Analysis methodologies fitness assessment of residential project sustainability for context Maceió - AL

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ABSTRACT: The search for ways to measure the level of sustainability of buildings is increasing. We note the relevance of the application of methodologies that drive the act of designing more sustainable to improve the quality of the built environment in order to minimize their impact. Thus, this study aimed to verify certification systems and its better adaptation to climate and constructive reality of the city of Maceió - AL. The methodology consisted of a pre-selection of environmental certification systems for residential buildings and their application in a multifamily residential building project, set in the context of the city. They were applied in a residential building project certifications AQUA, Reference GBC Brasil Casa e Selo Azul Caixa, developed or adapted specifically for Brazil. It was found that the analysis of the building project failed to meet up with the minimum conditions to get the certification of selected systems, as it does not meet most of the mandatory requirements: opening area of environments for prolonged stay, absence of protection for shading, implementation on the land without concern for the orientation as regards the sun and wind, among other criteria considered important for achieving a more sustainable building in Maceió. Also, we noticed a gap of these instruments in important aspects related to urban infrastructure. It appears anyway a need for methods of measurement of the level of sustainability more targeted to specific circumstances to obtain a more reliable result in the level of design sustainability.

Keywords *sustainability, architectural design, assessment methodologies.*

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1. INTRODUCTION

The construction industry accounts for a significant portion of the impacts on the environment arising from human activities, because their activities require great demand for natural resources and production. However, despite progress, these activities still do not have more appropriate technologies for their implementation (GRAMACHO et al, 2013).

Sobreira (2010) attests that there is growing demand for the measurement means of building sustainability level through certifications that will assign "value" to these buildings. These measurement methods are important for the determination of scanning parameters of compliance with various aspects of sustainability (Grunberg, MEDEIROS, TAVARES, 2014).

It is known that the emphasis on aspects adopted by each certification system is based on the priorities of the environmental agenda in each country (SILVA, SILVA and Agopyan, 2003). Internationally certified buildings do not necessarily correspond to the needs and reality of others (SILVA, 2013). In this regard, it emphasizes the importance of developing methods for measuring environmental sustainability level facing specific climatic realities.

Given the above, this article aims to apply certification systems in a multi-family residential building project in order to verify compliance with the criteria set for them and determine which is best suited to the climate and constructive reality of the city Maceió - AL.

2. MATERIAL AND METHODS

At first, we selected three seals that have been developed specifically for the country and the residential area: Seal Casa Azul, AQUA and Reference GBC Brasil Casa.

The Seal Casa Azul is an environmental rating of residential developments Caixa Economica Federal. It was developed by a multidisciplinary team in partnership with the Polytechnic School of the University of São Paulo, Universidade Federal de Santa Catarina and State University of Campinas. It is the first project sustainability rating system offered in Brazil, developed for the reality of the Brazilian housing construction.The Blue House Seal has 53 evaluation criteria in six categories that guide the project classification

The creation of the Brazilian certification AQUA (High Environmental Quality) was carried out by the Foundation Carlos Alberto Vanzolini, in partnership with the Department of Production Engineering from the Polytechnic School of the University of São Paulo (USP) and the Centre Scientifique et Technique du Bâtiment (CSTB) . The system adopts more appropriate problematic to Brazilian regional panoramas to be analyzed (VANZOLINI Foundation, 2007). It is a methodology adapted to the Brazilian regional context, from a pre-existing French system certification, the HQE (Haute Qualité Environnementale).

The certification process AQUA is completely independent of the French authorities, through on-site audits, who spend exclusively in Brazil. In the universe of the 14 categories that make up the certification of technical reference, there are 38 sub-categories that are broken down into about 160 concerns, of which over 40% is required to achieve the minimum concept (good) in each category, which does not it is sufficient to achieve the certificate.

The Referential GBC Brasil Casa (GBC Brazil, 2014) is a design tool, construction and operation. With a simple structure, it is based on performance specifications and makes

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reference to the environmental principles and energy use in consolidated standards and third party agencies recommendations, with recognized credibility.

It was developed by the Green Building Council Brazil with over 200 professionals from various sectors involved, organized in technical committees distributed in different areas of sustainability of a building: implementation, rational use of water, energy efficiency, materials, indoor environmental quality and responsibility social.

After the selection of seals, a residential architectural design for multifamily individualized application of environmental certification systems was chosen. The choice of the project took into account typological characteristics that according to IBGE (2010) were the most common design patterns of local building - apartments with two to three bedrooms.

The selected architectural design has six (6) floors types, more pilotis and basement; It consists of two (2) independent units that communicate only by common floor areas and has been developed in practice of conventional construction, not being designed in an integrated manner. There was the employment of staff to carry out compatibility in the final project phase.

Selected certification systems have been applied in the residential project. The categories relating to social practices have not been evaluated. Finally, we performed comparative analysis in order to verify the adaptation of the same environmental and constructive local reality.

3. BACKGROUND

Maceio, the capital of Alagoas, with an area of 510.655 km^2, has hot and humid weather, with annual average temperature around 25 ° C, average relative humidity of 78%, southeast of prevailing winds and average annual rainfall of 2167,7mm with rainiest months from April to July (BRAZIL, 1992). In this study, parameters were considered for evaluation of projective bioclimatic strategies indicated by Steps (2009) for housing architecture in Maceió and described in Table 01.

Table 01 - Bioclimatic strategies for Maceió-AL.

Bioclimatic Strategy	**Architectural Elements**	**Conditions**
Natural ventilation daytime	Mobile shutters, louvers, window frames Pivoting	Control openings
Night natural ventilation	Pergola, ventilated sills	
Evaporative cooling	Vegetation	Do not use hybrid means/resources
Shadowing	Overhangs, louvers, cobogós	
Protection against rain	Eaves	

Source: Adapted from Passos (2009).

As for the infrastructure of the studied reality, Maceió has 203,565 households connected to the public water supply (74, 3%) but only 30.4% of the units have access to the sewage disposal system. Disposal of solid waste is accessed by 97.6% of housing units through the garbage collection offered by the municipality, collected by cleaning or waste bins service (IBGE, 2010).

The distribution of electricity in Maceió is accessed in 98.5% of housing units that are connected to the municipality´s power distribution network. Less than 50% of the roads have culverts, as it demonstrates the fragility of the urban drainage system aggravated by the constant flooding in the city during the rainy season. In 38.3% there is open sewage. As for urban mobility, Maceió has as a means of public transport bus and urban train. There is irregularity of service, high waiting time at bus stops and the lack of maintenance of vehicles.

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4. RESULTS AND DISCUSSIONS

4.1 Application of Selo Azul Caixa

It is observed that a total of 53 criteria, only 14 have been met. However, from the 18 mandatory criteria, they fulfilled 11. Some observations:

- The criterion 1.1 was met due to the fact that the land on which the project under analysis will be built observed all requirements, including schools and colleges. It is an area with a large flow of vehicles located in an expanding region of the city, including the opening of new routes. Furthermore, there are no sources of noise, excessive and constant odors and pollution in the proximity of the terrain.
- Criterion 1.5 was not included, since the analyzed field is not characterized as urban void.
- In the category Design and Comfort, it was found that the landscape design around the building was not done, aside from just some small garden areas on the stilts floor. The project was not designed to forecast changes; but internal changes may be proposed by the owners and executed upon approval of the construction. Also, measures that could provide the neighborhood with suitable conditions of insolation, ventilation, among others, were not set out.
- Criterion 2.7 was not met as regards the size of the openings for ventilation and lighting. The recommended thermal transmittance was obeyed regarding the recommendations for external walls. As for the cover system, the heat transfer coefficient is 3.73 [W / (m^2K)] just above the maximum recommended value (≤ 3.70 [W / (m^2 K)]).
- Criterion 2.8 has become optional for the bioclimatic zone 8, after the review to adjust it to NBR 15,575 (2013) and Seal Procel Edifica (PROCEL INFO, 2013), being only recommended shading in long-stay rooms facing west . On the other hand, we know the importance of building on the land accordingly to avoid excessive heat gain in the environment causing discomfort for future user.
- In the category Energy Efficiency, from the 8 criteria only 2 were met. There are plan for presence sensors, but there is no solar heating systems and heating planned gas project. There is a natural gas forecast for kitchen supplies.
- Within the category of Water Management, the only criterion that was met is the 5.1, which indicates that the use of individual meters. There was neither provision for rainwater harvesting, nor for its retention for later disposal, or its to natural infiltration.
- The 3% of accessible units was not observed in the project. There is only accessible in public areas. The doors of the bathrooms of the apartments have a width of 0.70 m below the recommended by the NBR 9050 (ABNT, 2015).
- One of the requirements to fulfill the criterion 1.1 is the existence of treatment within the project or sewage treatment plant in the region. The project provides an anaerobic wastewater treatment plant. This item is important, given the data of IBGE (2010) as regards the domestic sewage of the local reality.

4.2 Appliciation of Referencial GBC Brasil Casa

The application of certification shows that within the 62 criteria distributed in 7 categories, 11 criteria were met, with only 4 required. Some observations:

- Within the category Implementation of the 16 criteria, only 4 have been met, with anyone being mandatory.

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- The land selection was made in an appropriate place, without environmental restrictions and in an area close to community resources and public transport.
- Within the 12 criteria not met, it is worth mentioning the inadequacy of the implementation of the building on the land without providing more pleasant conditions of environmental comfort.
- In the category Rational Use of Water, only 1 criterion was met, regarding the installation of individual meters. There is no provision of installation reducing consumption equipment or for irrigation use.
- Within the category Energy and Atmosphere, from 14 criteria only 2 were met. The Indoor Environmental Quality category had no criteria met, highlighting the lack of concern with performance in environmental comfort of the building.
- Within the category Materials and Resources, 3 criteria were met, showing a concern for the origin of the wood used in the work, and the management of waste generated.
- Despite the fact that Referential GBC Brazil Casa did not deal with the disposal of wastewater, the project provides an anaerobic wastewater treatment plant, included in the category and Innovation and design criteria.

4.3 Application AQUA

The AQUA certification requirements are divided into 14 categories, grouped into four themes: Environment; Energy and economies; Comfort; Health and safety. Within each category there are subcategories, in turn, can have more than one item to be served. We note greater requirement in order to obtain the seal in that certification system compared to the others.

Regarding the 14 categories, 9 were not fulfilled in any of the criteria and requirements (building's relationship with its surroundings; energy management; waste management; Comfort hygrothermal, acoustic comfort, visual comfort; Comfort Olfactory; health Quality of Air and water. It is noteworthy, however, a higher level of requirements of the criteria for its scope in relation to other studied certification systems. For example, one of the criteria for Category Water management requires the prediction of annual consumption of drinking water and, therefore, provides the fulfillment of three items: estimate the annual consumption of drinking water in m3 / year by residents and transmit this information to future users in the owner's manual and common areas; estimate the annual consumption of drinking water in m3 / year for the common areas and identify the total consumption of non-potable water in m3 / year, if any, and their points of consumption in housing units and common areas.

In the remaining 6 categories (Quality of components; Sustainable Construction, energy management, water management, management of conservation and maintenance of spaces and quality), some criteria were partially met and there was no criterion obeyed in all of their requirements. Some of the obeyed requirements were the use of legalized wood, commitment to job responsibilities, the use of ceramic tile in the wet areas environments, installation of access control device in the building entry, location of individual water meters in the common area.

It was observed that in order to achieve a criterion within each category it necessary to meet up several requirements, turning that system of certification a bit difficult to be obtained. An account of the score was not possible; thus, it was not possible to achieve the minimum qualification to obtain the AQUA certification.

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4.4 Comparative analysis of the applied certification systems

Table 05 lists the categories and criteria of the three certification systems applied in the case study. We observed similarities between categories and criteria but there is a wider range of requirements to be met for the scope of a project and therefore a more sustainable building by AQUA certification system.

Table 05 - Relationship between the categories and criteria for certification systems Selo Casa Azul, Referencial GBC Brasil Casa and AQUA (criteria in bold and same color of cells have similar objectives).

CATEGORIES	CRITERIA – SELO AZUL CAIXA	CRITERIA – REFERENCIAL GBC BRASIL CASA	CRITERIA - AQUA
URBAN QUALITY/ IMPLEMEN-TATION/ BUILDING RELATIONS HIP WITH THE ENVI-RONMENT/ IN CHARGE OF THE SITE	Surrounding quality - Infrastructure	Control of erosion, sedimentation and dust in construction activity	Analysis of the development
	Surrounding quality - Impacts	Project orientation - Solar Charter	Land organization in order to create a pleasant environment
	Improvements of Environs	Do not use Invasive Plants	
	Recovery of Degraded Areas	Urban Development Certificate	Land organization to promote the EcoMobility
	Rehabilitation of Homes	Land Selection	Commitments and objectives of the site
		Location Preferably Developed	Organization of site
		Basic Water and Sanitation Infrastructure	Management of construction waste
		Proximity to Community Resources and Public Transportation	Limitation of nuisances and pollution at construction site
		Access to Open Space	Consideration of social aspects in construction site
		Site Administration	
		landscaping	
		Heat Island Reduction - Floor and Coverage Areas	
		Control and Management of rainwater - Quantity	
		Control and Management of rainwater – Quality	
		Control of Pest Without Poisons	
		Compact implementation	
WATER MANAGE-MENT / RATIONAL USE OF WATER / WATER MANAGE-MENT	Individualized Measurement - Water	Rational Use of Water - Basic	Measurement of water consumption
	Economizers devices - Discharge System	Single Measurement of Water Consumption	Reduction of the distributed water consumption
	Economizers devices - Aerators	Rational Use of Water - Optimized	hot water need
	Economizers devices - Registration Flow Regulator	Submetering Water Consumption	Management of wastewater
	Rainwater utilization	Efficient Irrigation Systems	Rainwater management
	Rainwater retention		
	Infiltration of Rainwater		
	Permeable areas		
ENERGY EFFI-CIENCY/	Low consumption lamps - Private Areas	Performance of envelopment	Thermal design
	Economizers devices -	Efficient Water Heating Sources	Reducing energy

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ENERGY AND ATMOS-PHERE / ENERGY MANAGE-MENT	Common Areas		consumption for air conditioning systems, ventilation and exhaust
	Solar Heating System	Quality of Electrical Installations of Low Voltage	solar thermal and / or photovoltaic panels
	Heating Gas Systems	Artificial lighting	System performance for hot water production
	Individualized Measurement - Gas	Get the PBE Build label	artificial lighting
	Efficient elevators Efficient Appliances	Meet Level A of PBE Edifica Solar Heating Efficient sources	Elevator (if any) Reducing the energy consumption of other equipment
	Alternative energy sources	Artificial lighting - Optimized	Control of energy consumption
		Gas Refrigerant Management Residential	
		Efficient Electronics Equipment	
		Renewable energy	
		Commissioning Installed Systems Measurement and Verification	
RESOURCE CONSER-VATION MATE-RIALS / MATERIALS AND RESOUR-CES / CONSER-VATION MANAGE-MENT AND MAINTE-NANCE/ WASTE MANAGE-MENT / QUALITY OF COMPO-NENTS	Modular coordination	Waste Plan Construction Management	technical quality of the materials, products and equipment used
	Quality Materials and Components	Legalized wood	environmental quality of the materials, products and equipment used
	industrial components or Precast Forms and Reusable Anchors	Plan for Waste Management of Construction and Operation Certified wood	sanitary quality of materials products and equipment used floorings (vertical condominiums)
	Construction and Demolition Waste Management (RCD)	Environmentally Preferable Materials	floorings (houses)
	Concrete with Optimal Dosage	Contaminants Material Control	Choose product manufacturers and service providers who do not practice informality in the production chain
	Blast Furnace Cement (CPIII) and pozzolanic (CP IV)	materials Certificates	Identify and classify the use of waste production and operation for the purpose of valuation
	Paving with RCD	Desmontabilidade and Waste Reduction - Structural Systems	Choose the collective mode of waste storage
	Facade of Serviceability	Desmontabilidade and Waste Reduction - Non-systems structure	Reduce waste and improve screening
	Wood Planted or Certified		collective storage of the waste regardless of the project waste removal (requirement to be satisfied if the waste storage is done in the enclosure venture)

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			Information about maintenance Control of water flow Maintenance of waste storage area (if any) Design to ensure efficient maintenance of the other equipments technical management of building and home automation systems
DESIGN AND COMFORT / INDOOR ENVIRON-MENTAL QUALITY/ HYGROTHERMAL COMFORT / ACOUSTIC COMFORT / VISUAL COMFORT / OLFACTORY COMFORT / QUALITY OF SPACES	landscaping Design Flexibility Relationship with the Neighborhood Workaround Transport Place for Selective Collection Equipment Leisure, Social and Sports Thermal Performance - Prohibitions Thermal Performance - Orientation to the Sun and Wind Natural lighting of common areas Ventilation and lighting Bathrooms Natural Physical adaptation to terrain conditions	Flue Gas Emission Control Located Exhaustion - Basic Internal Environmental comfort Local Moisture Control Located Exhaustion - Automated Contaminants Particles Control the Garage Coming Pollutants Protection Radon protection - high risk areas acoustics	Implementation of architectural measures to optimize hygrothermal comfort of summer and winter Comfort in winter period Comfort in summer period Measure the level of humidity Take account of the acoustics in architectural provisions sound quality External visual context Natural lighting Artificial lighting Control of sources of unpleasant odors Ventilation
INNOVA-TION AND DESIGN	The project schedule	Integrated Planning and Design Quality Management, aimed at durability User manual Product Environmental Declaration Innovation and Design	
REGIONAL CREDITS		Regional Priorities: North Regional Priorities: Northeast Regional Priorities: South Regional Priorities: Southeast Regional Priorities: Midwest	
DISCRETION BONUSES	It consists of not contemplated project items among the criteria stamp and contribute to sustainability project, if previously approved by CAIXA.		
HEALTH QUALITY OF			Control external pollution sources

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AIR		Control the internal sources of pollution Ventilation Measuring air quality
HEALTH QUALITY OF WATER		Water quality Reduce the risk of legionellosis and burns
SOCIAL PRACTICES / SOCIAL REQUIRE-MENTS	Not Rated.	

As much as systems are based generally on the NBR 15575 (ABNT, 2015) for the definition of appropriate conditions for achieving a more environmentally comfortable building, we observe a weakness in this respect, as on the adoption of bioclimatic strategies for the project, the norms speaks of a percentage of opening to allow ventilation, but do not address the need for strategies like cross ventilation and shading.

The certification system AQUA is the only one among the applied systems to state that in the bioclimatic zone 8, provision should be made for the cross ventilation, but it does not address other bioclimatic strategies.

6. CONCLUSIONS

The systems have similarity in their categories and criteria, and we noted criteria with similar goals in different categories. The Aqua system was more comprehensive compared to other systems. The Referential GBC Brasil Casa was more complete and detailed than the Blue House Seal system for the specific application of the case study. However, all fail to examine important aspects when facing climate and constructive conditions of Maceió-AL.

It is noted that accessibility is addressed only in the building, forgetting its integration with the surroundings. The sewage is observed in simplified form in the Aqua Seal and Casa Azul Systems, which is one of the major national and municipal issues under study, among others.

The Referential GBC Brasil Casa system, for the context under study, fits more adequately in the assessment of climatic conditions and environmental comfort, it has a greater focus on the implementation and impact on the neighborhood, as the thermal performance of the envelope, among others. The Blue House Seal emphasizes fundamental issues of municipal infrastructure.

Considering only the environmental characteristics, the reference GBC Brasil Casa fits better with the climate context of Maceió-AL. However it is necessary to emphasize that their use does not necessarily imply that the local sustainable construction will be possible. One should check the requirements of the specific set of implementation of the project environment, thus enabling a real sustainable project.

The application of seals for the case study showed, finally, that projects developed especially within the conventional construction practices do not reach the minimum level for a certification of environmentally sustainable construction, since it does not meet criteria considered mandatory.

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