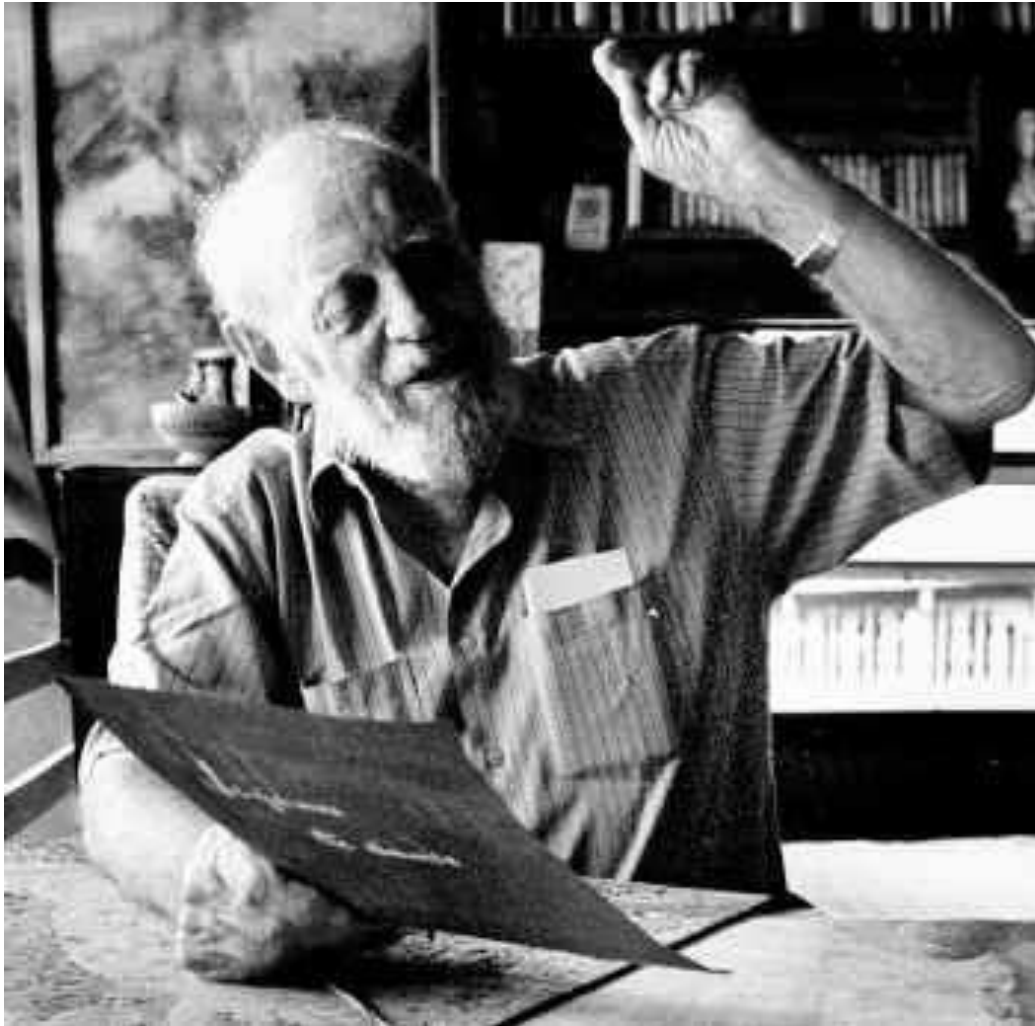




Frugal Architecture and Design

A study through Laurie Baker
construction methods

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Project guide

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Declaration

I declare that this report represents only my idea in my own words, and where others Ideas or words have been included, I have cited and referenced the original source. I also declare that I have adhered to all principles of academic honesty and integrity and have not falsified, misinterpreted or fabricated any idea/data/facts/sources in my report. I understand that any violation of the above will be cause for disciplinary action by the institute and can also invoke penal action from the sources from which proper permission has not been taken, or improperly cited.

Sign :

Name : Alvin P Gopal

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Date :

Approval sheet

This design research seminar report entitled "Frugal architecture and design", by Alvin P Gopal is approved in partial fulfilment of the requirements for Master of Design degree in Mobility and Vehicle Design.

Project guide

Date :

Place :

Acknowledgement

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Alvin P Gopal

Date

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1. Introduction

Housing is a basic need of human being since the beginning of mankind. Now a days building a house has become a more polluting and wasteful activity and causes many direct and indirect impacts to the environment. Common building practices give importance to form and image and trying to make big monuments with high spatial qualities, wasting energy and having a little or no relation with the tradition and culture of the community in which it has been built. In contrast, frugal architecture always design spaces by means of minimal and effective use of resources to meet the needs of the user or community, which is intended to serve. Three basic factors of frugality are reducing, reusing and recycling.

Uncontrolled exploitation of natural resources and resulting pollution, introduced a new trend of using products made out of recycled, reusable and eco- compatible materials. In a

country like India many people are poor and can't afford a quality housing. Here, the principles of frugal architecture become more relevant. The buildings and spaces designed with frugal approach, are technologically advanced and economically accessible to even poor people as well.

This report covers various aspects of frugal architecture through Ar. Laurie Baker method of construction, which holds the principles of frugality. I have done my research with the help of "COSTFORD" (Centre of Science and Technology For Rural Development) Thrissur, Kerala, an organization co-founded by Laurie baker and doing lot of construction activities across various parts of Kerala. The research part included various sites visits of building construction at different stages, and the details have been documented with the help of images.

2. What is frugal architecture?

Frugal architecture always make sure the best use of design process to solve the various housing related problems according to its situation rather than expensive and unnecessary architectural practices. This method follows the principle of under consumption rather than over consumption of resources and give emphasis on the best possible use resources or recycling some materials to keep it without wastage. The architect always try to identify and understand the site, culture, resources and through the creative blending of his knowledge and skill, provides a feasible solution. Frugal architecture designs are not only economically efficient but are technologically and functionally advanced and playing an important role in raising the living standards of common man.

3. Laurie Baker

Laurie Baker or Laurence Wilfred Baker was a British architect, born on March 2, 1917 in England. He is one of the great Architects, who introduced a frugal method of architecture in India especially in Kerala. After the successful completion of his graduation in architecture, he became a member of Royal Institute of Architects in 1938. During Second World War period he left his job as an architect and dedicated his life to treat the casualties and leprosy patients for many years. During one of his journey, he met Gandhiji and got inspired by his thoughts. Gandhiji encouraged Baker to come back and work for India. Baker came back with the decision to help the poor and neglected people of India.

He married Elizabeth Jacob, a doctor from Kerala and spend their initial periods in a remote Himalayan region. During this period Baker came to understand the problems

and actual conditions of rural India. After a few years, he moved to Kerala and again chose a remote mountain area among the neglected tribes, and settled there. During this period Baker acquired more knowledge of south Indian especially Kerala rural life, and he identified that housing is a basic and most important need of the rural people.

In 1969 he moved to Trivandrum and settled there with his family. In Kerala, he got enough chances to work with lot of Government and semi government projects. In fact he got inspired by the traditional Kerala architecture and building practices, which according to him are extremely suited to the climatic and cultural conditions of Kerala and uses locally available building materials cleverly. He identified the importance of reuse, recycling and the use of eco compatible and locally available materials in building construction and developed a brand new method which is cheaper and convenient than the conventional construction practices. In 1984 Baker co-founded COSTFORD

along with Dr.D.R. Chandradutt, Dr. K.N. Raj an economist and Mr. Achutha Menon, the former Chief Minister of Kerala.

Baker always gave emphasis to the cultural and climatic features of the locality where a building is supposed to be built. According to baker an engineer or architect is not the person to select the type of house, but the decision should be taken by the man who is going to build and live in that house. The techniques and methods which Baker suggested is useful for the poor as well as for middle class people. In 1990 country honoured him with the prestigious Padmashree award. Even during his late 80s he was immersed in his creative works and has been spending his time at various construction sites with the labours, by giving them advises. After 35 years of successful and happy life in Trivandrum, he passed away on 1st April 2007 at his home "The Hamlet".

4. Costford

COSTFORD is an organization founded in 1984 by Mr. Achutha Menon, the former Chief Minister of Kerala, Laurie Baker, Dr.K.N. Raj an economist and Dr.D.R. Chandradutt for the purpose of providing technical assistance for rural development in Kerala. Since 1984 they have been working for the upliftment of poor and neglected communities of the state. COSTFORD started their construction activities from 1986 with it's head office at Thrissur with 13 sub centres in Kerala and one at Gurgaon. COSTFORD has a good set of experts from various fields including architects, engineers, advocates, economists, sociologists, geophysicist, agricultural scientists, medical practitioners, industrial consultants and educationalists. Since the beginning they have executed around 20,000 buildings in Kerala, based on Laurie Baker method. These buildings can be easily identified by exposed brick work, arches, pyramidal roofs, brick jalis, slender towers and

jutting out roofs. For the last 25 years COSTFORD have been giving capacity training programmes for both women and men and also providing multi-disciplinary technical support for local level development programmes.

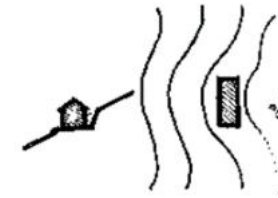
5. Laurie Baker method and principles

According to Laurie Baker the conventional building practices are a costly activity since that always try to make unnecessarily fashionable buildings rather than making it according to the basic customer needs. Moreover they are giving least importance for the local availability of resources, climatic and cultural aspects of the site. His method give emphasis right from the planning phase like discussion with the client/beneficiary, site selection, building layout and orientation, material selection, labour preferences, climatic and cultural aspects. He always preferred optimum usage of energy.

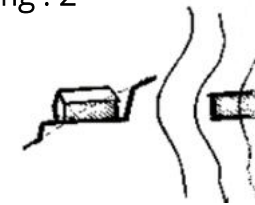
For example the reduction of steel and cement will help to reduce the energy utilised in their manufacture and transportation, which will in turn help to reduce the potential pollution caused by these industries and vehicles used for transportation. Use of locally available materials and labour will help to reduce the transportation energy and cost. Reuse and recycling of materials gives new dimensions for building construction. The following session mention the various concepts of Laurie Baker building construction method, with the help of his own sketches. Almost all concepts have been used and tested by Baker over half a century, during his professional life.



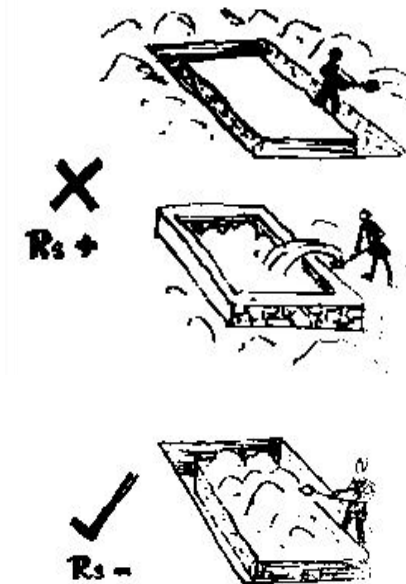
Img : 1



Img : 2

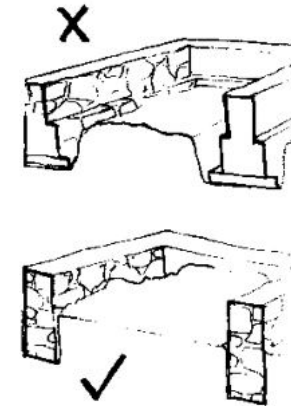


In the given images 1 & 2 he shows how to align a building in a given site. He explains that keeping a building in the middle of the terrace will help to reduce the cost, if we are planning to build on a terraced site. In image (1) lower figure the depth of foundation is quite high, which will increase the construction cost. In image (2) he showed how to reduce the cutting and filling of earth by placing the building parallel to the contours. If the building is aligned perpendicular to the contour/slope, the amount of earth to be removed will be higher to get a flat ground.



Img : 3

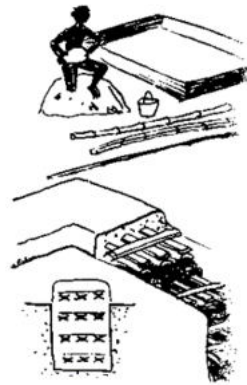
Image number (3) demonstrates how to minimise the manpower, energy and money during the excavation for building foundations. When excavating the trenches for foundation, instead of throwing the soil outside of the trench, we can shovel the soil inwards. That will help to reduce the labour to keep the soil inside after the completion of foundation.



Img : 4

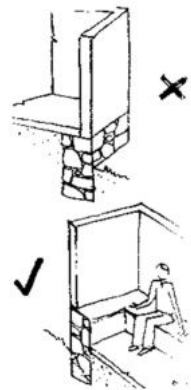
The above figure shows how can we reduce the foundation cost effectively. According to Baker, for small single and double storey houses, and where the stone is available, an 18" (45 cm) wide random rubble foundation wall is fair enough on most soils and there is no need of a wider concrete base beneath the foundation.

In places, where stone and brick are not available, we can use bamboo as a reinforcement in layers with the moistened soil, as given in the following image (5), to make the foundation. This



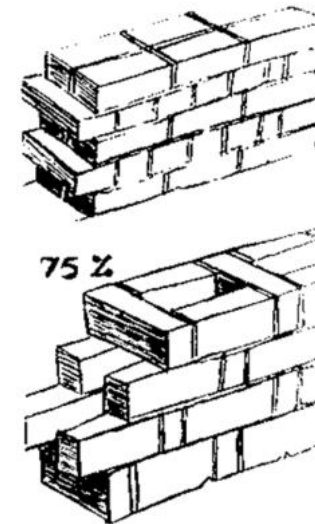
Img : 5

concept shows, how we can incorporate natural materials in building construction effectively.



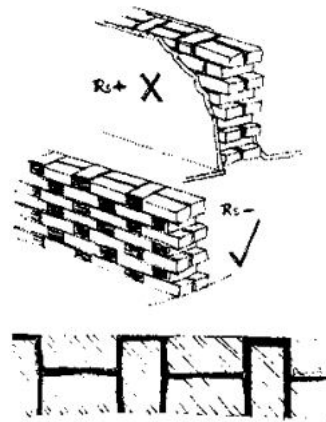
Img : 6

Image (6) shows, by providing built in seats, beds, work tables etc. by raising the basement wall to suitable heights will help to cut down the expenses for furniture.



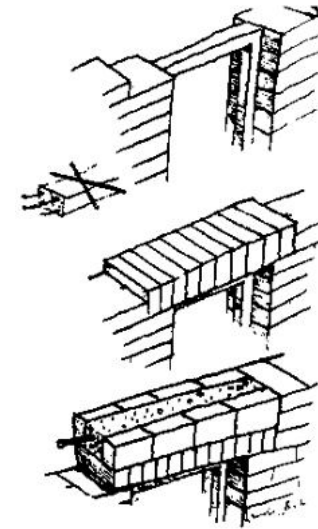
Img : 7

Image (7) demonstrates how to use a 9 inch Rat-Trap bond, to reduce about 25% of the total number of bricks and cost of the wall. The cavity in the masonry has better heat insulation properties, and these cavities can be used for taking electric wiring cables as well.



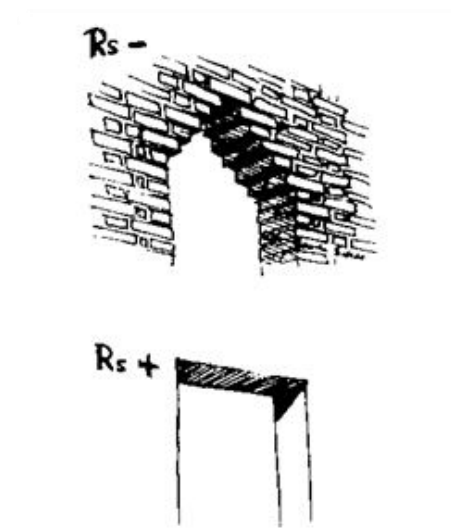
Img : 8

The normal brick walls will be plastered on both sides, which accounts up to 10% of the total building cost, moreover they need periodical painting and maintenance. Instead of plastering, Baker suggest to fill the sunken end of the brick with mortar, which will make some pleasing pattern on the wall and no painting and maintenance is needed. This method is commonly known as pointing of brick masonry. By this method the natural texture of brick can be maintained. By reducing the use of cement mortar, we can indirectly cut down the energy used for it's manufacture and transportation.



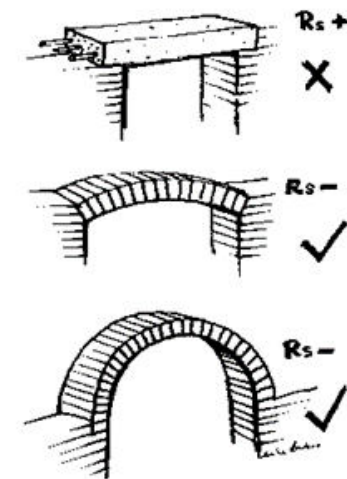
Img : 9

Up to 4 feet width door and window openings, there is no need of a reinforced concrete lintel. Instead of that we can keep ordinary brick on edge as shown in the middle figure of image (9) to carry the load over it, which is called brick lintel. For more strength, the bricks will be arranged in such a way that it creates a small cavity between the two brick layers kept nearby, and which is filled with concrete having one or two steel rods embedded in it.



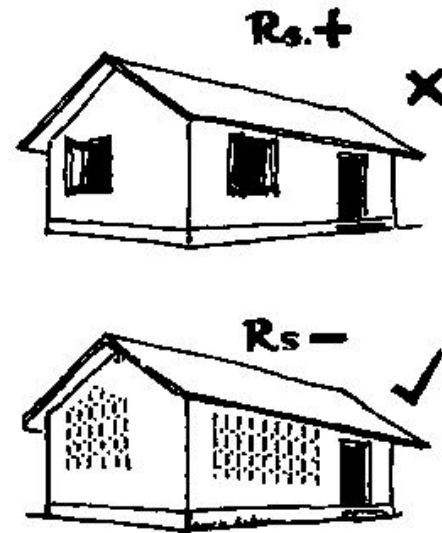
Img : 10

Through the above image Baker trying to demonstrate the fact that, if we remove a door or a window, the whole wall will not fall down, the maximum will be the amount of wall with in a triangle above the frame. Lintel carries only this much amount of brick, not the entire wall and roof. According to him, a simple “corbel” arch is the most inexpensive way of providing a hole in a wall. In a corbel arch each row brick projects 2.25 inches beyond the course below until the bricks meet together in the middle.



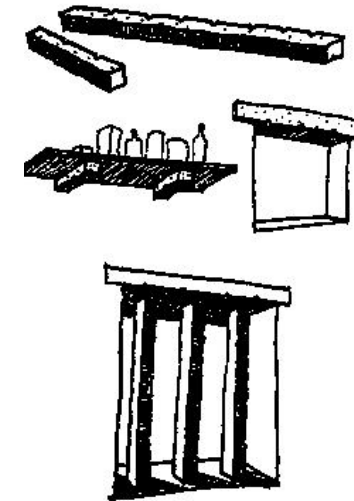
Img : 11

Image (11) shows the effectiveness of brick arches over the RCC lintels. According to Baker, RCC lintels will account for the excessive use of cement, sand and steel. The concrete for RCC lintels require more amount of cement and sand compared to the requirement for the cement mortar used for brick masonry. Moreover they causes lot of direct and indirect energy wastage during their manufacturing, transportation and processing. But bricks are cheaper compare to steel.



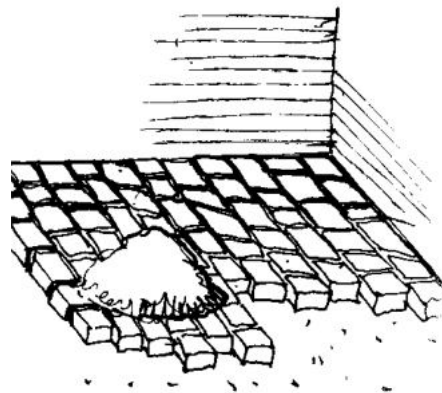
Img : 12

The above two sketches demonstrates how can we replace windows by brick jallis at a lower cost but more effectively. Through this method we can avoid the window frames and panels, fittings, reinforced concrete lintels etc. More over this brick jallis will creates some nice patterns on the wall and ensures good natural lighting and ventilation inside the building all the time.



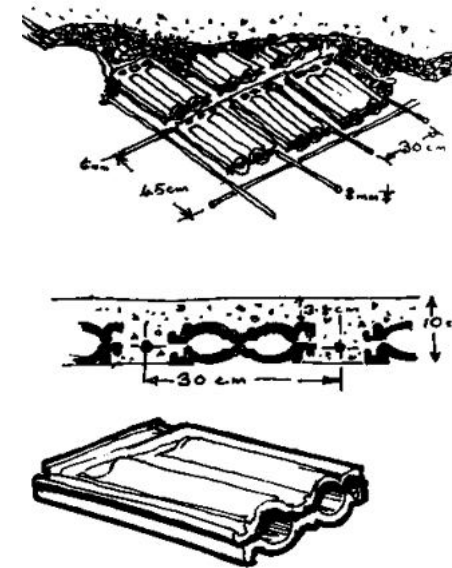
Img : 13

The above figure shows even a common and cheap material like a split stone can be used as lintel, or as brackets to carry wall shelves or table or slabs, or even as security post in window openings. Through this method we can avoid RCC lintels which account for more energy and money expenditure. This methods shows the relevance of using naturally and easily available materials for building construction.



Img : 14

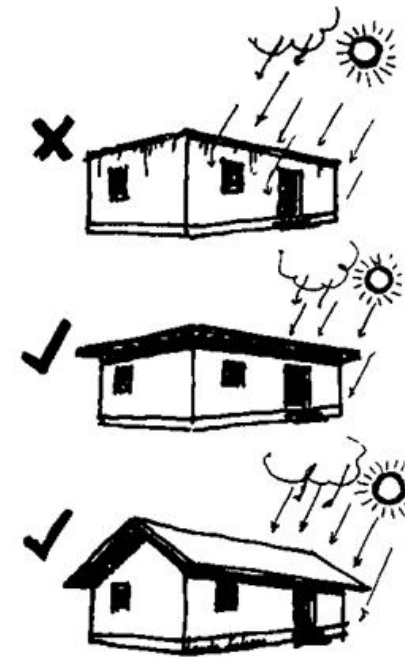
The above sketch is a wonderful example which demonstrates, how to do an inexpensive flooring for a building. Baker suggest us to fill the basement with sand or soil at the early stages, which will get hard as the work progresses. After the roofing, collect all the broken bricks and lay them side by side on the rammed earth. Make a mix of sand and lime and spread it over the bricks and brush it on, so that it will fills all the gaps between the bricks. This brick layer base is sufficient enough to support a floor finish over it. This method is an example of reuse of materials in building construction.



Img : 15

Conventional RCC (Reinforced Cement Concrete) slabs are very costly due to the extensive usage of cement, sand and steel. More over the concrete slabs get heated up during day time and it will be very difficult to live under it. So here Baker introduces a new method to reduce the overall cost of a RCC slab. The alternative slab is called "Filler slab", which will be less expensive, lighter and heat insulator than the normal RCC

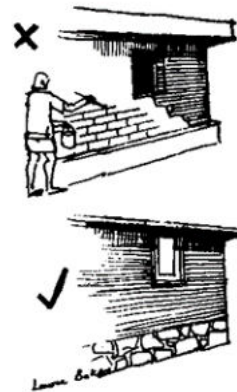
slabs. Usually Mangalore tiles, country tiles or even coconut shells are suggested as filler materials, these tiles may not be a new one. In contrast to the conventional RCC slabs we are using only one layer of reinforcement instead of two layers. The two tiles are placed together as in the given image (15) and will kept between the reinforcement bars. The middle sketch shows the cross section of a typical filler slabs. These tiles will act as a heat insulating as well as light weight material. By using filler slabs, we can reduce the total cost of the RCC slabs by 30% -35 %. Since the roof and the intermediate floors account for 20%-25% of the total building cost, this reduction will make a considerable fall in the budget.



Img : 16

The following image (16) explains the importance of roof overhangs. The modern houses with no overhanging roof, allow the walls to absorb rain and heat from the sun. As a result of this the upper part of the walls are much more prone to moss and fungal attack and become ugly, much faster.

The roof over hangs helps to reduce heating of the walls during day time, and blocks considerable amount of direct sunlight from coming inside and it prevents rain water as well. Another advantage of roof over hang is, it makes the rain water from the roof to fall at a considerable distance from the building.



Img : 17

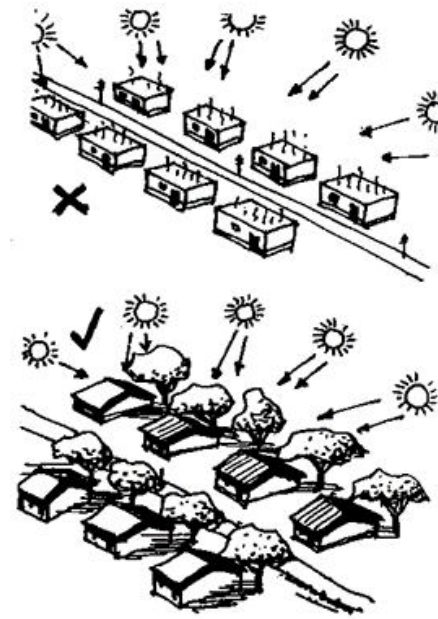
Through the above image Baker tries to explain the unnecessary practice of plastering and painting of a brick or masonry wall. According to him *"a brick wall should look like a brick wall and a stone wall should look like a stone wall and concrete should look like concrete and not to be plastered or painted to look like marble"* (Laurie Baker). Most of the materials have their own characteristic features and natural texture, so by keeping it unplastered or unpainted will help to retain their natural texture, colour and patterns. The plastered and painted walls will look like artificial and

not always go with the surroundings. So if we avoid plastering and painting that will results a 10% savings on the total cost of construction.



Img : 18

By avoiding the little sunshades as in image (18), we can save a good amount of money used for concreting and plastering of it. A good roof overhang will serve the purpose better as a normal sunshade. The brick work for the parapet wall around the roof is also causes unnecessary wastage of money.



Img : 19

The given image (19) shows the importance of type of roof and the alignment of building in a given plot. Small flat-roofed buildings will absorb a lot of heat from the sun but pitched or sloping roofs absorb less heat. If shade trees are grown on the south and west side of buildings, which helps to reduce the heating up of buildings by the sun light, and ensure more comfort to live in.

6. Construction works by COSTFORD

As mentioned before COSTFORD is carrying out Laurie Baker method of building construction. Utilisation of locally available materials, energy efficient materials and construction practices are their prime concern. From the planning stage itself, involvement of the client will be ensured. The site conditions, local traditional architecture and culture are considered with utmost priority. Most of the buildings are equipped with natural lighting and ventilation through inner courtyards and jalis. By the intelligent blending of technology and innovation, use of local and energy efficient materials, they are trying to follow the principle of *"Think globally and act locally"*.

Here frugal architecture has been explained with the help of few buildings at various levels of construction. Few completed buildings were also covered as a part of study.

These houses are constructed/constructing under the guidance of COSTFORD, and are located at various places in Thrissur district, Kerala. For the purpose of this study, I have visited few construction sites and documented the details, with the help of site engineers/supervisors of the respective sites. Through each of the examples, I tried to explain different ideologies of Laurie Baker method. These buildings include residential buildings, educational buildings, Public buildings etc.

using for conducting seminars, workshops by COSTFORD and sometimes as a class room as well.



Building 1

Laurie Baker Hall

Location: Thrissur, Kerala

Type of use: Multi-purpose hall

This hall is a multi-purpose hall constructed for the purpose of serving different activities of COSTFORD. This building has been designed by Laurie Baker and which is one of the best examples for frugal architecture by him. Being a multi-purpose hall, it is mainly



It is completely a brick masonry building, with a curvy layout. It has a random rubble masonry foundation with Concrete is provided only for roofing. As far as Thrissur is concerned brick is available locally and easily. Baker made sure the use of local materials through this approach.



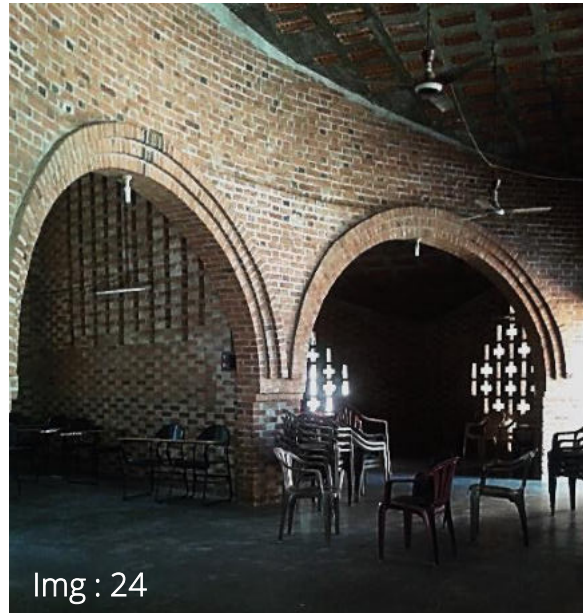
Img : 22

This building have an in built brick jali, which permits natural light and ventilation inside the hall as well as creates interesting pattern on the wall. These extensive jali work makes more open feeling inside the hall and helped



Img : 23

to reduce the use of wood for windows, which is quite expensive and need periodical maintenance. The walls are not plastered, but the joints in the masonry are just pointed with very light mix of lime cement mortar (Mix of cement, lime, sand and water) helped to keep the natural texture and pattern of the bricks. Money for plastering and painting could be saved by this way. More over, due to the natural lighting and ventilation the need for electric fans and bulbs have reduced considerably. Thus electric bills could be controlled with in an optimum limit.



Img : 24

Brick arches are used instead of RCC beams in the partition walls. These arches giving more aesthetics to the interior as well as helped to reduce the cement, sand and steel which would be needed for RCC beams. The interior space is divided into two main areas, one main hall and three adjacent rooms. These rooms are separated from the main hall by the brick arches and are

directed towards the centre of the main hall. These three rooms have its own privacy but it acts as a part of the main hall. These rooms are used as class rooms. Thus in the building itself, Baker incorporated multi-purpose facility. According to him all public buildings should be of multipurpose use.



Img : 25



In two previous images door frames are completely replaced with small wooden planks. These planks are inserted on to the wall only at necessary points having attached hinges and fastenings to fix and close the door. Considerable amount of wood has been saved in this way. Since it is a public building it does not need much more privacy, so Baker maintained a very open type of design.

Filler slabs are used for roofing, which help to reduce the cost as well as weight of the roof. Mangalore tiles were used as filler material.



The pattern formed by the tiles is not very perfect, but if it is finished well, it will create a wonderful appearance



Flooring has been done with red oxide, which is comparatively cheaper than the flooring tiles, marble or granite. Altogether, this building is a wonderful example of Laurie Baker's of frugal architecture.

Building 2

COSTFORD Design office

Location: Thrissur, Kerala

Type of use: Public building for office use

This is also a brick masonry building

constructed on the same principle of Laurie Baker, which is mainly used as Design office of COSTFORD. This building is not very rectangular shaped one, but has a curvy layout, with spiral staircase inside, which connecting different floors at different levels. This staircase is the only way to reach different floors, and staying as a physical connection between each floor, In fact the privacy and access of each rooms are maintained nicely.





Like the previous one, this building also has a brick masonry wall with inbuilt brick jali, without windows. So that the expenses for windows and other related items, could be saved. The masonry wall has an exposed brick work.

with minimal pointing at the brick joints. The cost for plastering and painting was saved like this. Its roof is a filler RCC slab, which is in fact less expensive than the conventional RCC slab.



Img : 32



Img : 33

In some of the intermediate floors, coconut shells are used instead of roofing tiles, as filler material for roof Slabs. Coconut shell is cheap and abundantly available in Kerala, so this is an example of using natural and locally available material. Inside the rooms the filler slabs are nicely finished and painted in white, creating nice pattern on the ceiling. This building is also a pure example of frugal architecture by Laurie Baker method.



Even by providing brick parapet on the terrace, by avoiding windows and by using filler slabs, they have made a major

reduction in the use of steel, needed for RCC parts window grills etc.

Building 3

Sthree Shakthi Kendram
Location: Thrissur, Kerala
Type of use: Public building.

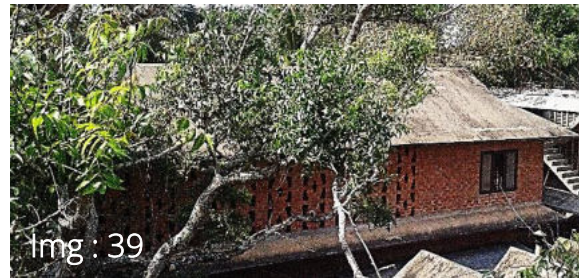
This building is the head office of COSTFORD, located at Thrissur and completed its construction on 2001. This building can be considered as one of the more finished version of building which is designed according to Laurie Baker method.



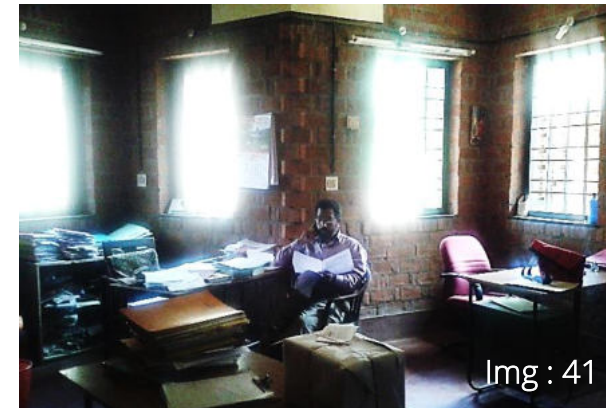


The exposed brick work is the main feature of this building also. The main office part is having windows instead of brick jali. But as far the safety and privacy is concerned, the provision of window is adequate and this can be considered as an example to show how Laurie Baker method has been applied for a different requirement.

Instead of RCC lintels brick lintels are provided over the windows and door openings, which is one of the cost reduction factor in Laurie baker method. Use of cement, steel and sand could be reduced by this method. The plastering and painting is completely avoided by retaining the exposed brick and concrete parts.



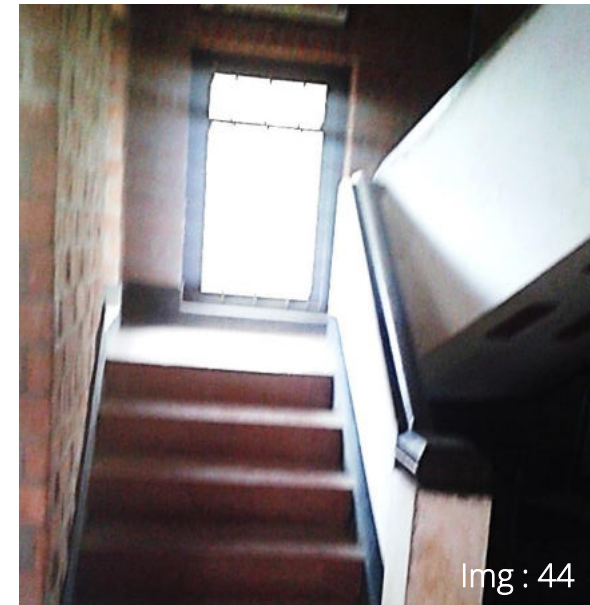
The other wing of the building is also equipped with windows and jalis. The exposed brick work and concrete are retained. Brick arches and parapet are provided on the balcony area, to reduce the usage of steel for RCC beams and had rails, but in a matching way with the overall design.



If we go into the interior, the rooms are arranged in such a way that, lot of natural light and ventilation is available all the time.



The walls are having exposed brick work without plastering, but with pointing at the joints with a normal lime and cement mortar. The edges of the filler slab tiles are pointed with cement mortar and applied white wash to it, helped to get a nice rectangular pattern of tiles on the ceiling. They have provided exposed wiring using black PVC pipes, gives a traditional look to the interior and helped to avoid making conduits for wiring in the wall.



Comparatively cheaper red and black oxide have been used as floor finish, which is truly a frugal approach over the conventional floor tiles, marbles and granites. For staircases brick hand rails are used instead of steel, wood or cast iron which are quite expensive. Interior plastering and painting has been completely avoided to reduce the cost and to retain the raw natural feel.

Building 4

Government Anganwadi

Location: KILA, Thrissur, Kerala

Type of use: Educational building

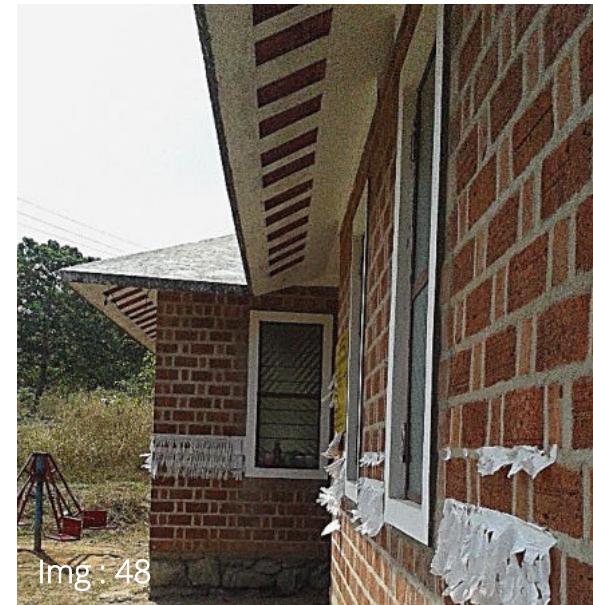
This building is a more refined and comparatively new project of COSTFORD. The building is an Anganwadi, for kids of the age group 3-4 years old. As it is for kids, the overall building is well finished and having very open kind of design. Now a days people have started giving more attention for finishing and detailing than the older buildings.



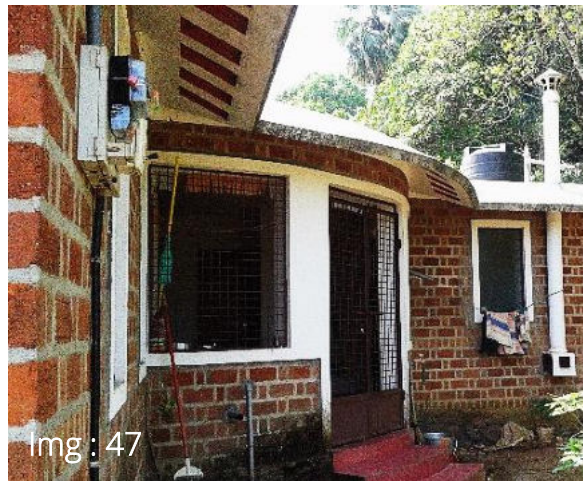
This Anganwadi is a single storied building with normal RR masonry foundation. The exterior wall is having exposed brick masonry with pointed edges. They have followed Rat-trap bond for brick masonry, which helped to reduce the cement, sand and bricks. As mentioned before, Rat-trap bond creates air cavity in the masonry, which act as a thermal insulator. These cavities can be used for taking electric wires for building electrification, thus eliminates the need for cutting the walls again. Long and comparatively wider windows are provided for better light and ventilation. The outer side of window opening is provided with a thin band of plastering, which is a part the detailing work. The concrete roof applied with white wash only, which is very cheap compared to the normal exterior paints. The sloped roof helped to reduce the heating of the building as well as to drain off the rain water during the lengthy monsoon season in Kerala. The roof overhang is good enough to avoid separate sunshade.



Img : 46



Img : 48

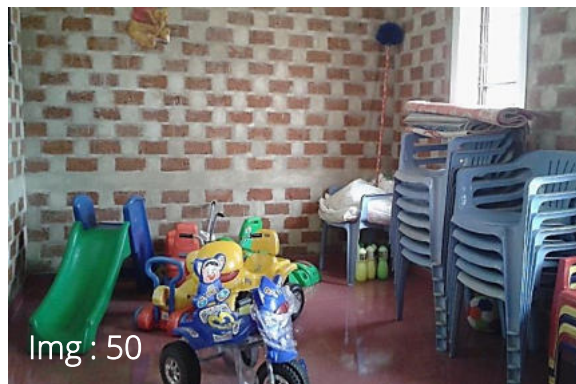


Img : 47

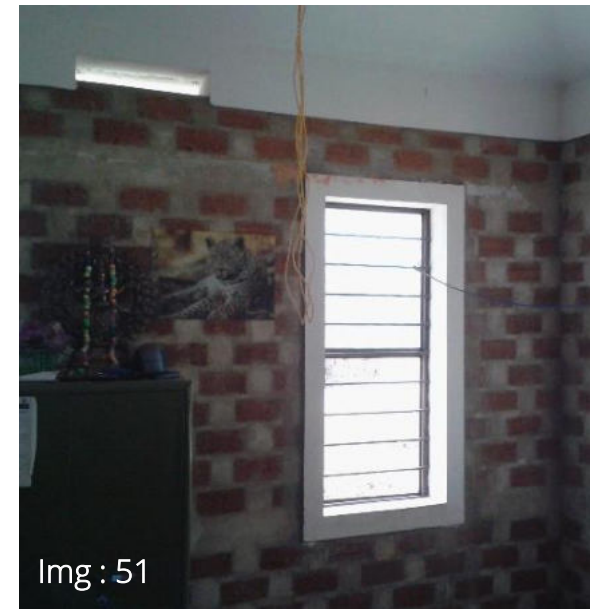
All the outer doors are made out of steel grill, so that lighting and ventilation is available even in the closed state. In this building steel is majorly used for window grills, frames and roof concreting. On the other hand the expensive wood is completely avoided. Filler slab is provided for roofing and the outer edges of the filler tiles are finished with cement mortar.



The exposed brick work is been decorated with a different kind of pattern with the normal cement and lime mortar, plastering and painting is avoided on the wall.



Since kids are playing on the floor, it should not be rough. So the floor is finished with ceramic tiles which is cheaper than the vitrified tiles or marbles.



On the ceiling, filler slab is completely plastered and painted white to get a nicely finished ceiling and to maintain good lighting inside the room.

Building 5

Type of use: Residential building
Area:

Through this building various aspects of Rat-trap bond is explained, as the construction is in brick masonry stage. As mentioned earlier, this type of brick masonry is a speciality of Laurie Baker method. Since there is no plastering on the wall, the perfection and alignment of each layer of brick is very important and which needs very highly skilled labour. The various features and steps of rat-trap bond are as follows.



Img : 52

Before starting the masonry work, bricks are kept soaked in water for few hours. If the bricks are not soaked before masonry, they will absorb moisture from the cement mortar which used to bind the bricks together in the masonry. This situation can make very weak and hollow masonry joints.



Img : 53

The above figure represents a typical rat-trap bond masonry. The mason lays the first layer of brick as in the given figure, leaving a cavity inside the bricks. The bricks will always keep sideways.



After laying the bricks, using a straight edge the mason align the bricks properly. This will help to get the bricks arranged in the same line. The gap between the bricks are maintained carefully.



Gaps between the bricks are filled with cement mortar. After that mortar will be spread on the top to keep the next brick layer over it..



Using a small stick, mason spread it on the top of the brick. This will help to get a mortar layer with uniform thickness.



The mortar is laid only above the longitudinal bricks, by which the quantity of mortar can be reduced with same efficiency.



The pattern of each brick layer is repeating in alternate layers, thus eliminates the chances of having joints in the same vertical line.



The cavity formed between the bricks can be used as conduits for wiring. There is no need to make conduits separately, thus we can avoid further cutting on the wall. This is an example of cutting down extra labour. Thus by using rat-trap bond, there is reduction in the use of bricks. As compared to the 500 numbers per m³ of brick wall by English bond masonry, only 425 bricks are needed for the same volume of brick wall by Rat-trap bond. This will in turn reduce the quantity of cement and sand for mortar. The extra labour for making wiring conduits can be avoided. Apart from this the evenly laid brick layers will make an interesting pattern on the wall, which will eliminate the need for plastering and painting.

Building 6

Type of use: Residential building
Area: 1330 sq ft



Plan view

This building is used to explain the filler slab construction. Various steps involved in this type of construction are covered

during the roof concreting. As far the site is concerned, it is located near to a paddy field with lot of open spaces on the four sides of the building. This particular site was blessed with lot fresh air, light and scenic beauty. The cleverness of the site selection is clearly visible here.



The foundation and the basement of the building is made up of RR masonry. Over that the super structure is built using laterite masonry using 1: 8 cement mortar. Laterite was chosen because it is locally available there, thus the selection of local materials is maintained in this project as well.



Enough window openings are provided to get maximum light and ventilation inside the building. More over these openings will make sure the cross ventilation all the time.



Img : 66

As far the filler slab is concerned, the major difference is the filler material, which is not there in the conventional RCC slab construction. Here the designer has used very old and used Mangalore tiles of 1975, as the filler material. By using the old and used tiles, the principle of reuse have implemented effectively and successfully. Moreover we can save a good amount of money from buying new tiles. Filler slabs are lighter than normal RCC slabs and which also help to reduce the usage of steel, cement, and sand.



Img : 67

The cleaned and soaked tiles are kept on the top of form work before concreting start. Normally the roof slab thickness is about 100 mm. In the filler slab the bottom part will be occupied by the filler material that will be around 50 mm and the rest of the 50 mm on the top of it will be occupied by concrete. Usually single layer of reinforcement is used in filler slabs. For a span up to 3m 8mm steel bars and for span more than 3 m, 10 mm steel bars are used. Usually a centre to centre spacing of 55 cm and 35 cm are provided between the reinforcing steel bars.



Before starting the concreting, terrace will be watered nicely, otherwise this surface will absorb all the moisture from the concrete and that will reduce the quality of concrete. The various steps of filler slab concreting are as follows.



Place the tiles in proper place with keeping a cavity between them and pouring of concrete will start. Since mechanical vibrator can't use because of the chances of displacement of filler

tiles, the mason tamp the concrete with steel rods manually.



Top of the concrete is levelled with a trowel keeping slab thickness as 100mm.

Building 7

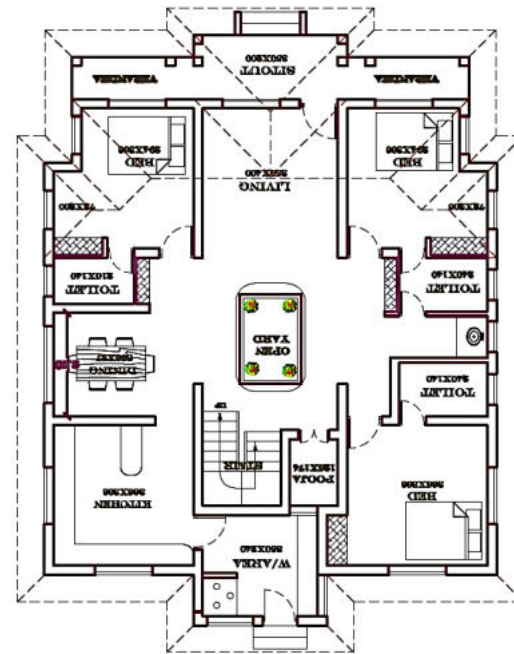
Type of use: Residential building

Area: 2200 Sq ft



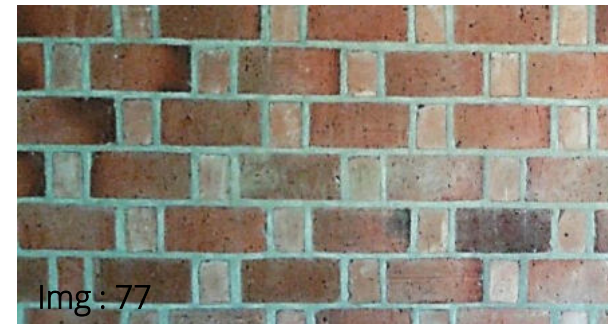
This house is an example I am trying to show how COSTFORD is executing the finishing works in their projects. Over the period of time we can see, Laurie Baker method has been adapted slightly to match with the changing customer needs. The current customers are looking for more finishing and detailing, sometimes the principles of frugal architecture have not been implemented

in its actual way. In this house only the kitchen and toilets are plastered and painted, based since which are more exposed to water.



Plan view

Img : 75

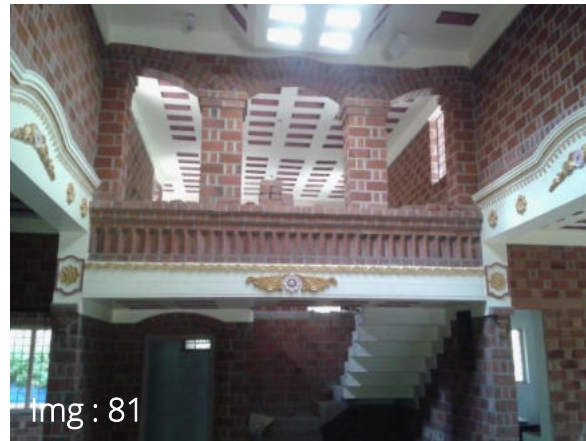


The above images show, how exposed brick work in rat-trap bond will appear after pointing. Wire cut brick are used for masonry work, to get better appearance on both sides of the wall. The pointing has been done with lime and cement mortar in 1:1:4 proportion (1 part cement: 1 part lime : 1 part sand)



On the exterior, only the sloped roof and the roof overhang are plastered, and the other brick portions are kept exposed. A considerable amount of money has been saved from plastering and following painting.





The main hall of this house is equipped with enough sky lighting, through the openings given on the roof. The interior is a mix of the typical Baker method and some additional ornamentation works. These ornamentations have been done according to the customer preference, which not belongs to the Baker principle. The additional beams, and inbuilt shelves are plastered and painted white. These are the only areas where additional labour have been used. Inbuilt shelves reduced the use of additional fittings, otherwise the interior is much cheaper than the conventional buildings.



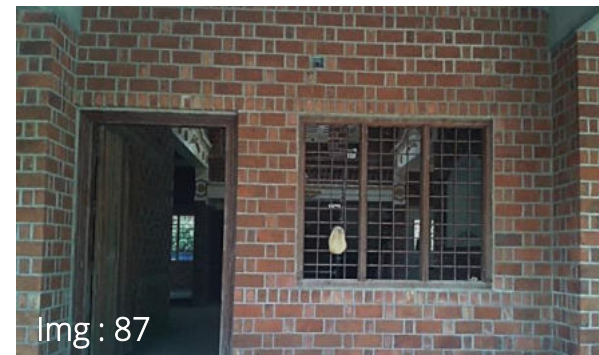
Img : 84



Img : 85



Img : 86



Img : 87

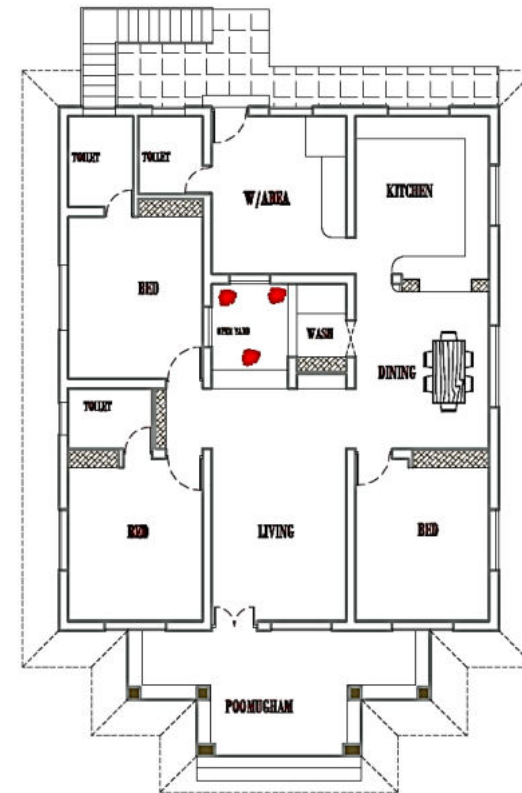
Normally in conventional houses we can see RCC lintels and pillars, they consumes lot of cement, sand and steel. By using brick pillars and brick lintels, which are quite effective and act as design elements, and helped to reduce the construction cost.

Building 8

Type of use: Residential building.
Area: 1500 sq.ft.



This is an example to show how frugality have been used in a modern way.



Plan view

Img : 89



Usually bricks use a lot of fuel to make them, stones need quarrying, shaping and transporting, concrete consumes lot of energy for its ingredients and for its making. By considering all these factors COSTFORD engineers put forward a new concept of using traditional materials like laterite and mud for making an energy efficient house like this. The basic idea was to find mud from our own site or bring it from a shorter distance as possible and find some cheap and easily available stabilizers. Thus by following these methods the engineers could save

good amount of money and energy needed for its construction.

Mr. Biju Warriar is a teacher by profession was the client who wanted to make a low cost house in traditional Kerala style. The basic notion was to build a house with effective and efficient use of money and resources. For this purpose he approached COSTFORD and Er. Shantilal have done the design job for it. The design of this house typically follows the basic elements of traditional Kerala architecture, like sloping tiled roof, gabled window, laterite masonry etc. This house is not completely made out of earth but the red earth has been used for interior plastering rather than the common cement plaster. Masonry has been done with laterite stone which is easily and abundantly available in the nearby area. The external wall is kept unplastered to retain the natural texture but provided with pointing. The outer boundaries of doors and windows are provided with a cement plastered strip and painted in light colour to create a contrast on the wall.



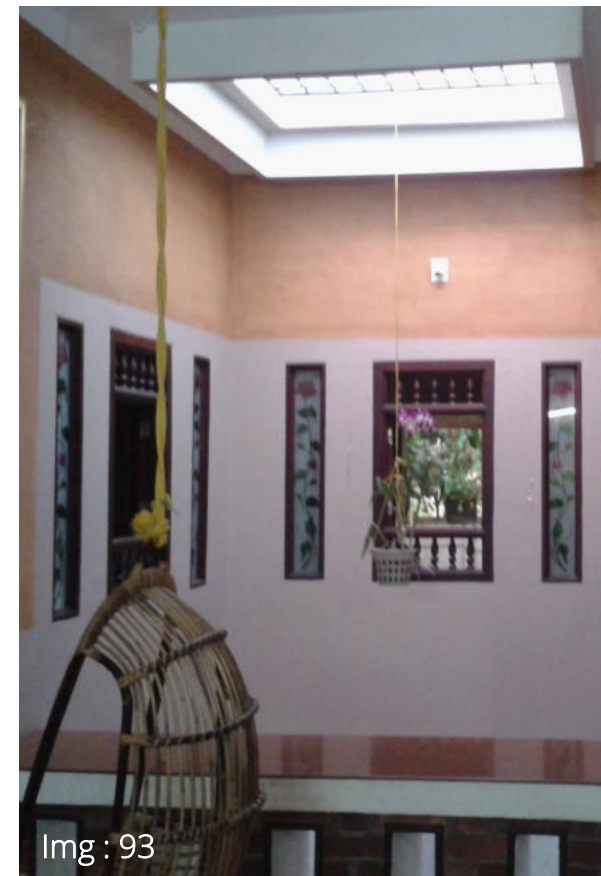
Img : 91

In front veranda there are 6 pillars made out of laterite and given a stone kind of texture for plastering. This stone looking pillars and the non-plastered masonry gives more natural appearance to the exterior.

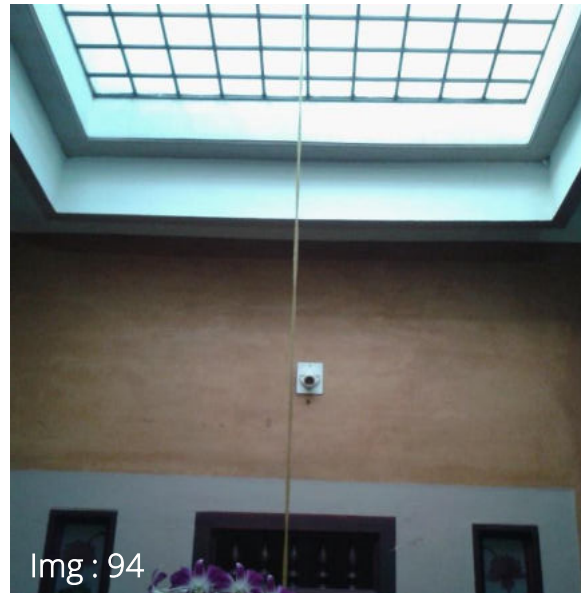


Img : 92

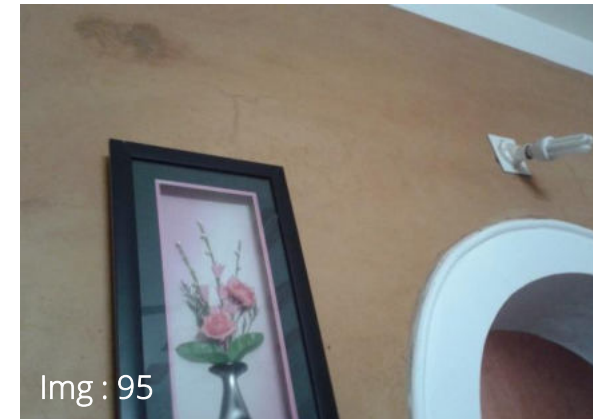
On the veranda few openings are provided on the roof which is covered it with glass, gives more natural lighting all the time.



Img : 93



When we enter in to the house, near to the main hall and opposite to the front door, there is a central courtyard, which is one of the typical elements of Kerala " Nalukettu " architecture. The courtyard is covered with steel grill which enables natural ventilation and lighting inside the house. In contrast with the exterior, interior is completely plastered with mud mortar. The natural texture and colour of the mud is retained.

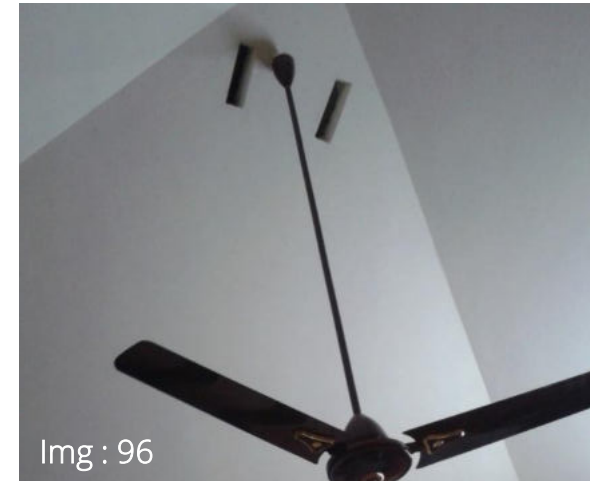


Only the edges of openings are painted white, which gives more contrast to the walls. The natural texture, colour and cracks of mud plaster gives more natural feeling than the common cement plastered and painted walls.

The process of making mud plaster begins with sieving the red earth in to required fineness. The sieved red earth is mix in dry state with lime in proportion of 1 part of lime and 8 part of red earth. To this mix 1 part of sand, 1 part of husk and 1 cup of Chebulic myrobalan (Kadukka in Malayalam) soaked water is added and mix thoroughly. This mix will

keep for two weeks in heaps to become mud plaster or mud mortar. Within this two weeks chemical reactions will happen and the mix will attain its plaster properties. After two weeks some stabilizers and termite resisters will be added to the premixed mud mortar. 1 cup of Jaggery soaked water and Aloe vera soaked water are added as stabilizers, similarly cow urine is added as a termite resister. All these ingredients are mixed properly and used as the final mud plaster. Usually two coats of mud plaster is applying on the masonry wall. Sometimes few cracks will be formed, in that situation one more coat of plaster will be applied to get the final finished surface. Usually the mud plastered walls will be look light brown in colour but there can be slight variations in colour according to the type of read earth used.

On the sloped, roof openings are provided through the gabled window always ensures natural ventilation inside the building. The following figure shows this kind of ventilation.



The nicely plastered and finished filler slab makes a nice pattern on the ceiling. Filler slab construction helped to reduce the use of concrete and steel could be reduced to a certain extent. By retaining the natural colour and texture of mud plaster, a huge amount painting could be avoided, which helped to save a lot money in this regard. Even the exterior walls are not plastered or painted, only pointing has been done, which eliminated the need for exterior painting. Only the toilets and kitchen walls are

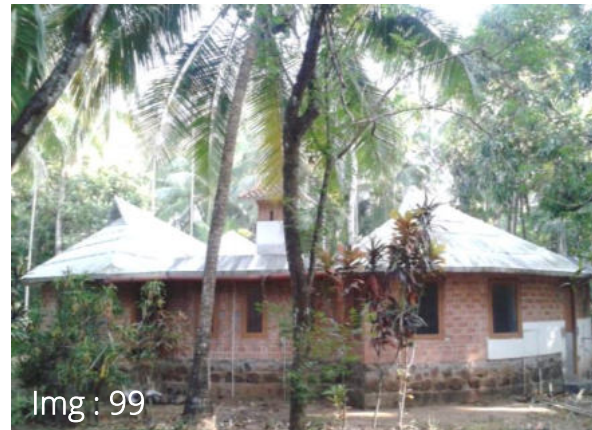
plastered and painted, as it is more subjected to water, heat and smoke. The flooring is done with vitrified tiles, which can be considered as a non frugal approach.



Considering all these factors, this house is a wonderful example of a cost and energy efficient building, which constructed according to the frugal architecture principles. The various features of Laurie Baker method like Non plastered walls, filler slabs, use of locally and naturally available materials, provision of natural light and ventilation, use of local traditional architecture are maintained in the entire building. This can be considered as a new generation interpretation of Laurie baker architecture.

Building 9

Type of use: Residential building
Designer: Laurie Baker



This particular residence is owned by Mr. Mr. T.R. Chandradutt, the director of COSTFORD and is a typical example of frugal architecture, designed by Laurie Baker. It is a single storied building with a circular plan. This house is a wonderful example of Baker's brilliance in architecture. The basic principles of frugality are nicely accommodated on exterior as well as interior of this house.





Img : 102

A small sit out welcomes us in to the house, which opens into the main hall. The sit out is having an inbuilt seating facility which eliminated the need for a wooden or steel furniture. The floor is finished with red and black oxide, which is one of the cheapest materials available for floor finish. The basement and superstructure masonry is of exposed type, which is finished by pointing the brick joints. Exposed masonry work helps to eliminate plastering and thus saves a considerable amount of cement, sand, and man power needed for it.



Img : 103



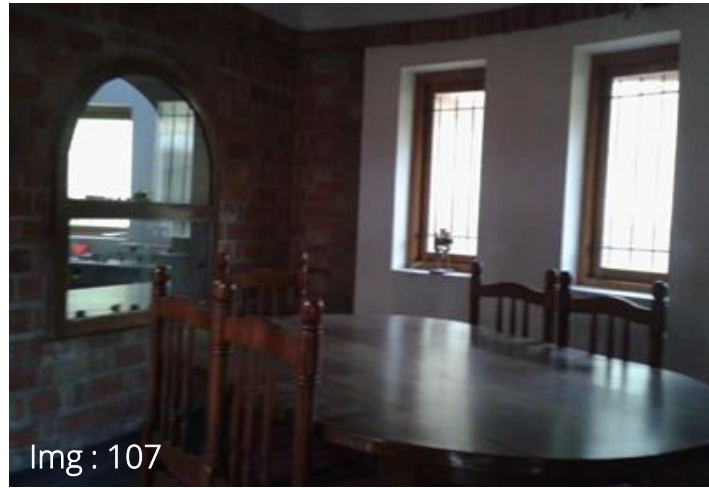
Img : 104



In the interior, rooms are arranged around a central circular courtyard, which helps to provide enough natural light and ventilation for the interior. The rooms are separated from the courtyard by a circular corridor.



The safety and privacy of the corridor is maintained by providing a brick wall with in built jali. The jali work completely eliminates the need for windows and ensures continuous natural light and ventilation inside the house.



The images in the previous page shows more features of interior. Rooms including dining, and bed rooms are provided with exposed masonry work and filler slabs. As mentioned earlier this method helps to reduce the plastering and painting work considerably, and creating nice texture and patterns on the walls and ceiling. Plastering and painting is only provided in kitchen and toilets. The gabled window openings on the sloped roof ensures natural light and ventilation, thus helps to eliminate the need for other electric ventilation devices. Enough natural ventilation helps to remove heat, humidity, air born pollutants from inside and keeps the interior safe and comfortable.

Circular plan helped to reduce the perimeter of the building. As a result the number of bricks and rubble required could be reduced compared to a building with same area but having different layout. Ultimately the cement, sand required for masonry work, removal of earth for foundation and man



power have been reduced. Circular layout helped to get a better view of each part of the house from any point of the interior yet maintaining the privacy. Shade from the jalli wok creates nice patterns on the inner walls and corridor.

7. Conclusion

Considering the current economic and energy crisis, Laurie Baker method of building construction have lot of relevance in present Indian society. The concept of optimum use of resource, reuse, recycling, eco friendliness and incorporation of technology will help to build up a sustainable living in the future. Ultimately this will help to retain the natural resources for the future generation.

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