Sustainable Construction Solutions that Reduce Time, Labor and Cost

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BamCore

Learning Objectives

- 1. Explain how the mechanical properties of bamboo in our system result in better embodied CO2 and building performance
- 2. Describe our CAD-CAM workflows and industrialized construction methods
- 3. Showcase how we are bringing “BIM to the masses” with the job-site app and MEPI marking solutions
- 4. Share information on the sustainability of bamboo with data from our white paper on CO2 Farming with Timber Bamboo

Description

The traditional method of site building walls using studs is labor and time intensive, and results in a fundamentally flawed product, with a substantial percentage of the wall being thermally and acoustically bridged.

BamCore has developed a building code compliant system that uses a structural and load bearing wood-bamboo hybrid panel and enables us to build walls from panels that are pre-fabricated to customer specifications and eliminate 80-90% of the internal framing, along with the thermal and acoustic bridges that framing creates in traditional walls.

This also reduces the need for hard to find job-site labor, as the wall panels arrive on the job-site as a “kit”, with all of the panels stacked flat on pallets and ready to stand up into their installation locations. 80% of contractors report having a hard time finding, training and keeping labor, so anything that reduces the need for labor and time spent on site is a big benefit. We have spoken with developers who have had to put projects on hold,
because they could not find enough labor, and they are looking at us as a possible solution to this issue.

This class will cover the design steps we use, CAD-CAM workflows, the marking of MEP locations and our job-site app, giving a comprehensive view of our industrialized construction processes. We will also talk about the tremendous sustainability of the BamCore system, which comes both from the use of incredibly fast growing timber bamboo and the dramatically improved thermal envelopes that our walls provide.

Traditional Framing                                               BamCore Framing

Speaker(s)

Brenden Morton worked as a property developer for fifteen years, during which time he first came in contact with BamCore and the amazing sustainable solutions that they represent to many of the problems that are widely recognized in the AEC industry. He became the first BamCore
customer in 2011, and also built the first BamCore house in Hawaii in 2017. He has been working at BamCore full time since 2018 as the Director of Platform and Fabrication, leading the development of BamCore’s digital assets and CAD-CAM processes.
1. Explain how the mechanical properties of bamboo in our system result in better embodied CO2 and building performance

BamCore Prime Wall:

- Two runs of panels sandwich top and bottom plates of standard dimensional lumber
- Openings are blocked in with the same lumber
- Vertical seams are ship-lap
- All attachments are made with pneumatically driven nails, no special equipment is required
1- Bamboo is significantly stronger than wood, and the increased strength allows us to achieve greater spans with less material, resulting in less need for on-site labor than traditional materials. It is also a botanical fiber which pulls CO2 from the air as it grows, so using it in a durable good like building materials in place of steel or concrete immediately reduces the carbon impact of that building. Concrete alone is generally recognized to account for 5-8% of greenhouse gas production worldwide.

2- We make panels that are a hybrid of bamboo and wood, carefully engineering them to capture the best attributes of both. Whole pole bamboo has been used for centuries as a building material, but capturing the strength of bamboo fibers in a way that maximizes their mechanical properties in western style dimensional building products has required substantial research. We have been testing bamboo species extensively, and have a database that gives us deep insight into how to best utilize the characteristics of different varieties for a wide range of applications.
3- This enables a complete re-imagining of the building envelope. We started with the premise that the way we build can be shifted radically to solve for the lags in efficiency that the AEC industry has experienced compared to almost every other industry.
1- Stronger: The BamCore Prime Wall is 51% stronger in vertical load bearing than 2x6 construction.

2- Quieter: Can achieve the same Sound Transmission Class rating as 2 layers of gypsum wall board (drywall) with resilient channels by using only 1x layer of gyp and no resilient channels, saving material, time and labor.

3- Better thermal envelope: 80% better thermal performance when compared to a stick framed wall with same cavity thickness and same type of insulation. Additionally, using the BamCore Prime wall makes it simple to increase cavity thickness for very little material cost and no increase in labor: <$1,000 on a typical house and increases thermal efficiency of walls by another 25%.

4- Less air leakage: 67-82% reduction in air leakage compared to conventional stick framed walls, radically reduces heating and cooling loads and results in a more comfortable building.

5- DoJ Ballistics Rating for small handguns

6- Flame Spread Rating of 40, compared to 85 for Douglas Fir or 150 for OSB. Much better results in out projectile test: https://youtu.be/FyrwDDQ6AfU
2. Describe our CAD-CAM workflows and industrialized construction methods

1- We start with modeling in Revit, either from a BIM file or by tracing over a DWG from a CAD file, or even working from PDF’s sometimes.
2- If we are specified early in the process, we can provide Revit families to be used in the design, cutting out the need for re-work later in the process.

3- The complete design of the wall package includes the locations and profiles of all walls, the panelization of the project according to our rules, and the naming and annotation of each element (including any internal framing) in the wall package.

4- We also use a custom Dynamo script to generate pallet lists with additional data such as dimensions and weight of each panel.
5- Once this is complete we, isolate geometry of the panels and apply tool paths for cutting by a CNC machine. This is an automated process developed by CIM-TECH. It is now compatible with Revit at BamCore’s request, and operates in AutoCAD with Inventor functionality added in for specific iLogic applications: https://youtu.be/IK4cjcCKa54

6- We have also developed a method of marking the locations of mechanical, electrical and plumbing locations directly on panel surfaces, to serve as a guide for installation. This reduces time and labor on job-sites, as well as reducing clash and potential rework.
This is achieved in an automated fashion, with the use of CNC technology. The marking happens first, then the marked panel is automatically moved to the cutting station, where cutting commences, while the next panel in the stack at the marking station is getting marked simultaneously: https://youtu.be/MS3XicK2qE8

7- The entire project is stacked flat on pallets with no wasted air space for easy transport to the job site and numbered sequentially for simple assembly. This is the entire wall package for a two story 1,900 sq ft house, stacked easily on seven pallets. It will go on the back of a single truck for delivery.
8- The installation of a BamCore job is radically faster than traditional site built stick framing. The time lapse here shows a recent install:  https://youtu.be/iRtHJhLquC0 The general contractor on the job reported that using BamCore saved his crew five days on framing and sheeting alone.

3. Showcase how we are bringing “BIM to the masses” with the job-site app and MEPI marking solutions

1- We have developed a Forge application to make the BIM model available to multiple trades, allowing easy cross-discipline collaboration and giving access to more data to more stakeholders:  https://youtu.be/61sU3mQAhJ4 No Revit or BIM 360 software or training required, thus reducing barriers to gaining use of BIM data. This increases efficiency and speed, reduces likelihood of mistakes and re-work, and reduces dependence on highly skilled job-site labor. It also allows for reconciliation of the model between all stakeholders (architecture, engineering, construction, trades) without requiring them to have any particular software or training.

2- Our Design-Bid-Build app allows trades to mark locations of their service runs in the Forge platform, which then gets translated to color coded lines indicating install locations right on panel surfaces. This is broken down into trade specific apps,
starting with plumbing:  https://youtu.be/hhNTsr4EwsA  Next comes electrical: https://youtu.be/dAQyOeisjsQ  This translates straight into the jobsite through MEPI marking applied to panels with our new CNC based marking system.
4. Share information on the sustainability of bamboo with data from our white paper on CO2 Farming with Timber Bamboo

a. Bamboo pulls CO2 from the atmosphere 4-5 times faster than even the quickest growing trees can. This makes it one of the most powerful natural carbon sequestering engines. Storing this sequestered CO2 in a durable good like construction materials (rather than a temporary product like paper) is one of the best ways to keep it locked up and mitigate the potential for causing further climate change.

Bamboo also is more efficient in terms of land use, as illustrated by the next two graphs. The first shows the amount of structural fiber produced by bamboo compared to wood, with bamboo producing 5X as much fiber as wood.

The next shows the amount of useable material generated, with the results again heavily tilted towards bamboo.
b. Bamboo is also harvested sustainably, by intercutting the culms (poles) in a clump, rather than by clearcutting entire sections of forest, as is commonly done with trees. This method of harvesting ensures a steady supply of revenue for farmers, while leaving the canopy and root system in place, preventing erosion and maintaining habitat. Bamboo produces 5-10x more fiber per acre than trees, depending on species and conditions. This also keeps large amounts of CO2 stored in the root system, rather than releasing it through decomposition upon harvesting, as is the case with trees.
c. The CO2 sequestration benefits of using bamboo in our materials are magnified to an even greater degree by the thermal benefits of the BamCore Prime Wall. The thermal efficiency of the hollow wall is 80%+ greater than a traditional stick framed building, leading to energy and CO2 savings throughout the life of the structure.
As you can see, the elimination of the studs greatly reduces thermal bridging and air gaps in the insulation. This leads to a big portion of the 220+ metric tons of CO2 that are abated throughout the course of an average sized BamCore house’s 70 year life cycle compared to a conventionally framed structure.

![Graph showing carbon savings](image)

*Figure 11: Carbon savings of the BamCore home versus the traditional home. EoL shown here is incineration with energy recovery, and represents the US weighted average climate zone for heating and cooling.*

We would like to thank our partners, who helped us put the various pieces of this system together: C.R. Onsrud, CIM-TECH, and, of course, Autodesk. Thanks for tuning in!