Konstruktives Gestalten und Baukonstruktion

TECHNISCHE UNIVERSITÄT DARMSTADT

Master Thesis – Goutham, Vadakkoot

Indoor climate analysis and optimization for a school building in India with special focus on sustainability

Research motivation and objective

In the hot and humid regions of India, climate change has further amplified the thermal discomfort due to the elevated relative humidity (>75 %) and high temperature (>31 °C). School buildings hold particular significance as more than 30 % of a child's life is spent in classrooms and they are more susceptible towards heat stress which could adversely affect their learning capabilities. The main research objective was to optimize the indoor climate of an existing school in Kerala, a southern state of India, through realistic retrofitting strategies, without compromising the principles of sustainable building development.

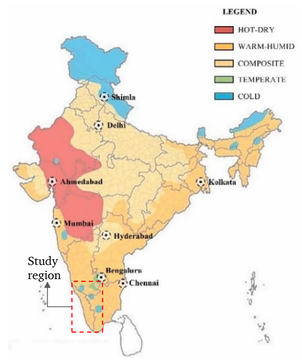

Fig.1: Climatic zones in India (Bureau of Indian Standards, 2016)

Fig.2: Example of a smart classroom in India (www.thestatesman.com)

Reference school building

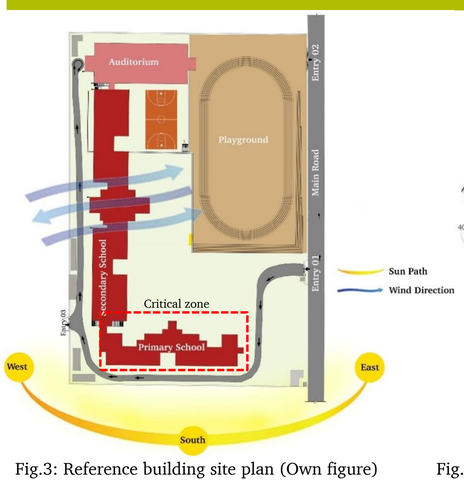

Fig.3: Reference building site plan (Own figure)

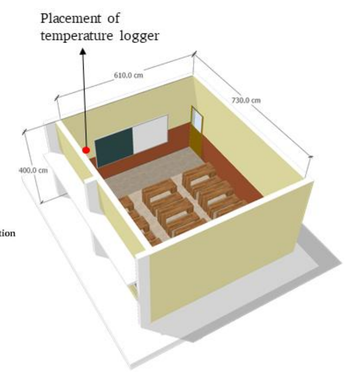

Fig.4: Reference classroom (Own figure)

Fig.5: On-site photographs (Own figure)

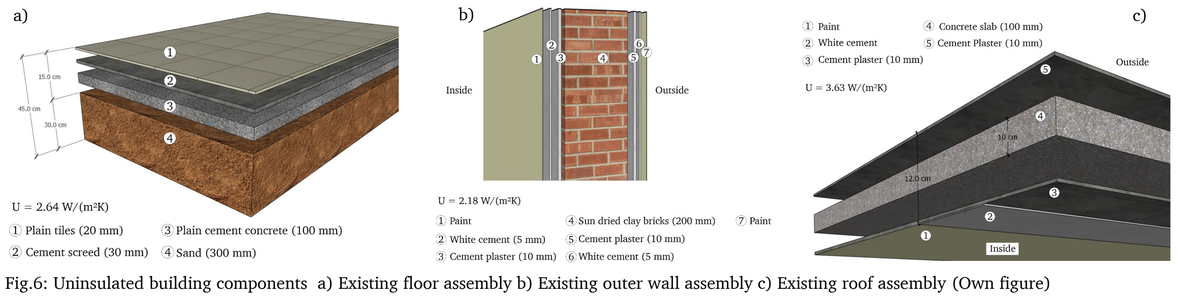

Fig.6: Uninsulated building components a) Existing floor assembly b) Existing outer wall assembly c) Existing roof assembly (Own figure)

- Energy consumption (Electricity)

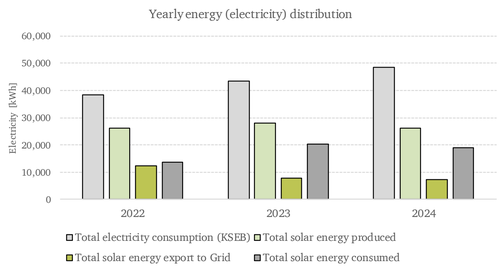

Fig.7: Total energy distribution between solar and Kerala State Electricity Board - KSEB (Own figure)

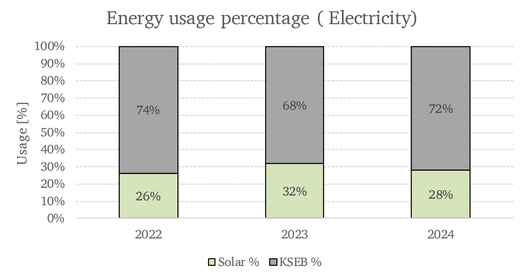

Fig.8: Percentage of energy consumed from Solar and KSEB (Own figure)

- Indoor climate

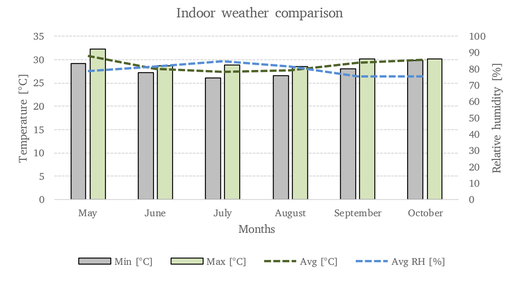

Fig.9: Existing indoor temperature and relative humidity during working hours (Own figure)

- Energy demand

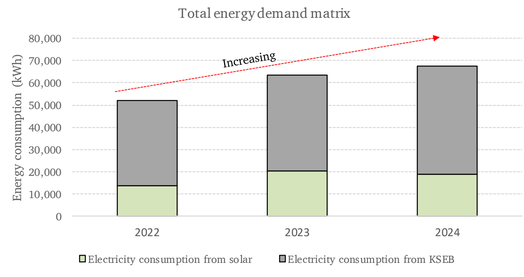

Fig.10: Total energy demand from 2022 - 2024 (Own figure)

Indoor climatic simulation

The indoor climate simulation was performed in WUFI Plus for the proposed modernization scenario, which enhances the building envelope using coir-fiber insulation and incorporates PV-assisted air conditioning to improve energy sustainability.

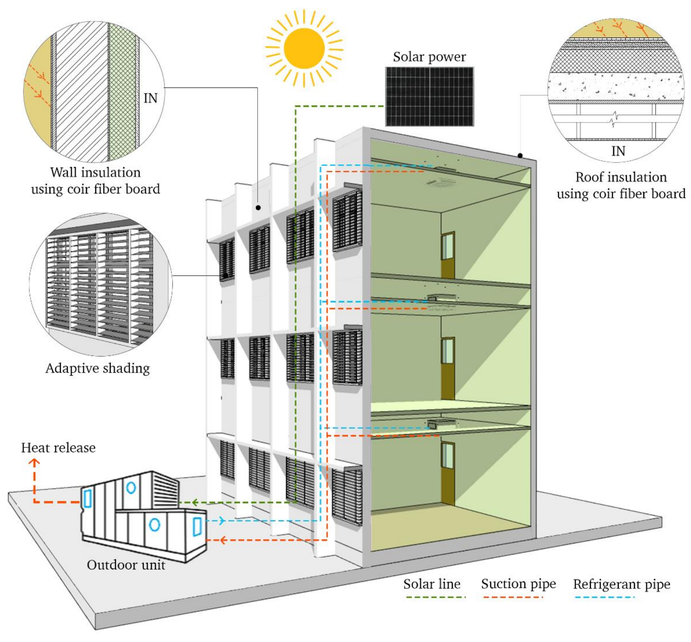

Fig.11: Proposed modernization scenario for the indoor climatic simulation (Own figure)

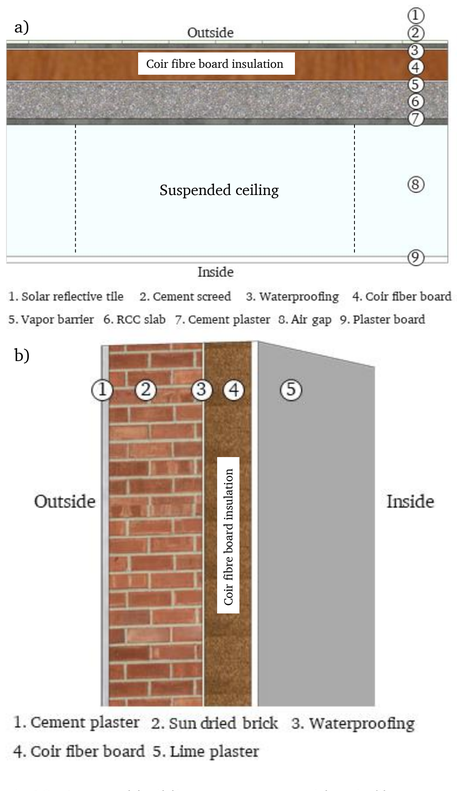

Fig.12: Proposed building components with coir fibre board as insulation a) Ceiling b) Wall (Own figure)

- Indoor temperature and relative humidity

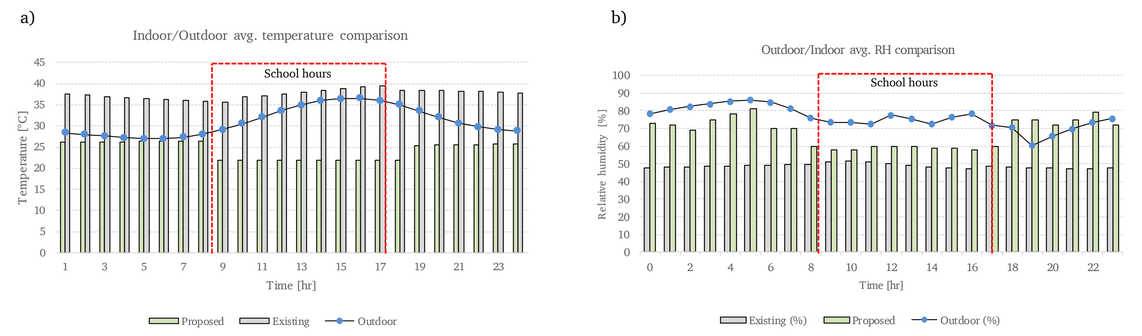

Fig.13: Comparison of existing and proposed indoor climatic simulation a) Temperature b) Relative humidity (Own figure, Data: WUFI PLUS)

- Cooling energy sustainability

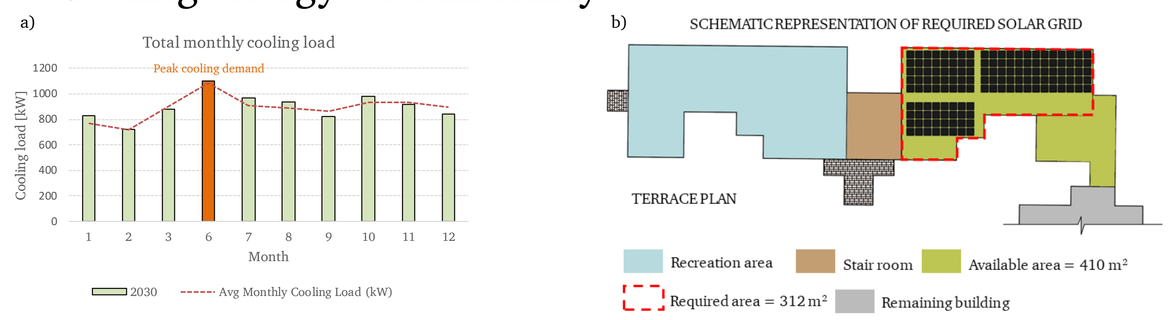

Fig.14: a) Total monthly cooling load b) Required solar grid to offset the cooling load (Own figure, Data: WUFI PLUS)

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