

Innovative Development of Civil Engineering Materials - Application of 3D Printing Technology

Prof. Wei-Ting Lin

Department of Civil Engineering, National Ilan University, Taiwan

Industry 4.0 changed the “manufacturing mindset” from mass production to mass customization. It focused on “smart manufacturing,” thus opening the milestone of Construction 4.0. Construction 4.0 automated construction using intelligent technologies, such as AI and 3D printing. It additionally utilized real-time data to optimize efficiency, reduce waste, and increase safety. This revolutionized the industry and allowed for more customized and personalized builds. Construction 4.0 also improved collaboration and communication between all stakeholders, as the construction process was now automated and data-based. It also allowed for more accurate forecasting of project timelines and budgets.

3D printing has been widely applied to plastic or metal materials. This research first introduced the evolution and application of 3D printing in construction engineering and illustrated the advantages of 3D printing through successful cases. Then, it presented recent research highlights and physical demonstrations of cement-based materials, ultra-high-performance concrete and geopolymers. This research provided an in-depth overview of the current and potential applications of 3D printing in construction engineering. It also discussed 3D printing challenges in construction engineering and strategies to overcome them. Finally, it offered recommendations for further research and applications.

Finally, the speaker presented the printing results in the laboratory, including the recently developed cementless 3D printing material and the same printing material with low thermal conductivity. The research results will contribute to advancing 3D printing in construction engineering in Taiwan. Cementless 3D printing material was a viable option for large-scale construction due to its low cost and energy efficiency. The low thermal conductivity material was also demonstrated to be an effective insulator, making it suitable for various construction projects.

Experience:

Prof. Wei-Ting Lin is the head of the Department of Civil Engineering at National Ilan University in Taiwan. His research specialties include cement-based composites, geopolymer, cementless binders, 3D printing materials, cement chemistry and microanalysis. He has published 124 articles (in Scopus) with an H-index of 18 and 1136 citations. He is also the director of the Energy and Resource Technology R&D Center at National Ilan University. He promotes research on net-zero carbon emissions, the circular economy and green materials at this center.