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Building Lifecycle and Sustainable Development



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Definition

With regard to the three elements of sustainable development - economic growth, social progress and effective protection of the environment - the construction industry importance cannot be disregarded in this context. To do so, it is essential to include the life cycle assessment perspective in the quest for sustainability, considering three basic principles: resource management, life cycle design, and human and environmental design (Sev 2009).

Introduction

Considering the impacts that civil construction industry may cause on the environment, it is necessary to choose sustainable materials to carry out the constructions, since natural resources must be considered as finite and the amount of waste generated is concerning.

In terms of sustainability, it is also important to consider issues such as changes in climate and temperature, and the proposal to make cities and human settlements inclusive, safe, resilient, and sustainable, ensuring access to adequate housing for all. These are the assumptions cited in objective 11, found in the “Agenda 2030 for Sustainable Development,” which is based on the three pillars of sustainability: economic, social, and environmental issues (United Nations 2015).

That said, it should be noted that interior design can offer ways to apply appropriate techniques and materials and thus contribute to reduce environmental impact without losing the personality or aesthetic aspects of the project and without necessarily raising the cost of the project.

Pazmino (2007) defines sustainable design as one in which the product is environmentally correct, economically viable, and socially equitable, and that considers a range of items to be observed in the development/production of a product much larger than in conventional design.

According to Moxon (2012), the work of designers and architects can produce favorable results with lower environmental impact. This is due to the use of local materials and methods, and use of bioclimatic design principles, which has the main aspects of “heat gain by insolation, solar shading, thermal inertia, thermal insulation, natural ventilation, air tightness and natural lighting” (p. 68).

The author also mentions that designers have a wide range of possibilities regarding available

materials that are consistent with sustainability. In this sense, the use of materials, in turn, must first consider reducing, then reusing, recycling, and, finally, use of renewable sources. Moxon (2012) emphasizes the priority of reducing the amount of materials that is used, adopting reuse materials – such as demolition timber, choosing those with recyclable content, and, where there is no such possibility, opting for those which raw materials originate from renewable energy sources.

Pazmino (2007) points out that in view of technological evolution of last decades, increase in consumption and search for high standards of comfort – that led to environmental degradation, the intervention of professional designer is increasingly necessary to improve the established relationship between products, environment, and society. Therefore, designers have at their disposal several possibilities for application of materials suited to sustainability. However, to analyze each material from an environmental point of view, it is necessary to incorporate the concept of Life Cycle Assessment – LCA (Rodrigues and Gregory 2017).

In the light of the above, this article presents a reflection on the choice of environmentally friendly products in interior design and in what ways they can contribute to sustainable development, considering the life cycle of materials and buildings.

The Life Cycle of Buildings, Sustainability, and Interior Design

When relating sustainability to interior design there are some inherent limitations to the built environment, because most of the time, when looking for a more ecologically balanced posture in the civil construction, only environmentally responsible products, use of renewable energy, and water saving are mentioned (Sarmiento and Souza 2016). Papanek (1995, p. 115) points out that: [...] architecture can only thrive if the built houses are in harmony with the people living in them, with nature and with culture. This will mean a big step for users and for the sustainability of the built environment. “So, when thinking about

environments designed in harmony with the people who will live in them, the role of interior design is reflected on sustainability and, consequently, there is a contribution to sustainable development” (Sarmiento and Souza 2016).

According to Agopyan and John (2011), nowadays the civil construction sector presents accelerated growth, which generates housing and quality of life to the population, which are essential conditions for human life. On the other hand, it can be considered the sector of human activities that most consumes energy and resources, besides generating great amounts of waste. For Kozáková et al. (2014, p. 485):

Energy consumption in buildings is a relevant issue to permanent sustainable development. Reduction of energy consumption in buildings and exhaust fumes is a priority for European Union and other countries. As stated by the U. S. Energy Information Administration (EIA2013) in the International Energy Outlook, the energy performance of buildings (except for buildings not designated for production) was higher than 1/5 of overall world consumption in 2010. There is an expectation of another increase by approximately 0.6% per year in OECD countries and by 2.7% per year in non-OECD countries.

The authors still mention that “buildings have a significant share in overall energy consumption and, regarding the prognosis for future development, there is the expectation of further growth in consumption” (Kozáková et al. 2014, p. 485). In addition, the amount and kind of energy use during the life cycle of a building material, from the production process to its handling after the useful life can, for example, in different ways, over different periods of time, affect the flow of greenhouse gases to the atmosphere (Lenzen and Treloar 2002).

In addition to energy consumption, construction and its operations rely heavily on the use of water from the environment. Water is consumed in the extraction, production, manufacture, and delivery of materials and products to the construction site (Akadiri et al. 2012).

Regarding the impacts related to the civil construction sector, it is also important to mention that the extraction and consumption of natural resources as building materials, or as raw

materials for building materials production in implementing construction works has a direct impact on natural bio-diversity, due to the fragmentation of natural areas and ecosystems caused by construction activities. As it is known, built environment consumes large amount of mineral resources, most of which are nonrenewable (Akadiri et al. 2012).

In this way, the choice of the materials that will be used in a construction is of paramount importance, and for this purpose, the Life Cycle Assessment (LCA) should be used. In the life cycle assessment, there should be an analysis from the environmental perspective that considers the extraction of raw material, transportation and energy spent in this route, manufacturing, planning, use, generation of waste, and its disposal (Agopyan and John 2011).

In the search for sustainability, LCA plays a fundamental role since it involves the compilation and evaluation of the inputs, outputs, and possible environmental impacts that a product can produce throughout its useful life. In an LCA study of a product or service, all resource extraction and emissions to the environment are quantitatively measured over the lifecycle, from birth to death, as well as the potential impacts of resources used on the environment and human health (Ferreira 2004).

When they opt for a particular material and manufacturing process, civil construction, architecture, and interior design professionals have an impact on humanity and ecology. These impacts are diverse and are related, among other factors, to the place of extraction of chosen raw materials and to the type of labor involved in materials processing. Thus, projects do not serve only the final consumer but all individuals involved in the process. It is clear, this way, that material selection has consequences for the whole society (Rodrigues and Gregory 2017).

The LCA process has four components, which are successively: (1) – the Definition of Objectives and Scope, which defines and describes the product, process, or activity, and establishes the context in which the evaluation will be carried out, identifying the environmental limits and effects; (2) – Inventory Analysis, which identifies and quantifies the energy, water and materials

used, as well as environmental waste; (3) – Impact Analysis, which analyzes the human and ecological effects of the use of energy, water and materials used, as well as the environmental discard, mentioned in the previous item; (4) – the Interpretation, which evaluates the results of the two previous analyses and select the most appropriate product, process, or service (Ferreira 2004).

Therefore, LCA should be included in the decision-making process of materials and resources to be used, as it enables the understanding of environmental impacts and impacts on health and human life. In this sense, it is a tool that should be used to better decision-making when choosing the materials to carry out a construction or an interior design, balancing the cost-benefit.

Serrador (2008, p. 267) supports this approach by explaining that LCA in buildings is “an internationally accepted method to qualify the total environmental effects associated with products, from the extraction of raw materials to manufacturing and transportation, installations, use and maintenance of a building, its final disposition and reuse.” According to the author, this procedure allows a scientific evaluation of the situation, considering each stage of the process, from its extraction to the demolition of the construction, analyzing what will be the environmental impacts, how much waste will be produced, the durability and quality of the material, etc.

In this sense, interior designer interventions are increasingly necessary to achieve a better relation between product/process, environment and society, and this can initially be achieved with creation of a culture of designers aware of social problems and environmental impacts (Pazmino 2007).

In order to bring socioenvironmental advantages to its proposals, designers must act in each phase of the product life cycle: pre-production, production, use, disposal, recycling, and reuse. This way, it is possible to take ecologically correct decisions that minimize various environmental impacts (Pazmino 2007).

In this context, it is relevant to highlight that the civil construction sector is directly related to the search for sustainability, since it is considered to be the largest consumer of resources and generates great amounts of solid, liquid, and gaseous

residues (Tajiri et al. 2011). In order to ensure that the activities carried out in the field of construction can be considered sustainable, it is important to understand and incorporate the concept of sustainable development. According to the definition of the report issued by the Brundtland Commission, it is a development “that meets the needs of current generations without compromising the ability of future generations to meet their needs and aspirations” (Comissão Mundial sobre Meio Ambiente 1991, p. 46).

Regarding this issue, it is known that sustainability is based on three pillars: economic, environmental, and social. The first one considers not only the formal economy but also informal activities, which increase the monetary income and living standard of individuals. The second stimulates companies and organizations to consider the impacts of their activities on the environment, as also counts on the participation of the State in the issue of the implementation of socio-environmental public policies. Finally, the third is the social dimension, considering the human aspect and its characteristics (Almeida 2002).

Therefore, the fact that buildings must be sustainable has to be considered as fundamental, so that it is possible to have the resources and means to meet the needs of future generations, as well as to preserve those of the current generation. In a construction considered sustainable, the means are important, but the main point is how much this activity really minimized or stopped generating socioenvironmental impacts, besides the need to maintain the proposed system and not forgetting the human dimension that involves the concept of environment and sustainability.

Sustainable construction refers not only to the planning and execution of the work but also to the operation and maintenance phases of the buildings. In this perspective, it is worth mentioning the concept of *ecodesign*, which took on greater proportions in the 1990s, due to the accelerated industrial development and the socio-environmental impacts generated from this reality. Researchers were concerned about using a method for manufacturing products that would cause less impact to the environment, without interfering in the quality and functionality of the final product. Vitor Papanek, an American

designer, popularized the term through his idea of creating environmentally friendly products, that is, products with low environmental impact, making its application in the design of his tables and chairs (Papanek 1995).

According to Naime et al. (2012), “the understanding of design as an activity involving project makes us think about the performance of the designer not only in the conception of the product itself, but in all the steps necessary for its production, distribution and disposal.”

Thus, *ecodesign* conducts life cycle study of the products, in which there is a planning from the development through production, use, and discard. Papanek (1995) divides the product development process into six steps, which are considered as principles and requirements for an *ecodesign* project.

The first stage emphasizes the choice for sustainable material, that is, nontoxic materials that use as little energy as possible in the manufacturing process and can be recycled. The second stage deals with efficiency in this process. The third step discusses how the parts are manufactured, suggesting greater durability, reducing the disposal, and the amount of waste. The fourth stage is concerned with the useful life of the product. The fifth stage is related to transportation; and the sixth stage involves the management and destination of waste generated (Papanek 1995).

For Naime et al. (2012), each of the steps can be understood as principles and requirements for a sustainable project. In this context, it is necessary that the materials return to the productive cycles in a closed circuit chain, once the great majority of the raw materials are constituted by nonrenewable natural resources. From this perspective, it should be emphasized that the concepts of design and *ecodesign* have much to help change the paradigms in search of holistic parameters of broad sustainability.

From that point, it is important to mention the interior design that, according to Brooker and Stone (2014, p. 11), involves “any type of interior design, from decoration to renovation. It is the art of decorating interior spaces – rooms or environments – to convey a characteristic identity which goes well with the existing architecture.”

For Sarmiento and Souza (2016), interior design is the possibility to transform the geometry of a space into an environment rich in emotions, senses, and memories that reveal the identity of its users. The authors also mention that:

The interiors reveal not only a physical environment, but also a psychological environment of values, meaning a symbology of tastes and meanings. The values relate to our awareness of the natural environment. If the human being has to live as an integrated and interdependent whole, it is necessary for him to identify the point of balance between the integrity of these built environments and their destructive exploitation. (Sarmiento and Souza 2016, p. 1892)

In view of the above, it can be said that interior design affects the environment in different ways, and many professionals work to show how it is possible to incorporate sustainability principles into the internal environments as well (Rodrigues and Gregory 2017). For this, the professional needs to observe and study what would a sustainable interior design be. “The results do not necessarily have to fit into an ‘eco’ style: sustainability can simply be part of any good project” (Moxon 2012, p. 6).

Manzini and Vezzoli (2011) mention that design projects should consider life cycle at all stages, and that all activities involved in pre-production, production, distribution, use, and disposal of the product are considered as one unity.

In this sense, the authors describe Life Cycle Design (LCD) as one that perceives the relations between the consumption of matter and energy in the transformation of products and their respective emissions to the environment. LCD allows one to identify, in a particularized way, the set of consequences of a product proposal, even for those phases that would not normally be considered at the time of design.

Manzini and Vezzoli (2011) also propose a culture in project design that is capable of transitioning from traditional proposals to sustainability, promoting a generation of products and services that are essentially more sustainable, operating with LCD and design for sustainability.

In this context, as a basic environmental objective, each project should minimize the use of materials and energy, as well as emissions and

discards. In addition, it is extremely important to consider also the duration of the product life cycle, as well as reuse of some of its components and materials. Thus, for some products, it becomes a priority and more effective plan to start from strategies of optimizing product life cycle and extending the life of materials (Manzini and Vezzoli 2011).

Regarding the ecological issue, some alternatives have been adopted by interior design professionals. It is possible to reuse material such as bamboo leftovers, recycled PET bottles or recycled glass, pallets, handcrafted and regional pieces, and natural fiber or wood furniture which have the Forestry Stewardship Council (FSC) certification, while maintaining warmth and aesthetics of the environment. It is also possible to use LED bulbs in the lighting design, as well as natural lighting and ventilation. These techniques, in addition to giving personality and originality, are flexible, practical, and economically viable, since it uses old and unused materials and objects that the user already had, also making a significant contribution to the environment, as it reduces the inappropriate discard (Coutinho 2013).

In Brazil, it is possible to find some sustainable furniture stores, which use reforestation wood, banana tree, ecological leather, among others, which can add value to the project, besides using of the technology and the functional techniques to plan and harmonize the environment at the same time (Coutinho 2013).

Still considering the Brazilian reality, it is worth mentioning some examples of sustainable architectural and interior design projects carried out by professionals who care about the environment and who seek the use and development of technologies that collaborate for sustainability.

Starting from this premise, there are some examples of Brazilian designers who seek the implementation of sustainable projects, such as the architect and interior designer Marisa Murta. In her decor and interior design projects, it is possible to perceive her constant concern with two particular points: the guarantee of high durability of the products used and the ability to avoid waste. Thus, practices not only lead to considerable financial control, with less change of

furniture, coatings, and other inputs, but also prevent the unnecessary production of waste.

Marisa Murta uses three specific building systems for the adoption of sustainable interior design as the basis for her projects. The first refers to the intuitive system that has a connection with bioarchitecture, a concept that unites ecology, architecture, and urbanism, using construction processes in harmony with nature and its resources, promoting a balance between the environment and progress. The second is called passive system and refers mainly to the use of materials and techniques that perform well in the rationing of water and energy, such as in sanitary ware, lamps, and appliances of the “eco lines.” Finally, the active system, in which performance in the use of inputs and methods of abstraction and saving of water and energy is based on excellence, with the capacity to flexibilize its performance as the scenario of the space changes (TEM sustentável 2016).

Considering a research realized by Marisa Murta, it is worth mentioning Kang (2003) and Jones (2003), who observe the interior designers who focus on responsible design plan, specifying and executing environmental solutions, reflecting a concern for the world’s ecology and user’s quality of life. In this process, they analyze materials, methods, transportation, maintenance, and disposal of all furniture, utensils, and equipment specified in an interior design.

Another Brazilian example, the Andrade Morethin office develops projects that seek to adapt to the context, local conditions, and, at the same time, generate socioenvironmental and economic guidelines that can be applied on a national scale. Among the various projects, two houses stand out for the way they dialogue with sustainable thinking and practice, since they allow rapid assembly, low environmental impact, and little generation of waste. The first one (RR 2007) is located on the north coast of São Paulo and the second (OZ 2013) on the outskirts of the city of São Roque – SP. The constructions concept was to generate shelters formed by a wooden roof and closings in steel tile with expanded polystyrene (EPS) core for thermal protection. In addition, there are large covers, glazed or screen protected,

which ensure constant and controlled dialogue with the exterior (Aflalo 2014).

According to Azevedo and Machado (2008), among other factors, the role of interior designer is to contribute to market reorientation, offering sustainable alternatives, and promoting socio-environmental values, based on projects with focus on life cycle assessment that include concern with generation of income for the less favored communities.

For the headquarters of the Socio Environmental Institute, in São Gabriel da Cachoeira in Amazonas, the Brasil Arquitetura office incorporated local constructive traditions, such as sills and plots of wood and vine. In addition to the concern with environmental comfort, the work incorporated local techniques, materials, and manpower, adding agility and economical, environmental, and cultural interaction (Aflalo 2014).

Among recent projects, the Loeb Capote Arquitetura e Urbanismo office is the Bayer bridge, located at a point where the Pinheiros river in São Paulo meets the extravasation channel of the Guarapiranga dam. The bridge, for the exclusive use of pedestrians and cyclists, acts as a point of connection between the banks of the river, expanding the network of bicycle paths and bringing the workers from the company Bayer and other citizens closer Santo Amaro subway station. “In the project, two metal islands structure the 90 m of extension and, supported on concrete pipes, they form stop locations covered with vegetation. The central span is mobile, ensuring local navigability” (Aflalo 2014, p. 63).

Another aspect that can be applied in interior design is the furniture design, in which pieces are developed for people and even for specific places, and can be adapted to the sustainability issue, as the pieces by Hugo França who develops furniture sculptures from forest and urban waste. In order to do so, he makes use of naturally condemned trees, by weather conditions or by the action of the human being. That way, he is able to use them completely to activate his sensibility and artistic side, working with their time marks, roots, and cracks (Hugo França 2018).

In order to make the use of these waste possible, Hugo França and his team search the forests of Trancoso, in Bahia, besides having help from

the local population. The drawing of the piece arises from the first cuts of the wood, then it is finished. In addition to having environmental responsibility in the creation and design of his pieces of furniture, he also develops public furniture projects, such as the new bank in the Ibirapuera Park, in Vila Mariana, in São Paulo, where he took fallen trees from the city and used them for the creation of the bank. His idea was to transform this material that would be discarded, being able to reuse it in some way. For that, he made use of a large Tipuana twig that could no longer be recovered (Hugo França 2018).

In relation to this proposal, it is important to highlight that the role of the interior designer goes beyond design. These professionals have the responsibility to educate through their products and to encourage sustainable development through their work. In addition, they should design in order to reduce socioenvironmental impacts in all phases of a product life cycle and support initiatives that encourage material and energy reduction, income generation, and social inclusion (Azevedo and Machado 2008).

Finally, the project “A gente transforma” considers design as a space in which the social and environmental are not disaggregated from cultural values to the benefit of people. The proposal reveals opportunities within and outside communities, opportunities that mean recognizing traditions, bringing the permanence of culture and boosting self-esteem and dignity through the opening of markets and income generation. The process begins with the immersion of the professionals with the residents of the communities, stimulating the look for the local beauty, resulting not only in a collection of handcrafted design products but in a creative process of stimulating the protagonism and the local self-recognition (Rosenbaum 2014).

Thus, communities are stimulated, from their most authentic knowledge, to create opportunities to establish new alliances, new arrangements for productive inclusion and creative expression. They find value in the production of products that represent their culture and knowledge. This, in addition to fostering the creative economy, enables community members to assume the freedom to act and to

achieve autonomy as citizens. (Rosenbaum 2014, p. 21)

The project has already carried out interventions at Parque Santo Antônio, slum located in São Paulo; in Várzea Queimada in the backlands of Piauí and with the Yawnawá people, in the heart of the Amazon Rainforest in Acre (Rosenbaum 2014).

As proposed by project “A gente transforma” (Lopes 2014), in search for sustainability it is fundamental that interior designers understand the social, ecological, and environmental consequences of their activities.

Thus, the design that seeks sustainability must be integrally related to the capacity to promote production systems capable of responding to social and environmental requirements in its products and processes, considering their Life Cycle Assessment-LCA (Manzini and Vezzoli 2011).

Final Considerations

According to Manzini and Vezzoli (2011, p. 99), “Environmental limits are evidences that it is no longer possible to conceive any design activity without confronting it with the set of relationships that, during the life cycle, the product will have in the environment.”

Therefore, it should be emphasized that, even though it is challenging, it is necessary to evolve in the relationship between society and the environment, in order to achieve harmony between the two. It is necessary to rethink ways of experiencing daily life interacting with nature and generating less impact to the environment. In this way, it is evident that the multidisciplinary in the search for solutions among those involved in the perspective of civil construction, for example, is of paramount importance when thinking about sustainability. Architects, engineers, and designers are indispensable in their role and need to define projects that contribute to the environment by reducing environmental impacts in construction together (Sarmiento and Souza 2016).

Therefore, it is noticed that civil construction and interior design are related, since both may apply the correct techniques and materials. It is also noted that the sustainable solutions are not necessarily the most economically unfeasible and that creativity makes all the difference in the project, which brings originality and at the same time contributes to reduction of environmental impact without losing environment's characteristics or changing its aesthetics.

In this perspective, to reach sustainability, it is essential to consider Life Cycle Assessment in the processes that involve sustainable construction and interior design, given that only in this way will it be possible to know and recognize the social and environmental impacts associated with these practices. It is also essential to consider the human factors in this process, valuing, for example, the local culture and integrating in the projects the spaces in which people live.

Before production, the designer must also think of solutions that make his products accessible to the population as a whole, because if the intention is to protect the planet, the goal will be reached only with the adhesion of all consumers (Azevedo and Machado 2008).

From the development of this work, it can be concluded that, interior design, associated with LCA, can directly contribute to sustainability, as it relates not only to the choice of greener products.

Eco design is not the craft produced from scrap or recycling materials. It is a concept that takes into account not only the aesthetic, functional, safety, or ergonomic aspects of products but mainly the environmental factor throughout the product life cycle, in order to reduce the impact on the environment (Pazmino 2007).

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