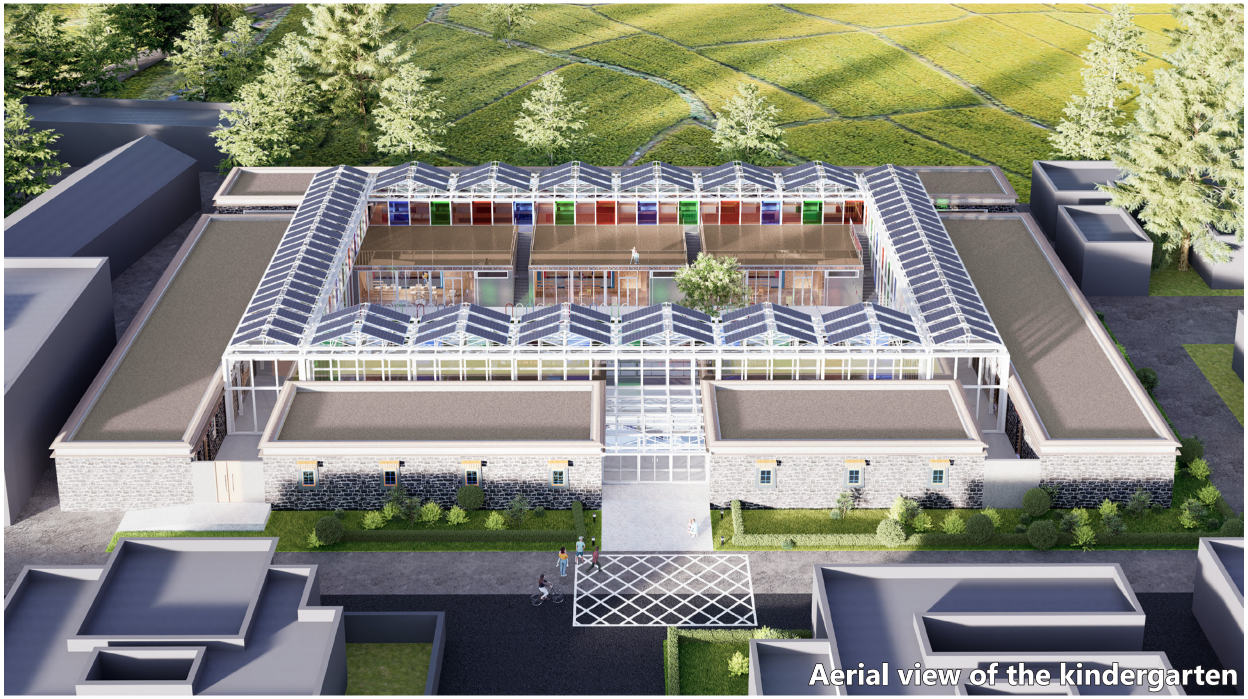
Education Category 20 Feb 2024

Southeast University & Tibet University

Kindergarten in Sanga Village

Project Overview

The Tibet Autonomous Region government is considering extending basic education facilities to every village in Tibet. Sangga Village, as one of the numerous villages urgently in need of basic education facilities, plans to transform a disused courtyard building in the village center into a kindergarten to address the schooling needs of 30 preschool children in the village. The project aims to serve as an exemplary zero-energy building in the local context of Tibet, creating a functional, vibrant campus that is inspiring for children and the community alike. The approach of transforming traditional courtyard buildings into small-scale educational facilities will also serve as a replicable model for future initiatives to promote in more traditional villages across Tibet.



Aerial view of the kindergarten

Design Strategy

The main challenge in the design is to integrate new forms, technologies, and concepts into a traditional village environment. The design will be guided by five main objectives: ensuring that the building's renovation and expansion respect and activate the site; balancing green conservation with maintaining people's daily habits and experiences; meeting zero-energy requirements while adapting technologies to the local economic situation; ensuring that the kindergarten benefits not only children but also the broader local community; and making the transformation of traditional buildings replicable and impactful for more traditional villages.

U.S. DEPARTMENT OF ENERGY Solar Decathlon

Project Data

- **Location:** Sangga Village, Shannan, Tibet Autonomous Region , China.
- **Climate Zone:** 5C
- **Lot Size:** 0.695 acre
- **Building Size:** 22942.2 ft2/single story
- **Occupancy:** 50 people
- **Energy Performance:**
  EUI w/o PV: 37.66(kBtu/ft2/yr)
  EUI w/ PV: -25.74(kBtu/ft2/yr)
- **Construction Cost:** 805,414 USD
- **Maintenance Cost:** 223,180 USD for 60 yrs
- **Embodied Carbon to grave:** 391 kg CO2e/m2

Technical Specifications

R-Values

- Wall:R-21
- Roof:R-31
- Floor: R-25
- Windows:U-0.19

HVAC

- The high-efficiency coupled heating system of gas boiler and air source heat pump
- Ventilation system with Heat Recovery

On-Site PV

- 427,038.28 kWh/yr w/o PV on existing roof
- 589,162.76 kWh/yr w/ PV expanded north

Design Strategy

1. Architecture - The project modestly renovates existing buildings with prefabricated light steel structures for solar corridors and classrooms in an internal courtyard, minimizing environmental impact. The transparent glass solar corridor is widened to foster interaction among children, connecting all building parts. Classroom modules, positioned southward and linked to the inner courtyard, break traditional layouts, encouraging more outdoor activities for children.

2. Engineering - The building renovation preserves the existing envelope as much as possible, and strengthens the building structure with standardized light steel structures. The steel structures also serve for internal partition wall modifications. New construction adopts standardized prefabricated assemblies for improved efficiency and cost-effectiveness. Additionally, efficient systems include an sewage treatment system taiored to Tibet, as well as a heating system combining air source heat pumps with underfloor heating.

3. Envelope - Envelope design Strategy involves the comprehensive utilization of local agricultural straw, using it as internal insulation and decorative panels, combined to create a high-performance protective structure, thereby reducing building energy consumption. On the other hand, recycling and reusing materials from inner courtyard walls are employed to control construction costs and minimize embodied carbon emissions.

View of the corridor

4. Efficiency - The project combines typical sunroom design with thermal storage flooring, high-performance building envelope, gas-fueled air-source absorption heat pump system, and a Building Integrated Photovoltaic system. This results in a significant reduction in the building's Energy Use Intensity from 37.66 kBTU/ft2/Yr to -25.74 kBTU/ft2/Yr. Moreover, through an increased deployment pattern, the building can also function as a small-scale power station.

5. Grid-Interactivity - The local climate poses challenges such as drought, frost, and snow disasters. To tackle these, the plan includes a grey-black separated sewage system for water recycling for drought issues. It also involves measures like foundation expansion and insulation to mitigate freeze-thaw damage. Additionally, a solar photovoltaic system provides electricity and heating during adverse weather or grid interruptions.

6. Life-Cycle - Less Carbon achieves by using locally sourced agricultural straw to reduce transportation emissions and employing bolted connections for recyclable lightweight steel structures. Additionally, prefabricated lightweight steel structures and wall panels are assembled on-site As a result, the building's embodied carbon emissions are kept to 391 CO2E/m^2, meeting Class A standards.

7. Health - The building controls air quality through material selection, ventilation, and monitoring. UV-sensitive films in quadruple glazing windows adjust UV radiation and brightness in the solar corridor for optimal lighting. Water management includes plumbing system for healthy and efficient water supply, as well as redesigned sewage treatment based on local habits. Indoor sound-absorbing materials minimize noise during children's activities.

8. Market - In Tibet, demand for renovating traditional village buildings and basic education facilities is high, with increased investment. The project's thermal corridor, classroom modules, and photovoltaic products are adaptable to various courtyard layouts. Modular products can expand to meet different needs. Total construction costs are 5,170,180 CNY (805,414 USD), with maintenance at 1,430,720 CNY (223,180 USD) in 60 years, making it promising for wider adoption locally.

9. Community - Spaces in Sangga Village are shared for vocational training and community activities. Agricultural waste integration, supports the sustainability and brings benefits for local agricultural industry. Abundant photovoltaic capacity offers cleaner energy. Also,the design optimizes space layout and wastewater treatment for nearby residents' living experience.