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KARADENİZ TECHNICAL UNIVERSITY
FACULTY OF ARCHITECTURE
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Review Article

# Evaluation of Daylight Performance in Double-Skin Facade Systems for Buildings

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Received: 04.06.2025, Accepted: 17.11.2025.

## Keywords

Double Skin Façade, Daylighting, Energy Efficiency, Facade Design, Sustainable Daylighting.

**Abstract** In buildings with double skin facades (DSFs), daylighting performance is influenced by parameters such as facade layer configuration, cavity depth, orientation, glazing properties, and shading devices. Although numerous studies have investigated the thermal and energy aspects of DSFs, research focusing specifically on daylighting remains limited. This review systematically evaluates previous studies on DSF daylighting performance using the PRISMA protocol. A comprehensive search of the Scopus and Web of Science databases initially identified 503 publications, which were screened and reduced to 24 relevant articles. The analysis highlights how architectural design parameters, particularly shading strategies, cavity depth, and facade orientation, shape daylighting outcomes. Overall, DSF systems tend to reduce absolute illumination levels compared to single skin facades but improve visual comfort by minimizing glare and ensuring more uniform light distribution. Certain configurations, such as perforated screens with 37–50% openness or multi-storey DSFs with optimized cavity depths (40–90 cm), demonstrated improvements up to 70% in useful daylighting illuminance and significant reductions in glare probability. The findings emphasize that DSFs, when appropriately designed, can balance daylight autonomy, visual comfort, and energy efficiency. This study contributes to filling a gap in the literature by synthesizing quantitative evidence and identifying research needs for integrating DSFs into sustainable daylighting design strategies.

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Cite this article;
Günay H. (2026). Evaluation of daylight performance in double-skin facade systems for buildings. *LivenARCH+ Journal, 3*(1): 82-94. DOI:10.65775/livenarch.1714468

## 1. Introduction

Daylighting is recognized as a fundamental component of sustainable building design. The Sustainability Guide (2020) emphasizes that effective daylight control reduces energy consumption from artificial lighting, enhances spatial quality and visual perception, and strengthens visual continuity between indoor and outdoor environments (Cheshire & Godefroy, 2020). In addition to energy efficiency, exposure to natural light has well-documented positive effects on human health, well-being, and cognitive performance. Consequently, the demand for transparent building facades has increased considerably in recent decades and is expected to continue growing (Pariafsai, 2016).

The performance of daylighting in buildings depends on multiple factors, including layout and orientation (Le-Thanh et al., 2022), task-related requirements (Konstantzos et al., 2020), glare risk (Bian et al., 2020), and the distribution and stability of light throughout the day and across seasons (Alrubaih et al., 2013). However, facade glazing also presents challenges such as excessive solar heat gain or loss (Hee et al., 2015), which are influenced by parameters like building geometry, site characteristics, and glazing design. Achieving efficient daylighting, therefore, requires a careful balance between maximizing illumination and mitigating adverse thermal and visual effects.

Within this context, double-skin facades (DSFs) have emerged as an important architectural and engineering solution. A DSF typically consists of an inner facade, an outer glazing layer, and an intermediate ventilated cavity, where shading devices are often placed (Barbosa & Ip, 2014). This configuration allows designers to improve thermal comfort, regulate solar gain, and achieve greater transparency while offering potential advantages for daylighting. DSFs are increasingly applied not only in new construction but also in retrofitting existing buildings in both hot (Barbosa & Ip, 2016) and temperate climates (Pomponi et al., 2016), as well as in recent retrofit projects (Khabir & Vakilinezhad, 2023).

Although extensive research has addressed the thermal and energy performance of DSFs, studies focusing on their daylighting performance remain comparatively scarce. Existing work often evaluates individual parameters, such as shading devices, cavity depth, or glazing type, without providing a comprehensive synthesis across building typologies and climatic conditions. This gap in the literature limits a holistic understanding of how DSF configurations affect visual comfort, daylight autonomy, and overall indoor environmental quality.

Therefore, this study conducts a systematic review of peer-reviewed literature on the daylighting performance of DSFs, following the PRISMA protocol. The primary objective is to synthesize existing evidence on how design parameters affect daylighting outcomes. The central research question guiding this review is: How do double skin facade configurations and design parameters influence daylighting performance, visual comfort, and energy efficiency in buildings? By addressing this question, the study aims to identify knowledge gaps, highlight best-performing DSF strategies, and provide guidance for integrating daylighting considerations into sustainable facade design.

## 2. Double Skin Facade Systems and Daylight Performance

In buildings with double skin facades (DSFs), daylighting is transmitted to the interior through multiple facade layers. The amount and quality of transmitted light depends on the reflection, transmission, and absorption properties of each layer, as well as the configuration of glazing and shading devices. Compared to conventional single skin facades, DSFs generally increase reflection and light diffusion, leading to more uniform but slightly reduced overall illumination indoors. Key parameters influencing daylight access include facade orientation, cavity depth, glazing type, shading elements, and overall building geometry.

Figure 1 illustrates the multiple daylighting pathways within a DSF system. Direct sunlight first strikes the external facade surface, where it may be transmitted, reflected, or diffused before entering the cavity. Additional contributions come from externally reflected daylight from surrounding buildings and externally diffused daylight scattered on outer glazing surfaces. Once inside, daylight is further distributed through internal reflections and material diffusion, ensuring a more balanced illumination compared to single facades. This layered transmission process helps DSFs mitigate glare while enhancing visual comfort.

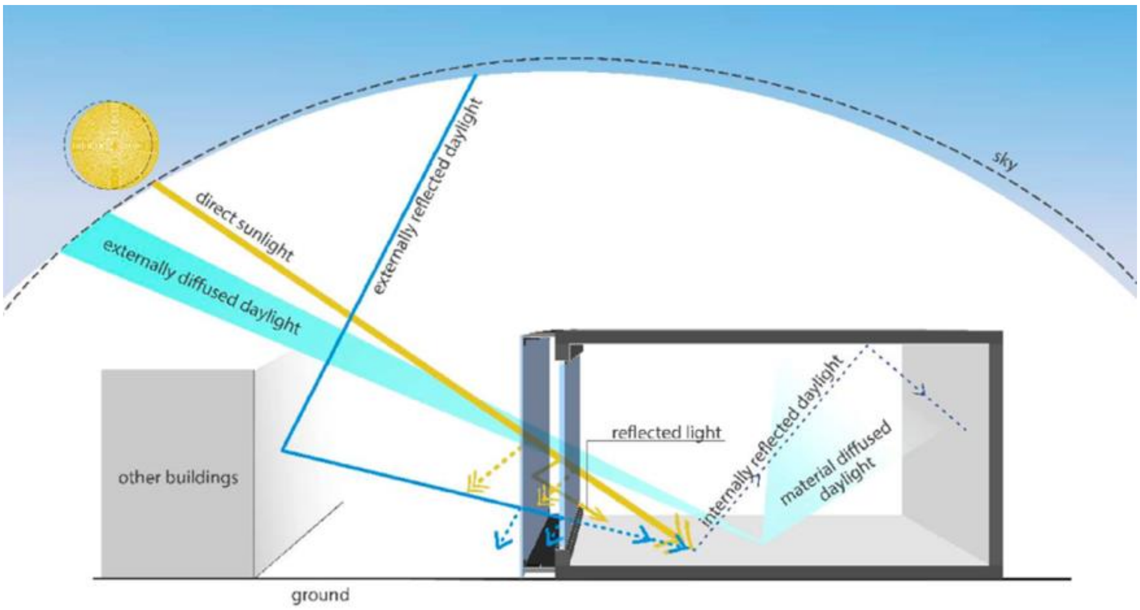


Figure 1. Lighting sources and reflections in a building with double skin facade (Barbosa, Alberto, & Piroozfar, 2024).

DSF systems are classified into four main types, box window, shaft-box, corridor, and multi-storey facades, depending on cavity design and airflow principles (Barbosa & Ip, 2014) (Figure 2). Each configuration has distinct implications for daylighting performance:

- Box window facades provide separate cavities for each floor, allowing localized control of shading and ventilation. This can improve daylight autonomy in individual spaces but may reduce uniformity across floors.
- Shaft-box facades incorporate vertical shafts that enhance ventilation and reduce obstruction of daylight, thereby improving penetration into deeper zones.
- Corridor facades use continuous horizontal cavities, supporting wider daylight distribution across open-plan interiors while allowing flexible shading strategies.

- Multi-storey facades feature uninterrupted vertical cavities spanning several floors. This design facilitates uniform airflow and deeper daylight penetration, reducing inter-floor shading effects and improving daylight uniformity.

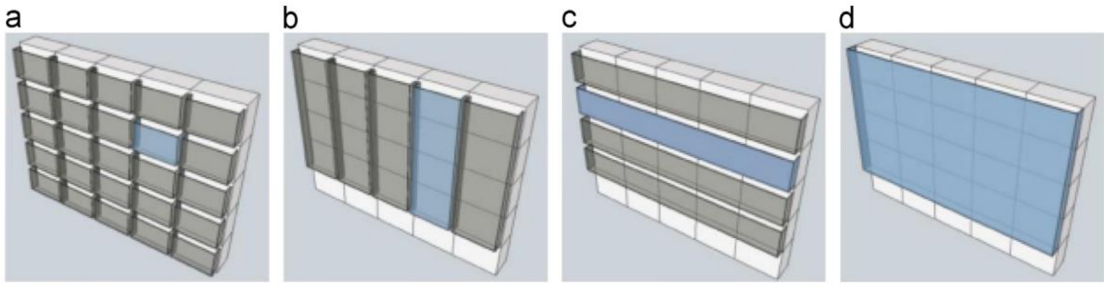


Figure 2. DSF classification: (a) box, (b) shaft, (c) corridor and (d) multi-storey double skin facade (Barbosa & Ip, 2014).

In summary, DSFs influence daylighting not only through glazing and shading characteristics but also through the type of cavity configuration. While box and corridor systems offer more localized daylight control, shaft-box and multi-storey systems enhance vertical daylight distribution and spatial uniformity. Understanding these distinctions is essential for evaluating DSF daylighting performance and comparing results across studies.

## 3. Methodology

The literature review was conducted in accordance with the PRISMA 2020 protocol (Page et al., 2021), which provides a systematic framework for ensuring transparency and reproducibility. The search was carried out in the Scopus and Web of Science (WoS) databases using the keywords (“daylight” OR “daylighting” OR “natural light” OR “sunlight” OR “daytime”) AND (“double skin facade” OR “double facade” OR “double skin system” OR “dual skin facade”). The initial Scopus search identified 458 records. After applying subject filters (*Engineering*), document type (*articles*), and language (*English and Turkish*), the number was reduced to 232. Further refinement using daylighting related terms decreased the dataset to 90. In addition, Scopus AI identified 7 directly relevant studies. The Web of Science search produced 45 records, 27 of which were articles and 10 of which met the inclusion criteria, with 3 of which overlapping with Scopus. In total, 503 studies were initially retrieved, and after screening for relevance and removing duplicates, 24 articles were selected for detailed analysis, including 4 review papers.

Studies were included if they addressed the impact of double skin facades on daylighting performance (e.g. daylighting factor, useful daylighting illuminance, glare probability) and were published in peer-reviewed journals between 2010 and 2024. Publications were excluded if they focused solely on thermal or acoustic performance, were not in English or Turkish, or appeared as conference proceedings or editorials. The selection process is summarized in the PRISMA flow diagram (Figure 3).

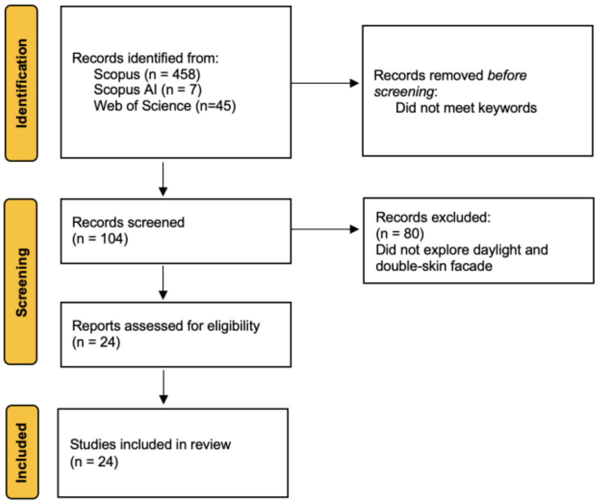


Figure 3. Flow diagram of the literature search strategy.

In addition to the database filtering process, Scopus AI was employed to refine the search by asking the direct query: “Can you list the articles that examine the daylight effect on double skin facades?” This targeted approach identified seven relevant studies, which were used to generate a focused concept map (Figure 4). To provide a broader perspective, a second map was created with VOSviewer using the full set of 503 retrieved publications (Figure 5).

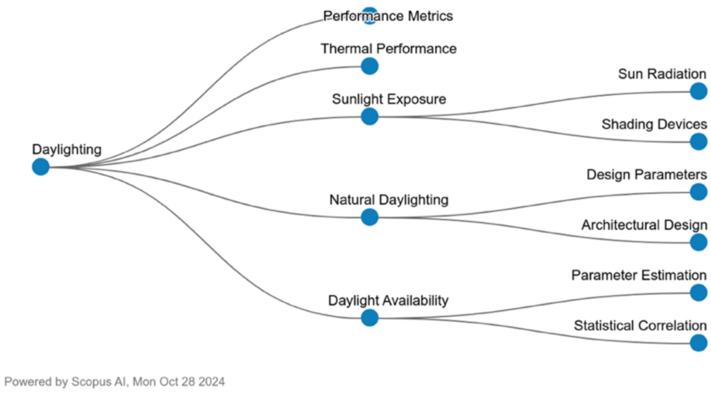


Figure 4. Scopus AI concept map.

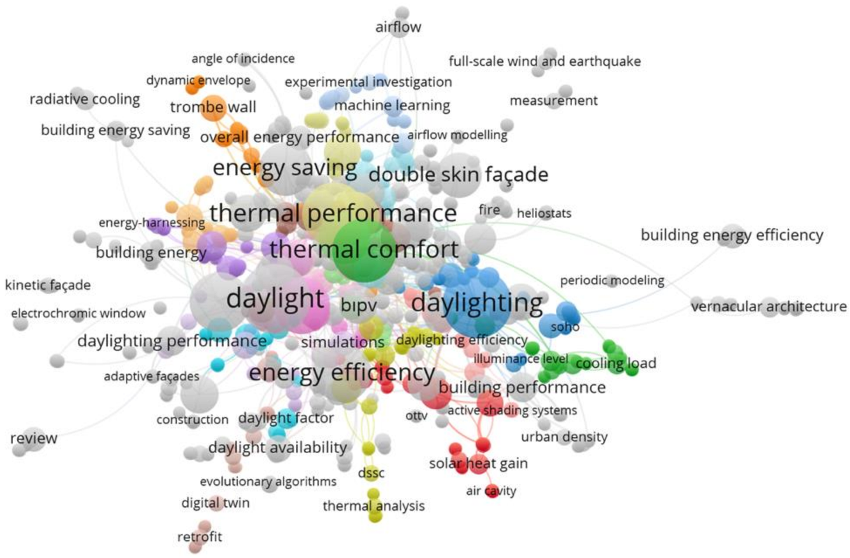


Figure 5. Concept map obtained from 503 sources.

## 4. Results and Discussion

This review synthesized the findings of 24 studies on daylighting performance in buildings with double skin facades (DSFs). The selected literature examined various design parameters, including building typology, facade orientation, DSF geometry, cavity depth, glazing materials, and shading devices. The parameters and case contexts of the studies are summarized in Table 1, while the main results are presented in Table 2.

Research commonly focused on south-facing orientations, cavity depths between 5 cm and 100 cm, and glazing alternatives ranging from conventional double glazing to advanced photovoltaic modules. Shading strategies such as venetian blinds, perforated panels, and ETFE foils were frequently investigated due to their significant impact on daylight distribution and glare control.

Table 1. Parameters influencing daylighting performance in DSF systems.

| Reference | Typology / use | Location | Orientation | DSF geometry | Cavity dept | Window-to-wall | Skins materials | Shading device | Method |
|---|---|---|---|---|---|---|---|---|---|
| Zheng et al., 2024 | n/a | Xiamen, China | south-facing | multi-storey | n/a | south:≈ 100% | aluminium alloy Venetian blinds with a high reflectivity coating, single-layer glass, and an external light shelf | Venetian blinds (VBs) | Experimental (full-scale test rooms) |
| Flor et al., 2022 | educational, commercial or office buildings | London, Barcelona and Shanghai | south-facing | corridor type | n/a | south:30%-90% | glazing and ETFE foil | ETFE foil | Experimental (spectral tests of ETFE) + Simulation (Radiance, Honeybee/Grasshopper) |
| Zhang et al., 2022 | residential buildings | Xi'an, China | south-facing | box type | 100 cm | south:≈ 33% | polycrystalline PV modules, solar thermal collectors, transparency double-glazed | PV modules and solar thermal collectors | Simulation (DesignBuilder, DF & UDI) |
| M. ElBatran & Ismaeel, 2021 | office buildings | Cairo, Egypt | south-facing | multi-storey | 20-60 cm | south:≈ 50% | glazed or tinted glass | perforated solar screens | Simulation (iterative daylight simulations, parametric + statistical analysis |
| Srisamranrungruang & Hiyama, 2021 | office buildings | n/a | south and west facades | n/a | 50-100 cm | n/a | glass and perforated steel screen | perforated steel screen | Simulation (DIVA + EnergyPlus/ DesignBuilder, daylight + energy) |
| Barone et al., 2024 | multi-storey buildings | Mediterranean countries, notably Cyprus | east-to-west orientations | multi-storey | 50-1000 cm | east-to-west:≈20% | monocrystalline PV panels and double-glazed glass | - | Dynamic simulation (TRNSYS + SketchUp + MatLab airflow/PV model) |
| Chi et al., 2017 | office buildings | Seville, Spain | n/a | multi-storey | 5 cm | 100% | perforated screens and glazing | perforated screens white paint finish with 90% visible and solar reflectance | Simulation (DOA optimization + daylight & energy modelling) |
| Gomes et al., 2022 | commercial buildings | Lisbon, Portugal | south-facing, with a slight eastward deviation | box type | n/a | n/a | double tilted Venetian blinds and glazing | Venetian blinds | Experimental (full-scale outdoor test cell, daylight measurements) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| C. Wang et al., 2022 | n/a | Hefei, China | south-facing | n/a | 7 cm | south:≈ 57% | CdTe PV glazing, clear glass | CdTe glazing | Experimental (full-scale facade test with CdTe glazing) + Simulation (validated daylight model) |
| Huang et al., 2024 | n/a | Wuhan, China | south-facing | multi-storey | 5 cm | south:100% | aluminium perforated screens and glazing | aluminium perforated screens | Simulation |
| Gaspari et al., 2024 | residential buildings | Bologna, Italy | west and south | multi-storey | n/a | n/a | glazing and metal panels | metal panels | Simulation (Dialux, daylight distribution) |
| Dewi et al., 2022 | educational building | Depok, Indonesia | north and south | corridor type | 135 cm | north:40%south:60% | glazing and opaque brick | opaque brick | Simulation (Dialux, daylight performance) |
| Gholami & Talaei, 2024 | office buildings | Mashhad, Iran | South | box and corridor type | n/a | n/a | glazing and metal panels | metal panels | Simulation (EnergyPlus, Radiance, Daysim via Ladybug, daylighting performance) |
| Aksamija, 2018 | office buildings | Duluth, Chicago, San Francisco, Miami | north, south, east, west | box, corridor, multi-storey | 60-90 cm | 100% | standard curtain wall and double-glazed panels | n/a | Simulation |
| Chen et al., 2021 | residential buildings | Guangha, China | southeast, southwest | box | n/a | 100% | double glass glazing - PV modules | PV modules | Experimental + Simulation |
| M. Wang et al., 2017 | office buildings | Hong Kong, China | south-facing | multi-storey | 40 cm | ≈44%, | tempered glass - PV layers | PV layers | Experimental + Simulation |
| Kim et al., 2015 | residential buildings | South Korea | south, southeast, southwest-facing | n/a | 90 cm | 100% | aluminium frame - glass | horizontal slats 20 cm width | Simulation (Radiance and Daysim) |
| Ioannidis et al., 2017 | office buildings | Montreal, Canada | south-facing | n/a | 10 cm 50 | n/a | glass glazing - PV modules | automated roller shades | Simulation |
| Roberts et al., 2023 | commercial buildings | London, United Kingdom | south-facing | box | 40 cm | 62% | semi-transparent a-Si PV glazing - double low-emissivity (Low-E) | semi-transparent PV glazing | Simulation |
| Khabir et al., 2024 | office buildings | Ahvaz, Iran | south-facing | corridor | 50 cm 100 cm 150 | south:45% | double-clear and triple -clear glazing | louvers (0.5-1.5 m) and window blinds | Simulation (DesignBuilder software) |

Table 2. Main findings of the studies.

| Reference | Main findings |
|---|---|
| Zheng et al., 2024 | Mechanically ventilated double skin facade systems combined with Venetian blinds and light shelves improve occupant comfort in hot climates by minimizing glare while increasing daylight utilization and energy efficiency in the interior. |
| Flor et al., 2022 | Double skin facades using adaptive ETFE foil reduce glare by distributing daylight homogeneously and increase energy efficiency indoors in different climatic conditions. |
| Zhang et al., 2022 | The integration of a productive double skin facade (PDSF) with photovoltaic and solar thermal modules significantly enhances indoor daylighting comfort while reducing outdoor light pollution, making it an effective solution for sustainable building design. |
| M. ElBatran & Ismaeel, 2021 | Optimizing double skin facades (DSF) with selected perforation ratios of 50-60%, combined with depths of 40-60 cm and a 40 cm gap width, effectively enhances daylighting and visual comfort in office buildings by achieving sufficient natural light while minimizing glare in hot arid climates. |
| Srisamranrungruang & Hiyama, 2021 | The study finds that a double skin facade with 40% perforation on the south-facing facade and 10% on the west-facing facade provides optimal daylight access while minimizing glare. |
| Barone et al., 2024 | The study finds that smaller DSF depths (less than 7 meters) are more effective for reducing heating demands, while larger DSF depths (greater than 6 meters) reduce cooling requirements. |

| | |
|---|---|
| Chi et al., 2017 | The study concluded that an optimally configured perforated solar screen with a 37.5% perforation ratio could increase the 'actual daylit area' by 50% and reduce overlit areas by 50%, compared to a fully glazed facade without PSS, achieving a balanced daylight level of 300 lux for at least 50% of occupied hours. |
| Gomes et al., 2022 | The study found that double tilted Venetian blinds (DTVB) significantly enhance daylighting in south-oriented spaces by increasing the average daylight factor (DF) up to 3.8 times compared to traditional Venetian blinds when the upper slats are tilted at 0° and lower slats at 90°, providing improved daylight distribution and reducing glare discomfort. |
| C. Wang et al., 2022 | The CdTe-DSV window system improved daylighting performance by achieving a daylight factor of 0.6%, reduced daylight glare index (DGI) by maintaining levels below 24 for 99.2% of the occupied time with 80% PV coverage and enhanced useful daylight illuminance (UDI) over 70% for 82% of the occupied area, ensuring visual comfort and optimal daylight distribution. |
| Huang et al., 2024 | The study identified the periphery-centre pattern as the optimum variation for non-uniform perforated solar screens. This pattern achieved the highest overall performance by providing balanced daylighting with a useful daylight illuminance (UDI) of 78%, minimized glare with a daylight glare probability (DGP) below 10%, and improved daylight uniformity, making it suitable for both visual comfort and energy efficiency across orientations. |
| Gaspari et al., 2024 | The study found that a perforated shading panel with a 15% openness factor (OF) optimized daylight distribution by maintaining 300 lux across 70% of the room, while limiting areas of glare over 1000 lux near windows. |
| Dewi et al., 2022 | As a result, reflective glass with a window-to-wall ratio of 40% and a shading coefficient of 0.42 is recommended for the north facade and transparent glass with a window-to-wall ratio of 60% and a shading coefficient of 0.95 is recommended for the south facade; however, additional electric lighting will be required to meet minimum lighting standards, especially in overcast conditions. |
| Gholami & Talaei, 2024 | The study found that adaptive shading strategies, particularly those adjusting shading angle and pattern geometry, improved daylight autonomy (sDA) by up to 26% in summer, reducing annual sunlight exposure (ASE) by 25.7% in high-glare conditions. |
| Aksamija, 2018 | The study found that the multi-storey DSFs with a 0.6 m cavity performed best in daylighting during the summer (July) for northern and eastern orientations, achieving up to 37% of floor area with illuminance levels of 500 lux or more in cities like Miami and Chicago. |
| Chen et al., 2021 | The bifacial PV module system achieved a daylight autonomy (DA) of 93% and a useful daylight illuminance (UDI) of 69%, indicating sufficient natural lighting while maintaining visual comfort, with optimal power generation and daylighting performance occurring at 74% PV coverage. |
| M. Wang et al., 2017 | The PV-DSF achieved daylight illuminance of up to 350 lux, fulfilling 70% of the office illuminance requirement. |
| Kim et al., 2015 | The double skin facade achieved a 17% improvement in illuminance uniformity, reduced glare with maximum daylighting levels below 1000 lux at the front space, and enhanced daylight penetration into deeper spaces by secondary diffused light while maintaining optimal cavity depth at 90 cm and shading slat width at 20 cm. |
| Ioannidis et al., 2017 | The study found that integrating semi-transparent photovoltaic (STPV) panels with 30% transmittance in a double skin facade (DSF) with a 0.5-meter cavity depth can reduce incident solar radiation by up to 92% during summer while maintaining adequate daylight levels, highlighting the effectiveness of combining shading devices and PV technology for optimized energy and daylight performance. |
| Roberts et al., 2023 | The study found that photovoltaic glazing in a double skin facade reduced maximum indoor daylight illuminance by 73% and achieved an average daylight factor of 0.65%, failing to meet the BREEAM daylighting criteria for office environments, thereby necessitating supplementary artificial lighting. |
| Khabir et al., 2024 | The study finds that single-skin facades provide higher spatial daylight autonomy, reaching up to 68%, but with higher risks of glare, with annual sunlight exposure up to 19%, while double skin facades effectively reduce glare to as low as 2% but significantly lower spatial daylight autonomy to as low as 30%. |
| Dastoum et al., 2024 | Geometric patterns in building facades, particularly tessellated designs, significantly enhance daylighting and thermal efficiency, but further research is needed to optimize their integration across varied climates and building types. |
| Barbosa et al., 2024 | The main finding regarding daylighting in double skin facades (DSFs) is that adding a second skin generally reduces daylight levels compared to single skin facades but enhances uniform light distribution, prevents glare, and deepens natural light penetration into indoor spaces, making it an effective solution for balanced daylighting in buildings. |
| Unluturk & Kazanasmaz, 2024 | The main finding related to daylighting in double skin facades (DSFs) is that DSFs allow for effective control and distribution of natural light, enhancing indoor visual comfort by reducing glare and ensuring even light spread, making them a sustainable solution for daylight optimization in buildings. |
| Tolba et al., 2023 | The study found that integrating adaptive technologies such as electrochromic glazing and dynamic shading devices into curtain walls (CWs) can improve daylighting performance by reducing glare perception by 20% and increasing useful daylight illuminance by over 50% during working hours, while maintaining energy efficiency and visual comfort in office spaces. |

The reviewed studies consistently reported that DSFs, compared to single skin facades, tend to reduce overall illumination levels but improve daylight uniformity and glare control. For instance, optimized perforated screens (Chi et al., 2017) and venetian blinds (Gomes et al., 2022; Zheng et al., 2024) were shown to significantly increase visual comfort while maintaining sufficient daylight. Similarly, ETFE foils (Flor et al., 2022) and photovoltaic modules (Chen et al., 2021; Ioannidis et al., 2017) provided not only daylight regulation but also energy co-benefits.

When analysed by DSF typology, different patterns emerge. Box-type systems offer more localized control of daylight but may compromise uniformity across floors. Corridor systems provide better distribution along wide interior spaces, while shaft-box systems improve penetration by reducing vertical obstructions. Multi-storey facades, by contrast, demonstrated the strongest performance in enhancing daylight uniformity and minimizing glare across several studies (Aksamija, 2018; Barone et al., 2024).

Design parameters also showed distinct effects. Studies found that cavity depths of 40-90 cm often achieved a balance between daylight transmission and glare reduction (Kim et al., 2015; ElBatran & Ismaeel, 2021). Excessive depth, however, was associated with greater light loss (Barone et al., 2024). The choice of glazing and shading devices was equally critical: semi-transparent PV glazing reduced daylight levels substantially (Roberts et al., 2023), whereas perforated or adaptive shading strategies improved both daylight autonomy and glare control (Huang et al., 2024; Gholami & Talaei, 2024).

Overall, the literature confirms that well-configured DSFs enhance indoor visual comfort and energy efficiency by ensuring balanced daylight distribution and reducing glare. However, trade-offs are evident: higher daylight uniformity often comes at the expense of lower daylight autonomy, requiring supplementary artificial lighting in certain conditions (Roberts et al., 2023; Khabir et al., 2024).

These findings underline the importance of considering DSF type, cavity depth, shading design, and glazing selection together rather than in isolation. Future research should expand comparative analyses across climates and building typologies, integrate occupant perception into performance evaluations, and further investigate hybrid DSF solutions combining adaptive shading and photovoltaic systems. Such directions would address current knowledge gaps and provide more comprehensive design guidelines for optimizing daylighting in sustainable facades.

## 5. Conclusion

This review systematically evaluated 24 peer-reviewed studies on the daylighting performance of double skin facade (DSF) systems. The evidence shows that while DSFs generally reduce absolute indoor illuminance compared to single skin facades, they consistently enhance visual comfort through more uniform daylight distribution and effective glare control. Optimized configurations, such as perforated screens with 37-50% openness, cavity depths between 40-90 cm, and adaptive shading devices, were found to achieve significant improvements in useful daylight illuminance (up to 70%) while reducing glare probability to acceptable levels.

Key design parameters, orientation, cavity depth, glazing properties, and shading strategies, were shown to interact strongly, underscoring the need for holistic rather than isolated design decisions. For example, south-facing DSFs offer higher daylight autonomy but also greater glare risk, which can be mitigated by appropriate cavity dimensions or adaptive shading. Similarly, while photovoltaic glazing provides energy co-benefits, it often reduces daylight autonomy, indicating trade-offs that must be balanced at the design stage.

The findings highlight that DSFs should not be considered as stand-alone daylighting solutions but as integrated components of broader facade and building design strategies. Incorporating user comfort, interior spatial requirements, and automated control systems is essential for achieving both visual and energy performance goals. Furthermore, different DSF typologies, such as box, corridor, shaft-box, and multi-storey systems, were shown to influence daylight autonomy and distribution in distinct ways, underscoring the importance of selecting the appropriate facade type according to building geometry and climatic context.

Future research should expand empirical validations across diverse climates and building types, integrate user perception studies with quantitative performance metrics, and explore hybrid DSF concepts combining adaptive shading with photovoltaic or smart glazing systems. Moreover, retrofitting opportunities for existing building stock remain underexplored and represent a promising area for improving both daylight quality and energy efficiency.

In conclusion, well-designed DSF systems can significantly contribute to sustainable building design by balancing daylight autonomy, glare control, and energy efficiency. The reviewed studies provide actionable guidance for architects and engineers, while also identifying critical knowledge gaps that should be addressed to advance DSF applications in future practice.

### *Declaration of Ethical Standards*

The article complies with national and international research and publication ethics.

Ethics Committee Approval was not required for the study.

### *Conflict of Interest*

There was no conflict of interest between the authors during the research process.

### *Authors' Contributions*

The author contributed alone to the article and takes full responsibility for the content and any modifications made during this process.

### *Declarations*

The author takes full responsibility for the content and any modifications made during this process.

During the preparation of this work, the authors used ChatGPT by OpenAI to translate the text from Turkish to English. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

### *Originality Report*

The article has been confirmed that it does not contain any plagiarism according to the originality report obtained from the iThenticate software.

## References

Aksamija, A. (2018). Thermal energy and daylight analysis of different types of double skin facades in various climates. *Journal of Facade Design and Engineering*, *6*(1), 1-39. https://doi.org/10.7480/jfde.2018.1.1527

Alrubaih, M. S., Zain, M. F. M., Alghoul, M. A., Ibrahim, N. L. N., Shameri, M. A., & Elayeb, O. (2013). Research and development on aspects of daylighting fundamentals. *Renewable and Sustainable Energy Reviews*, *21*, 494-505.

Barbosa, S., & Ip, K. (2014). Perspectives of double skin facades for naturally ventilated buildings: A review. *Renewable and Sustainable Energy Reviews*, *40*, 1019-1029.

Barbosa, S., & Ip, K. (2016). Predicted thermal acceptance in naturally ventilated office buildings with double skin facades under Brazilian climates. *Journal of Building Engineering*, *7*, 92-102.

Barbosa, S., Alberto, K. C., & Piroozfar, P. (2024). Natural daylighting through double skin facades: A review. *Architectural Engineering and Design Management*. https://doi.org/10.1080/17452007.2024.2400711

Barone, G., Vardopoulos, I., Attia, S., & Vassilliades, C. (2024). Optimizing energy-efficient building renovation: Integrating double-skin facades with solar systems in the Mediterranean landscape. *Energy Reports*, *12*, 2933-2945.

Bian, Y., Kim, J. J., & Kensek, K. (2020). Variable set points of glare control strategy for side-lit spaces: Daylight glare tolerance by time of day. *Solar Energy, 201*, 268–278. doi:10.1016/j.solener.2020.03.021

Chen, M., Zhang, W., Xie, L., He, B., Wang, W., Li, J., & Li, Z. (2021). Improvement of the electricity performance of bifacial PV module applied on the building envelope. *Energy and Buildings*, *238*, 110849.

Cheshire, D., & Godefroy, J. (2020). *Sustainability: CIBSE Guide L* (p. 190). London: CIBSE – The Chartered Institution of Building Services Engineers.

Chi, D. A., Moreno, D., & Navarro, J. (2017). Design optimisation of perforated solar facades in order to balance daylighting with thermal performance. *Building and Environment*, *125*, 383-400.

Dastoum, M., Sanchez Guevara, C., & Arranz, B. (2024). Efficient daylighting and thermal performance through tessellation of geometric patterns in building facade: A systematic review. *Energy for Sustainable Development*, *83*, 101563. https://doi.org/10.1016/j.esd.2024.101563

Dewi, O. C., Rahmasari, K., Hanjani, T. A., Ismoyo, A. D., & Dugar, A. M. (2022). Window-to-Wall Ratio as a Mode of Daylight Optimization for an Educational Building with Opaque Double-Skin Facade. *Journal of Sustainable Architecture and Civil Engineering*, *30*(1), 142-152. https://doi.org/10.5755/j01.sace.30.1.29744

ElBatran, R. M., & Ismaeel, W. S. E. (2021). Applying a parametric design approach for optimizing daylighting and visual comfort in office buildings. *Ain Shams Engineering Journal*, *12*(3), 3275-3284.

Flor, J. F., Liu, X., Sun, Y., Beccarelli, P., Chilton, J., & Wu, Y. (2022). Switching daylight: Performance prediction of climate adaptive ETFE foil facades. *Building and Environment*, *209*, 108650.

Gaspari, J., Fabbri, K., & Marchi, L. (2024). Investigating the influence of perforated facade skins on indoor illuminance level: A case study. *Architectural Engineering and Design Management*. https://doi.org/10.1080/17452007.2024.2322506

Gholami, H., & Talaei, M. (2024). Synergistic Strategies: Comparing Energy Performance in Climate-Adaptive Building Envelopes for Iran's Cold Semi-Arid Climate. *Journal of Daylighting*, *11*(2), 181–202. https://doi.org/10.15627/jd.2024.14

Gomes, M. G., Santos, A. J., & Calhau, M. (2022). Experimental study on the impact of double tilted Venetian blinds on indoor daylight conditions. *Building and Environment*, *225*, 109675.

Hee, W. J., Tang, Y., & Lee, S. (2015). The role of window glazing on daylighting and energy saving in buildings. *Renewable and Sustainable Energy Reviews, 42*, 323-343. doi:10.1016/j.rser.2014.10.027

Huang, L., Zou, K., Zhang, X., & Zhao, S. (2024). Effects of non-uniform perforated solar screen on daylighting and visual comfort performance. *Journal of Building Engineering*, *97*, 110684.

Ioannidis, Z., Buonomano, A., Athienitis, A. K., & Stathopoulos, T. (2017). Modeling of double skin facades integrating photovoltaic panels and automated roller shades: Analysis of the thermal and electrical performance. *Energy and Buildings*, *154*, 618-632. https://doi.org/10.1016/j.enbuild.2017.08.046

Khabir, S., & Vakilinezhad, R. (2023). Energy and thermal analysis of DSF in the retrofit design of office buildings in hot climates. *Architectural Engineering and Design Management*, *19*(6), 642-664.

Khabir, S., Vakilinezhad, R., & Sepúlveda, A. (2024). Comparative analysis of space layouts and facade systems for office retrofit design in hot climate. *Advances in Building Energy Research*, *18*(2), 126–155. https://doi.org/10.1080/17512549.2024.2343851

Kim, G., Lim, H. S., & Kim, J. T. (2015). Sustainable lighting performance of refurbished glazed walls for old residential buildings. *Energy and Buildings*, *91*, 163-169. https://doi.org/10.1016/j.enbuild.2014.12.058

Konstantzos, I., et al. (2020). The effect of lighting environment on task performance in buildings – A review. *Energy and Buildings*, *226*, 110394.

Le-Thanh, L., Nguyen-Thi-Viet, H., Lee, J., & Nguyen-Xuan, H. (2022). Machine learning-based real-time daylight analysis in buildings. *Journal of Building Engineering*, *52*, 104374.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ, 372*, n71. doi:10.1136/bmj.n71

Pariafsai, F. (2016). A review of design considerations in glass buildings. *Frontiers of Architectural Research*, *5*(2), 171-193.

Pomponi, F., et al. (2016). Energy performance of double-skin facades in temperate climates: A systematic review and meta-analysis. *Renewable and Sustainable Energy Reviews*, *54*, 1525–1539.

Roberts, F., Yang, S., Du, H., & Yang, R. (2023). Effect of semi-transparent a-Si PV glazing within double-skin facades on visual and energy performances under the UK climate condition. *Renewable Energy*, *207*, 601–610. https://doi.org/10.1016/j.renene.2023.03.023

Srisamranrungruang, T., & Hiyama, K. (2021). Correlations between building performances and design parameters of double-skin facade utilizing perforated screen. *Japan Architectural Review*, *4*(3), 533-544.

Tolba, L. E., El Mokadem, A. A., Badawy, N., & Shahda, M. M. (2023). A retrofitting framework for improving curtain wall performance by the integration of adaptive technologies. *Journal of Building Engineering*, *80*, 107979. https://doi.org/10.1016/j.jobe.2023.107979

Unluturk, M. S., & Kazanasmaz, Z. T. (2024). Integration of Daylight Use and Analysis in Double Skin Facades: A Literature Review. *Gazi University Journal of Science*, *37*(2), 520-544. https://doi.org/10.35378/gujs.1243933

Wang, C., Ji, J., Yu, B., Zhang, C., Ke, W., Wang, J. (2022). Comprehensive investigation on the luminous and energy-saving performance of the double-skin ventilated window integrated with CdTe cells. *Energy*, *238*, 121757.

Wang, M., Peng, J., Li, N., Yang, H., Wang, C., Li, X., & Lu, T. (2017). Comparison of energy performance between PV double skin facades and PV insulating glass units. *Applied Energy, 194*, 148-160. doi:10.1016/j.apenergy.2017.03.019

Zhang, Y., Zhang, Y., & Li, Z. (2022). A novel productive double skin facades for residential buildings: Concept, design and daylighting performance investigation. *Building and Environment*, *212*, 108817.

Zheng, C., Chen, C., Hong, X., Zhang, W., Yang, R., & Shi, F. (2024). Experimental evaluation of the thermal, lighting, and energy performances of a mechanically ventilated double-skin fac-ade with Venetian blinds and a light shelf. *Energy and Buildings*, *306*, 113947.