

Effect of Optimized Daylight Patterns on Employee Satisfaction: A Before and After Changes

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ABSTRACT

Objective: Nowadays, human satisfaction and well-being in office environments have become significant concerns, with notable social and economic impacts. The use of natural daylight in office spaces is crucial for the health, satisfaction, and cognitive performance of individuals. This study examines the quality and controllability of daylight distribution in indoor environments. In this research, office employees in Kerman were studied in two settings: one with plain glass windows and another with optimized daylight distribution pattern windows. The aim was to assess the impact of received daylight on desk surface satisfaction and job satisfaction among employees.

Methods: The research employed a descriptive and analytical method, involving 76 employees evaluated at two stages—before and after changes—using desk surface satisfaction and job satisfaction questionnaires. Data were analyzed using paired t-tests in SPSS 26.

Results: Findings revealed that the optimized daylight distribution pattern significantly improved desk surface satisfaction and job satisfaction, enhancing environmental perception compared to plain glass.

Conclusion: Post-implementation, desk surface satisfaction increased by approximately 46%, and job satisfaction by about 31%. Overall, the use of windows with optimized daylight distribution patterns not only increases useful daylight and reduces glare but also positively impacts satisfaction with the work environment.

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Introduction

In contemporary buildings, the quality of the indoor environment, particularly visual and thermal factors, has gained significant attention due to its substantial impact on productivity, quality of life, satisfaction, and the health of occupants (Choi and Moon, 2017; Cleary et al., 2019; Eshaghi et al., 2018; Loftness et al., 2018; Wierzbicka et al., 2018). This has led to various advancements in design and technology, particularly in the field of environmental controls in modern buildings (Bakker et al., 2014; Lee et al., 2012). On average, people spend 90% of their working hours indoors. Specifically, office facilities comprise a significant portion of these spaces and serve as the primary sites for major social production activities (Boubekri, 2014).

Therefore, creating a work environment that considers its occupants is essential. The indoor environment of a workplace differs from the outdoor environment in various aspects such as light, sound, heat, and air (Salthammer and Morrison, 2022; Seyedolhosseini et al., 2020).

Ambient light is one of the key factors in creating a comfortable indoor work environment. Environmental light factors include illumination levels, window sizes, and exposure to daylight, which influence occupant satisfaction in office spaces. Nowadays, utilizing daylight in indoor spaces is crucial for increasing satisfaction and enhancing the quality of life for occupants. Creating an environment with optimal lighting by integrating daylight and maintaining optimal illumination levels not only enhances cognitive performance, sleep patterns, and health but also significantly boosts environmental satisfaction and productivity (Bellia et al., 2014; Boubekri et al., 2020; Brainard et al., 2015).

Optimal window design alone cannot significantly improve occupant comfort. Therefore, advanced daylight control systems that distribute light more evenly throughout the space can contribute to ensuring comfort in buildings and reducing energy consumption (Ascione et al., 2015).

Based on the experiences of past generations in utilizing optimal daylight in interior spaces and modernizing their teachings alongside various advancements in design and technology in buildings, smart systems and optimizations can provide solutions to improve efficiency and save on electronic lighting consumption while also enhancing the quality and satisfaction of the occupants (Bisht et al., 2024; Marzouk et al., 2022). The use of light control elements in the hot and dry climate of Iranian architecture, such as the "Shabak" skylight, not only facilitates natural ventilation, maintains privacy, protects from glare, and provides visual comfort but also controls daylight to ensure optimal light levels in the interior environment.

In this context, various daylight distribution patterns from the Shabak skylight and light-permeable facades of the building's interior spaces are architectural criteria that have a profound impact on human perception. Since the daylight distribution pattern from the Shabak skylight can

be controlled as a function of solar radiation and daylight availability, it contributes to building energy performance, thermal and lighting quality, user satisfaction, and environmental sustainability. Additionally, the daylight distribution pattern helps to reduce glare (Abboushi, 2018).

Daylight distribution patterns, typically achieved through the use of shading devices and multi-layered facades on light-transmitting surfaces, significantly influence optimal daylight reception and utilization (Marzouk et al., 2022). Optimizing daylight levels in building design plays a crucial role in enhancing the well-being, health, satisfaction, and productivity of occupants (Hamadah et al., 2023). Research has shown that increasing ambient light and achieving appropriate and standard illumination levels can improve individuals' sense of satisfaction. Using geometric daylight distribution patterns as a passive design strategy can enhance thermal and visual comfort, while also improving the satisfaction, health, efficiency, and lifestyle of building users (Marzouk et al., 2022).

Recent studies have examined the efficiency of daylight distribution patterns and light shelves, primarily focusing on thermal and visual comfort performance. However, these studies have not addressed environmental health, satisfaction, and user productivity (Dorsey and Hedge, 2017; Lee et al., 2021). Therefore, this research aims to investigate the impact of daylight distribution patterns on desk surface satisfaction and job satisfaction of occupants by comparing the same group of office employees in two settings: one with plain glass windows and the other with windows fitted with optimized distribution patterns.

The study employed a range of pre- and post-survey tools to assess desk surface satisfaction and job satisfaction. In this context, the research seeks to answer whether optimized daylight distribution patterns installed on office windows affect employees' desk surface satisfaction and job satisfaction.

Literature Review

Distribution Patterns, Daylight, and Satisfaction

This section reviews previous studies to examine issues and topics related to the relationship between indoor environmental light and its users. The first part assesses users' perception of daylight distribution patterns in indoor environments and their impact on light quality. The second part focuses on understanding the physical effects of light on individuals, especially its influence on health and cognitive abilities. Additionally, this section reviews user experiences with indoor lighting conditions, highlighting how users react to different lighting environments. A safe and healthy work environment enhances efficiency, satisfaction, and productivity, reduces stress and conflicts, and is considered a fundamental right for employees (Berg et al., 2021).

In a study examining six daylight distribution patterns, the results serve as examples confirming the value of using subjective criteria for daylight quality through environmental aesthetic measures. The findings highlight the importance of simultaneously assessing qualitative and quantitative daylight indicators to achieve a comprehensive and optimal evaluation of well-lit spaces (Omidfar et al., 2015). In a study examining geometric patterns, light, and shadow, four Iranian patterns were modernized. The results indicated that reducing the ratio of openings decreases illumination levels. The ratio and size of the apertures significantly impact the reduction of glare (Emami and Giles, 2016). In a study titled "Examining Visual Comfort and Occupant Visual Interest in Sunlight Patterns in Office Spaces," three types of daylight distribution patterns were analyzed. The results indicated that the fractal pattern significantly impacted visual attractiveness, visual preference, and light quality (Abboushi, 2018). In another study evaluating light patterns affecting the quality of life of residents in residential units using fractal geometry, the findings indicate that windows and skylights utilizing fractal geometric patterns significantly impact the quality of life and uniformity of light for the occupants (Moazzeni et al., 2020).

Environmental factors have various positive and negative impacts on human satisfaction and health. In this context, the physical work environment includes all objects and stimuli that affect employees (Sander et al., 2019). Daylight impacts human physiology in three ways: through direct skin absorption, visual and non-visual effects on the nervous system, and circadian rhythms in the brain (Münch et al., 2017). In studies examining the effects of light environments on human health and sleep, findings indicate that spaces exposed to daylight result in favorable outcomes regarding sleep duration, quality, satisfaction, and overall health of users (Boubekri et al., 2020; Lee and Boubekri, 2020). In this context, employees' reactions to the workplace can be revealed by evaluating their cognitive, emotional, and relational responses to the characteristics of the office environment (Sander et al., 2019).

In another study focusing on the light spectrum, the effects of office indoor lighting and exposure duration on human health, sleep patterns, and cognitive performance were examined. The findings showed that increased exposure to the blue spectrum of daylight during working hours improves sleep quality and cognitive performance (Andersen et al., 2012). In another study focused on the light spectrum, the effects of office indoor lighting and the duration of light exposure on human health, sleep patterns, and cognitive performance were investigated. The findings revealed that increased exposure to the blue spectrum of daylight during working hours improves sleep quality and cognitive performance (Konis, 2013). Studies evaluating the impact of daylight on workplace efficiency and patient recovery in hospital environments have revealed the detrimental effects of excessive use of artificial light in indoor spaces. Furthermore, the

results demonstrated that daylight positively enhances performance, satisfaction, and productivity (Ferrante and Villani, 2022).

In another study examining the relationship between lighting conditions and energy performance using direct measurements and daylight simulation in an office space in Barcelona, survey results to gauge participants' lighting environment preferences and their use of blinds to achieve optimal conditions showed that the majority of participants were satisfied with the lighting environment. Additionally, nearly half of them adjusted the blinds to create an ideal lighting environment (Matterson et al., 2013). In a study examining the correlation between daylight and occupant comfort in residential buildings, the results indicated that the quantity and uniformity of daylight significantly affect the comfort and satisfaction of the residents (Xue et al., 2014). In this context, employees' reactions to the workspace can be revealed by evaluating their cognitive, emotional, and relational responses to the characteristics of the office environment (Sander et al., 2019).

Access to windows with natural light and outdoor views significantly enhances workplace satisfaction. Light quality and intensity affect behavior, while lack of daylight increases stress and dissatisfaction. Research highlights that insufficient daylight in offices lowers productivity, emphasizing the importance of visual comfort, especially due to frequent computer use (Ko et al., 2024). Given that a significant portion of many people's lives is spent in their workplaces, office design must not only address functional and aesthetic needs but also consider its impact on the mental and physical well-being of occupants, employee productivity, and overall satisfaction.

Daylight has the potential to influence nearly every aspect of human physiology. Its primary physiological effects occur through three mechanisms: visual pathways, direct absorption by the skin, and non-visual impacts on the brain's circadian clock and other neural pathways throughout the body (Münch et al., 2017). Roskams and Haynes argued that the workplace is a complex psychological system, integrating both objective physical stimuli and individuals' subjective perceptions. They concluded that the physical environment and human behavior are deeply interconnected (Roskams and Haynes, 2020). People associate spaces with emotions, such as “soothing” or “depressing,” which affect their experience. Design elements like window placement and furniture arrangement shape these impressions. Factors like perceived control, nature interaction, and personal space promote well-being. Employees' responses to the work environment can be analyzed through cognitive, emotional, and relational reactions (Sander et al., 2019). Therefore, the impact of the physical work environment on employee satisfaction and mental health depends on individuals' psychological and physiological responses to the physical characteristics of the workplace (Danielsson, 2008; Hassard et al., 2022; Seo et al., 2024).

Lighting Standards for Work Environments

Illumination is the amount of light emitted from a source per unit area, measured in lux. Lighting criteria are adjusted based on the type of target space and human activities. For workplace environments in offices, appropriate lighting varies according to the type of activity. The International Commission on Illumination (CIE) recommends 500 lux for general tasks and 750 lux for precision work (ISO-8995, 2022). The European standard EN 12464 also recommends a minimum of 300 lux and a maximum of 1500 lux depending on the type of activity (EN-12464, 2011).

These research findings underscore the significant impact of indoor lighting on human well-being and satisfaction. Consequently, the need for an optimal lighting environment in office spaces, where human health, collaboration, and productivity converge, becomes more pronounced. In the present study, an evaluation was conducted using a survey to determine occupants' responses to the daylight environment in office spaces. This study aimed to assess the satisfaction of occupants with indoor environments in office facilities where social production occurs. Specifically, we sought to identify and quantify the main factors influencing this satisfaction through measurements and questionnaires.

Previous research has demonstrated that indoor environmental light, especially daylight, positively affects the health and work efficiency of occupants. However, earlier studies have limitations in addressing the psychological satisfaction of occupants regarding the lighting environment. They often fail to integrate quantitative (measurements) and qualitative (surveys) methods and neglect to examine and classify the features of environmental light in various indoor spaces. Consequently, there were limitations in identifying key factors affecting occupant satisfaction concerning the lighting environment of these different spaces.

We conducted measurements to quantify the penetration of daylight into the space and categorized the results accordingly. In this study, we collected data on occupants' satisfaction with the lighting environment through surveys and pattern analysis. By doing so, our aim was to detect changes in satisfaction levels and pinpoint specific factors contributing to these differences. Ultimately, we extracted variations in employees' responses to daylight within the office space and identified factors that should be considered accordingly. These factors can serve as valuable reference standards for enhancing well-being, satisfaction, and optimizing work efficiency through space and environment design.

Materials and Methods

The research follows a quasi-experimental, comparative design, focusing on environmental psychology and daylighting strategies.

This study aimed to assess employees' satisfaction with natural lighting conditions in their workplace. The research employed a descriptive-analytical methodology, with data collected via structured questionnaires. The focus was on evaluating desk surface illuminance satisfaction, job satisfaction related to environmental quality, and psychological responses of occupants.

Study Phases:

Phase 1 (Pre-intervention): Assessment of existing conditions with plain glass windows.

Phase 2 (Post-intervention): Evaluation after installing optimized patterned films on windows.

The research was conducted in Municipal office building in Kerman, Iran, involving 76 employees across five floors, all positioned along the southern façade to ensure consistent daylight exposure. The study compared office spaces with plain glass windows and windows equipped with optimized light distribution films.

Evaluation Process: Employees located on the building's southern front were assessed before and after implementing the changes. The initial assessment served as the baseline, capturing occupant experiences with plain glass windows. Following the installation of optimized patterned films, the survey was conducted five weeks after implementation.

Data Analysis: Survey responses (desk surface illuminance and job satisfaction) were analyzed in two stages:

Pre-change condition (plain glass windows)

Post-change condition (windows with optimized patterned films)

Based on the research hypotheses, a paired t-test was applied using SPSS software to analyze the results.

Sample Size and Estimation Method

In correlational studies comparing two or more groups, the Cochran formula cannot be used; instead, software like SPSS Sample Power and G-power can be used to accurately determine the sample size under different research conditions. In the present study, a paired t-test was used to compare the indices in two conditions (Kang, 2021; Namian et al., 2021). Given the type of test, the sample size was determined using specialized software. This software has the capability to consider factors influencing sample size and estimate the optimal sample size in different situations, suited to statistical analysis methods. Based on the input values: effect size = 0.42, error (alpha) = 0.05 (with 95% confidence), and test power = 0.95, the final total sample size was calculated to be 76 (Figure 1).

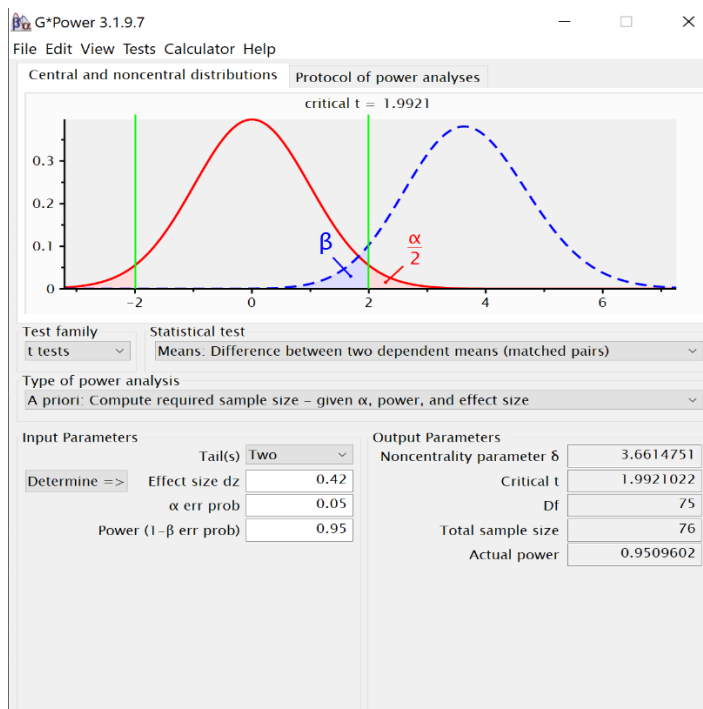


Figure 1. Sample size calculation.

Data Collection

To achieve the research objectives, data collection was conducted in two general stages. In the first stage, information was gathered through field studies in the Municipal office building under study in Kerman, which included using standard questionnaires to assess employee satisfaction and environmental quality as well as collecting physical information of the work environment as initial prerequisites for the modeling software. In the second stage, the optimized pattern was installed on the office space window. For this purpose, 15% tint window films, which allow only 15% of light to pass through, were used to evaluate the changes in the second stage of data collection. Five weeks after the installation, the questionnaires were redistributed and completed to assess employee satisfaction after the changes. The location and images of the office space under study are provided in Figure 2, with further details to follow.

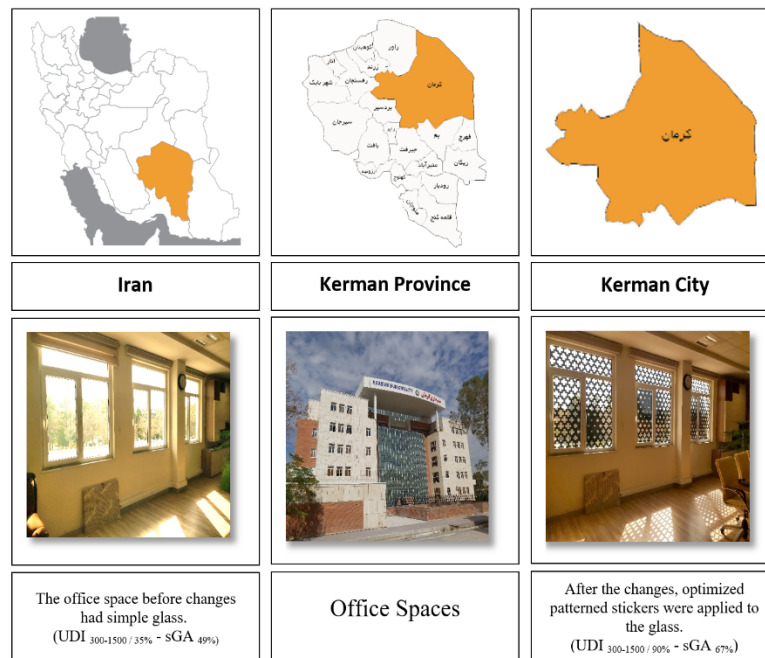


Figure 2. Location of the building and images of the office space before and after changes.

Qualitative Variables

In this section, frequency charts including the number of observed cases and their percentages for each variable are used to describe the qualitative variables. As shown in Figure 3, 76 employees participated in this study, distributed as follows: 22 women and 54 men. According to these statistics, out of the 76 participants, 71.1% are men and 28.9% are women.

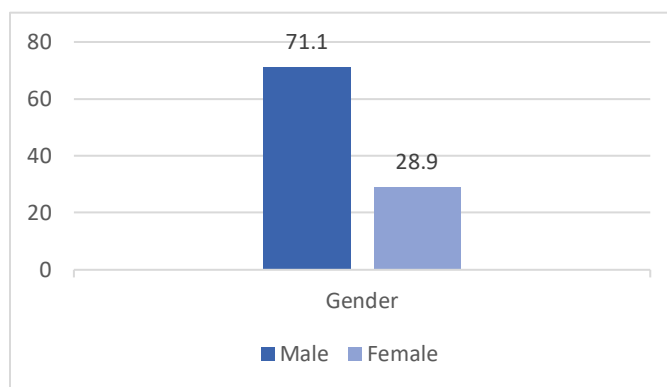


Figure 3. Gender variable frequency percentage.

According to these statistics, as shown in Figure 4, out of 76 participants, 50 were engaged in computer-related activities, 19 in reading and writing, and 7 in drawing.

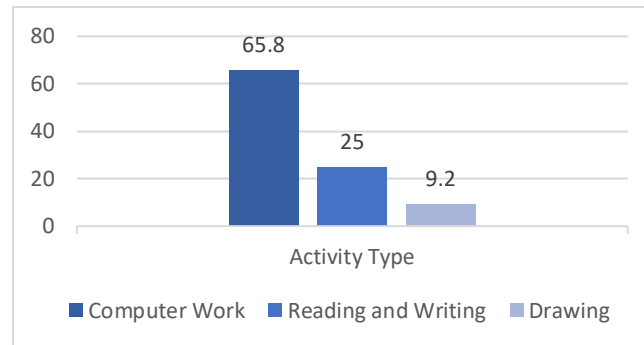


Figure 4. Pie chart of activity type frequency percentage.

As shown in Figure 5, the age distribution of the 76 participants indicates that the largest group (24 individuals) falls within the 41 to 50 age range, while the smallest group (15 individuals) is between 21 and 30 years old.

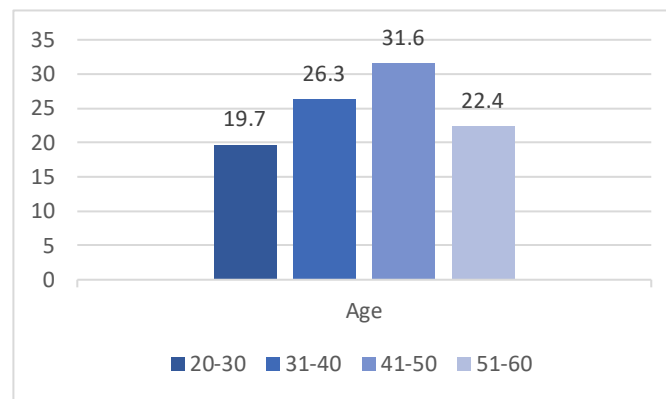


Figure 5. Bar chart of age variable frequency percentage.

As observed in Figure 6, the frequency distribution of floors is expressed with percentages. According to these statistics, among the 76 participants, individuals are almost equally distributed across each floor.

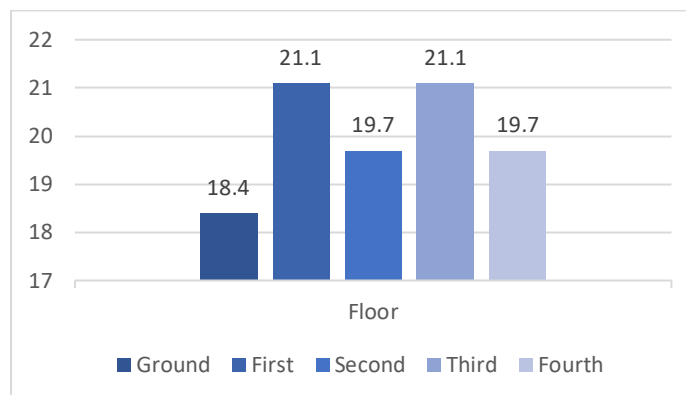


Figure 6. Bar chart of floor variable frequency percentage.

Quantitative Variables

To describe the quantitative variables (i.e., variables that can be measured and have values), central tendency indices (mean, median, and mode) and dispersion indices (standard deviation, minimum, and maximum) were used. Based on the mean of the variables, the status of each variable can be determined. The values of the descriptive indices (central tendency and dispersion indices) for the research variables are presented in Table 1.

Table 1. Values of descriptive indices for research variables.

Variable	Stage	Mean	Median	Mode	Standard Deviation	Minimum	Maximum
Desk Surface Satisfaction	Before Changes UDI 300-1500 / 35% - sGA 49%	6.76	7	3	2.90	3	12
	After Changes UDI 300-1500 / 90% - sGA 67%	12.65	12	12	2.67	6	20
Job Satisfaction	Before Changes	7.44	8.50	3	3.13	3	12
	After Changes	10.907	11	12	3.07	6	20

Based on the results obtained in Table 1, it is observed that the mean values of the variables related to satisfaction with environmental quality, positive feelings, desk surface satisfaction, job satisfaction, behavior control, positive emotions, and psychological well-being before the changes (UDI 300-1500 / 35% - sGA 49%) are lower than after the changes (UDI 300-1500 / 90% - sGA 67%). Conversely, the mean values of glare, negative feelings, anxiety, depression, and psychological distress are higher before the changes compared to after the changes. Therefore, the post-change state improves these variables. However, to examine the significant impact of light after the changes on these variables, tests must be conducted, which will be discussed below.

Results and Discussion

Data Analysis

Normality Test of Research Variables

Before examining the hypotheses, the normality of the variables must be assessed. The results of the Kolmogorov-Smirnov test in Table 2 show that only the significant value of satisfaction with environmental quality under standard light is greater than 0.05, and only this variable is

considered normal. However, given the sample size of more than 50, the normality of the variables should also be evaluated based on skewness and kurtosis coefficients (Ghasemi & Zahediasl, 2012). If the z-values for skewness and kurtosis are between -1.96 and +1.96, the normality of the variables is confirmed.

Table 2. Skewness and Kurtosis coefficients for research variables.

Variable	Stage	Kolmogorov-Smirnov Test		Skewness	Skewness Standard Error	Z-value for Skewness	Kurtosis	Kurtosis Standard Error	Z-value for Kurtosis
		Z-Statistic	Significance Value						
Desk Surface Satisfaction	Before Changes	0.152	0/001	0.215	0.276	0.77	-0.876	0.545	-1.60
	After Changes	0.163	0/001	0.360	0.276	1.30	0.099	0.545	0.18
Job Satisfaction	Before Changes	0.190	0/001	0.262	0.276	-0.95	-0.562	0.545	-1.03
	After Changes	0.151	0/001	0.415	0.276	1.50	0.145	0.545	0.26

Based on the results in Table 2, for all variables, these two z-statistics fall between -1.96 and +1.96, therefore, the assumption of normality for all research variables is accepted. Thus, parametric tests (paired t-test, independent t-test, and one-way ANOVA) can be used to examine the hypotheses. Daylight distribution patterns derived from light-diffusing elements used in traditional Iranian architecture can affect employees' desk surface satisfaction.

Table 3. Paired t-test results for comparing employee desk surface satisfaction before and after changes.

Variable	Item	Stage		Test Statistic	Paired t-test		Mean Changes	Percentage Changes
		Before Changes	After Changes		Degrees of Freedom	Significance Value		
Desk Surface Satisfaction	Light on desk for paperwork	2/10	4/13	15/005	75	0/001	2/02	49/15%
	Lighting for computer work	2/27	4/30	15/45	75	0/001	2/02	47/20%
	Overall lighting quality at workplace	2/38	4/23	14/49	75	0/001	1/84	40/60%
Total Environmental Satisfaction Score		6/75	12/65	17/02	75	0/001	5/89	46/64%

Based on the results in Table 3, it is observed that the significance values for all items are less than 0.05. Therefore, with 95% confidence, it can be said that there is a significant difference in

the mean desk surface satisfaction and the related items between the lighting conditions before and after the changes. Additionally, considering that the mean environmental satisfaction and the related items are higher after the changes compared to before the changes, it can be concluded that desk surface satisfaction is significantly higher after the changes.

In other words, the daylight distribution patterns derived from the light-diffusing elements in traditional Iranian architecture positively impact desk surface satisfaction. As observed, the post-change condition affects desk surface satisfaction by approximately 46%, leading to an increase in employee satisfaction. (Figure 7).

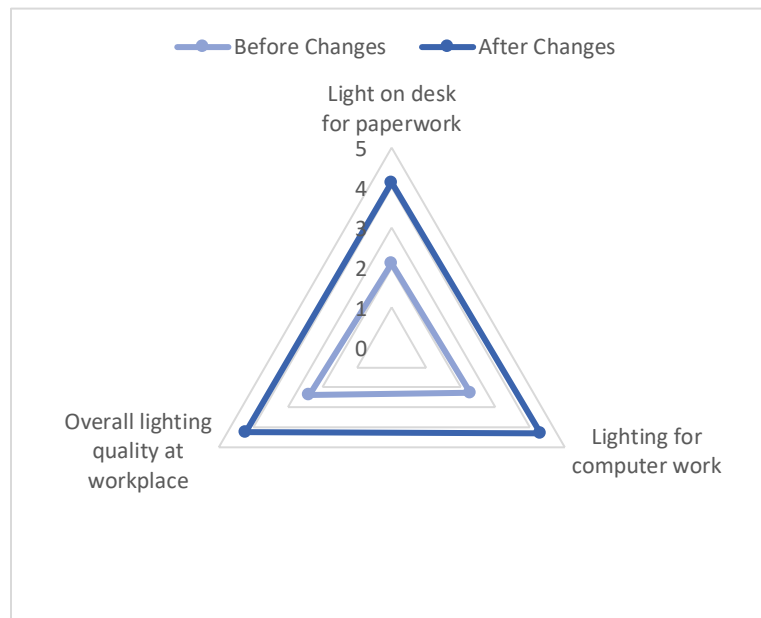


Figure 7. Comparison of desk surface satisfaction items before and after changes.

Daylight distribution patterns derived from light-diffusing elements used in traditional Iranian architecture can significantly affect employee job satisfaction.

Table 4. Paired t-test results for comparing employee job satisfaction before and after changes.

Variable	Item	Stage		Test Statistic	Paired t-test		Mean Changes	Percentage Changes
		Before Changes	After Changes		Degrees of Freedom	Significance Value		
Job Satisfaction	I am satisfied with my job.	2/50	3/64	8/94	75	0/001	1/14	31/31%
	The environmental conditions in my work area support my personal productivity.	2/43	3/67	8/60	75	0/001	1/23	33/78%
	I am satisfied with the internal environment of my work area.	2/51	3/59	7/93	75	0/001	1/07	30/08%
	Overall job satisfaction score.	7/44	10/90	9/38	75	0/001	3/46	31/74%

Based on the results in Table 4, it is observed that the significance values for all items are less than 0.05. Therefore, with 95% confidence, it can be said that there is a significant difference in the mean job satisfaction and related items between the lighting conditions before and after the changes. Additionally, considering that the mean job satisfaction and related items are higher after the changes compared to before the changes, it can be concluded that job satisfaction has significantly increased after the changes. In other words, the daylight distribution patterns derived from light-diffusing elements used in traditional Iranian architecture positively impact job satisfaction. As observed, the post-change condition influences job satisfaction by approximately 31%, leading to an increase in employee satisfaction (Figure 8).

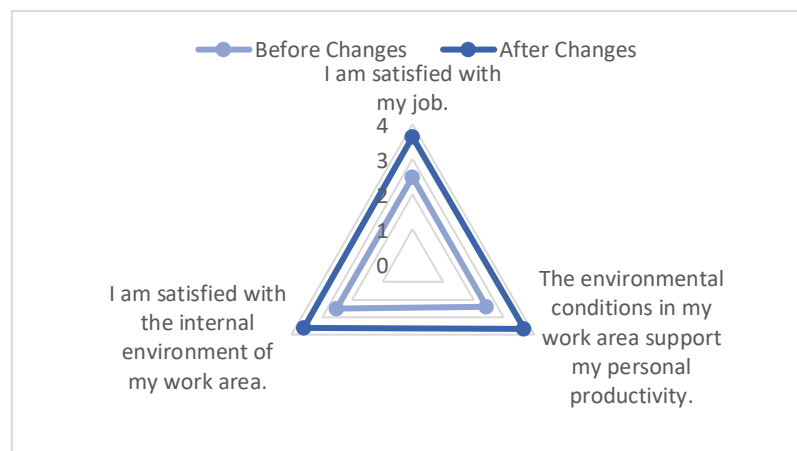


Figure 8. Comparison of job satisfaction items before and after changes.

Statistical Analysis by Gender

First, the differences in the variables before and after the changes were calculated. Then, these differences were analyzed based on gender using an independent t-test.

Table 5. Results of the independent t-test for comparing these variables by gender.

Variable	Gender	Mean	t-Statistic	Degrees of Freedom	Significance Level	Result
Desk Surface Satisfaction	Male	6/09	-0/894	74	0/374	Non-significant difference
	Female	5/40				
Job Satisfaction	Male	3/46	-0/010	74	0/992	Non-significant difference
	Female	3/45				

Based on the results in Table 5, it is observed that the significance values for the variables are greater than 0.05, thus the null hypothesis is not rejected. This indicates that the effect of optimized daylight distribution patterns on desk surface satisfaction and job satisfaction is the same for both genders.

The effect of optimized daylight distribution patterns on job satisfaction varies by social class. To investigate this, first, the differences in the variables before and after the changes were calculated. Then, the differences based on social class were determined using a one-way ANOVA test.

Table 6. One-way ANOVA results for comparing these variables by social class.

Variable	Level	Mean	F-Statistic	Significance Level	Result
Desk Surface Satisfaction	Ground	4/64	3/74	0/228	Significant difference
	First	5/31			
	Second	7/66			
	Third	7/06			
	Fourth	4/66			
Job Satisfaction Variable	Ground	3/50	1/81	0/135	Non-significant difference
	First	3/37			
	Second	5/20			
	Third	3/06			
	Fourth	2/20			

Based on the results in Table 6, it is observed that the significance values for desk surface satisfaction are less than 0.05; therefore, the null hypothesis is rejected. This indicates that the effect of optimized daylight distribution patterns on desk surface satisfaction varies based on employees' job levels. Observations show that the mean desk surface satisfaction is higher for employees on the second and third floors compared to other floors, and lower for employees on the ground floor. On the other hand, the significance values for other variables are greater than 0.05, indicating no significant difference in the effect of optimized daylight distribution patterns on job satisfaction based on employees' job levels.

The impact of optimized daylight distribution patterns on desk surface satisfaction and job satisfaction also varies with age. To investigate this, the differences in variables before and after the changes were first calculated. Then, these differences based on age were determined using a one-way ANOVA test.

Table 7. One-way ANOVA results for comparing these variables by age.

Variable	Age	Mean	F-Statistic	Significance Level	Result
Desk Surface Satisfaction Job Satisfaction Variable	20-30	7/46	3/93	0/012	Significant difference
	31-40	6/80			
	41-50	4/95			
	51-60	4/76			
Desk Surface Satisfaction	20-30	4/80	2/55	0/062	Non-significant difference
	31-40	4/30			
	41-50	2/62			
	51-60	2/47			

Based on the results in Table 7, it is observed that the significance values for satisfaction with environmental quality, glare, positive feelings, negative feelings, and desk surface satisfaction are less than 0.05. Therefore, the null hypothesis is rejected. This means that the impact of daylight distribution patterns derived from light-diffusing elements used in traditional Iranian architecture on satisfaction with environmental quality, glare, positive feelings, negative feelings, and desk surface satisfaction varies based on the age of employees. Moreover, it is observed that the mean values for satisfaction with environmental quality, glare, positive feelings, negative feelings, and desk surface satisfaction are higher for employees aged 20 to 30 years compared to other age groups and lower for employees aged 51 to 60 years. This indicates that the effect of daylight distribution patterns on these variables is greater for younger employees, while the effect is lesser for older employees.

On the other hand, the significance values for the remaining variables are greater than 0.05. Therefore, there is no significant difference in the impact of daylight distribution patterns on job satisfaction and mental health based on age.

The impact of daylight distribution patterns derived from light-diffusing elements used in traditional Iranian architecture on satisfaction with work quality, glare, positive and negative feelings, desk surface satisfaction, job satisfaction, and mental health varies based on the type of activity. To examine this, the differences in variables before and after the changes were first calculated, and then these differences were determined based on the type of activity using a one-way ANOVA test.

Table 8. One-way ANOVA results for comparing these variables by activity type.

Variable	Activity Type	Mean	F-Statistic	Significance Level	Result
Desk Surface Satisfaction Job Satisfaction Variable	Computer Work	6/00	0/927	0/400	Non-significant difference
	Reading and Writing	6/15			
	Drawing	4/42			
	Computer Work	3/64			
Desk Surface Satisfaction	Reading and Writing	3/78	1/81	0/17	Non-significant difference
	Drawing	1/28			

Based on the results in Table 8, it is observed that the significance values for all variables are greater than 0.05; therefore, the null hypothesis is not rejected. This indicates that the effect of daylight distribution patterns derived from light-diffusing elements used in traditional Iranian architecture on desk surface satisfaction and job satisfaction is the same across different activity types.

The application of patterned films effectively enhanced both physical lighting conditions and psychological comfort. This aligns with environmental psychology theories emphasizing the link between visual environment quality and occupant well-being. The results highlight the potential of low-cost, passive daylighting retrofits in improving user-centered outcomes in workplace design.

Conclusion

The findings of the study indicate that although the analyses align with the topic's background, the coherent indices of environmental quality satisfaction and psychological perceptions have been less addressed in the literature. Most related studies have focused on a single dimension of the examined aspects. However, this study evaluated and examined indices related to daylight distribution patterns and optimal light in office spaces. This allows for the assessment of daylight access in office spaces and the provision of various lighting levels for occupants.

By defining the optimal daylight design zone, the present research enables the assessment of the combined effects of spatial features and their psychological manifestations on occupants. This study allows users to identify their preferences for daylight utilization in office spaces and observe its positive impacts on environmental quality satisfaction and psychological perceptions. It also enriches the architectural experience of the space. The results show that illuminance levels above 1500 lux and below 300 lux positively impact environmental quality satisfaction and positive and negative feelings, while lower illuminance levels have negative effects.

It should be noted that the findings of daylight studies in Iranian office buildings have predominantly focused on energy consumption, lighting, office plan layout, window-to-wall ratio, shading, or façade design with different daylight distribution patterns, paying less attention

to user presence in the actual environment. The data collected from the questionnaires in the simple glass condition (UDI 300-1500 / 35% - sGA 49%) and the optimized daylight distribution film condition (UDI 300-1500 / 90% - sGA 67%) show an approximate 48% increase in environmental quality satisfaction, a 35% increase in positive feelings, and a 28% decrease in negative feelings. Overall, environmental quality satisfaction and psychological perceptions are better in the optimized daylight distribution film condition compared to the simple glass condition. The optimized daylight distribution pattern derived from light-diffusing elements (Shabk) in traditional Iranian architecture not only increases beneficial daylight and reduces glare but also positively impacts workspace satisfaction and psychological perceptions.

The study provides empirical evidence supporting the integration of patterned daylight films as a viable architectural intervention. Not only do such solutions improve visual comfort and satisfaction, but they also contribute to the psychological health and productivity of office workers, especially in daylight-rich climates. These findings can inform future design strategies and post-occupancy evaluations in bioclimatic architectural practices.

Author Contributions

All authors contributed equally to the conceptualization of the article and writing of the original and subsequent drafts.

Data Availability Statement

Data available on request from the authors.

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Ethical considerations

The authors avoided data fabrication, falsification, plagiarism, and misconduct.

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Conflict of interest

The authors declare no conflict of interest.

References

- Abboushi, B. (2018). *Investigating Occupant's Visual Comfort and Visual Interest towards Sunlight Patterns in Daylit Offices*. University of Oregon.
- Andersen, M., Mardaljevic, J., & Lockley, S. W. (2012). A framework for predicting the non-visual effects of daylight–Part I: photobiology-based model. *Lighting research & technology*, 44(1), 37-53.
- Ascione, F., Bianco, N., De Masi, R. F., Mauro, G. M., & Vanoli, G. P. (2015). Design of the building envelope: A novel multi-objective approach for the optimization of energy performance and thermal comfort. *Sustainability*, 7(8), 10809-10836.
- Bakker, L., Hoes-van Oeffelen, E., Loonen, R., & Hensen, J. L. (2014). User satisfaction and interaction with automated dynamic facades: A pilot study. *Building and Environment*, 78, 44-52.
- Bellia, L., Pedace, A., & Barbato, G. (2014). Daylighting offices: A first step toward an analysis of photobiological effects for design practice purposes. *Building and Environment*, 74, 54-64.
- Berg, J., Hilal, A., El, S., & Horne, R. (2021). World employment and social outlook: Trends 2021. *International Labour Organization*.
- Bisht, D. S., Kumar, V., Singh, S., Garg, H., & Shravana Kumar, R. (2024). Optical modeling and computational analysis of improved daylight collector geometry for a tubular skylight. *Applied Optics*, 63(4), 1039-1047.
- Boubekri, M. (2014). *Daylighting design: planning strategies and best practice solutions*. Birkhäuser.
- Boubekri, M., Lee, J., MacNaughton, P., Woo, M., Schuyler, L., Tinianov, B., & Satish, U. (2020). The impact of optimized daylight and views on the sleep duration and cognitive performance of office workers. *International journal of environmental research and public health*, 17(9), 3219.
- Brainard, J., Gobel, M., Scott, B., Koeppen, M., & Eckle, T. (2015). Health implications of disrupted circadian rhythms and the potential for daylight as therapy. *Anesthesiology*, 122(5), 1170-1175.
- Choi, J.-H., & Moon, J. (2017). Impacts of human and spatial factors on user satisfaction in office environments. *Building and Environment*, 114, 23-35.
- Cleary, M., Raeburn, T., West, S., & Childs, C. (2019). The environmental temperature of the residential care home: Role in thermal comfort and mental health? *Contemporary nurse*, 55(1), 38-46.
- Danielsson, C. B. (2008). Office experiences. In *Product experience* (pp. 605-628). Elsevier.
- Dorsey, J., & Hedge, A. (2017). Re-evaluation of a LEED Platinum Building: Occupant experiences of health and comfort. *Work*, 57(1), 31-41.
- Emami, N., & Giles, H. (2016). Geometric patterns, light and shade: quantifying aperture ratio and pattern resolution in the performance of shading screens. *Nexus network journal*, 18, 197-222.
- EN-12464. (2011). Light and lighting - Lighting of work places-Part 1: Indoor work places.
- Eshaghi, S., Moayedfar, S., & Esteghlal, A. (2018). Enhancing the Quality of Life in Historical Contexts with an Emphasis on Urban Regeneration Approach (Case Study: Imam Ali Square in Isfahan and its Surrounding Texture). *International Journal of Applied Arts Studies (IJAPAS)*, 3(1).

- Ferrante, T., & Villani, T. (2022). Pre-occupancy evaluation in hospital rooms for efficient use of natural light—improved proposals. *Buildings*, 12(12), 2145.
- Ghasemi, A., & Zahediasl, S. (2012). Normality tests for statistical analysis: a guide for non-statisticians. *International journal of endocrinology and metabolism*, 10(2), 486.
- Hamadah, M., ElSeragy, A., & ElDeeb, S. (2023). Well-being as a tool to improve productivity in existing office space: Case study in Alexandria, Egypt. *F1000Research*, 12, 639.
- Hassard, J., Wong, I., & Wang, W. (2022). Workplace empowerment, psychological empowerment and work-related wellbeing in southeast Asian employees: a cross-sectional survey. *Health promotion international*, 37(4), daac113.
- ISO-8995. (2022). International Standard. Lighting of Indoor Workplaces. In *International Commission on Illumination*. Vienna, Austria.
- Kang, H. (2021). Sample size determination and power analysis using the G* Power software. *Journal of educational evaluation for health professions*, 18.
- Ko, W. H., Burgess, I., Schiavon, S., Chung, S. T., MacNaughton, P., & Um, C. Y. (2024). Assessing the impact of glazing and window shade systems on view clarity. *Scientific Reports*, 14(1), 18392.
- Konis, K. (2013). Evaluating daylighting effectiveness and occupant visual comfort in a side-lit open-plan office building in San Francisco, California. *Building and Environment*, 59, 662-677.
- Lee, E. S., Claybaugh, E. S., & LaFrance, M. (2012). End user impacts of automated electrochromic windows in a pilot retrofit application. *Energy and Buildings*, 47, 267-284.
- Lee, H., Zhao, X., & Seo, J. (2021). A study of optimal specifications for light shelves with photovoltaic modules to improve indoor comfort and save building energy. *International journal of environmental research and public health*, 18(5), 2574.
- Lee, J., & Boubekri, M. (2020). Impact of daylight exposure on health, well-being and sleep of office workers based on actigraphy, surveys, and computer simulation. *Journal of Green Building*, 15(4), 19-42.
- Loftness, V., Hartkopf, V., Aziz, A., Choi, J.-H., & Park, J. (2018). Critical frameworks for building evaluation: user satisfaction, environmental measurements and the technical attributes of building systems (POE+ M). *Building Performance Evaluation: From Delivery Process to Life Cycle Phases*, 29-48.
- Marzouk, M., ElSharkawy, M., & Mahmoud, A. (2022). Optimizing daylight utilization of flat skylights in heritage buildings. *Journal of Advanced Research*, 37, 133-145.
- Matterson, M., Ferra, J., Salom, J., & Portilla, J. (2013). Dynamic daylight simulation and visual comfort survey in Mediterranean climate. Proceedings of the 13th Conference of International Building Performance Simulation Association, Chambery, France.

- moazzeni, m., toofan, s., & sattarzadeh, d. (2020). Assessment Optical Patterns Affecting the Quality of Life of Residents of Residential Units Using Fractal Geometry. *Journal of Architectural Thought*, 4(7), 122-137.10.30479/at.2020.12074.1381.
- Münch, M., Brøndsted, A. E., Brown, S. A., Gjedde, A., Kantermann, T., Martiny, K., . . Wirz-Justice, A. (2017). The effect of light on humans. *Changing perspectives on daylight: Science, technology and culture. Sponsored supplement to Science/AAS*, 16-23.
- Namian, P., Parva, M., & Kashmiri, H. (2021). Investigating the Changing Role of Women in Society based on Satisfaction Level of Kitchen Design Pattern (Case study: Kitchens of Zones 1, 2 and 7 of Shiraz City, 2008-2018). *International Journal of Applied Arts Studies (IJAPAS)*, 6(1), 33-46.
- Omidfar, A., Niermann, M., & Groat, L. (2015). The use of environmental aesthetics in subjective evaluation of daylight quality in office buildings. *Proceedings of IES Annual Conference*.
- Roskams, M., & Haynes, B. (2020). Salutogenic workplace design: A conceptual framework for supporting sense of coherence through environmental resources. *Journal of Corporate Real Estate*, 22(2), 139-153.
- Salthammer, T., & Morrison, G. C. (2022). Temperature and indoor environments. *Indoor air*, 32(5), e13022.
- Sander, E. L. J., Caza, A., & Jordan, P. J. (2019). Psychological perceptions matter: Developing the reactions to the physical work environment scale. *Building and Environment*, 148, 338-347.
- Seo, H. J., Hyun, E.-j., & Yoon, Y.-G. (2024). The Impact of Physical Hazards on Workers' Job Satisfaction in the Construction Industry: A Case Study of Korea. *Behavioral Sciences*, 14(12), 1197.
- Seyedolhosseini, A., Masoumi, N., Modarressi, M., & Karimian, N. (2020). Daylight adaptive smart indoor lighting control method using artificial neural networks. *Journal of Building Engineering*, 29, 101141.
- Wierzbicka, A., Pedersen, E., Persson, R., Nordquist, B., Stålné, K., Gao, C., . . Ness, B. (2018). Healthy indoor environments: The need for a holistic approach. *International journal of environmental research and public health*, 15(9), 1874.
- Xue, P., Mak, C. M., & Cheung, H. (2014). The effects of daylighting and human behavior on luminous comfort in residential buildings: A questionnaire survey. *Building and Environment*, 81, 51-59.

