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LEED O + M and Sustainable Development

LEED O + M: Requirement Analysis for the Adequacy of UNIFAAT University Center Administrative Building

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Definition

Currently green building has been recognized for its contribution to sustainability. Several assessment tools and classification systems were developed to analyze the environmental performance of buildings and thus integrate them into sustainable development proposals (Ali and Al Nsairat 2009). In this context, the Leadership in Energy and Environmental Design (LEED) certification is recognized as one of the most widely adopted initiatives to evaluate the sustainable performance of buildings. The certification, in addition to new constructions, also includes in its proposal existing buildings (LEED O + M) that can generate diverse environmental impacts in its operation. Thus, the importance of this type of certification for the promotion of sustainable development is noted.

Introduction

This entry shows a brief history of how the concepts of sustainability and sustainable construction emerged, as well as the introduction of these concepts in civil construction. It also addresses the importance of sustainable construction in the pursuit of the objectives of the 2030 agenda, with emphasis on the use of environmental certifications as a support to this search.

The research takes the administrative building of UNIFAAT University Center as object of study, analyzing it in the light of the parameters of the Leadership in Energy and Environmental Design (LEED) certification, according to the Existing Buildings typology (LEED O + M). Firstly, the current situation of the building is introduced, comparing its characteristics with the parameters demanded by the LEED O + M certification. Next, some suggestions for adaptations in the building's operating practices are presented in order to meet the minimum requirements presented by the certification.

Sustainable Building: LEED O + M

According to Agopyan and John (2011), the concern upon the impacts generated by the human being on the environment emerged in the 1960s, with publications and demonstrations on chemical and radioactive pollution from industrial and

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warlike industries. In this period, the concern with the development model began.

Later, the Brundtland report (entitled Our Common Future), published in 1987 and prepared by the World Commission on Environment and Development, defined sustainable development as a "development that meets the needs of the present without compromising the ability of future generations to meet their own needs," which "means enabling people, now and in the future, to achieve a satisfactory level of social and economic development and human and cultural attainment, while making reasonable use of land resources and preserving natural species and habitats" (CMMA 1991). Since Rio 92 event (United Nations Conference on Environment and Development), this concept has gained momentum and has been used in many sectors of activity.

From these events, the term green building became more frequent, including international events specifically organized to discuss the theme, such as the International Conference on Sustainable Construction, which first edition took place in 1994 in Tampa, Florida.

In 1999, Agenda 21 on Sustainable Construction was published, defining the concept of sustainable construction. In the following year, Agenda 21 for Sustainable Construction in Developing Countries was published, in which sustainable construction is defined as "a holistic process that aspires to the restoration and maintenance of harmony between natural and built environments, and the creation of settlements that affirm human dignity and encourage economic equity" (Ministry of the Environment 2017).

Agenda 21 comes to rescue the pillars of sustainability, with recommendations for sustainable construction, no longer focusing only on energy efficiency but also aiming at the quality of life provided by the built environment and its economic viability.

In an evolutionary process, Agenda 2030 was published in 2015. According to the UN it "is a plan of action for people, planet and prosperity. It also seeks to strengthen universal peace in larger freedom" (United Nations 2015). The agenda is composed of 17 objectives and 169 goals (Fig. 1).

Among those objectives, those which are more inherent to civil construction are the following: ensure the availability and sustainable management of water and sanitation; build resilient infrastructures; promote inclusive and sustainable industrialization and foster innovation; make cities and human settlements inclusive, secure, resilient, and sustainable; take urgent action to cease climate change and its impacts; protect, restore, and promote sustainable use of terrestrial ecosystems and sustainable management of forests; and combating desertification, detain and reverse land degradation and detain biodiversity loss (United Nations 2015).

According to Agopyan and John (2011), although civil construction is the industry that mostly consumes natural resources and generates waste, as the significant dust generation and noise pollution in construction sites located within cities, it still had not been placed as an industry with problems directly related to sustainability.

It is notorious that the activities related to the civil construction are very impacting, from the environmental point of view. Brazilian civil construction currently consumes 40% of natural resources and contributes with one third of greenhouse gas emissions (Tajiri et al. 2014).

The construction industry also changes the landscape in a significant way, either in the place

LEED O + M and Sustainable Development, Fig. 1 Agenda 2030 Goals. (Source: Reproduced from ONU 2018)

of the extraction of raw material or in the place of the building. After the end of construction, there is energy and water consumption during the use and maintenance of the built environment, mainly in public buildings and other places of great influx of people, such as office buildings for companies and student buildings.

In such cases, of buildings used by many people who often have different habits, it tends to be more difficult to achieve savings in electricity or water consumption, unless all users have a differentiated sustainable awareness level.

A housing or construction can be considered sustainable when environmental suitability, economic viability, and social justice are incorporated in all stages of its life cycle, that is, from the design phase through to construction, use, and maintenance phases and in a possible demolition process (Tajiri et al. 2014).

Considering the above, when the term sustainable construction is mentioned, it raises the idea of a concept applied to a new building, designed to obtain greater energy efficiency or, even, to reuse materials in its construction.

A previously existing building, built by traditional methods and making use of non-sustainable materials, cannot seek to correspond to this concept of sustainable construction, since it has no more means to apply environmentally adequate concepts in the design and construction phases of the building.

Regarding the quest for sustainability, considering that electric energy and treated water are consumed by almost the entire population in their homes, even more in urban areas, generating energy efficiency by reducing consumption is a highly relevant issue for achieving sustainable development. However, for the construction to be sustainable in accordance with the parameters of Agenda 21, this guidance must be considered throughout the life cycle of the building and not only with regard to energy consumption.

The operation of the Brazilian built environment accounted for 44% of the electricity consumption in 2007 (ANEEL 2008), and there is a tendency to increase this participation. On the other hand, changes in the buildings design can mean important savings in consumption and represent the reduction of impacts associated with energy generation (Lamberts et al. 1997).

In the case of a new building, in theory, everything can and should be thought and planned for sustainable development, such as building materials and their environmental and social impacts, for example, the analysis of the place from which the raw material for the manufacture of these materials was extracted; of the manufacturing process, which is a generator of greenhouse gases; and of material transport, which may be associated with small or large distances, directly influencing a smaller or larger amount of greenhouse gas emissions, among others.

Concerning the execution of the work, it should be planned to be executed in a way to reduce loss, generating less waste. In case of using the environment already built, it should provide well-being to its users, offering them thermal and acoustic comfort, air circulation, and easy access, among other benefits. Regarding the maintenance, it is possible to highlight issues such as the nonuse of chemically polluting paints and the search for processes capable of making it with less economic cost. These are just a few examples of issues to consider when it comes to materials. A number of other issues must be addressed in order to work in the field of sustainable construction, such as the application of protocols capable of avoiding inadequate working conditions – considering the people involved in all stages of the building's life cycle, as well as the creation of processes and practices responsible for making this whole cycle economically viable.

For an existing building, many issues remain unchanged. However, since it is an already-built environment, the focus should be on the reduce of energy consumption, improvement of its use, and sustainable maintenance. This consideration is strongly relevant, since the huge majority of world's population today occupies built environments that do not have any feature aligned with sustainable issues, as they were built in times when drivers in the construction industry did not have sustainability as an important concept to be considered.

The need for changes to make the construction sector more sustainable reveals the need to apply

tools that can guarantee adequate environmental performance for new or existing buildings. In this context, seals and certifications have been created, which magnitude of recognition to the people, public bodies, and market bears their influence on architects and engineers, encouraging them to use best practices in the projects and construction of buildings. In this way, they contribute to the movement of change and to a transformation of the market (Tajiri et al. 2014).

The certifications, both for materials and for the buildings themselves, are gaining importance in the Brazilian construction industry. Although it is a process that has gradually become reality, there are already some certification initiatives in the country's buildings. These examples are inspired on American and European certification models, which cover criteria such as the use of inputs from proven origin, the rational use of water, the search for energy efficiency, and the dissemination of recommendations for the use of internal environments in order to decisively reduce the impacts resulting from the execution of the work and, above all, the operation of the building (Tajiri et al. 2014).

It is notable that there is difficulty to implement the culture of certifying buildings, often because an inadequate approach is used when presented to consumer, since they are much more concerned about showing that their building has a differential compared to the others – more beautiful and durable, with an innovative system of abstraction of water, etc. than with the impact that the house can cause in socio-environmental terms – as its contribution to climate change (Tajiri et al. 2014).

In 1999, the United States Green Building Council (USBCG) created the LEED certification seal. The program brings financial and economic incentives to the US green building market (Motta and Aguilar 2009).

In 2007, the Green Building Council Brazil (GBCBrazil) was created in Brazil, aiming to be a reference in the evaluation and certification of sustainable buildings in Brazil, through the regionalization of the LEED evaluation tool. Also in 2007, the Brazilian Sustainable Construction Council (CBCS) was created, with the objective to implement sustainable concepts and practices in civil construction – however, the CBCS does not intend to certify buildings. Also in 2007, the Ecological seal for sustainable products and technologies IDHEA-Falcão Bauer was launched (Motta and Aguilar 2009).

In 2008, the Brazilian certification, High Environmental Quality (AQUA) certification, based on the French certification Haute Qualité Environnementale (HQE) was launched.

In Brazil there are also several other certifications and programs that are being used for the evaluation of new and existing buildings, such as:

Selo Casa Azul – created by Caixa Econômica Federal – qualifies projects of enterprises within social and environmental criteria, grouped into six categories: urban insertion, design and comfort, energy efficiency, material resources conservation, rational use of water, and social practices (Caixa Econômica Federal 2017).

Procel-Edifica (National Program for Energy Efficiency of Buildings) – developed by the Ministry of Mines and Energy and the Ministry of Cities, with the assistance of Universities and Research Centers in 2003 (Procel 2017).

Qualiverde – developed by the City of Rio de Janeiro, within the scope of the Municipal Council of Urban Policy – COMPUR, em 2012 2012 (Bezerra and Oliveira 2015).

With great recognition in the Brazilian market for being an international certification, the LEED ™ or Leadership in Energy and Environmental Design certification, used in more than 160 countries, is the main platform used for green buildings (GBC Brasil 2018).

LEED v4 certification is divided into several types of certification which are the LEED Building Design + Construction (LEED BD + C), LEED Operations + Maintenance (LEED O + M), LEED Interior Design + Construction (LEED ID+C), LEED Neighborhood Development (LEED ND), and e LEED Homes (GBC Brasil 2018).

LEED certification works for nearly all types of buildings and can be applied at any time in the

LEED O + M and Sustainable Development, Fig. 2 UNIFAAT University Center. (Source: Reproduced from UNIFAAT 2018a)

enterprise. Those who receive the LEED certification are analyzed in eight dimensions, distributed in prerequisites (compulsory practices) and credits (recommendations) which, once accomplished, guarantee points to the edification. The level of certification is defined according to the number of points acquired and can vary from 40 points to 110 points. The levels are Certified, Silver, Gold, and Platinum (GBC Brasil 2018).

LEED O + M Application in the Administrative Building of UNIFAAT

The study project deals with one of the buildings of the UNIFAAT University Center (Fig. 2) – more specifically, the building where the administration and the secretary are installed (Figs. 3 and 4), characterized as the one with the largest number of permanent users of the institution.

The UNIFAAT administrative building, when conceived, was not designed with certification in mind. The main driver was the concern to create a suitable environment for the installation of the administration of UNIFAAT University Center. Thus, traditional methods and structure with prefabricated materials were used in the construction, aiming at a good cost-benefit and execution of the work in the shortest time possible, and that the quality and durability of the building could be maintained.

Thus, the building does not have any sustainable certification. In this sense, this study aims to investigate possibilities about the hypothesis of submitting this building to a process to receive a LEED certification. In the case of the administrative building of UNIFAAT, the best typology in which it fits in is LEED O + M: Existing buildings.

The LEED O + M certification comes to certify various types of buildings, including the type addressed by this study, which is the operation and maintenance of existing building.

Old buildings are great consumers of water and energy. The application of LEED certification in an existing building is, above all, an attempt to reverse this scene. This inference comes from the observation that it can take up to 80 years to remedy the environmental impacts generated by demolishing an existing building and building a

LEED O + M and Sustainable Development, Fig. 3 Administrative building of UNIFAAT. (Source: The authors 2017)

new one, even if the new one is extremely (GBC Brasil 2018).

That is, finding ways to make an existing building more efficient is substantially more environmentally productive than demolishing it for a new construction – even if the new building is highly efficient.

The LEED O + M typology can be applied to various types of buildings, from commercial buildings to data centers.

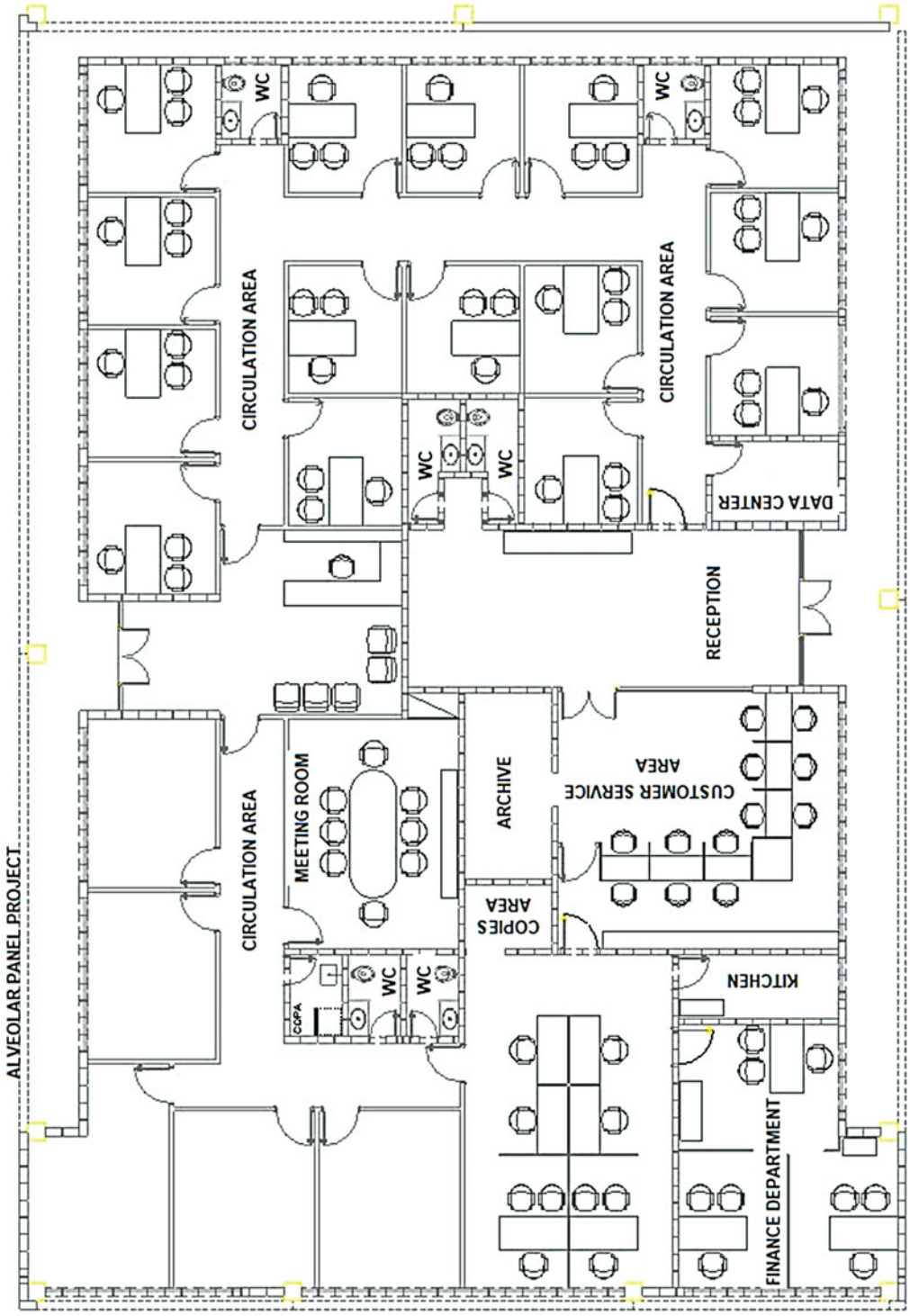
The LEED O + M v4 certification type addresses:

- Existing buildings – projects that do not have as their main function the education, retail, data centers, sheds, and distribution centers or lodging.
- Retail stores – for existing retail spaces, both showroom spaces and storage areas.
- Schools – for existing buildings consisting of primary and secondary learning spaces. It can also be used in higher education and non-academic buildings within an education campus.
- Lodging – existing hotels, motels, and inns as well as other companies within the service industry that provide short-term accommodation, with or without food.
- Data centers – existing buildings specially constructed and equipped to meet the high-density needs of computing equipment such as server racks used for data storage and processing.
- Warehouses and distribution centers – storing products, manufactured goods, raw materials, or personal belongings (such as storerooms) (GBC Brasil 2018).

For a LEED certification, the US Green Building Council (USGBC) evaluates buildings in eight dimensions, which are Location and Transportation, Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Innovation, and Regional Priority (GBC Brasil 2018).

The certification guide provided by USGB, LEED v4 for Operation and Maintenance of Buildings, was used to guide this study (USGBC 2014).

This guide provides information such as what are the dimensions evaluated by the certifier, what are the minimum requirements for each dimension, and what are the values of each requirement and credit in the sum of the total score for the certification. To receive the minimum certification, it is necessary to reach 40 points; for Silver



LEED O + M and Sustainable Development, Fig. 4 Floor plan of UNIFAAT administrative building. (Source: Reproduced from UNIFAAT 2018b)

Y	?	N			
3	12	0	**Location and Transportation**		15
3	12		Credit	Alternative Transportation	15
2	5	3	**Sustainable Sites**		10
	?		Prereq	Site Management Policy	Required
	1	1	Credit	Site Development-Protect or Restore Habitat	2
2		1	Credit	Rainwater Management	3
	1	1	Credit	Heat Island Reduction	2
	1		Credit	Light Pollution Reduction	1
	1		Credit	Site Management	1
	1		Credit	Site Improvement Plan	1
2	2	8	**Water Efficiency**		12
Y			Prereq	Indoor Water Use Reduction	Required
	?		Prereq	Building-Level Water Metering	Required
2			Credit	Outdoor Water Use Reduction	2
	2	3	Credit	Indoor Water Use Reduction	5
		3	Credit	Cooling Tower Water Use	3
		2	Credit	Water Metering	2
1	34	3	**Energy and Atmosphere**		38
	?		Prereq	Energy Efficiency Best Management Practices	Required
	?		Prereq	Minimum Energy Performance	Required
	?		Prereq	Building-Level Energy Metering	Required
Y			Prereq	Fundamental Refrigerant Management	Required
	2		Credit	Existing Building Commissioning— Analysis	2
	2		Credit	Existing Building Commissioning—Implementation	2
	3		Credit	Ongoing Commissioning	3
	20		Credit	Optimize Energy Performance	20
	2		Credit	Advanced Energy Metering	2
		3	Credit	Demand Response	3
	5		Credit	Renewable Energy and Carbon Offsets	5
1			Credit	Enhanced Refrigerant Management	1
7	1	0	**Materials and Resources**		8
	?		Prereq	Ongoing Purchasing and Waste Policy	Required
	?		Prereq	Facility Maintenance and Renovations Policy	Required
1			Credit	Purchasing- Ongoing	1
1			Credit	Purchasing- Lamps	1
1	1		Credit	Purchasing- Facility Management and Renovation	2
2			Credit	Solid Waste Management- Ongoing	2
2			Credit	Solid Waste Management- Facility Management and Renovation	2
1	13	2	**Indoor Environmental Quality**		17
	?		Prereq	Minimum Indoor Air Quality Performance	Required
Y			Prereq	Environmental Tobacco Smoke Control	Required
	?		Prereq	Green Cleaning Policy	Required
	2		Credit	Indoor Air Quality Management Program	2
	2		Credit	Enhanced Indoor Air Quality Strategies	2
	1		Credit	Thermal Comfort	1
	1		Credit	Interior Lighting	2
	2	2	Credit	Daylight and Quality Views	4
1			Credit	Green Cleaning- Custodial Effectiveness Assessment	1
	1		Credit	Green Cleaning- Products and Materials	1
	1		Credit	Green Cleaning- Equipment	1
	2		Credit	Integrated Pest Management	2
	1		Credit	Occupant Comfort Survey	1
0	6	0	**Innovation**		6
	5		Credit	Innovation	5
	1		Credit	LEED Accredited Professional	1
0	0	4	**Regional Priority**		4
		1	Credit	Regional Priority: Specific Credit	1
		1	Credit	Regional Priority: Specific Credit	1
		1	Credit	Regional Priority: Specific Credit	1
		1	Credit	Regional Priority: Specific Credit	1
16	73	20	**TOTALS**	Possible Points:	110

Certified: 40-49 points, **Silver:** 50-59 points, **Gold:** 60-79 points, **Platinum:** 80+ points

LEED O + M and Sustainable Development, Fig. 5 LEED O + M Checklist spreadsheet. (Source: Reproduced from USGBC 2018)

level certification, the minimum is 50 points; for Gold level certification, the minimum is 60 points; and for the Platinum level – the highest – the minimum is 80 points (USGBC 2014).

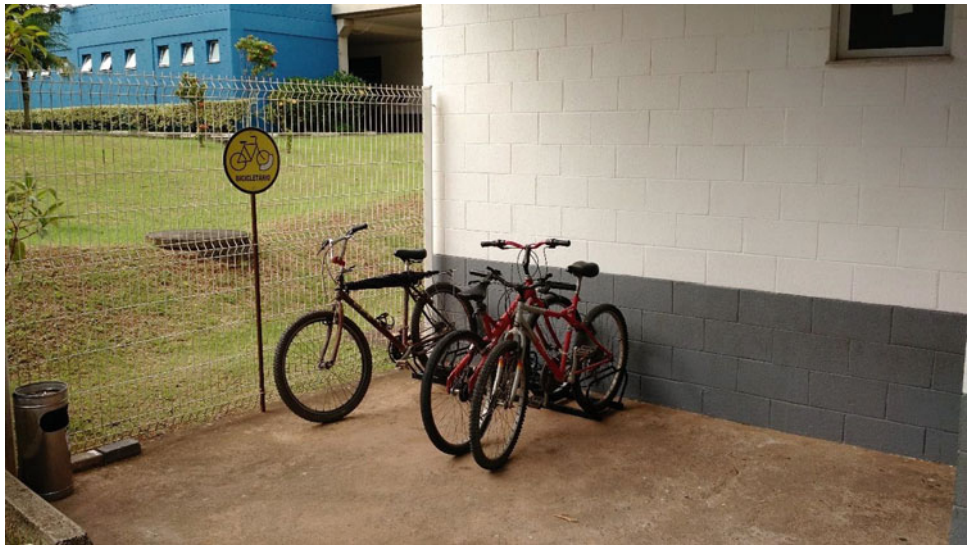
The checklist list provided by the USGBC certifier was used to check what score was achieved.

Basically describing the spreadsheet (Fig. 5), in the first column (green), the amount of credit score obtained in that item is inserted; in the second column (yellow), the scores that can be reached are inserted; in the third column (red), the scores that cannot be attended are inserted; in the fourth column, the items are described; and in the fifth and last column, the maximum score that can be reached is shown, where the letter Y refers to a prerequisite which was met and the letter N to a prerequisite which was not – there is still the possibility of the symbol of a question mark, referring to a prerequisite that can be met. Finally, in the last line of the checklist, the total points are shown.

Analyzing the administrative building of UNIFAAT in all dimensions covered by LEED certification O + M, it is noticeable that, currently, the administrative building of the institution meets only 3 prerequisites and reaches 16 credit points, not reaching the minimum to get the LEED O + M certification, which is 40 credit points and all prerequisites met.

But there are still 73 credit points that are possible to obtain. The UNIFAAT administrative building has great potential for a LEED v4 O + M certification, with the possibility of reaching the highest level – the Platinum level.

In order to do this, first of all, several prerequisites must be met in all dimensions. This can be achieved by changing some practices and promoting some changes such as in the prerequisite Site Management Policy (SS Prerequisite: Site Management Policy) in the Sustainable Sites (SS) dimension, where it is possible to implement a management policy that reduces the use of



LEED O + M and Sustainable Development, Fig. 6 Bicycle rack. (Source: The authors 2017)

harmful chemicals as well as promote a management of organic waste generated in the institution that submits this material to an appropriate composting process (USGBC 2014).

In the case of Indoor Water Use Reduction prerequisite, in Water Efficiency dimension, metals with reducing system of water consumption can be installed, aiming to achieve a consumption index below last year's average. And in Building-Level Water Metering prerequisite, install hydrometers that measure the total consumption of water in real time and also promote the measurement of recovered water (USGBC 2014).

In case of Energy and Atmosphere dimension, it is necessary to meet several prerequisites. This item requires special attention because it is the one which can grant the highest credit score. For this, it is basically necessary to reduce electrical consumption, which can be achieved with measures such as the installation of lighting system with automatic adjustment by level of clarity, automatic shutdown by presence sensor, and use of LED lamps. In this way, it is expected that, in general, it will be possible to reduce average annual consumption by at least 25% (USGBC 2014).

The Location and Transportation dimension is important because it aims to reduce the effects of automobiles pollution. For this purpose, alternative transportation to the automobiles should be encouraged (Fig. 6). In this matter, the administrative building of UNIFAAT already has 3 points and can reach 70% of this item – which will guarantee 15 points.

Based on the analysis carried out in the UNIFAAT administrative building, it is possible to reaffirm that existing buildings play a fundamental role in terms of sustainability, as they can bring direct and indirect benefits to environment conservation and guaranteed quality of life for the populations. In this sense, it should be emphasized that understanding a construction from a nonconventional and more sustainable perspective is an important step toward an urgent and necessary change in patterns that historically have caused diverse environmental impacts, as it is the case of civil construction sector.

Final Considerations

The use of practices and methods that meet the conception of sustainable construction refers to the preservation of natural resources for future generations, while maintaining the development to meet the needs of the current generation in a socially and environmentally responsible way.

Certifications, at first, come to assess the built environment to classify how much they contribute – or not – to reducing climate change, as well as assessing how sustainable they are in general terms. Today, however, the construction market uses certifications not only as a parameter of sustainability but also as a commercial differential that has led to changes in the market, directing companies which own buildings to seek certifications to fit into this search for sustainability, currently required by the final consumer regarding the need for socio-environmental changes and environmental preservation.

LEED certification, as one of the most widespread international certifications in civil construction, has been changing over the years. Currently, in version 4, it attempts to include various types of buildings. In the case of the LEED O + M typology, it seeks to create sustainable operation and maintenance parameters for existing buildings, making a great contribution to sustainability, since it covers a large part of the types of already existing buildings that have not been erected in shape or even to be sustainable. However, they can also contribute to sustainability by reducing their energy consumption and the pollution they generate during their operation and maintenance throughout their useful life.

The administrative building of UNFAAT, as all buildings located within an academic center, when certified by an environmental seal of an internationally recognized organization, such as USGBC, makes a great contribution to the promotion of sustainability. In addition to the contribution of becoming a sustainable building, it will also contribute to the dissemination of practical concepts related to sustainability, given the direct contact that thousands of students of Higher Education will have with this example of sustainable construction daily. These students are future professionals, who in the coming years will compose the labor market and dictate the trends that will guide the construction sector.

Another important fact is that a LEED-certified building within a University Center, as well as in most USGBC-certified buildings, denotes a strong commitment of the organization to sustainability and the next generations, as it is objectified in the 2030 Agenda.

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