Group #5
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Discovering the Potential of Wood as a Super Material

What did steel replace? Wood, because it was stronger, tougher and denser. We are going into a time where the real value of objects are in how compact and light they are compared to their heavier counterparts. In order to reduce the amount of finite supply of iron left in the world, we can create wood that is equally strong, but less dense than typical steel. The abundance, reusability and price tag of this treated wood will essentially replace steel as the main material in construction work to include houses, skyscrapers, and ships. This way we can save limited iron supply, and utilize and improve on pre-existing materials like wood. This way groups, families and companies can have better access to the modified wood as it will provide the same amount of strength for less than the cost of traditional steel.

Of course, modified wood could be less expensive than steel, and potentially be stronger in terms of strength, but one thing that we shouldn't forget is that it takes a very long time to grow wood. If we do ever exhaust the wood supply in the world, we would be in trouble. As we dig deeper, we found another material with great properties; Bamboo. Bamboo despite being a grass, is some of the strongest natural material the nature has given us. It has a stronger tensile strength than steel, while being better at compression than concrete. As we all know, wood might be cheap in general, but bamboo can grow way faster and be produced in a way cheaper manner. With only 7 years to grow fully, bamboo can be cheaply grown. With proper treatment and

manufacturing techniques, these natural material could potentially save a lot of money for people who still uses steel for structures.

Modern building materials, especially in foundational applications have been optimized for simplicity of use, flexibility in design, and maximum strength, but not necessarily for minimal impact on the environment. Our material, a super wood composite aims to add renewability and sustainability to the future of construction. Take for example, temporary installations for emergency shelter. Tents and other temporary structures offer little to no thermal insulation, nor do they offer any future structural protection should another natural disaster be able to biodegrade upon deconstruction, would be enormous in terms of reducing the impact of construction waste and the pollution associated. Another potential application coulster or event occur again. Having a system that is not only strong and simple to work with, but ad be temporary event structures like those for conventions and the Olympics. A perfect example of this can be found in Brazil Olympics of 2016, where many of the event structures erected for the games are currently left crumbling to pieces, leeching hazardous material into the waterways, and taking up land that could be used for housing or public works.

Developing countries, such as Brazil, that often times do not have the funds for steel-reinforced concrete, would benefit most from bamboo as the alternative material. If bamboo was taken into account for this scenario of the Rio de Janeiro Olympics aftermath, it being susceptible to biodegradation would not have been a limitation in this case, but a great solution. Throughout the destruction process of the venue, the clean up would have been a lighter load if the material contributors had been naturally broken down. Another advantage bamboo has is that it can grow rapidly in several places making it a far cheaper alternative. Steel prices have

recently skyrocketed due to its large consumption and production of limited fossil fuels. Bamboo consumes less energy to harvest and transport meaning that it lowers the pricing of manufacturing and it does not need sophisticated, expensive gadgets and technologies for constructing, which is the main factors to look for nowadays in creating buildings.

The material is going to be comprised of two main components: bamboo and concrete. A third component, such as a coating, will potentially be added for stems that are exposed to the air to limit the wood's deterioration due to humidity. First, the bamboo, known as Bambusa vulgaris, will be used. The shoot will be processed using a densification method designed by researchers at the University of Maryland, College Park. The treatment will remove the lignin and hemicelluloses which are both binding and strengthening polymers within the cell walls. Without this extra reinforcement, the wood will collapse onto itself and densify. Now, although this step might seem counterproductive to becoming more steel-like, the microscopic hollow caverns, tubes, and tunnels within the bamboo's structure are removed after this. The overall circular shape will shrink into a thin rod without any air pockets that can break under an applied force. To cement this feature, the rods will be heated to about 100 degrees Celsius and then cooled. At this point, the bamboo pieces will be too dense to float on water, but the strength and stiffness will have increased eleven-times fold. The rods will be wrapped together to make one collectively stronger pole that can be used to support the foundation of a house through a standard fabric woven pattern where poles are lined up next to one another either parallel or perpendicular to each other a few feet apart. With this stronger wood foundation, not only houses can be made more weather resistant but taller buildings like apartments, and office buildings as well. This would lead to less property damage in an event of a tornado, flood, or a heavy wind

storm.Compared to hardwood bamboo is cheaper and grows faster so it's more easily available. Bamboo also has a higher resistance to moisture allowing it to repel mold and mildew. For bamboo pieces that are too long for building specifications, the pieces sliced by a CNC machine will be used as steel fiber for blocks of concrete that can be sold as bricks, stairs, or other smaller building pieces.

Next, this bamboo feature will have cement laid upon it. The cement used will be fortified with remaining pieces of bamboo ends that were too small for fibers or the structure of a house. The bamboo pieces will be ground up and placed into a cement mix which will add to the strength of the material. Now, adding to the strength of concrete might not seem necessary, but for military aspects such as concrete walls and areas where extra reinforcement is needed, these extra pieces of dense wood are important.

Conclusively our bamboo based material could potentially replace the wood used in most building frames and structures, as well as replace the steel used in some techs. The bamboo would act as a stronger, yet lighter material that is biodegradable and moisture resistant at the same time. Mixing this material into cement could further strengthen a building's foundation. Making this material would be more cost efficient as it would take less time for it to grow than regular tree wood and it would be cheaper to process and manufacture into the state that is desirable. On average a tree would take about twenty years to grow and its wood could cost up to ten dollars per square feet depending on the type of tree used, while bamboo only takes three to five years to grow and only costs two to five dollars per square feet.With more research and experimentation this material could have a high chance of replacing the materials that are currently used today.

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