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Kaleidoscope pragmatism: enhancing indoor daylight access and visual comfort in dense urban environments

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This presentation focuses on a case study of an existing building in central Athens, which is undergoing transformation into a new office space. The work embodies a collaborative effort between Transsolar and DECA Architecture, with an ambitious goal to address the challenge of daylight access and visual comfort in established urban structures.

The city center of Athens, with its densely populated, high-rise structures often struggles with natural light accessibility. Most buildings, up to 10 stories high, face very narrow, canyon-like streets, significantly reducing daylight access and views. The typical building floorplate is 27 meters deep, a dimension conducive to open-plan work environments. However, with the building facades significantly apart, the depth of these floor plates restricts the penetration of natural light to their centers.

Our solution to this issue involves the introduction of a new concept, integrating both passive and active means to enhance natural light penetration. A primary feature is the inclusion of a lightwell in the center of the floor plate. A dual-axis heliostat—a mirror equipped with a mechanical bracket—is placed at the top of this lightwell. This mirror tracks the sun, reflecting its light into the lightwell and thereby allowing sunlight to illuminate the building's inner portions throughout the day.

Complementing the heliostat, the architects have innovatively designed a scaled kaleidoscope within the new lightwell. This optical instrument, consisting of highly reflective triangular mirrors and diffusers, creates multiple reflections, effectively channeling daylight further into the inner part of the building.

Our methodology revolves around a unified, step-by-step approach, initially involving testing and optimization through computer simulation. We use daylight simulation tools like Radiance, ClimateStudio, and Ladybug Honeybee, which facilitate rapid assessment of potentials, geometry optimization, and target definition for finish properties. Following this, we measure the finishes for both a 1:20 scale model and the actual 1:1 mockup using lux and candela meters. This rigorous procedure ensures alignment of surface properties and meaningful comparisons between simulations, model measurements, and the actual building.

The combined effort of incorporating the heliostat, kaleidoscope, and a set of other design strategies, has proved successful in enhancing daylight access, autonomy, and visual comfort on the building's typical floors. This presentation, targeted at daylight professionals and practitioners in Architecture and Engineering, hopes to contribute to the broader discourse on daylight access, visual comfort, and architectural design, particularly within the constraints of existing building stock.
Currently renovation works are ongoing and the building will open in early 2024.

Keyword 1

Kaleidoscope for Daylight Access

Keyword 2

Heliostat-enhanced Light Penetration

Keyword 3

Mirror-based Lightwell Implementation

Keyword 4

Daylight Optimization in Dense Urban Environments

Keyword 5

Dense Urban Building Renovation for Daylight Access

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