Hybrid sunlight and thermal transport for illuminating multi-story buildings with deep floor plates

by

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ABSTRACT

Daytime lighting, air conditioning and water heating loads in large buildings could be significantly reduced by employing façade-based sunlight and thermal transport. This would save money, reduce global warming and improve lighting quality.

Combustion of fossil fuels for water heating and for electricity used to light and cool office buildings is implicated in the rise of greenhouse gases worldwide. Daylighting for illumination is a proven method of reducing fossil-source energy consumption of buildings. But given the limitations of conventional daylighting, sunlight transport is the only viable method of daylighting multi-story buildings with deep floor plates.

A façade- and ceiling-integrated system is proposed that redirects and concentrates, filters, transports and then extracts direct-beam sunlight for the illumination of floor space not reachable by conventional daylighting. The system features a novel extruded-glass-and-flowing-water lens-filter that removes near-infrared solar energy for domestic water heating while redirecting visible light for transport deep into the building interior.

Recent advances in materials science, computer simulation and affordable control systems have enabled sunlight and thermal transport to be viable. Constraints governing this viability are explored and tested herein, with the conclusion that – with improvements in design – sunlight and thermal transport may indeed be a technically and financially viable means of reducing the environmental impact of large commercial buildings.