Contemporary Bamboo Architecture in India and its Acceptability

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With the Global warming issues raging the globe and the construction sector a major contributor, scientists across the globe are looking towards low energy, resource efficient building materials and technologies for solving the problem of keeping the pace of development without further raising the carbon levels.
Safety in a built environment is a fundamental right.

- Tropical and sub tropical regions have the largest housing and infrastructure deficit and are also the sites of major natural disasters.
- A sustainable building should be able to perform in both normal and extreme conditions.

<table>
<thead>
<tr>
<th></th>
<th>Developing and Threshold-Countries</th>
<th>Industrialized Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Natural Disasters</td>
<td>1,838</td>
<td>719</td>
</tr>
<tr>
<td>Economic Loss in million US $</td>
<td>329,615</td>
<td>457,091</td>
</tr>
<tr>
<td>Casualties</td>
<td>649,338</td>
<td>16,200</td>
</tr>
</tbody>
</table>

CHILE EARTHQUAKE 2010
CASUALTIES: 550 APPROX

UTTARAKHAND FLOODS 2014
CASUALTIES: OVER 5000

ANDAMANS TSUNAMI DISASTER 2004
CASUALTIES: OVER 7000
• Majority of the knowledge of bamboo building technologies is based on cultural traditions.

• India has a rich and diverse tradition of bamboo buildings with various indigenous technologies.

• How far do these alternative materials and technologies match up with the conventional ones?

• Why do people still hesitate to build a bamboo house for themselves?
Bamboo is now being hailed as the future sustainable material through research, development and usage across the globe! Then why still the questions?

Let’s connect the dots!

• Traditional Bamboo Architecture in India - A literature survey - Problems and Issues

• Contemporary Bamboo Architecture in India

• Acceptability of Contemporary Bamboo Architecture - Identifying major issues

• Systemic Solution as the Key
Traditional Bamboo Architecture in India – A literature survey
Bamboo houses in North Eastern states
Bamboo houses in river planes
Bamboo houses of Central India
Bamboo houses of desert regions
Bamboo houses of South India
Bamboo houses of coastal belt
Major Traditional Construction Systems of Bamboo Buildings of India
<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Building Components</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Foundation and Structure</td>
<td>Building on Stilts: Beam and Post system with bamboo in combination with local wood. In this case the flooring is made from bamboo in various ways. Local stone foundation with mud base with column and beam system with bamboo in combination with local wood. These houses have mud flooring.</td>
</tr>
<tr>
<td>2.</td>
<td>Wall</td>
<td><em>Ekra system</em>- Walls made from woven bamboo mats with either strips or flattened bamboo. They are either left exposed or plastered with mud or lime depending on the climate conditions. If thermal mass is required, plastering is done. But if ventilation and lighting is required, the wall is left exposed. The Assam system. Walls with wattle and daub method with widely spaced frame made of bamboo splits covered with mat, jute or mesh plastered with mud or lime mortar.</td>
</tr>
<tr>
<td>3.</td>
<td>Roof</td>
<td>Sloped roof- Almost the whole structure is made from bamboo in combination with local wood. Roofing material generally used is thatch, terracotta tiles and more recently tin or sheets. Flat roofs- Two methods were used. Some places bamboo was used for the under structure in combination with wood with lime <em>surki</em> slab on top. In the second system, bamboo was used as reinforcement in the lime <em>surki</em> slab.</td>
</tr>
<tr>
<td>4.</td>
<td>Doors and Windows</td>
<td>a. They are generally made of bamboo in combination with wood, or some places with only bamboo depending on economical and climatic considerations.</td>
</tr>
</tbody>
</table>
FOUNDATION AND STRUCTURE
THE WALLING SYSTEM
THE ROOF
DOORS AND WINDOWS

Ar. Neelam M
World Bamboo Co
<table>
<thead>
<tr>
<th>PROBLEMS</th>
<th>SOLUTIONS</th>
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</table>
| • Bamboo construction most widely done in lower strata of society where QUALITY is compromised.  
• SUPPLY < DEMAND= Price Escalation  
• Paper industry dominates the demand scenario for Bamboo in India, further adding to the price escalation of bamboo.  
• This forces people to go for cheaper and substandard materials.  
• Both forests and homesteads divert their resources to sectors offering higher prices. | • SUBSIDIZING Bamboo rates for EWS.  
• RATIONING of bamboos -in areas of short supply and high prices.  
• BAMBOO DEPOTS —for easy availability  
• WASTELAND PLANTATION, mid and lowland areas and homesteads of Bamboo should be encouraged and included in the Forest Department programs in rural and tribal areas.  
• Pucca Housing Status  
• SUSTENANCE: Economical treatment of bamboo for construction should be popularized.  
• POPULARIZE: Prototype bamboo houses suitable for local conditions and climate can be constructed to popularize it among the people. |
Contemporary Bamboo Architecture in India
Research & Development

IPIRTI, Bangalore
• Treatment of bamboo
• Bamboo ply, boards, flooring, corrugated roofing etc
• Construction system & Testing

IWST, Bangalore
• Treatment of bamboo
• Bamboo-wood – plastic composite

BMTPC
CGBMT and MANASARAM, Bangalore

- Pre-fabricated bamboocrete wall panels,
- Prefab houses,
- Bamboo construction systems with
  - BRC- bamboo reinforced concrete roof,
  - BFRC- bamboo fiber reinforced concrete,
  - Freeform and Shell bamboo roofs,
- Tensegrity and synergetic structures with bamboo
- Compressed blocks with bamboo and paper waste with mud etc.
CGBMT and MANASARAM have also taken most of the technologies developed by other organizations from lab to land in innovative and aesthetical manner in their live projects, thereby creating a string of examples and database for other architects and engineers to follow.
Some other Bamboo Projects
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Acceptability of bamboo architecture—Identifying major issues
FINDING SYSTEMIC SOLUTION IS THE KEY…

Social Acceptability of Bamboo Architecture in India

Material Limitations
- Durable and structurally safe material for construction
- Fire Rating
- Connection and Joining Systems
- Conical form of Bamboo
- Use of engineered bamboo, bamboo composites and prefabrication
- Splitting Behavior of bamboo
- Small spans of bamboo buildings
- Conventional Buildings are very poorly implemented

Academics, Research and Development issues
- Integration in Academic curriculum
- Architectural Solutions
- Building Components with Bamboo
- Non availability of data and Research results in usable format
- Need for standards and testing methods
- Field testing
  - Directly determine design values
  - Get correlated to values obtained in a laboratory test
  - Be accurately used to compare different batches of materials

Social Issues
- Affordability vs. Priorities
- Substituting Bricks, Cement, Steel and Timber alone can count for a cost reduction of up to 40% Cost reduction
- Social acceptability
- Need to evolve Standards

The legal, Administrative and financial machinery for implementation
- The legal, Administrative and financial machinery for implementation
- Need for Policy frameworks
- Redefining a Pucca House
- Inclusion in SSR and National Building Code
- Definition of Bamboo as tree
- Special Policies for bamboo buildings
- Finance for Bamboo buildings
- Housing standards
- Disconnect among various agencies
- Alternative Materials should be used only on merit
- Affordability varies with time

Execution Issues
- Material availability
- Skill development
- Pre fabrication
- Treatment of Bamboo
- Raising the standards of implementation
- Elaborate, expensive and inaccurate testing methods
- Backward linkages unavailable

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World Bamboo Congress, 2015
Material’s limitations

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ACADEMICS, RESEARCH, DEVELOPMENT ISSUES

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- Architectural Solutions
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Social issues

- Affordability vs. Priorities
- Social acceptability
- Need to evolve Standards
- Prefabrication of walls, beams, columns, fenestration with BMB to reduce time and costs

Substituting Bricks, Cement, Steel and Timber Alone can Account for a Cost Reduction of up to 40%
LEGAL, FINANCIAL AND POLICY ISSUES

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Comparative cost of Structural Elements and inner walls
Cost reduction: 13.8%

<table>
<thead>
<tr>
<th></th>
<th>As on 2012</th>
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<tbody>
<tr>
<td>A Housing Shortage as on 2007 (Mn)</td>
<td>24.71</td>
</tr>
<tr>
<td>B Households (Mn)</td>
<td>75.01</td>
</tr>
<tr>
<td>C Pucca Houses (Mn)</td>
<td>53.49</td>
</tr>
<tr>
<td>D Semi Pucca Houses (Mn)</td>
<td>10.05</td>
</tr>
<tr>
<td>E Katcha Houses (Mn.)</td>
<td>2.56</td>
</tr>
<tr>
<td>F Addition to households (Mn.)</td>
<td>8.71</td>
</tr>
<tr>
<td>G Addition to housing stock</td>
<td>7.27</td>
</tr>
<tr>
<td>H Upgradation of Katcha Houses (Mn.)</td>
<td>0.38</td>
</tr>
<tr>
<td>I Additional requirement (Mn.) (F-G+H)</td>
<td>1.82</td>
</tr>
<tr>
<td>Total requirement (Mn.) (A+I)</td>
<td>26.53</td>
</tr>
</tbody>
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Source: Ministry of Housing and Urban Poverty Alleviation
EXECUTION ISSUES

- Material availability
- Skill development
- Pre fabrication
- Treatment of Bamboo
- Raising the standards of implementation
- Elaborate, expensive and inaccurate testing methods
- Backward linkages unavailable
EPILOGUE

• Create a Parallel Construction Industry
• Selection and Looping
Thank You