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## Architecture and sustainability: the role of environmental rating systems - case study in Brazil

To cite this article: Monica Santos Salgado 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **294** 012059

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# Architecture and sustainability: the role of environmental rating systems - case study in Brazil

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**Abstract.** The predatory impact of civil construction industry does not seem to occur consciously. It is a process that results from the rapid growth of populations and the necessary response - with the construction of new buildings, the expansion of existing cities and the creation of new ones. In this sense, it seems pertinent to discuss the practices adopted during design and construction process in order to preserve the environment. Throughout the 1990s different environmental rating systems had emerged. UK BREEAM certification has been followed by North American LEED, French HQE and others. However, the careful analysis of the most popular methods indicates that the environmental and economic aspects of sustainability have been valued, leaving social issues in the background. On 2000, Japanese architects have drawn up a chart for environmental architecture which relates environmental, economic and social aspects in an inseparable way. The document reveals aspects that have never been considered by traditional environmental rating systems. In this sense, the purpose of this research is to present a critical analysis of the environmental rating systems adopted in Brazil confronting requirements defined by LEED and AQUA-HQE methods to the sustainable principles proposed by Japanese Architectural Charter for a Global Environment. Results indicate that, in decoupling environmental issues from other aspects of sustainable development, the environmental rating systems have become obsolete and inefficient.

## 1. Introduction

Sustainability is based on a tripod which includes environment, economic and social aspects. In this sense it is important to consider all three aspects equally in order to balance efforts towards sustainable developed. As presented by Cangussu et al [1] social progress is directly related to economic development, which depends on environmental protection. However, without social justice there will be no collective agreement to guarantee environment protection. Therefore, the three aspects of sustainability are closely related and cannot be dissociated.

Since 1990's architects and engineers have had the opportunity to evaluate the environmental performance of buildings through different rating systems. The use of those methods in Brazil has revealed their first results only on 2007.

Architecture plays an important role on this discussion as the design of buildings and cities can bring alternatives toward a more sustainable living space including solutions that can bring the nature back to our cities and homes. In this sense, it is worth to analyze what should be done to include social aspects on sustainable rating systems and the next steps towards social sustainable development.

Among the initiatives that discuss the role of architecture in sustainable development, the “Japanese Architectural Charter for a Global Environment” [2] stands out. The document had been



elaborated by five important institutes of architecture and sought to establish a global strategy for the benefit of sustainability in all nations.

The main purpose of this research is to present a critical analysis of the environmental rating systems adopted in Brazil considering the sustainable principles of Japanese Charter. The research presents a brief description of each evaluation method and the number of certified buildings until December 2018 – revealing some tendencies.

The final part confronts the principles defined on Japanese Architectural Charter with requisites defined by the most popular environmental rating systems adopted in Brasil, highlighting the aspects that are not been considered by those systems. It is worth mentioning the importance of those methods as the first step towards sustainable construction. However, the era of environmental rating systems ended, and it's necessary to stablish the next step.

## 2. Architectural Charter for a Global Environment and Environmental rating systems

Among the initiatives that discuss the role of architecture in sustainable development there is the Japanese Architectural Charter for a Global Environment, published in 2000. This document have been elaborated by five important institutes of architecture, and looked for global strategy for the benefit of sustainability in all nations. The signatory institutions of this document were: Architectural Institute of Japan; Japan Federation of Architects & Building Engineers Associations; Japan Association of Architectural Firms; The Japan Institute of Architects; and Building Contractors Society.

The Charter established five principles for sustainable development [2]:

- **Longevity** - Architecture shall be planned, designed, built, operated and maintained as a long-term social property, with a life that will span multiple generations.
- **Symbiosis** - Architecture shall constitute an element of a sound social environment which is in harmony with the natural environment and which co-exists with the diversity of life on the Earth.
- **Energy Conservation** - Architecture shall minimize consumption of energy throughout its lifetime, and maximize the use of natural and unused energy sources.
- **Resource Conservation and Cyclicity** - Architecture shall incorporate reusable and recyclable resources and materials of minimum environmental loads, and minimize consumption of natural resources throughout its lifetime.
- **Succession** - Architecture shall be created as a cultural component, respecting the local history and identity, relating to "genius loci", and succeeding for future generations as a good incubator.

### 2.1 *Principle of Longevity*

In European countries it is common to preserve buildings that have been in use for centuries. However, the culture of preservation occurs differently among countries and does not always exist.

The reduced life expectancy of a building implies its demolition and the construction of another one in substitution, generating a strong negative environmental impact by the emission of carbon, destruction of the forests and generation of enormous amounts of waste. Therefore, it is understood that it is essential to plan and design the buildings so that they remain in use for as long as possible. To ensure the longevity of buildings, it is necessary to consider aspects such as:

- Consensus formation through community involvement;
- Creation of new value;
- A social system that supports preservation of architecture;
- Architecture easy to maintain and preserve;
- Architecture flexibly and adaptable to changes;
- High durability and renewability;
- Law reform for architecture longevity.

## 2.2 *Principle of Symbiosis*

Architecture should be designed to promote a harmonious relationship between the built environment and the natural environment. However, particularly in the second half of the twentieth century, disorderly urban development and uncontrolled construction led to the loss of this connection and artificial environments were created that deprive people of their connection with nature.

An important task for the future would be the reconstruction of environments that allow society to live with the diversity offered by nature. This measure, in addition, would favor the maintenance of all species. Actions that can contribute are:

- Creation of an environment for natural eco-system;
- Restoration, maintenance and expansion of urban nature;
- Attention to environment impact of architecture.

## 2.3 *Principle of Energy Conservation*

The construction and operation of cities and buildings require the use of a large amount of energy. It is necessary to drastically reduce its use, designing our cities and buildings in order to take advantage of the natural resources, taking into account aspects such as:

- Architectural design conformable to local climate conditions
- Development and popularization of energy-conserving systems
- Reduction of energy use during construction
- Formation of locally based energy systems
- Urban tissue to allow use of natural energy
- Urban tissue to contribute to energy-efficiency transport
- Popularization and establishment of awareness regarding energy conservation

## 2.4 *Principle of Resource Conservation and Cyclicity*

Some natural resources are finite and the construction industry has contributed to their extinction - in addition to generating rubble in large proportions. Hence the importance of minimizing consumption and studying ways of reusing and recycling building materials, establishing a new production cycle.

Aspects related to this principle are:

- Use of materials with low environment load
- Promotion of re-use and recycling
- Extensive application of wooden structures and materials
- Reduction of waste through the promotion of construction byproduct distribution
- Hope for reformed everyday awareness and behavior patterns

## 2.5 *Principle of succession*

Architecture should be considered an inheritance to be passed on to future generations. For this reason, it is necessary to create an architecture that deserves to be preserved. For this, the work of architects should ensure the creation of an environment in which children can fully develop and grow healthily.

- Succession of a good architectural culture
- Attractive urban design
- Environmental improvement to enhance healthy child development
- Provision of information for succession

The proposal of Japanese Charter for the Global Environment presents a different perspective for sustainable architecture, humanizing the design decision through a more holistic analysis. Unfortunately, the most popular environmental rating systems consider only a small part of the aspects enrolled in the Japanese Charter.

## 3. Environmental rating systems adopted in Brazil

The architectural design process that considers the environmental requirements can, in general, be divided into two distinct stages: parameter definition, and design process. Castells [3] divides the

parameter definition phase into: (a) study of the environmental potential of the terrain; and (b) pre-programming with the hierarchy of environmental goals to be achieved with the design and construction of the building. The author considers as products of the parameters definition phase: a requirements book; and a list of recommendations to be considered by professionals during the architecture design process.

The interest on environment rating systems gave rise to different methodologies. Until 2019, four foreign rating systems have arrived in Brazil:

- BREEAM-UK (Building Research Establishment Environmental Assessment Methodology)
- DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen - German Society for Sustainable Construction)
- LEED™ (The Leadership in Energy and Environmental Design Green Building RatingSystem) the north-american methodology.
- HQE® (Haute Qualité Environnementale – High Quality Environment) developed by French government and mandatory for public buildings. This methodology has been adapted to AQUA (Acronym HQE in portuguese)

The LEED and HQE certifications were the first adopted by Brazilian entrepreneurs. HQE has been translated into AQUA certification. Given the nature of each one, the choice by one or the other depends on the type of building that is intended to certify. The LEED™ methodology was the first to certify a Brazilian building, with the issuance of the first certificate in 2007, for a bank branch project, located at Granja Viana in Sao Paulo. Two years later the first AQUA-HQE certification took place in Brazil: a store located in Niteroi (State of Rio de Janeiro).

### 3.1 LEED rating system

LEED version 3 the types of assessments were: LEED-NC – for new construction and major renovations; LEED-OM – for existing buildings; LEED-CI – for commercial interiors; LEED-CS – for Core and Shell; LEED for schools; LEED for retail; LEED for healthcare; LEED for homes; and LEED-ND – for neighbourhood development.

Table 1 – LEED certification on Brazil (May, 2019)

		Platinum	Gold	Silver	Certified	total
LEED CI	Version 2	0	5	1	2	8
	Version 3	10	25	9	6	50
LEED CS	Version 2	2	23	9	1	35
	Version 3	11	94	52	35	192
LEED EB_OM	Version 3	2	16	17	7	42
LEED NC	Version 2.2	0	13	7	4	24
	Version 3	12	49	48	36	145
LEED ND	Several versions	0	0	1	2	3
LEED Retail	Several versions	1	3	3	10	17
LEED for homes	Version 3	0	0	1	0	1
LEED for schools		0	1	1	0	2
LEED BD+C: NC	Version 4	0	1	0	0	1
LEED BD+C: WDC		0	0	1	0	1
LEED ID+C: CI		1	1	1	0	3
LEED ID+C: Retail		0	2	2	2	6
LEED O+M: EB		0	3	0	0	3
LEED BD+C: CS		1	0	0	0	1
O+M: EB WP		0	2	0	0	2
TOTAL		40	236	153	105	<b>534</b>

Source: Extracted from Green Building Council – May, 2019 [4]

The analyses on version 3 considered seven dimensions: Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Quality, Innovation in Design or Innovation in Operations and Regional Priority Credits. To those dimensions, version 4 added: Integrative thinking, Health and Human experience, Regional Impacts and Global/regional/local aspects.

Version 4 has changed merging some scopes as following: LEED BD+C: NC : Building Design & Construction (New constructions); LEED BD+C: WDC : Building Design & Construction (Warehouses and Distribution Centers); LEED ID+C: CI : Interior Design & Construction (Commercial Interior); LEED ID+C: Retail Interior Design & Construction (Retail); BD+C: CS (Building Design and Construction) ; LEED O+M: EB Operations and Maintenance. Table 1 presents the LEED certification in Brazil until May, 2019.

Eleven years later, after the first certification, on May, 2019, LEED has received 1362 registers in Brazil, which means, the number of entrepreneurs interested on the certification process. Of this group, 39% (534 buildings) has obtained the certificate, as shown on Table 1. LEED CS (for Core & Shell) is the most widely certification adopted in Brazil. One possible reason is the similarity with PROCEL label requirements (acronym in Portuguese for “National Program of Energy Efficiency”), particularly in what concerns to energy consumption (see subsection 3.5). The analysis also indicates that, in Brazil, there are few certified buildings. Initiatives are grouped on one region (Southeast) – mostly commercial or corporative facilities.[5]

### 3.2 *AQUA-HQE French method adapted to Brazil*

There are only two scopes: AQUA HQE for residential buildings, and AQUA HQE for nonresidential buildings. There is a specific certificate for each phase of building (from pre-design to operation and maintenance phase). That is the reason why the sum of all certificates emitted by AQUA HQE is not equal to the number of certified buildings (the same enterprise can receive several certificates).

AQUA HQE consider 14 dimensions on the evaluation process: Relation of the Building with its surroundings; Building adaptability and integrated choice of products, systems and building processes; Construction site with low environmental impact; Energy Management; Water Management; Management of Waste from use and operation of the building; Maintenance - permanence of environmental performance; Hygrothermal Comfort; Acoustic comfort; Visual comfort; Olfactory Comfort; Quality of the environments; Sanitary air quality; and Water quality. Building should attend with excellency at least 3 dimensions, and at maximum 7 dimensions on minimum level.

Currently AQUA-HQE rating system certification had achieved a large number of certified buildings, with 287 enterprises and 613 certificates (May, 2019). Table 2 presents AQUA HQE certificates until December, 2018.

*Table 2 – Number of AQUA-HQE certificates (May, 2019)*

	<i>Pre-design</i>	<i>Design</i>	<i>Execution</i>	<i>Operation Programming</i>	<i>Operation</i>	<i>Total</i>
<i>Certificates</i>	267	177	110	31	28	613
<i>Enterprises certified</i>						287

Source: Extracted from Vanzolini Foundation – May, 2019 [6]

### 3.3 *BREEAM in Brazil*

BREEAM method has initiated its activities in Brazil on 2011. The system measures sustainable value in a series of categories, ranging from energy to ecology. Each of these categories addresses factors as: low impact design and carbon emissions reduction; design durability and resilience; adaption to climate change; and ecological value and biodiversity protection. In this sense, BREEAM categories includes: energy saving, health and wellbeing, innovation, land use, materials, management, pollution, transport, waste and water. Those categories are evaluated according to the standard that includes [7]:

- BREEAM for communities (masterplanning)
- BREEAM for infrastructure – (pilot - civil engineering and public realm) – associated to CEEQUAL;
- BREEAM for New Construction (Homes and Commercial Buildings)
- BREEAM In-use (commercial buildings)
- BREEAM for Refurbishment and Fit-out (homes and commercial buildings)

The BREEAM classification ranges from OUTSTANDING to UNCLASSIFIED, according to punctuation: outstanding ( $\geq 85$ ); excellent ( $\geq 70$ ); very good ( $\geq 55$ ); good ( $\geq 45$ ); pass ( $\geq 30$ ) or unclassified ( $< 30$ ). Depending on the scope, there is an additional class ("ACCEPTABLE") between "pass" and "unclassified". This class is offered on BREEAM In-Use and has a different punctuation.

On 2018 a Brazilian building (SEBRAE Sustainability Center) received the BREEAM Award Americas 2018 in two categories [8]: “Best sustainable building” in the category of “New Constructions in Use in the Americas”, and the “Best sustainable building of the award”, elected by popular digital vote. Despite the award, Brazilian entrepreneurs are not very excited about BREEAM. The last public report available, indicates, on 2014, only 3 enterprises with BREEAM certificate [9].

### 3.4 DGNB - the German experience

DGNB method, had been launched on 2012 through a partnership between the Ministry of Economic Cooperation, the DGNB and German companies of the sector.[10]

The certification process considers four levels: bronze, silver, gold and platinum. The method considers six dimensions for evaluation: ecological quality, economic quality, social-cultural and functional quality, technical quality and quality of process.(Table 3)

Table 3 - DGNB requisites (part 1)

QUALITY SECTIONS	EVALUATION TOPICS	CRITERIA DESCRIPTION
ENVIRONMENTAL QUALITY	GLOBAL AND LOCAL ENVIRONMENTAL IMPACTS	Life Cycle Impact Assessment
		Local Environment Impact
		Responsible Procurement
	RESOURCE CONSUMPTION AND WASTE GENERATION	Life Cycle Assessment – Primary Energy
		Portable Water Demand and Waste Water Volume
ECONOMIC QUALITY	LIFE CYCLE COSTS	Land Use
		Life Cycle Cost
		Flexibility and Adaptability
SOCIAL CULTURAL AND FUNCTIONAL QUALITY	HEALTH, COMFORT AND USER-FRIENDLINESS	Commercial Viability
		Thermal Comfort
		Indoor air comfort
		Acoustic Comfort
		Visual Comfort
		User Control
		Quality of Outdoor Spaces
		Safety and Security
	FUNCTIONALITY	Inclusive Access
		Public Access
		Cyclists Facilities
	AESTHETIC QUALITY	Design and Urban Quality
		Integrated Public Art
		Layout Quality

Table 3 - DGNB requisites (part 2)

<i>QUALITY SECTIONS</i>	<i>EVALUATION TOPICS</i>	<i>CRITERIA DESCRIPTION</i>
<i>TECHNICAL QUALITY</i>	<i>QUALITY OF TECHNICAL IMPLEMENTATION</i>	<i>Fire Safety</i>
		<i>Sound Insulation</i>
		<i>Building Envelope Quality</i>
		<i>Adaptability of Technical Systems</i>
		<i>Cleaning and Maintenance</i>
		<i>Deconstruction and Disassembly</i>
		<i>Sound Emissions</i>
<i>PROCESS QUALITY</i>	<i>QUALITY OF PLANNING</i>	<i>Comprehensive Project Brief</i>
		<i>Integrated Design</i>
		<i>Design Concept</i>
		<i>Sustainability aspects in Tender Phase</i>
		<i>Documentation for Facility Management</i>
	<i>QUALITY OF CONSTRUCTION</i>	<i>Environmental Impact of Construction</i>
		<i>Construction Quality Assurance</i>
		<i>Systematic Commissioning</i>
<i>SITE QUALITY</i>	<i>SITE QUALITY</i>	<i>Local Environment</i>
		<i>Public Image and Social Conditions</i>
		<i>Transport Access</i>
		<i>Access to Amenities</i>

Source: DGNB System Brochure

According to Miranda [11], the DGNB Certification System can easily be adapted to the climatic, constitutional, legal and cultural particular features of other countries. This is one of the strengths of this system which might be applied internationally. Nevertheless, until December, 2018 there was no Brazilian Building with this certificate.

### 3.5 Brazilian environmental rating system: “Selo Casa Azul” and PROCEL

In addition to international methods, two rating systems have been developed in Brazil: “Selo Casa Azul” promoted by a Brazilian bank (CAIXA), and PROCEL - acronym in reference to the Brazilian National Program of Energy Efficiency in Buildings. The “Selo Casa Azul” (“Blue House Seal”) has been developed to disseminate good practices on sustainable construction, and is a socioenvironmental classification of housing projects financed by CAIXA. The method defines six dimensions and 53 requirements to be accomplished in order to obtain the qualification. The dimensions are: Urban Quality; Design and Comfort; Energy Efficiency; Material Resource Conservation; Water Management; Social Practices. The seal does not grant “certificate” since the bank is not a certified agent, but offers “qualification” within the method considering three levels: bronze, silver and gold. Although the seal has been launched since 2008, on December 2018 there were only 14 buildings recognized with this label [12]. This occurs probably because the method exists only in Brazil, with no international recognition.

The same occurs with “PROCEL Edifica”, a method developed to promote the design and construction of buildings with low consumption of energy. In commercial, service and public buildings, three systems are evaluated: facades, lighting and air conditioning. In this way, the label can be granted partially, as long as it always contemplates envelope evaluation. For residential buildings it must consider the envelope and the water heating system, besides the systems present in the common areas of the multifamily buildings, such as lighting, elevators, centrifugal pumps etc. The method exists since 2003 (after the arrival of the foreign methods). However, until 2018 there were only 16 certified buildings on design phase, and 29 constructed buildings all over the country. [13]



As presented, the foreign rating systems had achieved a great number of certified buildings in comparison to the Brazilian methods. But the task that must be discussed is the truly contribution of those systems to a more sustainable society, and how architecture can provide a more suitable built environment.

#### 4. Confronting LEED and AQUAHQE requirements with Japanese Charter principles

Although it is not possible to elaborate a direct correspondence among the requisites established by the two rating systems widely adopted in Brazil – LEED and AQUAHQE – and the principles defended by Japanese Charter for Global Environment, table 4 presents a correlation.

Table 4 – Architecture Charter for Global Environment versus LEED and AQUA-HQE rating systems

PRINCIPLES		LEED	AQUA/HQE
LONGEVITY	Consensus formation through community involvement	-	*
	Creation of new value	N/A	N/A
	A social system that supports preservation of architecture	*	*
	Architecture easy to maintain and preserve	*	X
	Architecture flexibly and adaptable to changes	X	X
	High durability and renewability	X	X
	Law reform for architecture longevity	N/A	N/A
SYMBIOSES	Creation of an environment for natural eco-system	-	X
	Restoration, maintenance and expansion of urban nature	X	X
	Attention to environment impact of architecture	*	*
ENERGY CONSERVATION	Architectural design conformable to local climate conditions	X	X
	Development and popularization of energy-conserving systems	X	X
	Reduction of energy use during construction	*	X
	Formation of locally based energy systems	*	X
	Urban tissue to allow use of natural energy	-	-
	Urban tissue to contribute to energy-efficiency transport	-	-
	Popularization and establishment of awareness regarding energy conservation	X	X
RESOURCES CONSERVATION AND CYCLICITY	Use of materials with low environment load	X	X
	Promotion of re-use and recycling	*	-
	Extensive application of wooden structures and materials	-	-
	Reduction of waste through the promotion of construction byproduct distribution	N/A	N/A
	Hope for reformed everyday awareness and behavior patterns	N/A	N/A
SUCCESSION	Succession of a good architectural culture	N/A	N/A
	Attractive urban design	-	-
	Environmental improvement to enhance healthy child development	-	-
	Provision of information for succession	N/A	N/A

\*The principle is considered indirectly /depends on the scope of certification - N/A =Not applicable

Although it is not possible to establish a direct correspondence among principles and requirements, it is necessary to understand how the social aspect of sustainability has been treated by environment rating systems. The proposals that considers social aspects should be incorporated to design process (and should be included as requisites on environmental rating systems) in order to truly help architects and engineers to build smart and sustainable cities.

However, as presented on Table 4, only part of the aspects discussed in the Japanese Charter has been incorporated by the environmental rating systems adopted in Brazil. The most significant and impacting subjects with regard to sustainable development, such as "longevity" and "succession" (for example), have not been considered.

## 5. Conclusions

The Japanese Chart formulated on 2000 highlighted five principles for sustainability, and considers social aspects as a key factor for sustainable development. However, the environment rating systems that emerged throughout the 2000s in Brazil did not considered social aspects as important as economic or environmental ones. In result, "sustainable buildings" has been evaluated partially (only in what refers to environment aspects), and mistakenly considered as synonymous of "green buildings". It is worth remembering that sustainability is based on a tripod which must consider environmental, economic and social aspects.

DGNB certificate seems to be more conscious in what refers to social sustainability, as the method includes requisites related to health, comfort and users-friendliness; functionality and aesthetic quality. In fact, the Brazilian seal "*Selo Casa Azul*" also includes those requisites on "Social Practices" dimension. But, unfortunately, both methods have not achieved a significant number of certified buildings.

It is important highlight that the construction of a sustainable society requires studies and propositions beyond the boundaries of buildings, but must consider the design of cities. In this sense, one of the thoughts presented by the Japanese Charter is: "*would our current cities be promoting the quality of life necessary for the healthy growth of future generations or would our architecture be the cradle of oppression, threats and isolation of people?*"[2] Thus, it is understood the importance of expanding the discussion from the environmental performance of buildings to the quest for the environmental quality of cities - enhancing people's life quality.

## 6. Acknowledgments

The author acknowledges the financial support of CNPq – National Council for Research and Development.

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