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Exploring the Effects of Window Design on the Restorative Potential of Movable Smart Co-Working Offices in Small Village Environments Through Immersive Virtual Reality

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Abstract

As remote and hybrid work models continue to grow, the design of workspaces and their surrounding environments has gained even more importance. This study explores the impact of window design on the restorative potential of Prefabricated Movable Buildings (PMBs) of smart/co-working located in small villages. Using Immersive Virtual Reality (IVR), seven window configurations, varying in size, frame ratio, and number of glass panes, were evaluated. Participants' sense of presence, defined as the subjective feeling of 'being there' in the virtual environment, and perceived restoration, referring mainly to the psychological (attention and emotions) and physiological (stress) resources recovery, were assessed using, respectively, Igroup Presence Questionnaire (IPQ) and the Perceived Restorativeness Scale (PRS). The overall IPQ results suggest that the virtual environment in this study provides a "High" sense of presence, highlighting the validity of IVR to evaluate architectural designs. The PRS results found that larger, uninterrupted windows with a higher Window-to-Wall Ratio and lower Frame Ratio significantly enhance participants' perceived restoration. Restoration effects were also higher when offices were located in small villages rather than in business districts. These results highlight the importance of incorporating large windows in smart/co-working spaces within culturally rich small villages to promote worker well-being and office sustainability.

Keywords: window design; immersive virtual office; small villages; virtual environment; smart co-working; prefabricated offices; restorativeness

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1. Introduction

In recent years, workplaces have undergone a profound transformation, driven by advancements in digital technology, sustainability concerns, and the shift toward remote and flexible work models [1]. Traditional office spaces are evolving into dynamic, adaptable environments that accommodate modern workers' needs. The increasing prevalence of remote and hybrid work has rendered conventional fixed offices increasingly obsolete, fostering the development of new workspace models prioritizing flexibility, collaboration, and well-being [2,3]. Sustainability plays a fundamental role in modern human-centered workspace design, integrating historical and natural elements, energy-efficient materials, and biophilic principles to enhance indoor environmental quality (IEQ) and support both well-being and productivity [4–6].

Windows are a crucial element in architectural design, acting as the primary link between indoor and outdoor spaces [7]. The concept of "view access" defines the extent

of visibility from a given viewpoint, influenced by both spatial relationships (e.g., window placement, distance, and orientation) and geometric window properties (e.g., size, shape, and sill height) [8,9]. Window design significantly affects multiple aspects of IEQ, including natural lighting, thermal comfort, acoustics, and air quality [10–13]. Additionally, outdoor views strongly influence occupants' health [14,15], well-being [16–19], and job performance [17,20–22].

Ensuring high-quality views in building design presents a complex challenge influenced by surrounding environmental factors, window size, and glazing properties [8,9,23–25]. However, the lack of clear guidelines complicates systematic assessments of view quality, defined as "the quality of the visual connection to the outdoors that satisfies building occupants" [26]. Views that are fragmented due to multiple windows, mullions, or shading elements are generally regarded as less attractive than uninterrupted views [27,28].

A widely used metric in window design is the Window-to-Wall Ratio (WWR), which represents the proportion of a wall's surface occupied by windows. WWR directly influences key factors such as daylight exposure, thermal performance, energy efficiency, and occupant satisfaction [9]. Studies show that increased WWR does not always improve energy savings, particularly in warmer climates, where excessive glazing raises cooling loads [29–32]. Despite these concerns, research indicates that occupants prefer larger, uninterrupted windows due to their psychological benefits, such as perceived spaciousness, improved mood, and enhanced motivation [33,34].

Experiments evaluating different WWR configurations reveal that higher values (e.g., 30%, 45%, 60%) enhance visual comfort, spatial satisfaction, and openness, although excessive glazing can raise privacy concerns [34]. Notably, a 60% WWR appears optimal for balancing work performance and workload reduction, as evidenced by studies employing Virtual Reality (VR) simulations [35]. Similarly, VR-based research has demonstrated that WWR values between 58.41% and 62.24% enhance learning efficiency while supporting physical and mental health [36].

VR technology has emerged as a powerful tool for simulating built environments, enabling researchers and designers to explore architectural alternatives with a high degree of immersion and realism. In the research sector, particularly in architectural design, VR allows for the creation of dynamic simulations with precise control over all relevant variables, offering visual and experiential insights that are difficult to achieve through physical models due to spatial and logistical constraints [37–41]. In recent years, several VR development tools have emerged, focusing on optimising user interfaces to enhance and streamline the overall user experience. Predominantly, these tools are built on established game engines like Unreal Engine and Unity, which provide the necessary architectural foundation for immersive virtual reality applications. Unreal Engine is one of the most popular game engines [42], offering high-fidelity rendering, real-time ray tracing, and advanced global illumination, making it ideal for photorealistic visualizations in industries like architecture, film, and AAA gaming [37,42]. Additionally, using VR reduces material waste and carbon emissions during the design process while facilitating widespread stakeholder engagement [43].

At the heart of Virtual Reality (VR) is presence: the feeling of "being there" in the virtual environment [44] is widely assumed to be a prerequisite for successfully using virtual environments. Technologically, VR is constructed using computer-generated, three-dimensional environments that can be explored by users in interactive real-time. However, this sense of presence is what sets a VR experience apart from traditional 3D interfaces. Or, in short: without presence, there is no VR.

While different approaches have been developed to measure this sense of presence, the administration of post-experience questionnaires is by far the most popular, as they

are easy to administer, and their analysis requires standard statistics. The Igroup Presence Questionnaire (IPQ), which enjoys increasing popularity within Virtual Reality [45], Telepresence [46] and Human-Computer interaction research [47] as a way to evaluate immersive experiences [45,47].

Tran et al. [48], through the analysis of 1771 articles that used the IPQ, developed a Ranking Classification Scale, an effective method to assess the sense of presence.

Beyond physical comfort factors, such as air quality, noise levels, daylight, and air temperature, additional environmental elements significantly impact individuals. Natural settings contribute to positive emotional and aesthetic experiences, reducing stress and enhancing attention restoration [49–53]. Research highlights strong correlations between well-being and natural elements, such as greenery (trees, grass) and water features (fountains, streams) [54–58]. The combined presence of these elements further amplifies their restorative effects [59–62].

Perceived restoration refers to the recovery process of emotional, attentional and physiological resources by relieving cognitive fatigue and emotional disorder [52,63].

According to Attention Restoration Theory (ART), engaging in tasks that demand sustained mental effort can lead to cognitive fatigue when attentional resources become overused [52]. ART outlines four essential characteristics of environments that support psychological recovery and stress reduction [64,65]: 'being away' (flighting from daily routine life and exhausted things), 'fascination' (engaging attention through specific environmental objects and features), 'compatibility' (alignment between personal intentions and environmental activities) and 'extent' (immersing oneself into a context distinct from the current one, including both tangible and intangible elements). The concept of "extent" does not imply a need for a large physical space but emphasizes environmental coherence and a sense of depth. As such, "extent" is often evaluated based on two properties: (i) 'coherence' means an individual's perception of harmony within the environment, (ii) and 'scope' refers to the scale of the environment and what can be achieved there [66,67].

Acoustics research increasingly indicates that most parts of natural soundscapes significantly foster psychophysical restoration and individuals' wellbeing than urban environments [68], promoting also stress recovery [69–71]. A field survey involving 419 visitors across five urban parks found that factors such as audio-visual integration and individual visitor traits can significantly shape how restorative a soundscape is perceived to be [72]. Crucially, the context in which sounds are experienced significantly influences their restorativeness effect, due to the complex interplay between sensory input and human interpretation. A change in the visual context can significantly influence people's responses to the acoustic environment. For example, Ma and Shu [73] applied different audiovisual conditions to measure participants' stress and fatigue recovery, and found a significant difference in the restorative effect of the same sound in different visual contexts. Masullo et al. [74] concluded that larger and enveloping shapes of installations were responsible for improving the restoration.

Given that modern lifestyles largely confine people to indoor environments, the potential restorative value of natural sounds inside buildings, such as in offices, classrooms, and healthcare facilities, has attracted growing academic interest [75,76].

Urban environments can incorporate nature-inspired designs to enhance aesthetic appeal and promote psychological restoration [71,74,77,78]. This aligns with Attention Restoration Theory (ART) [52], which suggests that environments capturing effortless, involuntary attention foster cognitive recovery. Historical and architecturally significant locations also exhibit strong restorative potential due to their capacity to evoke fascination and engagement [79–81].

Studies comparing historical sites, urban parks, promenades, and shopping malls indicate that historical settings and green spaces are the most restorative environments [82–85].

Lifestyle choices also contribute to overall well-being, as exemplified by the "slow living" movement, which prioritizes cultural appreciation, sustainable food, and deep connections to local landscapes [86–88]. This concept is particularly relevant to small Italian villages ("borghi"), which the Italian Ministry of Cultural Heritage has defined as settlements with fewer than 5000 residents [89]. These villages represent 70% of Italy's municipalities and house over 10 million people [90,91], yet they face challenges such as depopulation and economic decline.

Many small villages have adopted resilience strategies to counteract these trends, leveraging local resources to attract investment and stimulate development [90]. The National Recovery and Resilience Plan (NRRP) [92] allocates funds to revitalize historical and cultural sites using digital and sustainable approaches, improving infrastructure, safety, and accessibility, particularly in rural areas.

In recent years, smart co-working spaces have emerged as a crucial component of this transformation, providing shared, resource-efficient environments for freelancers, startups, and remote workers. These spaces enable users to balance work and leisure while supporting sustainability and workforce decentralization. Unlike conventional office buildings, Prefabricated Movable Buildings (PMBs) offer adaptable, movable solutions that seamlessly integrate with historical and natural landscapes. PMBs designed for temporary installation allow flexible configurations based on site-specific requirements while preserving cultural heritage [93–95].

Key features of PMBs include large windows and natural ventilation systems that enhance sensory connections to the surrounding landscape. This design fosters a multisensory experience that may positively impact users by promoting well-being and regenerative effects related to the context in which the office is located [96].

Environmental and energy efficiency assessments of PMBs demonstrate their viability as self-sufficient smart workspaces. These offices can achieve net-zero energy consumption by integrating smart windows, photovoltaic panels, and energy storage systems [94,95]. Additionally, studies indicate that working in PMBs located in small villages, especially near heritage buildings or water elements, enhances well-being and restoration compared to the city's business district [91]. Importantly, the quiet activities typical of village life do not negatively affect concentration, performance, or attention.

This study investigates the impact of window design and WWR on the restorative potential of PMB's smart co-working offices through Immersive Virtual Reality (IVR) simulations. The research examines how different window configurations influence workers' perceptions of external environments and their overall well-being. A small village in Italy, Cerreto Sannita, serves as the case study, offering insights into how restorative workspaces can be optimized for historical and rural settings. Instead, the control scenario is represented by a traditional office located in a skyscraper in the city's business district.

The findings aim to inform future workplace designs prioritising sustainability, user experience, and visual connections to restorative views. Therefore, the innovative aspect of this research lies in the integration of IVR simulations to evaluate the impact of window design and WWR on the restorative potential of PMBs in smart co-working spaces.

2. Materials and Methods

To assess the impact of various window designs and the external environment on workers' restoration, we created a virtual reality model of a Prefabricated Movable Building (PMB) located in both a Small Village (SV) and a City Business District (CBD). The study

examined seven distinct window configurations, varying in size and the number of Glass Panes (GP).

This section details the Prefabricated Movable Building (PMB) (Section 2.1), the Small Village setting (Section 2.2), the City's Business District setting (Section 2.3) and the development of the VR environment (Section 2.4). It also outlines the questionnaires used for analysis (Section 2.5), the characteristics of the eight VR scenarios (Section 2.6), the experimental setting (Section 2.7), participant details (Section 2.8), and the experimental procedure (Section 2.9).

2.1. "RES_STANZA" Prefabricated Movable Building

The proposed PMB named "RES_stanza", shown in Figure 1, was designed in the framework of the research project titled "New movable systems for smart/co-working taking advantage of life quality, sustainability and energy efficiency (RESTANZA)" [97] to create a space to optimize occupants' well-being, energy performance and integration of indoor environment with outdoor architectural/historical/landscape elements via innovative design methods. The PMB is composed of six indoor sections: a relaxation area (floor area of 9.6 m^2), three identical offices (labelled A, B, and C, with a floor area of 9.6 m^2 each), a toilets area (ante bathroom, WC1, and WC2, with a total floor area of 14.2 m^2), and a corridor to connect each section.

The offices and relaxation area feature large windows. These windows and natural ventilation grilles (integrated into vertical walls and used to supply fresh air to indoor spaces) provide significant visual and acoustic interaction with the surrounding landscape and soundscape. The PMB is designed to deliver regenerative benefits to workers by offering a multisensory experience that connects them with the environment in which the office is situated [96].

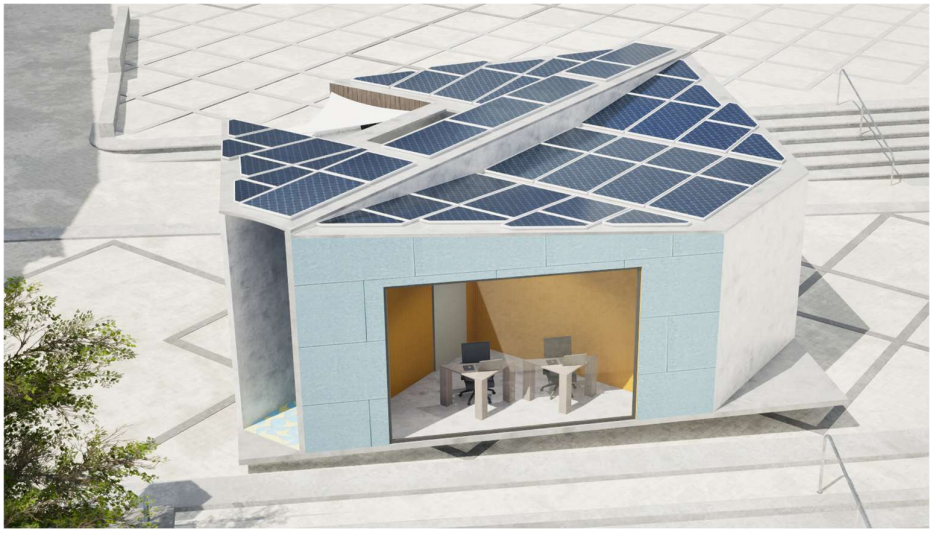


Figure 1. Architectural model of the RES_stanza building.

In smart/co-working mode, each office may accommodate up to two persons, for a total occupancy of six people.

Each office is internally characterized by orange walls, two triangular desks positioned in front of the large windows, and a flower box with green plants on the right wall.

The proposed mobile office was developed using a multidisciplinary approach that considered both objective (like indoor thermo-hygrometric conditions) and subjective (like occupant productivity, well-being, and health) aspects. According to previous research by authors [93–95], the "RES_stanza" building was designed as a renewable energy-based, self-

sustaining energy use, eco-friendly, modular, and flexible structure. The outside areas also feature an impluvium for rainwater recovery, a small garden, and a laboratory area. The roof is entirely covered with photovoltaic panels coupled with electric storage (necessary for energy self-sufficiency) [95].

It is intended for temporary use, allowing it to be removed or relocated when the occupied area is needed for other purposes.

2.2. Small Village: Cerreto Sannita

Italian Small villages ("Borghi"), which represent 70% of all municipalities, face challenges such as depopulation and economic decline [89–91]. Yet, these villages possess a rich historical and cultural heritage that offers significant restorative potential for people. These villages represent ideal locations for hosting workers through the creation of smart/co-working spaces. These spaces, located in SVs, represent opportunities for sustainable economic revitalization of small villages and a possibility to improve the well-being of workers.

Cerreto Sannita is a SV with a number of inhabitants equal to 3606 (under 5000 inhabitants [98]), located in the province of Benevento (Campania region, southern Italy). This small village, for its distinctive historical, architectural, and cultural characteristics, as well as characterized by a slow lifestyle, has been selected as a case study representative of the small villages in the Campania region.

Additionally, it has received financial incentives to improve digital connectivity [99], making it an ideal destination for remote workers and digital nomads. The municipality area under investigation is San Martino Square.

The urban layout of the square is orderly and rational, unlike many medieval villages characterized by narrow and winding alleys. San Martino Square opens up as a wide symmetrical space, is surrounded by historic buildings and presents a stone pavement, which enhances the image of a place that has managed to keep its history and identity. The surface is about 2293 m^2. Furthermore, almost the entire perimeter of the square is characterised by the presence of flowerbeds with vegetation and trees.

In order to underline the historical and identity of the place, the windows were considered facing “Palazzo del Genio” and the “Fontana dei Delfini”, the two prominent historical monuments in the square (Figure 2).



Figure 2. Image of San Martino Square with a view of the Palazzo del Genio and the Dolphin fountain.

The "Palazzo del Genio", which dominates part of the square, is a historical building whose construction dates back to the 18th century, during the period of the Kingdom of Naples. The Palazzo del Genio is used today as a municipal library and hosts cultural events and art exhibitions.

The Dolphin Fountain (a protected cultural asset) is located in the southern part of the square, in front of the "Palazzo del Genio". The fountain comprises a lower part in worked limestone and an upper part in lava stone. The water flows out of the mouths of the four dolphins, while in the center, there is a decorative pinecone. The "Fontana dei Delfini" symbolises an ancient and fascinating history and represents a pleasant spot for locals and visitors.

2.3. City's Business District: Naples Directional Center

The traditional City's Business District (CBD), viewed as the epicentre of economic and professional life, is characterized by office towers and commercial real estate. Offices are generally structured according to a traditional model, featuring private, enclosed spaces designed to accommodate one or two employees. Additionally, meeting rooms and hybrid open-space areas are available to encourage informal communication and promote collaboration among colleagues.

The Naples Directional Center has the offices of the Campania Region, universities, and major commercial and financial activities in the city. For modelling the CBD scenario, identified as a reference case, a southern-view office on the 10th floor of a skyscraper in the Naples Directional Center's northern section was selected (Figure 3). The CBD scenario is characterized by an outdoor view of other skyscrapers.



Figure 3. Typical skyscraper in a City's Business District.

2.4. VR Environment Development

In this study, VR is employed to simulate various window-to-wall ratios (WWRs) but also to replicate the broader environmental context, including lighting, shadows, and outdoor conditions, within a highly immersive workspace environment. The use of VR instead of real environments allows for quick control and modification of the simulated environments, significantly reducing the experimental cycle time and costs.

The creation of the scenarios used in the research started with modelling one of the three identical offices of the PMB in Unreal Engine 5 (UE5). The office is internally characterized by orange walls, two triangular desks in front of the large windows, and a flower box with green plants on the right wall, as depicted in Figure 4a. The 3D model of

the office was made using SketchUp software [100], giving specific attention to the window modelling, and imported into 3ds Max 2021 [101] for detailed optimization. Each surface underwent verification of normals, material assignment, UV map management, and light map creation. Then, the optimized model was imported into UE5, where all materials (defining colors and textures) were created and assigned to their respective surfaces.

The virtual model of San Martino Square (Figure 4b) started with a detailed geometric and photographic survey in situ of the square, buildings (in particular "Palazzo del Genio) and "Fontana dei Delfini" to create an accurate 3D model by means of the software SketchUp [100]. Google Earth was used to fill in missing information. In addition, photos were taken using an iPhone 13 Pro at 12Mp resolution (3024 × 4032 pixels) and used to evaluate the quality of the virtual model in relation to the real environment during all modelling phases. The 3D model was initially imported into 3ds Max 2021 for detailed optimization. During this phase, for each surface, normals were verified, materials were assigned, UV maps were managed, and light maps were created. The model was further manipulated to include vegetation, with careful attention given to the accurate placement and sizing of trees, hedges, and shrubs. Surface colors and textures were selected based on a photographic survey, ensuring the model closely matched the real one as much as possible. With the aim to enhance the immersive nature of the scenery, the acoustic environment was also recorded with an SQobold combined with Binaural Headset II [102]. The soundscape is characterized by human activities (older people sitting outside a Café and others crossing the square), the sound of the fountain water and low traffic noise. The resulting A-weighted sound equivalent levels, obtained through field acquisitions, were about 62 dB(A).

Instead, the outdoor view of the CBD scenario (Figure 4c) was obtained by importing in the Unreal Engine PMB offices project, the photo taken from the office on the 10th floor of a skyscraper in the Naples Directional Center, and placing them in front of the office window. The choice of a hybrid modeling solution, combining a 2D image with a 3D model, was made based on a literature review, which revealed that this approach is frequently used by several researchers [103–105]. Moreover, given the characteristics of the CBD scenario (office in a skyscraper building), this technique is sufficient to provide a high sense of presence, visual depth, and realism. For example, Svobodová et al. [103] demonstrated that for simulations of real environments, well-composed images can receive higher ratings than other types of representation. Moreover, Palmer et al. [104] provided guidelines for designing virtual scenarios based on the use of static images. Furthermore, the hybrid model provided a way to reduce both modeling time and costs, considering the complexity of the entire CBD area. The auditory environment is defined by noise originating from outside as well as from adjacent rooms and corridors. Sound recordings, carried out (in one real CBD office) with an SQobold combined with Binaural Headset II [102], were conducted with the windows closed, no workers in the room, and all devices (e.g., computers, smartphones, printers) and the air conditioning system turned off. The recorded A-weighted sound equivalent level was approximately 38 dB(A).

Finally, the SV and CBD immersive virtual reality scenarios were obtained by importing the PMB office into the VR model of the San Martino Square and Naples Directional Center. Once imported into the outdoor models, the office was positioned to ensure the correct outdoor view.

In the SV scenario, through the office window, workers can see San Martino Square in the municipality of Cerreto Sannita (Province of Benevento, Italy), featuring a historic building, a fountain, and people sitting outside a café. Afterwards, to take into account the sound insulation of the office's façade, an equalization filter that considered the transmission loss of the large window and ventilation grilles was applied, leading to an internal sound equivalent level of roughly 38 dB(A). This resulting indoor acoustic environment

represented the minimum sound insulation from the external environment. To avoid influencing judgments related to visual context, the abovementioned acoustic environment was kept consistent across all SV scenarios.

In the CBD scenario, from the window, workers view neighbouring skyscrapers. The auditory environment, heard by the workers in the office, is defined by noise originating from outside as well as from adjacent rooms and corridors. The resulting A-weighted sound equivalent levels were about 38 dB(A).

Furthermore, in the SV and CBD, the background noise due to the air-conditioning system and the desktop computer in the test room of the Sens i-Lab was also measured as about 38 dB(A).



Figure 4. Images of the model developed in VR: (**a**) internal image of the PMB virtual offices; (**b**) San Martino Square with the inclusion of "Palazzo del Genio" and the "Fontana dei Delfini"; (**c**) external window view of the office located in a City's Business District.

2.5. Questionnaire

Three distinct questionnaires were utilized in this research. A general information questionnaire was used to explore the participants' age, gender, educational qualifications, occupation, daily working hours, preferred types of vacation destinations, and desire to go on holiday more frequently. Furthermore, two different questionnaires (detailed in Appendix A and described in the following subsection) examined two specific aspects of the VR experience: self-reported sense of presence (Section 2.5.1) and perceived restoration (Section 2.5.2).

2.5.1. Igroup Presence Questionnaire (IPQ)

The Igroup Presence Questionnaire (IPQ) [45,106,107] was administered to measure the sense of presence, which refers to the feeling of being immersed in a virtual or real environment. The IPQ is a self-report scale of 14 items designed to assess the sense of presence in an environment (Table 1). It includes four subscales: (i) *General Presence* (1 item) relates to the feeling of "being there", (ii) *Spatial Presence* (5 items) evaluates the sense

of physically being in the environment, (iii) *Involvement* (4 items) measures the degree of engagement and focus within the environment and (iv) *Experienced Realism* (4 items) assesses how realistic the VR environment feels to the individual. The scale for item ratings is (−3)–(+3). The items were translated into Italian through a back-translation method (Table A1).

Table 1. The Igroup Presence Questionnaire (IPQ) with sub-scales: Spatial Presence (SP), Involvement (INV), Experienced Realism (REAL), and General Presence (GP). Items SP2, INV3, and REAL1 need reversing (multiplied by -1) before being combined with the other items to calculate the total score for the questionnaire. Data from igroup [107].

Factors	Item Name	Items	Anchors	Item Sources
General presence	G1	In the computer generated world, I had a sense of "being there"	not at all/-/very much	[108]
Spatial presence	SP1	Somehow I felt that the virtual world surrounded me.	fully disagree/-/fully agree	[45]
	SP2	I felt like I was just perceiving pictures.	fully disagree/-/fully agree	[45]
	SP3	I did not feel present in the virtual space.	did not feel/felt present	[45]
	SP4	I had a sense of acting in the virtual space, rather than operating something from outside.	fully disagree/-/fully agree	[45]
	SP5	I felt present in the virtual space.	fully disagree/-/fully agree	[45]
Involvement	INV1	How aware were you of the real world surrounding while navigating in the virtual world? (i.e., sounds, room temperature, other people, etc.)?	extremely aware/moderately aware/not aware at all	[109]
	INV2	I was not aware of my real environment.	fully disagree/-/fully agree	[45]
	INV3	I still paid attention to the real environment.	fully disagree/-/fully agree	[45]
	INV4	I was completely captivated by the virtual world.	fully disagree/-/fully agree	[45]
Experienced realism	REAL1	How real did the virtual world seem to you?	completely real/-/not real at all	[110]
	REAL2	How much did your experience in the virtual environment seem consistent with your real world experience?	not consistent/moderately consistent/very consistent	[109]
	REAL3	How real did the virtual world seem to you?	about as real as an imagined world/-/indistinguishable from the real world	[111]
	REAL4	The virtual world seemed more realistic than the real world.	fully disagree/-/fully agree	[45]

2.5.2. Perceived Restorativeness Scale

The Italian version of the Perceived Restorativeness Scale proposed by Pasini et al. [67], PRS-11, was used to evaluate the workers' restoration related to the use of PMB offices. The PRS-11, shown in Table 2, is based on four main components of restorativeness:

(i) Fascination, which refers to how an environment might attract the involuntary attention of a person; (ii) Being-Away, which refers to how an environment causes a person to feel free from everyday demands and obligations; (iii) Coherence, which refers to how an environment is perceived as organized or not; (iv) Scope that refers to how an environment offers the possibility of exploration, including the immediate surroundings and the areas that are out of sight or imagined. The scale for each item is an 11-Point Likert Scale rating of 0–10, "0" means "not at all" and "10" means "very much". Table A2 reports the Italian version of the PRS-11 questionnaire [67].

Table 2. The Perceived Restorativeness Scale (PRS-11) with sub-scales: Fascination, Being-Away, Coherence, and Scope. Data from Pasini et al. [67].

Factors	Item Name	Items	Anchors
Fascination	1	Places like that are fascinating	not at all/-/very much
	2	In places like this my attention is drawn to many interesting things	not at all/-/very much
	3	In places like this it is hard to be bored	not at all/-/very much
Being Away	4	Places like that are a refuge from nuisances	not at all/-/very much
	5	To get away from things that usually demand my attention I like to go to places like this	not at all/-/very much
	6	To stop thinking about the things that I must get done I like to go to places like this	not at all/-/very much
Coherence	7	There is a clear order in the physical arrangement of places like this	not at all/-/very much
	8	In places like this it is easy to see how things are organised	not at all/-/very much
	9	In places like this everything seems to have its proper place	not at all/-/very much
Scope	10	That place is large enough to allow exploration in many directions	not at all/-/very much
	11	In places like that there are few boundaries to limit my possibility for moving about	not at all/-/very much

2.6. VR Scenarios

To evaluate how different window designs and the resulting perceptions of the external environment affect workers' restoration, Virtual reality-based models of a Prefabricated Movable Building (PMB) placed in a Small Village (SV) and in a City's Business District (CBD) were developed. Seven different window designs were modeled, varying in size and the number of Glass Panes (GP). The Window-to-Wall Ratio (WWR), defined as the ratio between the window area and the total wall area, and the Frame Ratio (FR), defined as the ratio between the frame area and the window area, were used to identify the window types investigated.

The analyzed windows are composed of glass panes ranging from one to six. According to the size of the windows, the cases studied can be divided into two subcategories using the WWR obtained through the following formula:

$$WWR = \frac{A_W}{A_{Wall}} \cdot 100 \quad (1)$$

where A_W is the window area (which includes both the glass area and the frame area) and A_{Wall} is the total wall area (which includes the opaque wall area and the window area).

Based on the number of inner mullions and the number of glass panes (GP), the Frame Ratio (FR) was calculated for each case study. The FR is obtained through the following formula:

$$FR = \frac{A_F}{A_W} * 100 \quad (2)$$

where A_F is the frame area (which includes the area of the border and inner mullions) and A_W is the window area used previously in the formula.

Table 3 lists the key characteristics of window types considered, such as wall area, window dimensions, window area, windowsill height from the floor, frame area, WWR, FR, and number of glass panes (GP).

Table 3. The window types used for the experiment.

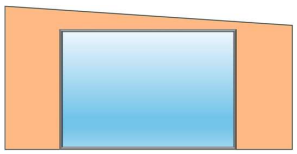
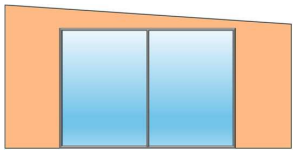
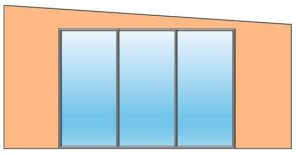
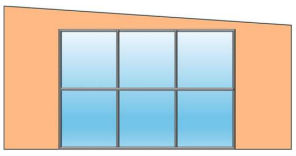
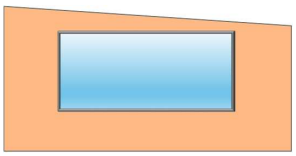
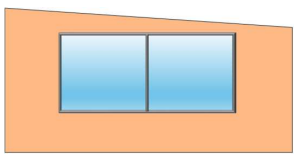
Case n.	Picture	Characteristics	
SV_L1 and **CBD_L1**	 WWR = 53.5 % FR = 6.7 % GP = 1	Wall area (A_{wall}) Window dimensions (W × H) Window area (A_W) Windowsill height from the floor Frame area (A_F)	20.18 m^2 4.00 × 2.70 m 10.80 m^2 0.00 m 0.72 m^2
SV_L2	 WWR = 53.5 % FR = 9.3 % GP = 2	Wall area (A_{wall}) Window dimensions (W × H) Window area (A_W) Windowsill height from the floor Frame area (A_F)	20.18 m^2 4.00 × 2.70 m 10.80 m^2 0.00 m 1.00 m^2
SV_L3	 WWR = 53.5 % FR = 11.8 % GP = 3	Wall area (A_{wall}) Window dimensions (W × H) Window area (A_W) Windowsill height from the floor Frame area (A_F)	20.18 m^2 4.00 × 2.70 m 10.80 m^2 0.00 m 1.27 m^2
SV_L4	 WWR = 53.5 % FR = 15.4 % GP = 6	Wall area (A_{wall}) Window dimensions (W × H) Window area (A_W) Windowsill height from the floor Frame area (A_F)	20.18 m^2 4.00 × 2.70 m 10.80 m^2 0.00 m 1.66 m^2
SV_S1	 WWR = 35.7 % FR = 8.7 % GP = 1	Wall area (A_{wall}) Window dimensions (W × H) Window area (A_W) Windowsill height from the floor Frame area (A_F)	20.18 m^2 4.00 × 1.80 m 7.20 m^2 0.90 m 0.63 m^2
SV_S2	 WWR = 35.7 % FR = 11.2 % GP = 2	Wall area (A_{wall}) Window dimensions (W × H) Window area (A_W) Windowsill height from the floor Frame area (A_F)	20.18 m^2 4.00 × 1.80 m 7.20 m^2 0.90 m 0.81 m^2

Table 3. *Cont.*

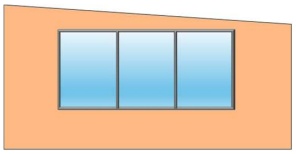
Case n.	Picture	Characteristics	
SV_S3	 WWR = 35.7 % FR = 13.7 % GP = 3	Wall area (A_{wall}) Window dimensions (W × H) Window area (A_W) Windowsill height from the floor Frame area (A_F)	20.18 m^2 4.00 × 1.80 m 7.20 m^2 0.90 m 0.98 m^2

Figure 5 shows the images of the eight virtual scenarios viewed by the participants through the 3D-HMD, obtained from the different combinations of window design and external view.



Figure 5. Views of the eight settings of the virtual scenarios (different windows design and outdoor views) presented to the participants: (**a**) SV_L1; (**b**) SV_S1; (**c**) SV_L2; (**d**) SV_S2; (**e**) SV_L3; (**f**) SV_S3; (**g**) SV_L4; (**h**) CBD_L1.

In the seven cases where the acronym starts with "SV", the outdoor view from the PMB office corresponds to the Small Village setting, while in the case where an acronym starts with "CBD", it is set in the Naples Directional Center, where the office is located on the tenth floor of a skyscraper.

Additionally, cases in which the second part of the acronym contains the letter "L" (Large) correspond to scenarios with a WWR of 53.5%, whereas those with the letter "S" (Small) indicate a WWR of 35.7%.

Across all cases, as described in Table 3, the wall area remains constant at 20.18 m^2, providing a consistent baseline for comparison. However, the window dimensions vary significantly depending on the case.

In the cases, SV_L1, SV_L2, SV_L3, SV_L4, and CBD_L1 (control scenario), the window has the maximum dimensions, measuring 4.00 x 2.70 m, which results in a window area of 10.80 m^2. In all five cases, the windows extend to the floor, resulting in a windowsill height of zero. The Window-to-Wall Ratio (WWR), which represents the proportion of the wall occupied by windows, remains constant at 53.5%, while the number of glass panes (GP) varies from 1 to 6. As GP increases, the frame area also increases, ranging from 0.72 m^2 to 1.66 m^2, with the corresponding frame ratio (FR) rising from 6.7% to 15.4%.

In the cases SV_S1, SV_S2, and SV_S3, the window has a lower height than those in the previous cases, measuring 4.00 $\times$ 1.80 m, resulting in a window area of 7.20 m^2. The windows do not extend to the floor, and the windowsill height is 0.90 m. The WWR remains constant at 35.7%, while the GP varies from 1 to 3. As GP increases, the frame area ranges from 0.63 m^2 to 0.98 m^2, with the FR rising proportionally from 8.7% to 13.7%.

2.7. Experimental Setting

The experimental session, characterized by the reproduction in IVR of the eight scenarios described in Section 2.4, occurred in the Sens i-Lab [112] at the Department of Architecture and Industrial Design, University of Campania Luigi Vanvitelli.

A desktop computer with an Intel Core i7-9000, 3.00 GHz CPU, 64 GB RAM and NVIDIA GeForce RTX 2080 Graphics Card was used for the study. The computer used Unreal Engine™ version 5.3.2 to run the VR environments.

Participants displayed VR scenarios through an Oculus Rift S [113], with a single fast-switching LCD binocular with a resolution of 2560 $\times$ 1440 pixels (1280 $\times$ 1440 per eye), and a refresh rate of 80 Hz. The HDM provides 88° nominal horizontal/vertical field of view, and inside-out tracking with built-in cameras for seamless movement tracking without external sensors.

In the Test Room, Astro Spatial Audio (which combines Spatial Sound Wave (SSW) technology with SARA II Premium Rendering Engine) was utilized to recreate the sound of each simulated scenario.

The HVAC system was employed to regulate the microclimatic experimental conditions at a temperature of 20°C with a dead band of $\pm$1°C, and relative humidity of 50% with a dead band of $\pm$10%. Both the return and supply air fans of the HVAC system operated at 30% speed.

The VR environment was also displayed on the monitor of the Computer, so the researcher could monitor the participant's view.

Figure 6 presents an image of the test room during the scenario's setup phase.



Figure 6. Setup phase in the Sens i-Lab.

2.8. Participants

A priori analysis of statistical power and effect size was conducted to ensure sufficient statistical validity of the results. The power analysis was performed using G-Power software [114,115] for an ANOVA repeated-measure test. A predefined effect size (f) of 0.33, a test power (1–β) of 0.95, and a significance level (α) of 0.05 were used to calculate the minimum required sample size for the experiment, resulting in a value of 31 subjects.

Moreover, using the Balanced Latin Square Generator [116], a balanced sequence was generated for the administration of the eight scenarios, with the aim of minimizing the effects related to the presentation order. This required the number of participants to be a multiple of 8. Consequently, the authors chose to involve a total of 32 participants.

Thirty-two volunteers participated in the experiment. They were distributed across three age groups: 8 participants aged 18–25, 15 aged 26–35, and 9 aged 36–65. Seventeen of the participants were female. Of the total, 37.5% lived in intermediate urban areas, another 37.5% in suburban areas, 15.6% in the city center, and 9.3% in either rural areas or the historic city center.

The participants included Master's and PhD students, administrative staff, and researchers/professors from the Department of Architecture and Industrial Design at the University of Campania 'Luigi Vanvitelli'.

Regarding educational background, six participants had a high school diploma (18.7%), three held a bachelor's degree (9.4%), fifty had a master's degree (50.0%), and seven had a PhD (21.9%).

Participants reported their daily working hours as follows: 6.3% worked less than 5 h, 53.1% worked 5–8 h, 34.3% worked 8–10 h, and 6.3% worked 10–12 h.

When asked about vacation preferences, all participants expressed a desire to travel more. Among them, 37.5% favoured small villages, 31.2% preferred city destinations, 21.9% chose seaside locations, and 9.4% favoured mountain areas.

All subjects were in good health and gave informed consent about their participation in the study after being told about the experiment's purpose and process.

The Ishihara test [117,118] was used to verify whether or not the participants had a color vision defect. None of the participants reported any colour vision problems, and thirteen participants wore corrective glasses during the experiment.

2.9. Experimental Procedure

Before the study commenced, ethics approval was obtained from the institution's Human Research Ethics Committee. The experimental procedure consists of three key phases: (i) Preparation, (ii) Pre-IVR experimental session, and (iii) IVR experimental session. A summary of the procedure of the experiment is illustrated in Figure 7.

At the beginning of the study ("Preparation" phase), informed written consent from the participants was obtained after a brief introduction, and they completed a short demo-

graphic and general information questionnaire. Furthermore, they perform the Ishihara test to determine the presence of any colour vision defects. The preparation phase for each participant lasted about 13 min.

The experimental session was conducted in the test room of the SENS i-Lab of the Department of Architecture and Industrial Design of the University of Campania "Luigi Vanvitelli", where the eight scenarios were reproduced using IVR.

During the "Pre-IVR experimental session" phase, in the test room, participants were invited to sit at an office desk. This configuration mimicked the VR room setup to enhance their sense of presence when in the environment. Before entering the IVR environment, participants were then instructed and trained in the upcoming tasks. The VR headset was then fastened to the participant's head. This setup enables an interactive viewing mode, where the displayed portion of the scene dynamically corresponds to the participant's head position. The pre-IVR experimental session for each participant lasted about 10 min.

In the "IVR experimental session" phase, at the start of each condition, as suggested by [39,119], participants were allocated 2 min to familiarize themselves with the environment before commencing with the task, i.e., they were allowed to look around while sitting. Additionally, previous visual studies conducted by Fotios and Cheal [120] and Fairchild and Reniff [121] have suggested that a two-minute adaptation period is sufficient for participants to adjust to the luminous environment and achieve at least 90% chromatic adaptation, ensuring the validity of the experiment.

After this period, a verbal questionnaire was administered for the PRS assessment, because participants could not see the questionnaires while wearing the HMD. The scenarios were presented to each participant following a balanced sequence, specifically designed to minimize the effects related to the order of presentation using the Balanced Latin Square Generator [116]. Finally, every participant who completed the visualization of the eight proposed scenarios was invited to answer an IPQ questionnaire verbally while viewing the SV-L1 scenario. The entire experimental session for each participant lasted about 37 min.

The total duration of the test was about 60 min.

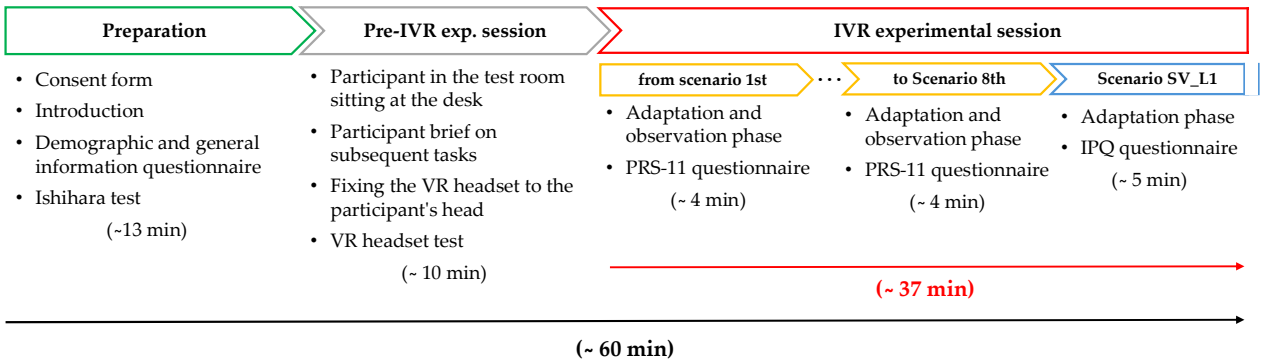


Figure 7. Procedure of the experiment.

3. Results

This section presents the analysis of the self-reported sense of presence (Section 3.1) and the perceived restoration by statistical analysis using a repeated-measures one-way ANOVA (Section 3.2).

3.1. Sense of Presence

To assess the sense of presence among the 32 participants at the experimental session in the immersive virtual environment, the results of the IPQ (14-item, 7-point Likert scale ranging from −3 to 3) were analyzed overall and for four sub-scale presence factors. Generally, a higher absolute IPQ score indicates a stronger sense of presence experienced

by the participants in the virtual environment. To verify the feasibility and validity of the findings derived from the developed virtual environment, the IPQ scores obtained were compared with the Ranking Classification Scale, developed by Tran et al. [48].

Tran et al. [48] categorized the sense of presence into five levels: Low, Moderate, High, Very High, and Exceptional. These categories were determined based on six-tier percentile thresholds. Scores below the 50th percentile were labelled "Low", while those above the 95th percentile were considered "Exceptional." Intermediate categories, such as "Moderate", "High", and "Very High", were mapped to ranges between the 50th, 75th and 90th percentiles. By applying statistical interpolation to the IPQ scores reported in prior studies, the researchers precisely determined the cutoff values for each percentile, effectively defining the boundaries for each ranking class. This methodology provides a structured and reliable framework for interpreting IPQ scores in research activity. The score ranges for these ranking classes were also analyzed with regard to the type of visual display utilized. Specifically, for three-dimensional head-mounted displays (3D-HMDs), the researchers examined data from 180 user studies. The analysis also highlighted the best performance of 3D-HMDs in fostering a strong sense of presence, compared to monocular displays (e.g., desktop monitors or mobile phone screens) and projection displays (e.g., CAVEs). This finding underscores the immersive advantages of 3D-HMDs over other display types in virtual and mixed-reality environments. Furthermore, the researchers extended the classification framework to the individual sub-scales of the IPQ: General Presence (GP), Spatial Presence (SP), Involvement (INV), and Experienced Realism (REAL). Similar to the ranking scale developed for the overall IPQ score, the researchers analyzed 162 reported scores for each IPQ sub-scale to define the range for ranking classes for each sub-scale. These ranges were determined based on 50th, 75th, 90th, and 95th percentile thresholds. This approach allows for a better interpretation of the IPQ scores, enabling researchers to assess the overall sense of presence and each sub-scale effect. The score ranges for the five ranking classes of each sub-scale of the 14-item IPQ, as determined by Tran et al. [48], are presented in Table 4.

The results of this work, associated with a self-reported sense of presence, were analyzed according to Tran et al. [48] and reported in Figure 8. This figure illustrates the mean values and their corresponding SD for each IPQ sub-scale alongside the associated score ranges for each ranking class (Low, Moderate, High, Very High, and Exceptional). This detailed visualization facilitates a clear and direct comparison between the study's results and the ranking classes proposed by Tran et al. [48].

Table 4. Ranking scale with the representations for each class (Low, Moderate, High, Very High, and Exceptional) of the range on the corresponding 7-point Likert-type scale [−3, 3] for each sub-scale (SP: Spatial Presence, INV: Involvement, REAL: Experienced Realism, GP: General Presence) and overall-scale of the IPQ. Data from Tran et al. [48].

Sub-Scale	Ranking Class IPQ Scale				
	Low [**–3.00**, $P_{50\ th}$)	**Moderate** [$P_{50\ th}$, $P_{75\ th}$)	**High** [$P_{75\ th}$, $P_{90\ th}$)	**Very High** [$P_{90\ th}$, $P_{95\ th}$)	**Exceptional** [$P_{95\ th}$, **+3.00**]
General Presence	[–3.00, 1.00)	[1.00, 1.50)	[1.50, 1.91)	[1.91, 2.10)	[2.10, 3.00]
Spatial Presence	[–3.00, 0.72)	[0.72, 1.30)	[1.30, 1.74)	[1.74, 1.99)	[1.99, 3.00]
Involvement	[–3.00, 0.26)	[0.26, 0.76)	[0.76, 1.06)	[1.06, 1.28)	[1.28, 3.00]
Experienced Realism	[–3.00, −0.37)	[–0.37, –0.03)	[–0.03, 0.43)	[0.43, 0.95)	[0.95, 3.00]
Overall IPQ scale (3D-HMD)	[–3.00, 0.40)	[0.40, 0.83)	[0.83, 1.17)	[1.17, 1.35)	[1.35, 3.00]

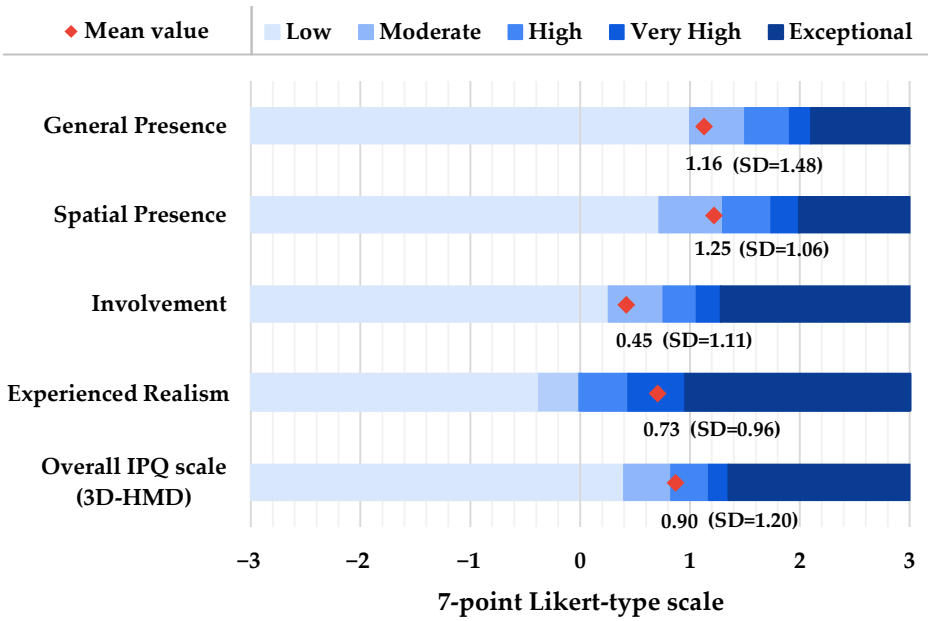


Figure 8. Graphical representation of the ranking classes (Low, Moderate, High, Very High, and Exceptional), based on the classification scale developed by Tran et al. [48]. The figure also displays the mean values (red markers) and their corresponding SD for each sub-scale of the 14-item IPQ obtained in this study.

This study's overall and sub-scale IPQ score results, as illustrated in Figure 8, reveal varying levels of sense of presence. These results are discussed in detail below:

- **General Presence** achieved a mean value of 1.16 (SD = 1.48), corresponding to the Moderate category. In detail, G exhibits an average value higher than 50% of the 162 total studies analyzed by Tran et al. [48], which fall within the Low range. Additionally, SP shows similar values at 25% of the total, while only 25% of the studies exhibit greater values, placed in the High, Very High, and Exceptional ranges. This indicates that participants experienced a Moderate feeling of "being there", considered acceptable as it exceeds the 50th percentile and is only below the 25th percentile.
- **Spatial Presence** recorded a mean value of 1.25 (SD = 1.06), classified as moderate. The SP value (as for the values of G) is higher than 50% of scientific works examined in [48], similar to 25%, and lower than only 25%.
- This suggests that participants have a "moderate" sense of physically being in the environment, which is acceptable as it exceeds the 50th percentile and is only lower than the 25th percentile.
- **Involvement** showed a mean value of 0.45 (SD = 1.11), still within the Moderate range. It ranks above 50% of the 162 studies analyzed in [48], similar to 25%, and below only the top 25%.
- This allows us to affirm that participants have a 'moderate' degree of engagement and focus within the environment, which is acceptable as it surpasses the 50th percentile and is lower than only the 25th percentile.
- **Experienced Realism** with a mean value of 0.73 (SD = 0.96), reached the Very High class. Compared to the 162 works examined in [48], the REAL value is higher than 90% of the cases, similar to 5%, and below only 5%.
- This highlights that, due to the design and technology employed, participants perceived the virtual environment as highly realistic.
- **Overall IPQ Scale** with a mean value of 0.90 (SD = 1.20), reached the High class. Compared to the 180 works examined in [48], the Overall IPQ Scale value is higher than

75% of the cases, similar to 15%, and below only 10%. This highlights that participants perceived a high level of presence in the experimental virtual environment.

Overall, the presence-related factors (G and SP) and factor INV belong to the "Moderate" ranking class, while the REAL factor belongs to the "Very High" ranking class. The overall IPQ score falls into the "High" ranking class.

The results suggest that the virtual environment in this study provides a sufficiently strong sense of presence for windowed space experiments. This is evident from the IPQ value, which falls into the "High" category, and the REAL subscale, in particular, which falls into the "Very High" category.

Additional information about the sub-scale results of the IPQ obtained in this study is summarized in Table A3.

3.2. Restorativeness

After verifying the respect of the ANOVA assumptions and identifying potential outliers and missing values [122], to compare the perceived restorativeness across the eight proposed scenarios, several one-way Repeated-Measures ANOVAs (RM-ANOVAs) were conducted, treating the scenario as an eight-level within-subject factor (CBD_L1, SV_L1, SV_L2, SV_L3, SV_L4, SV_S1, SV_S2, and SV_S3). The analyses were performed on the PRS-11 scale as well as on each individual item: Fascination, Being-Away, Coherence, and Scope.

Five separate one-way RM-ANOVAs were carried out to examine whether perceived restorativeness levels among workers varied as a function of window design (WWR and FR) and outdoor view (SV and CBD context).

Figure 9 presents the marginal means and standard error of the Fascination and Frame Ratios across different scenarios, categorized into two WWR groups.

The results show that a statistically significant difference exists [$F(7,217) = 5.99$, $p < 0.001$, $\eta^2_p = 0.16$] for the component Fascination. The post-hoc Bonferroni tests identified 6 statistically significant differences among the 28 possible pairwise comparisons. The significant post-hoc Bonferroni results are summarized in Table 5.

The results reported in Figure 9 and Table 5 revealed that:

- the maximum marginal means of fascination is observed in SV_L1, with a value of 7.24, characterized by the maximum WWR (53.5%) and the minimum FR (6.71%), as can be seen from Figure 9;
- when comparing the SV_L1 scenario with CBD_L1 under the same window design conditions (WWR of 53.5% and FR of 6.71%), participants attributed higher fascination to the Small Village (mean value = 7.24) than to the City Business District (mean value = 5.64), as shown in Figure 9;
- for the SV_L2 and SV_L3 scenarios, both with a WWR of 53.5% but with progressively increasing FR values (9.25% and 11.50%, respectively), participants attributed a higher level of fascination compared to CBD_L1 (Figure 9 and Table 5);
- the SV_S3 scenario, despite having a lower WWR (35.7%) and a higher FR (13.67%), still elicits significantly higher fascination compared to CBD_L1 (WWR = 53.5% and FR 6.71%);
- in SV_L4 (with WWR = 53.5%, FR = 15.41%, and GP = 6), the "fascination" effect associated with the Small Village (obtained in the cases SV_L1, SV_L2, SV_L3 and SV_S3) decreases, becoming comparable to that obtained in CBD_L1;
- comparing the marginal means of fascination reported in Figure 9 for SV_S1, SV_S2, and SV_S3 with SV_L4 reveals that, despite the former having a lower WWR (33.7% vs. 53.5%), they exhibit higher average fascination values. This suggests that a higher

number of GPs, with both vertical and horizontal mullions, for a given WWR value determines lower levels of fascination than cases where both GPs and WWR are lower.

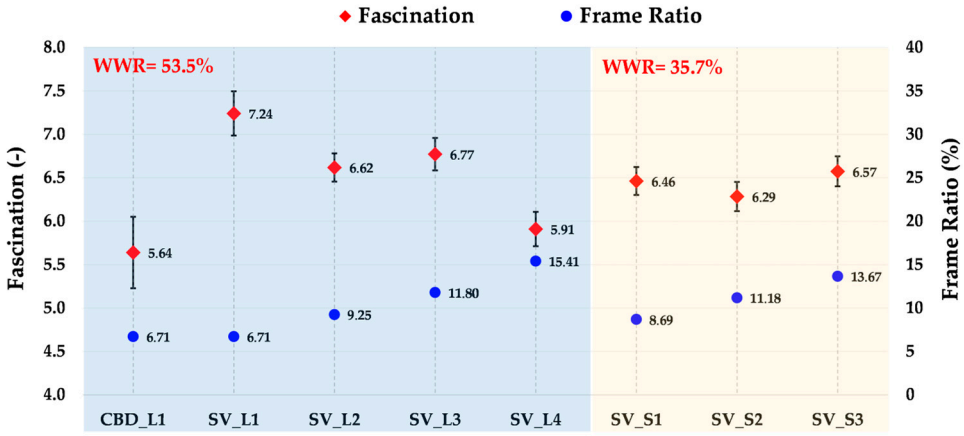


Figure 9. Marginal means and standard error of Fascination in the eight experimental scenarios, along with their corresponding WWR and Frame Ratio values.

Table 5. Statistically significant results of Bonferroni post hoc tests on Fascination.

Scenario 1		Scenario 2		Mean Difference	p_{bonf}	Condition
Case n.	Marginal Mean	Case n.	Marginal Mean			
SV_L1	7.24	CBD_L1	5.64	1.60	<0.001	$p < 0.001$
SV_L1	7.24	SV_L4	5.91	1.33	<0.001	$p < 0.001$
SV_L1	7.24	SV_S2	6.29	0.95	0.03	$p < 0.05$
SV_L2	6.62	CBD_L1	5.64	0.98	0.023	$p < 0.05$
SV_L3	6.77	CBD_L1	5.64	1.13	0.003	$p < 0.01$
SV_S3	6.57	CBD_L1	5.64	0.93	0.04	$p < 0.05$

Figure 10 presents the marginal means and standard error of the Being-Away and Frame Ratios across different scenarios, categorized into two WWR groups.

The results show that a statistically significant difference exists [$F(7,217) = 53.21$, $p < 0.001$, $\eta^2_p = 0.63$] for the component Being-Away. The post-hoc Bonferroni tests identified 9 statistically significant differences among the 28 possible pairwise comparisons. The significant post-hoc Bonferroni results are summarized in Table 6.

The results reported in Figure 10 and Table 6 revealed that:

- the maximum marginal means of fascination is observed in SV_L1, with a value of 7.89, characterized by the maximum WWR (53.5%) and the minimum FR (6.71%), as can be seen from Figure 10;
- when comparing the CBD_L1 scenario with SV_L1, SV_L2, SV_L3, SV_L4, SV_S1, SV_S2 and SV_S3, participants attributed significantly higher means value of being-away to the Small Village than to the City Business District, as shown in Figure 10 and Table 6;
- among the scenarios set in the Small Village, SV_L1 has a significantly higher marginal mean of 'being-away' than SV_L4 and SV_S1. SV_L4 and SV_L1 have the same WWR (equal to 53.5%) and differ for GP values (equal to 6 and 1, respectively); SV_S1 and SV_L1 have the same GP (equal to 1) and a lower WWR (equal to 35.7%).

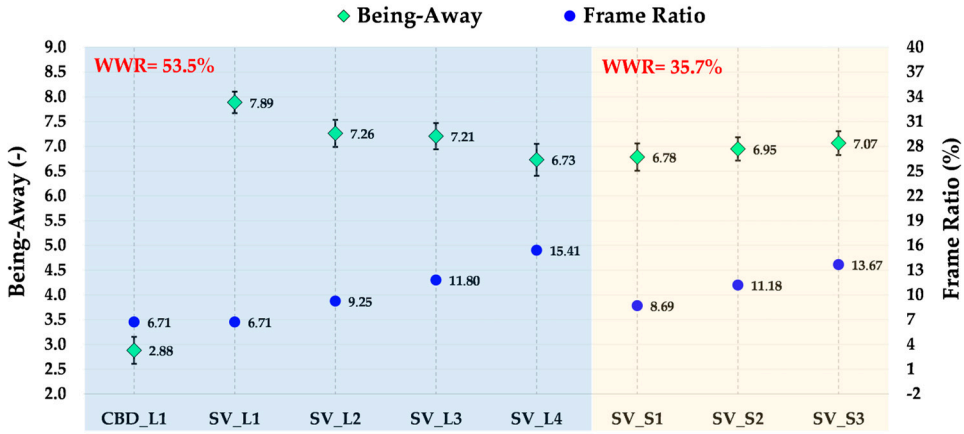


Figure 10. Marginal means and standard error of Being-Away in the eight experimental scenarios, along with their corresponding WWR and Frame Ratio values.

Table 6. Statistically significant results of Bonferroni post hoc tests on Being-Away.

Scenario 1		Scenario 2		Mean Difference	p_{bonf}	Condition
Case n.	Marginal Mean	Case n.	Marginal Mean			
SV_L1	7.89	CBD_L1	2.88	5.01	<0.001	$p < 0.001$
SV_L1	7.89	SV_L4	6.73	1.16	0.004	$p < 0.01$
SV_L1	7.89	SV_S1	6.78	1.10	0.008	$p < 0.01$
SV_L2	7.26	CBD_L1	2.88	4.38	<0.001	$p < 0.001$
SV_L3	7.21	CBD_L1	2.88	4.32	<0.001	$p < 0.001$
SV_L4	6.73	CBD_L1	2.88	3.85	<0.001	$p < 0.001$
.SV_S1	6.78	CBD_L1	2.88	3.90	<0.001	$p < 0.001$
SV_S2	6.95	CBD_L1	2.88	4.07	<0.001	$p < 0.001$
SV_S3	7.07	CBD_L1	2.88	4.18	<0.001	$p < 0.001$

Figure 11 presents the marginal means and standard error of the Coherence and Frame Ratios across different scenarios, categorized into two WWR groups.

The results show that a statistically significant difference exists [$F(7,217) = 21.14$, $p < 0.001$, $\eta^2_p = 0.41$] for the component Coherence. The post-hoc Bonferroni tests identified 11 statistically significant differences among the 28 possible pairwise comparisons. The significant post-hoc Bonferroni results are summarized in Table 7.

The results reported in Figure 11 and Table 7 revealed that:

- the maximum marginal means of coherence is observed in SV_L1, with a value of 8.16, characterized by the maximum WWR (53.5%) and the minimum FR (6.71%), as can be seen from Figure 11;
- when comparing the SV_L1 scenario with CBD_L1 under the same window design conditions (WWR of 53.5% and FR of 6.71%), participants attributed higher coherence to the Small Village (mean value = 8.16) than to the City Business District (mean value = 4.48), as shown in Figure 11;
- when comparing the CBD_L1 scenario with SV_L1, SV_L2, SV_L3, SV_L4, SV_S1, SV_S2 and SV_S3, participants attributed significantly higher means value of coherence to the Small Village than to the City Business District, as shown in Figure 11 and Table 7;
- comparing the marginal means of coherence reported in Figure 11 for SV_S1, SV_S2 and SV_S3 with those of SV_L4, it turns out that, despite the former having a lower WWR (35.7% compared to 53.5%), their coherence values do not show a significant difference, such that they can be considered almost constant (Figure 11 and Table 7). This suggests that a smart window with a WWR of 53.5% paired with 6 GPs (with both vertical and horizontal mullions), in comparison to a smart window with a WWR

of 35.7% and GPs values ranging from 1 to 3 (with only vertical mullions), exhibits coherence values that are almost constant.

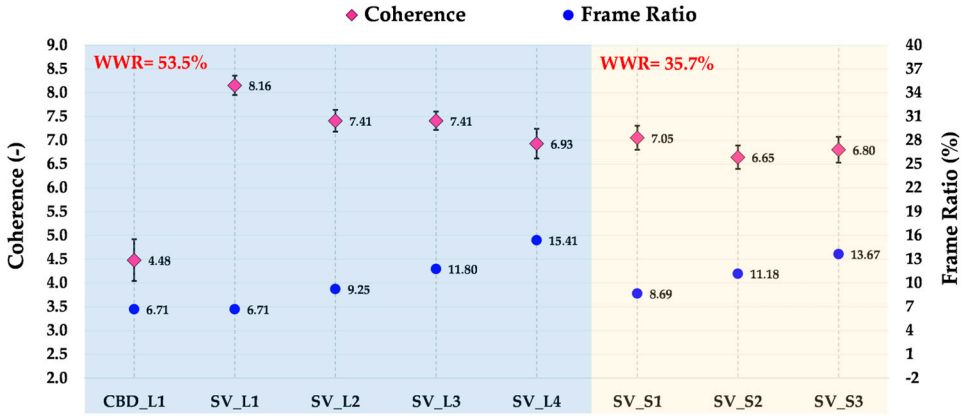


Figure 11. Marginal means and standard error of Coherence in the eight experimental scenarios, along with their corresponding WWR and Frame Ratio values.

Table 7. Statistically significant results of Bonferroni post hoc tests of Coherence.

Scenario 1		Scenario 2		Mean Difference	p_{bonf}	Condition
Case n.	Marginal Mean	Case n.	Marginal Mean			
SV_L1	8.16	CBD_L1	4.48	3.67	<0.001	$p < 0.001$
SV_L1	8.16	SV_L4	6.93	1.23	0.007	$p < 0.01$
SV_L1	8.16	SV_S1	7.05	1.10	0.027	$p < 0.05$
SV_L1	8.16	SV_S2	6.65	1.51	<0.001	$p < 0.001$
SV_L1	8.16	SV_S3	6.80	1.35	0.002	$p < 0.01$
SV_L2	7.41	CBD_L1	4.48	2.93	<0.001	$p < 0.001$
SV_L3	7.41	CBD_L1	4.48	2.93	<0.001	$p < 0.001$
SV_L4	6.93	CBD_L1	4.48	2.45	<0.001	$p < 0.001$
SV_S1	7.05	CBD_L1	4.48	2.57	<0.001	$p < 0.001$
SV_S2	6.65	CBD_L1	4.48	2.16	<0.001	$p < 0.001$
SV_S3	6.80	CBD_L1	4.48	2.32	<0.001	$p < 0.001$

Figure 12 presents the marginal means and standard error of the Scope and Frame Ratios across different scenarios, categorized into two WWR groups.

The results show that a statistically significant difference exists [$F(7,217) = 9.15$, $p < 0.001$, $\eta^2_p = 0.23$] for the component Scope. The post-hoc Bonferroni tests identified 8 statistically significant differences among the 28 possible pairwise comparisons. The significant post-hoc Bonferroni results are summarized in Table 8.

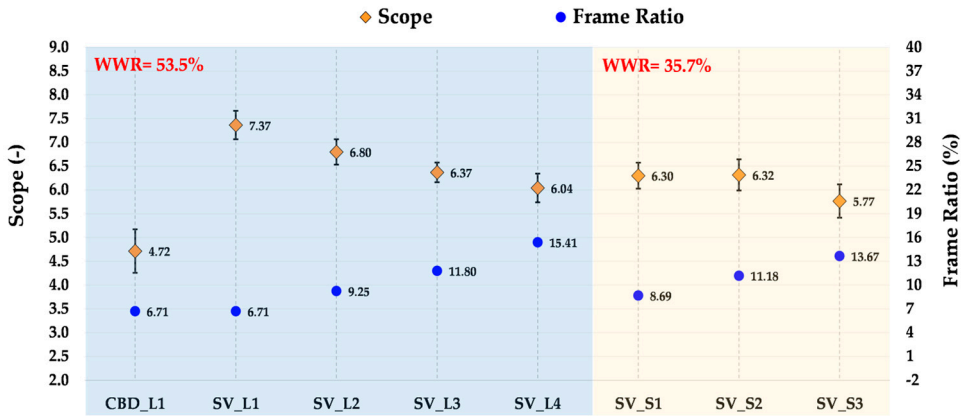


Figure 12. Marginal means and standard error of Scope in the eight experimental scenarios, along with their corresponding WWR and Frame Ratio values.

Table 8. Statistically significant results of Bonferroni post hoc tests on Scope.

Scenario 1		Scenario 2		Mean Difference	p_{bonf}	Condition
Case n.	Marginal Mean	Case n.	Marginal Mean			
SV_L1	7.37	CBD_L1	4.72	2.65	<0.001	$p < 0.001$
SV_L1	7.37	SV_L4	6.04	1.32	0.009	$p < 0.01$
SV_L1	7.37	SV_S3	5.77	1.60	<0.001	$p < 0.001$
SV_L2	6.80	CBD_L1	4.72	2.09	<0.001	$p < 0.001$
SV_L3	6.37	CBD_L1	4.72	1.65	<0.001	$p < 0.001$
SV_L4	6.04	CBD_L1	4.72	1.33	0.008	$p < 0.01$
SV_S1	6.30	CBD_L1	4.72	1.59	<0.001	$p < 0.001$
SV_S2	6.32	CBD_L1	4.72	1.60	<0.001	$p < 0.001$

The results reported in Figure 12 and Table 8 revealed that:

- the maximum marginal means of scope is observed in SV_L1, with a value of 7.37, characterized by the maximum WWR (53.5%) and the minimum FR (6.71%), as can be seen from Figure 12;
- when comparing the SV_L1 scenario with CBD_L1 under the same window design conditions (WWR of 53.5% and FR of 6.71%), participants attributed higher scope to the Small Village (mean value = 7.37) than to the City Business District (mean value = 4.72), as shown in Figure 12;
- scenarios SV_L1, SV_L2, SV_L3, SV_L4, SV_S1 and SV_S2 have significantly higher scope values than scenario CBD_L1 (Table 8).
- the SV_L1, SV_L2, SV_L3, SV_L4 scenarios with WWR equal to 53.5% as the FR increases (from 6.71% to 15.41%) and therefore the GP value (from 1 to 6) progressively reduces the marginal mean scope from the value of 7.37 to 6.04 (Figure 12).
- among the scenarios set in the Small Village, the pairwise comparison of the scope value of SV_L1(mean value = 7.37) with both SV_L4 (mean value = 6.04) and SV_S3 (mean value = 5.77) reveals a significant difference (see Figure 12 and Table 8), in particular, higher values for SV_L1 (with WWR = 53.5% and GP = 1) compared to SV_L4 (with WWR = 53.5% and GP = 6) and SV_S3 (with WWR = 35.7% and GP = 3).

Figure 13 presents the marginal means and standard error of the Perceived Restorative Scale (PRS-11) and Frame Ratios across different scenarios, categorized into two WWR groups.

The results show that a statistically significant difference exists [$F(7,217) = 31.09$, $p < 0.001$, $\eta^2_p = 0.50$] for the component Scope. The post-hoc Bonferroni tests identified 11 statistically significant differences among the 28 possible pairwise comparisons. The significant post-hoc Bonferroni results are summarized in Table 9.

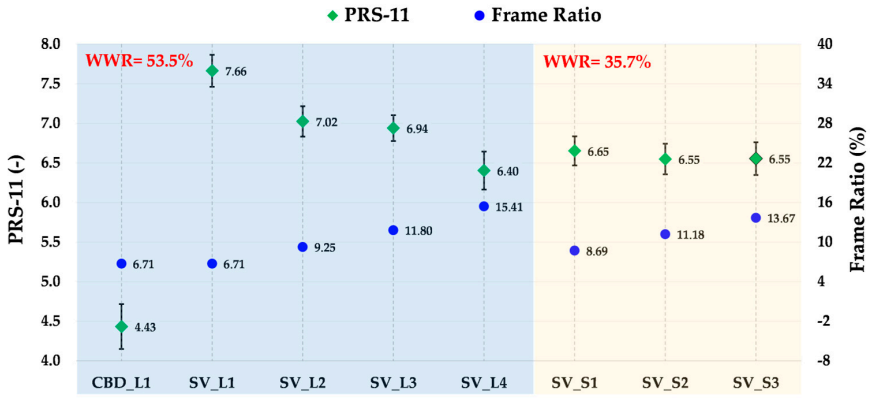


Figure 13. Marginal means and standard error of Perceived Restorative Scale (PRS-11) in the eight experimental scenarios, along with their corresponding WWR and Frame Ratio values.

Table 9. Statistically significant results of Bonferroni post hoc tests on PRS-11.

Scenario 1		Scenario 2		Mean Difference	p_{bonf}	Condition
Case n.	Marginal Mean	Case n.	Marginal Mean			
SV_L1	7.66	CBD_L1	4.43	3.23	<0.001	$p < 0.001$
SV_L1	7.66	SV_L4	6.40	1.26	<0.001	$p < 0.001$
SV_L1	7.66	SV_S1	6.65	1.01	<0.001	$p < 0.001$
SV_L1	7.66	SV_S2	6.55	1.12	<0.001	$p < 0.001$
SV_L1	7.66	SV_S3	6.55	1.11	<0.001	$p < 0.001$
SV_L2	7.02	CBD_L1	4.43	2.59	<0.001	$p < 0.001$
SV_L3	6.94	CBD_L1	4.43	2.51	<0.001	$p < 0.001$
SV_L4	6.40	CBD_L1	4.43	1.97	<0.001	$p < 0.001$
SV_S1	6.65	CBD_L1	4.43	2.22	<0.001	$p < 0.001$
SV_S2	6.55	CBD_L1	4.43	2.12	<0.001	$p < 0.001$
SV_S3	6.55	CBD_L1	4.43	2.12	<0.001	$p < 0.001$

The results reported in Figure 13 and Table 9 revealed that:

- the maximum marginal means of PRS-11 is observed in SV_L1, with a value of 7.66, characterized by the maximum WWR (53.5%) and the minimum FR (6.71%) and one GP, as can be seen from Figure 13;
- when comparing the SV_L1 scenario with CBD_L1 under the same window design conditions (WWR of 53.5% and FR of 6.71%), participants attributed higher PRS-11 to the Small Village (mean value = 7.66) than to the City Business District (mean value = 4.43), as shown in Figure 13;
- when comparing the CBD_L1 scenario with SV_L1, SV_L2, SV_L3, SV_L4, SV_S1, SV_S2 and SV_S3, participants attributed significantly higher mean values of PRS-11 to the Small Village scenarios than to the City Business District scenario, as shown in Figure 13 and Table 9;
- among the scenarios set in the Small Village, the pairwise comparison of the PRS-11 value of SV_L1 (mean value = 7.66) with SV_L4 (mean value = 6.40), SV_S1 (mean value = 6.45), SV_S2 (mean value = 6.55) and SV_S3 (mean value = 6.55) reveals a significant difference (see Figure 13 and Table 9), in particular, higher values for SV_L1 (with WWR = 53.5% and GP = 1) compared to SV_L4 (with WWR = 53.5% and GP = 6) and cases SV_S1, SV_S2, SV_S3 with same WWR = 35.7% and value of GPs ranges from 1 to 3.
- as the WWR increases (from 35.7% to 53.5%) while maintaining the same GP, an increase in the marginal means PRS-11 value is observed (Figure 13);
- for a given WWR value (53.5% or 35.7%), when varying the number of GPs (from 1 to 6), a higher marginal means PRS-11 value is found for cases with GP equal to 1 (Figure 13).
- the SV_L1, SV_L2, SV_L3, SV_L4 scenarios with WWR equal to 53.5% as the FR increases (from 6.71% to 15.41%) and therefore the GP value (from 1 to 6) progressively reduces the marginal mean PRS-11 from the value of 7.66 to 6.40 (Figure 11).

4. Discussion

This multidisciplinary research combines architectural design, environmental psychology, and innovative building technologies. It proposes modular, prefabricated smart offices that can be deployed in small villages while preserving the location's historical and architectural identity. Analysing the visual connection to the outdoors as a critical factor in well-being and performance offers a new perspective on the role of workplace views in cognitive and emotional aspects of restoration.

The results of this study underscore the critical impact of window design, particularly WWR and FR, on the perceived restorative potential of PMBs' smart/co-working offices in a small village context.

Specifically, statistical analyses of the self-reported PRS-11 questionnaire revealed a clear preference among participants for the SV_L1 scenario, characterized by a large-sized window with a single glass panel and a window view of a small village square with historical buildings and a fountain. Participants rated this scenario significantly higher in overall perceived restoration and across each sub-scale of the PRS-11 scale: Fascination, Being-Away, Coherence, and Scope.

The results align well with the findings reported by Dogrusoy and Tureyen [33], who emphasized that office users prefer large-sized uninterrupted windows due to their psychological benefits, including increased spaciousness, improved mood, and enhanced motivation. This also resonates with Yeom et al. [35] findings, which demonstrated that higher WWRs (up to 60%) are associated with improved cognitive performance and reduced perceived task load, ad wall as with Hong et al. [34] with suggests that expansive views through larger window areas facilitate enhanced visual comfort and spatial satisfaction, ultimately leading to greater psychological restoration.

The comparative analysis between a small village environment and a city's business district further supports previous research highlighting the restorative benefits of settings rich in historical and natural elements [79–82,91]. These findings support the Attention Restoration Theory (ART), which underscores the restorative effects of environments that attract effortless, involuntary attention and fascination [52].

This study also highlights, aligning with the findings of other researchers [37,38,43], the utility of IVR as a powerful method for evaluating human-environment interactions. Thanks to the high realism scores obtained, VR represents a potential instrument to accurately simulate real-world conditions for design evaluation purposes, offering a sustainable, flexible, and effective approach for future workplace design research. Indeed, the findings could inform future urban and rural planning policies, advocating for human-centred, sustainable, and technology-driven workspace solutions. In addition, this research suggests that integrating co-working spaces in small villages can help revitalize underpopulated areas, offering a model for workforce decentralization and economic sustainability.

Future research could further validate these findings by extending the current investigation to additional geographic and cultural contexts, exploring a wider variety of window designs and environmental settings (for example, rural contexts). Moreover, examining the long-term effects of restorative window views on productivity and job satisfaction would deepen understanding of their practical implications in workplace design. Finally, conducting similar studies in real-built environments would validate the findings and confirm the potential benefits identified through virtual reality simulations.

5. Conclusions

This research demonstrates how window design, specifically Window-to-Wall Ratio (WWR), Frame Ratio (FR), and Glass Panel (GP), significantly influences the restorative potential of PMB smart co-working offices, leveraging immersive Virtual Reality (VR) technology for comprehensive evaluation.

The findings clearly show that participants' perceived restorativeness is higher in the presence of large windows with a single glass panel, as they create a stronger connection with the outside world. The study highlights the significance of unobstructed views in improving occupant well-being, affirming the value of immersive VR as an effective tool for assessing environmental and architectural design choices.

When comparing small village settings with the city's business district, the research further emphasizes the benefits of placing smart/co-working offices in small villages rich in history and culture. Participants reported feeling significantly more restored in spaces featuring natural and historical elements, confirming that the surrounding environment strongly impacts well-being.

Finally, the study provides valuable insights for architects and designers to develop sustainable, human-centred smart co-working spaces in small villages. The offices with large windows that extend nearly from floor to ceiling, featuring a WWR greater than 50%, an FR below 7%, and a single GP, in a culturally and historically significant context, can substantially enhance occupants' restorative experiences and overall well-being.

Future research could validate these findings further by extending the current investigation to additional geographic and cultural contexts, exploring a greater number of window designs and other environmental settings (e.g., rural contexts), and conducting analyses even in real PMB. Additionally, other factors that may also be considered, as they depend on the window size and PMB orientation, are thermal comfort and costs.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. The Italian version of the Igroup Presence Questionnaire (IPQ) was obtained by the back-translation method.

Question
Quanto eri consapevole del mondo reale circostante mentre navigavi nel mondo virtuale (ad esempio suoni, temperatura ambiente, altre persone, ecc.)?
estremamente consapevole −3 −2 −1 0 +1 +2 +3 non ne ero affatto consapevole moderatamenteconsapevole INV1
Quanto ti è sembrato reale l'ambiente virtuale?
completamente reale −3 −2 −1 0 +1 +2 +3 per niente reale REAL1

Table A1. *Cont.*

Question
Avevo la sensazione di agire nello spazio virtuale, piuttosto che controllarlo dall'esterno. completamente in disaccordo −3 −2 −1 0 +1 +2 +3 pianamente d'accordo SP4
Quanto la tua esperienza nell'ambiente virtuale ti è sembrata coerente con la tua esperienza nel mondo reale? non coerente −3 −2 −1 0 +1 +2 +3 molto coerente moderatamentecoerente REAL2
Quanto ti è sembrato reale il mondo virtuale? come un mondo immaginario −3 −2 −1 0 +1 +2 +3 indistinguibile dal mondo reale REAL3
Non mi sentivo presente nello spazio virtuale. non mi sentivo presente −3 −2 −1 0 +1 +2 +3 mi sentivo presente SP3
Non ero consapevole dell'ambiente reale che mi circondava. completamente in disaccordo −3 −2 −1 0 +1 +2 +3 pienamente d'accordo INV2
Nel mondo generato dal computer avevo la sensazione di "essere lì" per niente −3 −2 −1 0 +1 +2 +3 molto G1
In qualche modo sentivo che il mondo virtuale mi circondava. completamente in disaccordo −3 −2 −1 0 +1 +2 +3 pienamente d'accordo SP1
Mi sentivo presente nello spazio virtuale. completamente in disaccordo −3 −2 −1 0 +1 +2 +3 pienamente d'accordo SP5
Ho continuato a prestare attenzione all'ambiente reale. completamente in disaccordo −3 −2 −1 0 +1 +2 +3 pienamente d'accordo INV3
Il mondo virtuale sembrava più realistico del mondo reale. completamente in disaccordo −3 −2 −1 0 +1 +2 +3 pienamente d'accordo REAL4
Mi sembrava di percepire solo delle immagini. completamente in disaccordo −3 −2 −1 0 +1 +2 +3 pienamente d'accordo SP2
Ero completamente affascinato dal mondo virtuale. completamente in disaccordo −3 −2 −1 0 +1 +2 +3 pienamente d'accordo INV4

Table A2. The Italian version of the PRS-11 [67].

Question
Luoghi come questo sono affascinanti Per niente 1 2 3 4 5 6 7 8 9 10 Molto
In luoghi come questo la mia attenzione è attirata da molte cose interessanti Per niente 1 2 3 4 5 6 7 8 9 10 Molto
In luoghi come questo è difficile annoiarsi Per niente 1 2 3 4 5 6 7 8 9 10 Molto
Luoghi come questo sono un rifugio dai fastidi Per niente 1 2 3 4 5 6 7 8 9 10 Molto
Per allontanarmi da cose che di solito richiedono la mia attenzione, mi piace andare in luoghi come questo Per niente 1 2 3 4 5 6 7 8 9 10 Molto
Per smettere di pensare alle cose che devo fare, mi piace stare in luoghi come questo Per niente 1 2 3 4 5 6 7 8 9 10 Molto
C'è un ordine chiaro nella disposizione fisica dei luoghi come questo Per niente 1 2 3 4 5 6 7 8 9 10 Molto
In posti come questo è facile vedere come sono organizzate le cose Per niente 1 2 3 4 5 6 7 8 9 10 Molto
In luoghi come questo tutto sembra avere il suo giusto posto Per niente 1 2 3 4 5 6 7 8 9 10 Molto
Questo posto è abbastanza grande per consentire l'esplorazione in molte direzioni Per niente 1 2 3 4 5 6 7 8 9 10 Molto
In luoghi come questo ci sono pochi elementi che limitano la possibilità di muovermi Per niente 1 2 3 4 5 6 7 8 9 10 Molto

Table A3. Sub-scale results of the IPQ (14-item, 7-point Likert scale ranging from −3 to 3) obtained in this study.

Sub-Scale	MeanValue	StandardDeviation	RankingClass	VisualModalityUsed	SampleSize
General Presence	1.16	1.48	Moderate	3D-HMD	32
Spatial Presence	1.25	1.06	Moderate		
Involvement	0.45	1.11	Moderate		
Experienced Realism	0.73	0.96	Very High		
Overall IPQ scale (3D-HMD)	0.90	1.20	High		

References

1. Battisti, E.; Alfiero, S.; Leonidou, E. Remote Working and Digital Transformation during the COVID-19 Pandemic: Economic–Financial Impacts and Psychological Drivers for Employees. *J. Bus. Res.* **2022**, *150*, 38–50. [CrossRef] [PubMed]
2. Dominoni, A.; Scullica, F. *Designing Behaviours for Well-Being Spaces*; Barbara, A., Bosoni, G., Camocini, B., Dominoni, A., Rossi, M., Scullica, F., Eds.; FrancoAngeli s.r.l: Milano, Italy, 2022; ISBN 9788835133636.
3. Bosworth, G.; Whalley, J.; Fuzi, A.; Merrell, I.; Chapman, P.; Russell, E. Rural Co-Working: New Network Spaces and New Opportunities for a Smart Countryside. *J. Rural. Stud.* **2023**, *97*, 550–559. [CrossRef]
4. Wijesooriya, N.; Brambilla, A. Bridging Biophilic Design and Environmentally Sustainable Design: A Critical Review. *J. Clean Prod.* **2021**, *283*, 124591. [CrossRef]
5. Zhong, W.; Schroeder, T.; Bekkering, J. Designing with Nature: Advancing Three-Dimensional Green Spaces in Architecture through Frameworks for Biophilic Design and Sustainability. *Front. Archit. Res.* **2023**, *12*, 732–753. [CrossRef]
6. Elnagar, E.; Düvier, C.; Batra, Z.; Christoffersen, J.; Mandin, C.; Schweiker, M.; Wargocki, P. Creating a Comprehensive Framework for Design, Construction and Management of Healthy Buildings. *Energy Build.* **2024**, *324*, 114883. [CrossRef]
7. Ko, W.H.; Schiavon, S.; Santos, L.; Kent, M.G.; Kim, H.; Keshavarzi, M. View Access Index: The Effects of Geometric Variables of Window Views on Occupants' Satisfaction. *Build Environ.* **2023**, *234*, 110132. [CrossRef]
8. Ko, W.H.; Kent, M.G.; Schiavon, S.; Levitt, B.; Betti, G. A Window View Quality Assessment Framework. *LEUKOS* **2022**, *18*, 268–293. [CrossRef]
9. Meng, X.; Wang, M. Exploring the Health Impacts of Window Views: A Literature Review. *J. Asian Archit. Build. Eng.* **2024**, 1–24. [CrossRef]
10. Kim, J.; de Dear, R. Nonlinear Relationships between Individual IEQ Factors and Overall Workspace Satisfaction. *Build. Environ.* **2012**, *49*, 33–40. [CrossRef]
11. Ochoa, C.E.; Aries, M.B.C.; van Loenen, E.J.; Hensen, J.L.M. Considerations on Design Optimization Criteria for Windows Providing Low Energy Consumption and High Visual Comfort. *Appl. Energy* **2012**, *95*, 238–245. [CrossRef]
12. Rosato, A.; El Youssef, M.; Guarino, F.; Ciervo, A.; Sibilio, S. Experimental Studies of Air-Handling Units' Faulty Operation for the Development of Data-Driven Fault Detection and Diagnosis Tools: A Systematic Review. *Energy Rep.* **2022**, *8*, 494–503. [CrossRef]
13. Ciampi, G.; Ciervo, A.; Rosato, A.; Sibilio, S.; Di Nardo, A. Parametric Simulation Analysis of a Centralized Solar Heating System with Long-Term Thermal Energy Storage Serving a District of Residential and School Buildings in Italy. *Adv. Model. Anal. A* **2018**, *55*, 165–172. [CrossRef]
14. Beute, F.; de Kort, Y.A.W. Salutogenic Effects of the Environment: Review of Health Protective Effects of Nature and Daylight. *Appl. Psychol. Health Well Being* **2014**, *6*, 67–95. [CrossRef] [PubMed]
15. Küller, R.; Ballal, S.; Laike, T.; Mikellides, B.; Tonello, G. The Impact of Light and Colour on Psychological Mood: A Cross-Cultural Study of Indoor Work Environments. *Ergonomics* **2006**, *49*, 1496–1507. [CrossRef]
16. Benfield, J.A.; Rainbolt, G.N.; Bell, P.A.; Donovan, G.H. Classrooms With Nature Views: Evidence of Differing Student Perceptions and Behaviors. *Environ. Behav.* **2015**, *47*, 140–157. [CrossRef]
17. Ko, W.H.; Schiavon, S.; Zhang, H.; Graham, L.T.; Brager, G.; Mauss, I.; Lin, Y.W. The Impact of a View from a Window on Thermal Comfort, Emotion, and Cognitive Performance. *Build. Environ.* **2020**, *175*, 106779. [CrossRef]
18. Leather, P.; Pyrgas, M.; Beale, D.; Lawrence, C. Windows in the Workplace: Sunlight, View, and Occupational Stress. *Environ. Behav.* **1998**, *30*, 739–762. [CrossRef]
19. Yildirim, K.; Akalin-Baskaya, A.; Celebi, M. The Effects of Window Proximity, Partition Height, and Gender on Perceptions of Open-Plan Offices. *J. Environ. Psychol.* **2007**, *27*, 154–165. [CrossRef]
20. Aries, M.B.C.; Veitch, J.A.; Newsham, G.R. Windows, View, and Office Characteristics Predict Physical and Psychological Discomfort. *J. Environ. Psychol.* **2010**, *30*, 533–541. [CrossRef]
21. Hellinga, H.I. Daylight and View: The Influence of Windows on the Visual Quality of Indoor Spaces. Ph.D. Thesis, Delft University of Technology, Delft, The Netherlands, 2013.

22. Jamrozik, A.; Clements, N.; Hasan, S.S.; Zhao, J.; Zhang, R.; Campanella, C.; Loftness, V.; Porter, P.; Ly, S.; Wang, S.; et al. Access to Daylight and View in an Office Improves Cognitive Performance and Satisfaction and Reduces Eyestrain: A Controlled Crossover Study. *Build. Environ.* **2019**, *165*, 106379. [CrossRef]
23. Hill, A.R.; Markus, T.A. Some Factors Influencing Vision through Meshes. *Arch. Sci. Rev.* **1968**, *11*, 123–136. [CrossRef]
24. Markus, T.A. The Function of Windows—A Reappraisal. *Build. Sci.* **1967**, *2*, 97–121. [CrossRef]
25. Ne'eman, E.; Hopkinson, R.G. Critical Minimum Acceptable Window Size: A Study of Window Design and Provision of a View. *Light. Res. Technol.* **1970**, *2*, 17–27. [CrossRef]
26. Ko, W.H.; Schiavon, S.; Altomonte, S.; Andersen, M.; Batool, A.; Browning, W.; Burrell, G.; Chamilothori, K.; Chan, Y.C.; Chinazzo, G.; et al. Window View Quality: Why It Matters and What We Should Do. *LEUKOS—J. Illum. Eng. Soc. Nor. Am.* **2022**, *18*, 259–267. [CrossRef]
27. Abd-Alhamid, F.; Kent, M.; Wu, Y. Quantifying Window View Quality: A Review on View Perception Assessment and Representation Methods. *Build. Environ.* **2023**, *227*, 109742. [CrossRef]
28. Keighley, E.C. Visual Requirements and Reduced Fenestration in Offices—A Study of Multiple Apertures and Window Area. *Build. Sci.* **1973**, *8*, 321–331. [CrossRef]
29. Li, J.; Zheng, B.; Bedra, K.B.; Li, Z.; Chen, X. Evaluating the Effect of Window-to-Wall Ratios on Cooling-Energy Demand on a Typical Summer Day. *Int. J. Environ. Res. Public Health* **2021**, *18*, 8411. [CrossRef]
30. Ma, R.; Ma, R.; Long, E. Analysis of the Rule of Window-to-Wall Ratio on Energy Demand of Residential Buildings in Different Locations in China. *Heliyon* **2023**, *9*, e12803. [CrossRef]
31. Tawfeeq, H.; Qaradaghi, A.M.A. Optimising Window-to-Wall Ratio for Enhanced Energy Efficiency and Building Intelligence in Hot Summer Mediterranean Climates. *Sustainability* **2024**, *16*, 7342. [CrossRef]
32. Cherier, M.K.; Hamdani, M.; Kamel, E.; El Amine Bekkouche, S.M.; Guermoui, M.; Al-Saadi, S.; Djeffal, R.; Bashir, M.O.; Elshekh, A.E.A.; Drozdova, L.; et al. Impact of Glazing Type, Window-to-Wall Ratio, and Orientation on Building Energy Savings Quality: A Parametric Analysis in Algerian Climatic Conditions. *Case Stud. Therm. Eng.* **2024**, *61*, 104902. [CrossRef]
33. Dogrusoy, I.T.; Tureyen, M. A Field Study on Determination of Preferences for Windows in Office Environments. *Build. Environ.* **2007**, *42*, 3660–3668. [CrossRef]
34. Hong, T.; Lee, M.; Yeom, S.; Jeong, K. Occupant Responses on Satisfaction with Window Size in Physical and Virtual Built Environments. *Build. Environ.* **2019**, *166*, 106409. [CrossRef]
35. Yeom, S.; Kim, H.; Hong, T.; Lee, M. Determining the Optimal Window Size of Office Buildings Considering the Workers' Task Performance and the Building's Energy Consumption. *Build. Environ.* **2020**, *177*, 106872. [CrossRef]
36. Zhang, Y.; Jing, X.; Liu, C.; Sun, Y.; Wang, W.; Gao, W. Restorative Benefits of Classroom Windows: A Study on the Effect of Window:Wall Ratio on Task Load and Learning Performance Based on VR Technology. *Int. J. Low-Carbon Technol.* **2024**, *19*, 1491–1500. [CrossRef]
37. Scorpio, M.; Bladowski, A.; Geisler-Moroder, D.; Martyniuk-Pęczek, J.; Sibilio, S.; Pfluger, R.; Sokół, N. Virtual Reality in Lighting Design: Insights from Academia and an International Survey among Professionals. *J. Build. Eng.* **2025**, *102*, 112036. [CrossRef]
38. Contini, G.; Grandi, F.; Peruzzini, M. Human-Centric Green Design for Automatic Production Lines: Using Virtual and Augmented Reality to Integrate Industrial Data and Promote Sustainability. *J. Ind. Inf. Integr.* **2025**, *44*, 100801. [CrossRef]
39. Abd-Alhamid, F.; Kent, M.; Bennett, C.; Calautit, J.; Wu, Y. Developing an Innovative Method for Visual Perception Evaluation in a Physical-Based Virtual Environment. *Build. Environ.* **2019**, *162*, 106278. [CrossRef]
40. Adams, R.; Finn, P.; Moes, E.; Flannery, K.; Rizzo, A. Distractibility in Attention/Deficit/Hyperactivity Disorder (ADHD): The Virtual Reality Classroom. *Child Neuropsychol.* **2009**, *15*, 120–135. [CrossRef]
41. Parsons, T.D.; Bowerly, T.; Buckwalter, J.G.; Rizzo, A.A. A Controlled Clinical Comparison of Attention Performance in Children with ADHD in a Virtual Reality Classroom Compared to Standard Neuropsychological Methods. *Child Neuropsychol.* **2007**, *13*, 363–381. [CrossRef]
42. Ali, Z.; Usman, M. A Framework for Game Engine Selection for Gamification and Serious Games. In Proceedings of the 2016 Future Technologies Conference (FTC), San Francisco, CA, USA, 6–7 December 2016; pp. 1199–1207. [CrossRef]
43. Iftekhar, M.W.; Prajapati, R.J. Impact of Virtual Reality and Eco-Friendly Interior Design Tool on Carbon Emission. *J. Online Eng. Educ.* **2023**, *14*, 32–40. [CrossRef]
44. Lombard, M.; Ditton, T. At the Heart of It All: The Concept of Presence. *J. Comput.-Mediat. Commun.* **1997**, *3*. [CrossRef]
45. Schubert, T.; Friedmann, F.; Regenbrecht, H. The Experience of Presence: Factor Analytic Insights. *Presence Teleoperators Virtual. Environ.* **2001**, *10*, 266–281. [CrossRef]
46. Müller, J.; Langlotz, T.; Regenbrecht, H. PanoVC: Pervasive Telepresence Using Mobile Phones. In Proceedings of the 2016 IEEE International Conference on Pervasive Computing and Communications (PerCom), Sydney, Australia, 14–19 March 2016; pp. 1–10.

47. Schwind, V.; Knierim, P.; Haas, N.; Henze, N. Using Presence Questionnaires in Virtual Reality. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19), Glasgow, Scotland, 4–9 May 2019; ACM: New York, NY, USA, 2019; pp. 1–12.
48. Tran, T.Q.; Langlotz, T.; Young, J.; Schubert, T.W.; Regenbrecht, H. Classifying Presence Scores: Insights and Analysis from Two Decades of the Igroup Presence Questionnaire (IPQ). *ACM Trans. Comput Hum. Interact.* **2024**, *1*, 1–26. [CrossRef]
49. Pasini, M.; Brondino, M.; Trombin, R.; Filippi, Z. A Participatory Interior Design Approach for a Restorative Work Environment: A Research-Intervention. *Front Psychol.* **2021**, *12*, 3742. [CrossRef]
50. Bluyssen, P.M.; Aries, M.; van Dommelen, P. Comfort of Workers in Office Buildings: The European HOPE Project. *Build. Environ.* **2011**, *46*, 280–288. [CrossRef]
51. Ulrich, R.S. Aesthetic and Affective Response to Natural Environment. In *Behavior and the Natural Environment*; Springer: Boston, MA, USA, 1983; pp. 85–125. [CrossRef]
52. Kaplan, S. The Restorative Benefits of Nature: Toward an Integrative Framework. *J. Environ. Psychol.* **1995**, *15*, 169–182. [CrossRef]
53. Berman, M.G.; Jonides, J.; Kaplan, S. The Cognitive Benefits of Interacting with Nature. *Psychol. Sci.* **2008**, *19*, 1207–1212. [CrossRef]
54. Watts, G. The Effects of "Greening" Urban Areas on the Perceptions of Tranquillity. *Urban Urban Green* **2017**, *26*, 11–17. [CrossRef]
55. Dzhambov, A.; Dimitrova, D. Urban Green Spaces′ Effectiveness as a Psychological Buffer for the Negative Health Impact of Noise Pollution: A Systematic Review. *Noise Health* **2014**, *16*, 157–165. [CrossRef]
56. De Coensel, B.; Vanwetswinkel, S.; Botteldooren, D. Effects of Natural Sounds on the Perception of Road Traffic Noise. *J. Acoust. Soc. Am.* **2011**, *129*, EL148–EL153. [CrossRef]
57. Watts, G.R.; Pheasant, R.J.; Horoshenkov, K.V.; Ragonesi, L. Measurement and Subjective Assessment of Water Generated Sounds. *Acta Acust. United Acust.* **2009**, *95*, 1032–1039. [CrossRef]
58. Jeon, J.Y.; Lee, P.J.; You, J.; Kang, J. Perceptual Assessment of Quality of Urban Soundscapes with Combined Noise Sources and Water Sounds. *J. Acoust. Soc. Am.* **2010**, *127*, 1357–1366. [CrossRef] [PubMed]
59. Axelsson, Ö.; Nilsson, M.E.; Hellström, B.; Lundén, P. A Field Experiment on the Impact of Sounds from a Jet-and-Basin Fountain on Soundscape Quality in an Urban Park. *Landsc. Urban Plan* **2014**, *123*, 49–60. [CrossRef]
60. Chau, C.K.; Leung, T.M.; Xu, J.M.; Tang, S.K. Modelling Noise Annoyance Responses to Combined Sound Sources and Views of Sea, Road Traffic, and Mountain Greenery. *J. Acoust. Soc. Am.* **2018**, *144*, 3503–3513. [CrossRef]
61. Lugten, M.; Karacaoglu, M.; White, K.; Kang, J.; Steemers, K. Improving the Soundscape Quality of Urban Areas Exposed to Aircraft Noise by Adding Moving Water and Vegetation. *J. Acoust. Soc. Am.* **2018**, *144*, 2906–2917. [CrossRef]
62. Chung, W.K.; Chau, C.K.; Masullo, M.; Pascale, A. Modelling Perceived Oppressiveness and Noise Annoyance Responses to Window Views of Densely Packed Residential High-Rise Environments. *Build. Environ.* **2019**, *157*, 127–138. [CrossRef]
63. Kaplan, R. The Role of Nature in the Context of the Workplace. *Landsc. Urban Plan.* **1993**, *26*, 193–201. [CrossRef]
64. Kaplan, R.; Kaplan, S. *The Experience of Nature: A Psychological Perspective*; Cambridge University Press: Cambridge, UK, 1989.
65. Hartig, T.; Korpela, K.; Evans, G.W.; Gärling, T. A Measure of Restorative Quality in Environments. *Scand. Hous. Plan. Res.* **1997**, *14*, 175–194. [CrossRef]
66. Hartig, T.; Evans, G.W.; Jamner, L.D.; Davis, D.S.; Gärling, T. Tracking Restoration in Natural and Urban Field Settings. *J. Environ. Psychol.* **2003**, *23*, 109–123. [CrossRef]
67. Pasini, M.; Berto, R.; Brondino, M.; Hall, R.; Ortner, C. How to Measure the Restorative Quality of Environments: The PRS-11. *Procedia. Soc. Behav. Sci.* **2014**, *159*, 293–297. [CrossRef]
68. Krzywicka, P.; Byrka, K. Restorative Qualities of and Preference for Natural and Urban Soundscapes. *Front. Psychol.* **2017**, *8*, 268521. [CrossRef] [PubMed]
69. Alvarsson, J.J.; Wiens, S.; Nilsson, M.E. Stress Recovery during Exposure to Nature Sound and Environmental Noise. *Int. J. Environ. Res. Public Health* **2010**, *7*, 1036. [CrossRef] [PubMed]
70. Medvedev, O.; Shepherd, D.; Hautus, M.J. The Restorative Potential of Soundscapes: A Physiological Investigation. *Appl. Acoust.* **2015**, *96*, 20–26. [CrossRef]
71. Zhang, Y.; Kang, J.; Kang, J. Effects of Soundscape on the Environmental Restoration in Urban Natural Environments. *Noise Health* **2017**, *19*, 65–72. [CrossRef]
72. Guo, X.; Liu, J.; Albert, C.; Hong, X.C. Audio-Visual Interaction and Visitor Characteristics Affect Perceived Soundscape Restorativeness: Case Study in Five Parks in China. *Urban Urban Green* **2022**, *77*, 127738. [CrossRef]
73. Ma, H.; Shu, S. An Experimental Study: The Restorative Effect of Soundscape Elements in a Simulated Open-Plan Office. *Acta Acust. United Acust.* **2018**, *104*, 106–115. [CrossRef]
74. Masullo, M.; Maffei, L.; Pascale, A.; Senese, V.P.; De Stefano, S.; Chau, C.K. Effects of Evocative Audio-Visual Installations on the Restorativeness in Urban Parks. *Sustainability* **2021**, *13*, 8328. [CrossRef]
75. Jahncke, H.; Halin, N. Performance, Fatigue and Stress in Open-Plan Offices: The Effects of Noise and Restoration on Hearing Impaired and Normal Hearing Individuals. *Noise Health* **2012**, *14*, 260–272. [CrossRef]

76. Watts, G.; Khan, A.; Pheasant, R. Influence of Soundscape and Interior Design on Anxiety and Perceived Tranquillity of Patients in a Healthcare Setting. *Appl. Acoust.* **2016**, *104*, 135–141. [CrossRef]
77. Scopelliti, M.; Carrus, G.; Bonaiuto, M. Is It Really Nature That Restores People? A Comparison with Historical Sites with High Restorative Potential. *Front. Psychol.* **2019**, *9*, 2742. [CrossRef]
78. Berto, R.; Barbiero, G.; Pasini, M.; Pieter, U. Biophilic Design Triggers Fascination and Enhances Psychological Restoration in the Urban Environment. *J. Biourbanism.* **2015**, *1*, 27–34. [CrossRef]
79. Weber, A.M.; Trojan, J. The Restorative Value of the Urban Environment: A Systematic Review of the Existing Literature. *Environ. Health Insights.* **2018**, *12*, 1–13. [CrossRef] [PubMed]
80. Wang, S.S.; Xu, Y.; Yang, X.; Zhang, Y.; Yan, P.; Jiang, Y.; Wang, K. Urban Cultural Heritage Is Mentally Restorative: An Experimental Study Based on Multiple Psychophysiological Measures. *Front. Psychol.* **2023**, *14*, 1132052. [CrossRef]
81. Masullo, M.; Ozcevik Bilen, A.; Toma, R.A.; Akin Güler, G.; Maffei, L. The Restorativeness of Outdoor Historical Sites in Urban Areas: Physical and Perceptual Correlations. *Sustainability* **2021**, *13*, 5603. [CrossRef]
82. Fornara, F.; Troffa, R. Restorative Experiences and Perceived Affective Qualities in Different Built and Natural Urban Places. In Proceedings of the International IAPS-CSBE & HOUSING Network 2009, Amasya, Turkey, 13–16 October 2009; pp. 1–10.
83. Galindo, M.A.P.; Hidalgo, M.A.C. Aesthetic Preferences and the Attribution of Meaning: Environmental Categorization Processes in the Evaluation of Urban Scenes. *Int. J. Psychol.* **2005**, *40*, 19–26. [CrossRef]
84. Hidalgo, M.C.; Berto, R.; Galindo, M.P.; Getrevi, A. Identifying Attractive and Unattractive Urban Places: Categories, Restorativeness and Aesthetic Attributes. *Medio. Ambiente Y Comport. Hum.* **2006**, *7*, 115–133.
85. Rapuano, M.; Ruotolo, F.; Ruggiero, G.; Masullo, M.; Maffei, L.; Galderisi, A.; Palmieri, A.; Iachini, T. Spaces for Relaxing, Spaces for Recharging: How Parks Affect People's Emotions. *J. Environ. Psychol.* **2022**, *81*, 101809. [CrossRef]
86. Kim, M.J.; Lee, C.K.; Kim, J.S.; Petrick, J.F. Wellness Pursuit and Slow Life Seeking Behaviors: Moderating Role of Festival Attachment. *Sustainability* **2019**, *11*, 2020. [CrossRef]
87. Botta, M. Evolution of the Slow Living Concept within the Models of Sustainable Communities. *Futures* **2016**, *80*, 3–16. [CrossRef]
88. Parkins, W.; Craig, G. *Slow Living*; Berg: Oxford, UK, 2006; ISBN 9781845201609.
89. Italian Ministry of Cultural Heritage National Small Villages Plan. Available online: https://cultura.gov.it/pnrr-borghi (accessed on 18 June 2025).
90. Ivona, A.; Lopez, L. Preserving and Developing Small Italian Borghi. An Economic Strategy to Enhance Sustainable Cultural Tourism? *Sustainability* **2025**, *17*, 1621. [CrossRef]
91. Maffei, L.; Ciervo, A.; Marzocchi, R.; Masullo, M. Exploring the Restorative Benefits of Work in Smart Working Structures on Vacations in Small Villages. *Front. Psychol.* **2023**, *14*, 1232318. [CrossRef] [PubMed]
92. Italian Government. Italia Domani: The National Recovery and Resilience Plan. Available online: https://www.italiadomani.gov.it (accessed on 18 June 2025).
93. Castanò, F.; Maffei, L.; Marzocchi, R.; Morelli, M.D. Slowork, Room with View. Behaviors, Heritage, Design for New Lifestyles. In Proceedings of the Proceedings Book of Extended Abstracts "BEYOND ALL LIMITS—International Conference on Sustainability in Architecture, Planning, and Design", 2022, Caserta, Italy, 11–12 May 2022; pp. 469–474.
94. Maffei, L.; Ciervo, A.; Perrotta, A.; Masullo, M.; Rosato, A. Innovative Energy-Efficient Prefabricated Movable Buildings for Smart/Co-Working: Performance Assessment upon Varying Building Configurations. *Sustainability* **2023**, *15*, 9581. [CrossRef]
95. Ciervo, A.; Masullo, M.; Boucherit, S.; Maffei, L.; Rosato, A. Effects of Climatic Conditions on Performance of Innovative Prefabricated Movable Buildings for Smart/Co-Working in Small Villages of Southern Italy. *Int. J. Sustain. Dev. Plan.* **2024**, *19*, 4127–4134. [CrossRef]
96. Browning, W.D.; Ryan, C.O. *Nature Inside, A Biophilic Design Guide*; RIBA Publishing: London, UK, 2020.
97. Ciervo, A.; Rosato, A.; Castanò, F.; Morelli, M.D.; Masullo, M.; Marzocchi, R.; Boucherit, S. *Research Project Title: New Movable Systems for Smart/Co-Working Taking Advantage of Life Quality, Sustainability and Energy Efficiency (RESTANZA)*; University of Campania Luigi Vanvitelli: Aversa, Italy, 2023.
98. Italian Government. National Recovery and Resilience Plan. Available online: https://www.governo.it/sites/governo.it/files/PNRR_0.pdf (accessed on 18 June 2025).
99. Ministry of Business and Made in Italy Ultra-Broadband Plan. Available online: https://bandaultralarga.italia.it/ (accessed on 18 June 2025).
100. Trimble SketchUp Pro. Available online: https://www.sketchup.com/en (accessed on 18 June 2025).
101. Autodesk 3ds Max Software. Available online: https://www.autodesk.com/asean/products/3ds-max/overview?term=1-YEAR&tab=subscription (accessed on 18 June 2025).
102. Head Acoustics SQobold. Available online: https://www.head-acoustics.com/products/data-acquisition/sqobold (accessed on 18 June 2025).
103. Svobodova, K.; Vojar, J.; Sklenicka, P.; Filova, L. Presentation Matters: Causes of Differences in Preferences for Agricultural Landscapes Displayed via Photographs and Videos. *Space Cult.* **2018**, *21*, 259–273. [CrossRef]

104. Palmer, J.F.; Hoffman, R.E. Rating Reliability and Representation Validity in Scenic Landscape Assessments. *Landsc Urban Plan* **2001**, *54*, 149–161. [CrossRef]
105. Lin, T.Y.; Le, A.V.; Chan, Y.C. Evaluation of Window View Preference Using Quantitative and Qualitative Factors of Window View Content. *Build. Environ.* **2022**, *213*, 108886. [CrossRef]
106. Schubert, T.W. The Sense of Presence in Virtual Environments: A Three-Component Scale Measuring Spatial Presence, Involvement, and Realness. *Z. Für. Medien.* **2003**, *15*, 69–71. [CrossRef]
107. Igroup Presence Questionnaire (IPQ). Available online: https://www.igroup.org/pq/ipq/download.php (accessed on 18 June 2025).
108. Slater, M.; Usoh, M. Representations Systems, Perceptual Position, and Presence in Immersive Virtual Environments. *Presence Teleoperators Virtual. Environ.* **1993**, *2*, 221–233. [CrossRef]
109. Witmer, B.G.; Singer, M.J. Measuring Presence in Virtual Environments. In *ARI Technical Report*; Army Research Institute for the Behavioral and Social Sciences: Alexandria, VA, USA, 1994; pp. 1–53.
110. Hendrix, C.M. Exploratory Studies on the Sense of Presence in Virtual Environments as a Function of Visual and Auditory Display Parameters. Master' s thesis, University of Washington, Seattle, WA, USA, 1994.
111. Carlin, A.S.; Hoffman, H.G.; Weghorst, S. Virtual Reality and Tactile Augmentation in the Treatment of Spider Phobia: A Case Report. *Behav. Res. Ther.* **1997**, *35*, 153–158. [CrossRef]
112. Unicampania SENS I-Lab. Available online: https://www.architettura.unicampania.it/images/ricerca/laboratori/EN/SENS-i_Lab_2024_EN_REV01.pdf (accessed on 15 March 2025).
113. Oculus Oculus Rift, S. Available online: https://vr-compare.com/headset/oculusrifts (accessed on 18 June 2025).
114. Faul, F.; Erdfelder, E.; Lang, A.-G.; Buchner, A. G*Power 3: A Flexible Statistical Power Analysis Program for the Social, Behavioral, and Biomedical Sciences. *Behav. Res. Methods* **2007**, *32*, 175–191. [CrossRef]
115. Faul, F.; Erdfelder, E.; Buchner, A.; Lang, A.G. Statistical Power Analyses Using G*Power 3.1: Tests for Correlation and Regression Analyses. *Behav. Res. Methods* **2009**, *41*, 1149–1160. [CrossRef] [PubMed]
116. Damien Masson Balanced Latin Square Generator. Available online: https://damienmasson.com/tools/latin_square/ (accessed on 18 June 2025).
117. Klinke, T.; Hannak, W.; Böning, K.; Jakstat, H. A Comparative Study of the Sensitivity and Specificity of the Ishihara Test With Various Displays. *Int. Dent. J.* **2024**, *74*, 892–896. [CrossRef]
118. Ishihara Ishihara Test. Available online: https://www.it.colorlitelens.com/ishihara-test-di-daltonismo.html (accessed on 18 June 2025).
119. Gargiulo, M.; Carleo, D.; Ciampi, G.; Masullo, M.; Chìas Navarro, P.; Maliqari, A.; Scorpio, M. Assessment of the Historical Gardens and Buildings Lighting Interaction through Virtual Reality: The Case of Casita de Arriba de El Escorial. *Buildings* **2024**, *14*, 273. [CrossRef]
120. Fotios, S.A.; Cheal, C. Lighting for Subsidiary Streets: Investigation of Lamps of Different SPD. Part 1—Visual Performance. *Light. Res. Technol.* **2007**, *39*, 215–232. [CrossRef]
121. Fairchild, M.D.; Reniff, L. Time Course of Chromatic Adaptation for Color-Appearance Judgments. *J. Opt. Soc. Am. A* **1995**, *12*, 824. [CrossRef]
122. Tabachnick, B.G.; Fidell, L.S. *Using Multivariate Statistics*, 3rd ed.; HarperCollins College, Ed.; Alyn and Bacon: New York, NY, USA, 1996; ISBN 0673994147/9780673994141.

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