

# Modular Overclad Composite Panels for Envelope Retrofits

## Building Envelope Materials Group



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Advanced manufacturing,  
low-carbon materials



**Nolan Hayes, PhD**

Structures, surveying,  
finite element simulations



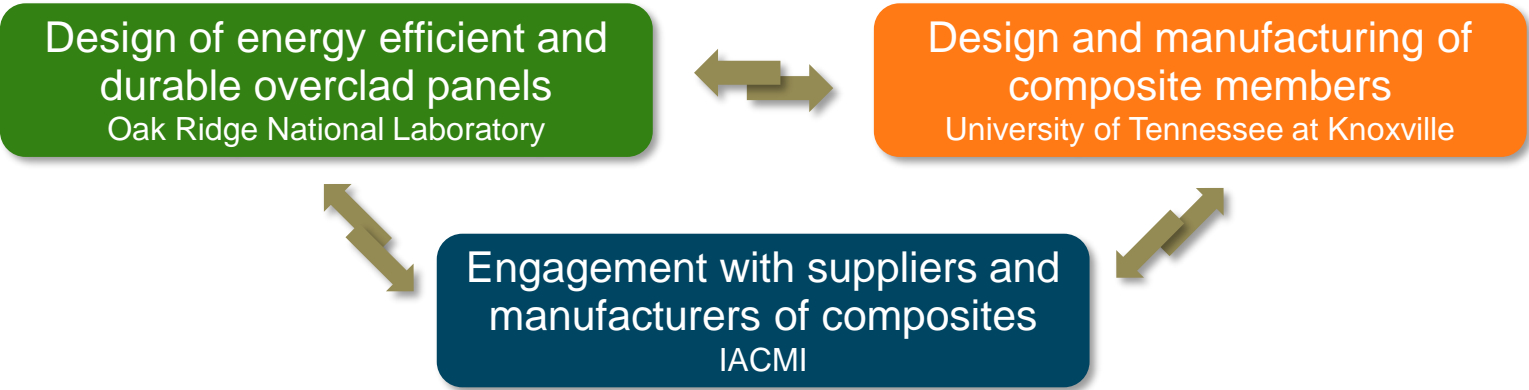
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Stephen Sheriff



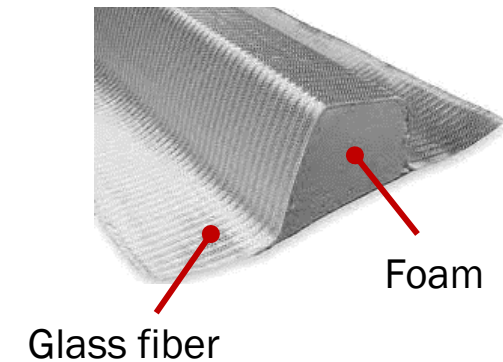
John A. Hopkins



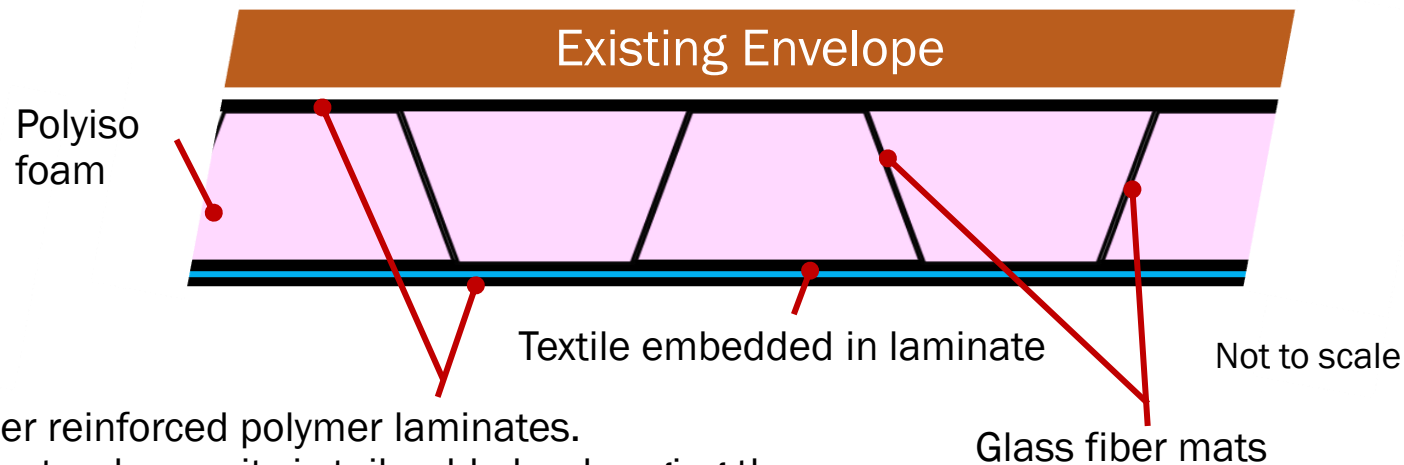
# Goals

- **Develop overclad fiber reinforced polymer (FRP) panels**
  - Lightweight
  - Appealing aesthetics
  - Suitable for several climate zones
  - High throughput manufacturing
  - Fast jobsite assembly

## PRISMA Composite Preforms

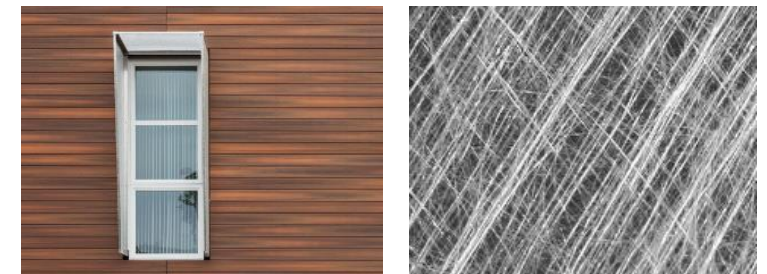


## Assembly (Top View)



Fiber reinforced polymer laminates. Structural capacity is tailorable by changing the thickness, layup and orientation of glass fiber mats.

## Cladding Laminates



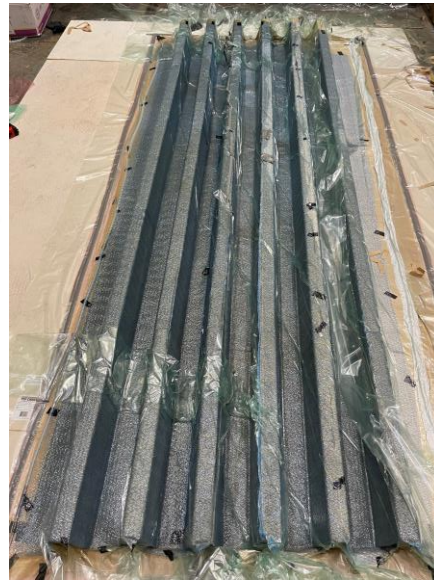
# Non-Optimized Large-Scale Prototype Assembly

Invention disclosure  
#202105025

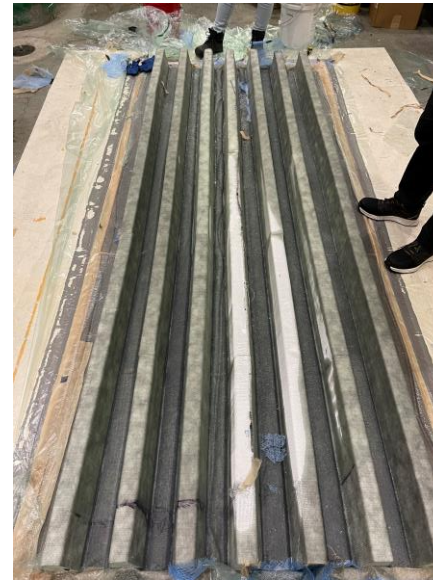
PRISMA  
Composite Preforms



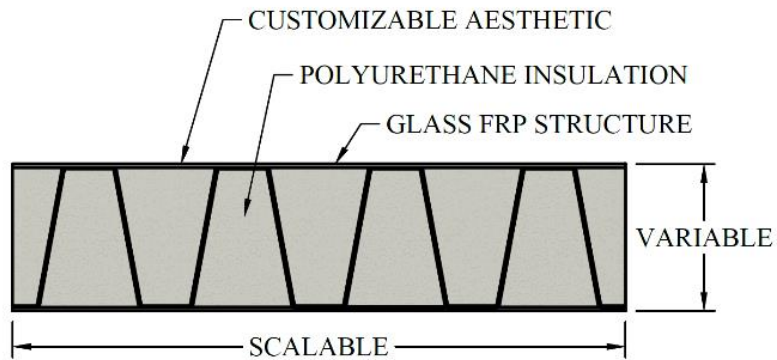
Vacuum Assisted Resin  
Transfer Molding (VARTM)



Panel Facer



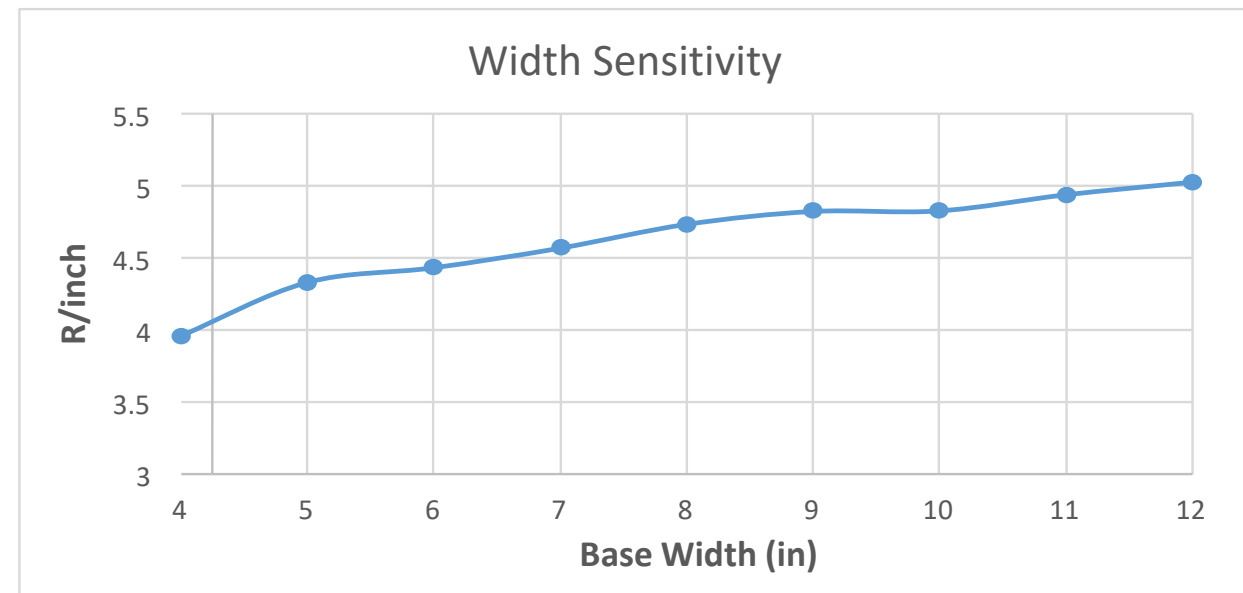
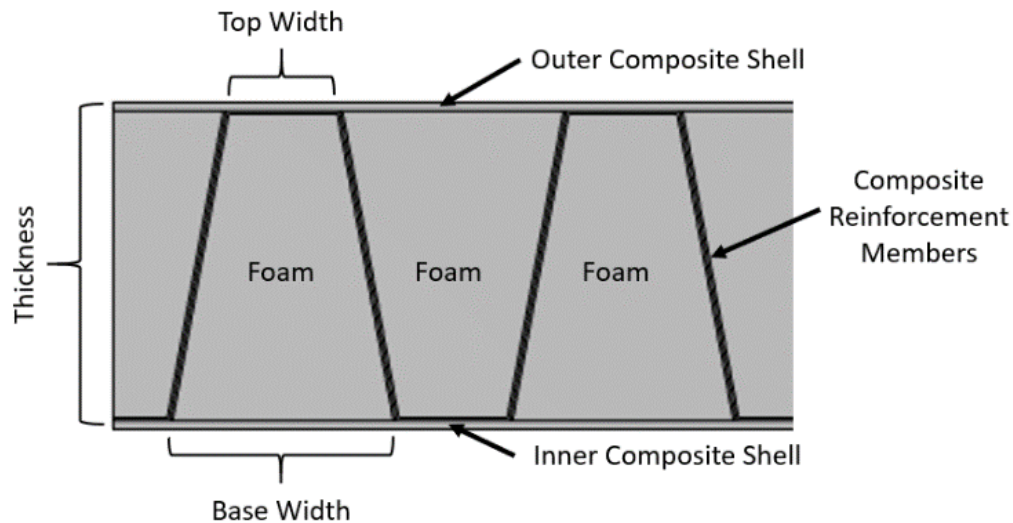
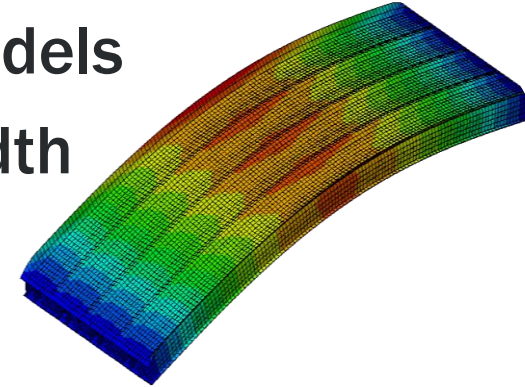
Assemble



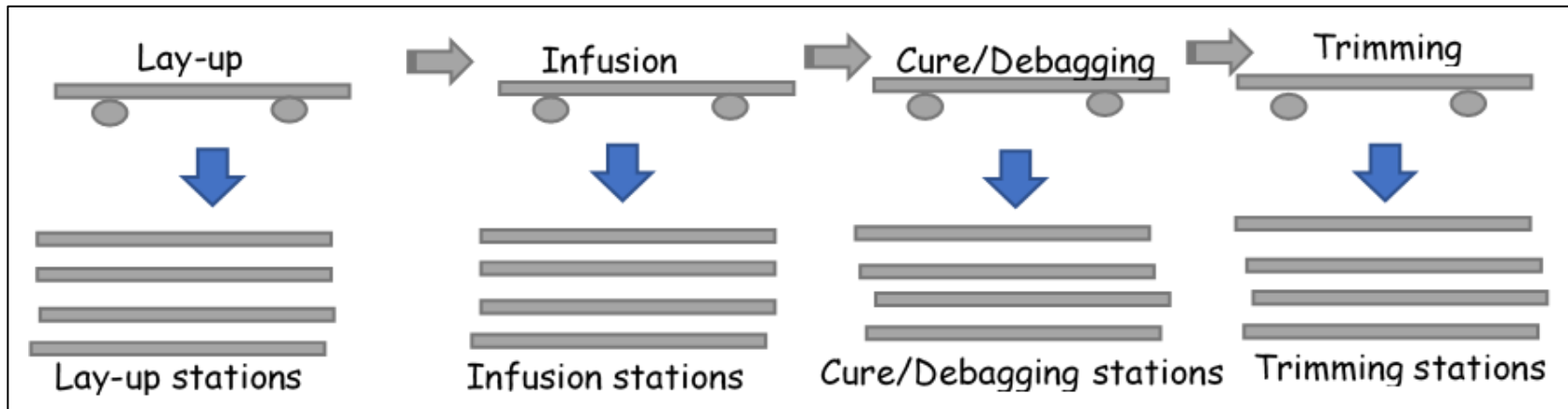
Assembly process allows scalable width and variable thickness and R-value  
Panels are lightweight ( $\sim 4 \text{ lb/ft}^2$ )

# Estimated R-values

- Polyiso trapezoids  $\rightarrow$  R5.8/inch
- Measured R-Value (ASTM C518) R3.8/inch used to calibrate models
- Simulated R-value improvement by increasing PRISMA base width
  - Reduced thermal bridging
  - Co-optimized to meet structural requirements using FEA



# Commercial Production Process Flow for Overclad Panels

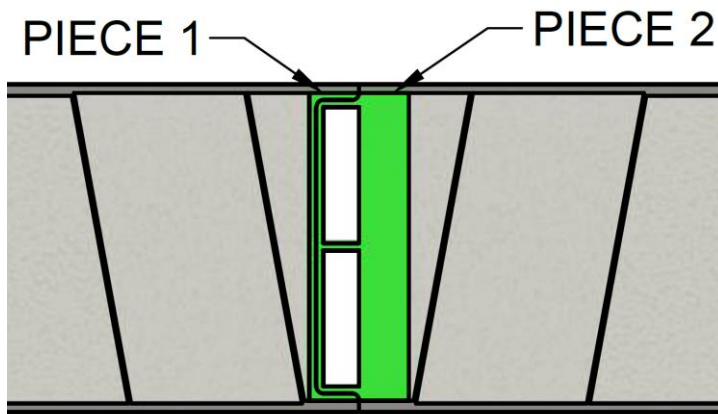


High throughput manufacturing process that requires minimal capital investment and can be rapidly expanded

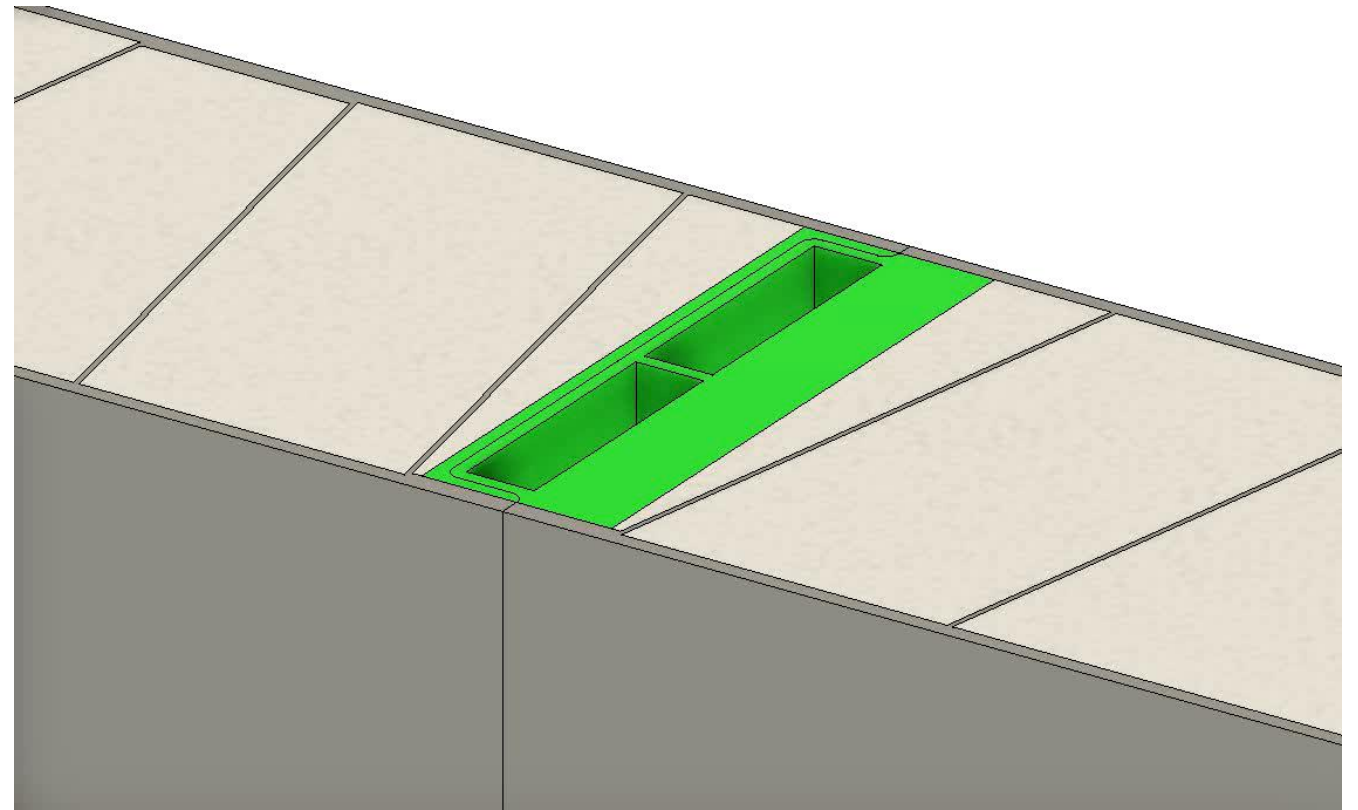
- 4 stages
- Several stations per stage
  - 2 persons per station
  - Stations are on wheels so can move to the next stage
  - Basic hardware that can be quickly reconfigured (e.g., plumbing for vacuum and compressed air)
  - Can rapidly increase number of stations to meet demand
- Commercial level production rate can be **~(12) 4ft x 12ft panels/hour** or **~100 panels/day**
- Preliminary cost estimate **~\$20/ft<sup>2</sup>** with large volumes, possibility to decrease to **~\$15/ft<sup>2</sup>** w/ optimization

# Panel Installation – Panel-to-Panel Connection Design

- Panel-to-Panel
  - Tongue and groove
  - Fastenerless, invisible
  - Preinstalled to panel ends



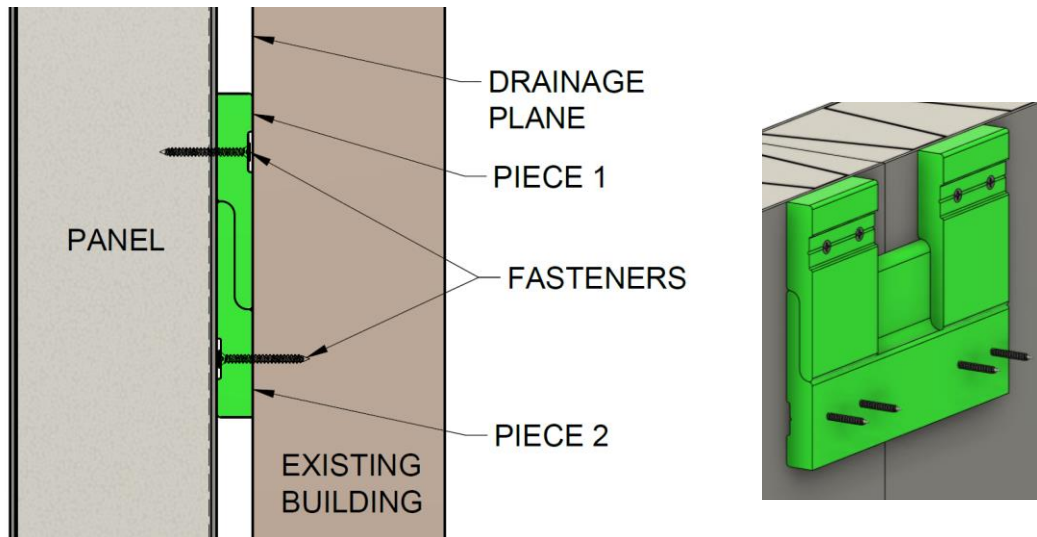
Facilitates rapid on-site installation, lowers installation errors, and maintains aesthetics



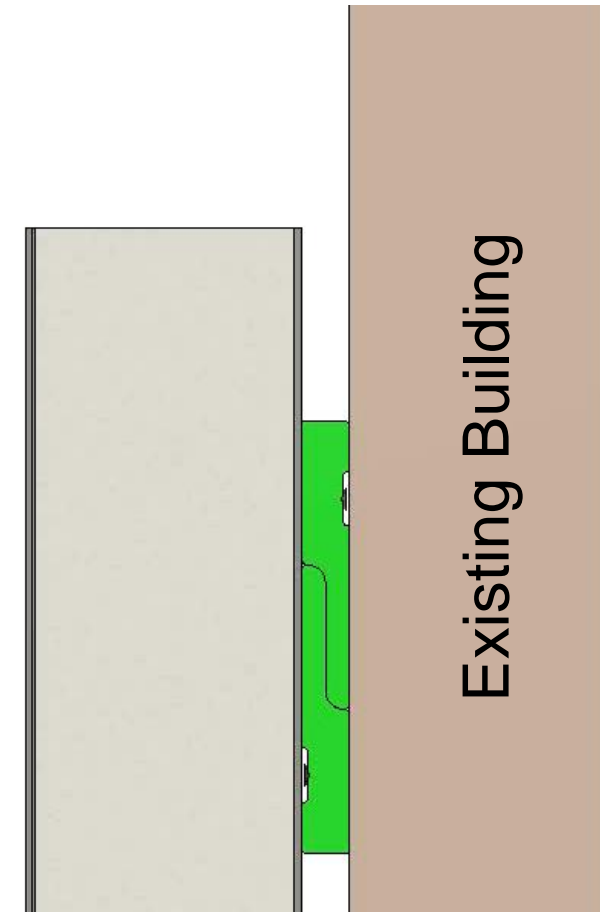
# Panel Installation – Panel-to-Building Connection Design

Invention disclosure  
#202105026

- **Panel-to-Building**
  - Preinstalled, invisible
  - Panels locked in-place at building roof



**Facilitates rapid on-site installation, lowers installation errors, and maintains aesthetics**



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**Questions?**