

Vernacular architecture in Brazilian semi-arid region: survey and memory in the state of Sergipe

Dayane Felix Andrade¹, Marco Antônio Penido de Rezende², Sofia Araújo Lima Bessa³

¹Federal University of Minas Gerais, Belo Horizonte, Brazil, dayanefelixa@gmail.com; ²marco.penido.rezende@hotmail.com;

³salbessa@gmail.com

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Abstract

*Buildings with earth in their composition have been common since the beginning of the Brazilian territory's settlement. Until this day, wattle-and-daub homes are frequent in the Northeast region of the country. This technique uses a structural cage made of the weft of woods whose interlocking voids are covered with thrown wet clay. Due to the current association of these buildings as shelters for insects that may contain *Trypanosoma cruzi* (which transmits the Chagas disease) numerous public policies guide eradication and replacement of these buildings by others built with masonry. Due to the destruction of these buildings, built with vernacular earthen techniques, this research aims to survey buildings that still resist in the semi-arid region of Sergipe state. Therefore, literature review was carried out on architecture in the semi-arid region and building investigation techniques using digital tools. Considering Sars-Cov-2 pandemic as a prohibitive condition that caused difficulties in collecting data in the field, it was necessary to seek out methods that could be used for a remote survey. Furthermore, an exploratory analysis was carried out with digitally available tools in which it was possible to observe popular buildings built with earth in the legal semi-arid region. Initially, data was collected from the latest demographic censuses carried out by the Brazilian Institute of Geography and Statistics (IBGE), as well as the socioeconomic data of Brazilian families in poverty situations registered with the government. This initial data, however, did not present information on geographic positioning of the dwellings, making it necessary to conduct a survey through Google Street View software, allowing the visualization of images at ground level, being effective on searching for wattle-and-daub residences. From these data, a catalog of the constructions found was generated and, by georeferencing these dwellings, the documentation produced may contribute to the preservation of vernacular constructive memory of this study's location object.*

Keywords: Earthen Constructions. Google Street View. Wattle-and-daub. Semi-arid.

1. Introduction

Earth based construction techniques were widely used when building popular residences throughout Brazil. On the countryside of Sergipe state, the most widely used technique is wattle-and-daub. Wattle-and-daub consists on a structural cage with vertical and horizontal timbers in a grid. The filling of this cage is done with loam, which is usually mixed with fibers. The

technique is known in Brazil as “taipa de mão”, in the rest of South America as “bareque”, “bahareque” or “bajareque”, “quincha” in Spain, and “lehm-bewurf” in Germany.

These buildings have been going through a process of destruction driven by several public policies. Those policies have, as sole objective, the eradication of these dwellings due to an ideal hygienist history and media pressure that

propagates the use of industrialized materials as progress and modernization (Vieira, 2017). This process takes place in greater intensity on rural areas, due to the concentration of houses built with vernacular techniques and actions of public policies, as well as housing programs, such as the National Rural Housing Program of Federal Government. In the last two decades, state and municipal governments have implemented programs such as “*Casa Nova, Vida Nova*” (2007), and “*Casa de taipa nunca mais*” (2018) that have the objective of tearing down wattle-and-daub houses to replace them with masonry built houses, using standardized projects that do not correspond to the individual needs and opinions of each family.

Moreover, there is an increasing dissemination that wattle-and-daub residences are sub dwellings, and that they present risks to public health. That’s because they would serve as accommodation for insects, such as *Triatoma cruzi*, vector of Chagas disease and, therefore, the need of their urgent destruction.

On the other hand, there are studies, such as Silva (2000), who indicates that these insects lodge in the cracks of the walls due to ecological imbalances that make so that wild animals get closer to human dwellings. This environmental imbalance have been occurring since the colonization, by the destruction of forest areas, thus causing insects to seek alternative shelters when losing their natural habitats.

On rural areas and the countryside, it is common that, even by receiving masonry houses through housing programs, residents of wattle-and-daub accommodations still have the desire of maintaining their old houses (Vieira, 2017). Recently, this desire is being ignored by the government. They do not present public policies that aim to maintain and improve these buildings, which are in precarious conditions, as an alternative to their replacement. The replacement by standardized houses generates a drastic change in Sergipe’s landscape since dwellings with different characteristics are losing their originality.

One of the main difficulties for the implementation of public policies, aiming to reform wattle-and-daub buildings, is the scarcity of information about current conditions, mainly, their location.

1.1 Google Street View as an emerging data collection technology

Schootman, Nelson, Werner, Shacham, Elliott, Ratnapradipa, Lian, & Mcvay. (2016). treat the use of tools such as Google Street View (GSV), drone aero photography, monitoring cameras, and social media, as emerging technologies that can effectively and inexpensively serve to analyze a changing environment.

Regarding Google Street View and based on previous studies in the health area, authors reckon that it can serve as a good tool for analyzing the built environment, especially when conditions make it difficult to collect on-site data, such as studies that evaluate large regions, several areas, or distant locations.

Google Street View is a feature launched in 2007 that offers panoramic views from around the world. Images are captured with the aid of 360° cameras coupled on vehicles. In a search carried out by using *Portal Capes* periodicals, it was found the existence of about 169 published and peer-reviewed articles that have the keywords Google Street View, and their abbreviation, GSV.

They also have relation to the following areas of knowledge: history and archeology, anthropology, geography, sociology, and engineering. Within these articles, 28 stand out because they have subjects closer to this study. It can, then, be noticed that the use of this tool is increasing, especially in the last decade, in countries of North America and Europe (Nesse, & Airt, 2020).

Nesse and Airt (2020) conducted a systematic review of the subject, reinforcing that Google Street View is being increasingly used in research within the areas of public health, architecture and urbanism. Their study aimed to

verify the use of GSV in place of face-to-face field research in contexts where there are prohibitive conditions for the execution of such.

Nesse and Airt (2020) also draw attention to some criteria that should be analyzed in the research using GSV: 1. The scale of the object to be searched needs to be compatible with the quality of images. Transience also needs to be taken into account, so that a research aiming to map, for example, the pollution of streets of a large city, will probably not succeed using GSV as a tool; 2. Attention and accounting are required in dating of images available in GSV, the year of capture must be flagged in the research; 3. Observers need to be specifically trained so that they can find exactly what is being sought.

As the time of GSV images is outside the researcher's control, close attention should be paid to the time they are taken and thus incorporate it into the research project and report it in the study. In addition, training observers to observe through GSV requires different instructions. In summary, GSV can be a useful tool to replace face-to-face observations of street environment characteristics if classic parts of the survey research project (research time and researcher training) are carefully considered (Nesse & Airt, 2020).

Furthermore, Google Street View is being used in studies that aim to verify its feasibility to verify changes caused by environmental disasters, such as hurricanes (Zhai & Peng, 2020), and vulnerability in floods (D'Ayala et al., 2020) as well as accidents with nuclear power plants (Mabon, 2016). In the area of architecture and urbanism, there are studies focused on the detection and analysis of urban art in facades, such as graffiti (Novack et al., 2020), urban landscape analysis (Hong, 2020), and (Kim et al., 2021), among others. Despite the increasing use of GSV, few studies yet use it to analyze the existence of building's materials and housing conditions.

In some locations, GSV has a function that allows for the recovery of images taken at different times. By default, the tool shows the latest

images, but it is possible to select other times in the web viewer. It can also be done through programs that use the *Application Programming Interface* (API) in free translation – made available by Google.

The GSV image API is also being used in programming-focused studies. Those studies use the concept of deep learning, that consists on programming computers to perform tasks normally done by humans, in which case computers analyze images and identify the criteria previously established as urban vegetation cover (Lu, 1994), presence of traffic signs (Zhang et al., 2018), abandoned houses (Zou & Wang, 2021), and others.

In light of this, the general objective of this paper was to create a survey of vernacular constructions built with wattle-and-daub houses in the semiarid region of the state of Sergipe, aiming to obtain a mapping of the general situation. Only digital tools were used in this survey, due to Sars-Cov-2 pandemic's locomotion impediments.

2. Methods

To search the vernacular architecture in the legal semi-arid region of Sergipe, an exploratory analysis was carried out with digitally available tools, which made it possible to observe popular vernacular buildings.

2.1. Area of study

Through previous research, it was possible to delineate a diagnosis about wattle-and-daub occurrence on houses, in a few localities of Sergipe. Those localities include Mem de Sá Island, in the city of Itaporanga d'Ajuda/SE (Andrade, 2020), as well as in cities that were part of the sugar economic cycle (colonial times) as Estância, Santa Luzia do Itanh, Santo Amaro, Itaporanga d'Ajuda, São Cristóvão e Laranjeiras (Maia et al., 2020). Also a short study regarding residences built with earth located in villages in the cities of Lagarto and Itabaiana was conducted (Santos, 2020).

In addition, no studies were found in other municipalities, therefore, this research intends to adhere to the semiarid region of the state.

The first intention of this study was to relate to "polygon of droughts" appointed by the Superintendence of Development of the Northeast (SUDENE) and used in *the Digital Atlas on Water Resources of Sergipe* (2016), provided by the Secretary of State for the Environment and Water Resources of Sergipe (SEMARH).

The delimitation of the polygon of droughts is exceeded due to the new scope approved by the Resolutions of the Deliberative Council of Sudene of No. 107, of 07/27/2017, and of No. 115, of 11/23/2017, which names the region as "Legal Semiarid" (Fig. 1).

The choice of geographical scope takes into account the absence of previous studies and also that it is a relatively homogeneous region regarding climate, population, and economic characteristics. In addition, the region comprises 29 of the 75 municipalities of Sergipe, thus being a very significant portion of the state.

2.2. Data collection

At first, data from demographic censuses elaborated by the Brazilian Institute of Geography and Statistics (IBGE) were used, but they are not clear about the predominant constructive technique in buildings, since the summary tables published have an inefficient classification system. That because, masonry not coated is in the same category as the uncoated wattle-and-daub, making it impossible to differentiate the specific amount of houses in which each technique was applied.

In light of this, a consultation was carried out using a digital tool called CECAD Tab 2.0, which made publicly available socioeconomic data of people inserted in the Single Registry of Federal Government in Brazil. This tool is also available to municipal and state managers, so that it may be used as basis for public policies.

With CECAD, data on predominant material in the external walls of registered households was collected. The platform provides data specific of each municipality and allows for additional filters, such as urban or rural areas as well as traditional and specific population groups that reside in such dwellings.

However, data collected from IBGE and CECAD are not georeferenced and, when studying vernacular architecture, it is important to know the location of these buildings and the specificities regarding their geographic context. In some situations, buildings may be found in different conditions than those originally expected, or even not be found at all (Carter & Crowley, 2005).

Due to the limitations related to Covid-19 pandemic, it was necessary to perform a digital survey, in order to have an overview on buildings found in the study area and better direct field research. This survey was carried out using Google Street View (GSV) *software*, which consists of a virtual representation that allows for user to travel, as if in a vehicle, through available routes. Another *software* used was Street View Download 360 Pro which uses the API provided by Google to enable the acquisition of panoramic images available in a given region, ensuring files with higher resolution quality.



Fig. 1. Location of the Brazilian semiarid region and the state of Sergipe (Map prepared by the author, 2021).

3. Vernacular Architecture in the Semi-arid region of Sergipe

During September, October, and November, 2021, virtual investigations were carried out through roads that have GSV images and data, every 200 meters. Although the region of Sergipe's legal semiarid encompasses most municipalities of the state, it can be noticed that routes with GSV images are not present in all roads of the region. Thus, only routes that had GSV images were covered. Some regions have not been analyzed by the existence of GSV routes and other impediments such as demarcated indigenous territory (Caiçara/Ilha de São Pedro) in the municipality of Porto da Folha. Due to the

situation of Covid-19 pandemic it was also not possible to conduct a face-to-face survey of this region. Therefore, this article deals only with the digital survey carried out at GSV.

In municipalities of Sergipe's legal semiarid region, there are GSV images captured in the years of 2012, 2015, 2018, and 2019, being all of those used in this study.



Fig. 2. Example of a wattle-and-daub dwelling in Porto da Folha, Sergipe, Brazil (Source: Google Street View, 2019).

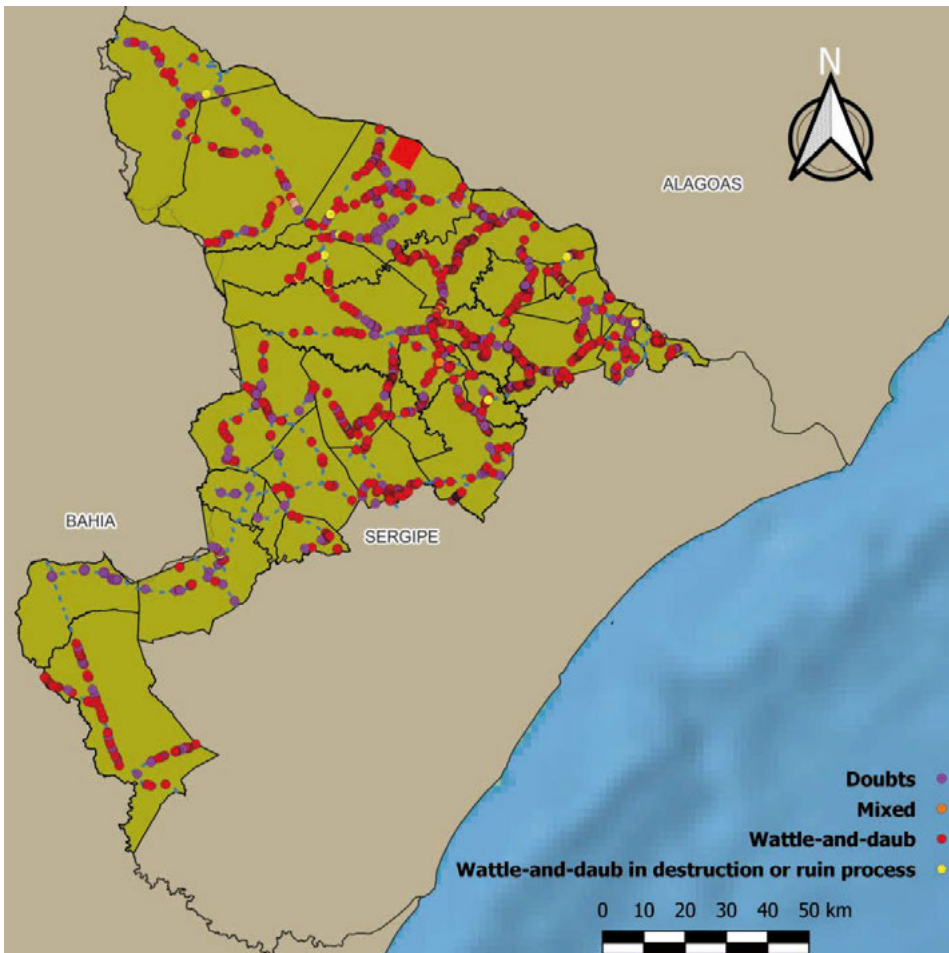


Fig. 3. Survey of the vernacular architecture of the semi-arid region of Sergipe (Map prepared by the author, 2021).

In this virtual investigation, dwellings were marked where it was possible to identify the constructive technique used (Fig. 2), but there were also buildings in which it was not possible to visually identify external coating on the external walls in good condition.

In order to compose the synthesis map (Fig. 3) four identification categories were created: i) red for houses in which it was possible to identify wattle-and-daub; ii) purple for dwellings that have characteristics that may indicate the use of wattle-and-daub on external walls, but that could not be confirmed; iii) yellow for houses in wattle-and-daub that, at the time of the GSV images, were in destruction or ruin process; and iv) orange for mixed-use of wattle-and-daub with other construction techniques.

In total, 1,394.52 km were covered and 1,810 dwellings (Fig. 4) were marked in the categories reported above. After this survey, it was possible to show data in an overview table (Table 1) and, through that, understanding which municipalities of the legal semi-arid have a large number of buildings in wattle-and-daub, possible to identify under visual analysis.



Fig. 4. Example of a wattle-and-daub dwelling in Gararu, Sergipe, Brazil (Source: Google Street View, 2019).

City Name	Year of Data	Wattle-and-Daub	Doubts	Mixed	Total
Amparo de São Francisco	2012 e 2019	3	7	0	10
Aquidabã	2012, 2015 e 2019	189	27	10	226
Canhoba	2015 e 2019	6	7	0	13
Canindé de São Francisco	2012 e 2015	18	13	0	31
Carira	2012, 2015 e 2019	44	9	0	53
Cedro De São João	2012, 2015 e 2019	25	5	0	30
Cumbe	2015	16	2	0	18
Feira Nova	2015 e 2019	51	15	1	67
Frei Paulo	2012 e 2015	13	7	1	21
Gararu	2012, 2015 e 2019	166	39	1	206
Gracho Cardoso	2012, 2015 e 2019	121	19	0	140
Itabi	2012, 2015 e 2019	56	16	0	72
Macambira	2012 e 2015	29	12	0	41
Monte Alegre de Sergipe	2015 e 2019	17	4	0	21
Nossa Senhora Aparecida	2015	81	15	2	98
Nossa Senhora da Glória	2015 e 2019	38	19	0	57
Nossa Senhora das Dores	2012, 2015 e 2019	89	27	5	121
Nossa Senhora de Lourdes	2019	55	5	1	61
Pedra Mole	2015	0	1	0	1
Pinhão	2015	0	4	0	4
Poço Redondo	2015 e 2019	46	12	1	59
Poço Verde	2012 e 2015	0	6	0	6
Porto da Folha	2012, 2015 e 2019	136	51	3	190
Propriá	2012 e 2019	33	2	0	35
Ribeirópolis	2012 e 2015	65	14	0	79
São Miguel do Aleixo	2015	2	3	0	5
Simão Dias	2012, 2015 e 2019	13	17	1	31
Telha	2012, 2015 e 2019	18	5	0	23
Tobias Barreto	2012, 2018 e 2019	70	21	0	91
Total					1810

Table 1. Synthesis of data collected

4. Conclusions

Although wattle-and-daub is a vernacular technique applied in popular dwellings of Sergipe's semiarid since the beginning of settlement, over time it began to be associated with poverty and disease spread and, therefore, these dwellings began to be replaced and vernacular architecture rejected in these communities. Thus, the absence of in-depth studies on these buildings.

This study fulfills its purpose of being an initial diagnostic of the current situation on vernacular buildings built in wattle-and-daub in the semiarid region of Sergipe. The research, using data from IBGE and CECAD, allowed, on one hand, to perceive the existence of data related to the number of dwellings and who are the specific families and groups living thereof. On the other hand, however, it was noticed the lack of georeferenced data, which is of fundamental importance to delineate investigation of this architectural production.

To fill in this gap, a survey with Google Street View allowed to aggregate the location of buildings, as well as the physical conditions in which their external walls are. This association of quantitative, qualitative, and georeferenced data has given an overview of the conditions in which these buildings are found.

Thus, a considerable amount of popular housing was found, some in precarious conditions of maintenance of their external structures. This initial survey is then, necessary to suggest changes and improvements to them, as well as to help governments understand this housing production, that, at the same time, needs to be preserved because of the historical-cultural value and its relationship with the natural landscape of backcountry, and also to develop public policies focused on providing significant improvements to housing quality and, consequently, the quality of life of the population.

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