3D Printing Will Be Aid in Making The Future More Sustainable

In the past year, the United States has emitted 1350 million metric tons of carbon dioxide from energy demands into the air (Matthews, 2012). The fossil fuels and the smoke of damaged or burnt land travel from factories and forests to the oceans, into the atmosphere, and to many acres of land across the globe. With the use of rapid prototyping, the objects created by these machines will be able to help decrease overall costs of shipping and handling along with sustaining the environment to prevent destruction.

Sustainability is defined by the means of meeting our needs today without compromising the ability of the future generation to meet their own needs (Wildey, 2011). Different ways to increase the chances of sustaining the planet are by educating the public about the harm of not taking care of the environment (Reay & Withell, 2011) and recycling everyday plastic bottles and cans which can lower the cost of material values collectively by $50 million dollars because dispersion is very high (Bertling, 2012).

Sustainability in Different Eco Systems and the Enhancement of Biodiversity

A study conducted by Reay & Withell in 2011 that analyzed the consequences of human impact on the people and the planet. In other words, it reveals the negative impacts and the neglect from humans towards the earth. Reay & Withell define sustainability as meeting the needs of the present generation without compromising the ability of the future generation to meet their own needs. Now, more than ever the ideas and principles sustainability need to be enforced throughout the world because of the harmful effects on the environment and on future human development (Reay & Withell, 2011).

The rapid and constant consumption of natural resources is due to the many "needs," "wants," and "demands" of society. This use has sparked climate change, ecological degrading,

and prevalent poverty. As a result of these factors the humans' current carbon footprint is thought to surpass the world's ability to regenerate it. In future generations, it is imperative for individuals and families to drastically change their lifestyle in order to prevent the harmful influences to the environment.

The C2C Approach

The Cradle-to-Cradle (C2C) is a method used in developing sustainable framework to make different products influenced by natural systems. It is more clearly stated as creating a product that would not harm the environment.

By using this method it eliminates the concept of waste, a product discarded because it serves no purpose to someone or something. Everything created using C2C, an output, is useful for another process, an input. As a result, the outcome may be able to replace and replenish things lost in various eco systems.

Theoretically this is a good approach to replacement and replenishment of eco systems, it is not practical. It would not be able to reflect the actualities of complex and intricate social and environmental processes.

3D Printing and Biodiversity

Another approach Reay & Withell used to help preserve eco systems was using a 3D printer. The goal of the project conducted by the Sustainable Product Design Research Group is to develop ceramic tiles for building barriers and fences that will serve as ecological habitats for different plant and animal species. The creation of the tiles needed the collaboration of variety of experts including engineers, designers, ecologists, conservation experts, as well as social scientists. They were specifically constructed knowing that the structure of the tiles will be weathered, thus it was embedded with supports that will allow geological elements to harm them.

Phase one. Use a 3D printing method to create ecological barriers that can now be used as a functional prototype.

Phase two. This phase will be used to test the durability of the blocks in a variety of environmental stress over a long period of time.

Hopeful conclusion. The goal is having the ability to open doors to different methods of sustaining the environment using this method, ceramic tiles and a 3D printer (Reay & Withell, 2011).

The Combination of 3D Printing and Architecture

These studies were conducted to explore the use of 3D printing as a mechanism to help select the materials to use in the construction of a building that has a composition with the most potential for energy efficiency. With the assistance of energy modeling, the CAD software, and rapid prototyping, it could bring them to closer to their goal (Wildey, 2011) & (Lange, 2008).

Energy Modeling

Energy modeling defined by Widely & Lange is, a highly technical examination of the many variables that together create the energy requirement of a structure. The models made using this method show an assumption of the amount of energy required to complete the desired building or structure.

The accuracy of each building representation varies due to the different levels of complexity and cost of the entire project. To find a more concrete answer to both questions, quantity of energy needed and cost, different energy analysis tools are used. The four major types are 1) screening tools for use primarily during budgeting and programming of retrofits, 2) architectural design tools for use primarily during programming, schematics, and design

development of new construction and major retrofit, 3) load calculation for use primarily during design development and construction documentation of new construction and major retrofit, 4) economic assessment tools for use throughout the design process.

Combining Rapid Prototyping and Energy Modeling

The incorporation of rapid prototyping in this study is to utilize its ability to display an accurate and scaled down model of a project/building. Dr. Larry Sass of MIT states that "through the use of rapid prototyping… [will be able to make] many physics scales, evaluating manufactured ideas and engineered solutions" (Lange, 2008). The aid of the CAD software will also be able to present an effective way to show creative concepts and examine special relations.

Objective

By using energy modeling joined with rapid prototyping and the CAD modeling software, it will be able to create tools that allow a product, building, or structure while it is still in the early stages of development. The ideal tool would have 1) a slight learning curve, 2) provide an analysis of the original design and offer suggestions for improvement, 3) the ability to incorporate the ideas of current architecture softwares, and 4) support all file types that are linked with the softwares of rapid prototyping technologies (Wildey, 2011).

A slight learning curve. This is the capability of easily integrating new technologies with the current version of the program. This will create a more user-friendly way to construct designs.

Provide an analysis of the original design and offer suggestions of improvement. By incorporating different elements into the architecture software it enables the user to find better and more efficient ways to minimize the total amount of energy throughout the whole

conceptualized structure or general locations where more energy is needed to build this area of a structure. This will ultimately improve the design.

The ability to incorporate the ideas of current softwares. Modern programs currently require the CAD software. In other words, any software used must be compatible with CAD because the printer will then be able to recognize the design sent to it.

Support all file types that are linked with rapid prototyping softwares. Once a model is created it needs to be exported to the printer. The need for a program to be compatible with the 3D printer in imperative, otherwise the file sent will not be compatible with the printer.

Their Conclusions

A 3D model of a plan is both easier to understand and presents visualization to indicate the intricate components of the design. Dr. Gerard Ryder at IT Tallaght Dublin said, "models allow those without an understanding of the information conveyed in 2D technical or building drawings to better the design and communicate design intent" (Lange, 2008). By integrating energy modeling and rapid prototyping together it has the ability to create a new kind of tool that directs architects in a more sustainable direction. In other words, different characteristics that aid in the conservation of energy is the key to improving the technology in a sustainable fashion.

Future Research

The next step in this research is to continue to enhance current programs with similar methods that will be applicable to both energy modeling and the CAD softwares.

Using Direct Digital Manufacturing to Help with Sustainable Production

Digital Direct Manufacturing (DDM) is a type of additive manufacturing that produced products, which are now obsolete. When they are printed, these item are manufactured without the use of molding, casting, or machining.

DDM is many times referred to as the future of manufacturing because the lifestyle of coming generations will be managed by questions of sustainability. Many believe this to be true because DDM it is a tool and mould-free process where there is no material loss (during the actual printing process), and the production will help sustain longevity of the product (Bertling, 2012).

The Role of DDM in Sustainability

Mass production is no longer conducive to the many individualized consumer product requests. Fortunately, with the use of DDM consumers have the ability to conceptualize any item and have it created. For example, a chamber heater or a laser, which are parts of a Selective Laser Sintering 3D Printer. To help shape this movement, the creation of FabLabs in 2002 at MIT started to engage people in creative design and customization. The basic, standard equipment provided by a FabLab usually consists of a 3D printer, laser cutter, and a milling machine for separating metal that is all based on the concepts of DDM.

For Future Reference

In order to preserve resources and not damage the environment more than it already is, people all around the world need to change their life styles to help lower the ecological footprint. With the use of FabLabs placed around the country is becomes easier to conceptualize the goal of slowly starting to reduce the excessive amount of resources we use to help to sustain the environment. The cost of printers has decreased which can allow for product design and revenue to increase.

Tools for Sustainable Product Design

The development of additive manufacturing has been able to create many new opportunities for different fields to utilize the abilities of a 3D printer. It has taken away many restrictions that designs may have faced because many products can be customized.

The Relationship between Design Quality and Sustainability

The majority of sustainable product designs lead to the focusing of lowering the environmental impacts of material, resources, and energy usage. It is ideal to achieve this by creating a product that could allow a customer to develop an attachment to which would prevent them from discarding the object. A general example is a stuffed animal or toy one has had for a long period of time. The owners of both these toys have created an attachment to them, making them more valuable. To help build that stronger bond there are two ways a designer could approach the product design. They are manufacturing-design compromise and eliminating the concept of the one-size-fits-all. In other words, one-size-fits-all means the items made are specifically designed for an individual person.

Manufacturing-design compromise. The original design of a product may be visually and/or show an instant attachment to a person in the opinion of the designer. By trying to keep in mind a factor of sustainable design, the desirability of the item may not be as exciting was it was without added sustainable factor due to alterations (Diegel, 2010).

One-size-fits-all. The generic object that was created in order for the product to be appealing to all types of people instated of customize for an individual.

The Different Manufacturing Design Considerations

Although additive manufacturing may be able to customize certain products for individuals, all other manufacturing restrictions have not disappeared. Fortunately, there are many design considerations that can be made to make the designing of a product easier.

Enclosed voids. The different parts of the model are built using a powder, as it is the material used. The actual object will be built using a laser or electron beam and the remainder of the material acts as a support to the object being created.

Surface finish. Surface finish is an important part of the final appearance of a finished product. This happens because the flat layers that are piling in a curved pattern are eventually converted into spirals. This can result in a "stair case" structure visible along the sides of an object. Yet, by using the selective laser sintering process to print, this "stair case" structure is not as severe. To erase the marks, one could use rumbling, bead blasting, or sanding the final object.

Strength and flexibility. Small variations can occur due to the flexibility and strength between each of the printed layers. For example, a different shaped curve or spiral.

Machine and material costs. To determine the cost of the product being printed, it is based on the ratio of the cost of the machine to the quantity that will be printed. Many times, the lower the cost of a machine, the higher price of production or if the machine is expensive, then the amount of money needed to produce the product is less (Diegel, 2010).

Open Source Appropriate Printing

Open Source Appropriate Technology (OSAT) is the printing of an object made from natural resources that are used by communities to meet their needs.

Appropriate Technology

E.F. Schumacker introduced Appropriate Technology (AT) in the 1970's due to the rapid increase of people and families falling under the poverty line. Poverty mostly occurred in the developing countries.

AT is defined as those technologies that are easily and economically used from readily available recourses in local communities to meet their needs. It must agree with the environmental, cultural, economic, and educational resource constraints of any specific community.

The majority of the resources used in AT came from the populations that are geographically located in places with an abundance of raw materials (Pearce et al., 2010).

RepRap and the Fab@Home

The RepRap and Fab@Home are 3D printers that are used to help utilize the ideas of OSAT printing. By using the natural resources, the materials for printing, these printers are able to regenerate their parts. They are designed to do this because it is easier for the printer to reproduce their own parts instead of producing the part elsewhere or using another machine. It lowers the cost of production and other factors such as processing and shipping.

Conclusion

There are many different areas of sustainable 3D printing. As previously stated, various methods will be able to help lower the carbon footprint. This therefore will help to sustain the world for future generations to come without compromising their needs.

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