Kaza Eco-Community Centre

by Auroville Earth Institute (AVEI) / 2016-06-23 09:01:17 / International / 18365 / EN

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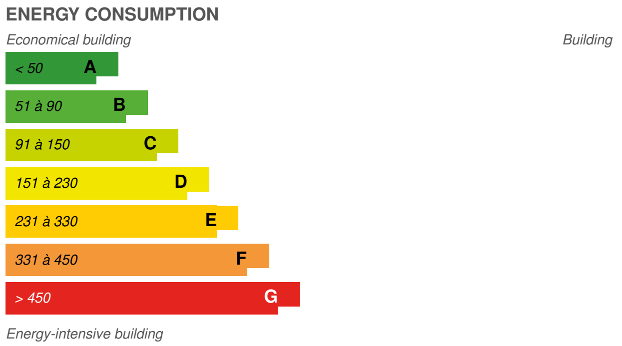
Primary energy need :

1 kWhpe/m^2.year

(Calculation method : Other)



Building Type : Other building
Construction Year : 2013
Delivery year : 2015
Address 1 - street : Kaza 172114 HIMACHAL PRADESH, India
Climate zone : [H] Highland Climate(mountainous terrain).

Net Floor Area : 580 m^2
Construction/refurbishment cost : 155 000 €
Number of none : 5 none
Cost/m2 : 267.24 €/m^2

General information

In partnership with the Spiti Projects Charity, the Auroville Earth Institute has designed and built theKaza Eco- Community Centre with key participation of villagers in Kaza and local earth craftsmen of the Spiti Valley. The centre aims to provide amenities for the community which are valuable for local cultural heritage, while providing access to certain essential facilities for health care. The following will be managed by various local cooperative groups:

- An Eye clinic for testing and treatment of severe eye disorders due to high altitude UV exposure.
- A Dental clinic with dietary specialists.
- A Library for information on traditional culture, craft and medicine.
- A Craft Centre and small shop for the traditional skill of hand-knit socks and shawls.
- A Community kitchen and meeting hall for the practice of traditional dance and folk music, meetings, celebrations and festivals in winter.
- Homestay facilities to make the community centre sustainable in the long term and to cater to the needs of local people from outlying villages who commonly walk >50 km to reach Kaza for the use of health care facilities.

Located in the remote Spiti Valley, Himachal Pradesh, India, the building, which consists of a stonemasonry foundation, raw rammed earth walls, and compressed stabilized earthblocks, has been designed especially for the harsh winter climate of Spiti. Trombe walls have been incorporated for passive solar heating of the buildingduring the winter, and for a fully self-sufficient building which does not relyon imported wood as is commonly practiced in the valley. As the region is proneto seismic activity, extensive earthquake-resistant features have been integrated, hybridizing vernacular techniques and certain low-tech modern innovations to improve building performance.

The primary construction technique employed for the Community Centre is the traditional Spiti rammed earth technique (‘Gyang’), an ancient Tibetan building technology which is one of the truly exemplary living traditions of earthen construction still practiced in India. By introducing modest innovations into traditional building practices, the aim of the centre is to reinvigorate acceptance of these centuries old methods, and to demonstrate that the most sustainable, economical and thermally comfortable buildings in this climate… already exist.

See more details about this project

http://www.spiti.org/multimedia-archive/kaza-community-centre/
http://www.earth-auroville.com/kaza_en.php
http://www.construction21.org/articles/h/low-carbon-winner-of-the-gbcsawards-2016-kaza-eco-community-centre-india.html

Stakeholders

Stakeholders

Function : Designer

Auroville Earth Institute (AVEI)

Satprem Maïni, Swati Negi, Lara Davis, T. Ayyappan

http://www.earth-auroville.com
Architectural Design & Construction Supervision

Function : Others

The Spiti Projects charity

Joan Pollock (founder)

http://www.spiti.org/
Charity Sponsoring the Project

Function : Contractor

The Spiti Projects

Jeet Singh (Contractor), Tash Bodh (Site Supervisor), Ramesh Lotey

Site Contractor

Function : Construction company

n/a

Local traditional raw rammed earth builders (Pin Valley, Himachal Pradesh)

Function : Others

n/a - The community of Kaza

Local stakeholders

Function : Others

Contracting method

Other methods

If you had to do it again?

OBSTACLES ENCOUNTERED & SOLUTIONS:
Initially, the Auroville Earth Institute made the mistake of conceiving of the rammed earth work itself along the lines of an imported European rammed earth system: steel rammers, high compaction ratio, optimal moisture content, etc. (as usually done for rammed earth). However, the first tests with the masons indicated that this would not work effectively. The formwork was designed for this special context and adapted from the traditional formwork; therefore, on a technical level, a high degree of compaction was producing flaws in the rammed earth. However, the technical difficulty opened the doors for discussion with the masons and ultimately resulted in a much more collaborative process: the masons demonstrated the local technique with comments on the benefits of this method. The Auroville Earth Institute was able to learn a great deal from the local masons and better understand how and why this technique was so well adapted for the local context. Ultimately, the community centre could be championed by the local builders as a successful model of innovation which still employs the traditional method. In competition with concrete in the market, this was a very valuable turn of events for the community of traditional builders.

Another challenge was that the construction season is so short in Spiti on account of the long, harsh winters. Construction work generally commences May/June after the snow melts on the Spiti river shelf and ends in late September when the snow begins again. Furthermore, for one month in the height of this short construction season, all masons leave for the annual pea harvest (the main income for the valley). This leaves less than 5 months for construction. Buckets of water on site often freeze overnight through June, and running water and electricity are rarely available when needed. Further, the precarious mountain roads from Manali have recently been open for only 3 months of the year, and the roads from Shimla have been fraught with severe landslides which often strand truckloads of needed material for several months at a time. The only way to manage these challenges is to plan exceedingly well, to improvise in the face of impossible material constraints (expressed by the Hindi word “jugaad”) and to work very hard.

Building users opinion

AVEI has explored a wide range of interventions to make a positive impact on the construction sector of this region, while emphasising the appropriateness of local materials and building techniques. Daily visitors to the building site, including local villagers, politicians, monks and foreign visitors, are given tours of the building in an attempt to spread awareness. Through these conversations, the building has successfully stirred up the otherwise suppressed debate about the suitability of cement in this region. Government officials have been urged to take this knowledge forward and continue to use earth for future development. The community centre has set a benchmark, showcasing the intelligence and appropriateness of vernacular knowledge in Spiti.

Energy

Energy consumption

Primary energy need : 1,00 kWhpe/m^2.year

Primary energy need for standard building : 1,00 kWhpe/m^2.year

Calculation method : Other

0

Envelope performance

Envelope U-Value : 1,70 W.m^{-2}.K^{-1}

More information :

Wall Structure: The primary construction technique employed in the construction of the community centre is the local Spiti rammed earth technique (a several hundred year old tradition), which is supplemented with CSEB in key locations. For this traditional technique, the type of soil is selected from natural quarries in the mountainsides which have appropriate clay content and a large fraction of very coarse gravel and pebbles to reduce shrinkage cracking. Several days before ramming, the soil is prepared and the clay is activated by saturating deep holes opened by pry bars, then the soil is mixed a number of times until the moisture content is even. The high moisture content makes the earth much more plastic than usual for rammed earth; the moisture content is between that of rammed earth and cob. The raw, unstabilized earth is rammed into a wooden formwork, first manually by the feet and body weight of the masons (in a movement we affectionately call the “Spiti dance”), and then finished with the aid of wooden mallets and panels.

The result is a 40-50cm thick rammed earth wall of relatively low density with a high degree of entrained air. This makes the traditional rammed earth a highly effective thermal mass wall system, which insulates against the cold and maintains tolerable indoor temperatures even in this sub-freezing climate. 50cm of earth masonry is an optimal thickness for thermal comfort, as solar gain requires up to 12 hours to travel through the masonry, to regulate interior temperatures for night-time thermal comfort. As the rammed earth is raw, un-stabilized earth of low density, its hydrothermal performance is excellent, effectively generating condensation heat with cold exterior temperatures.

Building Compactness Coefficient : 0,12

More information

This building has not yet been operational for a sufficient duration to collect data on energy performance.

Renewables & systems

Systems

Heating system :

- Solar thermal

Hot water system :

- No domestic hot water system

Cooling system :

- No cooling system

Ventilation system :

- Natural ventilation

Renewable systems :

- Solar photovoltaic

- Solar Thermal

PASSIVE & ACTIVE SOLAR:
Heating and electrification are serious challenges throughout the winter months in Spiti. With extreme subfreezing temperatures, there is no electricity or running water in homes for months at a time. Wood is a scarce resource in the valley (i.e. trees are very sparse at this altitude), and firewood for domestic heating is imported in truckloads from old growth forests in neighbouring regions. Each family typically burns 6,000 – 8,000 kilos of firewood annually, which costs 40 - 50,000 Rupees (or ~550 - 700 Euros) per family per year. The long term effect of this is both economically and environmentally alarming. There is an urgent need to move away from combustible heating and lighting systems, towards passive and active solar energy systems for greater human comfort, cost savings for families and reduced CO2 emissions.

Trombe Walls: Trombe walls have been installed on the East, West and South façades, to make the building independent for its winter heating requirements. A trombe wall is a glass façade installed a few inches from a thick mass wall, which, facing the direction of maximum solar exposure, absorbs solar radiation and transmits heat by convection and radiation into the building. The rammed earth structure has two vent openings at the top and the bottom of each trombe wall. Solar radiation penetrates the façade, heats up the rammed earth wall and the air in the interstitial cavity, which then rises and enters through the upper ventilator to heat the room. Cool interior air is drawn out through the lower ventilator, creating a natural convection cycle to heat interior spaces. The ventilators have specially designed louvers that can be closed during the night to prevent the reverse process, as well as a secondary louver which can be opened in the summer season to prevent excessive heat from entering the building.

Environment

Urban environment

The Spiti Valley is situated in the Greater Himalaya Mountains, just over the Tibetan border in the Indian state of Himachal Pradesh. Most of the ancient monasteries and forts of Spiti – some, recognized heritage architecture over 1,000 years old – are built with either rammed earth or adobe. Earth has historically been the primary building material for all building types of the valley, and for good reason. At an altitude ranging from 3,800 to 4,500 m, Spiti is a high altitude desert region above the treeline with very limited local resources for construction. Its remoteness and the precariousness of its mountain roads likewise make the import of building materials dangerous and expensive, particularly as heavy snowfall cuts the valley off completely for more than 6 months each winter; yet earth is an abundantly available local material. Spiti's extreme climate makes earth equally superior; with temperatures reaching -40°C in winter and +40°C in summer, earthen walls provide excellent thermal mass and insulation against the harsh, sub-freezing conditions of winter and the high-altitude UV exposure of summer. In comparison, concrete buildings have completely inadequate thermal properties and are virtually unliveable in winter periods.

Yet despite the clear environmental, economic and human comfort benefits of earth, market forces and urbanization in India have caused the concrete market to creep far into this remote area, and to begin to replace traditional earthen construction. According to locals, the villages of Spiti valley are now "99% earth, 1% concrete", while the valley's capital, Kaza, is "1% earth, 99% concrete". This trend of urbanization – along with climate change in the Himalayan range (e.g. the onset of regular rains in Spiti for the first time in recorded history) – places enormous risk to the built earthen heritage and traditional constructive culture of the valley.

With this background – and many years of collaboration between local Spitians, the Spiti Projects and the Auroville Earth Institute – the Kaza Eco-Community Centre aims to promote renewed use of traditional Tibetan building techniques and materials in the valley, while introducing a number of modestly innovative features to improve the seismic resistance, thermal comfort and energy efficiency of buildings in this context. For example, the centre has introduced "trombe" walls with a special ventilation system for passive solar heating in winter, to reduce the heavy consumption of firewood for domestic heating.

Land plot area : 883,00 m^2

Built-up area : 315,00 %

Green space : 500,60

Products

Product

Compressed Stabilized Earth Blocks

Auroville Earth Institute

info@earth-auroville.com

http://www.earth-auroville.com

Product category : Gros œuvre / Structure, maçonnerie, façade

Compressed Stabilized Earth Blocks (CSEB) are unfired earthen blocks made by combining soil with a small amount of sand/gravel and between 5 to 8 percent cement or lime stabilizer. These components are mixed and manually compressed with the Auram 3000 press. After curing for 28 days, they attain their full strength which rivals that of concrete block or fired brick with a dry compressive strength of 7.5 MPa.

As soil can be quarried directly from the construction site and the blocks produced there, the transportation cost for materials is reduced, and it provides an opportunity for local unskilled and semi-skilled labor. The lack of firing greatly reduces the pollution produced by manufacture and does not contribute to deforestation for firewood. At the end of life of the CSEB, it is ultimately biodegradable.

Within a 5 year period, CSEB technology has been successfully disseminated to the extent that all new constructions for certain local monasteries have been built with CSEB by locally initiated construction companies.

Embodied energy of CSEB 548.52 MJ/m3. Carbon emissions CSEB 49.366 kg CO2/m3.

Costs

Health and comfort

Life Cycle Analysis

Eco-design material : 95% of Raw rammed earth for load-bearing walls

Water management

Greywater and Blackwater treatment:
Typically, houses in Spiti employ a soak pit system for disposal of sewage; sewage is not treated and contaminates ground water aquifers, particularly in the rapidly urbanising area of Kaza, as local residents rely heavily on hand pumps for their water consumption. AVEI has introduced a baffle reactor system for the first time in Kaza to passively treat wastewater. This system is comprised of six chambers, which direct wastewater in a path of maximum dynamic flow within a limited space. This activates anaerobic bacteria, which assist in the decomposition of waste before it enters a soak pit, therefore protecting the ground water from harmful pathogens.

Indoor Air quality

See below.

Comfort

Health & comfort : The Spiti Projects has been monitoring the health of inhabitants of the Spiti valley for over 23 years. In recent years the trend has changed from traditional building methods and materials (earth) to heavy reliance on Portland cement. However, it is commonly acknowledged by locals that concrete buildings have completely insufficient thermal properties for this climate of -35 C winters - they are unliveable in winter periods, causing respiratory problems, chest infections and an increase in arthritis among the elderly. Additionally, concrete does not absorb excess environmental moisture and can therefore be detrimental to the health of the residents in such a climate (e.g. causing dampness, mould growth, etc.).

The use of a low-density, high u-value, raw rammed earth structure provides sufficient thermal mass in winter, added hygroscopic condensation heat production, and adequate breathability to prevent moisture driven health vectors. Nearly 25 years of health monitoring has demonstrated the superior health benefits of local, traditional construction systems in this remote and extremely harsh mountain climate.

Acoustic comfort : One secondary benefit of the very low-density, traditional raw rammed earth walls is that the acoustic insulation is excellent. However, this may be qualified as a "secondary" benefit in the region, as the primary requirement of high-insulating wall systems is for thermal comfort in a winter climate which commonly reaches - 35 C.

Carbon

GHG emissions

Building lifetime : 250,00 year(s)

All emissions calculations will be performed after a testing period of 2 years of building operation.

Contest

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