Research Paper

BAMBOO A Glocal Solution

Hiral JOSHI, India

Abstract

Bamboo has been in wide usage since ancient times as a low-cost material for construction. They are the largest & the fastest growing members of grass family in the world. Bamboos are of noteable economic& cultural significance. This is an alternate building material which is renewable, environment friendly & widely available, as the wood resources are diminishing & restrictions are imposed on felling the natural forests. To re-establish a healthy urban environment we seek to develop policies for adaptable cities and to make the building environment more resilient to extreme weather conditions and to overcome challenges such as pollution , climate change , heat islands and resistance against health hazards (eg : pandemic covid 19) ,utilisation of bamboo as an alternative building material will be considered as Glocal solution for implementing of eco-systematic approaches. The detailed case study will be presented in paper later.

Keywords: BAMBOO,RENEWABLE,ECONOMIC, RESILIENT,GLOCAL, ECO-SYSTEMATIC .

1. Introduction:

Men and Nature work hand in hand . The throwing out of balance of the resources of nature throws out of balance also the lives of men.

---- Franklin D. Roosevelt!

So in order to maintain balance among men and nature sustainable development is the key. Plant resources have gain new utilisation phase, due to quick advancement in science and technology. To support human existence and development, plant resources have been used as the foundations for the human societies since ancient times. In this global era the renewable sources are considered more reliable for raw materials, food, clothing, medicine, energy, furniture, construction materials etc. Bamboo is very important natural resource. It belongs to the perennial grasses group. Bamboo is renowned for its adaptability and short development lifecycle and extraordinary rapid growth. Bamboo species are easily adaptable according to the climatic conditions such as tropical , sub-tropical and temperate areas.

1.1 History:

"Centre of the life is Bamboo , it is said that from Birth (craddle) to Death (bier)every step of life is supported by Bamboo".

Bamboo share almost 1500 species and almost 90 genera. It grows approx. 7.5 to 40 cm a day, with world record being 1.2 m in 24 hrs. in Japan. Commercially important species of bamboo usually mature in 4 to 5 years time span, after which multiple harvests are possible every second year for upto 120 years in some species and indefinitely in others. China has the highest bamboo diversity in world followed by Japan and India. Bamboo is considered as one of the important non- wood forest resource. It is wood substitute and help to minimise the timber demand pressure on forest wood production.

1.2.Properties of Bamboo:

1) Physical Properties of Bamboo:

Compared to wood the thermal conductivity is slightly higher of bamboo so it has excellent insulation property. The outer wall or the cortex of the culm consists of two epithermal cell layers with a high silica content which provides the strength to the epidermal layer. It is covered by a glossy surface with a wax coating on top. This provides an extraordinary hardness to the outer surface of

the culm , which provide protective shield against insects , wearing out and even for improving the acoustical quality of the sound feel in a bamboo forest. Specific gravity varies between 0.5 to 0.9 g /cm 3 depending mainly on the species and the type of rizome.

2) Mechanical properties of some Woods and Bamboo:

Woods	Strength (MPa)	Mod. Elasticity (GPa)	Density (g/cm3)
Ceder	29.3-48.5	4.5-9.8	0.29-0.46
Fir	30.7-33.8	5.9-6.7	0.31-0.34
Pine	34.0-41.6	6.5-8.8	0.36-0.42
Spruce	31.0-41.6	7.3-8.5	0.38
Oak	47.7-74.9	7.9-12.4	0.53-0.61
Bamboo (Fibre)	6.10	46	1.16
Bamboo (Matrix)	50	2	0.67
Bamboo (Composite)	140-230	11-17	0.6-1.1

Table :1 Source :(Bodig&Jaine , 1993) in Amada et al (1996)

3) Chemical properties of Wood &Bamboo

Components	Wood	Bamboo
Cellulose (%)	40-50	45.3
Hemi-cellulose	20-35	------
(%)	15-35	25.5
Legnin (%)	-------	24.3
Extractive (%)	34-220	150-520
Olyses (%)	< 10	2.6
Tensile strength (MPa)		

Table :2 Source : Li, Zeng , Xiao , Fu, Zhou (1995)

4) Fire resistance of Bamboo :

The fire resistance is very good due to high content of silicate acid. Bamboo can stand a temperature of 400 degree c as it contains water and due to its high elasticity it can be used as a building material in earthquake zones. Fire resistance protection for structural bamboo – As boron is fire retardant but for even more protection the following formula can be used. Boric acid / Copper sulphate /

zinc chloride / sodium di chromate: ratio 3:1:5:6 recommended concentration is 25% for indoor and outdoor use.

(Ref: Neelam Manjunath, GuaduaBamboo)

1.3.Importance of Bamboo:

People in all cultures believe in positive energy and 5 major elements which are wood, earth , fire , water and metal. These 5 major elements are signified by a bamboo species called “Lucky Bamboo.” The stem represents the wood element and rocks represent earth. Water that is poured daily on this plant represents water element. The red colour ribbon tied on this plant represents the fire element. The glass pot represents the metal element. So in this way all the 5 elements are balanced by this plant. A lucky bamboo plant belongs to the lily family “Dracaena Sanderiana”. But as it resembles bamboo more than lily, the bamboo word is attached to its name. As it shows good fortune lucky word is associated with it. As bamboo is a fastest growing and highest yielding plant, its maintenance does not require much labour and it provides source of livelihood to many local artisans. In current scenario it is being used as industrial raw material for pulp and paper, construction and engineering materials, health, food, handicrafts etc.

1.4.Environmental Importance Bamboo:

Bamboo has a significant environmental importance as its soil grabing roots could help to prevent soil erosion with a sum of stem flow rate and canopy intercept of 25% which in-turn helps to reduce rain run off , preventing massive soil erosion and making it very earth friendly that maintains the stability of soil. Also its roots could leach heavy metals from the soil and efficiently draw water closer to the surface due to its strong water absorption capacity. As a result environment that is inhospitable to other plants could be improved and modified. Bamboo can absorb high amount of Nitrogen from soil and Carbondioxide from air and act as a natural air purifier which help alleviate water and air pollution problems. In comparison to other trees/plants bamboo releases 35% more Oxygen, which can reduce Carbon footprint and help fight global warming.

Ref: lewisbamboo.com

1.5.Nutritional Importance of Bamboo:

The high concentration of cellulose in bamboo have been shown to stimulate the appetite , improve digestion low carbohydrate diets have been shown to help prevent or improve some medical conditions , including diabetes , HBP and cardio vascular disease. Bamboo shoot is a rich source of Vitamin B1, Potassium , Iron , Copper selenium , Amino acids, Dietary fibre , Phosphorous Magnesium , Nicotin –acid , Potassium Protein , Sodium , Calcium Zinc , Ribo Flavin , Carotene and essential minerals. (image of dwarf bamboo).

1.6.Medicinal importance of bamboo

1) Chemical benefits of bamboo: Bamboo plant is rich source of betaine , reducing sugar , oxalic acid , gluteline , vaxes , benzoic acid , cyanogenic glycosides ,silica etc.
2) Antimicrobial properties of bamboo: The extracts of bamboo like ethanolic and aqueous extracts for antimicrobial activity against the strains of staphylococcus aureus , E.coli, etc. Thus it can be observed that the extracts of bamboo have effective inhibitory ability against staphylococcus aureus. In comparison to penicillin the ethanolic and aqueous

extracts are highly effective. Therefore it is proved that the extracts of bamboo plant is potential source of antimicrobial drugs.

3) Rhinorrhagia treatment : Rhinorrhagia means nose bleed a health condition marked by hemorrhage from the nose. Bamboo shoots , leaves , roots and seeds can be used as herbal medicine for the treatment of rhinorrhagia.
4) Anthelmintic Purposes: With the strong anthelmintic compositions , bamboo leaf can be used for preparing herbal drugs to destroy parasitic worms.
5) Astringent properties: Bamboo plant has strong astringent properties so it is used for preparing herbal astringent lotion to reduce bleeding from minor cuts etc . It is also used for cosmetic purposes in treating oil skin.
6) Antispasmodic effects: Bamboo plant is used for preparing antispasmodic drugs for relieving spasm of the involuntary muscles.
7) Aphrodisiac properties : The bamboo plant has aphrodisiac properties that can be used for preparing medicines for stimulating sexual desires.
8) Culinary purposes : As a green vegetable bamboo shoots & tender leaves , are used for cooking food , soup , curry , pickles , meat and fish dishes. The young shoots are also used in the production of bamboo wine and soft drinks.
9) Livestock fodder: To provide feed to livestock and farm animals such as cattles, cows, goats, sheeps etc the bamboo leaves can serve as fodder.
10) Phlegm treatment: For treating phlegm the branches, roots, leaves and seeds of bamboo plant are used for preparing herbal medicines. These medicines helps to get relief specially during cold and to cure thick viscous substance secreted by the mucous membranes of the respiratory passages(helpful in treatment of Covid -19).
11) Laryngitis treatment: It is a health condition caused as a result of the inflammation of the larynx which results in painful cough , huskiness , harsh breathing or loss of voice can (Covid -19 symptoms) be treated with the help of herbal medicine prepared from bamboo shoots.
12) Febrifuge Properties: In the treatment of fever reduction and cure, bamboo leaves, stems and roots can be used as a herbal medicine.
13) Antioxidant potential of Bamboo: Due to its high anti-oxidizing properties bamboo can be used as removal of potentially damaging oxidizing agents in living organisms.
14) Anti-cancerous properties of bamboo : Bamboo has anti cancer properties as the alkaline extracts of Sasa-Senanensis leaves is known to be effective for treating cancerous growth.
15) Anti-diabetic Properties of bamboo: To maintain the blood sugar level the herbal medicines prepared from bamboo shoots and its extracts can be used.
16) Balanced Cholesterol level: To regulate the cholesterol level bamboo plant parts are used for herbal medicines.
17) Healing of Skin eruptions: In the treatment of skin eruptions the decocted bamboo bark can be used.
18) Anti-laprotic properties: For the treatment of leprosy bamboo leaves are used for preparing medicines.
19) Laxative effect: For stimulating the evacuation of faeces the pungent bamboo seeds can be served as laxative.
20) Aids digestion: To boost our appetite and easy digestion bamboo shoots can be included in our diets.
21) Antibacterial properties : The bamboo leaves ca be used in tackling bacterial diseases .
22) Stimulating properties: To raise the levels of physiological or nervous activities in the body , bamboo leaves can be used as stimulant.

So above mentioned are the medicinal benefits of bamboo plant.

1.7.Importance of bamboo as an alternative construction material:

Bamboo plywood is a strong building material that is increasingly used as an alternative to more traditional hardwood. Bamboo plywood tends to be durable in fact it is 25% harder than re oak and 12% harder than maple wood, thanks to the tensile strength of 28000 psi. It has good heat preservation and heat insulation property. Bamboo is stronger than wood or timber in tension and compression. The tensile strength of fibres of a vascular bundle could be upto 12000 kgs per sq cm almost twice that of the steel. Bamboo can be processed very easily for use with even a stone axe.

1.8.Uses of Bamboo:

Bamboo has many benefits and uses as stated above. It is mainly used in construction like flooring , roofing , designing , scaffolding , interior products (furniture), partition walls , beams and columns , bridges , houses , bldgs., schools , different ciil structures, facades, roads, etc. Bamboo facade is used as a sustainable and eco-friendly alternative instead of scarce tropical hardwood. Due to the unique patented process bamboo is superior to the best tropical hardwood species. As the salts used in Bamboo facade have a hardness, stability and sustainability.Bamboo like wood is a natural composite material with a high strength to weight ratio useful for structures so it is preferable to use bamboos in earthquake prone zones due to its elastic properties . Bamboo roofing is an eco-friendly and economical alternative to steel and concrete roofing. It also provides better asthetical and natural look. Architecturally bamboo has become of the most popular chosen material in design projects due to its sustainability and hardwearing characteristics . It rivals the tensility of steel and has higher compressive strength than wood or concrete. It has a natural smooth surface that gives attractive aesthetic look due to which painting can be avoided making it cost effective construction. Also it is useful as biofuel , fabrics , cloth , accessories , paper , pulp , charcoal , food , ornamental garden planting and as a large carbon sink and good Phyto-remediation option , improving soil structure and soil , to promote fertility in cows , as medicinal purposes etc.

Electricity Supply: After a year when Thomas Edison developed the first practical light bulb , he was in search of right material for the filament (the part inside the light bulbs that glows when the electric current pass through it) more than 1600 materials were tested by Edison. Finally Edison ended up using bamboo fibre for the filament and it was discovered that carbonized bamboo had the capacity to conduct electricity and last more than 1200 hrs compared to any other material at that time. Ref : Ref :- Bal, M.L. Singhal etc.

Charcoal production: Researchers have discovered that bamboo charcoal is a natural “Nano tube “ that can conduct electricity as a very thin film disbursed on the surface of a glass or a silicon substrate.

1.9.Advantages of Bamboo:

Bamboos are friendly to the environment. They reduces pollution by producing oxygen more than 35% more than trees do. The roots of the bamboo creates a water barrier that helps to control soil erosion. Bamboo also helps in reduction of water pollution by consuming high quantities of Nitrogen. As compared to other construction materials ,

bamboo is light weight material so it is easier for transportation. Approximately 8000 pounds of waste is created from the construction of a single 2000 sq ft. home. The majority of the waste is wood , cardboard and dry wall that almost all of it ends up in landfills where in bamboo is completely recycle-able. Bamboo is strong. The strength ratio of some bamboo species is same that of steel and almost twice the compression ratio of concrete. So inspired by heightened interest an eco-friendly bamboo teams of architects and builders are creating amazing bamboo structures for schools, hotels , homes and even bridges. Bamboos are mostly available across the world hence energy required for transportation can be saved. With the above mentioned advantages of bamboo is destined to play a vital role in the green revolution. So the preference is been given by the people to build with this versatile , sustainable building material.

Ref : study by The National Association of home builders , Green Home Guide , Neelam Manjunath.

1.10.Disadvantages of Bamboo:

Shrinks much greater as compared to other types of materials.If Bamboo is not sufficiently treated it may undergo the fungus attack or attack caused by insects. There may be problem of swelling and shrinkage of bamboo in concrete. As bamboo decays quickest than wood it should be treated with proper preservatives in order to make it resilient.

2. Environmental Problem :

Air, water and land pollution are also significant environmental issues in local region (Doha Qatar). In addition to smog and acid rain, the nation has been affected by the air pollution generated by industrial emissions and vehicle emissions . Pollution from the oil industry poses a threat to the nation's water. The solution for above mentioned problem is given below.

Basic terminology:
Environmental Problems (ENVP)
High Blood pressure (HBP)
Water Pollution (WP)
Soil Pollution (SP)
Air Pollution (AP)

3. Territorial Approach to climate change:

Energy balance is the energy required to produce a unit of building material with a certain level of load-bearing capacity.

Energy balance of various building materials in MJ/m3 or N/mm2

Concrete : 240
Steel : 1500

Wood : 80
Bamboo : 30

Hence bamboo is SUSTAINABLE and GREEN!
Ref :From J.A. Janseen bamboo research at the Eindhoven university of technology , Neelam Manjunath.

Bamboos survived Hiroshima; An extraordinary example of Bamboo's resilience is the fact that it was the only plant to survive the radiation of the atomic Bombings in Hiroshima , Japan in 1945. The incinerating heat destroyed all trees and other plant life, except for 1 Bamboo grove. The grove has since been removed , but culms are preserved in a museum in Hiroshima. So bamboo's can be grown in hot climate zone of Doha Qatar. Also the structures build from Bamboo can be resilient and will provide livelihood to the local artisans of Doha Qatar making it a sustainable country.

3.1.Important Case Studies:

3.1.1. Natural resources are renewable and eco -friendly to use. Specifically to reduce carbon footprint caused due to construction materials needs to be reduced to have a healthy lifestyle. Here's the Glocal solution "Bamboo" used as construction material in one of the renowed sustainable building - Bamboo Symphony designed by Mansaram Architects.

Development and environment are inextricably linked. Three criterias to be necessarily retained are: social justice, ecological prudence and economic efficiency. There are two definite categories of development are emerging one based on the principle of recycling and the other on the use of natural materials. Mud and Bamboo figure prominently in the second category of development. Bamboo is the vital building material in the new architectural moment with sustainability and integrative approach due to its two important criteria HIGH SCIENCE AND SIMPLE TECHNOLOGY. (This project is short listed in the World Architectural Festival 2011).

Fig : 1 Bamboo Symphony

Fig: 2 Bamboo Symphony

- **Architects:** Manasaram Architects
- **Project:** Bamboo Symphony
- **Location:** Plot #7,Aditigreenscapes,Bangalore,India.
- **Client :** Manasaram Architects,Bangalore,India.

- **Built -up area :** 210.00 SQ
- **Completed Year :** Dec. 2010
- **Photographer:** Mr.Krishnau Chaterjee
- **Software used:** AutoCAD, SketchUp, Corel, Photoshop

Fig: 3 Bamboo Symphony

Bamboo plays a key role in the lives of 1/5th of the world population.

The office building serve as an example of professional practice both existing and in the future by embodying all the design philosophies along with other requirements of space and services. Bamboo has been used as the main material for the building and called it "Bamboo Symphony".

Bamboo Symphony is an effort to reverse this trend and replace steel , concrete etc with bamboo!

The tensile strength of bamboo fibers can be almost twice that of the steel. The engineering qualities of bamboo and its intrinsic structure anticipate the principles of many high-tech materials-making it an excellent value for money , with its attractive appearance an added bonus.

Special-Features:
A Zero Energy Development with a closed loop for the Building Materials, Processes and Technologies. The STRUCTURE of the building is its most unique feature. It is based on the structure of the fisherman's net, a structure in Synergy, where total load is distributed to the system ,i.e.,to all the Bamboo elements. THESE STRUCTURES ARE HIGHLY EFFICIENT WITH MINIMAL ENERGY & MATERIAL USAGE In nature we find several examples, like Cobwebs etc .The reason for their efficiency is homogeneous load distribution, which efficiently leads to global synchronization. Interestingly, the tensile strength of spider silk is greater

than the same weight of steel and has much greater elasticity, just like bamboo. model of SYNERGETIC AND TENSIGRITY structures.

Fig: 4 Bamboo Symphony

It has been designed as a hybrid of the two systems and was physically tested before concreting the roof. These types of structures are being made across the world with modern materials with high energy balance. Bamboo is the only Natural building material with lowest energy balance that can be used for these structures. The columns in BAMBOO SYMPHONY THOUGH LOOK HAPHAZARDLY PLACED HAVE DEFINITE POSITION, SIZE AND INCLINATIONS, i.e. are STRUCTURALLY RELEVANT, just like the highly evolved TECHNOLOGICAL LOGIC WE FIND IN NATURE!!! The ROOF WAS ALLOWED TO DEFINE ITS OWN SHAPE AS PER THE FLOW OF THE FORCES — NATURALLY, LIKE A FABRIC ASSUMING IT'S SHAPE. These structures are highly efficient with minimal energy and material usage.

Fig:5 Bamboo Symphony

Extensive Rainwater Harvesting System with 75,000 ltrs sump.
All water bodies created from rain water collection and DEWATS water treatment.
Special water conserving installation and fixtures, recycling and treatment, treated water for flushing, washing , gardening , etc. Natural Ventilation is 100% and natural utilization of building mass as thermal storage via passive cooling.

Solar energy System: For 100% energy requirement with grid connectivity as stand by.
Day Lighting: Approximate percentage area needing artificial light during daylight hours: 0% The Technology of construction with Bamboo is the greatest contribution the East and the South can give to to the West and the North towards our approach for Sustainable Architecture and Development.

Fig:6 Bamboo Symphony

Fig:7 Bamboo Symphony

Fig:8 Bamboo Symphony

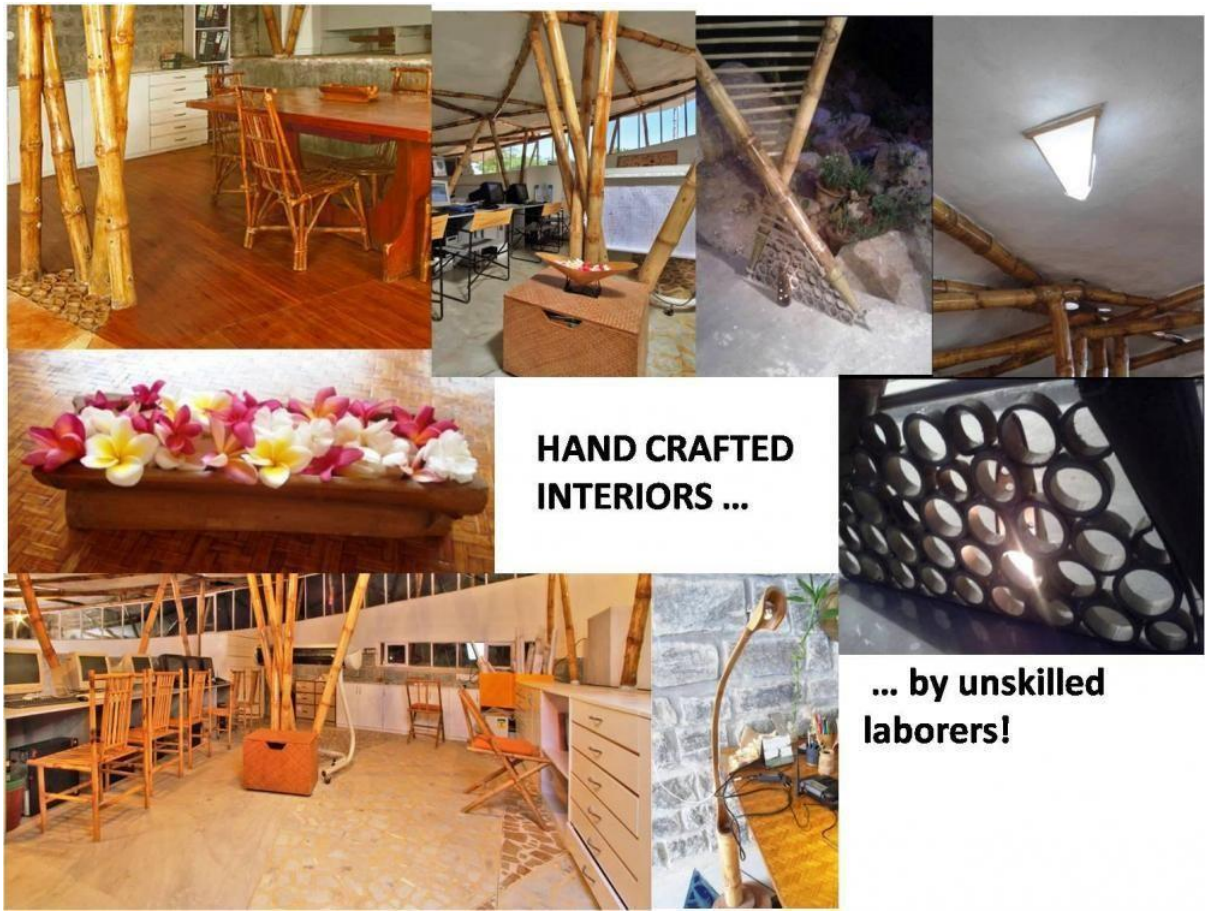


Fig: 9 Bamboo Symphony

Fig:10 Bamboo Symphony

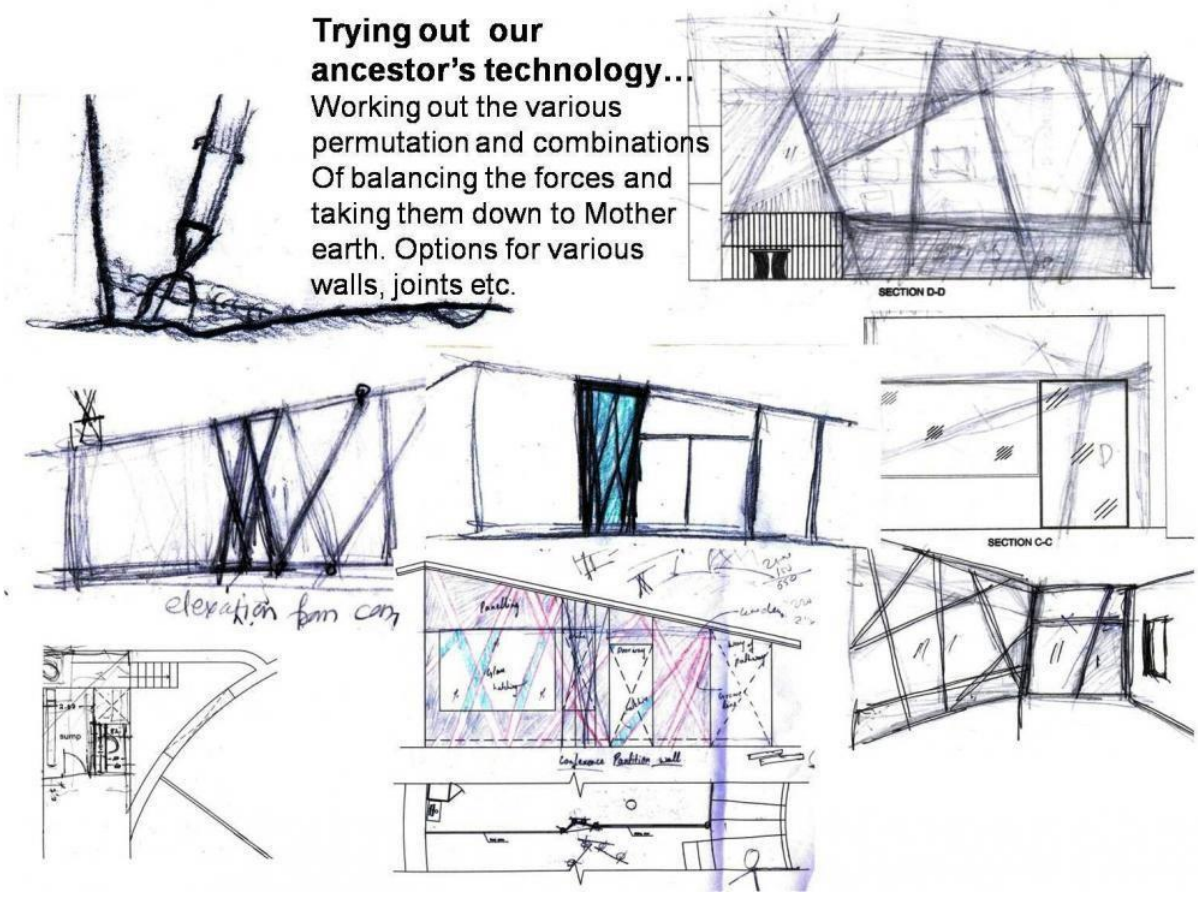
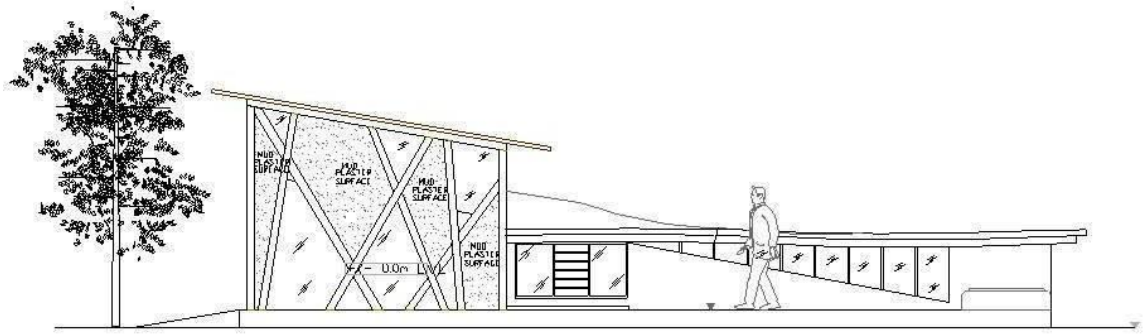
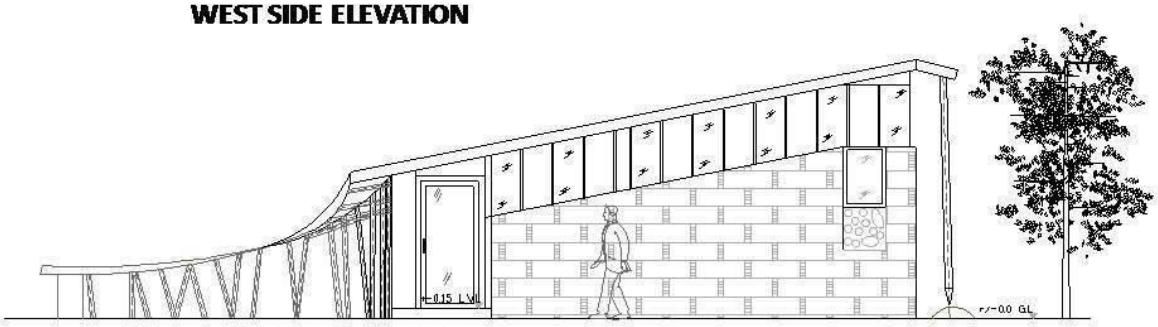


Fig:11 Bamboo Symphony



WEST SIDE ELEVATION



EAST SIDE ELEVATION

Bamboo Symphony

Fig:12 Bamboo Symphony

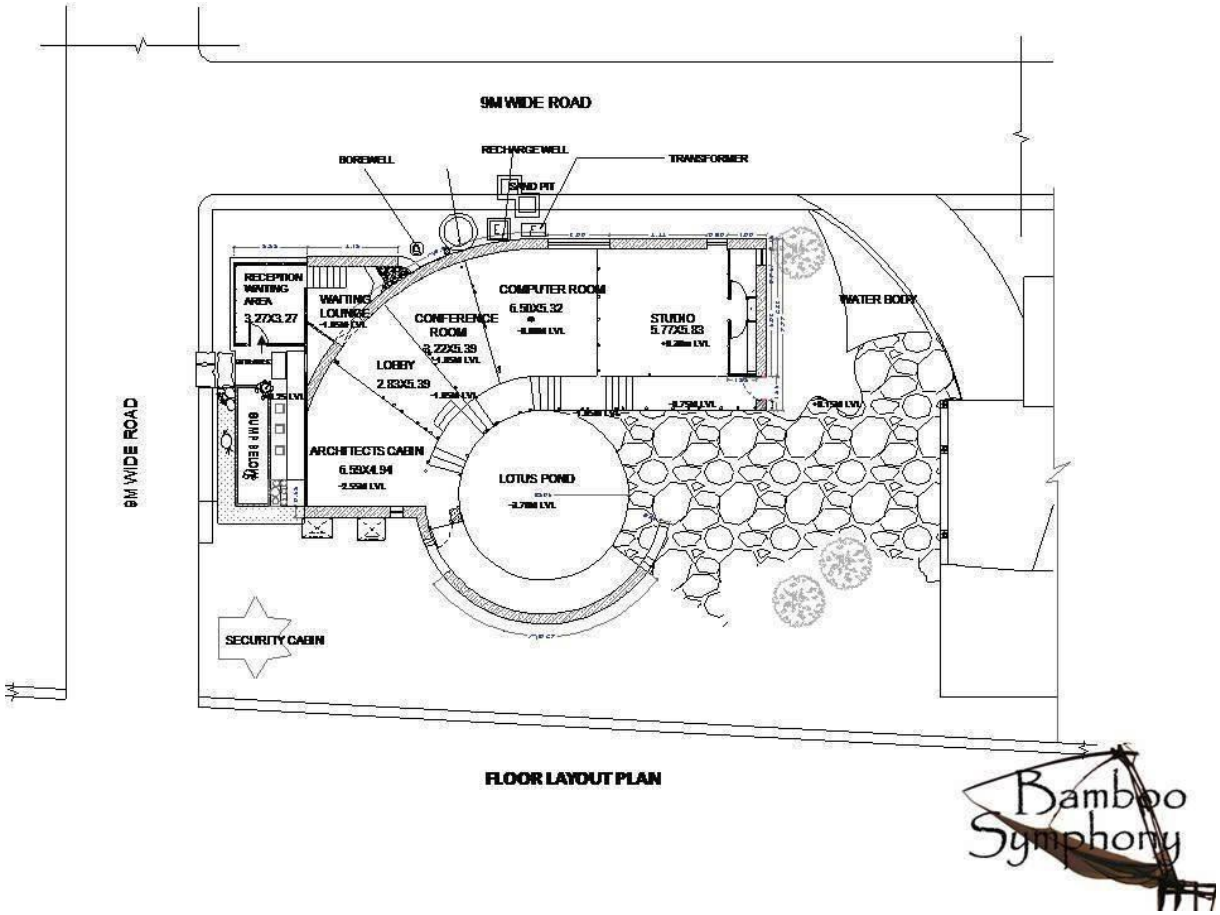


Fig:13 Bamboo Symphony

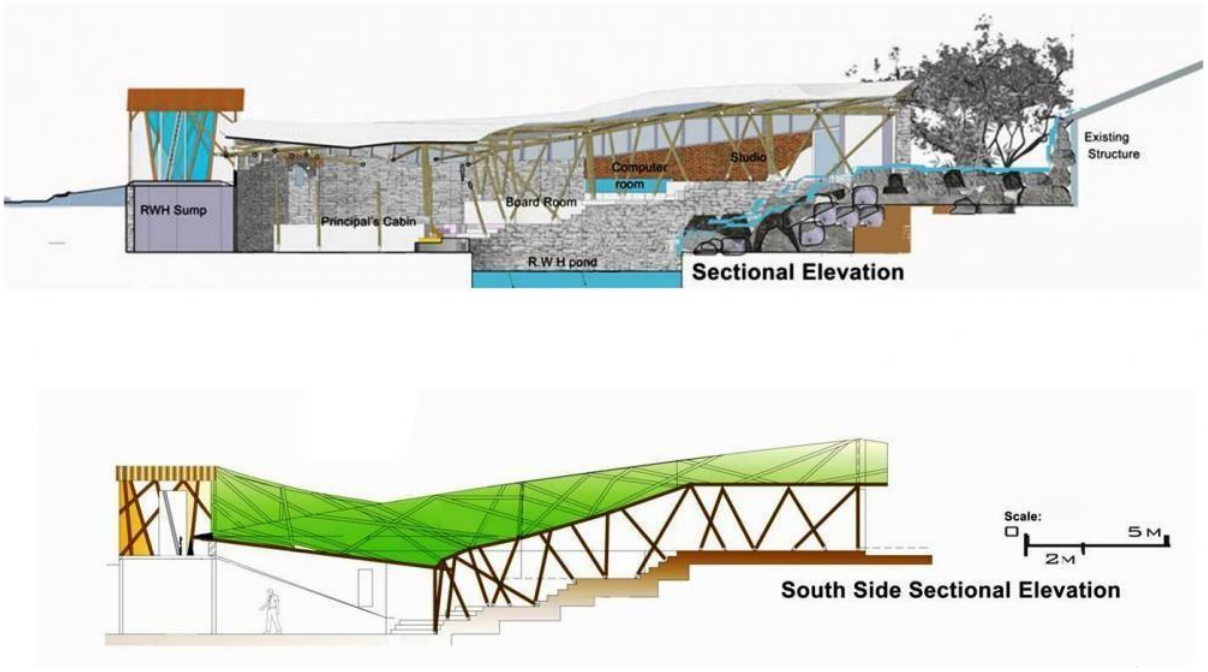
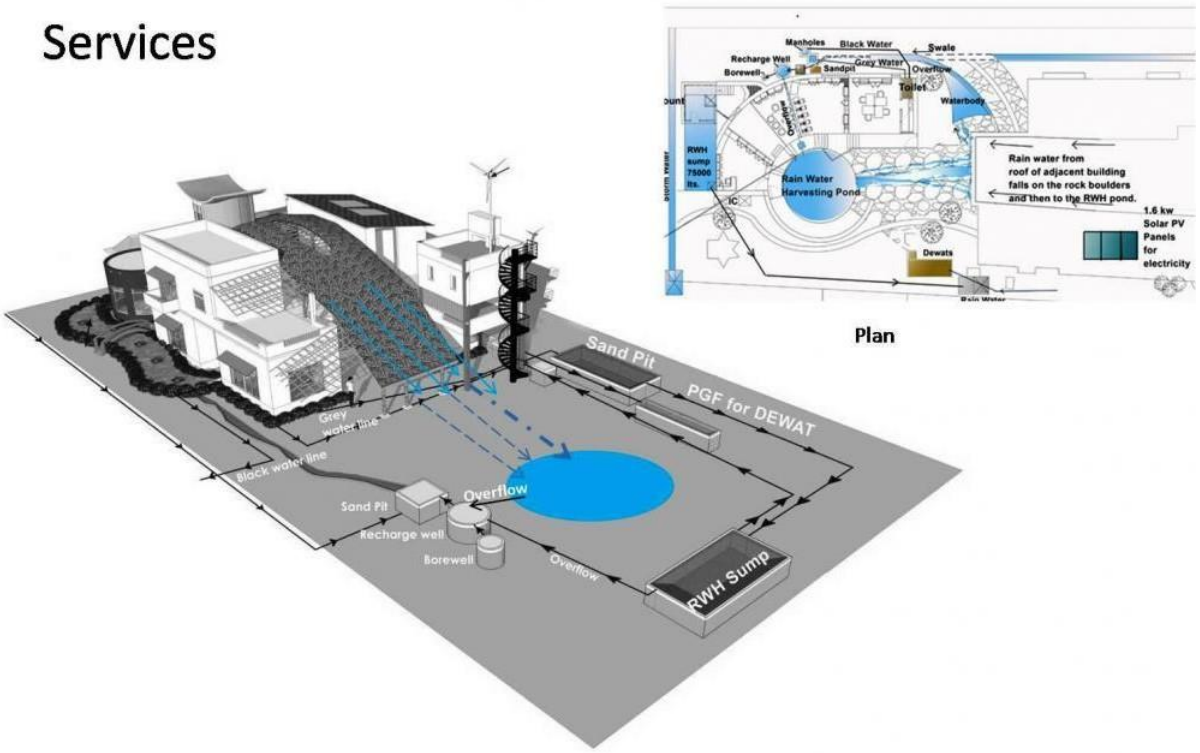


Fig:14 Bamboo Symphony



Collecting roof top rain water and flowing it through water fall in the lotus pond for Rain Water Harvesting .

3.1.2.People visit a building made of bamboo at a school at a village in Sibang, Badung regency on Bali island. Bamboo is so strong and versatile that the Indonesian island of Bali has made it an emblem of sustainableconstruction, replacing buildings of concrete and steel with far greener alternatives.

Case study of Green School Bali , Indonesia is giving its students a natural, holistic and student-centered education in one of the most amazing environments on the planet.

Fig : 16 Green School

Location: Sibang Kaja, Bali

Client : Green School

Site Area: 45,000 sqm

Floor Area : 2740 sqm

Fig:17GreenSchool

Fig:18 Green School

The main building of Green School was initially termed as" central administration building " which later transformed into Heart of School . The structure has three stories, with shape of the roof in the form of three nautili spiraling into one another, supported by three giant bamboo towers.

Kindergarten Class Room at Green School:

Location: Sibang Kaja, Bali

Client : Green School

Site Area: 45,000 sqm

Floor Area : 155 sqm

Fig:19 Green School

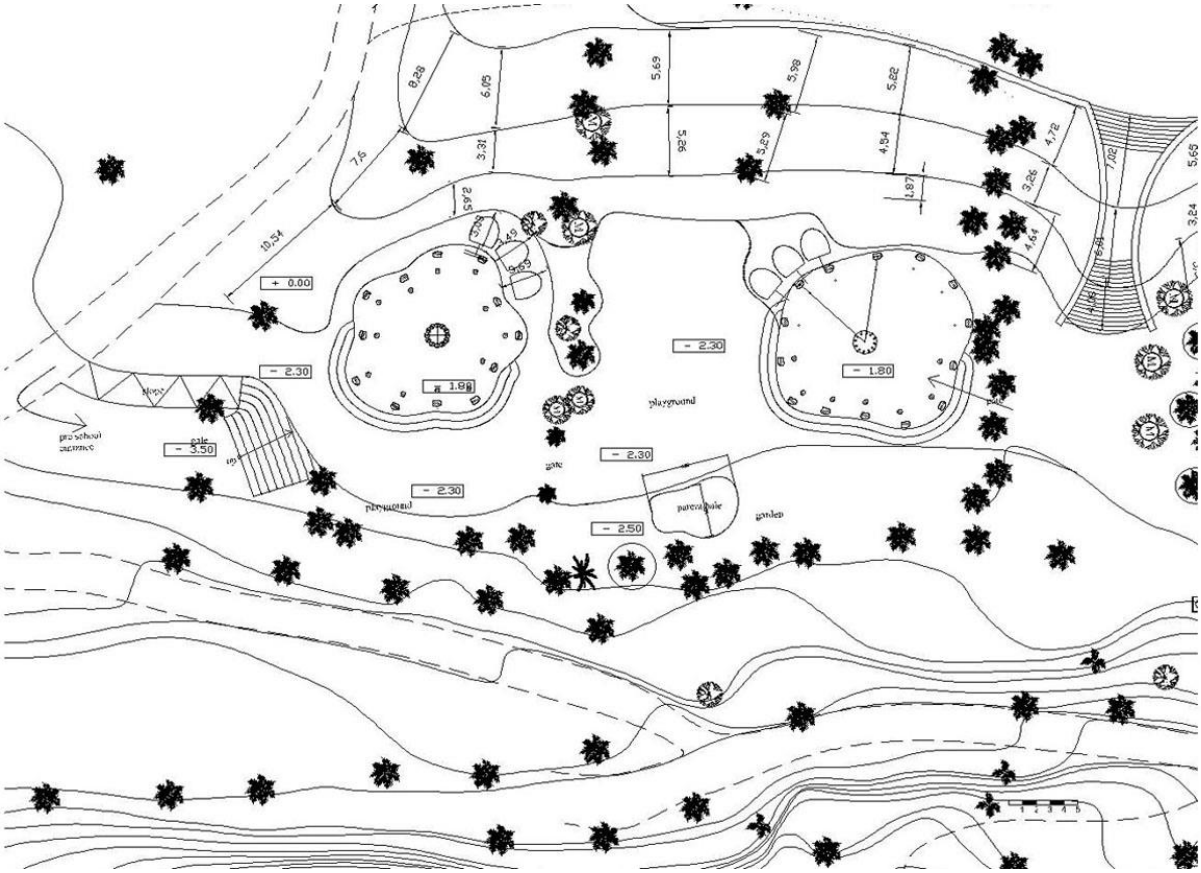


Fig: 20 Green School

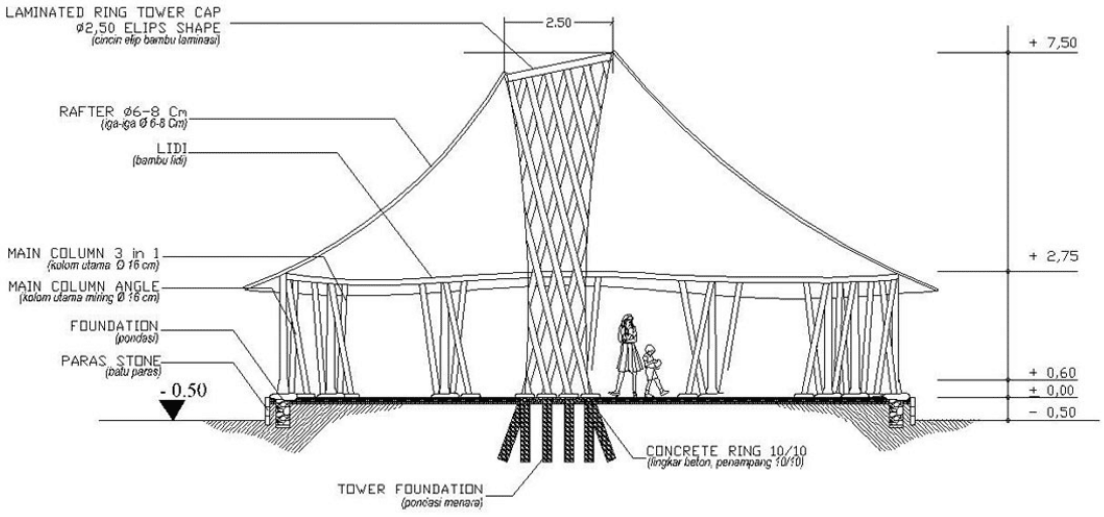


Fig: 21 Green School

Turtle Class Room at Green School :

Location: Sibang Kaja, Bali

Client : Green School

Site Area: 45,000 sqm

Floor Area : 140 sqm

Fig: 22 Green School

It is one of the favorite Class Room at Green school having capacity to accommodate 30 students. Its elliptical structure and 4 cubby areas make it a dynamic space that feels expansive yet comforting.

Fig: 23 Green School

Mepantigan Auditorium at Green School :

Location: Sibang Kaja, Bali

Client : Green School

Site Area: 45,000 sqm

Floor Area : 330 sqm

Fig: 24 Green School

Fig:25 Green School

The Mepantigan Auditorium is a multipurpose event space at Green School ,it is supported by two giant arches that span across 15 mtrs. Inside it feels like being outside but without inconvenient whether conditions.

Aldo’s Kitchen:

Location: Sibang Kaja, Bali

Client : Green School

Site Area: 45,000 sqm

Floor Area : 500 sqm

Fig:26 Green School

Fig :27 Green School

Aldo's Kitchen is a living legacy of the brilliance of the late Aldo Landwher. This structure was one of the earliest expressions of some the key architecture concepts currently used by IBUKU. It is a 3 stories high and includes a basement and a secret under-ground tunnel. It is currently used to house the IBUKU design team.

Millennium Bridge at Green School:

Location: Sibang Kaja, Bali

Client : Green School

Site Area: 45,000 sqm

Floor Area : 70 sqm

Fig:28 Green School

fig:29 Green School

The Millennium Bridge is testament to the strength of Bamboo. It is the largest Bamboo bridge in Asia with a span of 23 m and an impressive Minangkabau inspired roof. It stands as an outstanding example of what is possible when Architects , Engineers , designers and craftsmen come together to build in a new way.

Star Lodge at Green Camp: Location:

Sibang Kaja, Bali

Client : Green School

Floor Area : 145 sqm

Fig: 30 Green School

The star dorm was built for green camp which offers short term residential programes on Green School Campus. It is two stories tall with a mezzanine above and can accommodate 40 people.

Hence the school's physical space supports critical thinking , creativity and entrepreneurship . Its location is integral for enabling students to connect directly with nature and consider ways to help the planet. All learning is directly connected to real world application. The school takes a thematic and interdisciplinary approach to teaching content. In comparison to other normal schools , the students of Green School showed lower levels of stress , greater resilience , less distraction , higher self-esteem and greater motivation along with holistic development. The school's impact also extends to the environment.

Such ambitious bamboo projects in Bali are mostly driven by eco-conscious foreigners. With studies showing construction to be one of the world's least sustainable industries -- eating up around half of the globe's non-renewable resources -- sustainable construction is slowly taking root around the world. It is among the key topic for discussion at the Rio+20 United Nations Conference on Sustainable Development, which opens June 20 in Rio de Janeiro. In Sibang, the tawny brown bamboo buildings with their grass thatched roofs appear to be rising from the earth. The three-storey chocolate factory is pieced together using a complex system of scissor trusses and bolts, thanks to clever architecture. It resembles the traditional longhouses found on Borneo island and was made with more than 18,000 metres (59,000 feet) of bamboo from Bali and Java. At Sibang's nearby Green School, the 240 students -- most of them children of expatriates -- learn in semi-outdoor classrooms decked with bamboo furniture. The bamboo interior of a school at a village in Sibang, Badung regency on Bali island.

3.3. Conclusion:

From being " Glocal solution" to being called "Green Gold" the perception of bamboo as an alternative construction material promotes the sustainable architecture which blends the technology and creative skills . The construction should be done by keeping in mind nature and to sustain the mother earth eco system. Bamboo combined with other natural resources like mud a, stone etc provides sustainable development, environmental security, economic prudence and livelihood to local artisans all at the same time. As bamboo is easily available, renewable, resilient, easily adaptable, naturally abundant, low energy local material it is a Glocal solution to fight back climate change.

As bamboo generates more amount of oxygen it is the need of an hour to incline towards major cultivation of Bamboo as the entire globe requires the solution for sufficient amount of O2 for healthy lifestyle specifically during this pandemic of Covid-19. Tourism can be uplifted which in-turn will create circular economy (reduce, reuse, recycle). If the basic rules and innovative technologies along-with complementary materials and treatments used for Bamboos are followed, the possibilities worldwide are endless.

I am excited to see that Bamboo will be proven a Glocal solution in creating resilient, adaptable, holistic urban environment along-with Green infrastructure.

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