Land and Architecture. 2026; 5:286
doi: 10.56294/la2026286

ORIGINAL

Bioclimatic Assessment and Thermal-Lighting Comfort in Vernacular Dwellings in the Jejenal District

Evaluación Bioclimática y Confort Térmico-Lumínico en Viviendas Vernáculas del Recinto Jejenal

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Cite as: Moreira Moreira DE, Delgado Moreira JJ, Intriago AAF. Bioclimatic Assessment and Thermal-Lighting Comfort in Vernacular Dwellings in the Jejenal District. Land and Architecture. 2026; 5:286. https://doi.org/10.56294/la2026286

Submitted: 07-01-2025 **Revised:** 01-05-2025 **Accepted:** 18-11-2025 **Published:** 01-01-2026

Editor: Prof. Emanuel Maldonado

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ABSTRACT

This work addressed the issue of vernacular housing in the Jejenal area in the parish of San Isidro, with the aim of determining the climatic adversities such as high temperatures and relative humidity, which condition the capacity for thermal and light comfort of the population. A mixed-approach investigation was carried out that combines in situ measurements and computer simulations. The current conditions of these homes and their performance in relation to the environment were assessed, as well as the strengths and weaknesses that local construction strategies have been generating. The research work aims to make local architectural traditions efficient in order to improve the quality of life of the population that inhabits them through sustainable solutions. Although the homes in the Jejenal area formally represent a cultural heritage, there are important deficiencies, including the utility of the homes, as well as the overheating of the air inside them or an inefficient distribution of the windows. The results obtained demonstrate that, although native materials such as guadua cane or wood have great potential to offer sustainable solutions, their application entails correcting major deficiencies in construction techniques. Strategies such as the correct orientation of homes, the generation of shadows, as well as the use of passive ventilation are identified as key solutions for improving living conditions. This work proposes both construction guidelines, especially those that integrate traditional and bioclimatic knowledge, a model of sustainable rural housing that responds to the climatic and socioeconomic conditions of the region.

Keywords: Thermal Comfort; Light Comfort; Guadua Cane; Vernacular Housing; Bioclimatic.

RESUMEN

El presente trabajo trató la temática de las viviendas vernáculas del recinto Jejenal en la parroquia de San Isidro,cantón Sucre, con el objetivo de determinar las adversidades climáticas como son las altas temperaturas y la humedad relativa, se trabajó en una investigación de enfoque mixto que combina mediciones in situ, simulaciones computacionales. Se valoró las condiciones actuales en que se encuentran estas viviendas y su desempeño ante el entorno, así como las fortalezas y debilidades que las estrategias constructivas locales han ido generando. El trabajo investigativo pretende hacer eficientes las tradiciones arquitectónicas locales para mejorar la calidad de vida de la población que las habita a través de soluciones sostenibles. Las viviendas del recinto Jejenal, aunque suponen formalmente un patrimonio cultural, existen deficiencias importantes entre ellas la utilidad de las viviendas, así como el sobrecalentamiento del aire en su interior o una distribución de las ventanas poco eficiente. Los resultados obtenidos demuestran que, si bien los materiales autóctonos como la caña guadua o la madera tienen un gran potencial para ofrecer soluciones sostenibles, su

aplicación conlleva subsanar grandes deficiencias existentes en las técnicas constructivas. Estrategias como la correcta orientación de las viviendas, la generación de sombras, así como la utilización de ventilación pasiva se identifican como soluciones clave para el mejoramiento de las condiciones de habitabilidad. Este trabajo propone tantos lineamientos constructivos especialmente aquellos que integran saberes tradicionales y bioclimáticos, un modelo de vivienda rural sostenible que responde a las condiciones climáticas y socioeconómicas de la región.

Palabras clave: Confort Térmico; Confort Lumínico; Caña Guadua; Viviendas Vernáculas; Bioclimática.

INTRODUCTION

The limited supply of housing in Ecuador, in rural areas of the country such as the Jejenal district of the San Isidro parish, Sucre state, is one of the greatest barriers to sustainable development and quality of life for the population. The problem is exacerbated by the fact that many of the homes currently being built are not designed to meet minimum thermal and lighting comfort standards.

Bioclimatic design could be one of the solutions to overcome these limitations. Given the local climatic conditions and the natural conditions of the target psychological environment, the aim is to minimize the deficiency of external energy resources, maximizing efficiency in heating and transit through the lighting of the home. In this sense, bioclimatic design is essential in accordance with the use of natural ventilation, solar orientation, and improving the happiness of its occupants.

The study of thermal and lighting comfort in the homes of the inhabitants of the Jejenal complex not only allows for a reduction in energy consumption but also modifies the traditional type of construction. By applying bioclimatic design principles appropriate to the climate and environment of the parish of San Isidro, we will contribute to obtaining resilient and sustainable homes that, in turn, meet the current needs of the local population.[1] The objective of this research is therefore to gain greater knowledge, but also to seek to optimize the comfort of the inhabitants of the dwellings, i.e., a housing model that is not only efficient and sustainable but also adaptable to climate change and, at the same time, conducive to reducing energy consumption.[2]

The present research aims to analyze the vernacular dwellings of the Jejenal area in the parish of San Isidro, Sucre canton, in order to evaluate the thermal and lighting comfort conditions through mixed research to generate architectural guidelines that improve the habitability and quality of life of its population.

METHOD

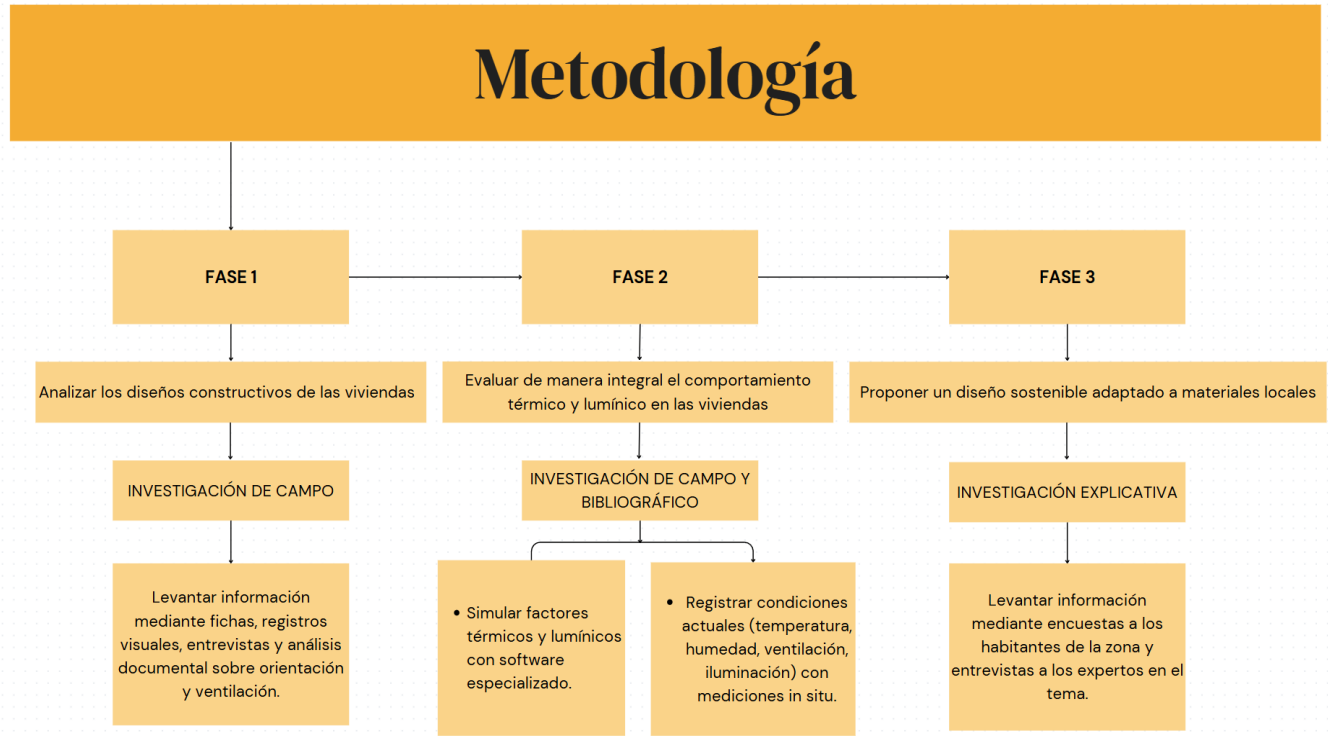


Figure 1. Schematic diagram of the methodological framework

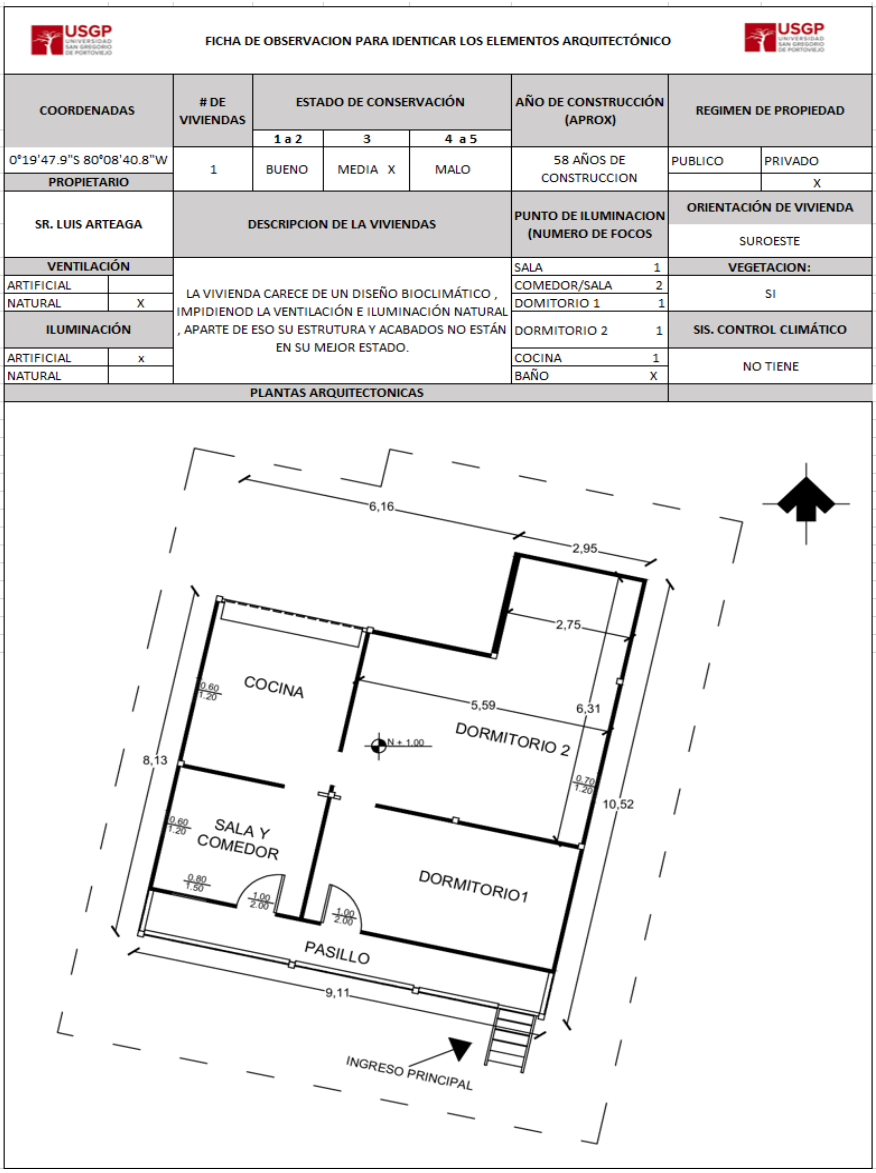
The study was conducted using a mixed approach, according to Hernández[3] combining quantitative and qualitative techniques to analyze a topic from different angles. According to Hernández Sampieri et al.[4] research design is the way in which the researcher approaches and responds to the problem at hand. The field research is based on the need to capture the different environmental conditions of the San Isidro parish and how they interact with the conventional building materials of the dwellings. On-site measurements ensure that the data collected accurately reflect the thermal and lighting conditions of the environment, allowing for a more accurate and contextualized analysis of possible solutions that could improve the comfort of the dwellings examined.

In addition, the study incorporates interviews and surveys to capture the perceptions of the inhabitants. Likewise, professionals knowledgeable about the thermal and lighting conditions of vernacular dwellings will be interviewed, complementing the quantitative data from the bioclimatic analysis. This provides a contextualized view of local adaptations and needs to improve comfort.[5] Figure 1 below shows the steps followed to carry out the research.

RESULTS

It was found that, although San Isidro had a large repertoire of traditional materials such as guadua cane, this material was rarely used in today's constructions. Surveys of residents at the time showed a certain negative opinion associated with houses in the lower socioeconomic stratum, leading to a preference for materials such as brick or block.

Results of phase 1



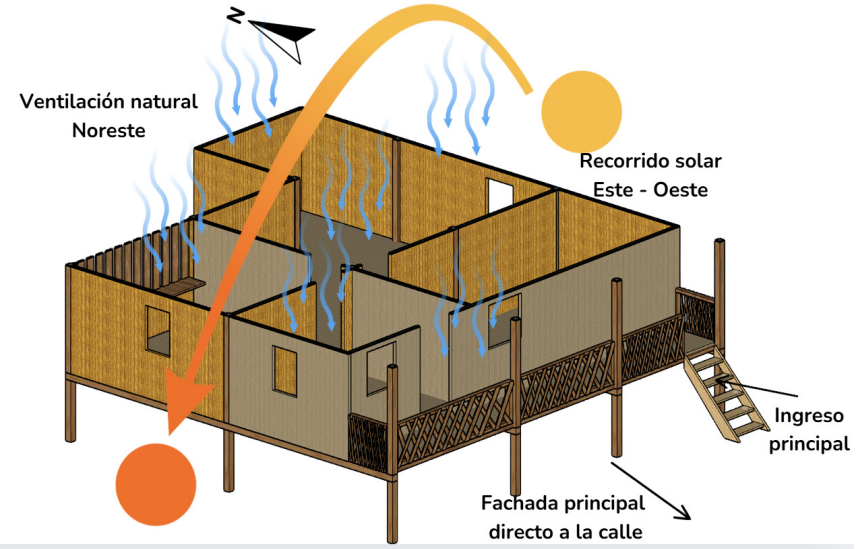
FICHA DE OBSERVACION PARA IDENTICAR LOS ELEMENTOS ARQUITECTÓNICO

COORDENADAS	# DE VIVIENDAS	ESTADO DE CONSERVACIÓN			AÑO DE CONSTRUCCIÓN (APROX)	REGIMEN DE PROPIEDAD	
		1 a 2	3	4 a 5			
0°19'47.9"S 80°08'40.8"W	1	BUENO	MEDIA X	MALO	58 AÑOS DE CONSTRUCCION	PUBLICO	PRIVADO
PROPIETARIO							X
SR. LUIS ARTEAGA	DESCRIPCION DE LA VIVIENDAS				PUNTO DE ILUMINACION (NUMERO DE FOCOS	ORIENTACIÓN DE VIVIENDA	
						SUROESTE	
VENTILACIÓN	LA VIVIENDA CARECE DE UN DISEÑO BIOCLIMÁTICO , IMPIDIENOD LA VENTILACIÓN E ILUMINACIÓN NATURAL , APARTE DE ESO SU ESTRUTURA Y ACABADOS NO ESTÁN EN SU MEJOR ESTADO.				SALA 1	VEGETACION:	
ARTIFICIAL					COMEDOR/SALA 2	SI	
NATURAL	X				DOMITORIO 1 1		
ILUMINACIÓN					DORMITORIO 2 1	SIS. CONTROL CLIMÁTICO	
ARTIFICIAL	x				COCINA 1	NO TIENE	
NATURAL					BAÑO X		
PLANTAS ARQUITECTONICAS							

Figure 2. Observation sheets for construction elements

AREA DE CONSTRUCION:			80.66 m2	AREA DE TERRENO:	770 m2
DESCRIPCIÓN FISICA CONSTRUCTIVA					
ELEMENTOS CONTRUCTIVOS	ESTADO DE LA ESTRUCTURA			MATERIALES DE CONSTRUCCION	OBSERVACIONES
	BUENO 1-2	MEDIO 3	MALO 4 - 5		
CIMENTACIÓN			X	Madera	La imagen refleja condiciones precarias que no son adecuadas para garantizar un entorno de vida digno. La estructura hecha de caña o madera rústica parece desgastada, con una evidente falta de mantenimiento. Además, las condiciones climáticas medidas con el dispositivo podrían estar exacerbando la situación, ya que materiales como estos ofrecen poca resistencia frente a cambios de temperatura, humedad o lluvias. Este tipo de construcción evidencia la ausencia de políticas efectivas de vivienda por parte del Estado, dejando a las familias en una situación vulnerable que compromete tanto su comodidad como su salud.
CONTRAPISO	X			Madera	
ESTRUCTURA			X	Madera	
MUROS			X	Caña guadua	
PAREDES			X	Caña guadua	
CUBIERTAS		X		Zinc	
SOPORTES	X			Madera	
VENTANAS		X		Caña guadua	
PUERTAS			X	Madera	
CIELO RASO				Ninguno	
ESCALERAS			X	Madera - Caña guadua	
PORTANTES	X			Madera	
BARANDALES			X	Caña guadua	

Figure 3. Solar path and natural ventilation - House one



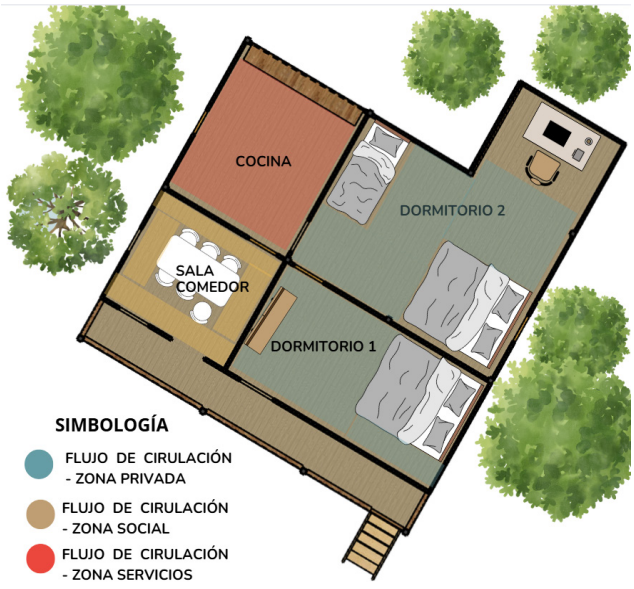


Figure 4. Circulation flow - Analysis of house one

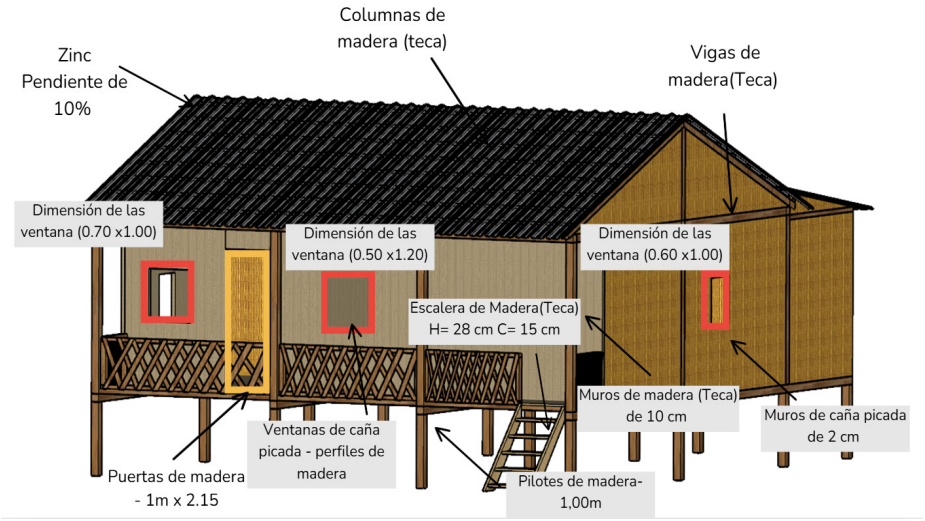


Figure 5. Analysis of the architectural elements of house one

Results of Stage 2

Figure 6. Application of simulators for solar radiation in each time period (Sun Earth tool, Sun path)

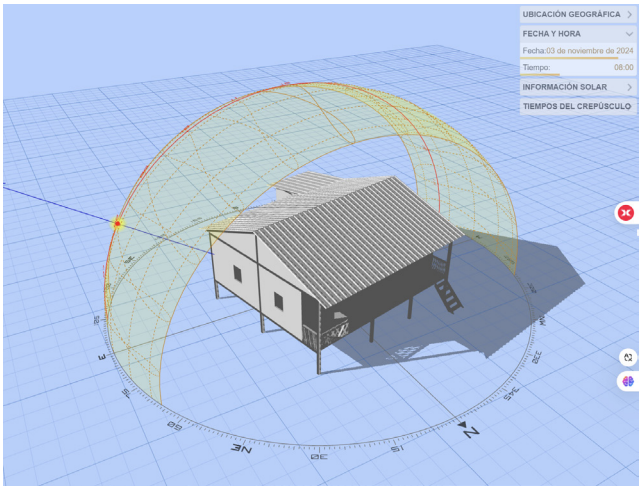


Figure 7. Application of simulators for solar radiation from 8:00 to 9:00 (Sun - path)

https://doi.org/10.56294/la2026286 ISSN: 3072-7634

Wind speed (km/h)

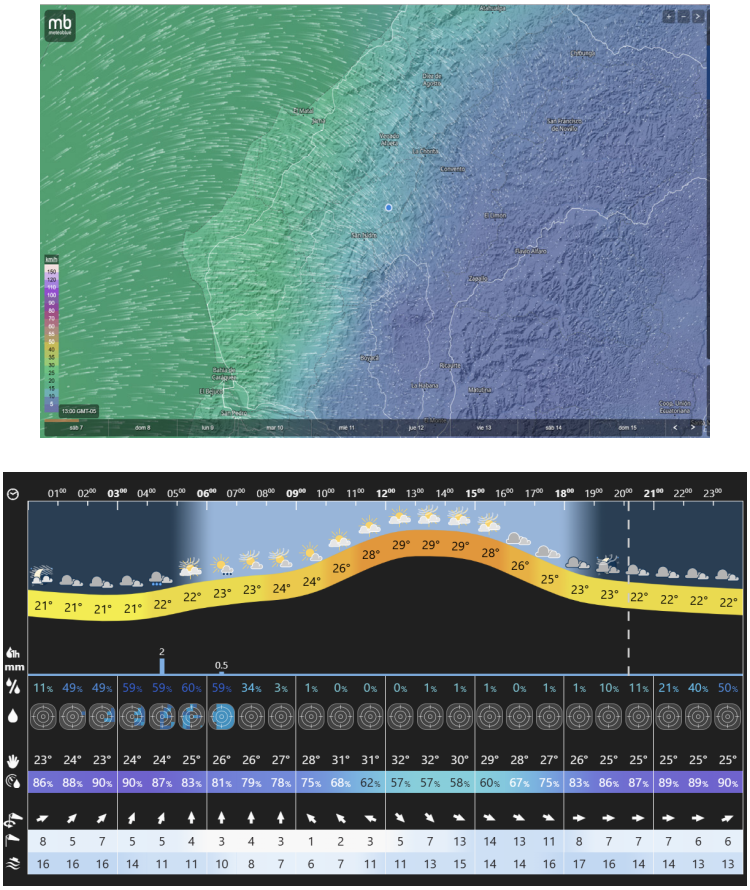


Figure 8. Application of simulators for natural ventilation (meteoblue)

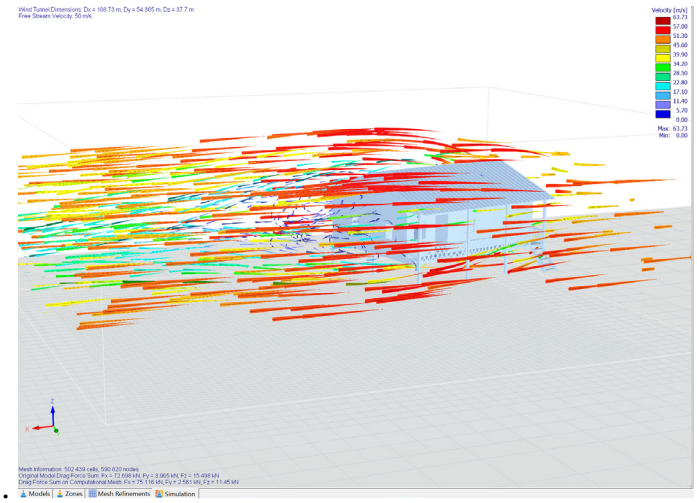


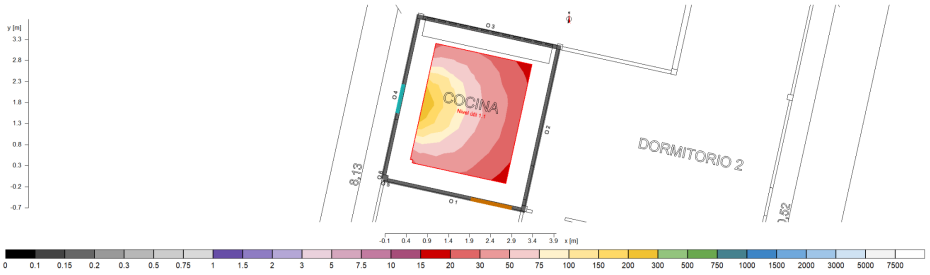
Figure 9. Application of simulators for natural ventilation (km/h) in each period and zone

The measurement data for ventilation in the first dwelling also reveal that wind circulation is highly variable. It is clear that wind speed is low in the living room and dining room (3,76 to 6,50 km/h) and increases progressively towards the afternoon, suggesting that ventilation is greater during this period, probably due to the prevailing wind direction in this direction. The highest speeds (9,76 to 14,90 km/h) are found in the bathroom, which would indicate greater exposure to wind currents, probably due to its orientation and/or the existence of openings in the building, as the bathroom is not located inside the dwelling. On the other hand, the kitchen has the lowest values, with speeds ranging from 0,80 to 2,07 km/h, which may mean that there are significant obstacles to wind diffusion or that the orientation is less favorable to wind currents. The bedroom, on the other hand, has moderate speeds of 3,10 to 4,20 km/h, which would seem to indicate more stable but also more limited ventilation conditions, especially in the morning.

UNIVERSIDAD SAN GREGORIO DE PORTOVIEJO												
ELABORADO POR :	JOSSELYN DELGADO , ARIEL FRANCO										HORA DE VISITA:	
FECHA: 03/12/24	COORDENADAS:			UBICACIÓN DE LA VIVIENDA:			SUROESTE				AREA: 80,66 M2	
DATOS DE MEDICIONES IN SITU (VENTILACIÓN - VIENTO)												
ZONAS/ÁREA	8:00 a 9:00			11:00 a 12:00			13:00 a 14:00				Observación	
SALA	BUENA (20 o Más Km/h)			BUENA (20 o Más Km/h)			BUENA (20 o Más Km/h)					
	REGULAR (10 a 20 Km/h)			REGULAR (10 a 20 Km/h)			REGULAR (10 a 20 Km/h)					
	BAJA (0-10 Km/h)	3,76 km/h	X	BAJA (0-10 Km/h)	4,65 km/h	x	BAJA (0-10 Km/h)	6,50 km /h	x			
	INEXISTENTE			INEXISTENTE			INEXISTENTE					
	ARTIFICAL			ARTIFICAL			ARTIFICAL					
	NATURAL		X	NATURAL		X	NATURAL		X			
DORMITORIO	BUENA (20 o Más Km/h)			BUENA (20 o Más Km/h)			BUENA (20 o Más Km/h)					
	REGULAR (10 a 20 Km/h)			REGULAR (10 a 20 Km/h)			REGULAR (10 a 20 Km/h)					
	BAJA (0-10 Km/h)	3,10 km/h	x	BAJA (0-10 Km/h)	3,85 km/h	X	BAJA (0-10 Km/h)	4,2 km/h	X			
	INEXISTENTE			INEXISTENTE			INEXISTENTE					
	ARTIFICAL			ARTIFICAL			ARTIFICAL					
	NATURAL		X	NATURAL		X	NATURAL		X			
COMEDOR	BUENA (20 o Más Km/h)			BUENA (20 o Más Km/h)			BUENA (20 o Más Km/h)					
	REGULAR (10 a 20 Km/h)			REGULAR (10 a 20 Km/h)			REGULAR (10 a 20 Km/h)					
	BAJA (0-10 Km/h)	3,76 km/h	X	BAJA (0-10 Km/h)	4,65 km/h	x	BAJA (0-10 Km/h)	6,50 km /h	x			
	INEXISTENTE			INEXISTENTE			INEXISTENTE					
	ARTIFICAL			ARTIFICAL			ARTIFICAL					
	NATURAL		X	NATURAL		X	NATURAL		X			
BAÑO	BUENA (20 o Más Km/h)			BUENA (20 o Más Km/h)			BUENA (20 o Más Km/h)					
	REGULAR (10 a 20 Km/h)			REGULAR (10 a 20 Km/h)	14,90 Km/h	x	REGULAR (10 a 20 Km/h)					
	BAJA (0-10 Km/h)	9,76 Km/h	x	BAJA (0-10 Km/h)			BAJA (0-10 Km/h)	8,41 Km/h	X			
	INEXISTENTE			INEXISTENTE			INEXISTENTE					
	ARTIFICAL			ARTIFICAL			ARTIFICAL					
	NATURAL		X	NATURAL		X	NATURAL		X			
COCINA	BUENA (20 o Más Km/h)			BUENA (20 o Más Km/h)			BUENA (20 o Más Km/h)					
	REGULAR (10 a 20 Km/h)			REGULAR (10 a 20 Km/h)			REGULAR (10 a 20 Km/h)					
	BAJA (0-10 Km/h)	0.,80 km/h	x	BAJA (0-10 Km/h)	1,30km/h	X	BAJA (0-10 Km/h)	2,07km/h	X			
	INEXISTENTE			INEXISTENTE			INEXISTENTE					
	ARTIFICAL			ARTIFICAL			ARTIFICAL					
	NATURAL		X	NATURAL		X	NATURAL		X			
OBSERVACIONES:												

Figure 10. On-site measurements for dwelling 1 (ventilation)

Analysis of lighting by area (lux)



General

Algoritmo de cálculo utilizada		Parte indirecta media
Flujo luminoso de la luminaria		0 lm
Superficie de evaluación 1	**Nivel útil 1.1**	
	horizontal	cilíndrico
$\bar{E}_m$	59.7 lx	45.6 lx
E_{min}	20.1 lx	14.7 lx
$E_{min}/\bar{E}_m$ (U_o)	0.34	0.32
E_{min}/E_{max} (U_d)	0.09	
E_z/E_h		0.95
Posición	0.75 m	1.20 m
Superficies principales	$\bar{E}_m$	U_o
M 1.5 (Techo)	34.4 lx	0.20
M 1.1 (Pared)	23 lx	0.50
M 1.2 (Pared)	24.8 lx	0.42
M 1.3 (Pared)	22.6 lx	0.51
M 1.4 (Pared)	10.1 lx	0.79

Figure 11. Application of simulators for natural lighting (lux) in each period and area

The lighting analysis presented here concerns vernacular dwellings evaluated using the Relux simulator. For each space analyzed, times: 8:00-9:00, 11:00-12:00, 13:00-14:00. In the early stages, and in the case of the living room and dining room, the lighting is considered good (>101 lux): there is adequate natural light. In the bedroom, the lighting is also good, although the levels vary significantly depending on the time of day,

reaching 425 lux at midday. In contrast, the kitchen and bathroom have poor lighting control; both have regular lighting values (11-100 lux) or no lighting at all. In particular, the bathroom is a space outside the dwelling, covered with plastic and has no artificial lighting; in other words, being in this room represents a weakness in the living conditions.

USGP UNIVERSIDAD SAN GREGORIO DE PORTOVIEJO	UNIVERSIDAD SAN GREGORIO DE PORTOVIEJO									VIVIENDA N°
ELABORADO POR :	JOSSELYN DELGADO , ARIEL FRANCO									HORA DE VISITA:
FECHA:	COORDENADAS:			UBICACIÓN DE LA VIVIENDA:			NORTE			AREA:
DATOS DE MEDICIONES IN SITU (ILUMINACION)										
ZONAS/ÁREA	8:00 a 9:00			11:00 a 12:00			13:00 a 14:00			Observación
SALA	BUENA (101- MAS LUX)	181 LX	X	BUENA (101- MAS LUX)	232LX	X	BUENA (101- MAS LUX)	123 LX	X	
	REGULAR (11 a 100 LUX)			REGULAR (11 a 100 LUX)			REGULAR (11 a 100 LUX)			
	BAJA (0-10 LUX)			BAJA (0-10 LUX)			BAJA (0-10 LUX)			
	INEXISTENTE			INEXISTENTE			INEXISTENTE			
	ARTIFICAL			ARTIFICAL			ARTIFICAL			
	NATURAL			NATURAL			NATURAL			
DORMITORIO	BUENA (101- MAS LUX)	114 LX		BUENA (101- MAS LUX)	395LX	X	BUENA (101- MAS LUX)	425 LX	X	
	REGULAR (11 a 100 LUX)		X	REGULAR (11 a 100 LUX)			REGULAR (11 a 100 LUX)			
	BAJA (0-10 LUX)			BAJA (0-10 LUX)			BAJA (0-10 LUX)			
	INEXISTENTE			INEXISTENTE			INEXISTENTE			
	ARTIFICAL			ARTIFICAL			ARTIFICAL			
	NATURAL			NATURAL			NATURAL			
COMEDOR	BUENA (101- MAS LUX)	181 LX	X	BUENA (101- MAS LUX)	232LX	X	BUENA (101- MAS LUX)	123	X	
	REGULAR (11 a 100 LUX)			REGULAR (11 a 100 LUX)			REGULAR (11 a 100 LUX)			
	BAJA (0-10 LUX)			BAJA (0-10 LUX)			BAJA (0-10 LUX)			
	INEXISTENTE			INEXISTENTE			INEXISTENTE			
	ARTIFICAL			ARTIFICAL			ARTIFICAL			
	NATURAL			NATURAL			NATURAL			
BAÑO	BUENA (101- MAS LUX)			BUENA (101- MAS LUX)			BUENA (101- MAS LUX)			
	REGULAR (11 a 100 LUX)			REGULAR (11 a 100 LUX)			REGULAR (11 a 100 LUX)			
	BAJA (0-10 LUX)			BAJA (0-10 LUX)			BAJA (0-10 LUX)			
	INEXISTENTE			INEXISTENTE			INEXISTENTE			
	ARTIFICAL			ARTIFICAL			ARTIFICAL			
	NATURAL			NATURAL			NATURAL			
COCINA	BUENA (101- MAS LUX)			BUENA (101- MAS LUX)			BUENA (101- MAS LUX)			
	REGULAR (11 a 100 LUX)	45.6LX	X	REGULAR (11 a 100 LUX)	59.7 LX	X	REGULAR (11 a 100 LUX)	63 LX	X	
	BAJA (0-10 LUX)			BAJA (0-10 LUX)			BAJA (0-10 LUX)			
	INEXISTENTE			INEXISTENTE			INEXISTENTE			
	ARTIFICAL			ARTIFICAL			ARTIFICAL			
	NATURAL			NATURAL			NATURAL			
OBSERVACIONES:										
EL BAÑO SE ENCUENTRA FUERA DE LA VIVIENDA Y ESTA RECUBIERTO DE PLASTICO Y NO TIENE ILUMINACION ARTIFICIAL										

Figure 12. On-site simulation data for dwelling 1 (lighting)

The dwelling has significant deficiencies in natural lighting and ventilation in many spaces, thus affecting thermal and lighting comfort. High temperatures, ranging from 27ºC to 35ºC, combined with a lack of natural ventilation, create a hot and uncomfortable environment. In general, the dwelling is not designed to use natural resources to achieve thermal and lighting comfort, creating a general feeling of discomfort. The house is damp throughout. In other words, the house is always damp because there is no fresh air circulating, and the climatic conditions can lead to discomfort due to excessive heat or cold or excessive humidity, so it is better to promote fresh air, which helps to balance the humidity, as the house is uncomfortable.

USGP UNIVERSIDAD SAN GREGORIO DE PORTOVIEJO	UNIVERSIDAD SAN GREGORIO DE PORTOVIEJO									VIVIENDA #1
ELABORADO POR :	JOSSELYN DELGADO , ARIEL FRANCO									
FECHA: 03/12/24	COORDENADAS: 0°19'47.9"S 80°08'40.8"W			UBICACIÓN DE LA VIVIENDA:			NORTE			AREA: 80.66 M2
DATOS DE MEDICIONES IN SITU (TEMPERATURA)										
ZONAS/ÁREA	8:00 a 9:00			11:00 a 12:00			13:00 a 14:00			Observación
	UNIDADES EN °C									
SALA	ALTA (35-27°C)			ALTA (35-27°C)	29.9	X	ALTA (35-27°C)	29.3	X	
	MEDIA (26-18°C)	23.80	X	MEDIA (26-18°C)			MEDIA (26-18°C)			
	BAJA (17-15°C)			BAJA (17-15°C)			BAJA (17-15°C)			
DORMITORIO	ALTA (35-27°C)			ALTA (35-27°C)	30.5	X	ALTA (35-27°C)	28.7	X	
	MEDIA (26-18°C)	26.40	X	MEDIA (26-18°C)			MEDIA (26-18°C)			
	BAJA (17-15°C)			BAJA (17-15°C)			BAJA (17-15°C)			
COMEDOR	ALTA (35-27°C)	27.20	X	ALTA (35-27°C)	30.2	X	ALTA (35-27°C)	31.4	X	
	MEDIA (26-18°C)			MEDIA (26-18°C)			MEDIA (26-18°C)			
	BAJA (17-15°C)			BAJA (17-15°C)			BAJA (17-15°C)			
BAÑO	ALTA (35-27°C)			ALTA (35-27°C)	32.7	X	ALTA (35-27°C)	33.1	X	
	MEDIA (26-18°C)	24.60	X	MEDIA (26-18°C)			MEDIA (26-18°C)			
	BAJA (17-15°C)			BAJA (17-15°C)			BAJA (17-15°C)			
COCINA	ALTA (35-27°C)			ALTA (35-27°C)	30.1	X	ALTA (35-27°C)	29.8	X	
	MEDIA (26-18°C)	23.80	X	MEDIA (26-18°C)			MEDIA (26-18°C)			
	BAJA (17-15°C)			BAJA (17-15°C)			BAJA (17-15°C)			
PROMEDIO	**25.16**			**30.68**			**30.46**			
OBSERVACIONES:										

USGP UNIVERSIDAD SAN GREGORIO DE PORTOVIEJO	UNIVERSIDAD SAN GREGORIO DE PORTOVIEJO								VIVIENDA #1
ELABORADO POR :	JOSSELYN DELGADO , ARIEL FRANCO								
FECHA: 03/12/24	COORDENADAS:			UBICACIÓN DE LA VIVIENDA:			NORTE		AREA: 80.66 M2
DATOS DE MEDICIONES IN SITU (HUMEDAD)									
ZONAS/ÁREA	8:00 a 9:00			11:00 a 12:00			13:00 a 14:00		Observación
SALA	ALTA -61%	64%	X	ALTA -61%	61%	X	ALTA -61%	%63%	X
	MEDIA (60%-40%)			MEDIA (60%-40%)			MEDIA (60%-40%)		
	BAJA (-39%)			BAJA (-39%)			BAJA (-39%)		
DORMITORIO	ALTA (-61%)	61%	X	ALTA (-61%)	62%	X	ALTA (-61%)	61%	X
	MEDIA (60%-40%)			MEDIA (60%-40%)			MEDIA (60%-40%)		
	BAJA (-39%)			BAJA (-39%)			BAJA (-39%)		
COMEDOR	ALTA (-61%)	63%	X	ALTA (-61%)	62%	X	ALTA (-61%)	61%	X
	MEDIA (60%-40%)			MEDIA (60%-40%)			MEDIA (60%-40%)		
	BAJA (-39%)			BAJA (-39%)			BAJA (-39%)		
BAÑO	ALTA (-61%)	78%	X	ALTA (-61%)	82%	X	ALTA (-61%)	84%	X
	MEDIA (60%-40%)			MEDIA (60%-40%)			MEDIA (60%-40%)		
	BAJA (-39%)			BAJA (-39%)			BAJA (-39%)		
COCINA	ALTA (-61%)	62%	X	ALTA (-61%)	63%	X	ALTA (-61%)	61%	X
	MEDIA (60%-40%)			MEDIA (60%-40%)			MEDIA (60%-40%)		
	BAJA (-39%)			BAJA (-39%)			BAJA (-39%)		
PROMEDIO		**66%**			**66%**			**67%**	
OBSERVACIONES:									
EL BAÑO NO ESTA DENTRO DE LA VIVIENDA, ESTA EN EL EXTERIORI Y NO TIENE ILUMINACION ARTFICIAL POR ENDE TAMPOCO ESTA HECHO DEL MISMO MATERIAL DE LA VIVIENDA , TIENE COMO RECUBRIMIENTO PLASTICO , IMPIDIENDO EL CORRECTO CRUCE DE AIRE E ILUMINACIÓN									

Figure 13. On-site measurements of house 1 (temperature and humidity)

Thermal comfort software analysis created by the Center for the Built Environment (CBE)

The simulation in indicates that the required thermal conditions are not met according to ASHRAE 55-2023 standards. However, based on a e of 29,9 ˚C with 64 % humidity and low airflow (0,1 m/s), the PMV of 1,77 indicates a strong perception of heat, pointing to a PPD of 65 %, which indicates significant discomfort among the inhabitants. The climate shown is beyond the comfort zone of the psychometric chart, thus confirming a temperature difference. This situation reinforces the fact that excessive humidity and poor air exchange have a considerable influence on how we perceive the situation.

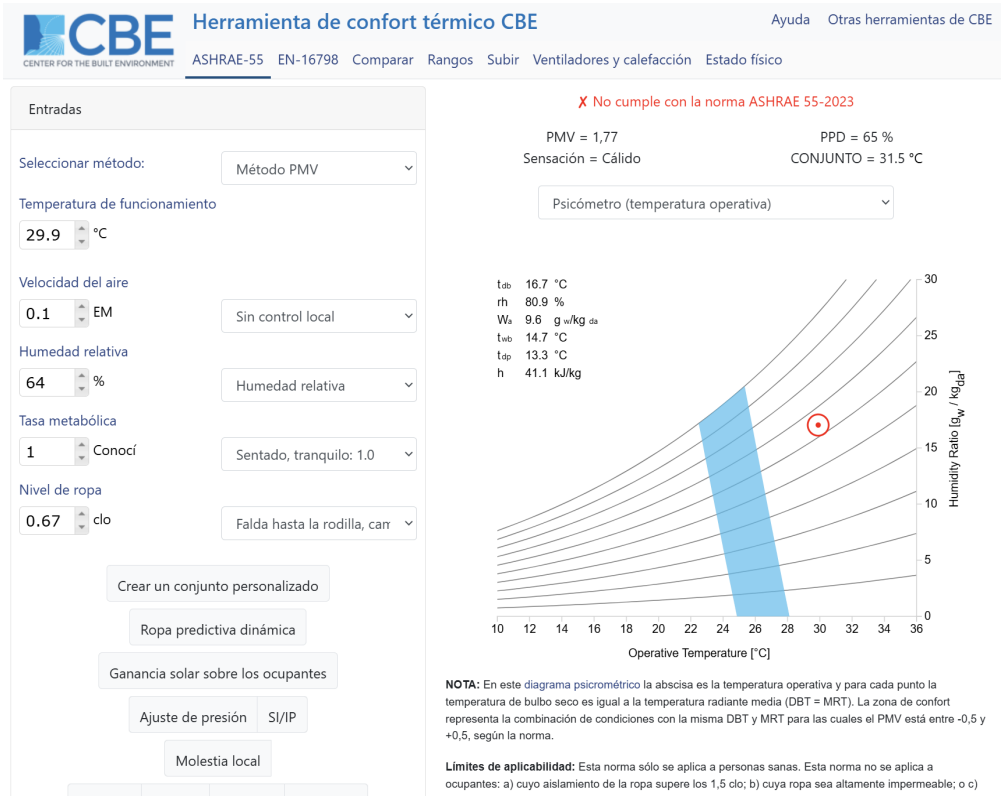


Figure 14. CBE thermal comfort software, dwelling 1

DISCUSSION

This study evaluates the thermal and lighting comfort of vernacular dwellings in the Jejenal area, San Isidro parish, Ecuador. Through a comprehensive bioclimatic analysis and the use of computer simulations, deficiencies in the climate adaptation of current buildings were identified. The results obtained confirm the need to optimize passive h y strategies, such as cross ventilation, shading, and the orientation of openings, to improve thermal and lighting efficiency.[6]

The research is based on previous studies by Bermello Moreira et al.[7] and Sigüencia Sojos et al.[8], who highlight the potential of indigenous materials such as guadua cane and wood in sustainable architecture. However, it is emphasized that without proper design, these materials lose their bioclimatic properties. In contrast to these studies, the Jejenal site study takes a more comprehensive approach, considering not only materials and openings, but also the relationship with the natural environment and the application of contemporary technologies.[9,10]

The findings highlight the lack of effective solar gain and passive ventilation strategies in the dwellings analyzed. It was verified that the integration of vegetation as a bioclimatic resource can significantly improve thermal regulation and indoor air quality. Likewise, the combination of traditional knowledge with digital technologies allows for the generation of guidelines to optimize living conditions in rural environments.[10,11,12]

Finally, the research positions the vernacular dwellings of Jejenal as an architectural heritage with high sustainability potential. It highlights the importance of incorporating bioclimatic strategies into rural design, minimizing dependence on artificial systems and improving energy efficiency. These results can serve as a basis for future architectural interventions that promote sustainable development in rural communities in Ecuador.[11,13,14,15]

CONCLUSIONS

This study highlights the importance of considering the vernacular dwellings belonging to the Jejenal site as cultural and contemporary heritage and that, despite their limitations, their design and materials have great potential for incorporation into contemporary sustainability practices.

It has been concluded that the incorporation of bioclimatic principles significantly improves thermal and lighting comfort, minimizes dependence on artificial resources, and optimizes energy costs. In the case of the use of indigenous materials such as guadua cane and wood, carefully processed and applied, they reinforce the sustainability of the dwelling itself.

Cross ventilation, proper orientation, passive shading, and raising the structures themselves are considered key strategies for achieving optimal living conditions.

Computer simulations and on-site measurements confirmed that the houses do not provide optimal bioclimatic conditions for habitability, highlighting factors such as orientation, passive ventilation, and natural lighting control.

It was found that the vernacular houses within the Jejenal site do not provide optimal construction conditions in terms of space functionality, materials, and inadequate construction processes.

The evaluation of temperature, humidity, ventilation, and lighting measurements in the four homes studied has made it possible to describe patterns of thermal and light- r comfort based on the local climate and the construction characteristics of each case. The measurements show significant changes in the bioclimatic conditions of the dwellings, mainly due to the influence of orientation, types of materials, and passive ventilation and lighting. These measurements can serve as a basic input for optimizing the design of sustainable rural houses and can lay the foundations for improving people's well-being and reducing the use of mechanical air conditioning and artificial lighting systems.

It was determined that the use of indigenous materials such as guadua cane and wood represents a strong asset to be considered, but their use requires improved techniques to take full advantage of their inherent benefits.

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FINANCING

None.

CONFLICT OF INTEREST

Authors declare that there is no conflict of interest.

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