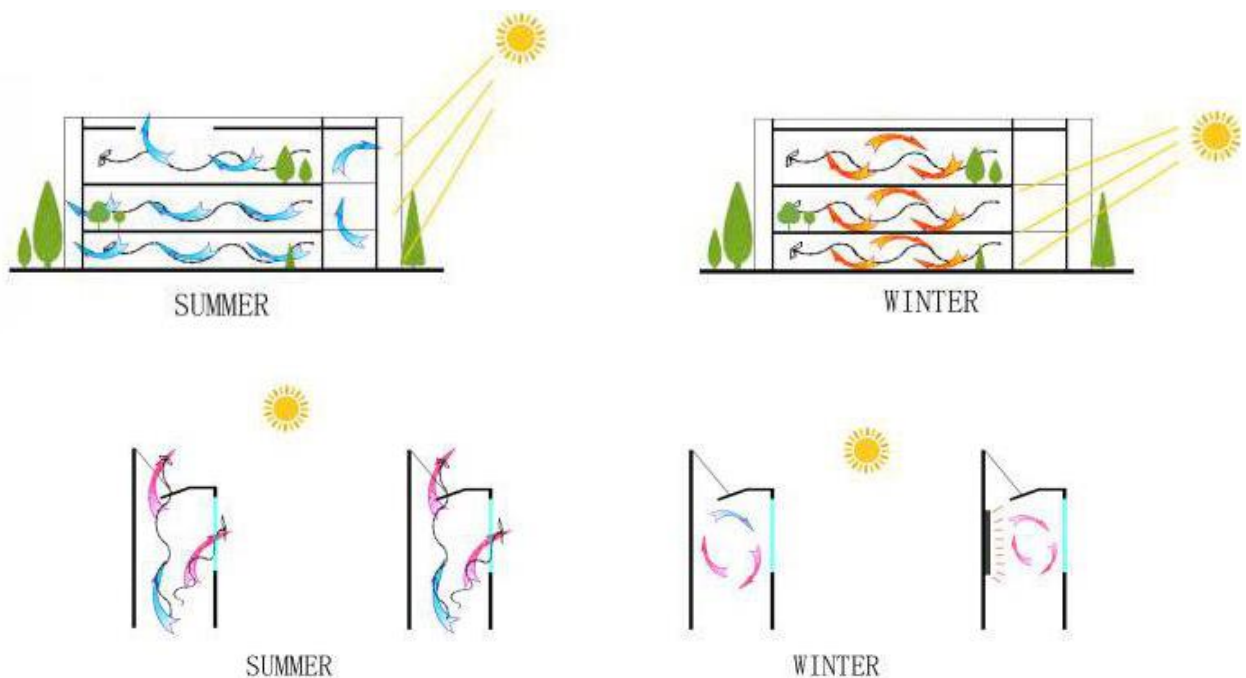


Figure 10 (ventilation lighting analysis)

4.3 components

In kindergartens full of children's interest, various building components are also important decorative parts. We can design ecological building components to improve the indoor environment while beautifying and marking spaces. Many kindergartens like to decorate the door panels with patterns that children like, or to hang some accessories to add to the indoor atmosphere. At this time, the door panels not only serve as a space for separation, but also have a decorative space. We believe that in addition to these functions, the door panel can be ecologically designed to allow the door to be ventilated in addition to the simple separation space. Because it has good airtightness for most doors, such as the indoor air circulation, the door leaf needs to be opened. But because most young children in kindergarten are still young, and they love to play anywhere, so that the teachers can hardly ensure the safety of every kids. Therefore, I think it is necessary to transform the door leaf into a form of free lighting and ventilation when it is not closed.

We can have the following design ideas for this: The door is breathable by the combination of adjustable louvers and door leaf. In the form of a single-layer breathing door, the adjustable louver is arranged on the door, the louver is open-

ned to a larger angle when a larger air intake is required, and the louver is opened to a smaller angle when a smaller air intake is required. Control the amount of air intake. This makes it easy to adjust the indoor air environment.

4.4 overhead space

"Empty space" often refers to a semi-outdoor space with no walls and a gray space, that is, a transitional level between indoor and outdoor space. Due to the impermanence of the weather, rainy weather or clear skies, there is no guarantee that young children in kindergartens can always be outdoors, so we designed an overhead space on the right side of the event room (Figure 12).

It can shelter from rain in rainy weather; it can also shade in hot weather; at the same time, the overhead space is higher than that in indoor rooms. Children can breathe fresh air, directly watch and touch natural landscapes, and stimulate their cognitive potential. And in this scenario it also has the function of guiding ventilation. That is, through the courtyard and the overhead main entrance space to form a good ventilation, guiding the summer ventilation. And because the overhead space is close to the courtyard, it naturally increases the sense of space and the range of outdoor activities for young children.



Figure 12 (overhead layer renderings)

5. Material analysis

5.1 double-glazed curtain wall application

Because young children tend to have a sense of exploration and freshness for new things, we tend to design kindergartens with a good vision and an open feeling, which is suitable for glass

curtain walls. However, due to the excessive window opening area, it often brings unnecessary heat load to the room. Therefore, we adopt the ventilation double-glazed curtain wall technology.

In the summer, the glass curtain wall can open

the upper and lower vents under the sunlight. The chimney effect causes the airflow of the hot aisle to flow naturally and take away too much heat to cool the room. In winter, the glass curtain wall can be closed and ventilated. The mouth makes the air inside and outside the curtain wall rise under the sunlight, forming a layer of hot air, preventing the outdoor cold air from entering, and also blocking the indoor heat from diverging to the outside.

At the same time, since the structure is three-layer glass, it can also reduce the interference of external noise on the internal space.

5.2 External wall insulation system

Considering the particularity of rural construction, we prefer to use localized insulation materials in thermal insulation design. Therefore, in this design, we use a self-insulating wall on the outer wall. This kind of wall is made of light aggregate (slag, perlite, construction waste, etc.) as the main raw material, and the new block combining heat preservation performance and enclosure performance. It saves time for installing insulation layer, shortens construction

period, and utilizes construction waste to reduce environmental pollution.

5.3 Application of environmental protection materials for interior walls

Since the project base is located in the countryside and the planting industry is prosperous, we consider applying straw wall materials to some interior wall structures.

The wall (Fig. 14) is made of crop waste wheat straw as raw material, and the cost is low. It is an effective measure to turn waste into treasure and save resources, and the cost is low, in the meanwhile the excessive consumption of bamboo and wood materials is avoided.

It can be completely degraded after use and has almost no impact on the ecological environment. In terms of thermal insulation properties, it also has excellent characteristics. Its thermal insulation coefficient is much higher than that of ordinary clay brick walls, and the heating heat consumption and heating cost are much lower than the local clay brick wall, which can save a lot of energy consumption every year, reduce heating costs.



Figure 14 (wheat straw wall)

6. Conclusion

Rural kindergartens are an important type of rural architecture. The exploration of green kindergartens is an interpretation and verification of the connotation of green buildings, which has a major impact on children's green education enlightenment.

The environmental protection construction of kindergarten buildings in the hot summer and cold winter areas should consider the site design, lighting and ventilation, material adoption and other aspects combined with the application of

passive technologies such as ventilation, sunshine and lighting to design suitable green technology solutions for this special area.

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