3D Printing of Buildings on Construction Sites

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Situation

3D printing is a new technology that is still under development. 3D printing enables industry to construct buildings and structures quickly and efficiently at low cost. Cost reduction results from reduced expenditure on labor . Most of the structures are printed in factories and assembled at the building site.

Figure 1. 3D Printing [1]

Research Question

How can 3D printing be used to print resilient and durable buildings on construction sites?

Problems

- Using 3D printers on the construction site can cause building to be structurally weak because 3D printers print in layers. This can result in damage to buildings when they are exposed to high stress (wind, earthquakes, gravitational force).
- Moreover, using 3D printers on the construction site requires storage and transportation of concrete which is expensive. This problem has made the development of large-scale additive manufacturing processes a major challenge and this has been regarded as a significant obstacle [2].
- Lastly, 3D printers require large amount of space around the construction site, which is not always possible.

Solutions

- Use concrete together with plastic. Plastic can be printed as a shell into which concrete can be poured. This will significantly improve the strength of 3D printed structures.
- Recycling concrete and soil on the construction site will save transporting and storage costs as well as save time. 3D printing of buildings in China has successfully demonstrated this method.
- Use of small 3D printers which work together to print the structure. These printers could be the size of a desktop printer and will be able to print structures of any size.

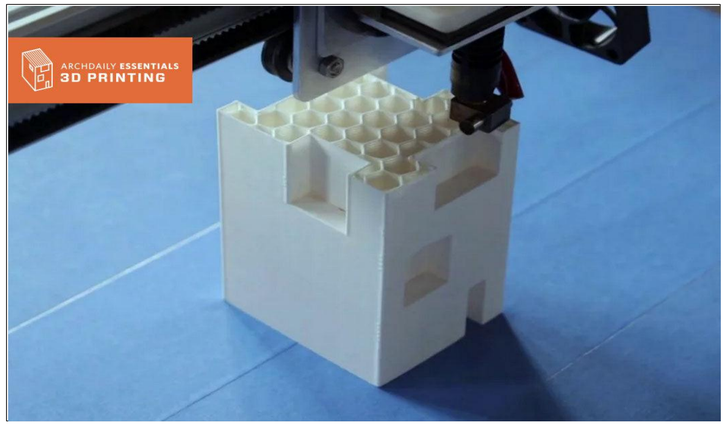

Figure 2. Plastic Formwork [3]

Evaluation

- Using plastic concrete as a formwork can increase structural strength but it will be expensive and time consuming. Since, recycled plastic will be used, this method will reduce pollution.
- The second solution is environmentally friendly but has an initial cost for purchasing the recycling machines. However, it saves a lot of time as concrete will be ready on the site.
- Small printers reduce the overall construction time. In addition, small printers are cheaper and more environmentally friendly compared to larger printers.

Figure 3. Minibuilder printing [4]

References

[1] I. Glink, 3D-printed houses: Coming to a neighborhood near you?. 2016. [Online]. Available: http://www.cbsnews.com/media/3d-printed-houses-coming-to-a-neighborhood-near-you/. [Accessed: 12- Nov- 2016]

[2] N. Labonnote, A. Rønnquist, B. Manum, and P. Rüther, "Additive construction: State-of-the-art, challenges and opportunities," Automation in Construction.

[3] "AD Essentials: 3D Printing", ArchDaily, 2015. [Online]. Available: http://www.archdaily.com/769338/ad-essentials-3d-printing. [Accessed: 17- Oct- 2016].

[4] N. Hall, "IAAC: Minibuilders, small robots with big ambitions", 3D Printing Industry, 2016. [Online]. Available: https://3dprintingindustry.com/news/iaac-minibuilders-small-robots-big-ambitions-83257/. [Accessed: 16- Oct- 2016].