Solar, Adaptive and Circular Facades: Parametric design workflow for evolving cities

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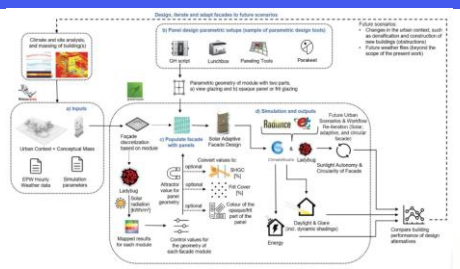
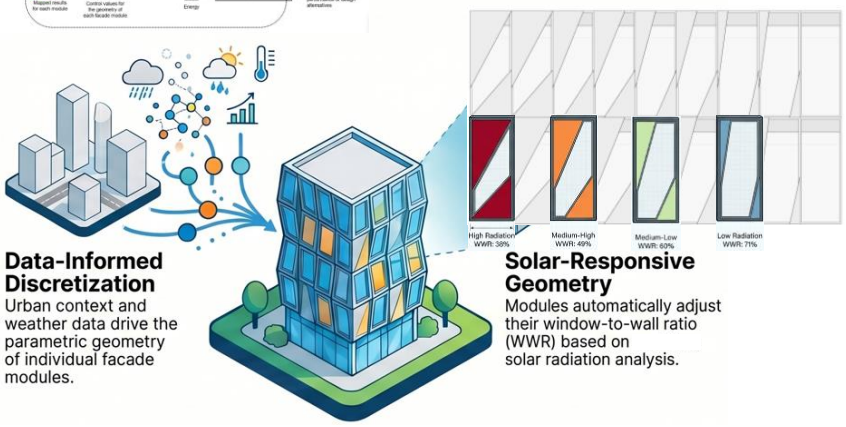
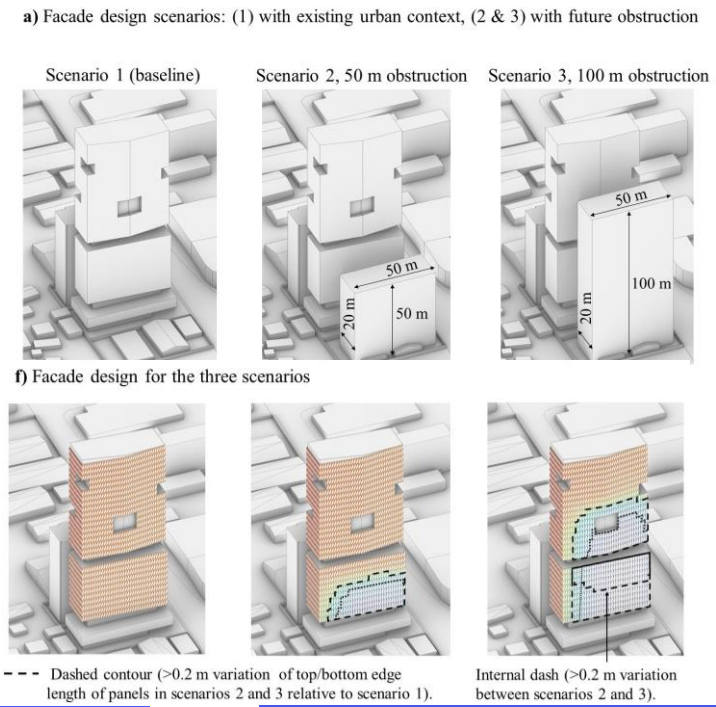
Parametric design workflow for solar, context-adaptive and reusable facades in changing urban environments. Journal of Building Performance Simulation, https://doi.org/10.1080/19401493.2024.2432916



Performance-driven workflow



Urban densification scenarios



The **Solar, Adaptive, and Circular Facade** is a performance-driven building envelope designed to navigate the challenges of urban densification and changing climate. It integrates solar control principles with a parametric design workflow to create a context-responsive skin to solar energy that balances aesthetics with long-term adaptability and circular flows in cities.

HOW IT WORKS

Solar Mapping: Radiation analysis informs module "openness" or Window-to-Wall Ratio (WWR), frit cover, and/or the solar heat gain coefficient (SHGC) of glass.

Adaptation: increase WWR in shaded areas to maximize light and decrease it in high-sun zones to control heat.

Design Continuity: Maintains original aesthetics while replacing or relocating panels as the city grows.

CIRCULAR STRATEGY

Solar Circularity Indicator (SCI): Tracks maintenance, reuse, and relocation of facade elements.

Resource Efficiency: Achieved an 85% SCI in a 100m obstruction scenario.

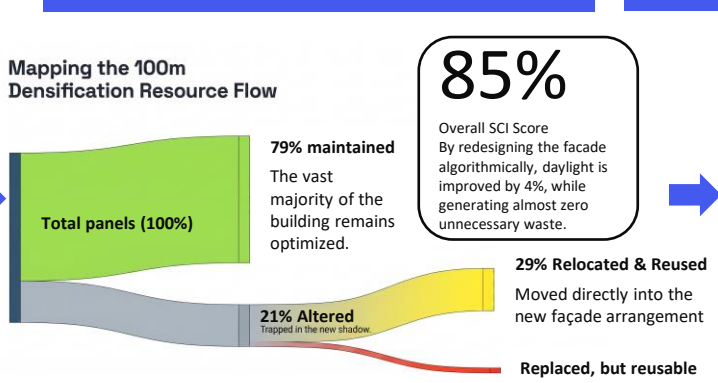
Module Recovery: Maintained 79% of modules and reused 29% of those altered by new urban shadows.

PERFORMANCE HIGHLIGHTS (vs. Glazed Facade)

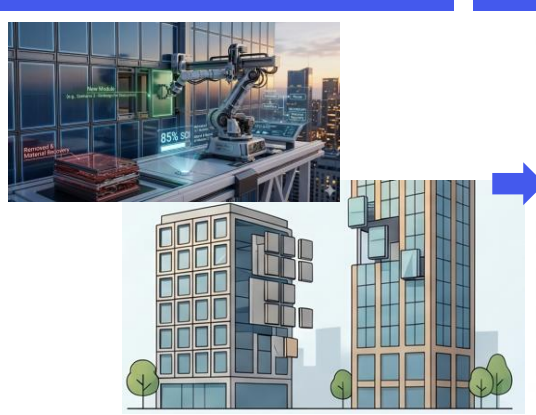
- +2% Useful Daylight ($UDI_{100\text{-}3000lx}$)
- 11% Reduction in Glare (sDG)
- 22% Lower Energy Use Intensity (EUI)
- +4% sDA through circular adaptation after re-design

DESIGN

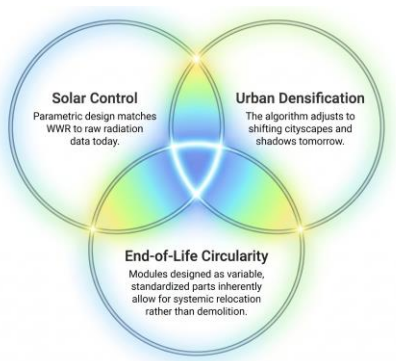
CIRCULAR FACADE FLOWS



REUSABLE IN OTHER BUILDINGS



ADAPTABILITY IS CIRCULARITY



OpenFace is an Erasmus+ project

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