

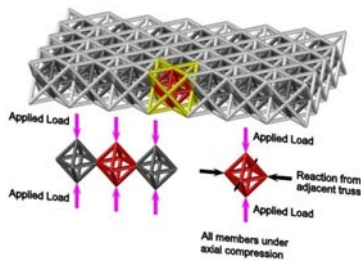
Optimized Lattices as a Basis for Efficient Façade Systems

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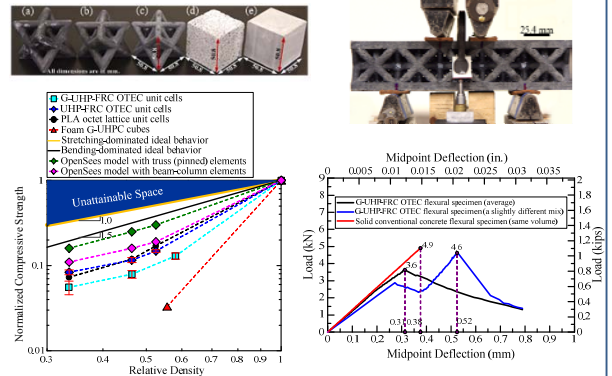
Motivation

The building envelope is a physical barrier between the indoor and outdoor environments. An inefficient envelope leads to excess energy usage for cooling and lighting, and reduces overall comfort of the building occupants. Our aim is to develop multifunctional façade systems that improve the indoor environment and reduce energy consumption while also reducing the total amount of material used.

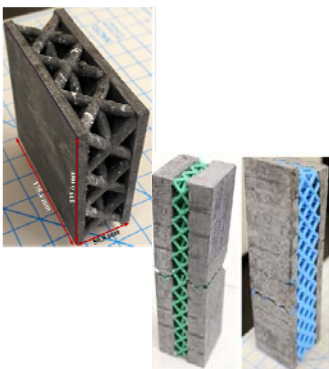
Octet Truss Engineered Concrete (OTEC)



OTEC provides strength and stiffness using a fraction of the material. Compression tests show OTEC approaches the ideal strength-to-weight ratio for bending-dominated lattices at low densities, and in flexural tests OTEC achieves equivalent strength of a solid concrete beam and higher ductility using only 52% of the material.



New Construction



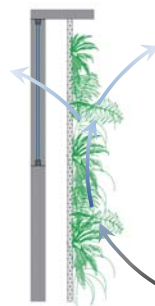
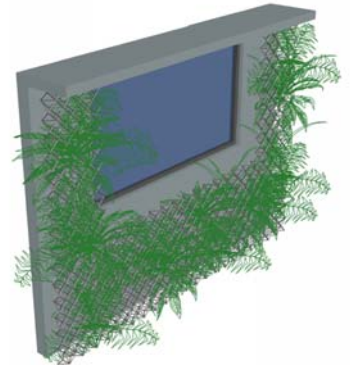
Double-skinned façade (DSF) panels can be constructed using OTEC or 3D printed polymer lattices. These use a fraction of the material of a conventional concrete wall and reduce the thermal transmittance. Conventional concrete DSF panels have been shown to reduce thermal transmittance by up to 43.2%

Additive manufacturing is used to create fully optimized shapes with three-dimensional structures that can't be fabricated with conventional methods. Automated construction can provide increased precision and reduce construction times and overall cost.



Building Retrofit

Existing buildings can be retrofit with lightweight lattice facades manufactured from recycled materials. The open structure of a lattice can provide a substrate for implementing green facades, or provide shade while allowing airflow.



Green facades can provide significant air purification, improving the environment both inside and outside the building. Adding a second façade layer can also provide the thermal benefits of a double-skinned façade system without replacing the entire wall.

A Framework for Multifunctionality

The open structure of cellular materials provides space within the building envelope to incorporate multifunctionality.

Breathability: Ongoing studies are being conducted to implement a low-energy air conditioning system that could deliver fresh, cool air directly through the façade walls.

Acoustic Dampening: Sonic crystals can be tuned to specific wavelengths to reduce certain types of ambient noise like planes or roadways.

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