Chapter 05

DIRECTED RESEARCH

"Field Technology Demonstration of a Sustainable Bamboo bridge for Tribal Resilience with Community-Driven Approach for Bridging 14 Isolated Hamlets in the Terrain-Sensitive Katri Region of Nandurbar through Eco-sensitive approach and Indigenous Materials"

"We build too many walls and not enough bridges."
— Isaac Newton

This research provides an overview of Field Technology Demonstration of a Sustainable Bamboo bridge for Tribal Rural population located at Katri Gram panchayat project site Naldapada Hamlet, Dhadgaon taluka, Nandurbar District, Maharashtra.

The proposed project is a joint work by the PWD Department of Nandurbar District, and IIT Bombay. Katri is having a terrain Sensitivity having 14 padas with each other and also from Talukas, it is difficult to get even the basic requirements like PHC, Schools, Market Govt Offices etc., The project will also have discussing & interacting with tribal population & PWD department for citing their connectivity issues followed by site selection so that access population needs to satisfy their minimum needs.

Further, the study will attempt to document and study at Naldapada Hamlet in katri village, the possible long-term impact for the Bamboo Bridge and additional social influences.

5.1. Introduction

Bamboo has frequently been known in the 21st century as the “green steel” and has played important roles in historically traditional construction principles in many areas of Asia, Africa, and South America (van der Lugt et al., 2006). One of the most remarkable uses for bamboo is in the construction of bamboo bridges, which reflect the values of creativity and innovation, sustainability, and adaptability of local communities and cultures. This study goes deeper than generalizations about the eco-friendliness of bamboo; it shows the role of engineering, the importance of local culture, and its role in present-day infrastructure.

The northeastern states of Assam and Arunachal Pradesh have established a great historical tradition of constructing bamboo bridges. In this context, bamboo transcends being merely a fixture of construction. It becomes a cultural symbol in the everyday lives of local usage. The

making and upkeep of the bamboo bridges in these parts are community activities that habitually involve the participation of most community members, as well as knowledge passed down to them from generations of bamboo bridge builders before them.

Moving away from the northeastern context, this report outlines the recent efforts in Katri village, Maharashtra to build a bamboo bridge to suit specific needs. In contrast to Assam and Arunachal Pradesh, where there are traditions of bamboo bridge construction, the work in Katri village is an attempt to build an appropriate bridge design using local bamboo as the context is different environmentally and socially than that of the traditions of bamboo bridge building in northeast India and Katri is making a unique attempt to consider the conditions in central India. The need to build a bridge stemmed from the need to provide dependable access during the monsoon rains across an otherwise seasonal stream that isolates parts of the village.

The Katri bamboo bridge project featured a comprehensive assessment of the main bamboo species, load testing and hydrology. Community members, supported by technical advisors, were involved at all points, from initial assessment of materials and treatment, to design and construction. Maintaining durability was important during the construction process. Treatments were applied to the bamboo culms to protect it from decay and insects. The modular aspect of the bridge design allows for easy replacement of damaged bamboo pieces to make sure the bridge can be kept usable for as long as possible.

In many rural tribal communities throughout India, conventional infrastructure solutions are impractical due to geographical, ecological, and socio-economic factors for those groups who are to develop. During the monsoon season, isolation from floods on rivers limits access to basic services- Hospital, school, market, and Government. At this time, constructing community growth bamboo bridges provides an accessible, environmentally friendly, and culturally appropriate option. These bridges help to facilitate physical connectivity, build a sense of local ownership, and strengthen ties - bridging both literal and social divides (Dhangar, 2025).

Bamboo bridges are more than just structures—they connect people, improve daily life, and protect the environment. The experiences from Assam, Arunachal Pradesh, and Katri village show how local knowledge and teamwork can create safe, strong, and eco-friendly bridges. With ongoing care and community involvement, bamboo bridges can continue to bring positive change and hope to rural areas, making life easier and more connected for everyone.

5.2. Objectives

The aims of the study are: ·

To design and construct bamboo bridge which is affordable and moreover it improves the connectivity of the 14 hamlets of tribal village, saving distance and time for access to basic amenities such as School, PHC, PDS Centre
To empower sustainable indigenous practices and use of bamboo for the various purposes, such as Arch bamboo bridge as best practical example
To encourage the tribal village people to intensely take part in planning, construction and maintenance of project, thereby implementing a good sense of ownership by using modern tools and improving project efficiency and generating tribal professionals, thereby deploying skilled workers and encouraging self-employment opportunities.
To increase awareness for bamboo construction as climate friendly rural infrastructure model for sustainable development, by praising and supporting local nature and advocating social economic upliftment.

5.3 Study Area

The study is conducted in the hamlets of Katri village, specifically among the Bhill community residing in Patil pada, Makakund, Naldapada which are located approximately 12 kilometers from the main village habitation covering other 14 padas.

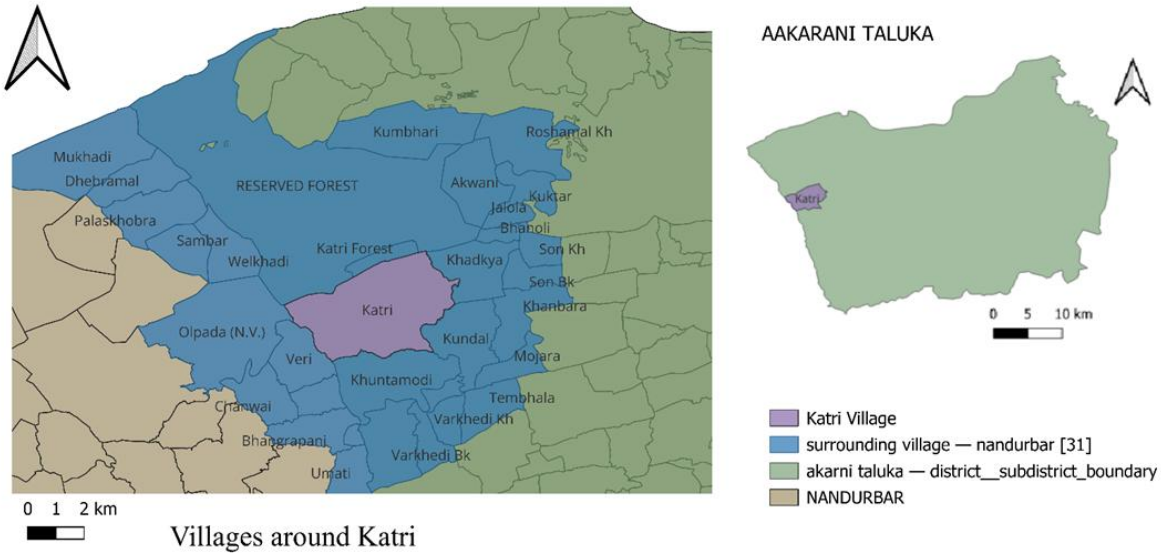

Figure 1 Village key Map of Katri, Source Author

The Houses in Naldapada Village, are significantly located far away from each other, and are mainly located in Terrain region.

Figure 2Site study Map, Source Author

5.4.Methodology

Detail Research Design for Naldapda, Katri Village, Nandurbar District, Maharashtra
This segment shows the methodology taken to understand the feasibility, structural requirement, and socio-economic assessment of building bamboo bridge in katri village, which is especially featured by heavy Monsson. There by understanding the loss of connectivity of 14 hamlets also, the present RCC bridge, at other village are often covered by floods in monsoon, losing and cutting of the access to other villages.
The methodology research includes various stages, thereby adding 9-week field stay in the village itself. This are inclusive of Architectural Design, PRA Activities, Bamboo distribution, field demonstration tests, considering view points of tribal villagers by making sure the eco-sensitiveness and as per design for structural stability balancing out with nature.

5.5Motivation For the Directive Research

The fundamental objective of this DR is to understand the tribal rural patterns of the 14 hamlets and mapping out their daily activities of the villagers along with their travel distance to PHC, Govt Offices, PDS and other activities, which would later help for calculating the foot falls ratio as well as vehicular connectivity to other padas and then creating the design parameters as per vehicles traffic to estimate the load and strength of bamboo bridge.
The solution driven scope extends by solving connectivity issues and to develop a Field Technology Demonstration model for tribal communities, especially development rooted in context specific to bamboo material and engineering To start with, we had an in-depth

knowledge for the terrain geographic region of village, their hydrology and intersection of flow of rivers system, along with GIS Maps and village flood history.
This research helped us to finalize the Naldapada as site for bamboo construction as the households surrounding the bridge are prone to seasonal floods, thereby giving best location for constructing of bamboo bridge.
To begin, we had an in-depth understanding of the physiographic regions, their hydrology, and river systems intersecting the areas, which, along with GIS Maps and village flood history, helped finalize Naldapada as a site Since river flow direction ends at Naldapada it would make the households more vulnerable to flood.
To increase better chances for construction and village wide support, we conducted a bamboo workshop with the motive of increasing the villagers understanding of bamboo as building material for the upcoming bridge.
As on-site pilot model of bamboo arch was built on scale to the required size. Also, the deflection test and 2-ton load test were performed to evaluate the structural stability and security check points.

Figure 3 Load Testing of Arches with sarpanch Sitting, Source Author

5.6.Data Collection Method

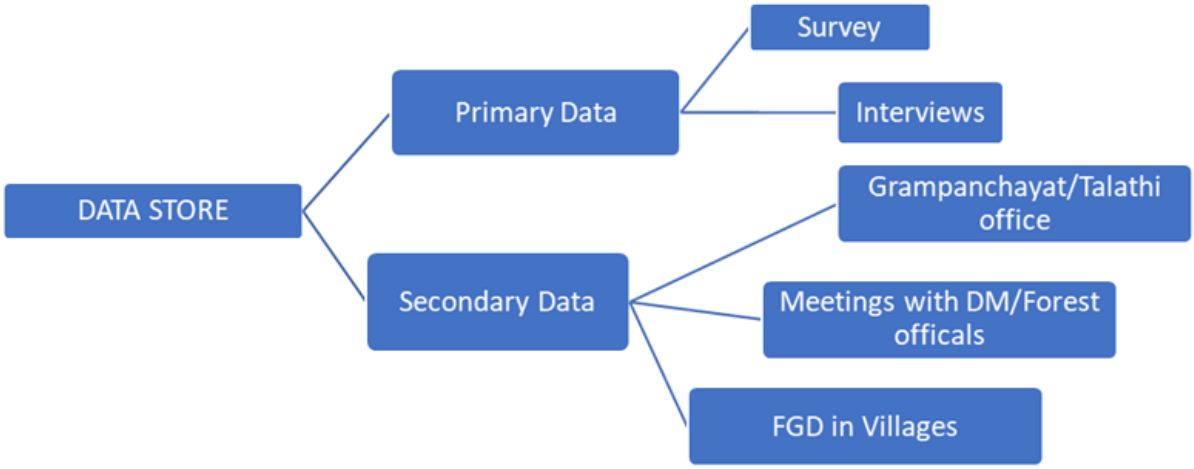

Figure 4 Data flow map Source Author

5.7.Discussions with Team Experts

In order to thoroughly grasp the potential and practicality of bamboo as a construction material, we spoke with specialists in bamboo construction, sustainable architecture, and rural infrastructure development. These specialists provided us with vital information that guided us in defining the construction details of the Bamboo bridge. With the bamboo and its chemical treatments, along with the joint connectors being renewable and locally available, the specialists provided us with valuable information in the cultivation of bamboo, current research in the field, and practical ways to empower rural citizens. Further, the specialists provided us with information on the cultural significance, environmental impacts, and economic advantages of bamboo in the village context. Their insights were valuable in addressing the problems of the material's source, durability, and the acceptance of the local community in its execution.

Figure 5 Discussion with Engineers at site, Source Author

5.8. Household (HH) Survey

We performed Household survey in Naldapada, where the bridge would be installed, to understand the issues, needs and expected outcomes. FGD with different age group on Pre-monsoon migration patterns and their struggles for livelihood
Meetings with surrounding artisans, craftsmen and officers from the forest department to explore sustainable bamboo sources and treatment methods.
A site-based supervision of the foundation and anchoring works included the construction of bunds and methods of water diversion, and methods for casting of columns and piers.

The data collected generates a comprehensive socio-technical study impacts report including architecture and structural drawings alongside maintenance manuals. These results produce a cohesive roadmap for localized execution, multi-stakeholder collaboration, and further development in other ecologically sensitive tribal areas.

Figure 6 Household Survey Near Bamboo Site, Source: Author

To assess these and to study the socio-economic and demographic profile of the population, results form a household survey; ranging in 16 houses near the Site of Bamboo Bridge, Naldapada. This method provided a notion that the observations were generalizable data, where it illustrated some of the situations of the Bhill settlement and how they faced tribulations. It provided data driven decision making and basic understanding of ideas for assessing subsequent versions.

The findings have informed the creation of targeted interventions for the village. This basic necessity of life is meant to be understood by a household survey that must incorporate both issues, whether it is before rain or after rain in order that the design is made keeping them in view.

5.9.Sampling Criteria

The Hamlets gives the singularity of the rural pattern and the fact that the entire population has the majority of Scheduled Tribes (ST), we have done sampling based on the house types such as Pucca, Kutcha and Semi-pucca. The data collected ourselves by calculating the houses during the visits, identifying total 172 households across the three padas

Hamlet	**Total no. of HH** (observation)	**No. of Pucca houses**	**No. of Semi Pucca houses**	**No. of Kutcha houses**	**HH Surveyed** (sample)
Patil Pada	69	10	40	19	30
Honi pada	60	8	40	12	14
Naldapada	43	3	15	25	16
Total no. of population (GP Office)	598				Total HH in village 172

The Patil pada was chosen, as this was the residents of Sarpanch, and the facilities and amenities had much more different than other padas.

The Honi Pada was chosen because it was junction point, connecting other major 6 padas, including kamodapada, padavpada, shelkadi pada, kundal,patil pada, thorkapada, shelkadipada

The Naldapada was chosen, after heavy discussion with Sarpanch and Gram panchayat officials for the Construction of Bamboo Bridge

5.10.Two Day Workshops for Understanding the Concept of Bamboo Bridge Design In with Villagers

A one-day workshop with people from Katri village was organized to make the community become more actively involved in the programme and also, they will be able to sustain the bridge itself in longer terms. These workshops became a means of dissemination of information, while bamboo was shared as an indigenous material and its sustainability, affordability, cost-effectiveness and abundance in nature were discussed, it further highlighted the disaster-prone terrains and the changing climate situation.

Figure 7 Bamboo Workshop at Katri village, Source: Author

Villagers were demonstrated different types of bamboo samples, their Mechanical & Load bearing Properties and various traditional treatment methods to strengthen, have long term benefit or any fungal damages could be avoided.

Experiments were also made for making bamboo arches, how they can be joined with either lashing or mechanical fasteners and how the structure stability is maintained with proper anchoring and bracing.

Also the workshop covered an adding bamboo, with RCC piers cap and foundation details. The construction stages with hand drawn models and working drawings were communicated to the villagers

Starting from creating bunds and site clearance are few footnote points. Rainfall, which we experienced while working on the bamboo construction, was a hamper for the work.

As a result, villagers were actively involved in building too, even by skilled, semi-skilled involvement of the direct labor base at village level itself during execution.

Figure 8 Bamboo Workshop Day 2, Source Author

It helped us to understand the Participatory construction model, and how sharing of information had empowered local communities to demonstrate successful repairs & maintenance, and replicate designs in other padas.

This created an ownership and pride with the project to link to the vibrant community.

Feedback:

- Farmers ask for yearlong connectivity
- Safety and durability concern
- Attraction for labor/material work during bamboo bridge (employment generate)
- How to Maintain the bridge
- Equal opportunity for using of bridges to all Hamlets
- The need for government support for future more bridges and planning
- Artisans, handicraft employment generating from other source of bamboo material

5.11. Meeting and Discussion for the Bamboo Bridge with Sarpanch, Up sarpanch and Gram panchayat officials

Figure 9 Meeting with Panchayat Committee, Source Author,

For better understanding the Site location and major connectivity of the villages and for identification of Potential sites we had a meeting with Sarpanch, Up Sarpanch and Gram Panchayat officials.

The Head of Hamlets, along with their team, were too invited for discussion; after scrutinizing the major catchment point of river flow and with heavy discussion, we had finalized the Naldapada Site.

The reason for finalizing the site, is because the naldpada ends at the tip of katri village, and major accumulation of river water is being there, during monsoons later disconnecting with other padas, majorly during rain.

Also, the residents residing there are being isolated and major facilities are been not provided to them, creating a sense of isolation among Villagers, therefore leading to more dropouts of children, mortality rate during monsoon and un availability of Food Grains

This decision was unanimously decided among the villagers of 14 padas along with sarpanch, therefore giving them major power for the Naldapada site.

5.12.Understanding the Local Community

The Naldapada has existed for a very long time in katri village. During our interactions with the oldest person of hamlet, age 92, he shared that her ancestor had been living in the area of generation, The mountains had more trees and multiple biodiversity existed. But now as the coming generations' population increases, the forest has been cut down, for farming and the local species, reduced drastically. The livelihood majorly depended on forest, but as untoward rain and increased animal husbandry and grazing, there has been times, there has been shortage of grains, and lack of connectivity of roads, they have to starve many times.

Demography of Naldapada

There are 43 Households at Naldapada, with 149 population with 75 males, 50 Females and 25 Children. More of the Population engaged in Agriculture, Goat Farming, and 8 males migrated to Gujarat as construction labor, with average income of 12,000 Rs to 15,000 Rs

Figure 10 House hold survey, Source : Author

5.13.Cultural Context

In the cultural context of Tribal Community, Education, Health, Infrastructure, Food security, Employment opportunities are majorly influenced by transportation, connectivity of roads and accessibility to various parts of their surroundings to meet their needs. As connectivity is lost, the celebration of yearly cultural festivals has been decreased. This loss of connectivity has also led to stagnant growth, increase of dropout of children from school as they are later made to work in fields and forest, thereby creating immediate economic needs over long term educational benefits and later the increase in mortality rate due to non- availability of PHC.

Figure 11 Wedding Program at Village, Source: Author

5.14.Current Facilities and Infrastructure

Figure 12 Road to Naldapda Site, Source Author

Figure 13Road Construction work Board at Bamboo site

Figure 14 Transmission Of Electric Pole Line, Source: Author

As of today, there are no facilities such as PHC, bore well and basic infrastructure in Naldapada Hamlet, the electric transmission lines are placed, with little too few good roads at few locations only done by sarvjanik bandkaam vibhag, at Sahadha

5.15.Stakeholders Analysis for Designing, Constructing of Bamboo Bridge at Naldapada.

Identification

Collaborators, Beneficiaries, Key Players were established through our surveys and community interactive activities were categorized into Beneficiaries groups, Strategic allies, External allies.

Beneficiaries Group: The one who will be directed benefited by this project such as Tribal village youth, School Teachers, skilled labors, masons are the primary active participants.

Strategic Allies: The Gram panchayat office, NGOs, and village volunteers acted as valued partners, adding for the resource generation and coordinators between all parties

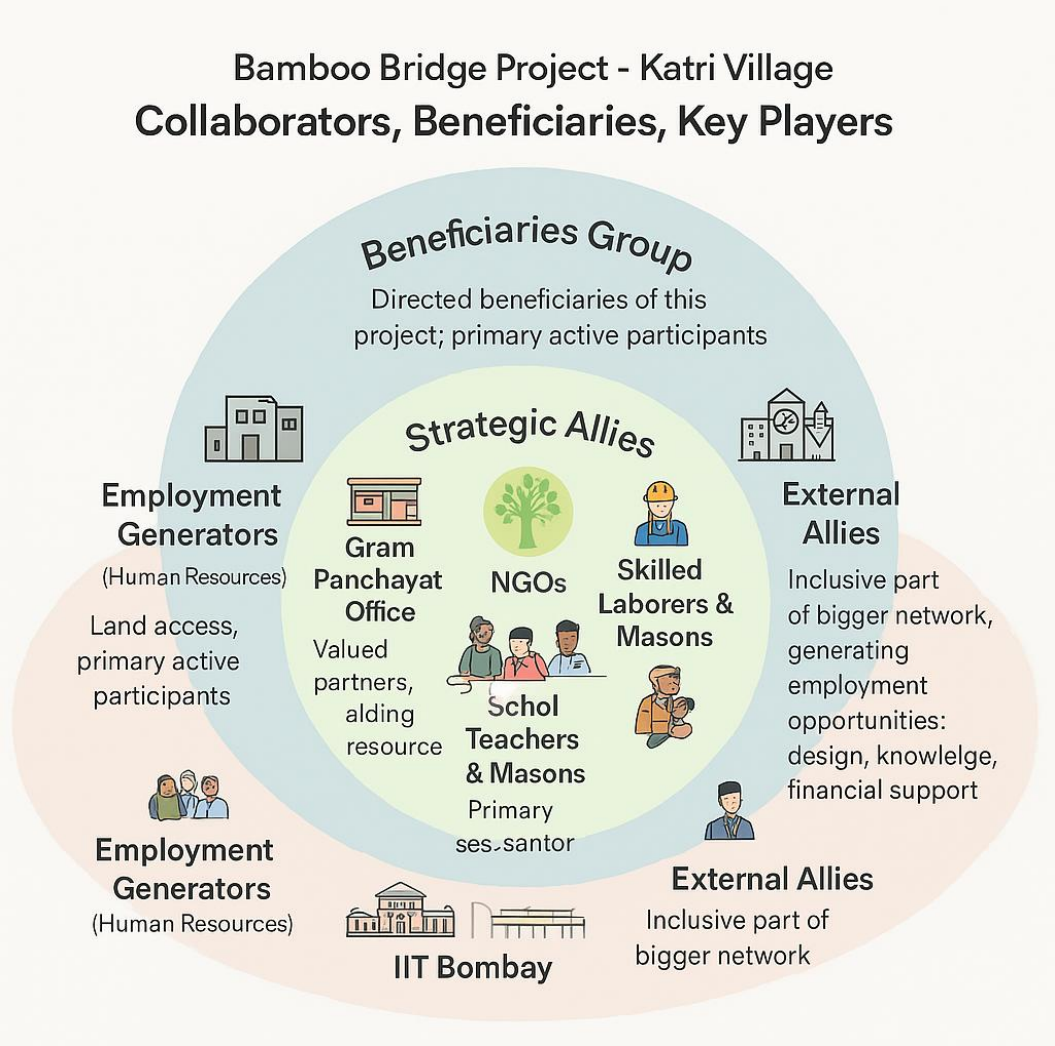

Figure 15 Targetd Group List, Source : Author

External allies: Employment Generators, (Human Resources), IIT Bombay, District Collector and other Govt Officials, were the inclusive part of bigger network, generating employment opportunities and Design, knowledge, financial support

5.16.Roles and Interests, from Key Partners such as Beneficiaries Group, Strategic Allies and External allies with their Interaction Plan for Bamboo Bridge Project, Naldapada, Katri Village, Nandurbar District

Project Aim

To Design and Construct sustainable eco sensitive bamboo bridge connecting 14 hamlets, thereby improving full year connectivity to other padas, majorly in monsoon.

Beneficiaries Group (Primary Participants)			
Target Group	**Needs**	**Gains from Project**	**Interaction activities**
Village Youth	Skills exercises, Job Opportunities, nearby connectivity	Job opportunities in construction, Travel access to school/markets	Direct working on bamboo bridge, within village employment, lesson to use in another sites
ZP School Children	Protected access to school especially in monsoon	Decrease in school dropouts and increase access in education	Village mapping to gain insights from children's paths route and adding children safety equipment/characteristic
Skilled artisans, craftsman, construction labor, mason	Upgrading living standards, secured work design	Employment opportunities, Acknowledgement, Respect in communities	Giving safe equipment's, creating report for training, execution drawing for same design repeat in future

Local travelers	Full year access to schools, PDS, Markets, govt offices and Training programmed, Anganwadi, cultural festivals meeting	Give more time for other activities, keep up with good mobility and increase more power in other hamlets by active participation	FGD to get better idea for regular activities, including women in design for feedbacks
Strategic Allies (Supporting Group)			
Group	**Needs**	**Targeted Gains from Project**	**Interaction activities**
Village Gram Sabha office	Better village transportation, Decrease Isolation of Padas	Gram panchayat good Reputation, Growing Credits	Memorandum of understanding from Govt and IIT's for site accessibility, Land Pattern usage, Finance, Transport support
Rural Elders and Leaders/ Visionaries	Cultural openness, Security for village assets	Ethnic Support with bamboo bridge built with available materials in Village	Experts meeting with verbal history inclusion, Vocal active participation

Non Govt Organization	Regional engagement, Ground level Transformation Budget friendly Design	Prototype project for expandable village model that can be replicate in other hamlets too	Joint effort in technical capacity building, public communication
Community Volunteers	Social contribution, skill-building, future leadership	Ownership, recognition, resume-building	Honor roll, leadership role in bridge maintenance post-construction
Group	**Needs**	**Targeted Gains from Project**	**Interaction activities**
IIT's (RUTAG, C-TARA) IIT Bombay	Solution Driven research, rural revitalization, Practical field application	Fruitful execution of budget friendly design, with field work research	Site visits, load calculation, checking tools, training for school children and creating the teams
District Magistrate/ Regional Govt Officials.	Disaster risk reduction for rural development Program, Project including in records.	Local govt Strong hold and timely actions, In the track with many govt schemes like MGNREGA, JJM, PMGSY	Presentation submission for proposing new projects, Invitation for site inspection before and after construction activities.

Employment camps, Job providers.	Setting up of workshop, training youth, working team, village outreach,	Bamboo bridge act as accessibility points for daily labor, wages market	generating employment opportunities using bamboo as main indigenous material, Mediator acting bridge for job offers
Corporate Social Responsibility Donors	Community impact, Villagers engagement	Acknowledgement, Social Tv Coverage, Photos for Press	Display of Brands, Networking
Major Academic Policies	Recent work study for development, Job internship availability	Gainful information for social science students, Planners, Architects, Engineers students	Summer projects thesis and reports paper publication and documentation

Table 17: Targeted Group , Source Author

5.17. Rural requirements and Contextual Check points Questionnaires asked in village

Rural needs and Concerns

Community Needs and Interests	
What are the biggest challenges you face in your community regarding connectivity, with continuation of other social aspects?	**Challenges:** Lack of mobility and access to quality education and limited job opportunities, especially during monsoon
What kind of vehicular would you be using once the bridge is constructed?	**Desired Vehicles:** 2-Wheeler, Platina, Bajaj splendor, Tractor and Bolero for Pickup driver job and for Transportation from one village to other
Job Profile Background and Aspiration	
What is your current level of Job Profile? What Vehicles do you possess?	Mostly Farmers, Agricultural activity and Daily labor wages worker Splendor, Platina, Tractors
Skill Development	

What technical skills are you interested in learning during construction of the Bridge?	**Technical Skills**: High interest in skilled labor work, mechanical bamboo cutting, Agriculture Farming in Bamboo
What skills do you think are important for your future after a bamboo bridge is constructed?	Basic understanding of site, material strength and bamboo farming, masonry work
Mentorship and Support	
How important do you think having a mentor is for your personal and professional development? If you are planning to enter the bamboo construction business as it is a major requirement in other villages/Padas too.	**Importance of Mentorship:** One of the crucial facts for career and local job opportunity, thereby not leaving children alone, especially women for migration job in Surat, Navapur, Gujarat
What type of support do you think would be most beneficial from a mentor?	**Desired Support:** Workshops related bamboo information and data sources in nearby talukas, related bamboo
Internships and Practical Experience	
How valuable do you think internships or on-the-field training related to bamboo would be for your career?	**Value of Internships:** Viewed as highly valuable for gaining real-world experience (especially women and youth)
Job Readiness and Entrepreneurship	

Are you interested in starting your own bamboo farming business? If so, what support would you need?	**Support Needed:** Monetary assistance, access to bamboo resources, and logistics mobility
Community Engagement and Outreach	
How can the Bridge effectively engage the youth in your community? What methods of outreach do you think would be most effective?	**Effective Engagement:** Regular community meetings and interactive sessions for bamboo training **Outreach Methods:** Social media, community events, and collaboration with local leaders and bamboo business men

Table 6: Questionaries asked to Villagers

5.18. Assessing the Impact of Building Bamboo Bridges in Tribal Areas

Expected Beneficial Outcomes:

- Distance time decrease from Home to Schools, PHC, Markets, PDS Centers, thereby not required to cross mountain areas to Villagers.
- Safety is ensured from wild animals and security for women especially during Night.
- Generation of Local Employment Opportunities in Youth and Women
- Active Participation in Cultural activities, Govt work and other personal work
- Development of Construction skills, that could be used in other work or construction of replica model in other parts of villages.
- The usage of bamboo materials and its sub set such as coir rope used for tying and wooden pegs to hold structure
- The sense of business model by selling bamboo and its byproducts will foster pride and dignity in society in villagers
- The sense of ownership of bamboo and responsible for keeping it will generate unity and togetherness in village

Potential Negative Impacts

- The location or choice of bridge in hamlets prioritization may create tension if its not done in fair and realistic manner
- Consideration and view of every villager should be taken, to avoid conflict.
- Concerned of bamboo bridge, if not maintained and well-treated.
- Excess Loading of vehicles and live stocks if more load is added as per given standards

- Designated roles and responsibilities if not shared in villagers, such as maintenance works may lead to tension

5.19. Strategies for Maintaining Prolonged Viability and Sustainability of Bamboo Bridge Project

The long-term sustenance of bamboo bridge having multi dimension approach with involvement of technical aspects, Govt/ Gram Panchayat accountability, villagers' active participation in interactive operations and yearly financial and audit planning.

Other than social encouragement, raising of funds and village ownership models that could be practically executed in Village

Structural and Technical Viability:

To keep the bamboo bridge safe and strong, we suggest regular checks and simple care. Every 6 months, local engineers or trained experts should inspect the bridge, with extra checks every 3 months for loose joints, tilt, and wear using simple tools.
After the monsoon, a special check should be done for erosion or damage. To protect the bamboo, apply a specialized coating every 12 -18 months and fix bolts and wires regularly. The top mat layer should be replaced every 3 months if damaged, especially after heavy rains. \
Keep 15–20 treated bamboo parts ready for quick repairs. Use new modular bamboo designs that are easy to replace. Also, plan ahead for floods with warning signs and alternate paths to ensure people stay safe.

Formation of village committee

We share the need for a local Bridge Samiti in the Gram Sabha having 6-8 trained members, some of whom are members of rural volunteer groups, who will continuously inspect the bridges, oversee repairs and report to government officers and staff.
One person could be made responsible for managing the road and water flow. The Gram Panchayat will include the bridge in their rural development annual budget, divert them to cross check and seek funding through MNREGA or the 15th Finance Commission for ordinary repairs. Furthermore, we propose working with technical organizations like RuTAG-IIT Bombay who will enable planned assessments of the bridge on a yearly on-consuming basis and structure

bridge improvements, and student induction programs all contribute to checking the state of the bridge thereby documenting research findings.

Instrumental Design to Channel Financial Resources

To keep the bridge well maintained, we can initiate a little maintenance fund through either the Gram Panchayat or CSR assistance.
A little goes a long way; if each family contributes only ₹10 per month, every little helps and collections could occur weekly at markets or local gatherings. Encouraging village leaders and other officials to donate annually would also help.
We also have the opportunity to partner with other entities under their CSR projects that focus on village level and tribal development. They could assist with costs for the annual repairs and same with record keeping.
For the labor we could also use MNREGA schemes for this bridge if we get permissions for bridge work by stating it as repair work, as they will give fixed-day jobs to villagers through job cards given through the Gram panchayat.

Technical Training and Capacity Building Approach

To ensure the future strength and safety of the bridge, we can train 6-7 local tribal youth as bridge technicians with an experiential RuTAG training and certification program, followed by two years of refresher training to enhance joinery, anchoring, and sealing skills.
We can also train local 10th–12th-pass youth in a small fellowship or apprenticeship program that can assist the bridge technician in supervising the bridge.
The training can be funded by schemes such as PMKVY.
In terms of quality checks, we can check bamboo moisture contents, joint bolts, and conduct load tests by placing water drums of water. A site engineer can also check the bridge weekly to ensure early detection.

5.20.METHODOLOGY FOR EXECUTION OF PROJECT

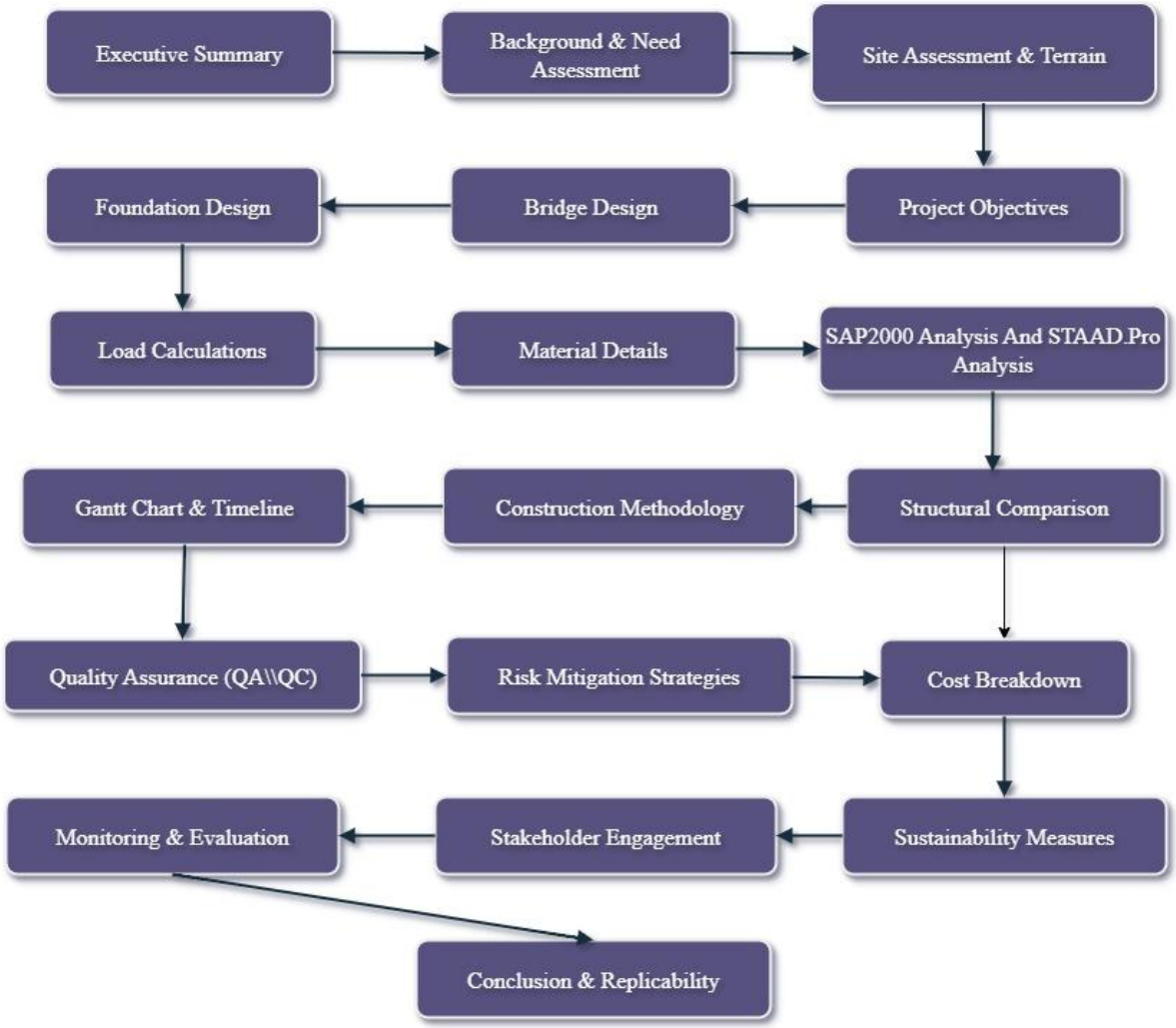

Table 1 Execution methodolgy, Source: Author

5.21. **Surrounding Infrastructure Assessment:**

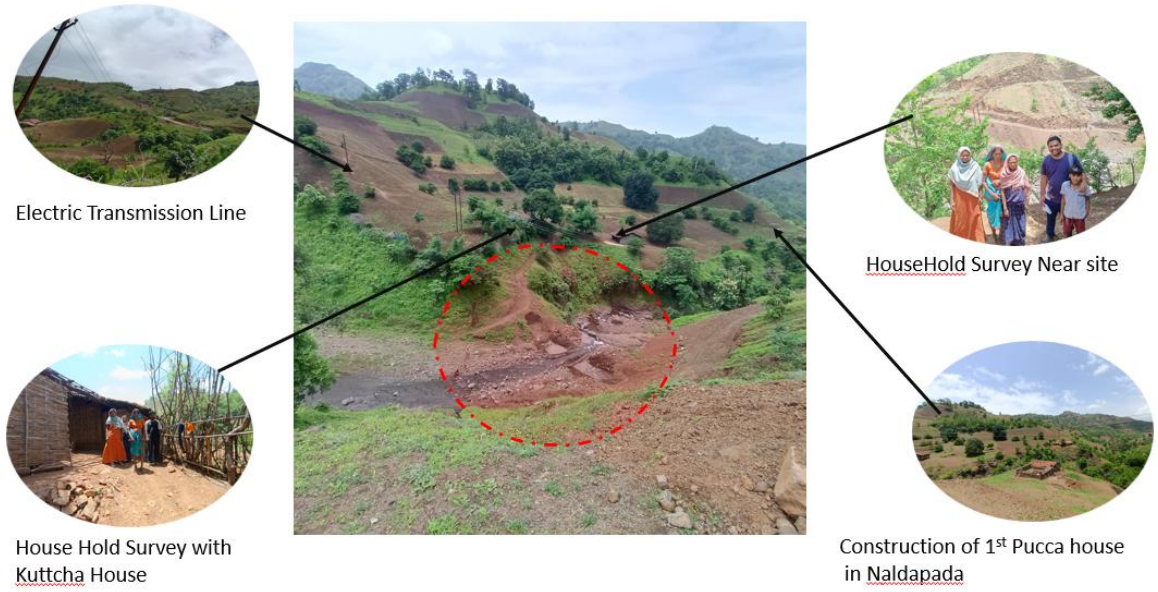

Figure 16 Infrastructure site assessment, Source Author

The site is surrounded by 43 houses, each far away from 700m to 900m, and located at the tip of mountain terrain region. There is one single grocery shop, which supplies bare minimum goods, charging transportation of good along with products. A 10 rupees Parle G Biscuit costs at 15 Rs, including transportation. There is an electric transmission line of pole can be seen, from one high pitch of mountain to another, these poles get break down, especially during monsoon and harsh winds, leading to loss of electricity, the availability of electricity is hardly 1 hours a day as majority are relying on solar panels, which starts, Light and mobile phone charge.

The 1st Pucca house being constructed can be seen in Naldapada, but it has been stalled from last 3 months, due to heavy rainfall, hampering transportation of raw materials

5.22. Detailed Project Report (DPR) for Bamboo Footbridge Construction at Naldapada, Katri Village, Nandurbar District, Maharashtra

1. Project Synopsis

The project includes the Design, Execution and development of Pedestrian Bamboo Bridge at Naldapada in Katri Village, in Nandurbar, Maharashtra. The fundamental objective is to connect the 14 padas among the tribal hamlets spread over a sensitive terrain region. The bridge has a total span of 18.9 meters, and focuses to provide affordable and easy maintenance by villagers especially during heavy monsoon. The project is reviewed and work under the guidance of Proff. Chaaru chandra korde, from IIT Bombay in collaboration with PWD Nandurbar District, Maharashtra

Coordinates: 21.87228° N, 74.064269° E

Elevation: ~490.87 meters above sea level

Client: Gram Panchayat, Naldapada, Katri Village, Nandurbar District, Maharashtra

Technical Partner: Ru-TAG, C-TARA, IIT Bombay

Scope: Bamboo Foot Bridge construction for 2-Wheeler and Pedestrian access.

2. Project Goal

The fundamental aim of this construction initiative is to make sure equal and reliable access to basic services for 14 padas that are cut off during monsoon.

Major Goals are:

- To give all season pedestrian connection across Naldapada river
- To use locally available bamboo material and develop community upliftment by using sustainable construction
- To decrease travel distance and time to basic facilities and amenities.
- To create similar repeatable model and methodology in bridge construction

3. Site Condition and Geographical Terrain Analysis

The bridge location is in a tribal remote area featured by uneven terrain, slope gradients and discontinuous water flow in the terrain region. Site and Geographic GPS based survey and topography

- **Soil morphology:** The substructure or bedrock includes large rock chunks and fragmented strata bed layers with occasional depressive soil deposits blocks, showing non uniform bearing capacity.

- **Water flow:** A river get dry for more than 7 months turns into a stormy seasonal river between June and September because of upstream flow river runoff. Highest flood depth is 1.5-2m.

- **Restricted access**: The end road to site approximate to 1.2 to 1.5 km are non-vehicular, making local transportation for materials not easy to access. Location material supply requires manual relay or rope trolley systems.

- **Climatic Exposure to Surrounding:** The location is exposed to direct heavy sunlight, heavy monsoon and very harsh winds, therefore requiring extra anchoring and weather proof considerations.

Logical Scheme structure

The logical scheme structure makes sure that the bamboo project stays stable in quantifiable goals, production, and results. The fundamental focus is to result into a secured, heavy rainfall-resilient, and easy maintenance of bridge. Major results include a well examined bamboo superstructure, open RCC foundations with shear keys, and SS rod-based anchoring mechanisms. The bamboo bridge helps to provide better access to basic facilities and amenities, giving benefits to over 200 daily users, especially schoolchildren and women. Main Approvals such as Forest Department NoC and Gram Sabha resolutions—are taken, with understanding of the project with the District Planning Committee's village infrastructure roadmap.

Extensive Project Assessment

A multi stage **project assessment** makes sure that the bridge is physically stable, societal acceptable, and affordable. The species for bridge is DendrFocalamus **strictus**, coated with **borax boric acid** and applied with **polyurethane varnish** for extended life. The foundation consists of M20 RCC with 600 mm dia pier and 500 mm pier cap on 16 mm stainless steel rods as per IRC SP:63 for pedestrian load of 5 kN/m².

The estimated overall expense is ₹12 lakh, and the bamboo would be locally sourced and labor accounts for 30% of the overall. This community-based labor cuts down on outside contractor overhead, conserving an estimated ₹2.4 lakh. The risk assessment identifies concerns such as terrain instability, monsoon delays, and lapses in treatment.

Mitigation measures like covering treated bamboo under covered racks, planning seasonally (Nov–Feb), and biweekly site monitoring are employed.

Figure 17 Concept of Bamboo Bridge Design, Source: Author

4. Technical Specifications

4.1 Superstructure

The superstructure includes a bamboo arch or girder system that can span 18.9 meters. The load path of the superstructure incorporated triangulated compression and tension members with treated bamboo.

Bamboo species: Dendrocalamus strictus, which is matured and treated in water, that is left for 15 Days in water

Decking system: Bamboo slats placed perpendicular to the span (on GI strip runners) to ensure lateral stiffness. Surface overlaid with non-slip coconut coir mat embedded in resin.

Railing system: Twin layer bamboo handrails with intermediate SS wire mesh for fall prevention and intermediary lateral restraint.

4.2 Substructure

Foundation: RCC open pad footing designed for 100 kN point load, stepped profile designed to slope down to the ground level. M20 grade concrete with (12 mm) rebar mesh (specified spacing).

Pier & Pier Cap: Circular pier (600 mm diameter x 3.5 m); pier stem capped by an RCC slab (500 mm thickness) tooled to receive anchor sleeves.

Cut-off drainage: Gravel packed apron with integrated PVC drainage pipes placed at bottom level to reduce water accumulation post monsoon.

4.3 Anchoring System

Deadman anchor: MS rods (16 mm) drilled into basalt layers using hammer drill; restrained by concrete-filled tyres (used as passive resistance) and gabion bag wall.

Connection system: U-clamps with high-tension bolts pre-tensioned with turnbuckles; embedded ends sealed.

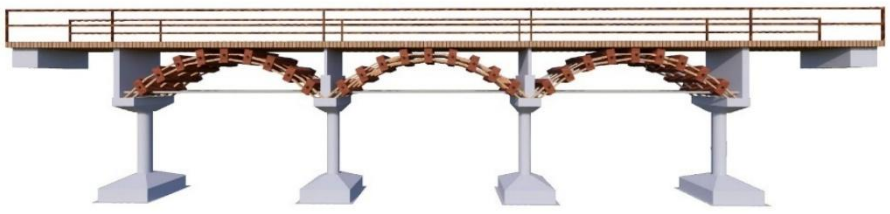

Figure 18 Structural Design of Bamboo, Source: Author

4.4 Numerical Structural Calculations

Live Load: 5.0 kN/m² (IS 875 – Part 2)

Total Bridge Deck Area: 18.9 m × 1.5 m = 28.35 m²

Total Uniformly Distributed Live Load: 5 × 28.35 = 141.75 kN

Assumed Dead Load (Bamboo + Deck): ~ 0.9 kN/m² × 28.35 = 25.52 kN

Total Load: 167.27 kN (Factored load = 1.5 × total load = 250.90 kN)

Maximum Moment (Simply Supported Approximation)

$M = (w \times L^2) / 8 = (5 \times 18.9^2)/8 = 223.0$ kNm

Shear at supports:

$V = (w \times L)/2 = (5 \times 18.9)/2 = 47.25$ kN

Bearing Pressure on foundation (1.2×1.2 m footing):

Total Load per footing = 100 kN + self-weight = ~ 120 kN

Area = 1.44 m²

Pressure = 120/1.44 = 83.33 kN/m² (within safe bearing capacity for compacted basalt > 150 kN/m²)

Figure 19 Design model for bamboo, Source: Author

5. Execution Methodology

Figure 20 mobilization and site clearance

Figure 21 checking of Kaat Kona For columns & Footing, Source: Author

Figure 22:Foundation excavation using handheld tools due to rocky substrate, Source: Author

Figure 23.RCC footing casting and pier erection, Sourced: Author

Figure 25 Bamboo kept for Construction

Figure 24 Joining 2 bamboo with Ms Plate, Source: Author

Figure 27Site checking of Bamboo, after Treatment, Source: Author

Figure 26 Treatment for bamboo for 15 days in water, Source: Author

5.23Estimation Of Quantities

Geographical Challenges During Execution:

- GPS Coordinates: Latitude 21.87228°N, Longitude 74.064269°E
- Steep Percentage: 6–10%, needed steep excavation and benching
- Soil Morphology: Pebbled strata mixed with loose alluvium and clay
- Connectivity: Motorbike for last 800 meters; no vehicular access to site edge

Seasonality: Heavy Rainy Season Stop the activity for 2-3 months, therefore requiring Dry Weather Planning

A. Site Clearance and Survey

Table 28: BOQ Sheet

Sl. No.	Detail	Unit	Qty	Rate (₹)	Amount (₹)
A1	Geographical Survey & Laying Out	Lumpsum	1	7000	70000
A2	Site Clearance	Sqm	100	25	2
A3	Geotechnical Data Work	Lumpsum	1	10,000	10,000

B. Foundation and for Below Structure Details

Sl. No.	Detail	Unit	Qty	Rate (₹)	Amount (₹)
B1	PCC 1:3:6 M15 for level of Bed	Cu.m	0.75	5,200	3,900
B2	RCC m30 for open footing	Cu.m	3.45	7500	25,875
B3	RCC M30 for Circular Pier	Cu.m	1.98	7500	14850
B4	RCC M30 for pier caps	Cum	1.44	7,500	10800
B5	HYSSD FE 5OO D STEEL HYSD Fe500D steel	kg	625	80	50800

B6	Shutter amount Shuttering charges	Sq.m	46	545	25,750
B7	Anchor Rods MS 16 mm	K.g	80	110	8,800

C. Above/Super Structure – Bamboo Arch and Decking system

Sl. No.	Detail	Unit	Qty	Rate (₹)	Amount (₹)
C1	Treated Coated Bamboo	No's	500.	160.	80000
C2	GI Covered Wire and U - Clamp	K.g	300	150	45,000
C3	Chemically Coating	Lumpsum	1	65,000	65,000
C4	ARCHED PREFABRICATION	Lump Sum	1	20,000	20,000
C5	Bamboo deck cover slats	Sqm	28.35	750	21,263
C6	Anti slipper mat	Sqm	28.35	300	8,505
C7	Railing on Bridge	m	38	400	15,200

D. Start Works & Signage

Sl. No.	Detail	Unit	Qty	Rate (₹)	Amount (₹)
D1	Erosion control and slope stabilization	Cu.m	6	2500	15000
D2	Site Grading and earth work	Cu.m	10	800	8000
D3	Drain outlet pipe and apron gravel	Lump Sum	1	7500	7500
D4	Sign board and signage	Lump Sum	1	10000	10000

E. Labor Quality Control and Assurance, Logistics.

Sl. No.	Detail	Unit	Qty	Rate (₹)	Amount (₹)
E1	Hard skilled labour	Lum Sum	1	-	3,78,000
E2	Quality Assurance and Control engineer	LS	1	40,000	40,000
E3	Site Kits and safety Tools	Sets	15	750	11,250
E4	Load testing and calculation	Lump Sum	1	25,000	25,000
E5	Transport from Sarting	Lump Sum	1	35,000	35,000

F. Extra work

Sl. No.	Detail	Unit	Qty	Rate (₹)	Amount (₹)
F1	Villager Interaction session	LS	1	-	28,250
F2	Unsafe Buffer	LS	1	-	32,750

Summary – Final BOQ Total

Section	Detail	**Amount (₹)**
A	Site Clearance and Survey	₹18,500
B	Foundation and for Below Structure Details	₹1,39,775
C	Above/Super Structure – Bamboo Arch and Decking system	₹2,54,968
D	Start Works & Signage	₹40,500
E	Labor Quality Control and Assurance, Logistics.	₹4,89,250

F	Extra work	₹61,000
	Total	**₹10,04,993**
	Add GST, Extra, Inflation (~18%)	**₹1,80,899**
	Grand Total (Round above)	**₹11,85,892 ≈ ₹12,00,000**

Grand Total (with taxes and buffer): ₹11,85,892 (~₹12,00,000)

Points to be Noted:

- Labor cost can increase around 30% including labour carriage, loading on Head and absent of mechanical machines.
- Treated bamboo could turn to waste, once not in used for longer period of time into arch formed
- Fire Proof coating may contain linseed oil, potassium silicate blend and annually to renew
- Hdpe sheet would be important in flood risk area for deck spaces to cover bamboo floor
- Load test is continuous to follow for 2-ton proof test by tribal community and dead load cement bags for 5 days

5.24Comparative analysis for Bamboo, RCC and MS Steel Bridges

This portion shows a combined analysis of structural engineering majorly used for construction of footbridges, that is Bamboo, Reinforced Cement Concrete and Mild Steel Bridges. The checking of individual material is carried as per thorough performance criteria such as mechanical strongness, load test capacity, concern for multiple terrains, time taken, affordability in construction and long-time maintenance especially in remote terrain tribal regions like katri village,in Nandurbar district, Maharashtra.

A. Criteria for the Bridge Evaluation

Table 29 Comparison of different types of Bridges

Conditions	**BAMBOO BRIDGE**	**Reinforce Concrete Cement Bridge**	**Mild Steel Bridge**
Required range length	18m – 20m (Arch/tension-based bamboo)	15m to 18m Beam or Slab systems	18m to 25m, modular or truss working.
Strength of Structure	Combined: 50 MPa, Flexual: 70- 80 MPa, Shear strength is around 8 MPa	Concrete work is M25-M30 around 25 -30 Mpa, Reinforcement jali is Fe 415- Fe 500	Yield output: 200-300 M.pa Tensile strength- 350 M.pa Shear Strength: 230 M.pa
Nature of Bridge:	Nonlinear, elastic; excellent energy dissipation High ductility; performs well in seismic zones	Rigid system; brittle failure under overload Requires precise cover and curing	Ductile and predictable failure modes Excellent in dynamic and cyclic loads
Deflection points	More due to Flexible in mature and can be reversed	Less deflecting in M25-M30 grades	less deflecting with mores stiffness ratios

B. Land use and Constriction Transportation

Keeping in mind the terrain landscape, there has been flooding at river bed and improper connectivity access in katri, this portion shows the potential for constructing type for the habitat and cultural context.

Conditions	**BAMBOO BRIDGE**	**Reinforce Concrete Cement Bridge**	**Mild Steel Bridge**
Foundation needs	Stone mason work and RCC anchor block, open footing design will be proper used for rock beds	Depth Foot, moreover require excavation and heaviest shutter level	RCC and Steel plates joined with highest load on both axis
Terrain Suitability	Major high -lighter weight, modular, assembled by human labour	Not good- as it needs heavy machinery and difficult to transportation	Medium work – prefabricated parts, loaded with crane and heavy machines
Construction Transportation	Manually carried out, built at site for terrain region	Needs road connectivity for RMC, and pumping	Transport depends on prefab and heavy vehicles such as crane access.
Heavy rainfall suitability	Needs to work before rainfall and other season	Problem of delaying due to curing required is more	Easily customizable, but required time for drying up
Depends on Good skilled for labour	Can be sourced locally, such as masons, carpenters, and can be trained easily.	Required training for shutters, concreting crew.	Need trained fabrication person and rigged team

C Costing, Maintaining and Durability of Bridge.

Conditions	BAMBOO BRIDGE	Reinforce Concrete Cement Bridge	Mild Steel Bridge
Starting Cost	Rs.10–12 lakh for 18–20 m length	Rs 40–45 lakh	Rs 30–35 lakh considering steel type used.
Life period	12–16 years (with 4–5 annually coating and treatment cycles)	35–50 years	40–50 years
Maintaining Works	Yearly GI Change, applying oil and Fire resistant.	Break out, top finishing every 6-8 years	Twice paint in a year to prevent rust, scrape and tight of bolt.
Repairment Model	Easily replaceable and repaired	Difficult to repairs and more expensive	Medium and can be replaced the plating, members as required.
Test for load and certification for the bridge	Manual loading and required tests	Worked carried out as per IRC: SP-72 rules	Worked out as per IRC: SP-70 & IS 900:2006 rules

Inferences:

Bamboo Foot bridge is more feasible for active development, less time period, less impact in constriction and community responsibility Bridge should be only considered were long time stability and heavy vehicular loading are at peak, but not in topographic region MS Steel Bridge is apt where pre-fabricated transportation and easily assembled.

Comparison of Costing for above bridges

Sections	**Bamboo**	**RCC**	**MS Steel**
Raw Materials	₹2.5–3.0 lakh	₹9.5–12 lakh	₹10–12 lakh
Skilled labour and supervised work	₹3.5–4.0 lakh	₹4–6 lakh	₹5–6 lakh
Foundation works	₹1.5–2.0 lakh	₹6–8 lakh	₹5–6 lakh
Prefab work and Transport	₹1.2–1.5 lakh	₹4.5–5.0 lakh	₹4.5–5.5 lakh
Quality control and Testing	₹0.5 lakh	₹1.0 lakh	₹1.0 lakh
Security and board signs	₹0.5 lakh	₹0.75 lakh	₹0.75 lakh
Extra work	₹1.0 lakh	₹2–2.5 lakh	₹2–2.5 lakh
Estiamated cost	**₹10–12 lakh**	**₹25–30 lakh**	**₹22–28 lakh**

5.25Monthly Checklist Points

Sr No	Description	Checking Points	Procedure	Duty alloted	Action to take
1	**Structural Auditing**	Checking pierd capping and foundation foot cracks or displacemental	Eye check or tapping	Local trained youth	To adding points in check list book and informed engineer
		Checking points for settling of soils or erosion of soil in bottom part.	Levelling of footings and at bottom	Community members	Flled with sand or soil
2	**Bamboo top part main structure**	Checking for fungus grwoth, rodents infestation and pests around it.	Eye test or scraping	local youth	Coating with special chemical
		To make sure joinery parts and clamps are tightly closed and ant rust free.	Physical test	Local trained youth	tighten loose parts and welding if required
		Check of seepage in bamboo	Tapping with hand	Local trained youth	drill small holes and drain them
3	**Deck sheet and top railing part**	Checking for decking partion and loose parts	tapping and pressure check points	local carpenter	Change or repair deck
		rail tighntenss and deflection	pull plomb tests	local enegneer	add lashes or support for railing
		meshed wire for children and elders safety	strenghth tension test	Local trained youth	replace mesh wire with ss
4	**Anchoring systems**	Checking ss rod anchored pints and pier joints	rench torqed test	Contractores	tight or weld sysrtem
		Defelction of bamboo arch	alighnment testing	Local trained youth	reset and realigned arch
	Drain point in terrain	side drains or excess silts around it	fowda and bucket clean	Village volunteers	Throwimg in downstream
		checking of water level in mosoons	log book entry	Village volunteers	excavte soaks at side if needed to be done
5	**Village participation**	monthly feedback meeting	minutes of meeeting , details	Village volunteers	take feedback and give reuoired actions
		keeping photos of every month	click photos and update on whatsapp	Local trained youth	share with structural engineers

Figure 30 Checklist Points

5.26 Conclusion and Future Scope

Bamboo Bridge – Katri Village, Naldapada

The project study action plans for the bamboo bridge at Naldapada, katri village now full fill the demands, that was basic needs for the villagers. Interaction of nearby hamlets, panchayat, SHG's and prominent institute, Forest Dept Officials creates base for support making it long term sustainable projects and realistic in nature.

The project is best examples of sustainable affordable village development from an engineering and infrastructure view point. Using bamboo, RCC open footing and anchoring with stainless steel together makes a bridge low in carbon emissions and affordable and is eco climate friendly. The arch shape bamboo resists the flood level as it has more height compare to RCC and MS steel structure, thereby much suitable for terrain region

The bridge the solve the major problems with social and economic connectivity. The isolated hamlet will be now connected to other hamlets especially during monsoon seasons.

The bridge also helps with urgent problems with social and economic mobility. The connectivity of this bridge will support 200 population footfalls, there by connecting to school, health care and all-round service year.The project will improve the standard of living and will foster new skills in youth, thereby generating local youth employment, and SHG workers.

The "bamboo Pull Dekh rekh Samiti", will adds up to youth and SHG members, that could be made because of community based capacity build program like skill labours in youth, treatment of RCC Construction, bamboo construction and joint works

This will ensure sense of responsibility in villagers by keeping the bridge in good shape and condition after the construction thereby maintaining the bridge for long time period.

Future Possibilities

The bridge has covered a biggest gap in accessibility, and has also paved up for new upcoming opportunities for constructing more infrastructure and binding together 14 hamlets in rural areas, Further improvement could be:

Upgrading to mobile base tracking sensors to check deflection of bridge, by youth in villagers

Joining hands with nearby eco – learnings and tourism as the beautiful scenery of mountain can be viewed in monsoon

Adoption of policies by PWD and Rural development departments for promoting and use of bamboo bridge

Planning for multi village level bridge cluster that can be replicated in other padas as well

Collaboration with Prominent institutes for design standards and funding source for other bridges work in hamlets

To conclude the Bamboo Bridge at Katri, Naldapada, is more than a piece of bamboo work, it's a part that connects sustainable development, empowering community and tribal resilience, successfully showing the respect for nature and co-existence of cultural and traditions, by combining modern technology in rural part of India

Chapter 06

Potential Topic for RuTAG Projects

Amchoor Processing Mini Factory

Problem Identification

the Nandurbar district of Maharashtra, katri village is occupied with lush green landscape, which look very beautiful especially during monsoon, but during summer seasons, the dense forest is covered variety of native mangoes. From April to June, there is different variety of mango, in which bitterness level as compared to other mangoes in India.

Thus, adding product value addition for the raw mango, but unfortunately these mangoes are left to waste In and are sold to passing traders at highway.

The PRA Conducted and as per field survey and observation more than 60% of these mangoes are been wasted each year, due to lack of facilities.

Even though the climatic condition is favourable, for perfect sun drying and the tribal community has abundance of knowledge about forests produce, there is no process unit that could be used for harnessing this potential

Thereby idea of setting up of small processing unit emerges as practical solution to boost economy of tribal villagers.

Solution:

The fundamental aim for this project is to empower SHG, youth and women led cooperative unit to use perishable raw mangoes for long lasting and in demand for amchur product. The aim is to get basic, long last demand product for amchur. We aim this by performing study to understand the rawness of mango, its density and proper processing unit. This could be achieved by creating topographical maps and gather climate data to identify the best location for drying and packing units. This study will allow the primary products description and later funding for this machinery units can be raised by local banks and self-help group or bachhat khata, in the meanwhile of setting up of unit, we will try to encourage the youth for attending training programmes in other processing

unit. Once the unit is set up, the machinery required will be set up and for the generation solar tunnel dryers or hybrid solar wind electricity. The location for this will be near Anganwadi centres, panchayat campus as power will be easily available to unit as per availability of land.To ensure everything goes without any problem, the hands-on training will be given to youth and hygienic protocols will be maintained. The actual work flow is washing, peeling, slicing before sun drying for 2 3 days under protective cover to keep them safe after contamination. Once this is done, it will send to powder processing with labelled pouches with branding in market. The product will be available in nearby talukas such as Akkalkuwa and Shahada and at SHG Bazars, the other value addition for product could be mango seed powder. The expertise of Ru-Tag could be value addition for enhancing the product and its output in market with good other value-added product.

Chapter 07

Individual Learning

SHANKAR JAMJAGALE

The 9 weeks stay was eye opening for me, as it was my firsthand experience to such rural area, as I have been born and raised in Mumbai. I was able to see the other part of the India, their struggles and the life they are living. The deep sense of community engagement and always ready to help each other is rarely seen in cities. The celebration of festivals with great enthusiasm and to helping out in funeral and other occasion is very commendable. As there was shortage of electricity and water, we had to struggle to get even one single bucket of water, this led to understanding every drop of water is so important and the people are living in such conditions even during when there is no water. There was hardly 1-2 hours of electricity a day, which was difficult to charge our phone, this led us the opportunity for exploring the nature and the people around it. We were welcome with open heart and the POC made sure, we get basic things to survive. The other part was open defecation of people when there is no water, we had also had to it, as it was terrain region and the harsh winds led to fall of electric pole, leading to no electricity for 5 -6 day. Overall, we had memorable experience, we understood the importance of every droplet of water and the importance of electricity and to survive in very limited resources.

DEEP PATIL

In the 9 weeks, we hardly get electricity and water. The experience taught me how to live life with very less resources and the correct use of resources available in nearby surroundings.Firstly, it gets hard to adjust, but later able to adjust in half water of bucket for a day. Villagers have lot of hard time and to deal with problems and when I talk, I do had seen last ray of hope in their eyes for development and process of village. Additionally, an important lesson was that they continuously faced things like a seasonal disconnect related to no bridges or water issues in some hamlets or limited or no electricity, and they found ways to work around these issues and help each other. I really appreciated the informal cooperation within the community and how they got themselves

organized together during crises like monsoon flooding. There I got to learn how people care for trees, forests and animals, which sensitised me, and the experience gave me a sense of fulfilment. Also, There I learned what people do for mountains, trees, Katri forests and animals, this sensitised me, and the experience helped me feel fulfilled. People can live peacefully in villages without needing lots of resources, but they must have access to basic facilities. The government can promote access to basic facilities, then, make India Viksit by itself and people will continue to excel by creating a very fine life.

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