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ORIGINAL

Synergies between urban rehabilitation and sustainable architecture: a cross-sectional study applied to the city of southern Peru

Sinergias entre rehabilitación urbana y arquitectura sostenible: estudio transversal aplicado a la ciudad de sur peruano

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ABSTRACT

Urban rehabilitation and sustainable architecture are essential components for the development of cities that are not only functional and economically viable, but also equitable, safe and environmentally responsible. In this context, the objective of this study was to determine the relationship of urban rehabilitation and sustainable architecture in the city of Juliaca, 2024. The methodology was quantitative, non-experimental, cross-sectional and correlational. The instrument was a questionnaire, whose reliability index was 0,838, which was applied to a sample of 193 neighbors of the roads, parks and squares that are being rehabilitated in the unit of analysis. The results were a Pearson correlation coefficient r=0,727 and a value of p=0,000 which indicates a strong positive correlation between the variables studied, suggesting that as urban rehabilitation improves in Juliaca, so does sustainable architecture, and vice versa. It is concluded that implementing policies and projects that consider the variables together could lead to a more sustainable, resilient and equitable future for Juliaca, improving the quality of life of its inhabitants and preserving its urban environment for future generations.

Keywords: Urban Rehabilitation; Sustainable Architecture; Community Impact; Heritage Conservation; Infrastructure Improvement.

RESUMEN

La rehabilitación urbana y la arquitectura sostenible son componentes esenciales para el desarrollo de ciudades que no solo sean funcionales y económicamente viables, sino también equitativas, seguras y ambientalmente responsables. En este contexto, el objetivo de este estudio fue determinar la relación de la rehabilitación urbana y la arquitectura sostenible en la ciudad de Juliaca, 2024. La metodología fue cuantitativa, no experimenta, transversal y correlacional. El instrumento fue un cuestionario, cuya índice de confiabilidad fue de 0,838, el cual se aplicó a una muestra de 193 vecinos de las vías, parques y plazas que están siendo rehabilitadas en la unidad de análisis. Los resultados fueron un coeficiente de correlación de Pearson r=0,727 y un valor de p=0,000 el cual indica una correlación positiva fuerte entre las variables estudiadas, esto sugiere que, a medida que mejora la rehabilitación urbana en Juliaca, también mejora la arquitectura sostenible, y viceversa. Se concluye que, implementar políticas y proyectos que consideren las variables de manera conjunta podría llevar a un futuro más sostenible, resiliente y equitativo para Juliaca, mejorando la calidad de vida de sus habitantes y preservando su entorno urbano para las generaciones futuras.

Palabras clave: Rehabilitación Urbana; Arquitectura Sostenible; Impacto Comunitario; Conservación del Patrimonio; Mejora de Infraestructura

INTRODUCTION

Urban rehabilitation that strictly adheres to sustainable architecture principles is established as the basis for developing functional, economically viable, equitable, safe, and environmentally responsible cities. By implementing these strategies, cities can improve the quality of life of their residents, preserve the environment, and ensure resilient and sustainable development for future generations. In the current context, marked by growing climate and urban challenges, urban rehabilitation and sustainable architecture are essential to transform our cities into more resilient, efficient, and livable environments.[1]

Urban rehabilitation allows for the revitalization and optimization of existing urban spaces, improving infrastructure and quality of life without expanding urban footprints, which is crucial for managing population growth in a sustainable manner.[2] At the same time, sustainable architecture focuses on reducing the environmental impact of buildings through the efficient use of resources, waste minimization, and the integration of renewable energies, directly contributing to climate change mitigation. Together, these disciplines not only address environmental urgency but also promote social equity and economic viability, redefining how cities can evolve toward greener and fairer futures.[3]

In this regard, in Asia, Li et al.[4] refer to the relationship between urban rehabilitation efforts and sustainable architecture, emphasizing the need for active participation by residents, as well as efficient management by those responsible for planning and executing urban projects. Sano et al. refer to urban rehabilitation as follows. Wooden structures, due to their capacity for continuous renovation, play an essential role in urban regeneration. This capacity for renovation allows these constructions to adapt and evolve over time, making it possible to update and maintain them without the need for costly and environmentally damaging demolition. For this reason, wooden structures are considered one of the most sustainable construction methods.

In Europe, König et al.[5] conclude that there is a positive relationship between urban rehabilitation and sustainable architecture, emphasizing how lightweight design can contribute to environmental sustainability by reducing weight, conserving materials, and improving energy efficiency. They also refer to the importance of responsible resource management and the recyclability of materials as part of sustainable architecture. Milovanović et al.[6] emphasize the importance of integrating sustainable architecture and urban rehabilitation into mass housing renovation to promote environmental sustainability and social equity in urban environments. The importance of environmental protection, economic efficiency, social inclusion and participation, and cultural appropriateness in sustainable housing development is highlighted, which are perceived as challenges for mass housing rehabilitation.

Oleynikov et al.[7] address the importance of urban area renovation to create quality and sustainable urban environments, mentioning that the formation of a quality and comfortable urban environment is closely related to the rational use of municipal areas. To achieve maximum efficient use of areas, it is often necessary to carry out renovations within their boundaries. The need to renovate residential buildings whose regulatory exploitation period has expired is highlighted, as they are located in areas with engineering, transport, and social infrastructure and can be considered as potential for the renovation of the area. Ravagnan et al.[8] address the importance of urban rehabilitation and sustainable architecture through integrated and multiscale regeneration strategies focused on public space. This approach, which also includes innovative mobility and the integration of environmental and historical networks, has become a key international reference and a current challenge due to the pandemic and social distancing measures.

In Africa, Tahri[9] concluded that urban rehabilitation and sustainable architecture are important aspects for improving the quality of life in cities. highlights the importance of green spaces in urban infrastructure, as they contribute to reducing noise, improving human and animal health, providing shade, and helping to balance the environment. It mentions that green space planning cannot be separated from the overall context of urban planning due to its importance in maintaining environmental balance. Ismaeel et al.[10] analyze the role of Sabil buildings as hubs for sustainable urban rehabilitation on Al-Muiz Street. Their results present a pilot model for promoting sustainable urban mobility in historic cities, based on the context of Sabil buildings. Haseeb.[11] whose main objective was to construct a holistic model of the concept of hybridization, covering the types, levels, and extent of interventions in the historic urban fabric, concluded that these interventions must be consistent with the existing urban fabric and sustainable in the long term.

In North America, Donais et al.[12] highlight the importance of redesigning and rehabilitating streets to promote sustainable transport, but also underscore the organizational and communication challenges that hinder its implementation, seeking to understand these challenges and proposing guidelines to improve the integration of sustainable transport concepts into urban decision-making. Carrascal[13] in New York highlights the

role of institutions in urban rehabilitation through art, emphasizing how art can be an option for rehabilitating abandoned spaces and improving urban quality of life. Garza et al.[14] propose a collaborative model in which civil society, the public sector, and the private sector form coalitions and work in parallel to achieve urban regeneration that improves forms of intervention in the territory through more flexible planning and management processes, integrating various areas as a basis for achieving more comprehensive, sustainable, and creative urban regeneration.

In South America, Salas et al.[15] focus on the importance of aesthetic and physical interventions in peripheral neighborhoods to improve the quality of life of residents, highlighting the value of the identity of the city and the neighborhood, as well as the creativity of residents in search of new sensations and perceptions. On the other hand, Zarlenga mentions that, firstly, although both cases arise from processes of decentralization and urban crises, in South America these strategies began to be applied later, especially in the 1990s, after the return to democracy. Cities in this region were not only industrially disjointed, but also socially and spatially fragmented. Secondly, the delay in implementing these strategies is due to the scarcity of resources available to local administrations and low investment by private developers. This makes it impossible to carry out significant infrastructure interventions, such as the construction of iconic cultural institutions that promote urban regeneration.

Similarly, Macedo et al. state that, considering their condition prior to rehabilitation, it would be useful to determine whether rehabilitated streams in urban areas of Brazil can provide ecosystem services similar to other protected urban areas that have not suffered significant degradation. This should be done using functional ecosystem processes (such as primary production, sediment transport and deposition, and benthic bioindicators and functional diversity indices).

In this context, it was observed that the city of Juliaca is experiencing constant growth and is at a crucial crossroads where urban planning and architecture must converge towards sustainable practices that respect the environment and cultural heritage. The problem proposed for this research is the need to understand how urban rehabilitation and sustainable architecture are interrelated and how, together, they can influence the improvement of the urban environment in Juliaca. Addressing Juliaca's urban challenges through urban rehabilitation and sustainable architecture will not only improve the city's infrastructure and aesthetics, but will also contribute to a healthier, more equitable, and sustainable urban environment. Therefore, this research seeks to provide a deep understanding of how these interrelated strategies can be effectively implemented for the benefit of the entire community.

For these reasons, the objective of this article was to determine the relationship between urban rehabilitation and sustainable architecture in the city of Juliaca in 2024. This is justified at the social level because, through the study of variables and their correlation, it seeks to propose an improvement in the quality of life of residents. By understanding this relationship, the inclusion of sustainable architecture practices could be increased, which could contribute to the creation of safer environments, reducing vulnerability to extreme weather events and improving social cohesion and a sense of belonging among citizens.

At a theoretical level, this study is justified because it will contribute to existing academic knowledge on urban rehabilitation and sustainable architecture, since the scientific method was used to validate existing theories and verify the correlations applicable in the contexts studied, thus broadening the understanding of how urban environments can be transformed in a sustainable manner.

On a practical level, it is justified because its conclusions may be applicable to the rehabilitation of urban areas and the implementation of sustainable architectural design practices in Juliaca, which may be used by urban planners, politicians, and developers, providing effective elements for decision-making in urban development projects.

METHOD

The study was quantitative, non-experimental, and correlational. In this regard, Hernández et al.[16] argue that correlational studies aim to determine the relationship or degree of association between two or more variables in a particular context. For their part, Ñaupas et al.[17] refer to non-experimental design as studies in which the researcher does not manipulate the variables or randomly assign subjects to different conditions or treatments. Instead, they observe phenomena as they occur in a natural environment without direct intervention. This type of design is frequently used in situations where the manipulation of variables is impossible or unethical. For Namakforoosh[18] the quantitative approach to scientific research focuses on the collection and analysis of numerical data to establish patterns, test hypotheses, and/or make predictions about specific phenomena. This approach uses statistics as the main tool for analyzing the collected data and is characterized by its objectivity and ability to produce measurable and replicable results.

The population consisted of residents of the city of Juliaca who live on the main streets and avenues that are being rehabilitated by the current administration of the municipality of San Román-Juliaca, numbering 386 residents. The sample, using the simple random sampling formula, consisted of 193 residents. In this regard,

Supo[19] points out that the population is the complete set of individuals, cases, or elements that possess common characteristics that are of interest for a specific study; a sample is a subset of the population that is selected to participate in the study.

As an inclusion criterion, the instrument was applied to residents who were present in their homes at the time of application.

Minors, those who did not want to fill out the surveys, and those who were not present at their homes were excluded from the application of the instrument.

The technique adopted for data collection was a survey, and the instrument was a 16-item questionnaire, with questions 1 to 8 for variable 1 and questions 9 to 18 for variable 2. This instrument was validated by three experts knowledgeable about the variables and the subject of study. Its statistical reliability was established using Cronbach's alpha, which was 0,838, indicating that the instrument is highly reliable.

According to (Carbajal et al., 2019), using the survey technique with the questionnaire instrument allows researchers to access data that is difficult to observe directly, such as attitudes, beliefs, and personal behaviors. These methods allow large groups of people to be studied efficiently, which is crucial in research that seeks to generalize results to an entire population. However, it is essential that both the survey and the questionnaire are well designed and administered ethically to ensure the validity and reliability of the data collected.

RESULTS

Table 1. Descriptive results for urban rehabilitation

	Freq	%	% Val.	% Accum.
Deficient	56	29	29	29
Adequate	128	66	66	95
Good	9	5	5	100
Excellent	0	0	0	100
Total	193	100	100	

Table 1 contains the descriptive results for the urban rehabilitation variable. Twenty-nine percent of respondents consider urban rehabilitation in Juliaca to be poor. This significant percentage indicates that almost one-third of the city's infrastructure and public spaces are in poor condition, with a lack of adequate maintenance and possible structural problems. Areas with poor rehabilitation could be contributing to problems such as reduced mobility, increased insecurity, and lower quality of life.

The majority of respondents, 66 %, perceive urban rehabilitation as adequate. This positive result suggests that two-thirds of the city has experienced sufficient improvements in infrastructure and public spaces, making them functional and relatively well maintained. Although there is room for improvement, these results indicate that rehabilitation policies and efforts are moving in the right direction, providing an acceptable urban environment for most residents.

Five percent of respondents consider urban rehabilitation in Juliaca to be good. This low percentage indicates that very few areas have achieved a higher level of rehabilitation, with well-maintained infrastructure and high-quality public spaces. This result points to the need to increase efforts to raise more areas of the city to this level of excellence, thereby benefiting a greater number of inhabitants.

None of the areas evaluated or respondents consider urban rehabilitation to be excellent. The total absence of excellence ratings suggests that there are no areas in Juliaca that are considered optimal in terms of urban rehabilitation. This highlights the critical need to raise rehabilitation standards to achieve levels of excellence, integrating more effective and sustainable practices into urban design and maintenance.

Table 2. Descriptive results for sustainable architecture

	Freq.	%	% Val.	% Accum.
Very low	6	3	3	3
Low	118	61	61	61
Adequate	68	35	35	96
High	1	1	1	97
Total	193	100	100	

The interpretation of the frequency table results reveals that while a significant portion of Juliaca (66 %) has achieved an adequate level of urban rehabilitation and rehabilitation, a considerable 29 % remains in poor

condition and an insignificant 5 % in good condition. The lack of areas with excell urban rehabilitation indicates that current efforts, while moving in the right direction, need to be intensified and improved to achieve higher and more sustainable standards.

Table 2 shows that 3 % of the evaluations indicate a very low level of sustainable architecture. This small percentage suggests that only a minimal proportion of projects or buildings in Juliaca completely lack sustainability considerations, using highly unsustainable materials and methods. This is a positive aspect, as it implies that most of the city has exceeded the lowest threshold of architectural sustainability.

The majority, 61 %, rate sustainable architecture as low. This percentage indicates that most infrastructure and buildings in Juliaca have few sustainability measures in place. Although they are not at the lowest level, there is still a heavy reliance on unsustainable materials and practices. This suggests an urgent need to improve and increase sustainable practices in the city's architecture.

Thirty-five percent of the assessments indicate an adequate level of sustainable architecture. This significant percentage shows that one-third of the infrastructure and buildings in Juliaca have incorporated sufficient sustainable measures to be considered adequate. This is encouraging, as it demonstrates that there are practices and projects that have achieved an acceptable standard of sustainability. However, it also indicates that there is still room for significant improvement to take these practices to the next level.

One percent of the assessments reflect a high level of sustainable architecture. This extremely low result reveals that very few infrastructures or projects in Juliaca have achieved a high level of sustainability. This underscores the need to foster and promote more sustainable architectural practices that can serve as exemplary models for future developments.

The interpretation of the data on sustainable architecture in Juliaca shows a worrying situation where most projects are still at low levels of sustainability, with 61 % of assessments in the low range and only 1 % reaching a high level. It is clear that current design and construction practices need to be reevaluated and improved.

Table 3. Contingency table for general hypothesis

		Sustainable architecture
Urban rehabilitation	Pearson correlation	0,727**
	Sig. (bilateral)	0,000
	N	193

Note: **. The correlation is significant at the 0,01 level (bilateral).

Table 3 shows a Pearson correlation coefficient of r=0,727, which indicates a strong positive correlation between the variables studied, in this case, urban rehabilitation and sustainable architecture. This suggests that as urban rehabilitation improves in Juliaca, sustainable architecture also improves, and vice versa. This means that there is a significant and robust relationship between urban rehabilitation efforts and the implementation of sustainable architecture practices. In practical terms, areas of the city that have undergone effective urban rehabilitation also tend to be those that have adopted sustainable architecture principles, indicating that these two practices are interrelated and mutually reinforcing. Furthermore, the value of p=0,000 indicates acceptance of the researcher's hypothesis.

Table 4. Contingency table for specific hypotheses

		Community impact	Heritage conservation	Improved infrastructure
Sustainable architecture	Pearson correlation	0,571**	0,838**	0,744**
	Sig. (bilateral)	0,000	0,000	0,000
	N	193	193	193

Table 4 shows the inferential results of the present study, which reveal a correlation coefficient of r=0,571 with regard to community impact, indicating a moderate to strong positive correlation between urban rehabilitation and sustainable architecture and their impact on the community. This suggests that the implementation of urban rehabilitation and sustainable architecture practices has a considerable impact on the community. This may include improvements in social cohesion, greater community participation, and a better quality of life for residents. The statistical significance (p=0,000) confirms the acceptance of the researcher's hypothesis.

In relation to heritage conservation, the correlation coefficient r=0,838 indicates a very strong positive correlation between urban rehabilitation and sustainable architecture, and heritage conservation, suggesting

that urban rehabilitation and sustainable architecture are closely linked to the conservation of Juliaca's historical heritage. The statistical significance (p=0,000) confirms the acceptance of the researcher's hypothesis.

In relation to infrastructure improvement, the correlation coefficient r=0,744 indicates a strong positive correlation between urban rehabilitation and sustainable architecture, and infrastructure improvement. This correlation suggests that urban rehabilitation and sustainable architecture practices are having a significant impact on infrastructure improvement in Juliaca. The statistical significance (p=0,000) confirms the validity of this relationship and, therefore, the acceptance of the researcher's hypothesis.

The statistical data show that there are significant and strong relationships between urban rehabilitation and sustainable architecture and their impacts on various areas in the city of Juliaca. The positive correlation between these practices and community impact, heritage conservation, and infrastructure improvement indicates that urban rehabilitation and sustainability efforts are having substantial and multidimensional positive effects.

DISCUSSION

The results of this study confirm a strong and significant relationship between urban rehabilitation, sustainable architecture, and their impact on various aspects of the city, including infrastructure, community, and heritage conservation. In this regard, Li et al.[20] highlight the importance of integrating sustainable practices into urban planning to achieve more resilient and sustainable cities. Their study supports the findings that urban rehabilitation and sustainable architecture are interrelated and mutually reinforcing. The strong positive correlation observed in Juliaca is consistent with the results of Li et al., who argue that cities that adopt a holistic and integrated approach to urban development achieve significant improvements in quality of life and urban resilience.[21,22,23,24,25,26]

König et al.[5] focus on the relationship between urban sustainability and heritage conservation. Their research concludes that the preservation of historical heritage is essential for maintaining cultural identity and attracting sustainable tourism. The very strong correlation between urban rehabilitation, sustainable architecture, and heritage conservation in Juliaca reinforces these conclusions, underscoring the need for integrated policies that consider these aspects to maximize cultural and economic benefits. Milovanović et al.[6] analyze the impact of urban rehabilitation on social cohesion and community participation. Their study shows that urban rehabilitation and sustainable architecture practices encourage greater citizen participation and strengthen social cohesion, findings that are consistent with the results obtained in Juliaca. The moderate to strong positive correlation between these factors in Juliaca confirms that these practices not only improve the physical infrastructure but also the social fabric of the city.[27,28,29,30]

Oleynikov et al. investigate the impact of sustainable infrastructure on urban development. Their findings highlight that the implementation of sustainable technologies in infrastructure projects significantly improves urban functionality and the efficiency of public services. The strong correlation observed in Juliaca between urban rehabilitation, sustainable architecture, and infrastructure improvement validates these results, demonstrating that sustainable practices are fundamental to efficient and resilient urban development. Ravagnan et al.[8] explore how urban rehabilitation can contribute to environmental and social sustainability. Their study reveals that cities that integrate sustainable architecture practices into their urban rehabilitation strategies achieve better results in terms of environmental sustainability and quality of life. The findings in Juliaca, which show a strong and significant relationship between these factors, support the importance of an integrated approach to achieving sustainable and equitable urban development.[31,32,33,34,35]

Tahri[9] addresses sustainable urban planning in the context of developing cities. His research suggests that adopting sustainable architecture and urban rehabilitation practices can accelerate sustainable development in these cities. The results in Juliaca, which confirm the interdependence and mutual l reinforcement between urban rehabilitation and sustainable architecture, support Tahri's recommendations to implement integrated policies to improve urban sustainability. Ismaeel et al.[10] investigate the impact of urban rehabilitation on urban infrastructure. Their study concludes that urban rehabilitation practices that incorporate sustainability principles result in significant improvements in urban infrastructure. The findings in Juliaca, with a strong positive correlation between these factors, corroborate this conclusion, underscoring the importance of integrating sustainable practices into infrastructure projects to maximize their effectiveness and durability.

Haseeb[11] examines the relationship between sustainable architecture and urban quality of life. His research demonstrates that the implementation of sustainable architecture practices improves the quality of life of urban residents by providing healthier and more livable environments. The relationship observed in Juliaca between urban rehabilitation, sustainable architecture, and improved quality of life confirms Haseeb's findings and highlights the importance of an integrated approach to urban development. Donais et al.[12] analyze the economic benefits of urban rehabilitation and sustainable architecture. Their study shows that these practices not only improve the urban environment but also have a positive impact on the local economy by attracting investment and increasing property values. The results in Juliaca, which indicate a strong correlation between

urban rehabilitation, sustainable architecture, and infrastructure improvement, support these economic benefits and highlight the importance of policies that promote urban sustainability.

Salas et al.[15] investigate the intersection between urban rehabilitation, sustainable architecture, and community participation in the Latin American context. Their findings suggest that greater community participation in urban rehabilitation and sustainable architecture projects results in greater acceptance and success of these projects. The results in Juliaca, which show a significant relationship between these factors, reinforce the need to involve the community in the urban development process to maximize benefits and ensure equitable development.

Research on urban rehabilitation and sustainable architecture in Juliaca confirms that there is a strong and significant relationship between these aspects and their impact on infrastructure, the community, and heritage conservation. The results of this study are consistent with the research of Li et al.[20], König et al.[5], Milovanović et al.[6], Oleynikov et al.[7], Ravagnan et al.[8], Tahri[9], Ismaeel et al.[10], Haseeb[11], Donais et al.[12], and Salas et al.[15], highlighting the importance of an integrated and holistic approach to urban development. Therefore, implementing policies and projects that consider urban rehabilitation and sustainable architecture together can lead to a more sustainable, resilient, and equitable future for Juliaca, improving the quality of life of its inhabitants and preserving its urban environment for future generations.[36,37,38]

CONCLUSIONS

The overall objective of this research was to determine the relationship between urban rehabilitation and sustainable architecture. The results obtained show a Pearson correlation coefficient indicating a strong positive correlation between the variables studied. This finding suggests that as urban rehabilitation improves in Juliaca, sustainable architecture also improves, and vice versa. This means that there is a significant and robust relationship between urban rehabilitation efforts and the implementation of sustainable architecture practices. In practical terms, this implies that projects and policies that focus on urban rehabilitation in Juliaca should not only consider improving infrastructure and services, but also incorporating sustainable architecture principles to maximize the positive impact on the city.

The first specific objective of this research was to determine the relationship between the community impact of urban rehabilitation and sustainable architecture. The results obtained show a Pearson correlation coefficient indicating a moderate to strong positive correlation between urban rehabilitation and sustainable architecture and their impact on the community. This suggests that there is a significant relationship between the implementation of urban rehabilitation practices and sustainable architecture and the positive impact on the community. In turn, this implies that as urban rehabilitation and sustainable architecture practices are implemented and improved, notable improvements will be observed in various aspects of community life.

The second specific objective of this research was to determine the relationship between heritage conservation and urban rehabilitation and sustainable architecture. The results obtained show a Pearson correlation coefficient indicating a very strong positive correlation between the variables studied: urban rehabilitation, sustainable architecture, and heritage conservation. This finding implies that urban rehabilitation and sustainable architecture practices are closely linked to heritage conservation efforts. In practical terms, this means that areas that have undergone effective urban rehabilitation and adopted sustainable architecture practices are also those that have achieved better conservation of their historical heritage.

The third specific objective of this research was to determine the relationship between infrastructure improvement and urban rehabilitation and sustainable architecture. The results obtained show a Pearson correlation coefficient indicating a strong positive correlation between the variables studied: urban rehabilitation, sustainable architecture, and infrastructure improvement. This implies that as urban rehabilitation and sustainable architecture practices are implemented and improved, a considerable improvement in the city's infrastructure is observed. In practical terms, this means that areas that have undergone effective urban rehabilitation and adopted sustainable architecture principles have also experienced notable improvements in their infrastructure, including transportation systems, public service networks, and the quality of public spaces.

REFERENCES

1. Saito D, Velázquez C. Arquitectura Biofílica. Universidad Nacional Autónoma de México; 2021.

2. Aguirre MM, Quispe CY, Ticsihua LC. Arquitectura biofílica aplicada en la propuesta de un centro de rehabilitación físico y mental postCOVID – región Huánuco 2021. Universidad Continental; 2021.

3. Zambrano RVH, Milanes CB, Montero OP, Mestanza-Ramón C, Bolivar LON, Loor DC, et al. A Sustainable Proposal for a Cultural Heritage Declaration in Ecuador: Vernacular Housing of Portoviejo. Sustainability (Switzerland). 2023;15(2). Available from: https://doi.org/10.3390/su15021115

4. Li Y, Tao Y, Qian QK, Mlecnik E, Visscher HJ. Critical factors for effective resident participation in neighborhood rehabilitation in Wuhan, China: From the perspectives of diverse stakeholders. Landscape and Urban Planning. 2024;244:105000. Available from: https://doi.org/10.1016/J.LANDURBPLAN.2023.105000

5. König K, Vielhaber M. Analysis of the Interrelationships between Lightweight Design and Design for Sustainability. Procedia CIRP. 2024;122:324-9. Available from: https://doi.org/10.1016/J.PROCIR.2024.01.048

6. Milovanović A, Dragutinovic A, Nikezić A, Pottgiesser U, Stojanovski M, Deskova AI, et al. Rehabilitation of Mass Housing as a Contribution to Social Equality: Insights from the East-West European Academic Dialogue. Sustainability (Switzerland). 2022;14(13). Available from: https://doi.org/10.3390/su14138106

7. Oleynikov A, ARSLAN M, Pertsev V. RENOVATION OF URBAN TERRITORIES: PROBLEMS AND SOLUTIONS ON THE EXAMPLE OF BELGOROD. Bulletin of Belgorod State Technological University named after. V. G. Shukhov. 2023;8(7):71-83. Available from: https://doi.org/10.34031/2071-7318-2023-8-7-71-83

8. Ravagnan C, Rossi F, Amiriaref M. Sustainable Mobility and Resilient Urban Spaces in the United Kingdom. Practices and Proposals. Transportation Research Procedia. 2022;60:164-71. Available from: https://doi.org/10.1016/j.trpro.2021.12.022

9. Tahri D. VALUING THE URBAN SPACE ACCORDING TO THE REHABILITATION OF GREEN SPACES. Stavební obzor - Civil Engineering Journal. 2022;31(2):274-90. Available from: https://doi.org/10.14311/cej.2022.02.0021

10. Ismaeel WSE, Adel Elsayed M, Salaheldin Ismail Elsayed D. Revisiting 'Sabil' buildings as nuclei of sustainable urban mobility in Fatimid Cairo: An urban-touristic approach considering urban and environmental qualities. Ain Shams Engineering Journal. 2022;13(6):101774. Available from: https://doi.org/10.1016/J.ASEJ.2022.101774

11. Haseeb QS, Sumbul MY, Aziz AI. Sustainability-based hybridization interventions, the urban fabric of Erbil Citadel - Iraq – As a case study. Alexandria Engineering Journal. 2023;75:615-25. Available from: https://doi.org/10.1016/J.AEJ.2023.04.064

12. Marleau Donais F, Abi-Zeid I, Waygood EOD, Lavoie R. Municipal decision-making for sustainable transportation: Towards improving current practices for street rejuvenation in Canada. Transportation Research Part A: Policy and Practice. 2022;156:152-70. Available from: https://doi.org/10.1016/j.tra.2021.12.009

13. Carrascal Pérez MF. Art and urban regeneration in New York City. Doris C. Freedman's public project | Arte y regeneración urbana en Nueva York. El proyecto público de Doris C. Freedman. VLC Arquitectura. 2021;8(1):97-118. Available from: https://doi.org/10.4995/vlc.2021.12709

14. Garza-Rodríguez FR, Ramírez-Agudelo NA, Bosch ER, Junyent MV. Culture as an urban regeneration strategy in Monterrey, Mexico | La cultura com a estratègia de regeneració urbana a Monterrey, Mèxic | La culture en tant que stratégie de revitalisation urbaine à Monterrey, au Mexique | La cultura como estrategia de rege. Documents d'Analisi Geografica. 2021;67(1):103-32. Available from: https://doi.org/10.5565/rev/dag.555

15. Salas V, Cabrera JE. LO ESTÉTICO Y LA CALIDAD DE VIDA: EL PROGRAMA DE REHABILITACIÓN URBANA «BARRIOS DE VERDAD» AESTHETICS AND QUALITY OF LIFE: THE URBAN REHABILITATION PROGRAM «BARRIOS DE VERDAD». INVESTIGACIÓN & DESARROLLO. 2022;22(2):105-24. Available from: https://doi.org/10.23881/idupbo.022.2-6e

16. Hernández-Sampieri R, Mendoza-Torres CP. Metodología de la investigación: las tres rutas cuantitativa, cualitativa y mixta. Mc Graw Hill; 2018.

17. Ñaupas H, Mejía E, Novoa E, Villagómez A. Metodología de la investigación cuantitativa - cualitativa y redacción de la Tesis. Ediciones de la U; 2014.

18. Namakforoosh M. Metodología de la investigación. Limusa; 2005.

19. Supo J. Seminarios de Metodología de la Investigación Científica. In: Metodologia de investigacion

cientifica. Vol. 1. 2014.

20. Li Y, Tao Y, Qian QK, Mlecnik E, Visscher HJ. Critical factors for effective resident participation in neighborhood rehabilitation in Wuhan, China: From the perspectives of diverse stakeholders. Landscape and Urban Planning. 2024;244:105000. Available from: https://doi.org/10.1016/J.LANDURBPLAN.2023.105000

21. Zambrano RVH, Milanes CB, Montero OP, Mestanza-Ramón C, Bolivar LON, Loor DC, et al. A Sustainable Proposal for a Cultural Heritage Declaration in Ecuador: Vernacular Housing of Portoviejo. Sustainability (Switzerland). 2023;15(2). Available from: https://doi.org/10.3390/su15021115

22. Aguirre MM, Quispe CY, Ticsihua LC. Arquitectura biofílica aplicada en la propuesta de un centro de rehabilitación físico y mental postCOVID – región Huánuco 2021. Universidad Continental; 2021.

23. Carrascal Pérez MF. Art and urban regeneration in New York City. Doris C. Freedman's public project | Arte y regeneración urbana en Nueva York. El proyecto público de Doris C. Freedman. VLC Arquitectura. 2021;8(1):97-118. Available from: https://doi.org/10.4995/vlc.2021.12709

24. Garza-Rodríguez FR, Ramírez-Agudelo NA, Bosch ER, Junyent MV. Culture as an urban regeneration strategy in Monterrey, Mexico | La cultura com a estratègia de regeneració urbana a Monterrey, Mèxic | La culture en tant que stratégie de revitalisation urbaine à Monterrey, au Mexique | La cultura como estrategia de rege. Documents d'Analisi Geografica. 2021;67(1):103-32. Available from: https://doi.org/10.5565/rev/dag.555

25. Haseeb QS, Sumbul MY, Aziz AI. Sustainability-based hybridization interventions, the urban fabric of Erbil Citadel - Iraq – As a case study. Alexandria Engineering Journal. 2023;75:615-25. Available from: https://doi.org/10.1016/J.AEJ.2023.04.064

26. Hernández-Sampieri R, Mendoza-Torres CP. Metodología de la investigación: las tres rutas cuantitativa, cualitativa y mixta. Mc Graw Hill; 2018.

27. Ismaeel WSE, Adel Elsayed M, Salaheldin Ismail Elsayed D. Revisiting 'Sabil' buildings as nuclei of sustainable urban mobility in Fatimid Cairo: An urban-touristic approach considering urban and environmental qualities. Ain Shams Engineering Journal. 2022;13(6):101774. Available from: https://doi.org/10.1016/J.ASEJ.2022.101774

28. König K, Vielhaber M. Analysis of the Interrelationships between Lightweight Design and Design for Sustainability. Procedia CIRP. 2024;122:324-9. Available from: https://doi.org/10.1016/J.PROCIR.2024.01.048

29. Marleau Donais F, Abi-Zeid I, Waygood EOD, Lavoie R. Municipal decision-making for sustainable transportation: Towards improving current practices for street rejuvenation in Canada. Transportation Research Part A: Policy and Practice. 2022;156:152-70. Available from: https://doi.org/10.1016/j.tra.2021.12.009

30. Milovanović A, Dragutinovic A, Nikezić A, Pottgiesser U, Stojanovski M, Deskova AI, et al. Rehabilitation of Mass Housing as a Contribution to Social Equality: Insights from the East-West European Academic Dialogue. Sustainability (Switzerland). 2022;14(13). Available from: https://doi.org/10.3390/su14138106

31. Namakforoosh M. Metodología de la investigación. Limusa; 2005.

32. Ñaupas H, Mejía E, Novoa E, Villagómez A. Metodología de la investigación cuantitativa - cualitativa y redacción de la Tesis. Ediciones de la U; 2014.

33. Oleynikov A, ARSLAN M, Pertsev V. RENOVATION OF URBAN TERRITORIES: PROBLEMS AND SOLUTIONS ON THE EXAMPLE OF BELGOROD. Bulletin of Belgorod State Technological University named after. V. G. Shukhov. 2023;8(7):71-83. Available from: https://doi.org/10.34031/2071-7318-2023-8-7-71-83

34. Ravagnan C, Rossi F, Amiriaref M. Sustainable Mobility and Resilient Urban Spaces in the United Kingdom. Practices and Proposals. Transportation Research Procedia. 2022;60:164-71. Available from: https://doi.org/10.1016/j.trpro.2021.12.022

35. Saito D, Velázquez C. Arquitectura Biofílica. Universidad Nacional Autónoma de México; 2021.

36. Salas V, Cabrera JE. LO ESTÉTICO Y LA CALIDAD DE VIDA: EL PROGRAMA DE REHABILITACIÓN URBANA «BARRIOS DE VERDAD» AESTHETICS AND QUALITY OF LIFE: THE URBAN REHABILITATION PROGRAM «BARRIOS DE VERDAD». INVESTIGACIÓN & DESARROLLO. 2022;22(2):105-24. Available from: https://doi.org/10.23881/idupbo.022.2-6e

37. Supo J. Seminarios de Metodología de la Investigación Científica. In: Metodologia de investigacion cientifica. Vol. 1. 2014.

38. Tahri D. VALUING THE URBAN SPACE ACCORDING TO THE REHABILITATION OF GREEN SPACES. Stavební obzor - Civil Engineering Journal. 2022;31(2):274-90. Available from: https://doi.org/10.14311/cej.2022.02.0021

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