ADVANCING NET ZERO CARBON
ARCHITECTURE + COMMUNITY

DESIGN NARRATIVE

BRIEF DESCRIPTION

Achieving adaptive thermal comfort with the least amount of energy demand is the underlying principle of this proposal. Thermal zones of different indoor environmental conditions would be created with different incoming solar heat gain, wind speed and so on. Occupants are encouraged to look for their own right spots that they feel thermally comfortable. With the advanced IoT technology and thermal sensors installed throughout the office space, nearby occupants are able to manually control the operable dynamic external shading as well as windows in order to block the excess solar heat gain and to capture the natural ventilation achieving their basic human comfort. Each operation of utilizing passive strategies would be measured at personal cell phone app and data would be sent to the central building management data center for record. The associated energy saving and carbon reduction would thus be calculated and reported. The occupants and thus tenants are being rewarded for each action associated with reduction in energy and carbon footprint.

ZERO CARBON PASSIVE DESIGN PRINCIPLES

Thermal Comfort and Human Wellness are essential to improve citizens' community life and enjoyment in the office area. Passive Design Strategies would therefore be integrated into the building to enhance citizen's health and well-being both physically and psychologically. Implementing passive design features, including light shelves, solar shadings, wind walls, etc. introduces adequate daylighting, reduces excess solar heat gain, and promotes natural ventilation across the building resulting in both cooling energy and economical savings in long term. With the idea of daylight autonomy, useful daylight would be maximized integrating with open plan layout in the office minimizing the energy demand of supplemental electric lighting.

External Fins as Shading and Wind Walls

For instance, proper architectural design of exterior shading devices could block nearly 80 percent of solar gain through clear windows. Shading windows could lead to an energy reduction of 25% of summer cooling load and a reduction of around 20% of total energy use. Therefore, the design of external shading would be of utmost importance to block the excess direct solar heat from the first place, and to act as wind wall to guide the prevailing airflow entering into the office area. Other Low / zero carbon technologies, for example, high volume low speed ceiling fan, would be followed.

Daylighting: Glazing properties

With the external shading, the effective window-to-wall ration would be controlled between 20% and 40% which is optimal in hot and humid climate. Daylighting would be also introduced by the light shelves allowing daylighting getting into a deeper space. The windows would be divided vertically into two portions: the top part would be the ***daylight glass***, while the bottom part is the ***vision glass***. The upper part is allowed for VT of 60% or more, however, the lower part is allowed for VT of 50% or more. In order to reduce the excess heat gain, both portions of glass should be of lower U-value, e.g. of 0.3 W/m2K, lower Solar Heat Gain Coefficient of 0.3 or less. Moreover, automated shade, if necessary, could also controlled manually leading to an estimated reduction of lighting annual energy usage by 65%.

EXPECTED EMBODIED CARBON REDUCTION

Integrated design of the passive and energy efficient system will be adopted to reduce building energy consumption. A wide range of renewable energy technologies, including photovoltaics, bio-diesel and solar thermal hot water system, will be deployed to offset carbon consumption onsite wherever possible

Solar Thermal Hot Water System

The purpose of solar thermal hot water system is to collect rich resources of solar energy in hot humid area and to convert into typical daily building use. In order to maximize this objective, the Solar Thermal Hot Water System is mainly installed on the opaque area of the façade, namely the south part of the east façade and the east part of the upper south façade. Another benefit of such thermal system is to shade the original façade and thus to reduce the solar heat gain and cooling load of the whole building as the opaque area sum up significantly.

Air Improvement Photovoltaic AIPV

AIPV not only generates renewable energy but also purifies air and improve air quality. With the Cadmium Telluride photovoltaic cells (CdTe), the energy conversion efficiency is between 9 and 14% for CdTe (EMSD), however, the energy conversion of CdTe is recently reported ranges from 15.3% to 18.2% with 110W to 450W of power output. (PV Magazine, Sep 2020). Besides, the manufacture of the solar modules is associated with less pollution emission and carbon footprint. Moreover, the AIPV is integrated with a super durable SolarIAQ-APSC coating system to decompose the organic air pollutants including automobile emissions, VOCs and PM2.5.

OCCUPANT EXPERIENCE

Wellbeing and Material Selection

The light and air design does not only account for the passive design in energy consumption reduction, it also enhances the overall environmental quality for thermal comfort and user experience. The quality of working, living and learning spaces will be optimized with flowing indoor and outdoor spaces, cross ventilation and day-lighting to create a highly inspiring yet low carbon building. Besides, eco-efficiency with high environmental quality but less material usage, less waste and less maintenance cost shall be emphasized.

Improving Air Quality

One of the exemplary experiences is that Air Improvement Photovoltaic (AIPV) generates renewable energy through Cadmium Telluride photovoltaic cells, as well as purifies and improve air quality of surrounding with the super durable SolarIAQ-APSC Top Coating System by decomposing organic air pollutants including automobile emissions, VOCs and PM2.5. The AIPV is also self-cleansing to reduce the maintenance cost and environmental waste.

SUMMARY

In order to further reduce the energy consumption and carbon footprint of existing Oxford House, occupant behavioral change is essential on top of the highly efficient building equipment. Therefore, this proposal encourages occupants to participate into the operation of the building to seek for their own adaptive thermal comfort at a right spot. The design features are meant to be manually and locally controlled by the occupants.