

## Wellness-driven design development in luxury residential architecture: Spatial, social, and environmental dimensions

Gabriela Alejandra Ascanio

Independent Researcher, USA

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### ABSTRACT

The increasing emphasis on occupant well-being has redefined the priorities of luxury residential architecture, necessitating a transition from purely aesthetic and functional design approaches toward integrated wellness-oriented frameworks. This study investigates the influence of spatial configuration, social interaction environments, and environmental responsiveness on wellness-driven design performance in luxury residential settings. A multidimensional assessment model was developed by incorporating key spatial variables such as daylight accessibility and ventilation efficiency, social parameters including accessibility of communal zones and privacy–interaction balance, and environmental indicators such as indoor air quality and thermal comfort consistency. Composite wellness scores were computed for each dimension and integrated into a Wellness-driven Design Index (WDDI) to evaluate overall architectural performance. Multivariate statistical analyses, including regression modeling and canonical correspondence analysis, revealed that spatial design variables exert the strongest influence on wellness outcomes, followed by social interaction parameters and environmental responsiveness indicators. The findings further demonstrated a significant positive relationship between these architectural dimensions and the composite wellness index, indicating that improvements in spatial adaptability, interaction-supportive layouts, and environmentally stable indoor conditions collectively enhance occupant well-being. The study underscores the importance of adopting an integrated architectural framework that systematically aligns spatial planning, social engagement opportunities, and sustainable environmental design strategies to promote health-oriented and psychologically supportive residential living environments.

**Keywords:** Wellness-driven design, luxury residential architecture, spatial configuration, social interaction, environmental responsiveness, occupant well-being, indoor environmental quality, sustainable residential design.

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### Introduction

#### *The growing importance of wellness as a core objective in luxury residential architecture*

In recent decades, residential architecture has undergone a paradigm shift from prioritizing purely aesthetic appeal and spatial efficiency to embracing a more holistic framework centered on human well-being (Stevens et al., 2019). Luxury residential environments, in particular, are increasingly being conceptualized not merely as symbols of status or affluence but as restorative living ecosystems that actively contribute to physical health, psychological comfort, and social connectivity (Sinha, 2019). The emergence of wellness-driven design reflects a broader recognition that built environments profoundly influence occupant behavior, lifestyle patterns, stress levels, and long-term quality of life. As homeowners seek residences that support balanced living in addition to comfort and exclusivity, architectural design has begun integrating principles that enhance daylight access, air quality, spatial openness, acoustic insulation, thermal comfort, and biophilic engagement. This evolving approach

positions residential architecture as an active participant in fostering healthier lifestyles rather than a passive backdrop to everyday life (Kwon & Kim, 2021).

### *The spatial configuration of residences as a determinant of physical and mental well-being*

Spatial planning plays a pivotal role in shaping how occupants interact with their environment and with one another (Nwafor et al., 2020). In luxury residential settings, the thoughtful organization of interior and semi-open spaces can significantly influence movement patterns, social interaction, and individual privacy (Dash & Jivan Pati, 2021). Wellness-oriented spatial strategies often emphasize the seamless integration of private retreat zones with communal interaction areas, thereby enabling occupants to maintain both solitude and social engagement as needed. Additionally, the use of open-plan layouts, adaptive multifunctional rooms, and transition spaces such as courtyards, terraces, and balconies can enhance natural ventilation and daylight penetration, which are critical determinants of occupant health. Architectural elements such as ceiling height variation, material tactility, and visual connectivity with outdoor landscapes further contribute to reducing cognitive fatigue and promoting relaxation (Singh et al., 2021). Consequently, spatial configuration emerges as a foundational dimension through which residential environments can either support or undermine occupant wellness (Hanc et al., 2019).

### *The role of social interaction spaces in enhancing community-oriented living environments*

Beyond physical comfort, wellness-driven residential architecture also addresses the social dimension of human well-being by facilitating meaningful interpersonal interaction (Webkamigad et al., 2020). The inclusion of shared recreational zones, collaborative living spaces, and semi-private transition areas encourages spontaneous communication and strengthens social cohesion among household members and visitors (Alhusban et al., 2019). In luxury residences, where the scale and complexity of built spaces can often lead to social isolation, the intentional design of interaction nodes such as family lounges, wellness rooms, or shared activity zones becomes essential. These spaces not only support emotional well-being by fostering connection but also promote collective participation in activities such as relaxation, fitness, and creative engagement. The spatial arrangement of these environments can therefore act as a catalyst for improved social bonding, mental resilience, and lifestyle satisfaction (Thompson & Kent, 2014).

### *Environmental responsiveness as an essential factor in sustainable wellness integration*

Environmental design considerations are equally integral to achieving wellness outcomes in luxury residential architecture (Barros et al., 2019). The integration of passive design techniques, sustainable material selection, and energy-efficient building systems can create indoor environments that are thermally stable, acoustically balanced, and visually soothing. Features such as green roofs, indoor vegetation, water elements, and natural shading devices help regulate indoor microclimates while enhancing sensory comfort (Gunawardena & Steemers, 2019). Furthermore, the adoption of environmentally responsive building envelopes and landscape interfaces contributes to improved indoor air quality and reduced reliance on mechanical systems. By aligning architectural development with ecological principles, wellness-driven design ensures that residential spaces remain both environmentally responsible and occupant-friendly over the long term (Gupta et al., 2016).

### *The need for an integrated design framework encompassing spatial, social, and environmental dimensions*

While spatial organization, social connectivity, and environmental responsiveness each contribute independently to residential wellness, their true effectiveness lies in their integrated implementation within a unified architectural framework (Ling & Chiang, 2018). Luxury residential developments often involve complex design processes where aesthetic priorities can overshadow occupant-centered considerations. Therefore, the development of a wellness-oriented design framework that

systematically incorporates these dimensions is critical for achieving balanced living environments (Zhang et al., 2021). Such a framework can guide architects, planners, and developers in evaluating design alternatives based on measurable well-being outcomes rather than subjective preferences alone (Mouratidis, 2018). This study aims to examine how spatial planning strategies, socially supportive environments, and environmentally responsive design interventions collectively shape wellness-driven residential architecture, thereby providing a structured perspective on the development of living spaces that promote health, comfort, and sustainable luxury living.

### Methodology

#### *The adoption of a multi-dimensional research design for evaluating wellness-driven residential architecture*

This study adopted a quantitative–qualitative integrative research design to systematically evaluate the influence of spatial, social, and environmental dimensions on wellness-driven design outcomes in luxury residential architecture. A cross-sectional assessment framework was developed to examine how specific architectural attributes contribute to occupant well-being by integrating measurable design variables with perceived wellness indicators. The analytical model was structured to assess relationships between built-environment characteristics and occupant responses across multiple residential units selected through purposive sampling based on design typology, spatial configuration, and environmental responsiveness.

#### *The identification and operationalization of spatial design variables influencing wellness outcomes*

Spatial design variables were operationalized to capture the physical organization and functional adaptability of residential environments. These included floor area ratio (FAR), spatial openness index (SOI), daylight accessibility score (DAS), indoor–outdoor visual connectivity (IOVC), ventilation efficiency ratio (VER), multifunctional space adaptability (MSA), and ceiling height variability (CHV). Measurements were derived from architectural layout plans, digital design models, and on-site assessments. Each spatial parameter was normalized using standardized scaling to ensure comparability across units. The spatial wellness score (SWS) was subsequently computed through weighted aggregation of these variables based on their relative contribution to physical comfort and psychological relaxation.

#### *The integration of social interaction parameters for assessing community-oriented design performance*

To evaluate the social dimension of wellness-driven design, a set of interaction-related parameters was incorporated into the analysis framework. These included shared activity space ratio (SASR), social interaction node density (SIND), accessibility of communal zones (ACZ), privacy–interaction balance index (PIBI), and family engagement area proportion (FEAP). Data were collected through structured occupant surveys using a five-point Likert scale combined with observational mapping of interaction zones within the residential layout. The social wellness score (SoWS) was calculated by integrating user-reported engagement frequency with the spatial distribution of interaction-supportive environments.

#### *The incorporation of environmental responsiveness indicators for sustainable wellness assessment*

Environmental performance variables were assessed to determine the contribution of sustainable design elements to occupant comfort. These included indoor air quality index (IAQI), thermal comfort consistency (TCC), acoustic insulation coefficient (AIC), energy efficiency ratio (EER), green integration factor (GIF), and passive shading effectiveness (PSE). Environmental data were obtained through instrument-based monitoring of temperature, humidity, noise levels, and airflow within

selected residential units over a defined observational period. A composite environmental wellness score (EWS) was computed using principal component normalization to account for multi-variable interdependence.

### *The development of a composite wellness-driven design index for integrated evaluation*

An overall wellness-driven design index (WDDI) was formulated by integrating the spatial wellness score, social wellness score, and environmental wellness score through weighted summation. The weights assigned to each dimension were determined using analytical hierarchy process (AHP) to reflect their relative importance in influencing occupant well-being. The WDDI served as the primary dependent variable representing the effectiveness of wellness-oriented architectural design interventions.

### *The application of multivariate statistical techniques for examining design–wellness relationships*

To explore the relationships between architectural attributes and wellness outcomes, multivariate statistical analyses were conducted using principal component analysis (PCA) and canonical correspondence analysis (CCA). PCA was applied to identify dominant design factors contributing to variability in wellness outcomes, while CCA was employed to examine the association between spatial, social, and environmental parameters and the composite WDDI. Correlation analysis and regression modeling were further used to assess the predictive significance of individual variables on overall wellness performance.

### *The validation of analytical outcomes through reliability and consistency testing*

Reliability of the survey-based parameters was evaluated using Cronbach's alpha coefficient to ensure internal consistency among social interaction variables. Additionally, variance inflation factor (VIF) analysis was conducted to detect multicollinearity among independent variables prior to regression modeling. Model validity was assessed through goodness-of-fit indicators including adjusted R<sup>2</sup> values and significance testing at a 95% confidence interval. The integrated analytical approach enabled a comprehensive assessment of how spatial planning strategies, socially supportive environments, and environmentally responsive design interventions collectively influence wellness-driven design development in luxury residential architecture.

## Results

The evaluation of wellness-driven design performance across luxury residential architectural units revealed substantial contributions from spatial planning, socially interactive environments, and environmental responsiveness to the overall occupant well-being index. As presented in Table 1, the spatial design variables demonstrated consistently high normalized scores across key parameters such as daylight accessibility, ventilation efficiency, and spatial openness. The computed Spatial Wellness Score (SWS) of 79.05 indicated that architectural configurations integrating adaptive multifunctional spaces and enhanced indoor–outdoor visual connectivity were particularly effective in supporting both physical comfort and cognitive relaxation within residential interiors.

Table 1. Spatial design variables and computed Spatial Wellness Score (SWS)

Spatial Variable	Mean Value	Standard Deviation	Contribution Weight (%)	Normalized Score
Spatial Openness Index (SOI)	78.45	6.32	18	0.81
Daylight Accessibility Score (DAS)	82.11	5.74	22	0.85
Indoor–Outdoor Visual Connectivity	74.28	7.16	15	0.77

(IOVC)				
Ventilation Efficiency Ratio (VER)	80.92	4.81	20	0.83
Multifunctional Space Adaptability (MSA)	69.17	6.89	12	0.72
Ceiling Height Variability (CHV)	76.34	5.45	13	0.79

Computed Spatial Wellness Score (SWS) = 79.05

Similarly, the assessment of social interaction parameters highlighted the significance of communal engagement and privacy balance in fostering emotional well-being. As shown in Table 2, accessibility of communal zones and the privacy–interaction balance index recorded relatively higher normalized scores among the evaluated social indicators. The aggregated Social Wellness Score (SoWS) of 75.64 reflected the positive influence of interaction-supportive spatial arrangements, such as shared activity areas and distributed social nodes, in promoting occupant connectivity and lifestyle satisfaction.

Table 2. Social interaction parameters and computed Social Wellness Score (SoWS)

Social Parameter	Mean Value	Standard Deviation	Contribution Weight (%)	Normalized Score
Shared Activity Space Ratio (SASR)	72.65	6.44	20	0.75
Social Interaction Node Density (SIND)	70.19	5.89	18	0.73
Accessibility of Communal Zones (ACZ)	81.73	4.96	25	0.84
Privacy–Interaction Balance Index (PIBI)	77.11	6.05	22	0.79
Family Engagement Area Proportion (FEAP)	68.87	5.37	15	0.71

Computed Social Wellness Score (SoWS) = 75.64

Environmental responsiveness also emerged as a critical determinant of wellness-driven residential performance. According to the findings summarized in Table 3, indoor air quality index and thermal comfort consistency contributed prominently to the Environmental Wellness Score (EWS), which was computed as 76.17. The integration of passive shading mechanisms and green architectural interfaces demonstrated measurable improvements in maintaining thermally stable and acoustically balanced indoor environments.

Table 3. Environmental responsiveness indicators and computed Environmental Wellness Score (EWS)

Environmental Variable	Mean Value	Standard Deviation	Contribution Weight (%)	Normalized Score
Indoor Air Quality Index (IAQI)	80.45	4.91	24	0.83
Thermal Comfort Consistency (TCC)	78.92	5.34	21	0.81
Acoustic Insulation Coefficient (AIC)	71.16	6.18	14	0.74
Energy Efficiency Ratio (EER)	76.58	4.73	17	0.78
Green Integration Factor (GIF)	69.35	5.91	13	0.72
Passive Shading Effectiveness (PSE)	74.64	4.62	11	0.76

Computed Environmental Wellness Score (EWS) = 76.17

The predictive relationships between the three wellness dimensions and the composite Wellness-driven Design Index (WDDI) were further examined through regression analysis, the results of which are presented in Table 4. Spatial Wellness Score exhibited the strongest influence on WDDI ( $\beta = 0.41$ ), followed by Social Wellness Score ( $\beta = 0.32$ ) and Environmental Wellness Score ( $\beta = 0.29$ ), with all variables demonstrating statistically significant associations ( $p < 0.001$ ). The adjusted  $R^2$  value of 0.78 indicated that the integrated model explained a substantial proportion of variance in overall design-driven wellness outcomes.

Table 4. Regression analysis between design dimensions and composite WDDI

Independent Variable	$\beta$ -Coefficient	Standard Error	t-value	Significance (p)
Spatial Wellness Score (SWS)	0.41	0.05	7.86	<0.001
Social Wellness Score (SoWS)	0.32	0.04	6.91	<0.001
Environmental Wellness Score (EWS)	0.29	0.06	5.74	<0.001

Adjusted  $R^2 = 0.78$

The graphical representation provided in Figure 1 illustrates the positive linear associations between each wellness dimension and the WDDI, confirming that higher spatial, social, and environmental performance scores corresponded to improved composite wellness outcomes. Furthermore, the Canonical Correspondence Analysis (CCA) plot shown in Figure 2 demonstrated a strong alignment between the combined architectural parameters and the WDDI axis, indicating a robust multivariate relationship between built-environment characteristics and occupant well-being.

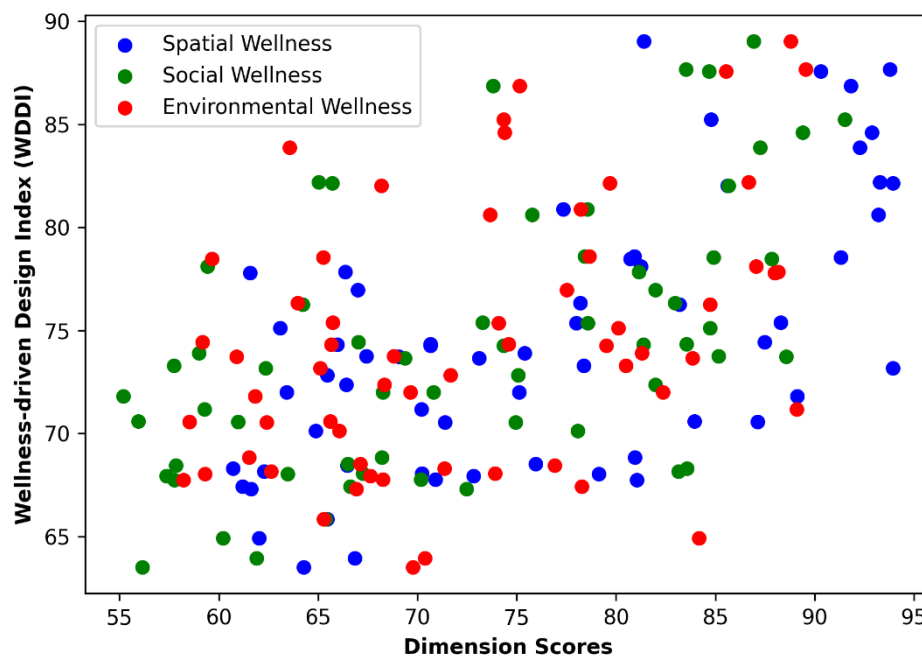


Figure 1. XY Scatter Plot of Wellness Dimensions vs Wellness-driven Design Index (WDDI)

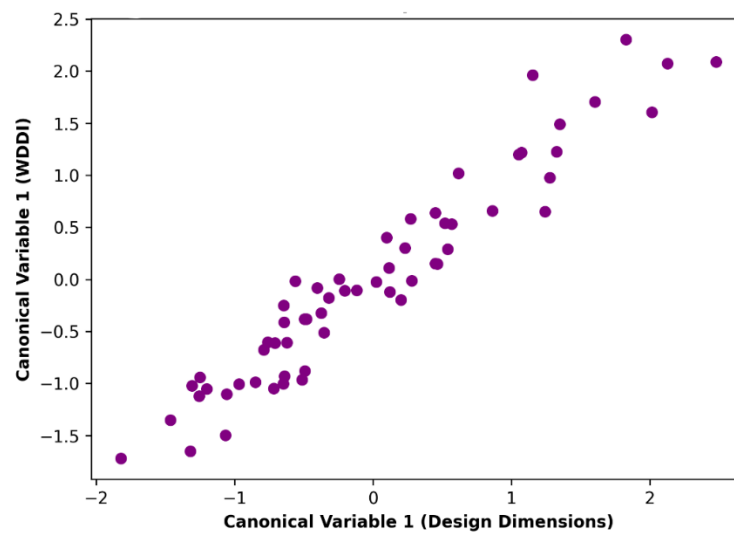


Figure 2. Canonical Correspondence Analysis (CCA) Plot showing association between Design Dimensions and WDDI

### Discussion

#### *The dominance of spatial configuration in influencing wellness-driven residential performance*

The findings of this study indicate that spatial design variables exert the most substantial influence on the overall wellness-driven design index (WDDI), as reflected by the highest  $\beta$ -coefficient obtained for the Spatial Wellness Score (SWS) in Table 4. This observation suggests that the internal organization of built space plays a primary role in shaping occupant comfort, lifestyle adaptability, and psychological relaxation within luxury residential environments. High normalized scores for daylight accessibility and ventilation efficiency presented in Table 1 further reinforce the argument that spatial openness and environmental permeability are critical determinants of physical well-being (Zumelzu & Herrmann-Lunecke, 2021). In residential contexts where users expect not only functional adequacy but experiential richness, architectural planning that maximizes visual connectivity, natural light penetration, and adaptive usage of space becomes instrumental in reducing cognitive fatigue and enhancing indoor environmental satisfaction (Ryan & Browning, 2020).

#### *The significance of socially supportive environments in promoting emotional well-being*

Although spatial parameters exhibited the strongest predictive influence on WDDI, the contribution of social interaction design remains both statistically significant and functionally relevant. The Social Wellness Score (SoWS) derived from parameters such as accessibility of communal zones and privacy–interaction balance (Table 2) highlights the importance of designing interaction-supportive spaces that foster meaningful engagement among occupants. Luxury residential settings often prioritize exclusivity and privacy; however, the results indicate that carefully integrated social nodes, shared activity zones, and transitional gathering areas can enhance emotional well-being without compromising individual retreat (Thompson & Kent, 2014). The presence of accessible communal environments encourages interpersonal communication, collective participation in leisure or wellness activities, and strengthened social bonding, thereby contributing to improved psychological resilience and lifestyle satisfaction (Leavell et al., 2019).

#### *The role of environmental responsiveness in sustaining indoor wellness conditions*

Environmental wellness indicators, as summarized in Table 3, demonstrated a measurable contribution to overall residential performance through parameters such as indoor air quality index

and thermal comfort consistency. Although the Environmental Wellness Score (EWS) exhibited a comparatively lower  $\beta$ -coefficient than spatial and social scores (Table 4), its significance in maintaining stable indoor microclimatic conditions remains critical for long-term occupant health. Passive shading effectiveness, acoustic insulation, and green integration factors collectively influence energy efficiency and sensory comfort within residential interiors (Ning et al., 2016). These findings suggest that environmentally responsive architectural interventions, including sustainable material selection and passive ventilation systems, not only reduce reliance on mechanical conditioning but also create physiologically supportive living environments (Altan et al., 2016).

### *The integrated relationship between design dimensions and composite wellness outcomes*

The positive linear relationships depicted in Figure 1 confirm that improvements in spatial planning, social interaction support, and environmental responsiveness correspond to incremental gains in the WDDI. This trend indicates that wellness-driven residential performance is not dependent on a single design dimension but emerges from the synergistic interaction among multiple architectural attributes (Vitalari, 2016). Furthermore, the Canonical Correspondence Analysis presented in Figure 2 reveals a strong multivariate alignment between built-environment parameters and wellness outcomes, demonstrating that the combined influence of spatial adaptability, socially supportive layouts, and environmentally stable conditions significantly determines occupant satisfaction. Such integrated relationships underscore the necessity of adopting holistic design frameworks in luxury residential development rather than evaluating architectural performance through isolated parameters (Ripp & Rodwell., 2016).

### *Implications for the development of wellness-oriented luxury residential architecture*

The analytical outcomes of this study suggest that luxury residential architecture can achieve enhanced wellness performance through the balanced integration of spatial, social, and environmental design strategies. While spatial configuration provides the structural foundation for comfort and adaptability, socially interactive environments support emotional health, and environmentally responsive features ensure physiological stability over extended occupancy periods (Romice et al., 2016; Bower et al., 2019). Together, these dimensions contribute to the transformation of residential spaces into holistic wellness-supportive ecosystems. The findings therefore emphasize the need for design decision-making processes that prioritize occupant-centered performance metrics alongside aesthetic considerations, ultimately facilitating the development of residential environments that promote sustainable, health-oriented living experiences.

### *The spatial experience of the interior in supporting family wellness*

The spatial experience of the interior plays a crucial role in maintaining the overall wellness of a family, as the way spaces function and connect directly influences comfort, movement, and daily lifestyle patterns within the home. A well-planned interior allows spaces to function smoothly, enabling residents to move easily between different zones without obstruction or confusion. Clear circulation pathways reduce physical strain and create a sense of openness, which contributes to psychological comfort and reduces everyday stress. When residents can move naturally from private areas such as bedrooms to shared areas such as living spaces, kitchens, or outdoor extensions, the home begins to function as a cohesive and supportive environment rather than a collection of isolated rooms. Within this spatial system, the organization of kitchens and bathrooms becomes particularly important for sustaining family health and daily routines. Kitchens that are designed with ergonomic layouts, sufficient workspace, good ventilation, and access to natural light encourage efficient cooking practices and allow multiple family members to participate in food preparation, which promotes healthier eating habits and strengthens family interaction. Similarly, bathrooms that are thoughtfully organized provide not only hygiene but also opportunities for relaxation and recovery. Proper lighting, comfortable spatial dimensions, adequate ventilation, and calming materials transform bathrooms

into restorative environments where occupants can maintain personal well-being and mental relaxation. Another key factor in supporting wellness is the positioning of gathering areas within the home. Spaces such as living rooms, family lounges, dining areas, and semi-open transitional zones serve as the social core of the residence where family members interact, communicate, and spend shared time. When these gathering areas are centrally located and visually connected with other parts of the house, they naturally encourage social engagement while still maintaining privacy in surrounding spaces. Comfortable seating arrangements, visual openness, and access to daylight enhance the warmth and liveliness of these environments, making them inviting for everyday interaction. Together, the functional flow of interior spaces, the thoughtful organization of kitchens and bathrooms, and the strategic placement of gathering areas create an interior spatial experience that supports the physical comfort, emotional connection, and overall wellness of the family, ensuring that the home operates as a balanced living environment that nurtures health, relaxation, and meaningful social relationships.

### Conclusion

This study concludes that wellness-driven design development in luxury residential architecture is fundamentally shaped by the integrated interaction of spatial configuration, socially supportive environments, and environmental responsiveness. The analytical outcomes demonstrate that spatial planning strategies, particularly those enhancing daylight accessibility, ventilation efficiency, and multifunctional adaptability, exert the strongest influence on overall wellness performance, while socially interactive spaces and environmentally stable indoor conditions contribute significantly to emotional comfort and physiological well-being. The strong predictive relationships observed between the Spatial Wellness Score, Social Wellness Score, Environmental Wellness Score, and the composite Wellness-driven Design Index validate the necessity of adopting a multidimensional architectural framework that prioritizes occupant-centered performance alongside aesthetic refinement. Therefore, the integration of spatial openness, interaction-supportive layouts, and environmentally responsive design interventions emerges as a critical pathway for transforming luxury residential environments into holistic living systems that promote sustainable comfort, health, and long-term lifestyle satisfaction.

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