Illustration by Haashim Aslam Maricar | 8th sem

10. Bamboo's Role in Eco-Friendly Architecture.

Conversation with **Ar.Udit Mittal,** Founder of QX Designs.

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Intent :
In this conversation, Architect Udit Mittal emphasizes his commitment to environmentally friendly architecture, focusing on bamboo as a sustainable alternative to traditional building materials. He advocates for a shift in the construction sector towards ecologically friendly practices and a comprehensive approach to material selection. Team Kalpa had the esteemed opportunity to engage in an insightful interview with Udit Mittal, to facilitate a thorough and meaningful discussion. Aligned with Kalpa's commitment to sustainability, the discussion explores Mittal's forward-thinking insights significantly contributing to a transformative narrative in architecture.

What led you to specialise in bamboo architecture, and what inspired you to work with this material, considering that no one thinks of bamboo as a material that can be used primarily in architecture and is normally thought of as a supporting element?

We are all ingrained with this conventional view of the construction industry. At some point during our education, we learned about global warming and realised that the construction industry contributes to more than 50% of it. So, naturally, we start thinking about other ways of construction, right? In fact, sometimes it's not a very conscious decision; it's just a desire to do things differently. When you start thinking about the options available to you in terms of materials, you begin to explore structural options as well. It's not about disliking concrete, but once you understand the consequences and implications that come with the cement industry, you start to think differently. Even though concrete is one of the largest contributors to Global Warming, there is also a great respect for concrete. There are things that RCC, PCC, or a certain mix of concrete can do that very few materials can compete with in that regard. And, of course, there is a history of construction using bamboo. However, it was mostly used as a temporary material. But, at least, you are drawn towards the understanding of what it is.It wouldn't be surprising to see any young architect explore these alternatives. I personally do not want to be labelled as someone focused on alternative construction methods. It's more about being sensitive and understanding what makes sense. What does it mean to use natural materials - those with low carbon emissions and low embodied energy? I remember in 2015 when I graduated, I applied for an internship in Nagaland under Richard Belho (which I couldn't get). I got a chance to create an installation for an art festival in 2017, and attend a workshop under Ravi Mukhopadhyay in Calcutta . They had a building centre with many engineers and technologists who had conducted extensive research over the last 25-30 years on the mechanical properties and understanding of bamboo as a material. So, many of my misconceptions about bamboo were clarified. It has amazing strength and incredible structural versatility, and there are ways to treat it. So, starting from that workshop, all the apprehensions that people have in general about bamboo started to fade away. I learned what it actually is, where the concerns lie, and how they are perceived. That's how I realised that it is an excellent material for becoming a carbon sink. When you look at bamboo at a holistic level, you never realise how much you can get into - the social impact, for instance. It's not limited to architecture; we start appreciating it right from the plantation, from farming, and how it can create a positive impact. To sum it up in two facts: If you talk about the material for its green value, bamboo is a plant (of course, there are multiple species), but in general, it's a kind of plant that can absorb 35% more carbon compared to any other plant. While other plants might take 25-30 years for such absorption, bamboo accomplishes it in just 4-5 years. Secondly, a few species have a higher tensile strength compared to metal. You see many values, and you become committed to exploring and applying them to see how you can address the drawbacks. We don't only work with bamboo; we don't want that as a label. Everything has its own relevance and is relative to the context. We have great respect for concrete, and we use it judiciously. All other materials are used contextually.

As you mentioned, bamboo is almost like a natural alternative to metal, so are there some unique properties which bamboo has as a construction material that can compare to any conventional materials that we use, such as steel, concrete, etc.?

In terms of comparing bamboo to conventional materials, if you look at bamboo, there are many species that have higher compressive strength compared to concrete. Let's say you have a pole of PCC and a similar pole of bamboo; the bamboo pole would have higher compressive strength, considering only a select species of bamboo. When it comes to tensile strength, a few species have higher tensile strength compared to steel. When we talk about bamboo in the construction industry, there are specific species that we focus on, like bambusa, asper and guadua which is one of the best species for construction. To understand this material in-depth, bamboo is made of fibres that run continuously from the root to the tip of the culm at the other end, giving it its strength, especially tensile strength. Understanding the properties of different species involves looking at the internodal distance, wall thickness, density, and diameters.

Bamboo does not only compare to architectural materials like concrete and steel but also plastics. We even see it being used for cups and mugs as alternatives to bakelite. But why haven't we seen this becoming mainstream? What do you think are the challenges that we are encountering while working with bamboo, and how would you try to overcome them?

From my understanding and exposure, there are many other factors connected to understanding this that go beyond architecture. It's about industrialization, market economics, and the significant role played by consumers and their purchasing choices. It also involves understanding where the craft of bamboo begins and ends and what it's precisely competing with. If we were to compare the use of plastic mugs and cups to bamboo, we need to consider the production of these materials. Plastic products are mass-produced thanks to industrialization, while bamboo hasn't seen much, that sort of a standardised method of reproducing products of the same quality in a mechanised way. So, we're comparing more than just the possibilities and properties of the material; we're comparing handcrafts to industrialised products, including factors like durability and cultural lifestyle.

The first big challenge arises because you can go to a market and purchase a steel section of a particular specification from a specific source, and you're very sure about getting exactly what you asked for. However, that's not the case with bamboo, which becomes the single most significant reason why it's not easy to start working with this material. For us, it was crucial to understand our sources and how we can treat bamboo to increase its longevity. Knowing the right species and the right source is a 50% game-changer; the rest lies in how we use it on-site. It depends on the approaches of the marketing cooperative. We allow for some intuitive changes, a different process of reading our buildings compared to standard drawings. There is room left for improvisation on-site based on the behaviour of the material. This process makes us feel more connected to the construction activity.

When we look at your projects, what really impacted the team was the disaster-resilient community shelter in the Sundarbans that you designed. Firstly, could you give us a brief overview of the process of designing the shelter?

Certainly. First, it's crucial to understand the unique geographical context and the issues faced by the Sundarbans. The main issues were annual flooding, which was increasing in severity and frequency. For over a century, people had been building their homes on the ground. So they need to elevate their houses, essentially building on stilts. When we talk about disaster resilience in architecture, we're looking for an affordable solution that provides shelter above the flood level, with a strong roof that can withstand strong winds. The solution not only had to be affordable but also adoptable, so that people could easily use it, learning new techniques. This complexity makes it a challenging design problem. So, the outcome involved a two-stage intervention in this village for disaster resilience. The second stage was the guest house, while the first phase involved smaller huts. In this phase, collaboration with the local community was crucial. We needed to respect their feedback and determine what would work and what wouldn't. Our design process was a collaborative effort, not just my own work. We collaborated with a team led by a non-profit organisation called Blue Planet, headed by Sangeetha Kapoor. She connected with various technologists and engineers in the country and gathered their input. We formed a team in Calcutta, including a highly seasoned architect and engineer Laurent Fournier familiar with the Sundarbans, having worked there for a long time. The third member was myself. Together, we developed three technologies and three different prototypes and solutions. Our goal was to provide the

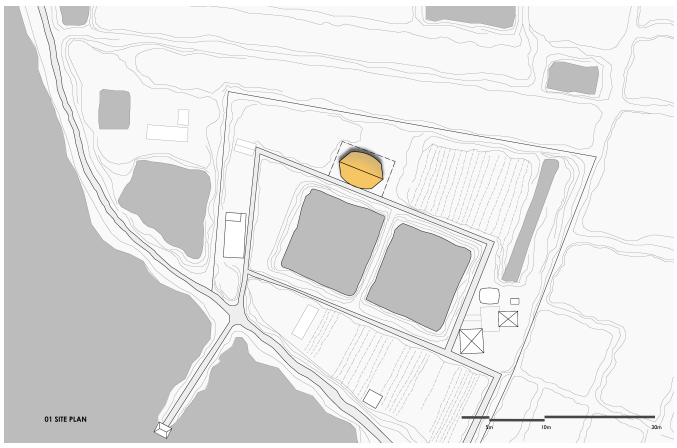

Fig 1. Site plan of Mukti Guest house,Sunderbans (Source : QX Designs)

Fig 2. Concept behind Mukti Guest house,Sunderbans intended to be a cyclone resilient shelter (Source : QX Designs)

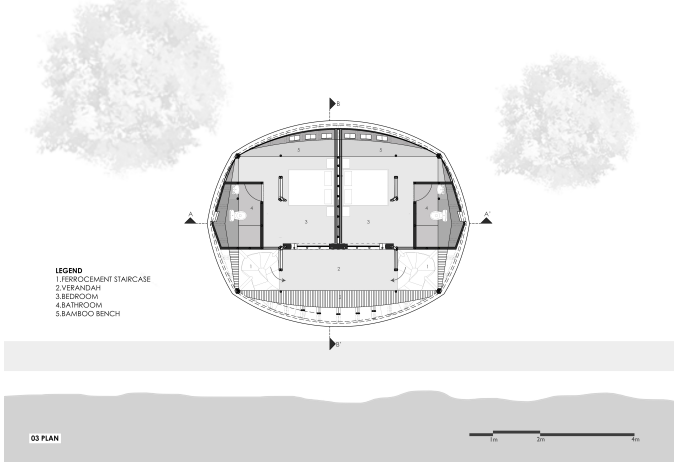

Fig 3. Plan of Mukti Guest house,Sunderbans (Source : QX Designs)

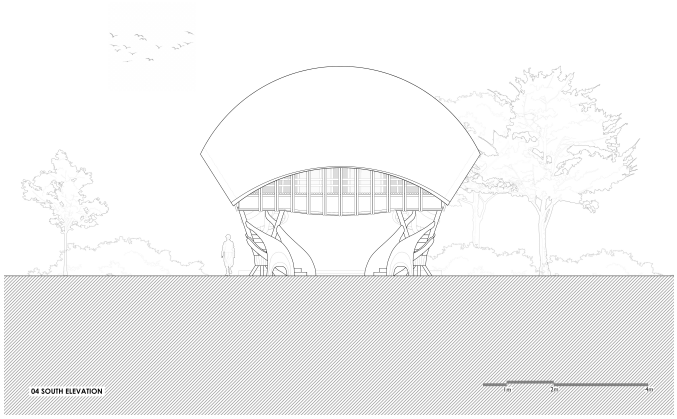

Fig 4. South elevation of Mukti Guest house,Sunderbans (Source : QX Designs)

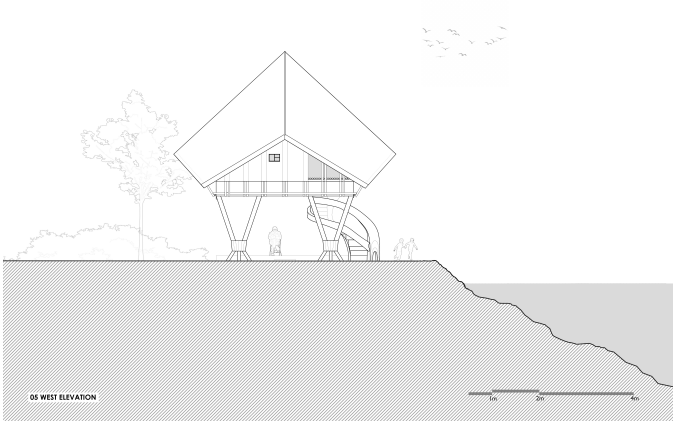

Fig 5. West elevation of Mukti Guest house,Sunderbans (Source : QX Designs)

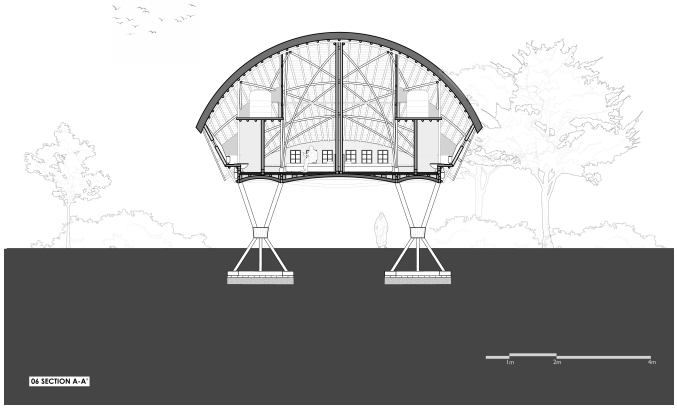

Fig 6. Section AA of Mukti Guest house,Sunderbans (Source : QX Designs)

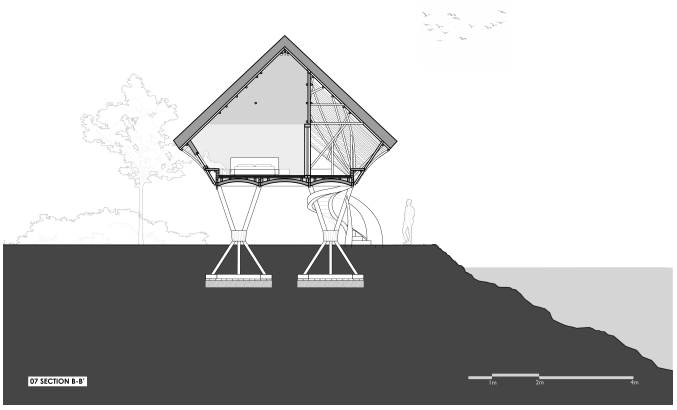

Fig 7. Section BB of Mukti Guest house,Sunderbans (Source : QX Designs)

villages with different options, covering everything from the foundation and stilts to the plinth, flooring, finishes, upper floors, slabs, and the roof. We maintained the same spatial configuration - a room above and a room below, a small balcony in the front and rear - while applying three different construction techniques. In the first phase, some construction techniques became popular, such as ferrocement for the floor slab and shallow domes. We introduced bamboo as a roofing material in this phase, with a conscious effort to abandon the use of mangrove wood. The third option featured thatch roofing. The second phase was easier since we had tried and tested techniques from the first phase on a smaller scale. The guest house used shallow domes in a playful manner, eliminating two shallow domes to create a staircase space. We also modified the stilt system, using in situ columns with different foundations, creating a pyramidal design. The guest house's design was intended to blend space and structure seamlessly, making it challenging to discern which came first.

Looping back to the idea of material itself: The project is very grounded in the context of Sunderbans, so in that purview, how do you think the project's location and climatic nuances of the location helped you select the material?

There is already a certain palette that we introduced, a few material technologies, which we wanted to use a comparatively layered feel now with the guest house. So right from the foundation, we use things that we've

Fig 8. Interior views of Mukti Guest house,Sunderbans (Source : QX Designs)

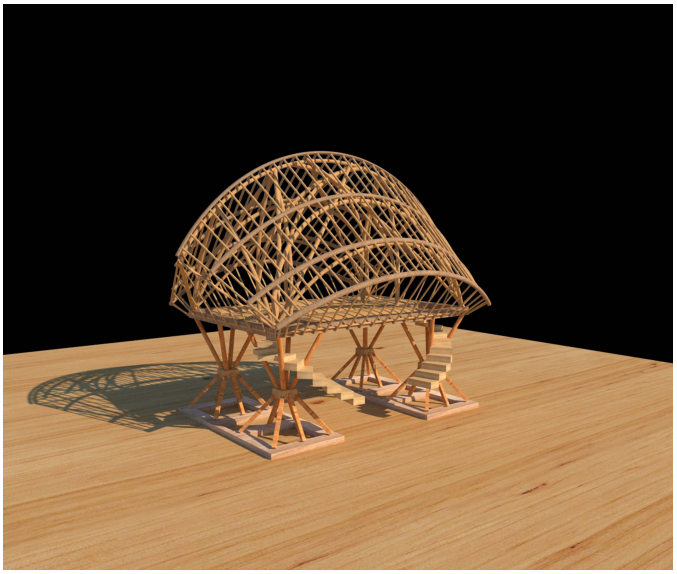

Fig 9. Model of Mukti Guest house,Sunderbans (Source : QX Designs)

already worked with. After the base, the foundation is like a pyramid. Four pyramids were made by prefab RCC posts, which is already done in villages, where you have 4x4 or 5x5-inch cross-sections that people purchase to make columns for the building. We changed the configuration of the steel required and even kept a hole in the column to place a tender right from the base of the foundation till the upper beam, which was for earthquake considerations. We deliberately decided not to build anything on the ground, although there had been earlier discussions with our clients of making a hall, or a storage, some place for caretakers. Raising the building allows for a visual flow and venturi effect. All these systems created the skeleton of our structure. To create spaces in this, we used wattle and daub walls with proper mud finishes, and something that came up in the process, bamboo with ferrocement, which are present on the walls of the gable side .

When we were looking at the design, there were many materials interfacing. You have ferrocement in the staircase and your foundations of concrete, shallow domes of bricks, bamboo on top. We were curious about the interface of these materials and how they work together. What are the considerations of these interfaces?

Some people perceive this combination of materials as a blend of high-tech and low-tech. Typically, when we see the use of RCC or concrete, we label it as somewhat high-tech, giving a sense of solidity. However, as an architect, I didn't see it that way. I was aware that we had a raised base on stilts with a bamboo thatch, which is often seen as less solid or 'pakka,' in common terms. Additionally, the flooring was seamless. Even in our previous cottage projects, we utilised bamboo for the roofs and had different stilt systems. In one case, it was simply a load-bearing wall with ferrocement shell, while in another, we used prefabricated posts for stilts and shallow domes, both covered by bamboo roofs. There was also an initial concept involving bamboo stilts, similar to a project we'd seen by Laurent Fournier done by the Seeds Organization. In that project, we observed the same shape and stilt system, but it was entirely constructed using bamboo. In our case, we understood the system where anchor points would connect with bamboo, with steel embedded into the bamboo. We were conscious of these connections, following the flow of forces from top to bottom. Laurent Fournier acted as a mentor, helped me grasp the entire structural concept, which was present from the project's inception. This concept was originally developed for a cyclone shelter by Fournier, featuring a stilt system and shallow dome. It was based on a "dochalla" roof style, which connected with the traditional Bengali roof, offering exceptional aerodynamics. We discussed how we could adapt this concept for the guest house. We aimed to create a similarly spacious interior, and we made improvements by tailoring it to our specific requirements and changes. This represents our design process—a comprehensive understanding of structural elements and how they interact. We viewed it as a composite structural system, always considering where the loads are being transferred. Our goal was to ensure they were directed to the corners, which held the weight.We incorporated partition walls and anchor points to create an internal column-based structural framework, all designed to support the positions of the columns. Initially, we established a 4-column system with 4 inverted pyramids, and we had to make sure that these 16 points supported the bamboo structure on top.

Interviewee's profile :

Ar. Udit Mittal

WHY, WHAT, HOW, and WOW are the four words that summarize the design process of QX Designs founded by Udit Mittal. They signify an inquiry into EMOTIONS, PROGRAM, and TECHNOLOGY in each project with an intent to PROVOKE. Based out of Kolkata and Bhubaneswar, Udit runs his practice along with his wife Kirti Jalan and a team of talented creatives from different parts of the country.

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