



Istanbul Technical University
Civil Engineering Faculty
Structural Engineering Department

Additive Manufacturing of Sustainable Construction Materials

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Successful R&I in Europe 2024: 11th European Networking Event

15-16 February 2024



Problems:

- More than 1 ton of carbon dioxide is released in the production of 1 ton of cement, one of the most important materials in the construction industry.
- Existing construction technologies lack economic efficiency and expeditiousness.

Solution:

- Employ environmentally sustainable materials in construction and enhance construction processes through novel manufacturing technologies

Advantages

- ✓ Additive manufacturing can be optimized for faster production and energy efficiency, especially when compared to processes involving excessive heat/energy consumption.
- ✓ Replacement of Portland Cement with geopolymers lowers carbon dioxide dissipation and enhances eco-friendly printing.

Objective: Production of sustainable building materials by 3D printers

Scientific/technological challenges/partner roles

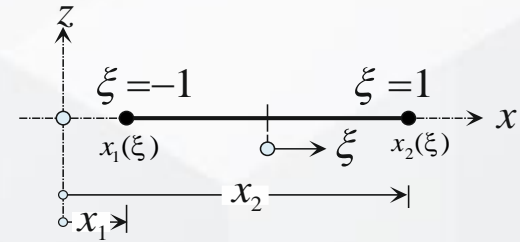
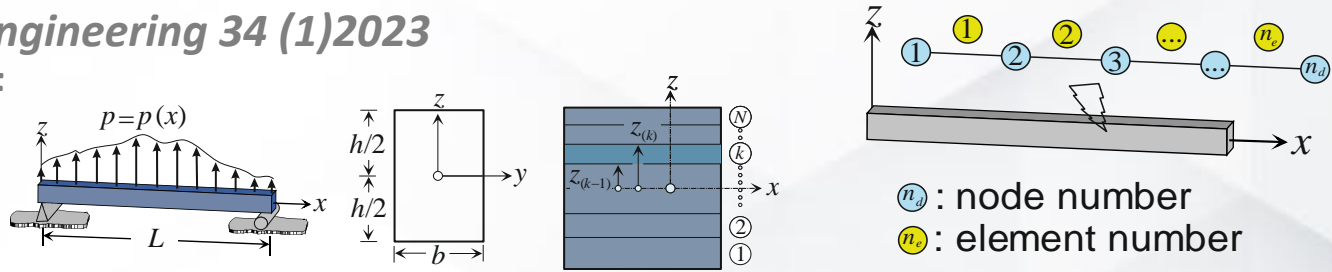
- Integrating computational modeling with AD is crucial. Special CAD packages should be obtained to design optimized structures, considering 3D printer constraints. Tools for process modeling, like extrusion, need inclusion for enhanced capabilities.
- Onsite printing systems can also be developed to optimize assembly and compactness, cutting logistics costs, and boosting construction efficiency. This fosters sustainability in the initial stages of 3D printing's life cycle energy.

- HORIZON-CL5-2024-D4-02-04: Design for adaptability, re-use, and deconstruction of buildings, in line with the principles of circular economy (Built4People Partnership)
- HORIZON-CL5-2024-D4-02-02: Robotics and other automated solutions for construction, renovation, and maintenance in a sustainable built environment (Built4People Partnership)
- HORIZON-CL5-2024-D4-02-01: Industrialization of sustainable and circular deep renovation workflows (Built4People Partnership)
- HORIZON-CL5-2023-D4-02-01: Innovative uses of lifecycle data for the management of buildings and buildings portfolios (Built4People Partnership)

✓ **Stress Analysis of Laminated HSDT Beams considering Bending Extension Coupling**

Turkish Journal of Civil Engineering 34 (1)2023

BAB YONCA, KUTLU AKİF



n_n : node number
 n_e : element number

✓ **Mixed finite element formulation for the buckling analysis of laminated composite beams using HSDT**

Proceedings of 3rd International Civil Engineering and Architecture Congress (ICEARC'23), Trabzon/Turkiye, 12-14 October 2023

KANIG DOGAN, BAB YONCA, KUTLU AKİF

✓ **Quasi-static response of viscoelastic plates based on mixed FEM and HSDT**

Proceedings of 3rd International Civil Engineering and Architecture Congress (ICEARC'23), Trabzon/Turkiye, 12-14 October 2023

BAB YONCA, KUTLU AKİF

✓ **A C0 continuous mixed FE formulation for bending of laminated composite plates based on unified HSDT**

ZAMM – Journal of Applied Mathematics and Mechanics / Zeitschrift für Angewandte Mathematik und Mechanik (2023)

BAB YONCA, KUTLU AKİF

✓ **A new C0 continuous refined zigzag {1,2} finite element formulation for flexural and free vibration analyses of laminated composite beams**

Composite Structures (2024)

YURTSEVER BATUHAN, BAB YONCA, KUTLU AKİF, DORDUNCU MEHMET



THANK YOU

FOR

YOUR ATTENTION

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