

A SKYLIGHT FOR COVERED EXTERNAL ESCALATOR

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1. ABSTRACT

We introduce a design of skylights for enclosed exterior escalators. Which give appropriate illumination in the escalators at night by using Solar energy. To create pleasant experience for customer.

An artificial skylight has been designed with the intent of generating the illusion of a daylight opening in the ceiling using an artificial sunspot and a blue sky with apparently infinite depth. While comparing artificial system to that created by a traditional lighting system, the artificial skylight and the surrounding escalator ambience were considered as natural and appealing. According to research, artificial skylights can enhance the perceived environment of an escalator, making it feel natural, attractive, less tense by boosting positive mood.

We can operate skylights using solar energy, perhaps leading to energy savings. Also scope of customisation in the 3D view for Cover based on the customer's requirements. We can create a skylight using acrylic sheet. Skylight roof Provide multiple shapes and others based on customisation.

We can utilize acrylic to manufacture escalator skylights. Outdoor skylights can be designed to meet IP standards. There is insufficient light if we use glass, so we utilize skylights for sufficient light in escalators.

It can be Designed with simplicity and easy installation in mind. Skylights can be integrated into the escalator covering structure, and the covering structure is mounted on the escalator truss, eliminating the need for exterior dependency.

2. INTRODUCTION

Introducing the Artificial Skylight Concept: A Sustainable Solution by Elevating Urban Mobility with Enhanced Safety and Aesthetics.

Outdoor escalators are now essential in urban areas, linking various elevation levels in public spaces like city centres, malls, parks, and transport hubs. However, their outdoor placement presents unique challenges: constant exposure to harsh weather (rain, snow, extreme temperatures) demands robust design. Beyond weather, lighting is a crucial, often overlooked, issue. Outdoor areas often have inconsistent natural light due to shadows, reducing visibility during dawn, dusk, or cloudy conditions and thus increasing safety risks for users.

To address these multifaceted lighting challenges, we propose exploring the artificial skylight concept. This innovative approach involves integrating features that simulate natural sunlight or provide continuous, consistent illumination around the clock. Whether powered by solar energy or utilizing advanced LED systems, artificial skylights offer several key advantages: they can deliver natural-like light throughout the day, irrespective of external environmental conditions; they ensure a uniform and consistent level of illumination at night, significantly enhancing visibility and safety; and they contribute positively to the overall aesthetics of both the escalator structure and its surrounding environment. This presentation will delve into the critical need for effective lighting in outdoor escalator designs and explore the potential of artificial skylights as a transformative solution. The Indispensable Role of Effective Lighting.

3. DESIGN CONSIDERATIONS:

3.1. Material Artificial Skylight:

The physical design of the artificial skylight must prioritize both resilience against ambient environmental factors and maximal luminous transmittance.

3.1.1. Panel Material: Polycarbonate or Tempered Glass



Figure 1. *Polycarbonate or Tempered Glass* (Polycarbonate pc sheet, 2023)

Polycarbonate or tempered glass are the ideal choices for the artificial skylight's transparent panels. Selected for their optical transparency, superior weather resistance, and effective light diffusion, these materials ensure prolonged service life and consistent photometric performance under various environmental conditions.

3.1.2. Column Structure:

The artificial skylight's structural integrity and aesthetic integration depend on its supporting columns. Galvanized steel is a common, corrosion-resistant material ideal for outdoor environments, while concrete offers robust support with adaptable architectural finishes. Columns must be carefully engineered for height and precise placement at intervals to ensure the escalator truss spans without deflection and provides adequate clearance. For long-term durability, especially with steel, robust protective coatings are imperative against rust and weathering.

3.2. Orientation And structure:

3.2.1. Considering Geometric Configuration and Scale:

The skylight's geometric configuration and overall scale must be engineered to provide sufficient illuminance across the entire escalator path.

3.2.2. Structural Integration for Outdoor Installation

The successful implementation of an artificial skylight on an outdoor escalator needs careful design of its supporting structure, specifically the column's integration with the escalator's truss. This ensures not only the functionality and safety of the combined system but also its seamless aesthetic integration within the surrounding environment. Here is a breakdown of the key components and structural considerations involved.



Figure 2. *Structural Integration* (Freepik, 2010)

3.2.3. Customized Shapes and Size:

The skylight's geometric configuration and overall scale must be engineered to provide sufficient illuminance across the entire escalator path.

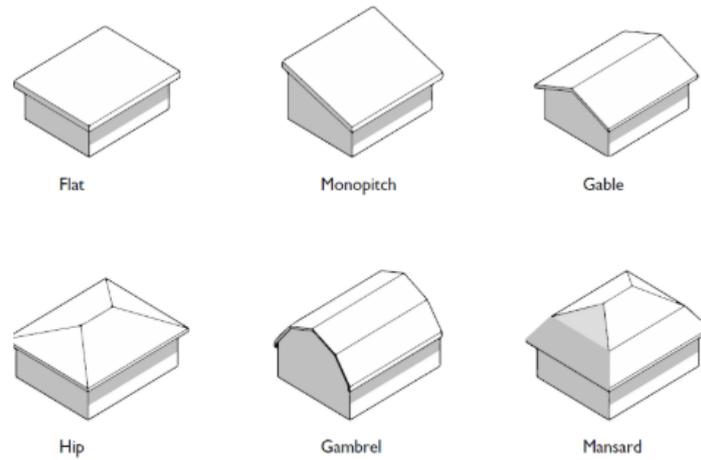


Figure 3. Shape and Size of roofs samples (Oncodes.ca, 2022)

3.2.4. Weather Considerations:

The artificial skylight system is meticulously designed for resilience against challenging outdoor conditions. It is engineered to be waterproof and highly weather-resistant to withstand exposure to rain, sun, and wind. Furthermore, the materials selected for the skylight are specifically chosen to withstand high temperatures without degrading and include UV-resistant coatings to prevent damage from prolonged sun exposure, ensuring long-term durability and performance.

UV Filtration To safeguard both human occupants and the internal mechanical and electrical sub-components of the passenger Escalator from solar degradation, the skylight system shall integrate specialized coatings for ultraviolet (UV) radiation filtration. This inclusion directly enhances operational safety and extends the lifespan

3.3. Solar Optimization:

The artificial skylight is engineered for effective solar optimization, utilizing either fixed skylights positioned at an optimal angle for consistent daylight capture throughout the day, or adjustable skylights that employ smart systems to dynamically track the sun, maximizing light intake. For energy efficiency, the system integrates solar-powered LEDs that collect and store energy during the day for illumination during low-light periods, complemented by smart lighting that adjusts brightness based on ambient levels, reducing energy waste. The entire structure, including the column on the escalator truss, demands careful design to ensure functionality, safety, and seamless aesthetic integration for outdoor installations.

4. MOUNTING ASSEMBLY FOR ARTIFICIAL SKYLIGHT ON ESCALATORS

This novel mounting assembly offers a robust, efficient, and aesthetically cohesive solution for integrating artificial skylights onto outdoor passenger Escalators, significantly enhancing safety and environmental protection. It overcomes the costly and complex challenges of attaching overhead structures to existing escalator trusses by providing an inexpensive, easily installed solution that seamlessly integrates with the current framework.

The installation method is straightforward:

1. Truss Support: Ensure the Escalator's existing truss structure is sound.
2. Main Bracket Affixation: Secure grooved main brackets along the truss.
3. Roof Bracket Engagement: Mount tabbed roof brackets to the main brackets, interlocking them to prevent separation.
4. Outer Decking Installation: Secure outer decking to the main brackets, enclosing the truss.
5. Aperture Creation: Cut openings in the decking to expose roof brackets.
6. Skylight Support Attachment: Secure the skylight's support structure (roof support members) to the roof brackets.
7. Skylight Panel Integration: Attach artificial skylight panels to the support members, partially enclosing the Escalator

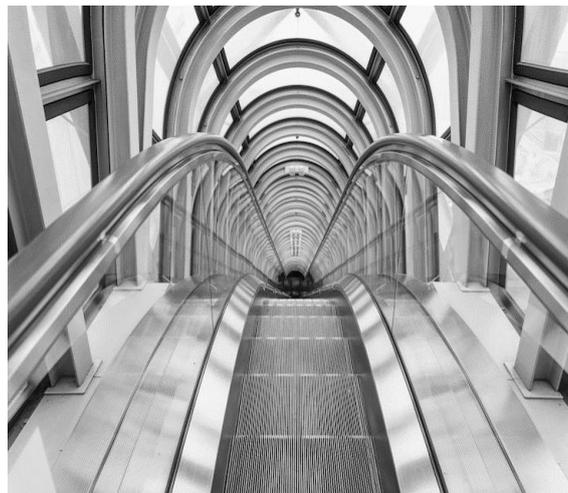


Figure 4. *Skylight Support Attachment* (Escalator in modern building, 2015)

5. SIGNIFICANCE OF SKYLIGHT

The artificial skylight's significance for outdoor escalators lies in its comprehensive approach to providing enhanced safety through consistent, UV-filtered illumination, achieving significant energy independence and sustainability through optimized solar harvesting and smart LED integration, and contributing positively to the urban aesthetic, all while maintaining robust structural integrity.

5.1. Enhanced Safety: Beyond merely illuminating, the system provides consistent, uniform light distribution across the entire escalator path, critical for reducing trip hazards and ensuring clear visibility in all conditions, from bright noon sun to deep night, or even during monsoon downpours. The integrated UV-filtered illumination actively safeguards both passengers' skin and eyes, and more importantly, protects the intricate mechanical and electrical sub-components of the escalator from long-term solar degradation, which can cause material breakdown and premature failure in outdoor environments.

5.2. Optimal Energy Efficiency: This system champions environmental responsibility by striving for energy self-sufficiency. Through solar power, whether from optimally angled fixed skylights capturing abundant sunshine or dynamic adjustable ones that track the sun's path to maximize energy harvesting, it drastically reduces the escalator's reliance on the conventional power grid. Integrated smart LED lighting further refines energy consumption by autonomously adjusting brightness levels based on real-time ambient light, ensuring illumination is always adequate but never wasteful, leading to significant operational cost savings and a reduced carbon footprint. provide a continuous light source also enhances visual appeal. Artificial skylights provide natural light during the day to integrate the escalator into public spaces, and maintain sufficient night lighting via integrated, solar-powered or energy-efficient LEDs.

5.3. Improved User Experience: The delivery of natural-like light creates a more open, secure, and inviting environment for passengers, significantly enhancing their sense of comfort and reducing potential anxiety often associated with enclosed or dimly lit spaces. Beyond functionality, the thoughtful design ensures the skylight aesthetically integrates seamlessly with the surrounding urban landscape, becoming an architectural feature that elevates the visual appeal of public spaces rather than merely being a utilitarian addition.

5.4. Increased Durability: Functioning as a robust protective canopy, the artificial skylight effectively shields sensitive escalator components from direct exposure to harsh weather elements prevalent in outdoor settings, including intense solar radiation, heavy rain, and corrosive humidity. This physical barrier prevents premature wear, corrosion, and accumulation of debris, thereby extending the operational lifespan of the entire escalator system and reducing the frequency and cost of maintenance interventions.

5.5. Psychological Benefits: Artificial skylights provide notable psychological benefits by simulating natural daylight: exposure to which reduces stress, improves mood, and promotes general well-being. Furthermore, by mimicking natural light cycles, these skylights aid in keeping healthy circadian rhythms, especially beneficial in enclosed or naturally dim outdoor escalator environments.

6. TYPES OF ARTIFICIAL SKYLIGHT SYSTEMS

Artificial skylight systems use diverse technologies to simulate natural light, catering to various functional and aesthetic requirements in passenger Escalator installations.

6.1. Tunable LED Skylights

These systems use LED arrays with adjustable colour temperatures, capable of transitioning light output from cool daylight to warm sunset hues. This mimics the diurnal progression of natural sunlight, allowing for dynamic environmental mood and productivity regulation within the escalator's illuminated path.



Figure 5. Tunable LED skylights (Dreamstime, 2025)

6.2. Panel Skylights (Backlit Panels)

Comprising flat, LED-illuminated panels, these units are ceiling or wall-mounted to create an illusion of natural daylight. They often incorporate high-resolution imagery (e.g., sky or cloudscape) to enhance the perceived openness, making them suitable for areas where conventional fenestration is infeasible.



Figure 6. Panel Skylights (New York School Interior Design, 2025)

6.3. Fiber Optic Skylights

This technology employs fibre optic cables to send illumination from an external light source (natural or artificial) into the enclosed space. Light is collected at a primary source (e.g., roof-mounted collector) and precisely routed via optical fibres to ceiling-mounted diffusers, providing a natural, glare-free glow where direct natural light access is restricted.

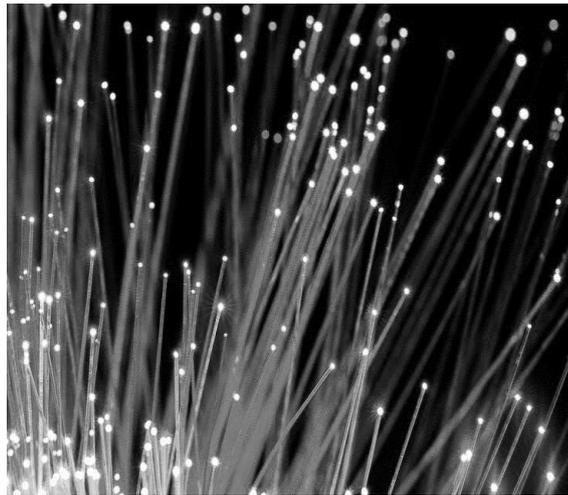


Figure 7. Fiber optic (Britannica, 2025)

6.4. Smart Skylights

Characterized by advanced digital controls, these systems allow for user-defined adjustment of brightness and colour temperature via integrated applications or voice commands. Models offer seamless integration with building management systems, enabling automated light level adjustments based on time-of-day schedules or occupancy, improving energy efficiency and user convenience.



Figure 8. Smart Skylights (Stockcake, 2025)

6.5. Artificial Light Tubes (Sun Tunnels)

These consist of highly reflective tubular conduits designed to channel either external daylight or artificial light from a roof-mounted unit into the space below. They are particularly effective for transmitting light to specific, smaller areas where traditional skylights are structurally or spatially impractical.



Figure 9. Self-flashing Aluminum Tubular Skylight (Velux, 2025)

6.6. LED Panels with Sky Simulation

These are large-format LED display panels capable of making high-definition, dynamic images of the sky or natural scenery. The illumination is diffused through the panel, creating a soft, uniform light distribution that fosters a calming and expansive atmosphere, ideal for enhancing psychological well-being.



Figure 10. LED Panels with Sky Simulation (LaVoz, 2025)

6.7. Solar Tubes with Integrated Artificial Lights

Like standard light tubes, these units use mirrored surfaces to channel natural light, but critically, they include an integrated artificial LED lighting part. This hybrid design ensures consistent light levels during overcast conditions or nighttime, providing reliable illumination regardless of external solar availability.

6.8. LED Sky Panels

These panels are specifically designed LED matrices that simulate the appearance of a skylight by displaying static or dynamic images of the sky. They provide both ambient illumination and an enhanced feeling of openness, commonly deployed in environments looking to use simulated daylight for psychological benefits.



Figure 11. LED Sky Panels (LaVoz, 2025)

6.9. Emitting Skylight Roof Panels

These are integrated structural panels directly incorporating embedded LED lights within their transparent or semi-transparent material. They are designed to mimic the appearance of traditional skylights while offering superior energy efficiency and a more streamlined installation, particularly suitable where conventional skylight structures are cost-prohibitive or impractical.



Figure 7. Roof Panels placement (Exporters india, 2025)

7. FUTURE DIRECTIONS AND INNOVATION

Looking ahead, the evolution of artificial skylight systems for escalators will be driven by advancements in Smart Skylight Technology and principles of Sustainable Design. Future innovations will incorporate advanced sensors and automation to dynamically refine performance: for instance, motion sensors could enable the skylight's brightness to adjust based on real-time passenger flow, while weather-responsive designs would autonomously adapt illumination and energy capture according to ambient light levels and weather patterns. These developments will further refine energy efficiency, ensuring the escalator's lighting is always optimally tailored to demand and environmental conditions. Concurrently, a commitment to sustainable design will guide the integration of innovative materials and energy-neutral operation, positioning these systems as benchmarks for eco-conscious urban infrastructure.

8. CONCLUSION

Outdoor escalators, while integral to urban mobility, present significant challenges related to environmental exposure and inconsistent illumination, directly affecting user safety and comfort. This presentation has introduced an innovative and comprehensive solution: an artificial skylight system specifically engineered for enclosed exterior escalators. By creating the compelling illusion of a natural daylight opening, complete with an artificial sunspot and an infinitely deep blue sky, our system fundamentally redefines the covered escalator journey.

Our design prioritizes best, consistent illumination around the clock, seamlessly transitioning from harnessed natural light during the day to intelligent, solar-powered LED lighting at night. This not only directly addresses critical safety concerns by ensuring clear visibility but also profoundly enhances the psychological well-being of users. The integration of natural-like light has been shown to boost mood and reduce stress, transforming potentially uninviting and tense escalator environments into more natural, secure, and attractive public spaces.

Moreover, by strategically using solar energy, our artificial skylight delivers substantial energy efficiency and sustainability benefits, aligning with contemporary urban development goals for eco-conscious infrastructure. The system's design emphasizes simplicity and ease of integration, ensuring it can be installed directly into existing escalator covering structures without extensive redesigns.

In closing, the proposed artificial skylight system stands for a significant advancement in outdoor passenger conveyor design. It transcends mere illumination, offering a multifaceted solution that dramatically improves user experience and safety, while simultaneously promoting environmental responsibility. This innovation is poised to redefine the covered escalator journey, setting a new standard for functional, safe, and aesthetically pleasing urban mobility.

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10. BIOGRAPHICAL DETAILS



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