Recibido 08-01-2025
Aceptado 07-05-2025
https://doi.org/10.22320/07196466.2025.43.067.08

Cecília Heidrich-Prompt
Doutora em Arquitetura e Urbanismo
Arquiteta e Urbanista
Universidade Federal de Santa Catarina
Florianópolis, Brasil
https://orcid.org/0000-0002-7937-7075
ceciprompt@gmail.com

Julio Cesar Lopes-Borges
Licenciatura em Física
Estudante de Mestrado em
Energia e Sustentabilidade
Universidade Federal de Santa Catarina
Florianópolis, Brasil
https://orcid.org/0000-0003-4620-9881
jlopesborges@yahoo.com.br

Lisiane Ilha-Librelotto
Doutora em Engenharia de Produção
Professora/Pesquisadora no corpo docente
em Arquitetura e Urbanismo
Universidade Federal de Santa Catarina
Florianópolis, Brasil
https://orcid.org/0000-0002-3250-7813
lisiane.librelotto@ufsc.br

ASSESSMENT OF SUSTAINABILITY IN EARTH-BASED CONSTRUCTION AND ARCHITECTURE

AVALIAÇÃO DA SUSTENTABILIDADE EM ARQUITETURA E CONSTRUÇÃO COM TERRA

EVALUACIÓN DE LA SOSTENIBILIDAD EN ARQUITECTURA Y CONSTRUCCIÓN CON TIERRA

Figura 0. Residence built with bagged earth and wattle and daub walls. Source: Architect - César Costa. Photo by Cecilia Prompt.

The work was carried out with the support of the Coordination for the Improvement of Higher Education Personnel - Brazil (CAPES) - Financing Code 001.

AS / Vol 43 / Nº 67 / 2025
ISSN Impresa 0716-2677
ISSN Digital 0719-6466

RESUMO

A Arquitetura e Construção com Terra (ACT) é aquela que usa o solo como principal material de construção. A ACT tem relação com a arquitetura vernácula por ser contextualizada e usar majoritariamente materiais locais e naturais. O presente trabalho tem como objetivo principal avaliar a sustentabilidade em ACT. Para o estudo de caso foram escolhidas seis edificações em propriedades agrícolas familiares em Santa Catarina, Região Sul do Brasil. O método aplicado foi desenvolvido com base no Projeto VerSus, adaptado à realidade local e às normativas brasileiras. Para tanto, desenvolveu-se um sistema de indicadores para atribuição de pontuação, aplicados a princípios de sustentabilidade. Os resultados são apresentados com ênfase no âmbito socioeconômico. Neste, quatro edificações atenderam aos indicadores adotados e duas atenderam parcialmente. A análise dos resultados permitiu a compreensão da influência de fatores intrínsecos à ACT e daqueles vinculados à realidade local.

Palavras-chave: projeto VerSus, habitação rural, meio ambiente, autoconstrução, mão de obra

ABSTRACT

Earth-Based Construction (EBC) and Architecture use soil as the primary construction material. EBC is related to vernacular architecture, as it is contextualized and uses mostly local and natural materials. The main objective of this work is to evaluate EBC's sustainability. Six buildings on family agricultural properties in Santa Catarina, the southern region of Brazil, were chosen for the case study. The method was developed based on the VerSus Project and adapted to the local reality and Brazilian regulations. To this end, a system of indicators, applied to sustainability principles, was developed to assign points. The results are presented with an emphasis on the socioeconomic sphere. Four buildings complied with the adopted indicators in this assessment, and two partially did so. The analysis of the results allowed an understanding of the influence of factors intrinsic to EBC and the local reality.

Keywords: VerSus project, rural housing, environment, self-construction, labor

RESUMEN

Arquitectura y Construcción con Tierra (ACT) es aquella que utiliza el suelo como principal material de construcción. ACT está relacionado con la arquitectura vernácula, ya que está contextualizada y utiliza mayoritariamente materiales locales y naturales. El principal objetivo de este trabajo es evaluar la sostenibilidad en ACT. Para el estudio de caso, se eligieron seis edificios en propiedades agrícolas familiares, en Santa Catarina, Región Sur de Brasil. El método aplicado fue desarrollado con base en el Proyecto VerSus, adaptado a la realidad local y a la normativa brasileña. Para ello se desarrolló un sistema de indicadores para asignar puntos, aplicados a principios de sostenibilidad. Los resultados se presentan con énfasis en el ámbito socioeconómico. En este, cuatro edificios cumplieron con los indicadores adoptados y dos edificios los cumplieron parcialmente. El análisis de los resultados permitió comprender la influencia de factores intrínsecos a ACT e intrínsecos a la realidad local.

Palabras clave: proyecto VerSus, vivienda rural, ambiente, autoconstrucción, mano de obra

INTRODUCTION

Earth-based Construction (EBC) and Architecture encompass everything that uses soil as the primary building material (Neves & Faria, 2011; Neves, 2023). Given its context and use of mainly local and natural materials, EBC has characteristics attributed to vernacular architecture (Prompt, 2021).

However, the millennial techniques of EBC have been neglected since the advent of the construction industry, which brought new technologies to the market that have become responsible for part of the planet's environmental degradation. Consequently, in the search for sustainable architecture, the use of non-industrialized materials in project design is growing, and the modern interpretation of ancient techniques provides them with credibility. Earth, therefore, becomes a possibility for constructing buildings with low environmental impact due to its reduced embodied energy (Niroumand et al., 2017).

Some characteristics of EBC are related to concepts attributed to vernacular architecture, such as: (1) prioritizing the use of local materials (Niroumand et.al., 2017); (2) occupation of an area by a group with similar sociocultural conditions, long-term permanence in the place, and the evolution of construction systems (Ferreira, 2014); (3) transmission of techniques between community members (Okretic et al, 2024); and (4) simplicity, adaptability, creative nature and plastic intention as a result of the techniques and materials used (Weimer, 2005)

EBC production in Brazil has been the subject of research, projects, works, and the development of technical standards (Prompt & Lisboa, 2022). However, its production is artisanal and experimental, often used without technical support from a qualified professional, from the project to the work itself. Thus, problems arise that can compromise the building's quality (Prompt, 2012).

In Brazil, contemporary earth-based architecture has been strongly influenced by the spread of permaculture (Neves et al., 2022). In the country's southern region, where the state of Santa Catarina is located, small family farms dominate, and rural social movements are strong. In this context, several EBC projects (Prompt & Librelotto, 2018) have been implemented with objectives such as technological autonomy and sustainable development (Neves et al., 2022).

Prompt (2012) evaluated nine buildings built using earth in family farms in western Santa Catarina. The buildings were appropriate to the sociocultural context in which they were inserted, but some situations could compromise their sustainability. To understand these aspects, the main objective of this study was to evaluate sustainability in earth-construction buildings through a post-occupation evaluation after ten years of use.

This analysis selected a sample of six buildings (Table 1) in the municipalities of Seara, Paial, and Arabutã (Figure 1, Figure 2, Figure 3, and Figure 4), all on family farms (Figure 5, Figure 6, Figure 7, and Figure 8). This article intends to report the study conducted, emphasizing the socioeconomic aspect of sustainability (Figure 9, Figure 10, and Figure 11).

AS / Vol 43 / Nº 67 / 2025
ISSN Impresa 0716-2677
ISSN Digital 0719-6466

	Year	Use	Built Area	Techniques Used	Labor System	Photo
Building 01	2002	Seed storage	30 m²	Hand-rammed bagged Earth	Self-build	
Building 02	2008	Residential	112 m²	Bagged earth, CEB	Self-build	
Building 03	2009	201 m²	Residencial	Hand-rammed bagged earth, cordwood	Self-build	
Building 04	2011	Residential	222 m²	Hand-rammed bagged earth, vegetable cover	Self-build/contractor in specific stages	
Building 05	2010	Residential	139 m²	Bagged earth, vegetable cover	Self-build	
Building 06	2019	Residential	292 m²	Hand-rammed	Contractor/Self-Build	

Table 1: Presentation of Case Studies. Source: Prepared by the authors.

AS / Vol 43 / Nº 67 / 2025
ISSN Impresa 0716-2677
ISSN Digital 0719-6466

Figure 1. Building for seed storage comprising bagged earth and mortar ramming. Source: Photo by Cecilia Prompt.

Figure 2. Residence built with bagged earth and compressed earth blocks. Source: Architect - Iuri Moraes. Photo by Cecilia Prompt.

Figure 3. Residence built with bagged earth and a green roof. Source: Architecture - Silvio Santi. Photo by Cecilia Prompt.

AS / Vol 43 / Nº 67 / 2025
ISSN Impresa 0716-2677
ISSN Digital 0719-6466

Figure 4. Residence built with bagged earth and a green roof. Source: Architect - Silvio Santi. Photo: Cecilia Prompt.

Figure 5. Residence built with wooden structure, wattle and daub walls, and a green roof. Source: Architect - Silvio Santi. Photo: Cecilia Prompt.

AS / Vol 43 / Nº 67 / 2025
ISSN Impresa 0716-2677
ISSN Digital 0719-6466

Figure 6. Residence built with wooden structure, wattle and daub walls, and a green roof. Source: Architect - Silvio Santi. Photo by Cecilia Prompt.

Figure 7. Shed with joinery and storage, made from bagged earth. Source: Photo by Cecilia Prompt.

Figure 8. Residence built with wooden structure, wattle and daub and bagged earth walls, and a green roof. Source: Architect - Cecilia Prompt. Photo by Cecilia Prompt.

AS / Vol 43 / Nº 67 / 2025
ISSN Impresa 0716-2677
ISSN Digital 0719-6466

Figure 9. Residence built with wooden structure, wattle and daub and bagged earth walls, and a green roof. Source: Architect - Cecilia Prompt. Photo by Cecilia Prompt.

Figure 10. Residence built with bagged earth and wattle and daub walls. Source: Architect - César Costa. Photo by Cecilia Prompt.

Figure 11. Residence built with bagged earth and wattle and daub walls. Source: Architect - César Costa. Photo by Cecilia Prompt.

THEORETICAL FRAMEWORK

Sustainable architecture

Architecture production has always been related to the environment, since its primary role is shelter and protection from the weather. The concept of sustainability in architecture has grown alongside the environmental movement. Zambrano (2008) shows the evolution of the concept from solar architecture (1970). From the late 1990s, the concept evolved into sustainable architecture, which views sustainability more broadly, reaching the environmental, social, and economic spheres. Hence, it is understood that a balance between these three areas is necessary to achieve sustainability in a building (Silva, 2003).

AS / Vol 43 / Nº 67 / 2025
ISSN Impresa 0716-2677
ISSN Digital 0719-6466

Because the buildings analyzed in this research are examples of EBC, they are related to the concept of bioconstruction, which treats the building as a biological unit that interacts with the natural environment and its social, cultural, and economic environment. The house should be designed to take advantage of the climate, prioritizing using natural materials (such as Earth) that are local, recycled, or have little processing. This architecture is closely tied to permaculture, which treats the building as the center of the project and states that the built space must be in harmony with the environment (Borges & Prompt, 2024; Vegas et al., 2014; Mars, 2008; Morrow, 2010).

To seek a method for assessing sustainability in rural buildings that dialogues with the particular aspects of EBC and considers the relationships between it and vernacular architecture, sustainability in architecture must be contextualized and adapted to specific situations (Prompt, 2012). Housing in rural settings allows families to stay in the countryside, not only for social reproduction, but also for work-related activities. That is, buildings in a family farming context are sustainable as long as they contribute to human development, reduce social inequality, and eradicate poverty. Factors regarding the environmental sphere must be observed: a well-ventilated and lit environment, which does not use toxic materials, generates health and well-being, and contributes to the quality of life and ability to work.

In a context where self-construction is common, social interaction between family farmers is possible thanks to exchanging experiences and hours of work on the construction site and professional training for farmers who begin to work in earth-based constructions as an economic activity (Prompt, 2012). Socioeconomic distribution, in turn, impacts the environment and the activity itself (Borges, 2023). Therefore, architecture is understood not as a final, static product but as a transformative process (from conception to use and demolition) for the user (Guizzo, 2018). Different exchanges emerge from the interconnection within the rural space in the production, which are also established between the building and the people. (Glaeser, 2024).

From the perspective of architecture as a process, the educational potential of construction is emphasized, either through teaching activities and labor training or by the didactic demonstration of the technologies used. This dynamic, already widespread in academic contexts (Bessa & Librelotto, 2021), can be extended to community experiences.

Socio-economic aspects and their associations with architecture and earth-based construction

The economy and society are subsets integrated into nature, manifesting themselves in the biosphere's spatial organization. As one of these subsets, society involves a wide range of local, regional, and global exchanges. In the social sphere, the economy is dedicated explicitly to symbolic relationships and/or monetary exchanges that are socially accepted in a given local or regional context (Cavalcante, 2022).

Inhabiting the Earth, the manifesto for the right to build with earth, released by the journal, ***EcologiK E Architectures à Vivre*** in partnership with CRAterre, the National Higher School of architecture of Grenoble and UNESCO Chair (AEDO, 2014), highlights that earth-based construction promotes the use of a local resource that is especially accessible to those with fewer resources, since they can build directly with the earth available beneath their feet.

Neves and Faria (2011) state that earth is widely used to build shelters in low-income communities, especially in developing countries, where the survival of primitive building systems is associated with the need for housing. In turn, Weimer (2005), when specifically analyzing EBC in a context of popular production, points out that earth-based construction is "very cheap", which possibly contributes to the perception of this technique as being of "low quality". However, it is important to highlight that low cost is directly linked to local soil availability and community collaboration in construction, a common situation in populations that traditionally build with earth.

The demand for housing requires a socioeconomic analysis that prioritizes community self-sufficiency. Fathy (2009) demonstrated that traditional timber was replaced with vaulted structures made with adobe to make housing construction for low-income peasants economically viable.

Activities aimed at disseminating earth construction techniques are recurrent in environmental education centers that become business models. Well-established examples of these sites are Tibá – Intuitive Technology and Bio-architecture, and IPEC – Institute of Permaculture and Ecovillages of Cerrado. In the state of Santa Catarina, Nova Oikos stands out. It disseminates EBC, among other techniques for construction and food production (Prompt & Librelotto, 2019).

The Versus Project and its socio-ecnomic focus

The Versus - Vernacular Knowledge for Sustainable Architecture - Project was developed under the leadership of the Escola Superior de Gallaecia (Portugal), in partnership with the École Nationale Supérieure ***d'architecture*** of Grenoble (France), the ***Universitat Politècnica de Valencia*** (Spain), and ***Università degli Studi di Firenze*** and ***Università degli Studi di Cagliari*** (Italy). The project is based on principles of vernacular architecture to develop building sustainability strategies (Correia, Dipasquale & Mecca, 2015).

Its two main objectives are: (1) to recognize vernacular heritage in its historical qualities and values, highlighting its potential contribution to

AS / Vol 43 / Nº 67 / 2025
ISSN Impresa 0716-2677
ISSN Digital 0719-6466

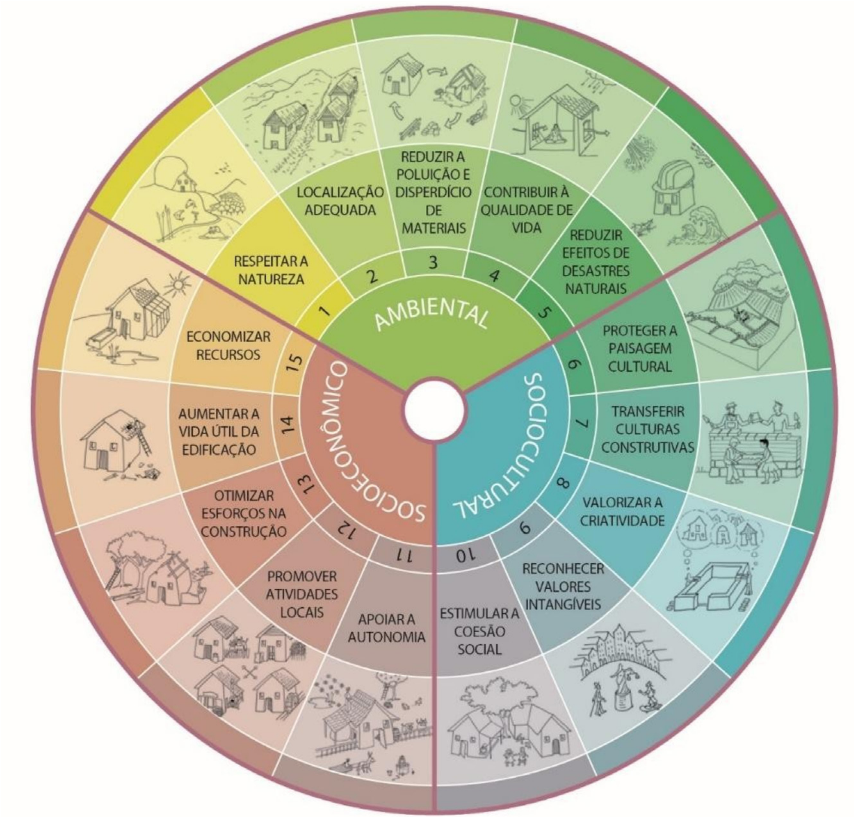

Figure 12. Principles and strategies for sustainability in architecture according to the VerSus Project. Source: Adapted from Guillard et al. (2014). Translation by the authors.

the sustainability of contemporary architecture, and (2) to disseminate and adapt these principles, strategies and techniques to current needs in terms of culture, identity, constructive quality and environment. Figure 12 presents the illustrative outline of the VerSus Project's assessment principles.

The socioeconomic dimension encompasses principles 11 to 15 (Figure 12). Traditionally analyzed based on financial aspects and monetary values, this dimension acquires another perspective when observed from vernacular architecture, where the concept of cost is associated with the notion of human effort and the investment of non-necessarily financial resources.

The eleventh principle seeks to promote autonomy. The proposed strategies are (11.1) resource sharing, (11.2) use of local and accessible materials and resources, (11.3) promotion of local crafts, (11.4) encouragement of local production, and (11.5) promotion of community empowerment. This principle is associated with concepts such as self-sufficiency, integration between housing and productive activities, access to water, and food safety.

The twelfth principle seeks to promote local activities. The proposed strategies are (12.1) strengthening urban agriculture and local food production systems; (12.2) reducing displacement; (12.3) promoting the collective use of spaces; (12.4) including areas destined to productive

AS / Vol 43 / Nº 67 / 2025
ISSN Impresa 0716-2677
ISSN Digital 0719-6466

activities on urban and architectural scales, and (12.5) developing handmade products based on local resources.

The thirteenth principle deals with optimizing construction processes. The associated strategies are (13.1) optimizing the use of materials; (13.2) adapting the scale of buildings; (13.3) technical simplification of construction systems; (13.4) reducing material transport distances; and (13.5) using materials with a low level of processing. This principle is associated with concepts such as multiple-use spaces and planning the work in stages.

The fourteenth principle refers to extending the useful life of buildings. The strategies are (14.1) provision for periodic replacement of building elements; (14.2) consideration of the effects of erosion on materials; (14.3) planning maintenance over time; (14.4) design of spaces flexible to changes and extensions; and (14.5) construction of sturdy and durable structures. This principle is associated with concepts of resistance of materials and adaptability of environments.

The fifteenth principle deals with the economy of resources. The strategies are (15.1) the use of recyclable materials; (15.2) the promotion of urban densification; (15.3) guaranteed supply from renewable energy sources; (15.4) the development of building systems appropriate to local conditions; and (15.5) the implementation of natural ventilation, heating, and lighting solutions. This principle is associated with energy efficiency, using renewable energies, reducing embodied energy, and adopting passive systems for heating and cooling buildings.

Post-Occupation Assessment

According to Li, Froese, and Brager (2018), post-occupation assessment (POA) is a process for assessing a building's performance after a specific period of use. The authors emphasize that POA is restricted to the building's use phase. Galvão, Ornstein, and Ono (2013) define POA as "a set of methods and techniques with potential application in the environments in use," highlighting its character as aimed at analyzing buildings in operation.

METHODOLOGY

A method based on the principles and strategies of the Versus Project was developed to perform a post-occupation analysis from the perspective of sustainability in earth-based constructions.

The approach adopted, denominated in this study as the Versus method, was chosen because it integrates, in its conception, guidelines focused on sustainability in buildings that present characteristics of vernacular architecture.

AS / Vol 43 / Nº 67 / 2025
ISSN Impresa 0716-2677
ISSN Digital 0719-6466

Based on this reference, a scoring system was developed to evaluate each item (Table 2). The proposal involves assigning a score to the 75 VerSus strategies and classifying each one into three levels: "complies," "partially complies," and "does not comply." The assessment of each strategy was based on developing a set of indicators (Prompt, 2021, pp. 105-112) that guided the assignment of scores according to the degree of compliance observed.

Table 2. Symbology and scoring to evaluate each of the 75 strategies. Source: Prepared by the authors.

Assessment	Symbol	Scoring
Complies		1
Partially Complies		0,5
Does not comply		0

Initially, each of the 75 strategies was evaluated individually. Then, the arithmetic mean of the assigned scores was calculated to obtain the score for each principle. Subsequently, the reverse process was applied: through a scoring system defined for each principle (Table 3), it was possible to evaluate each aspect by consolidating the results of the principles it comprises.

Table 3. Scale for assigning symbology to each principle and each aspect. Source: Prepared by the authors.

Scoring	Assessment	Symbol
0 – 1,6	Complies	
1,7 – 3,4	Partially Complies	
3,5 – 5	Does not comply	

The methodological procedures adopted included a bibliographic review, documentary analysis, architectural survey, photographic record, visual inspection, in situ observation, questionnaire application, and semi-structured interviews.

Specific indicators were defined for evaluating each strategy (Prompt, 2021, pp. 105 to 112), as shown in Table 4, which presents the indicators used in evaluating Principle 11.

Table 5 presents the results of the analysis of the six buildings in the scope of the socioeconomic sphere:

AS / Vol 43 / Nº 67 / 2025
ISSN Impresa 0716-2677
ISSN Digital 0719-6466

Principle 11 - Promoting autonomy		
Item	Strategy	Indicator
11.1	Resource sharing	• Foresee sharing systems, services, and energy sources • Promote fair compensation for the worksite team • Share knowledge about technologies • Share resources produced around the building
11.2	Use of locally accessible materials and resources	• Incorporate, into the process, qualified resident professionals from the region • Use materials extracted from the site itself • Use locally produced materials • Use recycled or repurposed materials
11.3	Promotion of local crafts	• Choose artisanal construction techniques • Provide or use indoor architectural elements of local artisans • Allow artistic expressions during the work
11.4	Stimulating local production	• Add food production systems around the building • Add places for processing and storing food
11.5	Promotion of community empowerment	• Promote teaching and training activities related to construction • Stimulate self-construction

Table 4. Indicators to assess Principle 11. Source: Prepared by the authors

Table 5. Result of the analysis of the six buildings for the socio-economic sphere. Source: Prepared by the authors

	Building					
	01	02	03	04	05	06
Principle 11	▲	▲	▲	▲	▲	▲
Principle 12	▲	▲	✖	●	●	▲
Principle 13	✖	✖	✖	✖	✖	✖
Principle 14	▲	●	●	▲	▲	▲
Principle 15	●	✖	✖	▲	✖	●

RESULTS

From this point, the evaluation of principles 11 to 15 is discussed to approach the analysis in the socioeconomic sphere effectively. This seeks to reflect on the strategies adopted in the case study, place them in an expanded perspective, and consider the possibility of applying the method in other contexts.

Principle 11: Promotion of autonomy

The general assessment of principle 11 highlights the following aspects: the sharing of knowledge and labor as a practice resulting from EBC; the use of materials from the site itself; the absence of technical support in certain situations; the possibility of artistic expression provided by the use of earth and other natural materials; know-how rooted in local culture;

AS / Vol 43 / Nº 67 / 2025
ISSN Impresa 0716-2677
ISSN Digital 0719-6466

housing as a factor of permanence of families in rural areas; and food production integrated into buildings as a characteristic element of the analyzed context.

Principle 12: Promotion of local activities

The assessment of principle 12 revealed the following factors of influence: agricultural production as families' main economic activity; economic activities within the properties; the existence of private spaces with no community use; the provision, in projects, of rooms to support production activities; and the development of bamboo-manufactured products, directly related to EBC practices.

Principle 13: Optimize construction processes

The assessment of principle 13 identified the following influencing factors: reworking due to the poor application of technologies, attributed to technical ignorance; inadequate choice of construction techniques due to lack of knowledge about the type of soil; use of fragile and untreated wood, resulting in pathological manifestations; inadequacy in dimensions and functionality of the designed spaces, associated with failures in the design stage; the ECB, as it is still innovative in the region, presents additional challenges; on the other hand, the predominance of little processed materials from the site itself, contributes to the reduction of transportation-related efforts.

Principle 14: Extension of the building's useful life

The assessment of Principle 14 revealed the following influencing factors: absence of manuals for use, operation, and maintenance of buildings; degradation of construction elements due to poor application of techniques or abandonment; lack of regular maintenance practices; use of rigid construction techniques, such as bagged earth and compressed earth blocks (CEB), which hinder future extensions or modifications; presence of low quality industrialized materials; and use of fragile wood without adequate treatment.

Principle 15: Saving resources

The assessment of principle 15 showed the following influencing factors: use of reused materials or from demolition; adoption of organic forms that, in some cases, generate residual spaces; presence of environments with excessive dimensions, which compromise comfort and functionality; absence or non-use of installation systems, reflecting the absence of complementary projects in most buildings; ignorance or inadequate choice of local soil; and inefficiency in ventilation and daylighting systems.

AS / Vol 43 / Nº 67 / 2025
ISSN Impresa 0716-2677
ISSN Digital 0719-6466

CONCLUSION

This study aimed to present the results of evaluating sustainability in buildings built with earth, emphasizing the socio-economic aspect. The final considerations focus on the relationship between the data obtained, the factors intrinsic to earth-based construction (ECB) and architecture, and the local family farming culture in the studied region.

First, the factors that contributed positively to the results of the evaluations are highlighted. Among the positive aspects associated with the use of earth, it is identified that: (1) EBC, as an artisanal technology, stimulates the local production of manufactured items; (2) favors sharing knowledge, as it is a technology in constant development, dependent on local conditions; (3) encourages collaboration through sharing labor; and (4) allows extracting material directly from the ground, reducing logistical efforts with transport. On the other hand, aspects such as rework and low durability, often associated with inadequate technique application, especially in self-construction contexts, adversely impacted the building's assessment.

As for the positive factors intrinsic to the reality of family farming, the following stand out: (1) know-how, although not directly linked to civil construction, is part of the local culture and contributes to the efficient execution of the projects; (2) the existence of adequate housing is a fundamental element for families to stay in the countryside and the continuity of their economic activities; (3) the integration between food production and housing space reflects the logic of family farming and represents a favorable sustainability criterion; and (4) the fact that the main economic activity occurs on the property itself contributes to reducing transportation and travel costs.

Factors that negatively impacted the analyses were also identified, especially those related to the design stage. The following stand out: (1) the absence of detailed studies on solar incidence on buildings; (2) the absence of installation projects in most cases, in addition to treated water management as a secondary aspect; (3) the lack of passive strategies appropriate to the bioclimatic zone; (4) the failure to meet the minimum requirements for daylighting and ventilation established by NBR 15550; and (5) inadequate design decisions regarding the dimensions of spaces, resulting in excessively large rooms, with potential for thermal discomfort and increased energy consumption for heating.

Some reflections arise regarding the application of the VerSus method. Considering its particularities, to what extent would it be possible to reproduce it in different contexts? Would its principles, based on solidarity and collaborative relationships, be adaptable to conventional commercial contexts? Moreover, would the results be equivalent if the buildings in this study were evaluated by another method to measure sustainability?

AS / Vol 43 / Nº 67 / 2025
ISSN Impresa 0716-2677
ISSN Digital 0719-6466

Applying the VerSus method to other types of buildings may allow comparative analyses in future studies. In addition, the project objectives recommend incorporating the VerSus principles and strategies even in the work's design and planning phase. Finally, it is suggested that didactic material that is accessible beyond the academic world be prepared. This material should support the popular production of EBC and the work of professionals in the area. It should integrate the principles of VerSus and adapt them to Brazilian reality.

CONTRIBUTIONS FROM CRediT AUTHORS

Conceptualization, C.H.P., J.L.B., and L.I.L.; Data curation, C.H.P.; Formal analysis, C.H.P.; Obtaining funding, C.H.P., and L.I.L.; Research, C.H.P.; Methodology, C.H.P., L.I.L.; Project management, C.H.P., and L.I.L.; Supervision, C.H.P., and L.I.L.; Validation, C.H.P.; Writing - original draft, C.H.P., J.L.B., and L.I.L.; Writing - revision and editing, C.H.P., and L.I.L.

BIBLIOGRAPHIC REFERENCES

Aedo, W. C. (24-28 de noviembre de 2014). ¿Por qué construir con tierra? Universalidad y sostenibilidad [Sesión de conferencia]. 14° Seminario Iberoamericano de Arquitectura y Construcción con Tierra (SIACOT), Anais, San Salvador.

Bessa, S. A. L., & Librelotto, L. I. (2021). A importância das práticas construtivas nos canteiros experimentais em cursos de arquitetura e urbanismo. PARC Pesquisa em Arquitetura e Construção, 12(00), e021028. https://doi.org/10.20396/parc.v12i00.8660850

Borges, J. (2023), Uma introdução à economia ecológica: ideias para um primeiro debate. Em H. Costa de Brito, M. M. Neto da Silva (Org.). *Meio Ambiente e Sustentabilidade: Pesquisa, reflexões e debates emergentes*. (1 ed. Vol. IV, pp. 196-206). Amplla Editora. https://doi.org/10.51859/amplla.mas3200-1

Borges, J. C. L. , & Prompt, C. H. (2024). Energetic study applied to permaculture in Barra da Lagoa in Santa Catarina. *LUMEN ET VIRTUS*, 15(39), 2942-2956. https://doi.org/10.56238/levv15n39-103

Cavalcanti, C. (2022). Economia ecológica: desafio à interdisciplinaridade: Uma possível referência para o desenho de sistemas humanos realmente sustentáveis. *Inovação & Desenvolvimento: A Revista da FACEPE*, 1(8), 17-24. https://revistainovacao.facepe.br/index.php/revistaFacepe/article/view/82/96

Correia, M., Dipasquale, L., & Mecca, S. (Eds.). (2015). *VERSUS: HERITAGE FOR TOMORROW: Vernacular Knowledge for Sustainable Architecture*. Firenze University Press. https://library.oapen.org/viewer/web/viewer.html?file=/bitstream/handle/20.500.12657/55140/9788866557425.pdf?sequence=1&isAllowed=y

Fathy, H. (2009). *Arquitetura para os pobres. Uma experiência no Egito rural.* Dinalivro.

Ferreira, T. L. (2014). *Arquiteturas vernáculas e processos contemporâneos de produção: Formação, experimentação e construção em um assentamento rural* [Tese de Doutorado em Arquitetura, École Nationale Supérieure d'Architecture de Grenoble]. Instituto de Arquitetura e Urbanismo da Universidade de São Paulo, Grenoble. http://www.teses.usp.br/teses/disponiveis/102/102131/tde-08092015-142648/

Galvão, W. J. F., Ornstein, S. W., & Ono, R. A. (2013). Avaliação pós-ocupação em empreendimentos habitacionais no Brasil: da reabilitação aos novos edifícios. Em S. Barbosa Villa, Sh. Walbe Ornstein, (Comps.), *Qualidade ambiental na habitação: avaliação pós-ocupação* (1° ed., pp.1-400). Oficina de Textos.

Glaeser, L. M. (2024). Ruptura metabólica: a visão de Marx sobre a desconexão do ser humano com a natureza pelo capitalismo. *Alamedas*, *12*(3), 256-262. https://doi.org/10.48075/ra.v12i3.33218

Guillaud, H., d'Architecture de Grenoble, É. N.S., Moriset, S., Sánchez Muñoz, N., & Sevillano Gutiérrez, E. (Eds.). (2014). *Lessons from vernacular heritage to sustainable architecture*. Versus leçons du patrimoine vernaculaire pour une architecture durable lezioni dal patrimonio vernacolare per l'architettura sostenibile contributo do património vernáculo para a arquitetura sustentável lecciones del patrimonio vernáculo para una arquitectura sostenible. CRAterre & Escola Superior Gallaecia. https://www.esg.pt/versus/pdf/versus_booklet.pdf

Guizzo, I. O. (2018). O construir como afeto: A casa como corpo e não manifesto. Arquitextos, 19(218.04). https://vitruvius.com.br/revistas/read/arquitextos/19.218/7030

Li, P., Froeser, T. M., & Brager, G. (2018). Post-occupancy evaluation: State-of-the-art analysis and state-of-the-practice review. *Building and Environment, 133*, 187-202. https://doi.org/10.1016/j.buildenv.2018.02.024

Mars, R. O. (2008). *O design Básico em Permacultura*. Via Sapiens.

Morrow, R. (2010). *Permacultura passo a passo.* Mais Calango.

Neves, C. (2023). *Materiais de construção* e sistemas construtivos com T*erra*. Ed. da Autora

Neves, C., Fernandes Maranho, M., Lelis, N., & Borges Faria, O. (Eds). (2022). *Arquitetura e construção com terra no Brasil* (1° ed., pp. 1-251). ANAP.

Neves, C., & Faria, O. B. (Org.). (2011). *Técnicas de construção com terra*. Faculdade de Engenharia de Bauru/Red Iberoamericana PROTERRA. https://redeterrabrasil.net.br/wp-content/uploads/2020/08/T%C3%A9cnicas-de-constru%C3%A7%C3%A3o-com-terra.pdf

Niroumand, H., Kiberdt, C. J., Barcelob, J. A., & Saaly, M. (2017). Contribution of national guidelines in industry growth of earth architecture and earth buildings as a vernacular architecture. *Renewable and Sustainable Energy Reviews, 74*, 1108-1118. https://doi.org/10.1016/j.rser.2017.02.074

AS / Vol 43 / Nº 67 / 2025
ISSN Impresa 0716-2677
ISSN Digital 0719-6466

Okretic, G. A. V. W., Carlos, Y. B. A., Santana, D. R., Ximenes Santos, I. & Rodrigues Silveira, M. T. (2024). Grupo de Pesquisa Sobre Arquitetura Vernácula: técnicas utilizadas no interior do Ceará. Em O. B. Faria, S.S.B. Saraiva, e L. Maia (Eds.). *TerraBrasil 2024 - Congresso de Arquitetura e Construção com Terra no Brasil* (9° ed., pp. 439-452). TerraBrasil / UFBA. https://www.academia.edu/122158858/TerraBrasil_2024_1

Prompt, C. H. (2012). *Arquitetura de Terra em Unidades Agrícolas Familiares: Estudo de Caso no Oeste Catarinense* [Tese de Mestrado, Universidade Federal de Santa Catarina]. Repositório Institucional UFSC. http://repositorio.ufsc.br/xmlui/handle/123456789/101027

Prompt, C. H. (2021). *Avaliação da Sustentabilidade em Arquitetura e Construção com Terra. Estudo de Caso no Oeste Catarinense* [Tese de Doutorado, Universidade Federal de Santa Catarina]. Repositório Institucional UFSC. https://repositorio.ufsc.br/handle/123456789/231172

Prompt, C. H., & Librelotto, L I. (2018). Arquitetura e Construção com Terra em Santa Catarina. Em C. Neves, F. Cardoso, e L. Maia (Orgs.). *TerraBrasil 2018 - Congresso de Território e trabalho: a produção da arquitetura com terra no Brasil* (7° ed., pp. 346-355). TerraBrasil / UFBA. https://www.academia.edu/122137212/Terra_Brasil_2018

Prompt, C. H., & Librelotto, L. I. (2020). Avaliação da Sustentabilidade em Arquitetura e Construção com Terra. Adaptação do Método Versus em Santa Catarina. Em *Actas 2º Seminário Arquitetura Vernácula Patrimônio & Sustentabilidade* (2ª ed.). https://static.even3.com/anais/202463.pdf

Prompt, C. H., & Lisboa, S. (2022). Panorama dos Profissionais da Arquitetura e Construção com Terra na Região Sul do Brasil. Em C. Neves, F. Cardoso, e L. Maia (Eds.). *TerraBrasil 2022 - Congresso de Arquitetura e Construção com Terra no Brasil* (8ª ed., pp. 307-318). TerraBrasil: UFSC. https://www.fundacionantoniofontdebedoya.es/libro-terra-brasil/

Silva, V. G. (2003). *Avaliação da sustentabilidade de edifícios de escritórios brasileiros: diretrizes e base metodológica* [Tese de Doutorado, Universidade de São Paulo]. Biblioteca Digitas USP. https://doi.org/10.11606/T.3.2003.tde-10032025-143614

Vegas, F., Mileto, C., Guimaraens, G., & Navalón, V. (2014). Defining Sustainable Architecture. Em M. Correia, L. Dipasquale, S. Mecca (Eds.) *VERSUS: Heritage for Tomorrow: vernacular Knowledge for Sustainable* Architecture (pp.34-39). Firenze University Press. https://doi.org/10.36253/978-88-6655-742-5

Weimer, G. (2005). *Arquitetura Popular Brasileira*. WMF Martins Fontes

Zambrano, L. M. A. (2008). *Integração dos Princípios da Sustentabilidade ao Projeto de Arquitetura* [Tese de Doutorado, Universidade Federal do Rio de Janeiro]. PROARQ — Programa de Pós Graduação em arquitetura da UFRJ. https://proarq.fau.ufrj.br/producao/teses-e-dissertacoes/1032/integracao-dos-principios-da-sustentabilidade-ao-projeto-de-arquitetura