Transforming Civil Construction: Environmental seal as a mark of sustainable commitment

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ABSTRACT

Sustainable Civil Construction, also referred to as green construction or green construction, seeks environmental certification as evidence of efficient evaluation in its process. Allied to this purpose, environmental certification seals play a crucial role. This article aims to present a compilation of information and considerations from several authors regarding the certificates available and most used in Brazil, to assist those who seek to validate their civil construction works with sustainable requirements. The origins and main characteristics of each seal are described. As a result, a table was developed that synthesizes information about each seal regarding the date of appearance, origin, responsible entity, categories and evaluation criteria, classification levels, among other aspects. Thus, this document offers, in a consolidated way, valuable information for decision-making in relation to the choice of certification, providing ease for those seeking certification and encouraging new research in the field.

Keywords: Sustainable Construction, Environmental Seal, Environmental Certification, Categories or Evaluation Criteria.

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INTRODUCTION

In the 2000s, there was talk and discussion about sustainable constructions and certification systems for sustainable enterprises (Environmental Seal), with the emergence of terms such as: ecological constructions, green constructions and buildings with environmental certification (TECHIO; GATES; COSTA, 2016). These construction models are considered as another form of *greenwashing* (false disclosure of sustainability, "green makeup" or "greenwashing") in the construction sector, and have had a direct impact on the definition that most people make about sustainability and, consequently, reverberate in the attitudes and actions of the consumer.

The credible environmental certification process should give builders of sustainable buildings the recognition and incentive to mitigate environmental impacts, and reduce the use of natural resources, which aims to encourage change, with a focus on the sustainability of the construction sector. They attest that the enterprise has a good environmental performance, making it known that the space has systems for saving resources and reusing materials, developing with environmental awareness (CONTO ET AL., 2017),

Environmental certification systems seek solutions and construction methods capable of reducing the impact on the environment caused by civil construction, "in addition to energy efficiency, quality of internal environments and user well-being, during the life cycle of a building" (PELLIZZETTI, 2017). Pellizzetti (2017) further states that:

> Obtaining environmental certification for homes assures the owner that their investment was used as planned, meaning lower risks, better energy and water efficiency of the installed systems, reduction of operating costs, quality of internal environments and well-being of the user during the life cycle of the house (PELLIZZETTI, 2017, p. 37).

In order to implement the constructive sustainability currently recognized, several evaluation methodologies have been developed over time in order to implement the *Green Building* . The first building environmental assessment system was launched in 1990 in England. The so-called *Building Research Establishment Environmental Assessment Method* (BREEAM) and had an initial focus on new office buildings under construction. This model has been gradually expanded, and has been integrated with other certifications available in China and Pakistan, for example. In Brazil, the Green Building Councils make up the global network (WorldGBC), which develops and manages certification tools around the world (GBCBR, 2023 COSTA; CARVALHO; ALVES, 2021).

To obtain the certification (ecological seal), the construction process is subjected to strict criteria and constant evaluations, which guarantees consumers a safe source of information, with a high degree of credibility, bringing benefits to all parties involved (VALENTINI; FALCÃO, 2015). For the Entrepreneur, the certification promotes a significant increase in the speed of sales or leasing, asset stability, association of the company's image with environmental concern and improvement in

the relationship with environmental agencies and communities. For the Buyer, the benefits can be direct water and energy savings, lower condominium costs - energy, water, conservation and maintenance, better comfort, health and aesthetic conditions, and greater equity value over time. For Sustainability, the benefits are numerous, such as lower water and energy consumption, reduction of greenhouse gas emissions, reduction of environmental pollution, better health conditions of buildings, better use of local infrastructure, less polluting potential in areas surrounding the construction work, better working conditions and reduction of waste production (VALENTINI; FALCÃO, 2015, p.5/6).

For Albuquerque, Alves and Machado (2018), certifications are tools that guide the authenticity of buildings as recognized as sustainable. According to the evaluative capacity of each seal, there is responsibility and commitment to validate results, within extensive lists known as *checklists*.

It seeks to bring here considerations from several authors about the types of sustainable civil construction certifications available and most used in Brazil.

METHODOLOGY

This is a bibliographic research, and a search was carried out for articles, dissertations, theses, which exposed data on the importance of the use of sustainability seals in civil construction.

The literature review, according to Noronha and Ferreira (2000), is characterized by selecting works of greater interest, comparing and merging the main focuses on the subject; gathering recent works for the current interpretation of the case studied. Revision jobs are defined as:

> studies that analyze the bibliographic production in a given thematic area, within a period of time, providing an overview or a report of the state-of-the-art on a specific topic, evidencing new ideas, methods, and sub-themes that have received greater or lesser emphasis in the selected literature (NORONHA; FERREIRA, 2000, p. 191).

It was based on a larger work in which we sought to know sustainable materials and/or construction techniques in Brazil. We searched the Capes Periodicals Portal, which hosts the main and well-known databases, such as: ACM Digital Libray; Library, Information Science & Technology Abstracts; Nature; Oxford Journals; Science (AAAS) and Scopus scientific papers using the words: "sustainable civil construction models"; "sustainable construction" and "materials"; "types" and "sustainable construction"; "Sustainable Civil Construction" and "Methods"; "sustainable civil construction" and "techniques or materials"; "sustainable modes of civil construction"; "sustainable civil construction"; "materials" and "sustainable construction"; "Materials and construction building". In the end, we searched for "certifications and sustainable civil construction".

From the publications found, we selected those that, in some way, dealt with the application of seals in civil construction.

The main aspects of each seal were reported and the information was condensed into a table that can serve as a guide for the choice of the seal to be applied in a given civil construction with sustainable materials or techniques.

DEVELOPMENT

The main characteristics of each seal or certification that aims to characterize a civil construction as sustainable are presented here. The following are the most significant considerations of researchers who are a reference in this area about the main seals or certifications used in Brazil:

BUILDING RESEARCH ESTABLISHMENT ENVIRONMENTAL ASSESSMENT METHOD (BREEAM)

Created in 1990, the Environmental Assessment Method of Constructive Research (Building Research Establishment Environmental Assessment Method - BREEAM) was the first certification system. It was developed by the Building Research Establishment (BRE) in 1992. It is the leading and most widely used building environmental assessment tool in the UK, recognised as an internationally pioneering labelling.

According to Calixto (2016); Dagostin and Jorge (2022); Lemos (2017) and Coelho and Cruz (2017) would be the most widespread construction sustainability assessment system in the world. The document establishes good practices in the conception, design, construction, and operation of sustainable buildings, covering ten (10) categories, according to Table 1, and 15 criteria according to Costa, Carvalho, and Alves (2021). The evaluated items can be classified into six levels: unclassified, approved, good, very good, excellent, excellent (COELHO, 2017). Also, according to Summerson, Atkins, and Harrie (2023), this classification can be quantified on a scale of 0 to 100. Table 2 comparatively presents the two forms of classification mentioned. In both forms of evaluation, the classification is obtained by the sum of the percentages in each category of analysis. It is the most comprehensive seal and the one with the greatest depth of quality in the criteria related to environmental impacts (COSTA; CARVALHO; ALVES, 2021).

Table 1 – Categories evaluated by the BREEAM Seal

CATEGORIES
Water or water consumption Waste or waste or residue management Energy or energy consumption
Construction Management or Management Innovation Materials Pollution or contamination Health & Wellness or Health & Comfort Transport Land use or land use (ecology) or land use

Source: the authors, based on Lemos; Calixto and others

Table 2: Classification of categorized items for sustainability assessment in civil construction.

COELHO, 2017	Atkins e Harrie, 2023
Unrated	> 10 = not classified
Approved	10 < 25 = acceptable
Good	25 < 40 = approved
Very good	40 < 55 = good
very good	55 < 70 = very good
Excelente	70 < 85 = excellent
	85 = out of the ordinary.

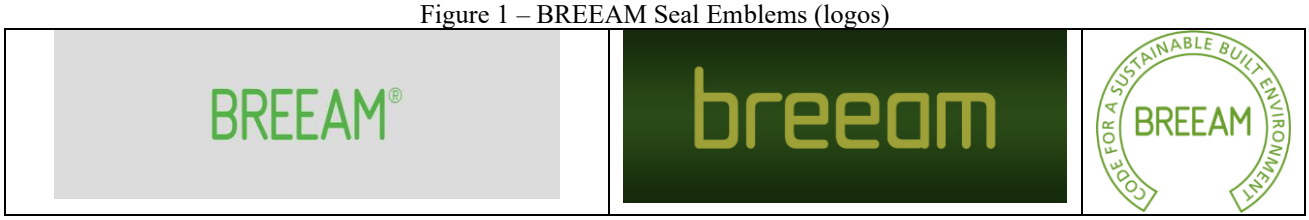
Source: the authors with data from Coelho (2017) and Atkins; Harrie (2023)

According to Dagostim and Jorge (2022), BREEAM is the certification considered to be one of the most advantageous in terms of costs and international recognition. In English law, it defines tax benefits to the owner of the property, according to the points obtained when the building is classified. According to Calixto (2016), there are 13 variants, depending on the typology of the buildings, namely: single- or multi-family dwellings; eco-friendly homes; office buildings; commercial spaces; health units; schools; industries and manufacturing units; Courts; prisons; community centres and leisure facilities; data centers; buildings of diversified uses; buildings with adaptations to other countries.

The cost to obtain BREEAM certification corresponds, on average, to 1,100 pounds sterling, approximately R$7,000.00 at the current exchange rate. However, there is the possibility of reducing this fee the more projects are registered on the platform. If, for example, up to 100 buildings enter the same process, it would be 20 pounds sterling per unit (~R$130.00) (DAGOSTIN; JORGE, 2022).

Figure 1 shows examples of emblems or logos representing this seal. The variations of the seal image shown in Figure 1 have the same meaning (they do not represent different classifications), and are used according to the user's selection.

Figure 1 – BREEAM Seal Emblems (logos)



Source: https://www.google.com/search?q=logo+do+selo+breeam

LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED)

The sustainable seal "Leadership in Energy and Environmental Design" (LEED) emerged em Washington D.C., in the United States in 1998 and was developed by the non-governmental organization United States Green Building Council (USGBC), created in 1993, which is responsible for the documentary analysis of environmental sustainability practices, issuing the seal. It is one of the most recognized systems in the world, present in more than 160 countries (COAST; CARVALHO; ALVES, 2021; PELLIZETTI, 2017). This seal tends to prioritize performance through the application of systems that depend exclusively on technological products (ALBUQUERQUE; ALVES; MACHADO, 2018). It is evaluated the performance of the building, over the life of the building (CALIXTO, 2016).

The criteria that attest to the sustainability of the construction are: location and transportation; sustainable space; efficiency in the use of water, energy and atmosphere, materials and resources; indoor environmental quality; innovation and processes; regional priority credits (GBCBR, 2023; HERZER FERREIRA (2016); LIMA; RIOS, 2019; NUNES, 2018).

According to Calixto (2016), the system is based on points, when certain prerequisites are met. There are 5 main categories and 2 secondary categories evaluated as shown in Table 3, with 69 criteria according to Costa, Carvalho and Alves (2021).

Table 3: categories evaluated by the LEED sustainable seal and their respective scores.

Main Categories	**Punctuation**
Sustainable Locations	26 points
Water Efficiency	10 points
Energy me atmosphere	35 points
Materials & Resources	14 points
Indoor environmental quality	15 points
SUM	100 points
Secondary categories	**Punctuation**
Innovation in design	6 points
Regional priority	4 points
SUM	10 points

Source: the authors with data from Calixto (2016)

It is a method with a simple structure, with ease of understanding and adaptation. The Certification is valid for 5 years. It has 9 variants, depending on the type of buildings.

It is necessary to obtain at least 40, 50, 60 and 80 points to achieve the respective classifications of: Certified, Silver, Gold and Platinum; 110 being the maximum score that can be obtained. To grant the certification, an analysis is made based on the documents provided by the consultant, architect or owner, preferably before the beginning of the work, and through monitoring and photographic record during the execution, proving compliance with the criteria (COSTA; CARVALHO; ALVES, 2021).

The level of certification is defined by the final score as described in Table 4 (HERZER; FERREIRA, 2016; LARA, 2021; LIMA. RIOS, 2019; PELLIZZETTI, 2017).

Table 4: LEED Scores

Stitches	Levels
40 to 49 months	Certificate
50 to 59	Silver
60 to 79 months	Gold
Over 80	Platinum

Source: the authors

According to NUNES 2018, LEED-certified buildings "use less water, energy and resources, generate less waste and promote the well-being of the occupant during their construction, operation and maintenance". The LEED seal offers economic, social, and environmental benefits. Economic, such as reduction of operating costs, appreciation of the property, modernization, less obsolescence of the building. Social related to the improvement of the safety and health of workers and occupants, social inclusion, professional training and awareness of workers and users, increase in employee productivity, increase in user satisfaction and well-being, stimulation of public policies for sustainable construction. Environmental, such as rational use and reduction of natural resources, reduction of water and energy consumption, mitigation of the effects of climate change, use of materials and technologies with low environmental impact, reduction, treatment and reuse of construction waste (GBCBR, 2023).

LEED had its first adaptation to the Brazilian reality in 2014, with the GBC Casa certification. In 2016, Brazil "maintained the 5th position in the world ranking of LEED projects, with 380 certified projects and a total of 1,156 registrations, behind the United States, China, the United Arab Emirates and India" (PELLIZZETTI, 2017, p. 37). With the certification in Brazil, the buildings present savings in the value of the condominium of up to 30% by reducing energy and water and the cost of maintenance and renovations. A 20% increase in sales value is expected after 20 years of use (HERZER; FERREIRA, 2016; LARA, 2021; LIMA; RIOS, 2019; PELLIZZETTI, 2017).

According to the UGREEN website, the cost, in dollars, to obtain LEED certification follows certain steps, such as: a) registration fee ranging from $1,200.00 to $2,750.00 for new projects and from $900.00 to $1,750.00 for existing buildings; b) certification fee ranging from $2,500 to

$22,000.00 for new projects and from $1,750.00 to $15,000.00 for existing buildings; c) consulting fees ranging from $10,000 to $30,000; d) testing and verification fees, ranging from $1,000 to $10,000, plus additional costs (https://www.ugreen.com.br/quanto-custa-a-certificacao-leed-um-guia-para-empresas-de-construcao/).

Some emblems or logos representative of this seal can be seen in Figures 2 and 3. Figure 2 refers to the LEED image presentation badges. Figure 3 shows the emblems according to the classification obtained by the points achieved.

Figure 2 – LEED seal emblems (logos)

Fonte: https://www.google.com/search?q=logo+do+selo+leed

Figure 3 – LEED seal badges according to the classification obtained by levels: (a) certificate; (b) silver; (c) gold and (d) platinum.

Source: Lima and Rios (2019)

HIGH ENVIRONMENTAL QUALITY (AQUA)

Created and launched in Brazil in 2008, by the Venzolini Foundation (created, maintained and managed by the professors of the Department of Production Engineering at USP), based on the French HQE system, it is thus an international certification adapted to the Brazilian reality in terms of climate, culture, technical standards and legislation. It is a construction project management process, applied to buildings yet to be built or also to reconstruction or rehabilitation projects. Certificates are awarded for each specific phase of the project: program, design, implementation, operation or deconstruction. The evaluation is made by two standards: management system and enterprise (commitment of the entrepreneur, planned implementation and operation, monitoring and analysis of the entire management process) and environmental quality of the building (in the EcoConstruction groups, which covers matters, processes and systems and environmental impact;

Management; which comprises energy, water and waste management and maintenance); Comfort, which includes hydrothermic, acoustic, visual and olfactory; and Health, including sanitation, air and water quality) (CALIXTO, 2016; GOMES; MARTIN; MARINO; FERNANDES, 2016; LARA, 2021; VANZOLINI FOUNDATION, 2023; HERZER; FERREIRA, 2016; LEMOS, 2017).

The 14 evaluation categories are listed in Table 5. According to Costa, Carvalho and Alves (2021), there are 210 criteria, 110 of which are mandatory.

Table 5 – Evaluation categories of the AQUA Seal

EVALUATION CATEGORIES	EVALUATION CATEGORIES
Low environmental impact construction site	Energy management
Acústic Comfort	Waste management from the use and operation of the building
Hygrothermal comfort	Maintenance (permanence of environmental performance)
Olfactory comfort	Sanitary water quality
Visual comfort	Sanitary air quality
Integrated choice of products, systems and construction processes	Sanitary quality of environments
Water management	Relationship of the building with its surroundings

Source: the authors, based on Lemos (2017)

According to Gomes, Moraes, Marino and Fernandes (2016) and Herzer and Ferreira (2016), the AQUA certification is granted by the Vanzolini Foundation, which is the Brazilian technical reference for sustainable constructions. In the criteria for certification, it is necessary to define the environmental profile of the project in relation to the Environmental Quality for the Project (QAE). Environmental concerns are expressed in 14 performance categories, defining which level of performance is intended to be achieved: Good, Superior or Excellent, or Base Level, Good Practices Level and Best Practices Level, and at least three categories must be classified as Excellent (Best Practices), four categories as Superior (Good Practices) and seven at the Good level (Base Level). The evaluation criteria are based on: optimization of construction site waste management; reduction of inconveniences caused by the construction site; reduction of pollution and resource consumption on the construction site; construction of social aspects on the construction site.

According to Lemos (2017), the advantages of the AGUA system for the user would be: savings in water and energy consumption; lower condominium expenses; better conditions of comfort and health; higher equity value; awareness of their contribution to sustainable development.

According to Nunes (2018), the AQUA certification process requires the adoption of an Enterprise Management System (SGE) and makes the evaluation in phases that are: Pre-project, Project and Execution. It seeks the implementation of a healthy and comfortable building, with the most controlled environmental and economic impacts possible, with good energy and water performance. And the costs, according to Rodrigues (2020), for projects with up to 1,500 m2 would

be R$17,500.00 and above 1,500 m2, an increase of R$1,609.00/m2. According to Sugahara, Nuns and Cruz (2021), they would start from 31,022.00.

Figure 4 illustrates some of the logos of this label, which vary according to the demands of the users.

Figure 4 – Emblems (logos) of the AQUA seal

Fonte: https://www.google.com/search?q=logo+do+selo+aqua

BLUE HOUSE BOX

Provided by CEF (Caixa Econômica Federal) for housing development projects and was prepared by a technical team from Caixa, with the support of multidisciplinary professors from the state and federal universities USP, Unicamp and UFSC (NUNES, 2018). The Casa Azul Caixa seal was created in 2009, and updated in 2020 with the objective of financing initiatives that will stimulate the adoption of quality urban and architectural solutions, rationally using natural resources, raising awareness among entrepreneurs and residents (COSTA; CARVALHO; ALVES, 2021).

This seal, aimed at the housing program, is evaluated in the design phase, with six categories and 53 criteria, 19 of which are mandatory, classified according to the score. (COSTA; CARVALHO; ALVES, 2021; ALVES; FRANAÇA; SANTOS, 2017; NERI, 2015; COELHO; CRUZ, 2017; NUNES, 2018; LARA, 2021; SUGAHARA AND RODRIGUES, 2019). Also Blue Box Seal Guide V019, (2023). The categories, scoring positions, and criteria can be seen in Tables 6 and 7.

Table 6 – Blue Box Seal scoring categories and positions

Categories (six)	Scoring (four positions)
1 – Urban quality 2 – Design and comfort 3 – Energy efficiency 4 – Conservation of material resources 5 – Water management 6 – Social Practices	50 points = Bronze/Crystal (mandatory criteria) 60 points = Silver/Topaz (required + 6) 80 points = Gold/Sapphire (required + 12) 100 points = Diamond (required and more than 12)

Source: the authors

Table 7 – The 53 evaluation criteria of the Blue Box Seal

Mandatory criteria (19)	Optional criteria (34)
Quality of the surroundings – infrastructure	Improvements to the surroundings
Quality of the surroundings – impacts	Recovery of degraded areas
Landscaping	Real estate rehabilitation
Selective collection site	Design Flexibility
Leisure, social and sports facilities	Relationship with the neighbourhood
Thermal performance – seals	Alternative transport solution
Thermal performance – orientation to the sun and winds	Natural lighting of common areas
Energy-saving light bulbs – private areas	Ventilation and natural lighting of bathrooms
Energy-saving devices – common areas	Suitability to the physical conditions of the terrain
Individualized measurement – gas	Solar Heating System
Quality of materials and components	Gas heating systems
Reusable shapes and struts	Efficient Elevators
Construction and demolition waste (CDW) management	Efficient home appliances
Individualized measurement – water	Alternative energy sources
Economizer devices – discharge system	Modular coordination
Permeable areas	Industrialized or prefabricated components
CDW management education	Optimized batching concrete
Environmental education of employees	Blast furnace cement and pozzolanic
Orientation to residents	Paving with CDW
	Ease of maintenance of the façade
	Planted or certified wood
	Saved Devices- Aerators
	Economizer devices – flow regulator register
	Rainwater harvesting
	Stormwater retention
	Stormwater infiltration
	Employee personal development
	Professional training of employees
	Inclusion of local workers
	Participation of the community in the design of the project
	Environmental education of residents
	Training for enterprise management
	Actions to mitigate social risks
	Actions to generate employment and income

Source: the authors based on the Cashier Guide

It applies to all types of housing projects submitted to CEF, including those of Social Interest Housing - HIS, and must comply with pre-established quality rules for the indication of an opinion of compliance or not of them. Caixa would charge R$ 328.00 as a fee for the analysis of the project (SUGAHARA; FRENCH; CRUZ, 2021).

The certification was developed for the national reality, with a proposal for environmental improvement, at a very affordable cost. It offers face-to-face inspections, from the purchase of the land to construction, raising awareness among entrepreneurs and residents about the concept of sustainable constructions. It is accessible to construction companies, public authorities, housing companies through HIS with access to population housing for those with a family income of up to three minimum wages. It focuses on energy efficiency and rational use of energy (LARA, 2021).

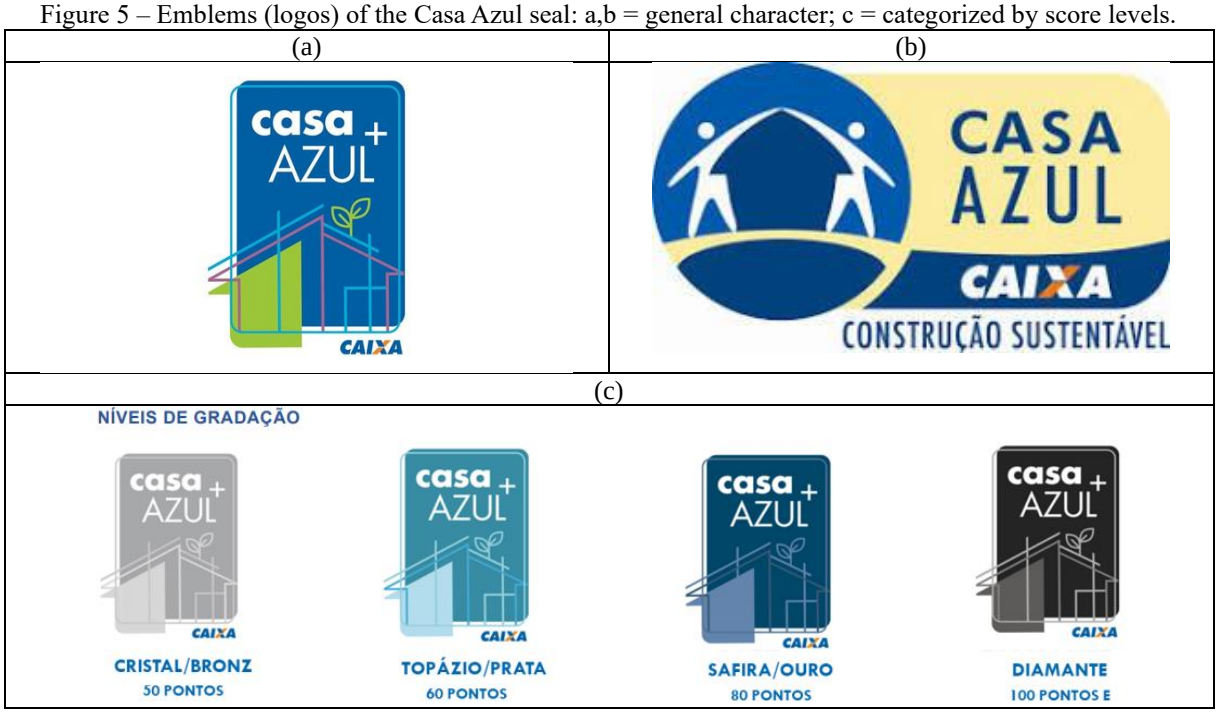
According to Lemos (2017, p. 93), "the CASA AZUL seal

> It is an instrument for the socio-environmental classification of housing projects, which seeks to recognize those that adopt more efficient solutions applied to the construction, use, occupation

and maintenance of buildings, with the objective of encouraging the rational use of natural resources and improving the quality of housing and its surroundings.

Emblems or logos resembling this seal, of a general nature in Figures 5a and 5b and according to classification by levels, can be seen in Figure 5c.

Figure 5 – Emblems (logos) of the Casa Azul seal: a,b = general character; c = categorized by score levels.



Fonte: https://www.google.com/search?q=logo+do+selo+casaazul

COMPREHENSIVE ASSESSMENT SYSTEM FOR BUILT ENVIRONMENT EFFICIENCY (CASBEE)

The Japanese CASBEE label, "comprehensive evaluation system for the efficiency of the built environment", has a greater dependence on architecture, following complements in management, technology and legislation (ALBUQUERQUE; ALVES; MACHADO, 2018). It evaluates and measures the environmental performance of buildings and the built environment. It was developed in 2001, with the collaboration of Academia, Industry and national and local governments in Japan, under the responsibility of the Japan Sustainable Building Consortium (JSBC). It is adapted for: house construction, building construction, urban (urban development) and city management (LEMOS, 2017).

It has four evaluation instruments: the design, new constructions, existing buildings and renovations. It evaluates the environmental quality and performance of the building and decreases environmental loads. The score results from the final grade of the building's classification in five possible levels.

According to Neri (2015) and Bastos and Rebello (2016), the categories and evaluation criteria are those shown in Table 8.

Table 8 – the categories and evaluation criteria of the CASBEE Seal

Evaluation Categories	Evaluation Criteria
Indoor environment Quality of services Outdoor environment within the building lot Energy Resources Materials	Environmental quality and building performance . Comfort and health of the user . Functionality, Durability . Plant and animal preservation . landscape, cultural features, etc Reduction of environmental loads . Energy efficiency . Water Saving . Greywater use . Rainwater use . Recycling Materials . impacts on the neighbourhood (air pollution, noise, vibrations, etc

Source: the authors, based on Neri (2015) and Bastos and Rebello (2016)

Evaluations are classified into five grades: Poor (C), Fairly Poor (B-), Good (B+), Very Good (A), and Excellent (S) (LIBRELOTTO, BANDINI, 2022). The emblem of this seal can be seen in Figure 6.

Figure 6 – Emblem (logo) of the CASBEE seal

Fonte: https://www.city.yaizu.Ig.jp/g06-003/casbee/index.html

EXCELLENCE IN DESIGN FOR GREATER EFFICIENCIES (EDGE)

EDGE "excellence in design for greater efficiency", forged in 2014 by the International Finance Corporation, also has certifications in Brazil. It aims to assist in the choice of technical solutions in the initial phase of the project to reduce operating expenses and environmental impact. It certifies projects that have a reduction in energy and water consumption and that use materials with low built-in energy. There are six types of buildings evaluated, new or rehabilitated: residential, hospitality, commercial, offices, hospital and educational. It has three categories of analysis, in the design phase or after construction, with up to 63 criteria varying according to the type of building. It does not use a scoring system. It evaluates whether the energy and water consumed for the operation of the building and the energy embodied in the manufacture of materials is lower than the consumption in the base project, of at least 20%. There are certifications: "EDGE Certified" for level 1 (20%), "EDGE Advanced" for level 2 (40%) and "Zero Carbon" for level 3 (100%). In residential buildings, there are 40 evaluation criteria (COSTA; CARVALHO; ALVES, 2021).

The costs to obtain this seal, according to UGREEN's website (2024), consist of: a fixed registration fee of US$300; certification fee: US$0.22 per m2; project audit fee US$4,000.00 and construction audit fee US$4,000.00. Some of its forms of representation are seen in Figure 7.

Figure 7 – EDGE seal emblem (logo)

Fonte: https://www.google.com/search?q=logo+do+selo+edge

SISTEMA GREEN BUILDING CHALLENGE (GBC)

It emerged from BEPAC (Building Environmental Performance Assessment Criterion), a Canadian system. In our language it would be "Green Building Challenge". It was developed by an international consortium, with the participation of more than 20 countries, including Brazilian researchers, to evaluate the environmental performance of buildings. It does not provide a performance certification; Its evaluation is based on a comparison of benchmark performances. It not only checks aspects of environmental sustainability, but also economic ones. The assessment comprises mandatory topics (resource use, environmental loads, and indoor air quality); optional topics (quality of services, economic aspects, and management) (LEMOS, 2017).

In 2012, GBC Brasil (Green Building Coucil Brasil) created a certification oriented to the reality of the Brazilian single-family residential sector, upper middle class, GBC Brasil Casa. In 2017, it adapted the parameters to meet the needs of multifamily residential buildings, creating GBC Brasil Condominiums. The certifications aim at sustainable construction, such as site layout and selection, water savings, energy efficiency, renewable energies, choice and management of materials, internal environmental quality, social requirements, innovation and regional specificities. The certifications follow the same criteria as LEED, with the evaluation categories being slightly different: deployment, efficient use of water, energy and atmosphere, materials and resources, internal environmental quality, social requirements, innovation, regional credits (NUNES, 2018). The following are the topics of the categories evaluated, as shown in Table 9.

Table 9 - Evaluation Topics or Categories

Lemos (2017)	Nunes (2018) – GBC Brazil
Mandatory • Resource Usage • Environmental loads • Indoor air quality Optional • Quality of services • Economic aspects • Management in pre-occupancy	Efficient use of water, energy and atmosphere Materials & Resources Indoor Environmental Quality Social Requirements Innovation Project and regional credits

Source: the authors, based on Lemos (2017) and Nunes (2018)

To obtain this certificate for single-family housing, the fees (registration, project and audit) in 2020 varied according to the total built area, ranging from R$5,590.00 to R$15,060.00

(https://www.gbcbrasil.org.br/wp-content/uploads/2019/06/Tabela-de-Custos-da-Certificac%CC%A7a%CC%83o-GBC-Brasil-Casa-e-Condomi%CC%81nio_-2020.pdf)

Its emblem can be seen in Figure 8, depending on the type of building.

Figure 8 – GBC Seal Emblem (logo)

Source: https://www.gbcbrasil.org.br/docs/casa.pdf

PROCEL EDIFICA

Seal launched in November 2014, a program of Eletrobrás, which aims to develop activities to disseminate and stimulate concepts of energy efficiency in buildings, and to support the feasibility of the Energy Efficiency Law – Law 10.295/2001 (BRASIL, 2001). Eletrobrás coordinates in six different areas: "Human Training", "Technologies", "Dissemination", "Regulatory Subsidies", "Housing and Energy Efficiency" and "Support – Marketing and Financing" (LEMOS, 2017).

For Sugahara, Freitas and Cruz (2019), it is an instrument of the Brazilian government, coordinated by the Ministry of Mines and Energy and executed by Eletrobrás to identify buildings with better energy efficiency ratings in a given category, encouraging the acquisition and use of more efficient properties. The evaluation is done by equations and tables or comparative simulation. The categories evaluated are: wrapping, lighting, air conditioning and bonuses. Its benefits would be: better quality of life for the user, savings in energy and water consumption, efficiency of the building in the envelope systems, lighting and air conditioning.

The costs to obtain this seal, according to Sugahara, Nuns and Cruz (2021), would range from R$11,000.00 to R$22,000.00 in projects between 500m^2 and 1500 m2. Emblems or logos that identify it can be seen in Figure 9.

Figure 9 – Emblems (logos) of the PROCEL EDIFICA seal

Fonte: https://www.google.com/search?q=logo+do+selo+proceledifica

SUSTAIN X

It is a sustainability label according to the International Organization for Standardization - ISO 14.024:2004. Established in 2007. It analyzes all the essential attributes of sustainability, such as: healthiness, quality, environmental responsibility, social responsibility, responsible communication (COSTA ET AL., 2021).

A seal developed by the Sustentax Group, it allows the identification and attestation of the environmental quality of the services of construction companies, in the commitment to environmentally correct practices, social responsibility and economic practices that avoid waste and increase productivity. The main evaluation criteria are: healthiness, quality, social responsibility, environmental responsibility, economy, safety, communication with the consumer and legal-tax regularization. To obtain the seal, one must go through 3 phases: Initial feasibility analysis; Product analysis (contract signing, documentation, technical guidance, evaluation of results, adequacy of processes, evaluation under SustentaX criteria); Seal Awarding (COELHO; CRUZ, 2017; COSTA ET. AL., 2021). Its visual representation can be seen in Figure 10.

Figure 10 – Emblem (logo) of the SUSTENTA X Seal

Fonte: https://www.google.com/search?q=logo+do+selo+sustentax

GERMAN SUSTAINABLE DEVELOPMENT COUNCIL (DGNB)

Created in 2007 in Germany, the Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB), "German Society for Sustainable Constructions", certifies both public and commercial and

residential buildings in construction or renovation. There is a gold, silver and bronze classification (SILVA; SARDEIRO, 2017)

The quality label for sustainable construction of the German Society for Sustainable Construction (DGNB) is new in Brazil, and is divided into gold, silver or bronze categories. The certification validates buildings that are built ecologically, with resource savings, economic efficiency and focused on user comfort (NERI, 2015; GONÇALVES, 2020).

The categories or evaluation criteria, according to Gonçalves (2020) and Coelho and Cruz (2017), are listed in Table 10 and the emblem of this seal can be seen in Figure 11.

Table 10 – Categories and criteria for the Evaluation of the DGNB Seal

Categories	Categories
Ecology or Environmental Quality • Construction Life Cycle Assessment • Impact on the local environment • Sustainable resource extraction (land use) • Potable water demand and wastewater volume Economic Quality or Economy • Life Cycle Cost • Flexibility and adaptability • Commercial viability Sociocultural and Functional Quality • Thermal comfort • Indoor air quality • Acústic Comfort • Visual comfort • User Control • Quality of indoor and outdoor spaces • Safety & Security • Design & Urban Quality	Technical Quality • Fire safety • Acoustic insulation • Thermal quality of the structure • Use and integration of construction technology • Easy to clean, recover and recycle • Emission Control / Mobility Quality of the site • Local environment • Social conditions and public image • Access to transport • Access to services Process Quality • Understanding and technical quality of the project • Sustainability aspects in the initial phase • Documentation for sustainable management • Environmental impact construction (construction site) • Supervision of the quality of the works • Systematic commission • User communication • Compatible planning (design and architecture)

Source: the authors, based on Gonçalves (2020) and Ceolho and Cruz (2017).

Figure 11 – DGNB seal emblem (logo)

Fonte: https://www.google.com/search?q=logo+do+selo+dbng

SUSTAINABLE SOCIAL HOUSING INITIATIVE (SUSHI)

The SUSHI - Sustainable Social Housing Initiative is a project developed by the United Nations Environment Programme (UNEP/UNEP) with support from the European Union for the

study of sustainable construction practices in the world, and focuses on social housing (HIS) in two developing countries: Thailand and Brazil (COELHO; CRUZ, 2017).

The SUSHI Project aims to conceptualize social housing and its interaction with the urban environment, efficiency in energy use and water consumption, which is durable, comfortable, healthy, easy to maintain, economical in expenses. (NERI, 2015; RABBIT; CRUZ, 2017).

This project is led by the Brazilian Council for Sustainable Construction – CBCS, created in 2007, which brings together institutions with experience in Social Interest Housing – HIS, involving energy efficiency, thermal comfort and rational use of water (COELHO; CRUZ, 2017). The emblem can be seen in Figure 12.

Figure 12 – Emblem (logo) of the SUSHI seal

Source: http://www.construirsustentavel.com.br/green-building/selos

SEALS AT THE MUNICIPAL LEVEL, SUCH AS:

Sustainable BH Seal

The Environmental Sustainability Certification Program of the Municipality of Belo Horizonte is a public policy initiated by the City of Belo Horizonte, through the Municipal Secretariat for the Environment and the Executive Committee of the 2014 World Cup, and resulting from discussions in the Municipal Committee on Climate Change and Eco-Efficiency - CMMCE.

The certification is intended for public and private, residential, commercial and/or industrial enterprises that adopt measures that contribute to the reduction of water and energy consumption, atmospheric emissions and solid waste generation, as well as recycling and reuse of the waste generated (NERI, 2015; PREFEITURA DE BELO HORIZONTE, 2022).

Once the certification program has been updated and reformulated, enterprises can receive Bronze (100 points), Silver (125 points), Gold (150 points) and Diamond (175 points) seals, and can also have "green credit" that offers discounts on Active Debt. The evaluation criteria are: permeability and vegetation; energy; water, mobility and waste (PREFEITURA DE BELO HORIZONTE, 2022). Its emblem can be seen in Figure 13.

Figure 13 – Emblem (logo) of the BH Sustainable seal

Source: http://www.construirsustentavel.com.br/green-building/selos

Green Factor

Seal used by the city of Fortaleza (CE), with three categories of certification (LIMA; RIOS, 2019). The criteria are inserted in the sustainable city factor, healthy environmental factor, energy factor, water factor, materials and waste factor, social factor. It has four levels of certification: bronze, silver, gold, and diamond, as provided for in the manual (PREFEITURA FORTALEZA, 2023). To obtain the rank levels (bronze, silver, gold, or diamond), the applicant needs to meet certain criteria.

Figure 14 shows the seal emblem and logos according to the classification categories, and Table 11 shows how to obtain this classification.

Figure 14 - Green Factor Seal Emblem and Logo of the Certification Categories


General Character Emblem

Badges by rank

Source: Lima and Rios (2019, p. 14).

Table 11 – Fulfillment of criteria for classification.

Classification level	Number of criteria met	Total Criteria
Bronze	12 required	12
Silver	12 required + 6 optional	18
Gold	12 required + 10 optional	22
Diamond	12 mandatory + 20 optional	32

Source: the authors based in Lima and Rios (2019).

RESULTS

From the information of each seal, presented here, we tried to build a table (Chart 1) where each seal is presented and its information regarding the date of appearance or use, the origin, the responsible entity, the categories or evaluation criteria, the classification levels, how it can be obtained. In some cases, if the seal is adapted to Brazil or originated in Brazil, its validity and the costs to obtain it. It is believed to be relevant information for those who seek, at a glance, to locate a certification process that is best suited to their project.

Table 1 – Brief information on the main seals of sustainable construction

STAMP	OF TA	PROCE DENCI A	RESPON ENTITY SHAD	CATEGORIE S CRITERIA EVALUATI ON	NIVEIS DE CLASSIF	HOW OB- HAVE	VALIDA TES FROM CERTIF	COSTS
BREEAM	1990 1992	UK	Building Research Establish ment (BRE)	10 categories 15 criteria .	No level Approved Good Very good Very good Excellent	Site to BREE AM	Build existent: 1 year Nova: There is no validity	£ 1.100
LEED	1998 2014	USA	U.S. Green Building Council	5 categories Main 2 Secondary categories 69 criteria	Silver Certificate Gold Platinum	LEED website	Build existent: 5 years Nova: There is no validity	Rates Add US$13.650 the US$64.750
AQUA	2008	Brazil HQE France	Vanzolini Foundation	14 categories 210 criteria, 110 of which are mandatory	Good Superior Excellent Or Base, Good Practices, Best Practices	Portal Vanzoli ni	Opera tion 1 year Too Certif: There is no validity	Projects up to 1500m2: R$17,500.00 (2020) or R$31.022,00 + R$1,609.00 or 2,810.00 p/m2
CASA AZUL	2010	Brazil	Caixa Econômica Federal	6 categories 53 criteria (19 obligatory) 34 faculty)	Bronze Silver and Gold	Caixa Econôm ica Federal	No Speci Located	Fee for project analysis: R$328,00
CASBEE	2001	Japan	JSBC – (Japan Sustaina ble Building Consor tium)	6 Categories 10 criteria	Poor (C), Quite Poor (B-), Bom (B+), Mto Bom (A) and Excellent (S).	JSBC	No Speci Located	Harmed
EDGE	2014	(IFC) [USA]	Internal Finance Corpora tion - IFC	3 categories 63 criteria	N1-Certified (20%), N2-Advanced (40%) and N3-Zero Carbon" (100%).	Applies EDGE	No Speci Located	Rates Fixa US$300 Certification US$0.22 pm², 2 Audit US$8.000,00

GBC Brazil	2012 2017	Brazil (Internal Forum) tion)	Green Building Council Brazil	6 Categories 53 LEED-like criteria	Green, Prata, Gold, Platinum.	GBC Brazil	No Speci Located	For construction Single-family, from R$5,590.00 to 15,060.00
PROCEL	2014	Brazil	Eletrobrás (Ministry of Education) of Mines and Energy)	4 categories	No graduations +efficient -efficient	Electro Brás	It's a Label Tage	R$11,000.00 to R$22,000.00 for projects between 500 and 15000 m2
SUPPORT TA X	2007	Brazil	SustentaX – Eng. de Sustentab	8 Criteria	No graduations	Group Sustain X	No Speci Located	Harmed
DGNB	2007 2009 2012	Germa n Nha	German Association for Sustainable Construction (DGNB)	6 Categories 33 criteria	Gold silver bronze	DGNB	No Speci Located	Harmed
SUSHI	2007	Thailan d day and Brazil	Brazilian Council for Sustainable Construction (CBCS)	Seal in Housing Social Interest (HIS)	No graduations	CBCS	No Speci Located	Harmed

Source: the authors

Thus, BREEAM takes into account 10 categories, 15 criteria and has 5 levels of evaluation; LEEAD works with 7 categories, 69 criteria, with 4 levels of evaluation; AQUA takes into account 14 categories, 210 criteria and 3 levels of evaluation; CASA AZUL, 6 categories, 53 criteria and 3 levels; CASBEE works with 6 categories, 10 criteria and 5 levels of evaluation; EDGE involves 3 categories, 63 criteria, and 3 levels of classification; GBC BRAZIL is concerned with 6 categories, 53 criteria and 4 levels of evaluation; PROCEL deals with 4 categories and only observes the level of energy efficiency; SUSTENTA X evaluates 8 criteria and has no undergraduate degrees; the DGNB takes into account 6 categories, 33 criteria and 3 levels of classification; SUSHI focuses more on social housing and has no classification levels.

Considering the requirements for obtaining any of these certifications (seals), the important thing is that this leads to thinking, reflecting, and trying to work so that more and more buildings really get closer to the standard of sustainability.

It should be noted that there are other labels or evaluation methods: HQE (Haute Qualité Enveronamentale), French; BEPAC (Building Environmental Performance Assessment Criteria), Canadian; NABERS (National Australian Buildings Environmental Rating System), Australian; SB TOL (Sustainable Biuldings Tool), from the principality of Monaco, with Czech, Italian, Spanish, Portuguese, Korean and Canadian versions; LIDERA (Leading for the Environment), Portuguese;

ECO FCT (from the Faculty of Science and Technology), Portuguese and ECO BUILD, Portuguese (CALIXTO 2016).

FINAL THOUGHTS

The bibliographic overview of the information on the environmental assessment seals of sustainable civil constructions in Brazil is important in the sense of providing a panoramic view, in a single document, of the criteria, evaluation systems and other information of each environmental seal, which may be useful to those who, in the planning and/or execution of sustainable constructions, can decide which certification to adopt.

Thus, it is believed that this study brings benefits to science, providing ease of understanding and alignment in subsequent research and to the civil community, in the sense of clarifying the different possibilities of choice, and may eventually be a stimulus for new studies with more information and improvement of the present work.

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