Performance of Building by Laurie Baker

[1]Vaishali, [2]Niharika, [3]Udita Devrani
[1]Architect, [2]Architect, [3]Architect
[1]Departement of Architecture,
[1]RSQR architects, Gurgaon, Haryana

ABSTRACT: Climate change is expected to have an impact on many aspects of building performance. The modern-day practice does not give due respect to passive and natural environment control measures in buildings. With modern materials and technology, the buildings of present architectural style results in high energy consumption, in an attempt to provide thermal comfort indoors. The vernacular architecture at any place on the other hand has evolved through ages by consistent and continuous effort for more efficient and perfect solutions. This paper has a qualitative analysis of the passive environment control system of vernacular architecture of Kerala that is known for ages for its use of natural and passive methods for a comfortable indoor environment. The orientation of building, internal arrangement of spaces, the presence of internal courtyard, use of locally available materials and special methods of construction, etc. have together created the indoor environment. A quantitative analysis was also carried out based on field experiments by recording thermal comfort parameters in a selected building. The study has provided positive results that the passive environment control system employed in Kerala vernacular architecture is highly effective in providing thermal comfort indoors in all seasons.

KEYWORDS: Vernacular architecture; Traditional Buildings; Design strategies; Comfortable Indoor Environment; Sustainability; Laurie Baker

INTRODUCTION

'The idea of sustainability … is our earliest, our world cultural heritage.' The concept of sustainability is a reaction to an over development of the material world.

Figure 1: Kerala Map

Date of Formation	1 November 1956
Location	South West tip of the India's main land/ North latitude between 8o 18` and 12o 48` East longitude between 74o 52` and 77o 22`
Capital	Thiruvananthapuram
Area	38,863 sq. km.

Table 1: Kerala State at a Glance

Vernacular architecture is a response to the facts of local geography and climate. The house form, materials and techniques of construction used in vernacular architecture are an effective response through appropriate or sustainable technology.

Winter Season	Average Temperature	Maximum: 28°C Minimum : 18°C
	Average Rainfall	25 mm
Summer Season	Average Temperature	Maximum : 36°C
		Minimum : 32°C
	Average Rainfall	135 mm
South West Monsoon	Average Temperature	Maximum : 30°C Minimum : 19°C
	Average Rainfall	2250-2500 mm
North East Monsoon	Average Temperature	Maximum : 35°C Minimum : 29°C
	Average Rainfall	450-500 mm

Table 2: Monsoons in the State

Baker's body of work is significant both in terms of the volume and sheer diversity as well as in terms of the innovative and practical concepts introduced. In Kerala alone, he has built over 2000 buildings. He has also done pioneering work into earthquake and tsunami proof housing.

Laurie Baker's faithful continuation of his responsibility to build for India according to Gandhi's advice needs to be understood as a practical and economic solution to India's housing problem. This paper looks at the contribution of Laurie Baker to the continuation of vernacular architecture.

OVERVIEW:

Laurie Baker and Sustainability: Words and Works

"… in 1943, Gandhi told Baker that his knowledge of western architecture would be of very little help in India, where the rural areas needed more attention than the cities. Gandhi gave Baker his idea of building houses, saying that the materials needed to build a house should be acquired from within 5 miles of the site. This idea was to have a great impact on the architect s life a few years down the line."

His practices are visible proof of his understanding of culture, climate and context.

1. **Economic: Being Cost-effective**

"The equation that a cost-effective house is a house for the poor, implying a bad looking house, can definitely be proved wrong. Isn't it the responsibility of the upper and middle classes to stop indulging in extravagance and make better looking houses instead?"

Slum Rehabilitation at Chengalchoola, Trivandrum

Baker's economic skills over the practice of building he was offered many housing projects by the Government of Kerala. The Fisherman village, where he was able to bring a communal harmony through his architecture and Chengalchoola

Another reason is its appearance as beautiful exposed brick row houses, even in its current use, which has its no connotations with a slum. This scheme can also be seen as middle path to economic high-density high-rise and comparatively costlier high-density low-rise.

Figure 2: Chengalchoola Housing, Trivandrum

2. Cultural: Incorporating Modernity

"We should remind ourselves that it is not 'Advancement' or 'Development' or 'Progress' to indulge in modern building materials and techniques at tremendous expenses and to no good effect when there is no justification or reason for their use, instead of older, simpler, inexpensive methods."

Centre for Developing Studies, Ulloor, Trivandrum, 1971

This institutional design accommodates functions from administrative office to residences and library to amphitheater.

Figure 3: Entrance of Centre of Development of Studies, Trivandrum

Baker intelligently handled the modernity through his innovative solutions. This is best explained in various blocks of Centre for Developing Studies, where the institution wanted modern infrastructure. Using double walls, with a small gallery in between, he created a blanket for its users. Playful brick jalis (fenestrations) facilitated not just the cross ventilation and day lighting but also projected a unique built-form character. **Through this, he responded to then irregular power cuts and reducing the electricity bills.**

In Computer Centre, challenge was not just designing a response towards a modern requirement, but was also to act harmoniously with existing forms, which were dancing through, as curved walls in the whole campus of Centre of Developing Studies. He again, skillfully, designed the double wall sections to reduce the heat gain for the rooms containing computing machines. **This building is an example of Baker's innovative approach towards incorporating modernity and technological advancements, without surrendering to the readily available but unsustainable commercial solutions like air-conditioning.**

3. **Historical- Learning from Tradition and Vernacular**

"Our modern, advanced scientific minds should know how to assess the merits and demerits of historical and factual evidence of the way people who have lived in a particular setting and climate, have coped with the problems which are still inevitably ours today."

Baker always respected the traditional wisdom and applied to his architecture. He always kept upgrading himself with more exposure to vernacular ways of doing things, be it his early years in Himalayas or later in the coastal Kerala. The 'Rural Community Buildings' explains the concepts further sample designs of small institutional functions like bank, library, offices, schools, hospital, auditorium etc. All of them illustrate some of the local and vernacular techniques of the construction with clearly mentioned "Do's and Don'ts".

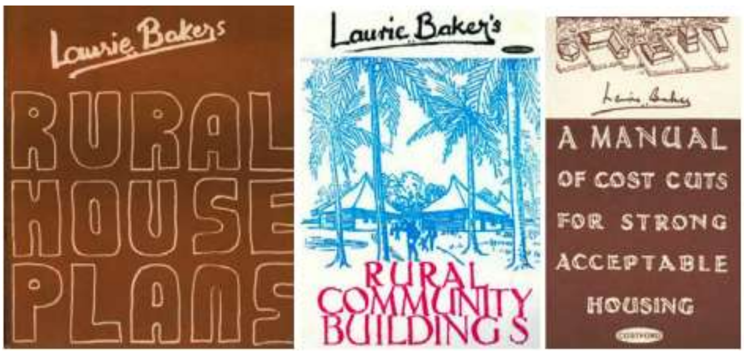

Figure 4: Small Booklets by Baker (Source: www.lauriebaker.net)

There are various individual and communities interested in knowing the rural building tradition. The documentation once again suggests that historical knowledge, as building traditions can be very useful for village economy, holistic development and sustainable futures.

THE STUDY CASE:

Laurie Baker focusing on his extensive use of common brick in building construction to achieve aesthetics, environmental harmony and most importantly cost efficiency.

Table 3: Technology for different phases of construction

Building elements	Traditional materials or Technology	Conventional materials or Technology (Presently in use)	Prevailing CEEF technology options			
			Commonly used in Kerala		Available in India and not popular in Kerala	
			Building materials	Technology	Building materials	Technology
Foundation and Basement	Laterite Rubble	Laterite Rubble Concrete		Sand Piles Mud with bamboo reinforcement	Latoblocks Sand – lime bricks Mud- concrete blocks Steam cured lime stabilized bricks	Brick arch foundation Stub foundation
Building blocks or superstructure	Wood Laterite Mud Rubble	Bricks Solid /hollow concrete blocks	Adobe Stabilized mud blocks. Rubble filler blocks Ferro cement Solid concrete blocks Hollow concrete blocks Interlocking blocks	Rat trap bond Flemish bond	Building blocks from industrial and agricultural wastes	Straw bale technology Rammed earth wall Ferro cement wall panels
Binder	Mud/ clay Lime Gypsum Cow dung	Cement Lime	Mud Combination mortar (cement-lime-sand)		Lime or cement pozzolana Stabilized mud mortars Cement/Lime soil mortar	
Roofing	Wood Palm leaves Thatch Tiles(since 1759 only)	Concrete Tiles Aluminium sheets Asbestos Cement sheets Galvanised Iron sheets FRP sheets Asphalt sheet		Filler Slabs Funicular shells Pre cast concrete ribbed slab Ferro cement Channel or shell units L Panel roofing	Ferro cement tiles Bamboo mat corrugated roofing sheet	Pre-cast brick panels Micro concrete roofing (MCR)tiles Fly ash MCR tiles Jack arch with bricks and pre-cast RCC joists Corbelled brick pyramid Brick vaults and Domes Fal-G vault Fibre-cement roofing sheets and tiles
Lintels or Beams	Wood or stone lintel Brick corbelling Brick Arches		Brick	Pre cast R.C.C lintels Ferro cement lintel Brick corbelling Brick Arches		
Flooring	Cow dung			Cement plaster over brick bats Burnt clay tiles over brick bats	Fly ash terrazzo tiles	

Table 4 : Alternative Building Materials

Type Of Waste (Industrial/Agricultural)	Source	Building Material
Fly ash / Pulverized fuel ash	Thermal Power plant	Portland- Pozzolana cement, Fly ash bricks, Roofing tiles
Red Mud	Aluminium industry	Bricks, Tiles, Blended cement, Fibre-reinforced panel products.
Lime sludge	Sugar, Paper, Fertilizer industry	Pozzolana cement Building blocks
Rice husk	By product from rice processing	Pozzolana cement Building blocks
Coir Pith	Coir industry	Building blocks
Rice Straw	Rice cultivation	Building blocks

Table 5: Embodied energy of basic building materials

Basic building materials	Embodied energy MJ/Kg
Aluminium	237
Structural Steel	42
Cement	5.85
Lime	5.63
Lime pozzolana	2.33
Bricks	1.4
Laterite	0
Sand	0
Rubble	0
Fly ash	0
Rice husk ash	0
Straw	0
Mud	0

Figure 5: Conceptual framework: sustainable-affordable construction

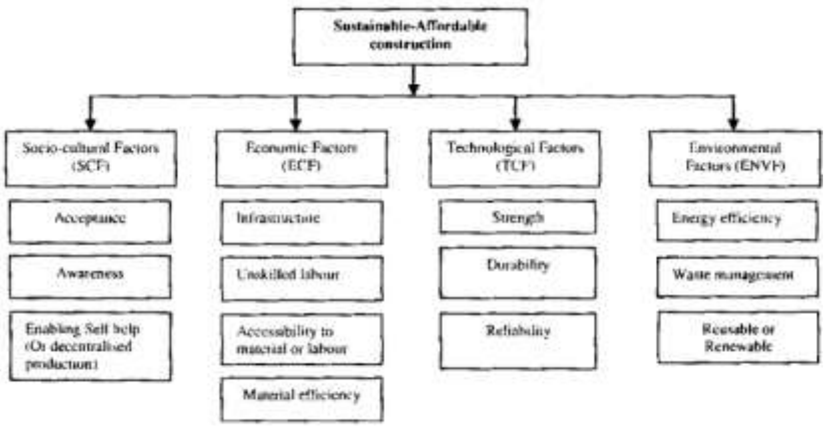

Table 6: Sustainability analysis for new technology options: Kerala

Technological options	Straw bale construction	Rice Husk Ash Pozzolana
Socio-cultural Factors (SCF) Acceptance	2	2
Self help or decentralised production	2	2
Total score SCF	**4**	**4**
SCF in %	**100**	**100**
Economic Factors (ECF) Infrastructure	2	2
Unskilled labour	1	2
Local materials	2	2
Less labour intensive	2	2
Total score ECF	**7**	**8**
ECF in %	**88**	**100**
Technological Factors (TCF) Strength	1	1
Durability	1	1
Reliability	1	1
TCF	**3**	**3**
TCF in %	**50**	**50**
Environmental Factors(ENVF) Energy	2	2
Waste management	2	2
Utilisation of renewable resources	2	2
Total score ENVF	**6**	**6**
ENVF in %	**100**	**100**
Aggregate score (100)	**85**	**88**

CONCLUSION

The analysis of that: major technological options in Kerala give a better overview on the sustainability of the present building process in the state. Among the present technologies, traditional building technology with, Mangalore pattern tile roofing and mud mortar is found to be that most sustainable technological option for affordable housing in Kerala. Locally produced hollow concrete block masonry can be suggested as an alternative technological in other places. This choice of building alternatives has been made from the prevailing popular technologies in Kerala. At the same time, we could not consider the potential of CEEF technology options like rat-trap bond masonry, adobe, soil stabilized mud blocks, rubble filler block, filler slab and shell roofing due to their comparatively poor scores in socio-cultural sustainability and economic sustainability.

None of the technological alternatives could be affordable in practice, if it has not enough support and acceptance from the society. This can be attributed to the present inferior image of CEEF technology against modern or prevailing energy intensive building process in Kerala.

The evaluation of present building process in Kerala also point towards the need for alternative technological options utilizing locally available agricultural and industrial wastes to replace energy intensive technology. Locally available materials, especially wastes, significantly reduce the consumption of energy and secondary resources needed for extraction, processing, fabrication and transportation. Straw bale (SB) and rice husk ash (RHA) are promising in this regard. In Kerala, straw and rice husk arc abundantly available as agricultural residues. Promoting these two alternatives in building industry can certainly contribute in realizing the dream of "shelter for all" and lead to sustainable future.

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