

Study and Analysis of Architectural Works of Ar. Vinu Daniel

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Abstract. An architect from Kerala is turning heads with his stunning innovation in his timeless designs and contemporary vernacular designs. Vinu Daniel creates his structures primarily using various systems of mud, waste, and environmentally friendly building materials like bamboo and terracotta. He spent a lot of time at the Auroville Earth Institute, where he worked with mud to find inspiration. adding additional waste materials to the mud, such as furniture made from recycled tree branches or jalis made from washing machine parts, to the structure. The crucial aspect of his designs is that he conceptualises the project using the site's natural features and primarily works there with his team. He has made ground-breaking advancements in the traditional methods of building and conceptualising the stereotypical mud houses.

Keywords-*Sustainable and cost-effective architecture, Mud and Waste(scrap)Materials, Vernacular architecture in contemporary style*

INTRODUCTION

Our earliest settlements were all constructed out of natural resources. However, despite the fact that earth is a more sustainable and long-lasting material, less than 30% of people worldwide now reside in buildings made of it. This sad fact can only be attributed to the rise of industrialization and the widespread demand for "cement" homes. At Wall Makers, we have committed ourselves to the cause of using waste and mud as the primary materials to create structures that are both functional and beautiful. The application of mud and material waste will be the main focus of this study because doing so will cut down on the need for other construction materials and be more economical. Understanding the synergy between conventional methods and environmentally friendly materials is important because the value of conventional methods will endure into the future, and using environmentally friendly materials allows us to conserve energy, money, and harmful substances. He followed the climatic aspects, site characteristics, and site environmental conditions in order to comprehend the design aspects of his projects.

VINU DANIEL BIOGRAPHY

Vinu Daniel was born in Dubai in 1982, and he was raised in Abu Dhabi by two older siblings in a traditional Indian family. In the UAE, his father ran a company that sold office supplies. Daniel spent two years at the auroville earth institute, near Pondicherry, learning about the engineering principles behind building with soil, cement, and mud blocks before returning to his ancestral home to attend architecture school at the college of engineering in Trivandrum. He began his business in 2007 by passing along the traditional building methods he had learned in Auroville to his craftsmen. His methods combine both contemporary and conventional techniques. He currently employs between 100 and 150 people, primarily artisans. Nearly 20 projects are being designed and built by him right now throughout India, each of which is being overseen by one of his architects who is stationed there. Vinu Daniel graduated with a B.Arch. in 2005 from the Trivandrum College of Engineering. He then worked for the Auroville Earth Institute on



post-tsunami construction projects for the UNDP (United Nations Development Program). When he returned from Pondicherry in 2007, he founded "wall makers," which was given that name by others because the company's first project consisted solely of a compound wall. He had many eye-openers during the course of his practise, which led him to decide to focus all of his efforts on the cause of environmentally friendly and economically sensible architecture. Wall Makers strives to strike a balance between innovative, practical designs and the creation of context-specific dreamlike spaces in order to construct sustainable spaces that are responsive to specific site contexts and conditions.

LITERATURE CASESTUDIES

IHA RESIDENCE

The main challenge we faced was the site's low-lying terrain, which had issues with water logging. The main goal was to make sure that the structure wasn't obstructing the flow of water. We had to make sure that the water could percolate into the ground and be harvested because Kerala is a state with frequent rains. We had to come up with a different, more environmentally friendly solution that could also improve the site's spatial quality. We decided to build a pond at the site's lowest point to help retain water while also enhancing the home's authentic feel.

MATERIALS USED IN CONSTRUCTION

One drawback of using bamboo for the façade is that it is unstable and cannot support an entire structure of such a large size. This barrier was taken down and shown to be false thanks to this project. The bamboo is strengthened with steel rods in order to create and maintain the bamboo façade in a stable position. You are given access to the front elevation of the house, which is supported by the staircase that hangs from it and also provides a semi-open space for your quiet thoughts, thanks to the continuous string of bamboos. A rotating jali work was made using the distinctive shape of CSEB bricks (compressed stabilised earth blocks) to give the bedrooms privacy. In addition to the wonder that the light produces, the consecutive polar arrangement permits uninterrupted airflow, allowing for adequate ventilation. An essential component of the home is the use of the washing machine base plate as scrap grills rather than new ones from the factory. By using these grills instead of new ones, you can promote the idea of upcycling and give workers who sweat to make beautiful works of art a way to get paid. By incorporating something we frequently see in junkyards, we have attempted to make small changes to the routine of waste. The use of washer motor base plates that have been welded together promotes reuse and sustainable living while also enhancing the aesthetic appeal of the home. Utilizing. The interior of the house is very plain and minimalist, which distinguishes it from typical homes. The furniture for the home was created by the architects using waste wood from sawmills and uprooted trees. In terms of the landscape, design, and materials, the structure has a strong connection to nature. The home embraces and maintains a close relationship with the tranquil surroundings outside as well as the friendly atmosphere inside its four walls.

SHIKARA RESIDENCE



The site was situated at the highest point in that particular area of the woods, against one of Trivandrum's quiet hilltops. The client was a travel enthusiast who frequently planned trips across the nation to far-off places. He had always been most fascinated by and drawn to the Himalayas, so it was fortunate that his home would be equally secluded, perched on the picturesque hilltop. However, because it faces west, one would need to raise a hand to protect their eyes from the glaring sun. The idea of designing the house as shikhara was born when that "hand" was reimagined as a slanting wall along the site (peak). This was a prerogative of Wall Makers since we only engage in sustainable building practices. The wall was to be brutal but a shelter from the intense heat and direct sunlight. However, the soil that was obtained by digging up the basement floor and the rainwater collection tank disguised an opportunity as a problem. The soil in the rocky terrain was full of pebbles and debris, making it unsuitable for making mud bricks. Consequently, the patented Shuttered Debris Wall method was applied in this case. As a result, a view to withhold and a slanting waste material wall were created. Lack of cross ventilation presented a new issue because the majority of the building's length ran along the West side as a solid wall with minimal openings. The solution emerged from market rummaging in the form of perforated aluminium coin sheets, which allowed light and air to pass through. It was given a rhythmic undulating pattern so that this facade served as both the staircase and a solution to the security issues. The overall feeling of living in this house is comparable to being in the mountains: it's full of nature but also strong and warm.

MATERIALS USED IN CONSTRUCTION

Shuttered Debris Wall -In order to create a sturdy wall, this technique for building walls involves skillfully combining cement, soil, and waste materials of different sizes (coarse aggregate), ranging from 10mm to 70mm (5.2MpA compressive strength).

Waste wood -In order to create furniture such as beds, kitchen cabinets, doors, etc., cut wooden scrap pieces have been joined.

Aluminium coin sheet -We can see the outside more clearly thanks to the semi-transparent screen created by the perforated aluminium sheets.

Cement Board -Cement fibre board with polish is used to create the interior bridge and the stair treads.

Oxide - Grey and white oxides have been used to finish the floor and some walls.



BIJU MATHEW RESIDENCE

The location of Mr. Biju Mathew's home was on a slope with the remains of a long-gone structure. The building is set up on multiple levels to make the most of the available space and to best accommodate the family and the client's desires.

An architectural project called Debris House - Residence for Mr. Biju Mathew was created by Wall makers in Kerala, India. This home was built with great care using recycled and environmentally friendly materials, making sure to get around any material limitations and let the architecture speak for itself.

AESTHETICS AND ARCHITECTURE

Dealing with small urban and suburban homes has a lot of potential for clients who come to architects with tight budgets and complex programmes. This home was built with great care using recycled and environmentally friendly materials, making sure to get around any material limitations and let the architecture speak for itself. Over a foundation that was found, the debris wall was erected using recycled materials. The architect can reduce concrete in the same by using the coconut shell filler slab. Although the house makes extensive use of alternative technologies, its design has a certain air of whimsy and playfulness. The windows were made from scrap, but with some careful detailing, and the small court ensures ventilation.

PROJECT TECHNOLOGY, STRUCTURE, MATERIALS USED

The building materials were thoughtfully chosen, taking into account regional variations and financial constraints. The walls rose from the ground that was excavated on the site, and the debris from the previous structure was transformed into a curvilinear wall that forms the central courtyard and serves as the house's focal point. This wall is known as the Debris Wall and marks the introduction of new technology. The furniture is made from recycled wood and was originally created as boxes to hold a lot of books for the client, a teacher. The concrete roof's filler of coconut shells gives the building a modern feel. Ferrocement shell roofs are used on the home's back half.

Debris wall - To create the set of walls defining the entrance, lump-sized debris mixed with 10% gravel, 5% cement, and 5% manufactured sand with water was lightly compacted in 2cm layers using mesh (22-gauge chicken mesh) casing reinforced with 6mm bars at 2 feet intervals vertically and horizontally.

Ferrocement shells - Precast concrete shells are manually lifted and positioned to form the roof. These wafer-like structures are arched shells with steel reinforcement and an effective thickness of 1.5 cm. They support the same weight as the corresponding R.C.C slabs. They successfully cut the total consumption of steel and cement by 30% and 40%, respectively.

Rammed earth - The remaining walls of the structure are constructed using rammed earth directly from raw earth with a stabilising cement content of 5%. The method is not only very efficient but also very robust, with a dry crushing compressive strength of 6 to 8 MPa.



PIROUTTE HOUSE

Pirouette House pays tribute to Laurie Baker's outstanding work by using "Last of the Mohican's" fired bricks. with spaces that are exquisitely created by the strict geometry and wall patterns that appear to be alive and dancing around. utilising sinusoidal walls to solve the fundamental issues with a typical rectangular grid home while retaining the existing trees on the property. Even though this project is located in a neighbourhood where there are houses on all four sides, light has been added throughout the majority of the house. The moving walls celebrated the congregation spaces with light, greenery, air, and interesting furniture while forming interesting nooks for some peace. From beginning to end, I had designed and implemented various aspects of this project under the direction of Ar. Vin Daniel, Wall Makers. By creating adequate living spaces with skylight niches and saving the trees by constructing the courtyard around them, the wave-like deviations room the straight lines solved the problem. The location was a small plot in the middle of an urban and crowded Trivandrum neighbourhood that was suffocated by other residential developments on all four sides. This house was designed to be inward-looking, with every room opening into a central courtyard that acts as a funnel. The house faces east and west. It seemed appropriate to change one of his introductions because Trivandrum is surrounded by islands that serve as a testament to many of Ar. Laurie Baker's masterpieces and have openings to allow for optimal cross-ventilation. In this location, the rat trap bond masonry technique was used, which prevented the creation of mud blocks or the excavation of the soil. This was also an effort to promote this regional agriculture-based industry that is on the verge of extinction, keeping in mind that brick kilns in Trivandrum are a dying industry as people choose wire-cut machine-made bricks instead. The central staircase and grill-work were quickly constructed using leftover scaffolding pipes from the construction phase.

Fired bricks for Rat Trap bond masonry – Rat trap bond is a brick masonry technique for building walls that Laurie Baker first used in Kerala. It involves placing bricks vertically rather than traditionally horizontally to create a cavity (hollow space) within the wall that improves thermal efficiency and uses fewer bricks overall.

Waste wood – A portion of the flooring has been panelled with cut wooden scraps joined together.

MMT Ferrocement shells - These wafer-like structures are actually arched shells with steel reinforcement and an effective thickness of 2.5 cm. They support the same weight as the corresponding R.C.C slabs. They successfully cut the total consumption of steel and cement by 30% and 40%, respectively. These take the place of R.C.C. Slabs in roofing because of their 1200 kg/m² strength.

Discarded Scaffolding pipes for Staircase and Grillwork – This house's staircase and grillwork are constructed entirely from leftover scaffolding pipes that have been welded into place.

Oxide – Grey and yellow oxides have been used to finish the floor and some walls.

Cane – To serve as a partial privacy screen, cane has been treated and woven together in between the grillwork.



CHIRATH RESIDENCE

The site is surrounded by thick vegetation and rubber plantations in the interior of the village of Pravithanam. The closest town, Pala, is located in Kerala's south-central district of Kottayam. The land belongs to Mr. Ramanujan Namboothiri's family and is surrounded by lands and a house that belong to his brother. The site is situated in Kerala's pravithanam village, which has pristine surroundings. The client wanted to construct a retreat or retirement home on land that was family property. a 1500–2000 square foot home with two to three bedrooms. A writer and environmentalist, the client requested a sustainable mud house with a rainwater collection tank.

The journey started with investigating the potential and getting past the restrictions of a conventional Keralan sloping roof house. One of the main drawbacks was the lack of light inside the house; even during the day, one had to sit in the veranda to access the sun. A sloping roof has the additional drawback of providing very few opportunities to collect rainwater. A doubly curved ferro-cement shell roof was our solution, and it ultimately shaped the entire project.

Mr. Ramanujan Basha named his home in Pala, Kerala, "Chirath," which is Malayalam for a traditional lamp. The rainwater harvesting tank, which is an addition to the pond, serves as a collection pit for the flow of stormwater from the sloping roofs. This stored water, which has a 35 cms capacity, is recycled for all domestic uses. The interior and exterior are intertwined by a pond with a fixed glass window directly behind it. The pond creates the impression that nature has been brought inside, while the window ensures a visual connection to the outside.

Shuttered debris wall – a method with a patent. In order to create a sturdy wall (5.2MpA compressive strength), this method for building walls involves skillfully combining cement, soil, and waste materials of different sizes (coarse aggregate), ranging from 10mm to 70mm.

Terracotta tile jali – Old tiles that are readily available locally are combined with M.S. rods to form successive sets that are stacked one on top of the other with ventilation gaps in between. Additionally, at night, this creates a rather appealing visual perspective effect.

Waste wood - Waste wood from sawmills has been cut into long pieces, joined together to create furniture like kitchen cabinets and chairs, etc.

Why ferrocement shells?

These are excellent because they use 4% less steel and 30% less concrete than an RCC slab. Light can also flow inside the structure thanks to the way the shells are woven together.

Ferrocement shell roof – These wafer-like structures are arched shells with steel reinforcement and an effective thickness of 1.5 cm. They support the same weight as the corresponding R.C.C slabs. They successfully cut the total consumption of steel and cement by 30% and 40%, respectively. These take the place of R.C.C. Slabs in roofing because of their 1200 kg/m² strength.

Scrap for window grills – Utilizing scrap steel rods and MS plates for window grills and ventilators is a beautiful use of materials.

Ferrocement walls and slabs – Ferrocement is used for the seating in the living area, kitchen slab, and restroom partition walls.

Oxide – Grey and white oxides have been used to finish the floor and some walls.

Special features: Pond – The pond in the living area promotes passive cooling and evapo-transpiration. An addition to the pond, the rainwater harvesting tank functions as a catchment area for the flow of stormwater from the sloped roofs. This 35m³ reservoir of stored water is recycled for all domestic uses. A modern ferrocement shell roof allows pockets of light to enter the structure, changing the atmosphere every hour.



COMPARITIVE STUDY

PROJECTS	IHA RESIDENCE	SHIKARA	BIJU MATHEW	PIROUTTE	CHIRATH
LOCATION	Thiruvananthapuram	Pothencode	Pathanamthitta	Thiruvanthapuram	Pravithanam
BUILTUP AREA	288sq.m	177sq.m	194sq.m	196sq.m	168sq.m
COMPLETION YEAR	2018	2019	2015	2020	2018
SITE CONDITION	Low-lying terrain with issues of water-logging	Hill top of Trivandrum, West facing site	Slope with a remnant of demolished building	Conventional grid house	Land being the ancestral property and the surrounded by rubber plantations and dense vegetation.
SUSTAINABILITY MATERIALS WITH TECHNIQUES	Bamboos bricks, scrap materials, washing machine base plate, ferrocement shell roof	Shuttered debris wall, waste wood, aluminium coin sheet, cement board, oxide	Debris wall, rammed earth wall, shell roof with coconut filler slab, scrap materials like meter box, etc..	Fired bricks for rat trap bond masonry, waste wood, ferrocement shells, discarded scaffolding pipes for staircase and grillwork, Oxide, cane	Shuttered debris wall, terracotta tile jail, waste wood, ferrocement shell roof, scrap for window grills, ferrocement walls and slabs, oxide
STRUCTURE	Framed	Framed	Framed	Framed	Framed

ANALYSIS AND FINDINGS

I learned about Vinu Daniel's design elements and various sustainable building materials and techniques throughout the research process, including bamboo bricks, ferro cement, shell roofs, debris walls, ramped earth, etc. I now know how to use leftover materials in designs. Mud and trash are the main ingredients in Vinu Daniels' creations. I won't let what I've learned go to waste; I'll apply it to my design.

REFERENCE

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