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Sustainable design in context to Energy saving in Buildings : Case of Residence in Jammu

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Developing countries like India usually have a restricted energy supply and energy savings in terms of lighting, space heating and cooling can improve security of energy supply as well as enhance comfort in the home and provide economic savings on energy bills. We are very well aware of the techniques or technological solutions involved which are tested and even simple changes can make a difference. However, there are different approaches depending on the typology of the building, its location, orientation and usage.

In this paper, I am stressing on the simple fundamentals of natural light and ventilation which should be incorporated in a residence to be designed in a composite climate in Jammu region. The energy saving techniques involved are building construction methods like rat trap bond in brick work for passive cooling and heating, cross ventilation in all spaces, use of solar energy for hot water, orientation and form of building to improve day lighting , use of landscaping for energy saving and use of energy savers gadgets for reducing energy supply. The case involves an existing house in Jammu in which these parameters of energy saving have been achieved by following simple practices of building construction.

Key Words: *Energy, saving, residence, lighting*

INTRODUCTION

Very often it is stated that it is possible to design climatically responsive buildings on bigger sites, but in most urban situations where the sites are restricted by their small size and fixed orientation, it is not possible to develop such a design. This residential project demonstrates a situation where a climate responsive form and design was achieved in an existing urban situation with a fixed site size and orientation.

Jammu located in the "composite climate" zone, has large climatic swings over the years, i.e. very hot and dry period of almost three months(maximum DBT 45^{o}C) and a colder period of shorter duration(minimum DBT 3^{o}C). The hot dry period is followed by a hot humid, monsoon period of about two months with intervening periods of milder climate.

THE SITE

Located in Jammu , this house has been designed and built in the "composite climatic context". The site of about 6050 s.ft. had a plan in the ration 1:2 with the shorter side facing the road and orientation North-East.

PLANNING IN RESPONSE TO CLIMATE

The demand on building design was to respond to the extremes: minimize(eliminate) heat gain in hot dry period, maximize ventilation in hot humid period from zones/ areas designed as heat sinks and maximize heat gain in the cold period. This has been achieved in the house entirely through the form and fabric of the building. The entire form has been evolved in such a way that all the spaces like drawing room, living spaces, kitchen area with utility have maximum south east exposure that is ideal for this context. A large living space is designed as a double height space in which the hot air rises up and is sucked by powerful exhausts given at the first floor level thus dissipating the heat outside. Buffer spaces like the toilets ,

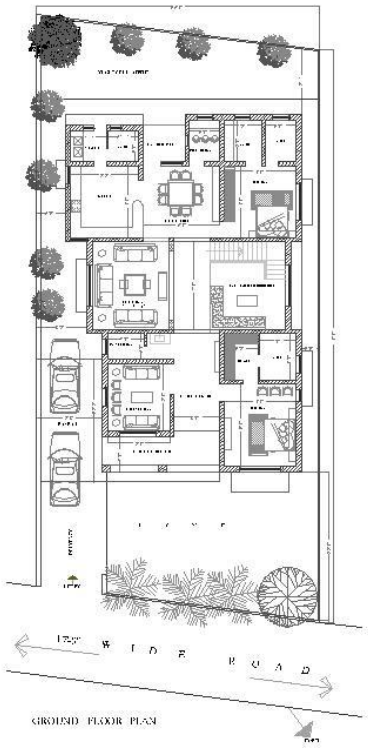


Fig.1 : Ground floor plan

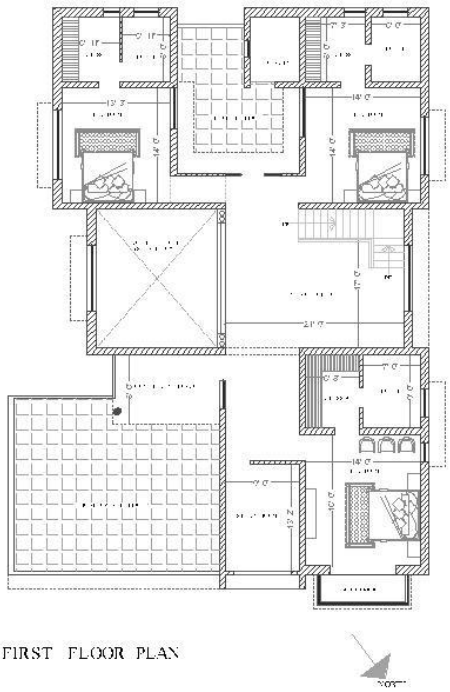


Fig. 2 : First floor plan

utility areas, stores are located on the overheated south-western exposure to eliminate the heat gain in summers.

The Materials, Techniques and methods

- The double storey building was designed in load-bearing brickwork and was without beams and columns, reducing the consumption of concrete and steel.

Fig.3 : Front elevation facing north-east

Fig.4 : Entrance to the house through covered verandah

- Use of innovative problem solving approaches in design as well as construction processes which strike a satisfactory balance between the varied requirements of the activities without compromising on any functional needs and the ambience.
- Conservation of resources through eco-friendly design principles of design and design decisions in all aspects.
- Design maximizes the use of locally available natural materials and avoids the use of synthetic materials.
- Load bearing structure with the external walls 13.5” thick with rat trap bond construction. The internal walls are 9”and 4.5” thick The cavities thus entraps air and at damp proof course level a cavity has been kept to dissipate the heat which entraps in the walls in summers but at the same time cavity is closed in winters so that the heat traps keeps the building warm. The external and internal walls are plastered with external finish of weather coat emulsion and internal finish in washable emulsion.
- Minimize the use of artificial light through strategic and adequate placement of openings.
- The building has maximum natural ventilation with cross-ventilation in every space of the built form.
- A perforated parapet, instead of a opaque parapet, to reduce the reflected solar radiation into the building by about 20%.
- Use of recessed windows with sunshades in the south side in order to reduce the heat gain.
- Terracing with brick tile and mud phuska on inverted hollow earthenware pots results in about 20% reduction in thermal absorption in roof.

Fig.5 : Exterior openings on double height façade

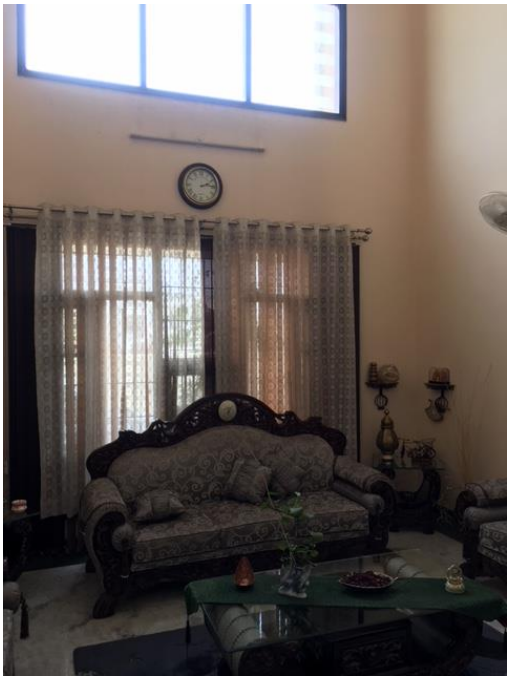


Fig.6 : Interior façade of double height living space

- Adequately designed lighting fixtures with due consideration to window locations has helped in energy conservation. All lamps and luminaries are based on LED's so as to reduce electrical loads to the maximum.

Fig. 7 : Split living space window on opposite wall of double height space allowing cross-ventilation

Fig. 8: Landscaping in the front lawn

Fig.9 : Rear open space- vegetable garden

- The three dimensional form of the building is generated to eliminate or allow solar penetration according to

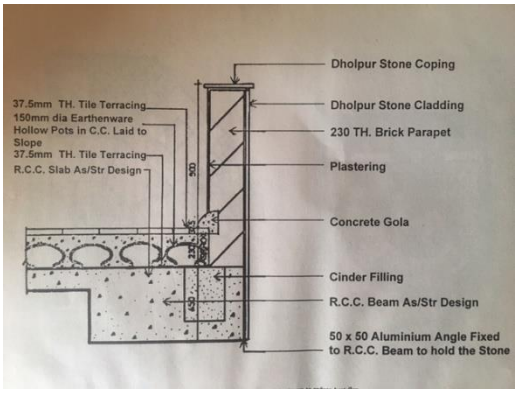
- 

Fig.10 : Indigenous terrace treatment

seasonal changes. Large volume spaces allow good ventilation. The plan and three-dimensional form of the building has, therefore, been developed entirely in response to solar geometry.

- Landscaping has been done on the southern side along the windows to provide shade. A landscaped lawn on the North-East side improves the microclimate of the area around the building and also serves as a hangout / play area in the heat of summers since it is shaded area of the house after 2:00 pm. The rear side has a kitchen garden cultivated with seasonal vegetables, fruit trees, etc.
- Solar plant has been installed to cater the solar water heating system.
- Two pits in the rear garden ensures the composting of kitchen waste. Also, rain water harvesting tank has been constructed to ensure the collection of rain water and its use in gardening.

CONCLUSION

The simple design features when incorporated in a project like this can have following advantages:

- Exterior cavity walls especially in north-east and south-west minimize heat gains.
- Strategically located trees provide shading and modify microclimate.
- Deep recessed windows cut direct solar heat gains.
- Light coloured finish of walls and roof reflects heat.
- Proper fenestration/openings design ensures natural lighting and adequate cross-ventilation.
- Minimized use of glazed surfaces optimizes heat gains.
- Use of lighting fixtures that are energy efficient.

References :

[1] Energy-efficient buildings in India

[2] Sustainability through building, by Prof. N.K.Bansal & Jeffery Cook