



## **The ASUS tool as a conceptual basis for proposing the inclusion of the sustainability concept in the formation of the Architect and Urbanist**

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**ABSTRACT:** The term sustainability is widely used in the construction industry as the subject of research, seminars and conferences. The discussion ranges from materials and techniques for construction to the use of the edification, allowing the identification of various application possibilities within the architecture field. The evaluation tools and certifications of buildings support achieving sustainable practices in the sector, as they set parameters that contribute to the decision-making since the project stage. However, theory and practice with its results are pushed apart due to both: no demanding for certifications in small projects; and the academic unpreparedness of professional designers, which are unaware of concepts and technologies for this purpose. This research is motivated by the identification of the need for disciplines that aim at what is called the teaching of sustainability in graduation. The objective of this research is the identification of potential disciplines for including sustainability concepts in the curriculum of Architecture and Urbanism course of the Integrated Faculties of Aracruz, considering the changing requirements of buildings and urban environments, as well as the mismatch of the theme in traditional curriculum. The methodology is based on the analysis of the disciplines and on the verification of applicability of the items from ASUS assessment tool, developed by the Planning and Project Laboratory at UFES. The result reveals both a discrepancy between teaching and the market, and a great potential of some disciplines for including concepts of more sustainable buildings and the related practices.

**Keywords** *Sustainability, pedagogical project, architecture, assessment tools.*

## 1. INTRODUCTION

Sustainability is present in almost everything around us. Much has been discussed on the subject in many areas and sectors of modern society. In civil engineering sector the term achieved an important place in the market, adding value to buildings by using more sustainable technologies. In the academy setting it has become an important object of study, research, seminars and conferences around the country and around the world, aiming at the same goal: building sustainable practices and technologies for the construction industry.

According to Agopyan & John (2011), to achieve the sustainability of the construction it is essential to incorporate innovation, including changes in all construction's activities, having as the concept of innovation the new knowledge that is put into practice.

Different justifications exist for investing resources in studies on the sustainability theme in civil construction. Amongst the most common ones is the possibility of reducing the impact generated by the construction of buildings, seeking for solutions where the new buildings are approximately balanced with the environment they are entering. It can also be noticed that economic and social motivations begin to take on an important role in this context. However, despite the justifications, the related innovation produced by researches are seldom effectively put into practice.

In recent years, one of the solutions implemented in the market to help reducing the environmental, social and economic impacts caused by construction was the creation of tools designed to evaluate and certify buildings as "sustainable". The evaluation of aspects related to technologies associated to environmental impacts is usually considered with greater intensity, giving rise to the so-called green buildings. This type of tool has supported the establishment of parameters, often with low or average cost of deployment. Even when there is no interest in certification, the tool contributes for decision-making at the project stage and guide it to a balance with the environment, with greater or lesser degree.

For example, the rainwater harvesting and solar heating are alternatives that have been often applied regardless of the interest in certification. This is due to a change in the industry mindset and the awareness about the importance of contributing to the environment. Moreover, such technologies are often associated with an effective savings during the useful life of the building.

The demand for certification in the construction industry has been growing in recent years according to each type of building. Despite the differences, all of them follow the same concept: causing less impact on the environment (Agopyan & John, 2011). However, the evaluation tools still have a limited coverage, usually being restricted to buildings that are aimed at achieving the title of "green building". It is believed that such restriction is due to the lack of professionals with the knowledge required to design with techniques, materials and technologies that lead the building construction to more sustainable solutions.

It is known, in principle, that this unpreparedness may be related to the training of professionals, which only find the needed expertise in specialized courses and post-graduate programs specifically focused on the sustainability theme.

In undergraduate courses, the disciplines usually do not cover specific content focused on sustainability issues, being the student restricted to two possibilities: learning from the teacher that has this specific knowledge or being motivated to search for the best performance of the building. In some cases, undergraduate students only come to learn about the theme when looking for subjects to develop their final graduation projects. In this way, the professional goes unprepared to the labor market and is often insecure to apply even simple techniques or to opt for more suitable materials.

Introducing these concepts in the academic community and contributing to the training of the professional by enabling him to execute more sustainable projects, is already part of the national curriculum guidelines for undergraduate courses in architecture and urbanism. According to the Ministry of Education, through Resolution No. 2 of June 17th of 2010 that establishes these guidelines, the course should follow a pedagogical proposal that ensures the training of professionals on acquiring the ability to understand and translate the needs of individuals with respect to design, organization and construction of indoor and outdoor space, including town planning, building, landscaping, conservation of built heritage, protection and balance of the natural environment and the rational use of available resources (Brazil, 2010).

Therefore, the general guidelines are already established but it is still necessary to have a methodology for the subject to be effectively inserted in the undergraduate curriculum. Ideally the theme should permeate each of the disciplines, rather than being addressed in a specific discipline with the title "sustainability" - or similar - disconnected from other ones.

The study presented in this article is based specifically on the curriculum of the Architecture and Urbanism Course of the Integrated Faculties of Aracruz (FAACZ), located in the city of Aracruz, Espírito Santo (FAACZ, 2016). The institution was founded in 1989 and the Department of Architecture and Urbanism was created in 2001. Since then, the curriculum has been undergoing constant changes, and the last revision took place in 2015. With each adaptation, the college searches for disciplines according to what it is required in the labor market, in order to keep students updated so that the knowledge gained in college is compatible with the professional needs.

Curriculum revisions should occur usually every 05 years, avoiding its lag. However, technological changes and market demands has made these adjustments more frequent. Thus, FAACZ has planned more changes for the curriculum in 2016. It is in this context that this research is justified: to include the sustainability concepts in the new curriculum of Architecture and Urbanism course.

## 2. OBJECTIVES AND METHODOLOGY

The general objective of this research is to contribute to the adaptation of the curriculum of the Architecture and Urbanism course in the Integrated Faculties of Aracruz (FAACZ). The curriculum is being reformulated in order to meet national curriculum guidelines as well as to provide a training that is more suitable to the labor market needs.

To fulfill this objective, both syllabuses of the course curriculum of 2015 and the ones proposed for 2016 were analyzed. Then, it was sought to identify the potential of each discipline by relating it to certain concepts concerning sustainability issues in architecture and urbanism. For example, in the discipline of Hydro-sanitation Facilities, which covers topics related to buildings systems of cold water, hot water, sewage and rainwater, it is feasible to insert several specific concepts such as use of rainwater harvesting, greywater reuse, solar heating, water-saving equipments, etc. Consequently, it is possible to extend of the class load foreseen as 80 hours in the previous curriculum.

The structuring of the evaluation process based on the content and indicators proposed by a sustainability assessment tool is adopted as a fundamental methodological approach for considering the following matters: (i) sustainability issues should be deeply linked to the local reality (Bissoli Alvarez & 2008); (ii) sustainability assessment tools address through their indicators the aspects inherent in the concept of sustainability for the building and the city; (iii) most of the desirable actions are defined in the project stage and therefore under the aegis of the architect and urban planner.

Therefore, the research methodology is based on confronting disciplines against evaluation criteria, carrying out the specific check of applicability in each criterion and identifying potential disciplines for its introduction. To this end it was chosen the sustainability assessment tool named ASUS Tool (PLANNING LABORATORY AND PROJECTS, 2015), which has criteria applicable for environmental, social, economic and cultural conditions of the State of Espírito Santo.

Furthermore, given that the effectiveness of teaching methodology is directly linked to the continuity and interdisciplinary, it was identified that in this study it is possible to propose learning stages for each topic to be addressed. The proposed stages are:

**Introduction:** where the issues can be addressed still in preliminary form, embedded in other contexts, usually in disciplines of the first periods, so that the student will be made aware of the importance of this subject and of its relationship with the production of architecture and urbanism;

**Conceptualization:** in disciplines that will address the subject still in a theoretic view but more in deep, explaining parameters, rules and specific concepts of each subject in order to enable the student to learn thoroughly the theme, preparing him for the following phases;

**Analysis and critical thinking:** at this stage, it should be addressed case studies, technical visits and other methods for approximating the students to the applicability of this matter in reality, allowing them to analyze and report the situation, exercising their critical thinking on the concepts previously studied;

**Project practice:** based on the studied concepts and after verifying the ways of application of the subject to architectural and urban design, the students should be encouraged to exercise it in project practice, having the evaluation criteria as constraints of the different projects developed during graduation.

The interdisciplinarity is considered the most appropriate way to introduce the sustainability content in the architecture and urbanism teaching - which can be done, for instance, through the practice of integrated workshops. However, achieving interdisciplinarity still presents some difficulties in the FAACZ course since it represents a major change along with the other ones proposed in this study.

Thus, the method used in this research is the systematization of information through data sheet where, for each evaluation criteria from the ASUS tool, each discipline can fall into one or more learning stages. The spreadsheets were developed by categories, having subcategories or evaluation criteria as columns and learning steps as rows. Thereby the disciplines can be distributed in a systematic way where a single discipline can approach more than one learning stage within the same sub-category or even approach a specific learning stage of several sub-categories.

The goal is to spread the content in the maximum possible number of disciplines so the student can get in touch with the themes in a distributed and contextualized way during all the proposed cycles by the institution's new curriculum. Therefore, in theory, the student will have at the end of the graduation course, the skill, knowledge and confidence to create a project based on the sustainability concept, seeking to meet each of the presented guidelines in the best way.

### 3. RESULTS

The application of the proposed methodology generated a number of tables, through which some observations are made in this Section.

The Table 1 shows an example of the method applied for the themes (i) "Resource Consumption" in its category "Water" and (ii) "Environmental Loads" in its category "Rainwater and Wastewater". This demonstrates the alleged need for expanding the class load of some disciplines, such as the one covering the contents of hydro sanitation facilities, in order to necessarily include in the course syllabus the several possibilities of saving, harnessing and reuse of water, besides architectural measures to help prevent waste, stressing that this is an aspect of fundamental importance for the current reality of the state of Espirito Santo.

Table 1. Application example of the methodology to the category “Water”

STAGE	B – RESOURCES CONSUMPTION		E – ENVIROMENTAL LOADS	
	B.3 – Water		E.3 – Residual water and rainwater	
	Use of alternative water sources	Rational use of water	Rainwater management	Wastewater management
Introduction	Urban infrastructure	Hydro-sanitation Facilities	Urban infrastructure	Urban infrastructure
	Hydro-sanitation Facilities		Hydro-sanitation Facilities	Hydro-sanitation Facilities
Conceptualization	Hydro-sanitation Facilities	Hydro-sanitation Facilities	Hydro-sanitation Facilities	Hydro-sanitation Facilities
Analysis and Critical Thinking	Hydro-sanitation Facilities	Hydro-sanitation Facilities	Hydro-sanitation Facilities	Hydro-sanitation Facilities
Project Practice	Architecture Project: Hybrid Building			
	Integration Project: Housing Complex			

The Table 2 shows an example of the method applied for the theme "Resource Consumption" in its category "Energy". It is possible to observe that exist only few disciplines whose syllabus would be able to absorb the learning stages of this category. Basically, disciplines such as Electrical Installations and Lighting and Thermal Comfort would have features that approach the concepts to be inserted in this theme. However, it is known that the current class load of these disciplines do not accomodate an increase of content, and therefore it would be required the expansion of the class load or the creation of new disciplines such as Electrical Installations II or similar.

Table 2. Application example of the methodology to the category “Energy”

B - RESOURCES CONSUMPTION						
B.1 ENERGY						
	Use of energy from renewable sources generated on site	Energy efficiency determined by envelopment	Energy efficiency of the air conditioning system	Density of limit light potency	Mechanisms for energy savings in the elevators system	Use of efficient equipment in the building's renewable energy system
Introduction	Electrical Installations	Electrical Installations	Lighting and Thermal Comfort	Lighting and Thermal Comfort	Electrical Installations	Electrical Installations
Conceptualization	Electrical Installations	Electrical Installations	Lighting and Thermal Comfort	Lighting and Thermal Comfort	Electrical Installations	Electrical Installations
Analysis and Critical Thinking	Electrical Installations	Electrical Installations	Lighting and Thermal Comfort	Lighting and Thermal Comfort	Electrical Installations	Electrical Installations
Project Practice	Architectural Project: Hybrid Building	Architectural Project: Hybrid Building	Architectural Project: Hybrid Building	Architectural Project: Hybrid Building	Architectural Project: Hybrid Building	Architectural Project: Hybrid Building

However, another observation from this study that can be exemplified with Table 2 is about the chronology of the disciplines. For example, the practical disciplines in whose project development proposals would fit the application of the studied concepts about energy happen in periods prior to the one where Electrical installations is studied. Thereby, the simple class load expansion for the discipline could not be as effective as expected in the process of teaching and learning, since students would not have project practices where they could apply the studied concepts. To this end, a proposal for a chronological reorganization of the disciplines would be required.

It was also observed that some aspects can be suppressed or grouped together. For example, still in Table 2, the criterium of "Deployment Feasibility Study of a renewable energy system generated in the building", originally existent in the ASUS tool, was suppressed from the table since this concept could be merged to the criterium "Use of Energy from renewable sources generated on site ". On the other hand, some aspects may be further subdivided or addressed in more than one discipline. For example, the conceptualization of the criterium "Multiple Uses" can be addressed under the historical aspect and within the urban legislation.

This restructuring of the criteria approached by the ASUS tool, proposed for the spreadsheets in this research, aims to their adaptation to support the inclusion of the sustainability concept, in its several possibilities, in the process of reformulation of the curriculum of the course of Architecture and Urbanism of FAACZ. To this end, the method aims to benefit from the systematization of the criteria, organizing them in a less complex way, enhancing the capacity and possibility of successful application in the specific situation here proposed.

In addition to the practical results, which indicate the possibilities of improvement in the method and suggest guidelines for restructuring the course curriculum, it can still be reported as a result the possibility of involvement of almost all disciplines of the course, in contrast to the idea that sustainability in buildings would apply only to the disciplines of technologies and projects.

Table 3 shows an example of the method applied for the theme "Enterprise Planning" in its category " Urban Interrelationship and Site Development".

Table 3. Application example of the methodology to category "Urban Interrelationship and Site Development"

A – ENTERPRISE PLANNING						
A.2 - URBAN INTERRELATIONSHIP AND SITE DEVELOPMENT						
	Harnessing of Constructive Potential	Multiple Uses	Incentive to non-motorized transportation	Compensations to traffic generating poles	Provision of green spaces in the enterprise	Use of native or adapted plants
Introduction	Architectural design	Integration Project: The Edification	Urbanism: Urban Analysis	Urbanism: Urban Analysis	Introduction to Architecture, Urbanism and Landscaping	Introduction to Architecture, Urbanism and Landscaping

Continues

Conceptualization	Integration Project: The Edification	Integration Project: The Edification	Urban infrastructure	Urban infrastructure	Green infrastructure	Green infrastructure
		Theory of Contemporary Architecture and Urbanism				
Analysis and Critical Thinking	Integration Project: The Edification	Theory of Contemporary Architecture and Urbanism	Urban infrastructure	Urban infrastructure	Green infrastructure	Landscaping
Project Practice	Architectural Project Community Equipment	Architectural Project Community Equipment	Urban Planning	Urban Planning	Green infrastructure	Landscaping
	Architectural Project Hybrid Building	Architectural Project Hybrid Building			Landscaping	

In this context, it is worth highlight that the analysis of the category "Enterprise Planning" points to a greater weight of responsibility in disciplines related to urbanism. Indeed, the urban planning within the sphere of government has the responsibility to regulate interventions in the territory, directing growth vectors, defining occupancy criteria, restricting or encouraging densification in certain areas, creating settlement patterns that minimize the need for cars, the consumption of energy and natural resources, etc. Therefore, the aspects of urban interference proposed by ASUS tool, such as the ecological value of the site, vulnerability to flooding and natural disasters, soil contamination, protection of water bodies, proximity to public transportation and incentive to non-motorized transportation, were considered in the same way as the procedures adopted for the edification.

#### 4. FINAL CONSIDERATIONS

From the first observations, it is identified that the viability of the proposal involves the chronological and structural reformulation of the course curriculum. However, it is worth noting that this research has a very specific focus, and that several other factors must be considered besides the systematic application of sustainability concepts, since the curriculum of the Architecture and Urbanism course is quite broad.

Given that this article presents the first step among many others that compose a broader work of support for the systematic restructuring of the curriculum of the course of Architecture and Urbanism of FAACZ, the results point to new unfoldings in the research, as it was expected.

As a result of this research, the introduction of the sustainability assessment criteria in the disciplines of the Architecture and Urbanism course is considered viable and has real possibilities of applicability. However, it was confirmed, as already expected, that it is essential to obtain the involvement of teaching staff and students to improve the initial

ideas launched in this research, indicating not only suggestions for structuring the proposed change, but also situations that could derail it.

In this regard, an important unfolding of this research will be the development of questionnaires to senior students, graduates working in the labor market and professors in order to identify expectations and obtain practical contributions from various points of view for adhering the disciplines to the various aspects of sustainability. In this way everyone involved will act as effective contributors, favoring the interdisciplinarity in which is based the success of this proposal.

Another result is that some subcategories could be suppressed or merged in other ones to simplify the method. Likewise, some subcategories could be subdivided.

The use of the Asus tool has shown to be an important initial parameter for this study, for being developed for the local reality as well as for being systematized into topics and for addressing in a broad way the application of the concepts intended to be inserted in the teaching practice of the Architecture and Urbanism.

This research also leads to reflection that the sustainability theme needs to be directly and clearly addressed in the classroom, not only in a generic way. It is important the undergraduate student to be aware of the term's meaning and how to apply it.

The concept of cultural sustainability emphasizes the need to seek local solutions, adapting them to the local culture and ecosystem. Due to that, the adaptation of the ASUS tool has shown to be fundamental, since the tool systematizes the aspects that are more relevant and have effective applicability in the state of Espirito Santo.

Furthermore, it was observed that organizing the teaching in stages properly outlined made it possible to cover almost all the disciplines of the proposed course curriculum, not leaving only to the practical disciplines the role of "teaching how to design" but also involving the theoretical disciplines, in order to provide the necessary knowledge for the students to develop the practical application of what they are studying.

In the practical disciplines, the student can exercise the contents taught in the theoretical disciplines aiming to apply the concept of sustainability, from the decisions related to the choice of the land – and establishing strategies conditioned to their natural features, including the expansion of the relevance of the building in relation with the surroundings – to the planning of operation and use of the building. It is also expected that with the improvement of the process, it will be possible to incorporate the concept of "from cradle to grave" for all project exercises in the course.

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