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Environmental comfort in adobe housing in southern Sinaloa: A preliminary review of a scale of thermal comfort and residential appraisal

Confort ambiental en vivienda de adobe del sur de Sinaloa: revisión preliminar de una escala de confort térmico y valoración residencial

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ABSTRACT

Earthen construction, and adobe in particular, has long been the material of much rural housing in Mexico, and its continuity depends both on its thermal properties and on how residents value it. This instrumental, cross-sectional and exploratory study reviewed the preliminary functioning of a ten-item scale with two dimensions, thermal comfort in the adobe dwelling and appraisal of the adobe dwelling, administered in the pilot survey of project FZ-HAB-0015 of the Factoriza UAS platform among adults living in adobe houses in southern Sinaloa, Mexico. A preliminary cut of 16 cases, out of a target of 100, was analyzed with descriptive statistics, Cronbach's alpha, item analysis and Spearman inter-item correlations; as a technical-route project, no omega, factor analysis or correlation between dimensions was estimated. Residents rated night-time temperature (M = 3.50) and coolness in the hot months more favorably than daytime temperature, tended to agree that their houses feel icy in the cold season, and expressed pride in living in an adobe house (M = 3.94), while low wall maintenance was rated least favorably within its dimension. Internal consistency was moderate for thermal comfort (α = .566) and low for appraisal (α = .468); the two reverse-worded items contributed nothing to their dimensions, and inter-item correlations suggest distinct seasonal and daily facets of comfort and heterogeneous aspects of appraisal. The perception component must be integrated with technical measurements of the dwellings.

Keywords: adobe housing; thermal comfort; earthen architecture; residential appraisal

RESUMEN

La construcción con tierra, y en particular el adobe, ha sido durante siglos el material de buena parte de la vivienda rural de México, y su continuidad depende tanto de sus propiedades térmicas como de la valoración de sus habitantes. Este estudio instrumental, transversal y exploratorio revisó el funcionamiento preliminar de una escala de diez reactivos, con dos dimensiones, Confort térmico en la vivienda de adobe y Valoración de la vivienda de adobe, aplicada en el levantamiento piloto del proyecto FZ-HAB-0015 de Factoriza UAS a personas adultas que habitan viviendas de adobe en el sur de Sinaloa. Se analizó un corte preliminar de 16 casos, de una meta de 100, con estadísticos descriptivos, alfa de Cronbach, análisis de reactivos y correlaciones de Spearman entre reactivos; por tratarse de un proyecto de ruta técnica, no se estimaron el omega, el análisis factorial ni la correlación entre dimensiones. Las personas encuestadas valoraron mejor la temperatura por las noches (M = 3.50) y en los meses de calor que durante el día, tendieron a percibir sus casas heladas en la temporada de frío y expresaron orgullo por vivir en una casa de adobe (M = 3.94), mientras que el poco mantenimiento de las paredes fue el aspecto peor valorado de su dimensión. La consistencia interna fue moderada en Confort térmico (α = .566) y baja en Valoración (α = .468); los dos reactivos inversos no contribuyeron a su dimensión, y las correlaciones entre reactivos sugieren facetas estacional y cotidiana del confort y aspectos heterogéneos de la valoración. El componente de percepción deberá integrarse con las mediciones técnicas de las viviendas.

Palabras clave: vivienda de adobe; confort térmico; arquitectura de tierra; valoración residencial

INTRODUCTION

Earth construction is one of the most widespread building traditions in the world, and adobe, the sun-dried, molded earth block, has been the material of much of the rural housing in Mexico and Latin America for centuries.

In recent decades, however, adobe has lost ground to concrete block and other industrialized materials, in a process that combines economic, regulatory, technical, and symbolic factors.

In Colombia, the knowledge associated with adobe has been described as heritage at risk of disappearing due to the use of conventional materials (Rivera-Salcedo et al., 2021). In Jojutla, Morelos, numerous adobe houses in the historic center were lost after the 2017 earthquakes, amid construction deficiencies, poor urban planning and weak risk management (Sánchez Calvillo et al., 2021).

At the same time, research on building materials has renewed interest in earth because of its thermal and environmental properties. Experimental studies on adobe blocks with fibers or agricultural residues have documented reductions in thermal conductivity and increases in heat capacity, indicating greater thermal inertia (Banaba et al., 2025; Sanou et al., 2024). In climatic chamber tests, a stabilized rammed earth wall showed a thermal lag of up to 90 minutes and a decrement factor of 0.85 (Fouad et al., 2025).

These properties suggest that earthen housing can dampen temperature fluctuations, a relevant attribute in hot regions.

Mass-produced social housing built with industrialized materials offers a contrast. In northwestern Mexico, residents of a social housing development in Culiacán described their homes as very hot (Barraza-Bracamontes et al., 2022); in Hermosillo, the predominant social housing showed less favorable energy performance than a house built to energy efficiency standards (Muñoz López et al., 2023); and in Ensenada, a cast-in-place concrete house with thermal coating had poor thermal performance in winter (Bacelis et al., 2024).

Housing policy in the first decades of this century favored the mass production of this type of housing (Hernández Ilizaliturri et al., 2025), and space cooling has become one of the main sources of residential energy demand in the country's hot climates (Galindo-Borbón et al., 2024; Treviño Hernández and Hernández Rejón, 2026).

In southern Sinaloa, adobe dwellings persist in rural communities and small localities. Little is known about their thermal performance, their state of conservation, or how their inhabitants value them. Residents' experience is a necessary part of that assessment: the comfort they perceive, the durability they attribute to their houses, the maintenance these houses demand of them, and their willingness to preserve them or replace them with concrete block houses are as relevant to the future of this type of housing as their physical properties.

Project FZ-HAB-0015 of the Factoriza UAS platform, classified under the technical track of the article-writing workshop, aims to study the environmental performance and comfort of adobe housing.

The dataset package available for this article contains the project's perception component: a ten-item scale organized into two dimensions (Thermal Comfort in the Adobe Dwelling and Appraisal of the Adobe Dwelling) and administered in a pilot survey. Technical measurements of dwelling performance are not part of the package, so this study is limited to the perception component and offers a preliminary review of how the scale functions.

The overall objective was to examine the preliminary functioning of the thermal comfort and adobe housing appraisal scale among people living in adobe dwellings in southern Sinaloa.

The specific objectives were: (a) to describe the distribution of responses to each item; (b) to estimate the internal consistency of each dimension using Cronbach's alpha and to analyze the contribution of each item; (c) to describe the correlations among the items within each dimension; and (d) to identify the aspects of the instrument and the procedure that should be revised before the final data cutoff and their integration with the technical measurements. The project did not state any hypotheses, so the study is framed as exploratory.

DEVELOPMENT

THERMAL PROPERTIES OF EARTHEN CONSTRUCTION

The ability of earth walls to moderate indoor temperature is attributed to their thermal mass and hygric behavior. In a rammed earth wall stabilized with construction waste and calcium

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oxide, climate chamber tests showed a time lag of up to 90 minutes and a decrement factor of 0.85, values that the authors interpreted as indicating favorable thermal inertia (Fouad et al., 2025).

In adobe blocks with rice husk, thermal conductivity decreased by up to 35% in a calcareous soil and 20% in a siliceous soil, specific heat capacity increased, and moisture buffering capacity, which was already high in the soils without additives, improved (Banaba et al., 2025).

In adobe blocks with cement and coconut fibers, thermal conductivity decreased with increasing fiber content, and the authors considered these units suitable for thermally comfortable housing (Sanou et al., 2024).

Housing performance does not depend solely on the walls. In rural dwellings in the Purépecha region of Michoacán, a thermal model showed that roof type was associated with increases in indoor temperature, which were greatest with black cardboard roofs, followed by asbestos and cement roofs; it also showed that the thermal mass of cement kept those dwellings cold during the low temperatures of the plateau (Espinosa-Gómez et al., 2026).

In the traditional architecture of other hot regions, envelope configuration and the layering of materials have been associated with lower indoor temperatures (Arminda and Darmayanti, 2026), and in Mexico, the revival of bioclimatic strategies in historic buildings has been explored through simulation (Aguilar Osante et al., 2026).

A scale of perceived comfort in adobe dwellings therefore captures the experience of a complete system, of which the walls are only one part.

ADAPTIVE THERMAL COMFORT IN RURAL HOUSING

The adaptive approach to thermal comfort has shown that people living in rural dwellings tolerate and evaluate indoor conditions according to their experience and resources. In rural dwellings in southwestern China, the occupants' neutral operative temperature was 29.33 °C, higher than that reported in previous studies in the same climate zone, and adaptive behaviors improved their ability to endure demanding indoor conditions; most occupants were unwilling to use energy-intensive cooling equipment (Wei et al., 2022).

In naturally ventilated rural dwellings in China, a study of 251 people from 98 households found that older adults tolerated heat better than younger adults (Gong et al., 2025). In a village in Guangzhou with a hot, humid climate, older adults adapted mainly by opening windows, using curtains and fans, and moving to other spaces (Tian et al., 2022).

In the state of Campeche, which has a warm subhumid climate, adaptive comfort models reduced estimated energy consumption compared with the static approach, and the authors concluded that local models are needed (May-Tzuc et al., 2023).

These results have two implications for the study of adobe housing. The first is that occupants' perception of comfort may be favorable even under conditions that a standards-based assessment would classify as demanding, a finding related to adaptation and expectations.

The second is that comfort is experienced differently depending on the time of day and the season: during the day, at night, in the hot season and in the cold season. The project's scale captures this variation with items on daytime temperature, nighttime, the hot months and the cold season, as well as an item on how comfortable the dwelling is for resting.

SOCIAL VALUATION OF EARTHEN HOUSING

Whether adobe housing persists also depends on how its inhabitants value it. In the municipalities of Pore and Nunchía, in Casanare, Colombia, survey respondents most frequently cited the benefits of industrialized materials (57%) and a lack of knowledge about adobe maintenance (37%) as reasons for abandoning adobe houses, although they described these dwellings as comfortable (Rivera-Salcedo et al., 2021).

In Jojutla, the poor performance of altered adobe buildings during the earthquakes was associated with a loss of confidence in traditional techniques and with reconstruction using new materials (Sánchez Calvillo et al., 2021). In the state of Guerrero, an assessment of perceived risk in adobe houses led to proposals for mixes reinforced with maguey fibers, coconut fibers or straw, which met the quality requirements of the masonry standard, and for a housing design based on the minimum spaces the inhabitants required (Jerónimo-Vargas et al., 2022).

The appraisal of earthen housing therefore combines very different aspects: pride in

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traditional knowledge, confidence in its strength, the burden of its maintenance, the willingness to recommend it and the desire to replace it with a concrete block house.

These aspects may be related to place attachment, which the literature associates with local characteristics that express history and culture (Kamani Fard and Paydar, 2024), but they need not vary together. A person may feel proud of their adobe house and, at the same time, wish to replace it with a concrete block house for maintenance or safety reasons.

SCALE-BASED MEASUREMENT

The internal consistency of a dimension is usually estimated with Cronbach's alpha (Cronbach, 1951), which assumes equivalent loadings across items. McDonald's omega does not make this assumption, and simulation studies have compared the performance of the two coefficients under different data conditions (Malkewitz et al., 2023).

Internal structure is examined through exploratory factor analysis, for which current recommendations call for verifying the adequacy of the data and ensuring a sufficient sample size before interpreting the results (Ferrando et al., 2022; Goretzko et al., 2021).

Scales with positively and negatively worded items may show wording-related biases, because some respondents respond inconsistently to the positive and negative items of the same dimension (Steinmann et al., 2022), and identifying these responses can reduce such biases (García-Batista et al., 2021).

Finally, in measurement theory, indicators that form a construct, rather than reflect it, are called formative, and their implications for factor analysis and reliability theory differ from those of reflective indicators (Bollen and Diamantopoulos, 2017). This distinction is relevant to an appraisal dimension that combines heterogeneous aspects of housing.

METHODOLOGY

DESIGN

An instrumental, quantitative, cross-sectional study with an exploratory scope was conducted to examine the preliminary functioning of a scale. Because the design was cross-sectional, the relationships reported are associations and do not allow causal inferences.

POPULATION, SAMPLE, AND DATA CUTOFF

The data come from the survey "Southern Sinaloa Pilot · Comfort in Adobe Housing" (LEV-0020) of project FZ-HAB-0015 on the Factoriza UAS platform, and from the frozen dataset DST-0045, with a data cut-off date of 16 October 2026. The survey population consists of people aged 18 years or older who live in adobe dwellings in southern Sinaloa, in communities with adobe housing selected by the project lead.

Table 1 shows the composition of the sample. Of the 22 people who opened the questionnaire, 16 completed it; no cases were excluded by the platform's quality control, and 16 cases with 10 items were analyzed. This is a preliminary data cut: n = 16 out of a target of 100, with data collection still ongoing. The results reported in this article describe that data cut and should not be taken as definitive.

Table 1. Sample composition.

Indicator	Value
People who opened the questionnaire	22
Completed questionnaires	16
Cases excluded by quality control	0
Cases analyzed	16
Items	10

Note. Survey "Piloto sur de Sinaloa · Confortenvivienda de adobe" (Southern Sinaloa Pilot · Comfort in Adobe Housing) (LEV-0020); population: individuals aged 18 years or older living in adobe dwellings in southern Sinaloa; territory: southern Sinaloa, in communities with adobe dwellings selected by the project lead. Dataset DST-0045, fingerprint 5d3938cfb7bd6b05. Source: Factoriza UAS. Preliminary cutoff: n = 16 of a target of 100, with the survey still open.

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INSTRUMENT

The perceived comfort scale for adobe housing consists of ten items with a 5-point response scale, ranging from Strongly disagree to Strongly agree, organized into two dimensions of five items each.

Thermal comfort in the adobe dwelling (R1 to R5) covers a pleasant temperature during the day, a mild temperature at night, coolness during the hot months, the sensation of intense cold during the cold season, and comfort for resting. Appraisal of the adobe dwelling (R6 to R10) covers pride in living in an adobe house, the perceived sturdiness of the house, the desire to exchange it for a concrete-block house, the low maintenance its walls require, and willingness to recommend adobe construction in the community.

Two items are reverse-worded (R4 and R8) and are recoded in the data matrix, so that for all items a high value indicates a favorable appraisal of the dwelling. Table 2 presents the wording of each item.

Table 2. Structure of the instrument.

Code	Item	Reverse
R1	Inside my adobe house, the temperature is pleasant during the day	No
R2	At night, my adobe house stays warm	No
R3	During the hot months, my adobe house feels cool	No
R4	In the cold season, my adobe house feels freezing	Yes
R5	Inside my adobe house I can rest comfortably	No
R6	I am proud to live in an adobe house	No
R7	My adobe house is resistant	No
R8	I would like to replace my adobe house with a concrete block one	Yes
R9	The adobe walls of my house require little maintenance	No
R10	I would recommend building with adobe in my community	No

Note. R1 to R5 = Thermal comfort in the adobe house; R6 to R10 = Appraisal of the adobe house. The dimension column is omitted to preserve table readability. Five-point response scale (Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree). Reverse-scored items have already been recoded in the delivered data matrix. Source: Factoriza UAS, project FZ-HAB-0015, survey LEV-0020, dataset DST-0045.

TECHNICAL COMPONENT OF THE PROJECT

The project belongs to the technical track, whose planned article in the project bank addresses environmental performance and comfort in adobe housing. The Factoriza package does not contain measurements of the dwellings' performance, so this article does not report technical results.

PROCEDURE

The questionnaire was administered through the Factoriza UAS platform, which records explicit online informed consent before the first question and does not collect data that could identify individuals. The platform applies a quality control check to completed questionnaires before adding them to the dataset; in this data cut, it did not exclude any cases.

DATA ANALYSIS

Factoriza UAS calculated the descriptive statistics for each item (mean, standard deviation, skewness, kurtosis, and percentages of responses at the minimum and maximum values), the internal consistency of each dimension using Cronbach's alpha (Cronbach, 1951), and the corrected item-total correlation and alpha if item deleted. It also computed the inter-item correlations within each dimension, which the notes to its tables identify as Spearman correlations, with 95% confidence intervals obtained through Fisher's z transformation.

The project belongs to the technical track of the article-writing workshop, whose data collections are not routed through the complementary psychometric analysis program; for this

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reason, McDonald's omega, exploratory factor analysis, and the correlation between dimensions were not estimated. In addition, with 16 cases for 10 items, factor analysis would not be defensible (Ferrando et al., 2022; Goretzko et al., 2021). No confirmatory factor analysis was performed.

ETHICAL CONSIDERATIONS

Participation was voluntary, with express informed consent recorded online by the platform, which does not collect names, addresses or other identifying data. The data were analyzed in aggregate.

STATEMENT ON THE USE OF ARTIFICIAL INTELLIGENCE

During the preparation of this manuscript, the Factoriza UAS platform was used for data management and for the descriptive, internal consistency and inter-item correlation analyses. The Claude Opus language model (Anthropic) was used for assisted literature searching, writing a draft and assembling the document from the results. As this was a technical-track project, the complementary psychometric analysis software was not used. The authors reviewed, corrected and approved the entire text, verified every reference and take full responsibility for the content of the article.

RESULTS
DESCRIPTION OF RESPONSES

Table 3 and Figure 1 present the descriptive statistics for the ten items. For Thermal comfort, mild temperatures at night had the highest mean (R2: *M* = 3.50, *SD* = 0.82), followed by coolness during the hot months (R3: *M* = 3.31, *SD* = 0.95) and comfort when resting (R5: *M* = 3.06, *SD* = 1.06).

Pleasant daytime temperature had a mean close to the midpoint and the greatest dispersion in the instrument (R1: *M* = 2.94, *SD* = 1.44). The reverse-scored item on cold had the lowest mean on the scale (R4: *M* = 2.44, *SD* = 1.09); in its recoded version, this value indicates that responses leaned toward agreement that the house feels freezing during the cold season.

In Appreciation, pride in living in an adobe house had the highest mean on the instrument (R6: *M* = 3.94, *SD* = 1.12), with a distribution skewed toward high values (skewness = -1.47). It was followed by willingness to recommend adobe construction (R10: *M* = 3.63, *SD* = 0.96). The strength attributed to the house (R7: *M* = 3.25, *SD* = 1.00) and the recoded item on the desire to replace it with a concrete block house (R8: *M* = 3.19, *SD* = 1.33) were slightly above the midpoint, the latter with high dispersion. The low maintenance required by the walls had the lowest mean in the dimension (R9: *M* = 2.88, *SD* = 1.02). The 69% ceiling for R2 corresponds to the highest observed value, as indicated in the table note.

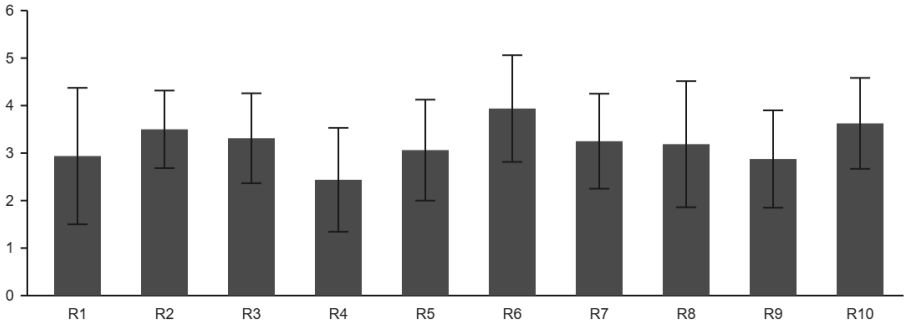
Table 3. Descriptive statistics of the items.

Item	M	SD	Skewness	Kurtosis	Floor	Ceiling
R1	2.94	1.44	-0.19	-1.36	25%	13%
R2	3.50	0.82	-1.26	-0.12	19%	69%
R3	3.31	0.95	-0.19	-1.03	25%	6%
R4	2.44	1.09	1.06	0.76	13%	6%
R5	3.06	1.06	-0.90	-0.26	13%	44%
R6	3.94	1.12	-1.47	2.27	6%	31%
R7	3.25	1.00	0.34	-0.74	25%	13%
R8	3.19	1.33	-0.19	-0.95	13%	19%
R9	2.88	1.02	-0.15	0.76	13%	6%
R10	3.63	0.96	-0.15	-0.68	13%	19%

Note.N = 16. R1 to R5 = Thermal comfort in the adobe dwelling; R6 to R10 = Appraisal of the adobe dwelling. The reverse-scored items R4 and R8 are shown recoded, so that a high value always indicates a favorable appraisal of the dwelling. Floor and ceiling indicate the percentage of responses at the minimum and maximum values, respectively. The item-total correlation column from the Factoriza descriptive table is omitted; its values do not match those in Table 4 because they are not calculated on the total of each dimension. Factoriza UAS run RUN-00251. Preliminary cut-off: n = 16 of a target of 100, with data collection still open.

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Figure 1. Mean scores per item with one-standard-deviation error bars.



INTERNAL CONSISTENCY

Table 4 presents the item analysis for each dimension. For Thermal comfort, alpha was .566. Pleasant daytime temperature (R1: .531), coolness during the hot months (R3: .500), and mild temperature at night (R2: .493) had the highest corrected item-total correlations, followed by comfort when resting (R5: .308). The reverse-scored item on cold had a slightly negative correlation (R4: -.052), and removing it would raise alpha to .701.

For Appraisal, alpha was .468. Willingness to recommend adobe construction (R10: .517), the low maintenance required by the walls (R9: .442), and pride (R6: .408) had the highest corrected item-total correlations. The strength attributed to the house had a low correlation (R7: .156), and the reverse-scored item on the desire to exchange the house for a concrete-block one had a slightly negative correlation (R8: -.087). Removing R8 would raise alpha to .670.

Table 4. Item analysis by dimension.

Dimension	Item	Corrected item-total r	α if item deleted
Thermal comfort	R1	.531	.355
Thermal comfort	R2	.493	.445
Thermal comfort	R3	.500	.422
Thermal comfort	R4	-.052	.701
Thermal comfort	R5	.308	.519
Assessment	R6	.408	.293
Assessment	R7	.156	.471
Assessment	R8	-.087	.670
Assessment	R9	.442	.282
Assessment	R10	.517	.242

Note.N = 16. Scale from 1 to 5; reverse-scored items R4 and R8 are shown recoded. Run RUN-00251 of Factoriza UAS. Preliminary data cut: n = 16 out of a target of 100, with data collection still open.

CORRELATIONS BETWEEN ITEMS

Table 5 presents the correlations between items within each dimension. For Thermal comfort, only the correlation between pleasant daytime temperature and mild nighttime temperature excluded zero (R1 and R2: r = .583, 95% CI [.123, .837], p = .018). The correlation between nighttime temperature and comfort for resting was moderate, but its interval included zero (R2 and R5: r = .477, 95% CI [-.025, .787], p = .062).

The recoded item on cold was moderately related to coolness during the hot months (R3 and R4: r = .413, 95% CI [-.104, .754], p = .112), but not to nighttime temperature (R2 and R4: r = -.013) or to comfort for resting (R4 and R5: r = .064).

In Appraisal, none of the correlations excluded zero. The recoded item on the desire to exchange the house for a concrete-block one was positively related to the willingness to recommend adobe (R8 and R10: r = .440, 95% CI [-.071, .768], p = .088) and negatively related to

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the strength attributed to the house (R7 and R8: r = -.436, 95% CI [-.766, .076], p = .091) and to low maintenance (R8 and R9: r = -.272).

Low maintenance was related to willingness to recommend adobe (R9 and R10: r = .436) and to durability (R7 and R9: r = .375), and pride was related to durability (R6 and R7: r = .395). Pride, however, was not related to willingness to recommend adobe (R6 and R10: r = .034) or to the desire to replace the house (R6 and R8: r = .067). With 16 cases, all of these intervals are wide.

Table 5. Correlations between the items of each dimension.

Dimension	Variable pair	r	IC 95%	p
Thermal comfort	R1 and R2	.583	[.123, .837]	.018
Thermal comfort	R1 and R3	.370	[-.154, .731]	.159
Thermal comfort	R1 and R4	.104	[-.413, .570]	.703
Thermal comfort	R1 and R5	.381	[-.141, .738]	.145
Thermal comfort	R2 and R3	.353	[-.173, .722]	.180
Thermal comfort	R2 and R4	-.013	[-.505, .486]	.962
Thermal comfort	R2 and R5	.477	[-.025, .787]	.062
Thermal comfort	R3 and R4	.413	[-.104, .754]	.112
Thermal comfort	R3 and R5	.240	[-.290, .658]	.370
Thermal comfort	R4 and R5	.064	[-.446, .542]	.814
Assessment	R6 and R7	.395	[-.125, .745]	.130
Assessment	R6 and R8	.067	[-.443, .545]	.805
Assessment	R6 and R9	.220	[-.310, .645]	.413
Assessment	R6 and R10	.034	[-.469, .521]	.900
Assessment	R7 and R8	-.436	[-.766, .076]	.091
Assessment	R7 and R9	.375	[-.148, .734]	.153
Assessment	R7 and R10	.148	[-.375, .600]	.585
Assessment	R8 and R9	-.272	[-.677, .258]	.307
Assessment	R8 and R10	.440	[-.071, .768]	.088
Assessment	R9 and R10	.436	[-.076, .766]	.091

Note.N = 16. Thermal comfort = Thermal comfort in the adobe dwelling; Appraisal = Appraisal of the adobe dwelling. The corrected item-total correlation excludes the item itself from the total of its dimension. Cronbach's α for each full dimension (5 items each): Thermal comfort = .566 (run RUN-00252); Appraisal = .468 (RUN-00254). Source: Factoriza UAS, Tables 4 and 6 of the package, combined without modifying values. Preliminary data cut: n = 16 out of a target of 100, with data collection still open.

DISCUSSION OF RESULTS

This study examined the preliminary performance of a scale measuring thermal comfort and appraisal of adobe housing in a sample of 16 cases from communities in southern Sinaloa. The first finding is descriptive and concerns comfort: respondents rated the temperature of their homes more favorably at night and during the hot months than during the day, and most tended to agree that the house feels freezing during the cold season.

This pattern is consistent with the thermal inertia that the literature attributes to earthen construction (Banaba et al., 2025; Fouad et al., 2025), which buffers outdoor heat, but also with the role that roofs and other elements of the dwelling play in indoor temperature (Espinosa-Gómez et al., 2026).

Without technical measurements, the study cannot separate the role of the adobe walls from that of the roofs, openings or modifications made to each dwelling, nor can it compare perception with recorded temperature.

The second finding concerns the cold item. Its moderate association with coolness during the hot months, but not with the other items, suggests that both capture the same seasonal facet of the dwelling's thermal performance: a house that stays cool in summer and does not feel freezing in winter, which corresponds to the damping of temperature fluctuations. The items on daytime, nighttime and rest, by contrast, refer to everyday comfort.

This distinction between seasonal and daily comfort is consistent with the adaptive approach, which shows that thermal experience varies with time and with occupants' expectations (Gong

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et al., 2025; Wei et al., 2022). It further suggests that the dimension could be organized into two facets. The slightly negative item-total correlation of the cold item is also compatible with a bias associated with reverse wording (García-Batista et al., 2021; Steinmann et al., 2022).

The third finding concerns housing appraisal, whose internal consistency was low. Pride in living in an adobe house was the most highly rated aspect, but it was not related to willingness to recommend adobe or to the desire to exchange the house for one made of concrete block. The desire to keep the adobe house, for its part, was positively related to willingness to recommend adobe, as would be expected, but negatively related to the strength attributed to the house and to its low maintenance requirements.

Although uncertain, this pattern is consistent with the literature describing the appraisal of earthen housing as a combination of appreciation for its qualities and practical reasons for abandoning it, such as maintenance and safety (Rivera-Salcedo et al., 2021; Sánchez Calvillo et al., 2021).

In measurement terms, these are aspects that make up the valuation of the dwelling rather than manifestations of a single attitude, and they behave more like formative indicators, for which internal consistency is not the appropriate criterion (Bollen and Diamantopoulos, 2017).

The low maintenance required by the walls was the lowest-rated aspect of the dimension. This is consistent with the lack of knowledge about adobe maintenance reported as a reason for abandonment in other contexts (Rivera-Salcedo et al., 2021) and with the importance of construction and reinforcement techniques for the safety of these dwellings (Jerónimo-Vargas et al., 2022; Sánchez Calvillo et al., 2021).

The relationship between this item and willingness to recommend adobe suggests that the maintenance burden could be a decisive aspect of the assessment, one that would be worth exploring in greater detail in the final data collection wave.

The results can also be read comparatively against social housing in northwestern Mexico, albeit with caution, since they do not come from the same study or use the same instrument. Whereas residents of social housing in Culiacán described their homes as very hot (Barraza-Bracamontes et al., 2022) and the concrete housing evaluated in Ensenada performed poorly in winter (Bacelis et al., 2024), people living in adobe houses in southern Sinaloa rated the temperature at night and during the hot months relatively favorably, though not the temperature during the cold season.

This difference, if confirmed by the final data cutoff and by technical measurements, would be relevant to the discussion of housing materials in hot climates, where the cooling demand and energy performance of social housing have already been documented (Galindo-Borbón et al., 2024; Muñoz López et al., 2023). A valid comparison would, however, require applying the same instrument to both housing types and controlling for the season, orientation, roofs, and ventilation habits of each household.

The results suggest several adjustments for the next stage. For the instrument, it would be advisable to separate the seasonal comfort items from the everyday comfort items, revise the wording of the reverse-scored items, and consider treating the housing evaluation as a set of aspects analyzed separately or as a formative index, rather than as a reflective scale.

In terms of procedure, it would be necessary to record the season in which participants respond, because comfort ratings could vary with it. The responses would also need to be linked to the characteristics of each dwelling and to the project's technical measurements, which would make it possible to gather validity evidence based on relations to other variables.

CONCLUSIONS

The study examined the preliminary performance of a ten-item scale on thermal comfort and the appraisal of adobe housing among people living in this type of dwelling in southern Sinaloa, based on an interim sample of 16 cases out of a target of 100.

Respondents rated the temperature of their homes more favorably at night and during the hot months than during the day, tended to perceive them as freezing in the cold season, and expressed pride in living in an adobe house, although they rated its maintenance less favorably. Internal consistency was moderate for Thermal Comfort (α = .566) and low for Appraisal (α = .468); the reverse-scored items contributed nothing, and the inter-item relationships suggest distinct facets within each dimension.

The study has limitations that should be kept in mind when reading all of its results. The first concerns the size and nature of the data cut: 16 cases out of a target of 100, with data collection

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still ongoing, are insufficient to estimate internal consistency and correlations precisely.

The second concerns the sample: the communities, the contact procedure, the type of sampling, and the characteristics of the participants and their dwellings have yet to be documented, and the results cannot be generalized.

The third concerns the absence of the technical component: the package contains no measurements of housing performance, so perceptions could not be compared with the recorded conditions.

The fourth concerns the analysis: because this was a technical-pathway project, omega, exploratory factor analysis and the correlation between dimensions were not estimated; the floor and ceiling percentages from Factoriza need to be verified; and no confirmatory factor analysis was performed.

The fifth concerns design: because the study is cross-sectional, it does not allow causal inferences.

Directions for future work follow from these limitations. The most important is integrating the perception component with the project's technical measurements: recording indoor temperature and humidity in a subsample of dwellings, together with their construction characteristics, would show the extent to which the occupants' experience reflects the performance of adobe housing and which features of the dwelling are associated with it.

Once the final data cutoff is reached, it will be advisable to repeat the item analysis, conduct the supplementary analyses if the Professor so decides, and examine whether the comfort dimension is organized into seasonal and everyday facets. This information would help guide the conservation and improvement of earthen housing in southern Sinaloa, at a time when residents' appraisal of it combines pride with practical reasons for replacing it.

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