Comparison among environmental certification systems. Relationships between systems and project. Case study: the recovery of a RSA.

Key words: building recovery, environmental certification, sustainability, health residence for seniors

Abstract

Environmental certification systems are tools for the evaluation of the sustainability of the buildings that are independent one from each other, different for contents, and for the applied methodology. International investors have asked for standardized certification systems to operate in the market with regard to both the phases of investment and management of the real estate. This created the need to compare the different environmental certification systems. The existence of different tools confuses the planner, whom wonders which environmental certification system is the most suitable for constructing new buildings or for the recovery of an existing building. The tendency is that of preferring a system to another based on its level of national adoption or based on individual competences and preferences. If a professional has already applied a system once, he is more driven to apply the same system for his future projects, as he is familiar with the themes and the evaluating methodology. Different researchers have compared these systems and in front of the different applied methodologies, it has emerged the need to use a certification system costumed for every plan proposal. The strong relationship between the environmental certification system and the development of a sustainable recovery project, led to the necessity to perform a preliminary analysis of the planning activity in order to pin-point the best fitting tool. This paper applies and compares three different environmental certification systems such as LEED, BREEAM and Protocol ITACA, to the project of recovery of the Sanitary Residence for Elderly (RSA) - Institute Configliachi (Padua). The historic building of the Configliachi Institute for blind people, find itself in a state of extreme decay and abandonment. It is located in the Arcella district, in the north of Padua, a strategic position with respect to the services in the area, to the main public transport networks (tram, railway, bus and motorway) and to the principal road knots of access to the city. This fact, with regard to the current strategy for the recovery and valorisation of the existing building capital, increases the interest for its reuse. The analysis carried out in this paper, focuses on the influences in choosing the project's certification system, it highlights the relationship between the existing building, the certification system and the project and it outlines new specific professional skills.

1. INTRODUCTION

"Which method of certification it is the best to establish a value for the sustainability?" With this question Drejeris and Kavolynas (2013) introduce one of the most heated debates regarding the systems of environmental certification. In front of the apparent simplicity of the question, the answer has not been found yet, both for the complexity of the matter, and for the variety of the variables at stake. This paper has tried to answer to the question with an analysis “limited” to three systems of certification named LEED[1], BREEAM[2] and Protocol ITACA[3].

Already other researchers, Kawazu, Shimada, Yokoo and Oka (2005), Fowler and Rauch (2006), Nguyen and Altan (2011), undertook the road of the comparison and the choice usually reverted on worldwide diffused systems, as LEED, BREEAM, CAASBE[4], HK-BEAM[5], GBTool[6], Green Globes™ U.S.[7] and Green Star[8].

The choice worked this study for has been different, because it is wanted to develop the analysis in the Italian context. Therefore have been chosen certification systems relevant in Italy. The Italian context, in fact, is characterized by the presence of a historical widespread heritage made up of historical inner cities (900), litter inner cities (6850) and historical housing units including nucleuses inhabited historical including isolated units, fractions, suburbs, villages, religious and military installations (15000)[9].

It is held therefore essential for the choice of the systems to compare the availability of a version specifically elaborated and/or adaptable to the Italian context. For instance for LEED, the Italian version (LEED Italia), for BREEAM the international one (BREEAM International), and finally a system born and developed in Italy as the ITACA Protocol. As Hirigoyen, Ratcliffe and Davey-Attlee(2008) assert, the greatest diffusion of the use of the systems of certification increased the demand of being able to compare them or to make them equivalent, answering also to the applications of the investors at the international level that need a standardized systems in order to operate in the real estate market in the phases of investment and management of the real estate patrimony. Today the majority of the certification systems on the market doesn't go very beyond the borders of the country of origin. Each system, in fact, to certify the sustainability of the building, has different objectives, adopts a different methodology. Therefore, the direct and immediate comparison among them is not possible.

Reed, Bilos, Wilkinson and Schulte (2009) point out that the difficulty of the comparison consists in the fact that the different fields of the various certification systems have different criteria according to the country in which they are adopted[10]. This matter is very felt at the international level. The problem is that from one side, pushing in the direction of the standardization, the risk is to lose the character of local adaptability and to twist the valued reality, in favor of an excessive simplification. From the other side, with systems of certification too specific it results difficult to appraise what is the best. As asserted by Reed, Bilos, Wilkinson and Schulte (2009) it is not surprising that these

[1] LEED, acronym of Leader in Energy and Environmental Design, is a certification system of voluntary application that appraises the energetic efficiency and the environmental imprint of sustainable high performance buildings. This standard is applied in different countries of the world, but it was born in the United States. The first project of LEED was born in 1998, due to the USGBC, Unites States Green Building Council, non-profit association born in the 1993.

[2] BREEAM is the system of official certification of the environmental qualities of the buildings of Great Britain and recognized at the international level. It ever deals with the first system of evaluation of the sustainability of the buildings and it has been taken into account as a model from many following protocols. Since it was born in 1990, BREEAM has certified more than 250000 buildings and now it is active in more than 50 countries in the world.

[3] ITACA is the system of certification of the energetic efficiency and the environmental sustainability of the buildings that aims to be the main certification system for Italy. This tool has been elaborate in 2004 from the Interregional Working Group on the subject of Green Building of the ITACA Institute. ITACA, acronym of Institute for the innovation and transparency of the contracts and the environmental compatibility, is a federal association born in 1996 thanks to the Italian Regions and the autonomous Provinces to promote and to guarantee an effective technical coordination and to assure the good link with government institutions, local societies and the house building corporate body.

[4] CAASBE, acronym of Comprehensive Assessment System for Building Environmental Efficiency, has been developed in Japan in 2001, under the guidance of the Ministry of the Territory, Infrastructures and Transports. There are 4 versions corresponding to the different phases of the cycle of life of the building.

[5] HK-BEAM , acronym of Hong Kong Building Environmental Assessment Method, has developed in 1996 in Honk Kong by BEAM Society .

[6] GBTool, acronym of Green Building Assessment Tool, has been developed by National Resource Canada in 1998.

[7] Green Globes™ U.S. has been adapted by the Green Globes Canada in 2004.

[8] Green Star has been developed in 2003 by Sinclair Knight Merz and BRE (Building Research Establishment) Group for the Green Building Council of Australia (GBCA). Green Star is a system of environmental certification for the buildings.

[9] 37° Report on the social situation in the country – Censis 2003 – Table 11 page 361.

[10] Account should be taken of some regional specificities as for example those in relationship to the use and the waste of the water. In fact there is a lot of difference if the certification happens in an arid country or if it happens in a country with a very elevated rate of rain.

systems promote standards reflecting the environmental conditions and the applications of local sustainability. A further challenge to the implementation of the systems of environmental certification is applying them, in general, in the recovery and reuse of the existing building patrimony, and particularly in the Italian context as in the case study considered.
In the case of recovery and reuse are underlined in fact the problems of the maintenance of the cultural values that are for instance identified through the typologies, the constructive technologies, the materials in the building object of intervention and their compatibility with the current normative standards of performance required. Besides are also underlined the consequences of the abovementioned problems in relationship to the possible repercussions on the scores for the purposes of the environmental certification.
Just for this, in sight of the application of the three systems, it is held necessary for each one to choose not only the more proper specific protocol, but also protocols comparable one among the other, both for the intended use and for the typology of building intervention. For this reason, for the LEED system has been used the protocol LEED NC 2009 and for BREEAM the International BREEAM NC, because both can be applied in the case of important refurbishment, while for the ITACA Protocol has been used the national residential protocol in the case of refurbishment.

2. COMPARISON AMONG ENVIRONMENTAL CERTIFICATION SYSTEMS ANALYZED

The three systems of environmental certification analyzed in this paper were born in different contexts and in different moments and consequently present similarities and differences. Table 1 shows the principal data related to the certification systems object of comparison.

Table 1 *- Data related to the certification systems analyzed*

	LEED	BREEAM	ITACA
Date	1998	1990	2004
Where it was born	United States	United Kingdom	Italy
Application in Italy	Yes, with LEED Italy	Yes, with the international version	Yes
Who develops it	U. S. Green Building Council	BRE (British Research Establishment)	ITACA with methodological base on SBMethod
To thing it is applied	Buildings: residence, offices, commerce, public, schools	Buildings: residence, offices, commerce, industry, public, schools	Buildings: residence, offices, commerce, industry, schools
Base	Voluntary	Voluntary	Voluntary

Among the similarities it is underlined that all the three systems are exclusively applicable on voluntary base and propose to certify every type of building. BREEAM and LEED show similarities both under the methodological profile and in the results of evaluation output.
As an example, remaining within in the field of the results output, for both systems, the obtained scores identify the class of affiliation of the building[11]. On the contrary, the ITACA Protocol, that inspires itself to the SB Method[12], is a certification system absolutely different from the first two, both for methodology and evaluation. In fact, in ITACA the output of the results it is not expressed with a class of affiliation but with a score expressed by a percent value.
BREEAM and LEED firstly identify the type of intervention (e.g. new construction) and then the intended use, while the ITACA Protocol moves in a opposite way. Beyond the purely formal aspects, the true comparison among the systems is on the contents. The three certification systems object of study, consider and examine different aspects of the planning and the construction of the building; for this purpose they define categories of evaluation for more general areas, every of which contains inside various and different criteria that allow to analyze more in detail every single footstep. Although all three systems are organized in general areas/categories that includes the criteria, nevertheless each system considers in a different way every aspect, because not only the number of the areas/categories and the number of the criteria is different, but also and above all, the weight assigned to every criterion. Besides, the terminology used doesn't make easy the comparison, due to the fact that in the three protocols, sometimes the same contents can be intended with different terms, and vice versa, with terms only apparently similar can be identified performances and/or contents partly or totally different. This situation makes impossible to proceed to an immediate comparison among the certification systems.

[11] For the LEED system the obtainable results are express in the following way: Certified, Silver, Gold and Platinum; for the BREEAM system the obtainable results are express in the following way: Pass, Good, Very Good, Excellent, Outstanding.
[12] SBMethod is a methodology of multicriteria evaluation developed and managed to international level by iiSBE (international initiative for to Sustainable Built Environment). iiSBE is an international non-profit organization born in 2000 for initiative of institutions, professionals and academicians of different nations that operate in the field of the sustainable housebuilding. It has a registered office in Canada and an operational center in Paris, near the French CSTB (Centre Scientifique et Technique du Bâtiment).

In order to demonstrate what said before and exemplifying it, LEED considers seven areas of evaluation, the ITACA Protocol considers five areas, while BREEAM considers ten categories, as shown in the Table 2. Furthermore, regarding the score, the ITACA Protocol assigns a score to every criterion (from -1 to 5) that the management software of which ITACA is equipped, systematically handles to turn into weight percent. Instead the BREEAM and LEED systems assign only a score, without putting in evidence the weight of every single criterion inside every single area/category. In the light of what said, the more emerges the difficulty to the comparison among the three systems the more it is evident the necessity to find a way to effect it.

The first phase of the work has consisted in finding a common denominator among the systems or rather an unity of measure equal for each of them. Firstly, all the criteria of LEED, BREEAM and ITACA are listed in a synoptic way, placed side by side when possible from the respective scores. For LEED and BREEAM the weight percent of each criterion has been calculated; in the case of ITACA, considering the scores already defined by the system, has been assumed only the percentage calculated by default by the manager software of the system. In this way for the three considered systems are obtained percent values related to the areas /categories as shown in Table 2.

Table 2 - *Weights in% related to every area/category for every system of certification*

	LEED	**Score**	**%**
AREAS	**Sustainable Sites**	**26**	**23,6%**
	Water efficiency	**10**	**9,1%**
	Energy and Atmosphere	**35**	**31,8%**
	Materials and Resources	**14**	**12,7%**
	Indoor Environmental Quality	**15**	**13,6%**
	Innovation in Design	**6**	**5,5%**
	Regional Priority	**4**	**3,6%**
	Total	**110**	**100%**
	BREEAM	**Score**	**%**
CATEGORIES	**Management**	**24**	**17,6%**
	Health and wellbeing	**20**	**14,7%**
	Energy	**25**	**18,4%**
	Transport	**9**	**6,6%**
	Water	**7**	**5,1%**
	Materials	**11**	**8,1%**
	Waste	**6**	**4,4%**
	Land use and Ecology	**12**	**8,8%**
	Pollution	**12**	**8,8%**
	Innovation	**10**	**7,4%**
	Total	**136**	**100%**
	ITACA	**Score**	**%**
AREAS	**A. Quality of the site** **Reuse of territory**		**9,0%**
	B. Quality of the site **External areas of common use equipped**		**4,5%**
	C. Resource Consumption		**40,5%**
	D. Environmental liabilities		**18,0%**
	E. Indoor Environmental Quality		**18,0%**
	F. Service Quality		**9,0%**
	Total		**100%**

Subsequently, on the base of the data that are in the user manuals of the three systems, have been analyzed for every criterion, the demands to be achieved, the specific objectives and the related prescriptions. The analysis allowed to pinpoint the criteria referring to the same environmental aspects.

Starting from the consideration that criteria with contents apparently similar, in the specific, could belong to different areas/categories on varying of the considered system, they have been placed side by side and gathered, independently from the affiliation labeling. For instance in ITACA the criteria water and energy have been located in an unique area denominated Consumption Resources, while in LEED and in BREEAM they belong to two different areas/ categories. It has been necessary, starting from the originating areas/categories, to identify new homogeneous areas whose totalities are formed from criteria coming from LEED, BREEAM and ITACA; with the precaution to maintain the same originating values and percent weights already attributed to the criteria by the systems of certification of origin.

The development of the search has led to identify the new homogeneous areas.
In this way are obtained the followings twelve area/categories of evaluation, of which two new:
1-Site, 2-External Environment Quality, 3-Services, 4-Water, 5-Energy, 6-Internal Environment Quality, 7-Materials and Resources, 8-Wastes and Emissions, 9-Quality in living, 10-Management and Maintenance, plus - Innovation in design, plus - Regional Priority.
For each area, investigated with the abovementioned precautions, it has been possible to give an evaluation with an percent index, gotten by the scores of the criteria aggregated for areas and maintained separate for the three systems.
In the following tables are shown the data of the comparison for each macro-area, before in wide way and then in synthesis.
1-Macroarea “Site”, respectively in Table 3 and 4.
It can be observed that ITACA is lacking in this area since the appropriate criteria are not present. The most comprehensive is LEED, whereas BREEAM focuses mainly on issues closely related to ecology, providing in that field the possibility of a greater possible score.

Table 3 *– Comparison criteria and their weights % for the macro-area “Site”*

1 - SITE	**CRITERION**	**CODE**	**WEIGHT %**
Site selection			
LEED	*Site selection*	SS C 1	**0,9 %**
BREEAM	*Site selection*	LE 01	**2,2 %**
ITACA			
Rehabilitation of damaged sites			
LEED	*Brownfield Redevelopment*	SS C 3	**0,9 %**
BREEAM			
ITACA			
Ecology			
LEED	*Site Development: protect or restore habitat*	SS C 5.1	**0,9 %**
BREEAM	*Ecological value of site and protection of ecological features*	LE 02	**1,5 %**
BREEAM	*Enhancing site ecology*	LE 04	**2,2 %**
BREEAM	*Long term impact on biodiversity*	LE 05	**1,5 %**
ITACA			
External spaces			
LEED	*Site development: maximize open space*	SS C 5.2	**0,9 %**
BREEAM	*Building footprint*	LE 06	**1,5 %**
ITACA	*External equipped areas of common use*	A 3.3	**1,0 %**

Table 4 *– Comparison Weights % summary for the macro-area “Site”*

1 – SITE	**TOTAL WEIGHTS %**	**TOTAL SCORE**
LEED	**3,6 %**	**4**
BREEAM	**8,9 %**	**12**
ITACA	**1,0 %**	**-**

2 – Macro-area "External environment quality", respectively in Table 5 and 6. It considers the quality of the surrounding space of the building and the ratio between the natural and artificial elements. In this case it is reported that BREAM neglected in evaluating the heat island effect.

Table 5 *– Comparison criteria and their weights % for the macro-area “External environment quality”*

2 – EXTERNAL ENVIRONMENT QUALITY	**CRITERION**	**CODE**	**WEIGHT %**
Soil permeability			
LEED	*Storm water design: quantity control*	SS C 6.1	**0,9 %**
LEED	*Storm water design: quality control*	SS C 6.2	**0,9 %**
BREEAM	*Surface water run off*	Pol 03	**3,6%**
ITACA	*Soil permeability*	C 4.3	**2,0%**
Heat island effect			
LEED	*Heat island effect-non-roof*	SS C 7.1	**0,9 %**

LEED	*Heat island effect - roof*	SS C 7.2	**0,9 %**
BREEAM			
ITACA	*Heat island effect*	C 6.8	**4,0 %**

Table 6 *– Comparison Weights % - Summary for the macro-area "External environment quality"*

2 – EXTERNAL ENVIRONMENT QUALITY	TOTAL WEIGHTS %	TOTAL SCORE
LEED	**3,6 %**	**4**
BREEAM	**3,6 %**	**5**
ITACA	**6,0 %**	

3 – Macro-area "Services", respectively in Table 7 and 8. It is an important area for the issue of the relationship between the context in which the building is situated and the users. In this area are taken into account the presence and the proximity of services that allow to avoid the use of cars.

Table 7 *– Criteria and their weights % taken into account by the three certification systems for the macro-area "Services"*

3 – SERVICES	CRITERION	CODE	WEIGHT %
Proximity to amenities			
LEED	*Development density and community connectivity*	SS C2	**4,5 %**
BREEAM	*Proximity to amenities*	Tra 02	**1,5%**
ITACA	*Functional mix of the area*	A 1.8	**3,0%**
Transports			
LEED	*Alternative methods of transport: public transportation access*	SS C 4.1	**5,4 %**
LEED	*Alternative methods of transport: Bicycle storage and changing rooms*	SS C 4.2	**0,9 %**
LEED	*Law-emitting and fuel-efficient vehicles*	SS C 4.3	**2,7 %**
LEED	*Parking capacity*	SS C 4.4	**1,8 %**
BREEAM	*Public transport accessibility*	Tra 01	**3,0%**
BREEAM	*Alternative methods of transport: facilities for cyclists*	Tra 03b	**1,5%**
BREEAM	*Energy efficient transportation systems*	Ene 06	**1,5%**
ITACA	*Public transportation access*	A 1.6	**4,0 %**
ITACA	*Support to the use of bicycles*	A 3.4	**3,0 %**
Drying space			
LEED			
BREEAM	*Drying space*	Ene 09	**0,7%**
ITACA			
Home office			
LEED			
BREEAM	*Home office*	Tra 06	**0,7%**
ITACA			
Proximity to infrastructures			
LEED			
BREEAM			
ITACA	*Proximity to infrastructures*	A 1.10	**3,0%**

Table 8 *– Comparison Weights % - Summary for the macro-area "Services"*

3 – SERVICES	TOTAL WEIGHTS %	TOTAL SCORE
LEED	**15,3 %**	**17**
BREEAM	**7,4 %**	**10**
ITACA	**13,0 %**	

4 – Macro-area "Water", respectively in Table 9 and 10.

Table 9 *– Criteria and their weights % taken into account by the three certification systems for the macro-area "Water"*

4 – WATER	CRITERION	CODE	WEIGHT %
Water consumption			
LEED	*Water consumption reduction*	GA P 1	**Mand.**

LEED	*Water consumption reduction*	GA C 3	**da 1,8 a 3,6%**
BREEAM	*Water consumption*	Wat 01	**3,6%**
BREEAM	*Water monitoring*	Wat 02	**0,7%**
ITACA	*Potable water for indoor use*	B 5.2	**2,0%**
Water use for irrigation purposes			
LEED	*Efficient management of water for irrigation purposes*	GA C 1	**1,8 % o 3,6%**
BREEAM	*Water efficient equipment*	Wat 04	**0,7%**
ITACA	*Safe water for irrigation*	B 5.1	**4,0 %**
Waste water			
LEED	*Innovative wastewater technologies*	GA C 2	**1,8%**
BREEAM			
ITACA	*Grey water sent in sewerage*	C 4.1	**4,0%**

***Table 10** – Comparison Weights % - Summary for the macro-area "Water"*

4 – WATER	TOTAL WEIGHTS %	TOTAL SCORE
LEED	mandatory	mandatory
LEED	**9,0 %**	**10**
BREEAM	**5,0 %**	**7**
ITACA	**10,0 %**	

5 - Macro-area "Energy", respectively in Table 11 and 12.

This macro-area is very important as it assesses the energy consumption and the use of green and renewable sources solutions. Being the resource most normed both at nationally and internationally level, the technical manuals of certification systems are marked with both the normative references and formulas to obtain data on energy consumption. It can be noticed that BREEAM does not consider the use of energy coming from renewable sources both for thermal and electrical use. However it has a criterion that evaluates the presence or absence of external illumination, which sometimes is a consumption not strictly necessary. Compared to energy efficiency LEED is able to achieve very high scores, up to 17%.

***Table 11** – Criteria and their weights % taken into account by the three certification systems for the macro-area "Energy"*

5 – ENERGY	CRITERION	CODE	WEIGHT %
Commissioning of energy systems			
LEED	*Fundamental commissioning of building energy systems*	EA P 1	**Mand.**
LEED	*Advanced commissioning of building energy systems*	EA C 3	**1,8%**
BREEAM			
ITACA			
Energy efficiency			
LEED	*Minimum energy performance*	EA P 2	**Mand.**
LEED	*Optimized energy performance*	EA C 1	**da 0,9 a 17,1%**
BREEAM	*Reduction of emissions*	Ene 01	**11,0 %**
BREEAM	*Energy efficient equipment*	Ene 08	**1,5 %**
ITACA	*Primary energy for heating*	B 1.2	**6,0 %**
ITACA	*Primary energy for domestic hot water*	B 1.5	**6,0 %**
Renewable sources			
LEED	*On-site renewable energy*	EA C 2	**da 0,9 a 6,3%**
BREEAM			
ITACA	*Renewable energy for thermal uses*	B 3.2	**2,0 %**
ITACA	*Energy produced on-site for electrical uses*	B 3.3	**2,0 %**
Green power			
LEED	*Green power*	EA C 6	**1,8 %**
BREEAM	*Low or zero carbon technologies*	Ene 04	**1,5 %**

ITACA			
External lighting			
LEED			
BREEAM	*External lighting*	Ene 03	**0,7 %**
ITACA			

Table 12 *– Comparison Weights % summary for the macro-area "Energy"*

5– ENERGY	TOTAL WEIGHTS %	TOTAL SCORE
LEED	mandatory	mandatory
LEED	mandatory	mandatory
LEED	**27,0 %**	**30**
BREEAM	**16,2 %**	**23**
ITACA	**16,0 %**	

6 – Macro-area "Internal Quality Environment" respectively in Tables 13 and 14. It is closely relevant when considering the health and well-being of users, because as well as provide guidance on technical issues such as insulation and light transmission, it is strictly focused on indoor comfort and perception of the environments. The ITACA Protocol satisfies almost fairly all exhaustive criteria, while LEED is the most lacking system, in particular it does not consider an important aspect as the acoustic performance of the building, which in the other two systems has a significant weight. It is interesting, however, the category concerning tobacco smoke. BREEAM also offers a check on the quality of water used by users; it was therefore decided to show in this category this criterion and not in the "Water" category.

Table 13 *– Criteria and their weights % taken into account by the three certification systems for the macro-area "Internal quality environment"*

6 – INTERNAL QUALITY ENVIRONMENT	CRITERION	CODE	WEIGHT %
Air quality			
LEED	*Minimum Indoor Air Quality Performance*	QI P 1	**Mand.**
LEED	*Environmental Tobacco Smoke Control*	QI P 2	**Mand.**
LEED	*Increased ventilation*	QI C 1	**0,9%**
BREEAM	*Indoor Air Quality*	Hea 02	**3,0%**
ITACA	*Ventilation and air quality*	D 2.5	**4,0%**
Thermal comfort			
LEED	*Thermal comfort: Design*	QI C 7.1	**0,9%**
LEED	*Thermal comfort: Verification*	QI C 7.2	**0,9%**
BREEAM	*Thermal comfort*	Hea 03	**1,5 %**
ITACA	*Air temperature in summer period*	D 3.2	**5,0 %**
Thermal insulation			
LEED			
BREEAM	*Insulation*	Mat 04	**0,7 %**
ITACA	*Thermal transmittance of the building envelope*	B 6.3	**3,0 %**
ITACA	*Thermal inertia of the building*	B 6.5	**3,0 %**
Visual comfort			
LEED	*Daylight and views for at least 75% of all the regularly occupied spaces*	QI C 8.1	**0,9 %**
LEED	*Daylight and views: external view for 90% of occupied areas*	QI C 8.2	**0,9 %**
BREEAM	*Visual comfort*	Hea 01	**4,4 %**
ITACA	*Natural light*	D 4.1	**4,0%**
Water			
LEED			
BREEAM	*Water quality*	Hea 04	**0,7 %**
ITACA			
Acoustic performance			
LEED			
BREEAM	*Acoustic performance*	Hea 05b	**3,0 %**
ITACA	*Acoustic performance*	Hea 5.6	**5,0 %**

***Table 14** – Comparison Weights % - Summary for the macro-area "Internal quality environment"*

6– INTERNAL QUALITY ENVIRONMENT	TOTAL WEIGHTS %	TOTAL SCORE
LEED	mandatory	mandatory
LEED	mandatory	mandatory
LEED	**4,5 %**	**5**
BREEAM	**13,3 %**	**19**
ITACA	**24,0 %**	

7 – Macro-area "Materials and resources", respectively in Tables 15 and 16. It analyzes the management and the use of recycled, recyclable and locally sourced materials, with an emphasis on eco compatibility, origin and re-use of available resources and it also proposes re-use in existing structures, topic in the case of a building recovery. Interesting are the "certified wood" criteria present in LEED and the "design for the resistance" criteria present in BREEAM, although the latter is, however, lacking in the theme "use of local materials."

***Table 15** – Criteria and their weights % taken into account by the three certification systems for the macro-area "Materials and Resources"*

7- MATERIALS AND RESOURCES	CRITERION	CODE	WEIGHT %
Building elements reuse			
LEED	*Building Reuse - Maintain Existing Walls, Floors and Roof*	MR C 1.1	**da 0,9% a 2,7%**
LEED	*Building Reuse - Maintain Interior 50% nonstructural Elements*	MR C 1.2	**0,9% o 1,8%**
BREEAM			
ITACA	*Structural elements reuse*	B 4.1	**2,0%**
Materials reuse			
LEED	*Materials reuse*	MR C 3	**0,9% o 1,8%**
BREEAM	*Life Cycle Impacts*	Mat 01	**4,4 %**
ITACA	*Recycled/reused materials*	B 4.6	**2,0 %**
Local materials			
LEED	*Regional materials*	MR C 5	**0,9% o 1,8%**
BREEAM			
ITACA	*Local materials for finishing*	B 4.9	**2,0 %**
Materials from renewable sources			
LEED	*Rapidly Renewable Materials*	MR C 6	**0,9 %**
BREEAM	*Responsible sourcing of materials*	Mat 03	**2,2 %**
ITACA	*Materials from renewable sources*	B 4.7	**2,0%**
Certified wood			
LEED	*Certified wood*	MR C 7	**0,9%**
BREAM			
P. ITACA			
Designing for robustness			
LEED			
BREAM	*Designing for robustness*	Mat 05	**0,7 %**
P. ITACA			

***Table 16** – Comparison Weights % - Summary for the macro-area "Materials and Resources"*

7- MATERIALS AND RESOURCES	TOTAL WEIGHTS %	TOTAL SCORE
LEED	**9,9%**	**11**
BREEAM	**7,3 %**	**10**
ITACA	**8,0 %**	

8 - Macro-area "Wastes and Emissions", respectively in Tables 17 and 18. It reviews the monitoring and the reductions of gaseous and solid wastes emissions, particularly those arising from the construction site. All systems contain criteria on the management of refrigerants. In the ITACA Protocol it is detected absences of criteria relating to the construction site impacts, the light pollution, the low-emission materials and the NOx emissions. However it is the only system which considers the presence and the intensity of the electromagnetic fields. LEED is the most attentive system to emissions and wastes, and to the use or otherwise of low emission materials.

***Table 17** – Criteria and their weights % taken into account by the three certification systems for the macro-area "Wastes and Emissions"*

8–WASTES AND EMISSIONS	CRITERION	CODE	WEIGHT %
Construction site impacts			
LEED	*Pollution prevention due to construction site activity*	SS P 1	Mand.
BREEAM	*Construction site impacts*	Man 03	**3,6%**
ITACA			
Light pollution			
LEED	*Light pollution reduction*	SS C 8	**0,9%**
BREEAM	*Reduction of night time light pollution*	Pol 04	**0,7 %**
ITACA			
Refrigerant fluid			
LEED	*Fundamental Refrigerant Management*	EA P 3	Mand.
LEED	*Enhanced Refrigerant Management*	EA C 4	**1,8%**
BREEAM	*Impact of refrigerants*	Pol 01	**2,2%**
ITACA	*Predicted emissions in operating phase*	C 1.2	**5,0 %**
Construction waste			
LEED	*Storage and collection of recyclables*	MR P 1	Mand.
LEED	*Construction Waste management*	MR C 2	**0,9 %o 1,8%**
BREEAM	*Operational waste*	Wst 01	**1,5%**
BREEAM	*Refurbishment Site Waste Management*	Wst 03	**2,2%**
ITACA	*Solid waste produced in the operating phase*	C 3.2	**3,0%**
ITACA	*Recyclable and dismountable materials*	B 4.10	**2,0%**
Recycled aggregates			
LEED	*Recycled content*	MR C 4	**0,9% o 1,8%**
BREEAM	*Recycled aggregates*	Wst 03	**0,7%**
ITACA			
Low-Emitting Materials			
LEED	*Low-Emitting Materials: Adhesives and Sealants*	QI C 4.1	**0,9 %**
LEED	*Low-Emitting Materials: Paints and Coatings*	QI C 4.2	**0,9 %**
LEED	*Low-Emitting Materials: Flooring Systems*	QI C 4.3	**0,9 %**
LEED	*Low-Emitting Materials: Composite Wood and Agrifiber Products*	QI C 4.4	**0,9 %**
BREEAM			
ITACA			
Chemical and pollutant sources			
LEED	*Indoor chemical and pollutant source control*	QI C 5	**0,9%**
BREEAM			
ITACA			
NOx emissions			
LEED			

BREEAM	*NOx emissions*	Pol 02	**2,2%**
ITACA			
Electromagnetic fields			
LEED			
BREEAM			
ITACA	*Magnetic fields at industrial frequency*	D 6.1	**2,0%**

Table 18 *– Comparison Weights % summary for the macro-area "Wastes and Emissions"*

8–WASTE AND EMISSIONS	TOTAL WEIGHTS %	TOTAL SCORE
LEED	mandatory	mandatory
LEED	mandatory	mandatory
LEED	mandatory	mandatory
LEED	10,8%	12
BREEAM	13,1 %	19
ITACA	12 %	

9 – Macro-area "Quality of living", respectively in Tables 19 and 20. It is focused on one side of the home automation, and on the other on the quality of some aspects related to security and user comfort. The LEED system has failed to achieve any score in this category because it does not consider the proposed aspects. BREEAM focuses on user safety, while ITACA on home automation aspects.

Table 19 *– Criteria and their weights % taken into account by the three certification systems for the macro-area "Quality of living"*

9– QUALITY OF LIVING	CRITERION	CODE	WEIGHT %
Safe and adequate access			
LEED			
BREEAM	*Safe and adequate access*	Hea 06	**0,7%**
ITACA			
Natural risks			
LEED			
BREEAM	*Risks*	Hea 07	**0,7 %**
ITACA			
Private space			
LEED			
BREEAM	*Private space*	Hea 08	**0,7 %**
ITACA			
Systems integration			
LEED			
BREEAM			
ITACA	*Systems integration*	E 1.9	**2,0%**
Wiring systems			
LEED			
BREEAM			
ITACA	*Quality of the wiring systems*	E 2.4	**2,0%**
Documentation			
LEED			
BREEAM			
ITACA	*Availability of the technical documentation of the buildings*	E 6.5	**2,0%**

Table 20 *– Comparison Weights % summary for the macro-area "Quality of living"*

9–QUALITY OF LIVING	TOTAL WEIGHTS %	TOTAL SCORE
LEED	0%	0
BREEAM	2,1 %	3
ITACA	6 %	

10 - Macro-area "Management and Maintenance", respectively in Tables 21 and 22. The last category common to all three systems is responsible for managing and monitoring the building in different and multiple aspects. The building monitoring is crucial with regards to the consumption. A careful maintenance and management can lead to considerable savings both in economic and in environmental terms. The ITACA Protocol is particularly lacking in this section, because it mostly prefers the aspects of design and construction of the building rather than the later stages. As can be seen in the following tables, BREEAM provides some criteria, but is lacking in others; LEED is the most exhaustive even though with some gaps. This is only apparent because the main criteria taken into consideration for LEED in BREEAM are merged into a single criterion. For example BREEAM in the "Energy Monitoring" criterion includes what LEED stands for "Monitoring of air flow rate of renewal", "Control and management of the installations: lighting", and "Control and management of the installations: thermal comfort". In summary it should be taken into account that the weight in % and in score given to the management and maintenance for BREEAM is much greater than in LEED and ITHACA as shown in Table 22.

Table 21 *– Criteria and their weights % taken into account by the three certification systems for the macro-area “Management and Maintenance”*

10– MANAGEMENT AND MAINTENANCE	**CRITERION**	**CODE**	**WEIGHT %**
Energy monitoring			
LEED	*Measurement and verification*	EA C 5	**2,7%**
BREEAM	*Energy monitoring*	Ene 02b	**1,5%**
ITACA			
Monitoring of the air renewal			
LEED	*Monitoring of the air renewal flow*	QI C 1	**0,9%**
BREEAM			
ITACA			
Construction IAQ management plan			
LEED	*Construction IAQ management plan: during construction*	QI C 3.1	**0,9%**
LEED	*Construction IAQ management plan: before occupancy*	QI C 3.2	**0,9%**
BREEAM			
ITACA			
Management of lighting systems			
LEED	*Optimize energy performance: lighting power and control*	QI C 6.1	**0,9%**
BREEAM			
ITACA			
Management of thermal systems			
LEED	*Management and control of systems; thermal comfort*	QI C 6.2	**0,9%**
BREEAM			
ITACA			
Management of solar radiation			
LEED			
BREEAM			
ITACA	*Management of solar radiation*	B 6.4	**3,0%**
Performance of the building envelope			
LEED			
BREEAM			
ITACA	*Maintenance of the performances of the building envelope*	E.61	**3,0%**
Ecological enhancement			
LEED			
BREEAM	*Protection and Enhancement of Ecological Features*	Man 01	**6,6%**
ITACA			
Construction site management			
LEED			
BREEAM	*Responsible construction practices*	Man 02	**1,5%**
ITACA	*Proximity to infrastructures*	A 1.10	**3,0%**

Stakeholders participation			
LEED			
BREEAM	*Stakeholders participation*	Man 04b	**3,6%**
ITACA			
Life cycle cost and service life planning			
LEED			
BREEAM	*Life cycle cost and service life planning*	Man 05	**2,2%**
ITACA			

Table 22 *– Comparison Weights % for the macro-area "Management and Maintenance"*

10– MANAGEMENT AND MAINTENANCE	TOTAL WEIGHTS %	TOTAL SCORE
LEED	7,2%	8
BREEAM	15,4%	22
ITACA	6,0 %	

11 – Macro-area "Innovation in Design", respectively in Tables 23 and 24. The concept of innovation should be understood not only in the strictly design field, but also as part of the process and of the product. In this macro area both LEED and BREEAM are present. BREEAM allows to consider a further 10% of weight to be added; LEED gives the possibility to acquire an additional 10 bonus points. ITACA is not present because it does not consider this aspect.

Table 23 *– Criteria and their weights % taken into account by the three certification systems for the macro-area "Innovation in design"*

11– INNOVATION IN DESIGN	CRITERION	CODE	WEIGHT %
LEED	*Innovation in design*	IP C 1	**4,6%**
LEED	*LEED accredited professional*	IP C 2	**0,9%**
BREEAM			**7,4%**
ITACA			**0,0%**

Table 24 *– Comparison Weights % -Summary for the macro-area "Innovation in design"*

11– INNOVATION IN DESIGN	TOTAL WEIGHTS %	TOTAL SCORE
LEED	**5,5%**	**6**
BREEAM	**7,4%**	**11**
ITACA	**0,0%**	

12 – Macro-area "Regional Priority", respectively in Tables 25 e 26. It is present only in the LEED system.

Table 25 *– Criteria and their weights % taken into account by the three certification systems for the macro-area "Regional Priority"*

12–PRIORITA' REGIONALE	CRITERION	CODE	WEIGHT %
LEED	*Regional Priority*	PR C 1/4	**3,6%**
BREEAM			**0,0%**
ITACA			**0,0%**

Table 26 *– Comparison Weights % summary for the macro-area "Regional Priority"*

11– REGIONAL PRIORITY	TOTAL WEIGHTS %	TOTAL SCORE
LEED	3,6%	4
BREEAM	0,0%	
ITACA	0,0%	

Table 27 shows the total percentage weights for each macro area/category. The total score corresponds to 100% for LEED, for BREEAM to 99.7% since there were approximations for rounding decimals. ITACA has a 102% instead of 100%. This "error" is present in the technical manual of the protocol: adding the contributions of the individual criteria already provided by ITACA the result obtained is 102% and it has been decided not to change the data provided.

Table 27 *– Criteria and their weights %*

	LEED	BREEAM	ITACA
1- SITE	3,6%	8,9%	1,0%
2- EXTERNAL ENVIRONMENT QUALITY	3,6%	3,6%	6,0%
3- SERVICES	15,3%	7,4%	13,0%
4-WATER	9,0%	5,0%	10,0%
5-ENERGY	27,0%	16,2%	16,0%
6- INTERNAL ENVIRONMENT QUALITY	4,5%	13,3%	24,0%
7- MATERIALS AND RESOURCES	9,9%	7,3%	8,0%
8- WASTE AND EMISSIONS	10,8%	13,1%	12,0%
9- QUALITY OF LIVING	0,0%	2,1%	6,0%
10- MANAGEMENT AND MAINTENANCE	7,2%	15,4%	6,0%
11- INNOVATION IN DESIGN	5,5%	7,4%	0,0%
12- REGIONAL PRIORITY	3,6%	0,0%	0,0%
TOTAL	100%	99,7%	102%

The contents of Table 27 are illustrated summarily in Figure 1 by graphics.

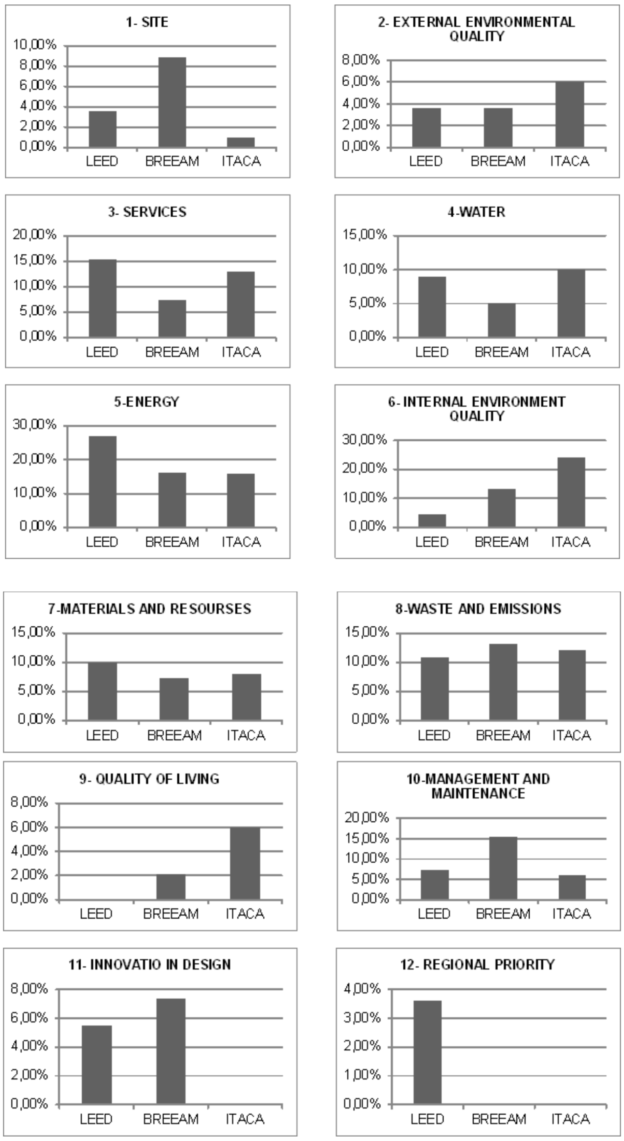

Figure 1 *- Values in % attributed to "new" criteria and system*

In addition, a further analysis was carried out in order to highlight the importance assigned by the three certification systems to the evaluation areas/categories identified. The result of this analysis is briefly depicted with diagrams of Figure 2. Diagrams show how LEED is more directed towards the area/category "Energy", while BREEAM, being more homogeneous in the different areas/categories, it is significantly focused on macro-areas "Energy", "Indoor environment quality", "Management and Maintenance" and "Wastes and emissions". The ITACA Protocol ignores almost entirely the three areas of "External Environment", "Management Priority" and "Innovation in Design" and has two peaks concentrated in "Indoor environment quality" and "Energy," while the other macro-areas are rather homogenous.

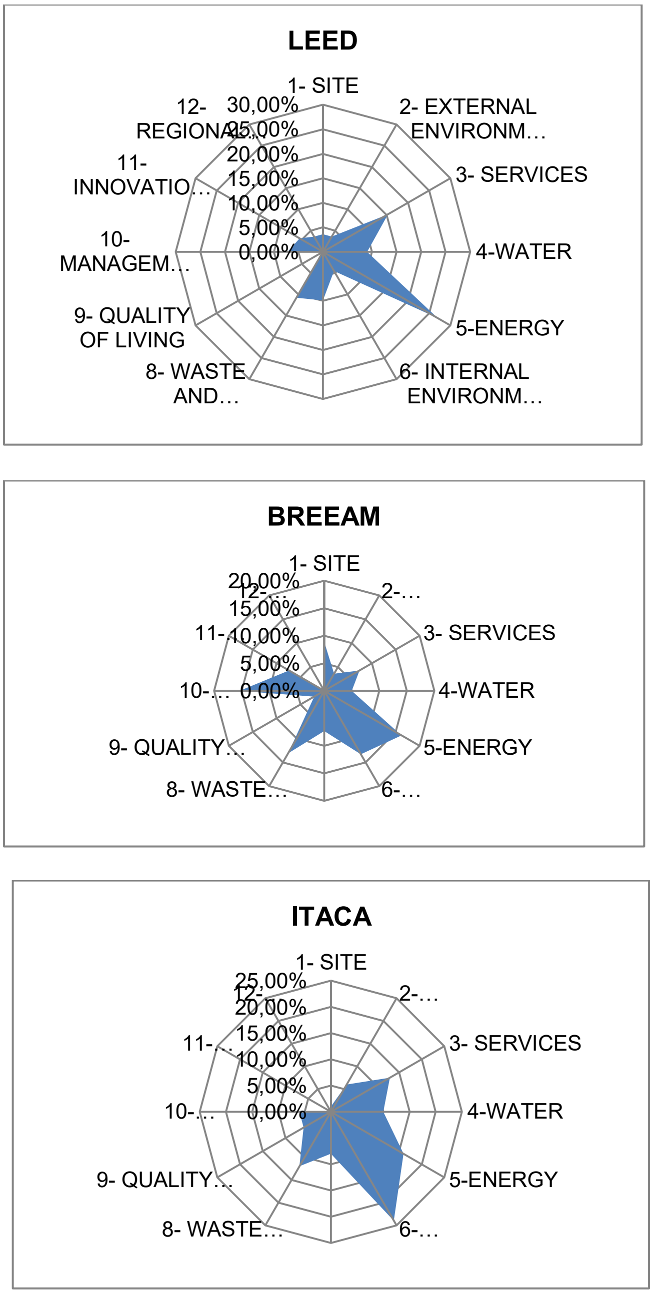

***Figure 2**–The diagram allows for each certification system to highlight the areas on which the system is concentrated*

The evaluation carried out so far has been complex, because the comparison among the various criteria was carried out by analyzing abstractly the contents of the three certification systems. But the appropriateness rating of a system with respect to another by comparing only and abstractly the number of credits assigned by each system has seemed to the authors not be exhaustive due to the fact that it does not allows to evaluate also the actual effectiveness in the operational phase of the studied systems. To highlight more clearly the aspects relating, respectively, to the information required by the criteria, to the difficulties of implementation and to the adaptability of certification systems in a specific building and geographic context, from the general comparison, it has gone to the study carried out on the field by applying the three systems on a case of building recovery.

The research work is limited to the application to a single case study because of the long time that the analysis requires and its complexity. In fact, to make the comparison among the certification systems, as well as developing a building recovery project, it is necessary to develop the project in accordance with the inputs that differ to the varying of the used certification system and that, simultaneously, taking into account the latest performance requirements related to issues of sustainability.

3. THE CASE STUDY

The case study focused on the building of the historical Institute for the Blind “Configliachi” in Padua, founded in 1838, which draws its name from its illustrious founder Luigi Configliachi (1787-1864), philanthropist, academician and rector of the Patavina University.

The choice of the case study fell on the building complex for the following reasons: availability of the commission to retrain the properties on which the authors have been able to realize a project proposal; strategic position and assessment of the existence of a cultural interest[13] on a part of the building complex; significant intervention size, in volume terms. The building is appropriate to a design process in which there are different types of intervention such as: conservative restoration, restructuring and to a lesser extent also new construction. These features make the case suitable for experimentation. It has to be highlighted that in reality, every design and construction intervention always presents unique aspects that make the study as a prototype.

This building is today in a state of extreme deterioration and neglect. Its location in the Arcella district, in the north compared to the historical center of Padua, is strategic in relation to services present in the district, to public networks of urban connection like tram and bus, to the railway network and all major access roads to the city (Fig. 3). This fact, as part of the current strategy of recovery and enhancement of existing buildings, renews the interest in the reuse.

The building has a complex history and is made up of several buildings constructed in successive historical

[13] 16th May 2011 the Ministero per i Beni e le Attività Culturali has verified the subsistance of the cultural interest on part of the building; for this reason it undergoes to the regulations of D. lgs 42/2004 parte seconda, Titolo I.

periods and in part amenable to a cultural and landscaping bond (Fig. 4).

The project plans identify as new destination a Health Residence for Seniors, with a day center services open to the district. The development of architectural design choices is oriented on one hand in search of historic and cultural status of the property and on the other to the fulfillment of standards, required in general by building urban requirements and in particular by the Veneto Region legislation for RSA. The development of the technological choices is oriented on the basis of what is required by the three considered certification systems.

Figure 3 *– Location of the building object of the intervention recovery*

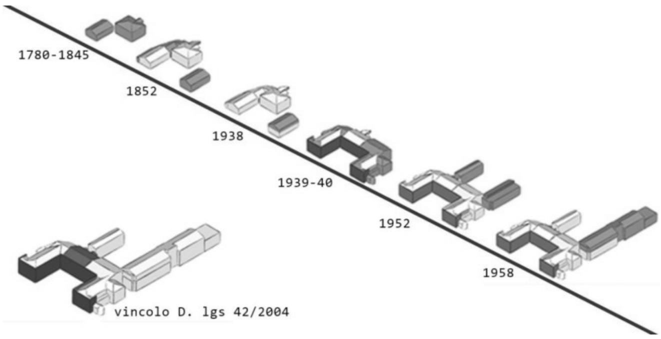

Figure 4 – Volumes of the buildings appeared in different historical periods and part currently bound under Decree 42/2004

The building in plant is divided into two parts: the body intended to host the day care center for seniors, with services open to the community such as gym, medical surgery and conference room and the east wing destined to guest rooms and related services (Fig . 5). It is planned the demolition of no more than 15% of the total volume (Fig. 6 and 7), because it consists of redundant bodies that prevented the reading of the historic building, reusing it to integrate the section reserved for guests. The height and the number of floors have been maintained as well as the original structural parts. In elevation, the building consists of three floors above ground (Fig. 8).

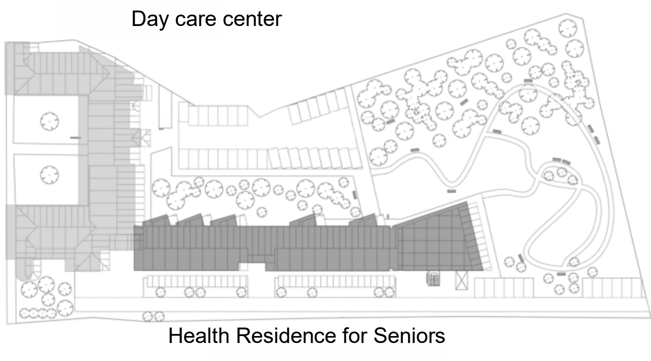

Figure 5 *– Functional articulation of the recovery project*

Figure 6 – Overview of the recovery project

Figure 7 *– Main facade*

Figure 8 *– View from the park*

4. APPLICATION TO THE CASE STUDY AND CONSIDERATIONS

Resuming what previously exposed in a theoretical way, we now turn to the application of certification systems in the case study, after analyzing and homogenize the three certification systems named LEED, BREEAM and ITACA in what are called "new criteria” proponing for each area evaluation a comparison chart both graphics and analytical.

For each evaluation area were summed both the percentages obtained and the corresponding points, so as to obtain the partial results concerning the individual categories as shown in Figure 9, where are reported the percentages obtained for each certification system. From Figure 9 it can also be appreciated the comparison for each macro-area among the percentages theoretically obtainable, as indicated in Figure 1, and the percentages actual obtained with the application of certification systems to the case study.

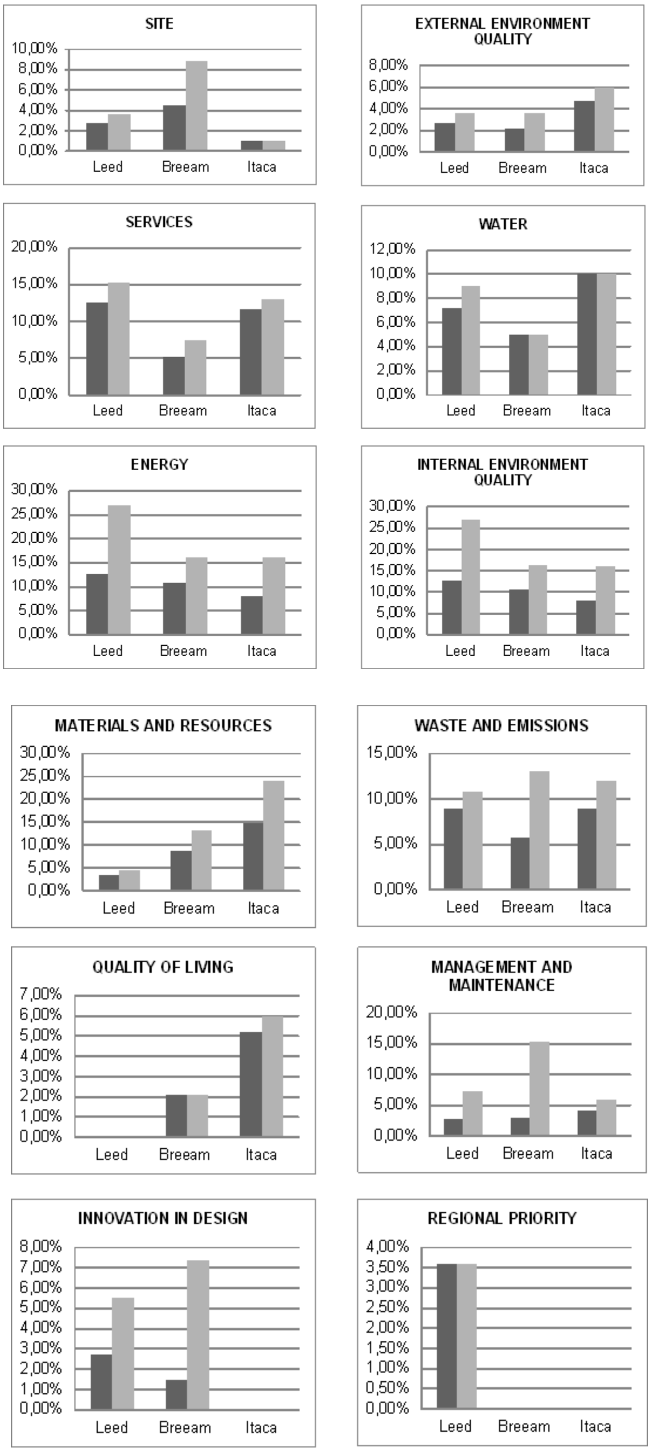

Figure 9 *– Comparison of the three certification systems applied in the case study. Resulting by macro-area and category*

The analytical representation is provided in Table 28, which shows the data obtained from the comparison of each certification system. The first column shows the data obtained, while the second shows the maximum achievable result. It has been noticed that the Protocol ITACA has reached the highest percentage of 76.5%.

LEED follows with a share of 64.8%, corresponding to 69 points.

***Table 28** – Analytical representation of data obtained from the comparison for each certification system applied in the case study. For each system, the first column shows the results obtained, the second column gives the best result obtainable*

	Leed	Leed	Breeam	Breeam	Itaca	Itaca
1- SITE	2,7%	3,6%	4,5%	8,9%	1,0%	1,0%
2- EXTERNAL ENVIRONMENT QUALITY	2,7%	3,6%	2,2%	3,6%	4,7%	6,0%
3- SERVICES	12,6%	15,3%	5,2%	7,4%	11,6 %	13,0%
4-WATER	7,2%	9,0%	5,0%	5,0%	10,0 %	10,0%
5-ENERGY	12,6%	27,0%	10,7%	16,2%	8,0%	16,0%
6- INTERNAL ENVIRONMENT QUALITY	3,6%	4,5%	8,8%	13,3%	14,8 %	24,0%
7- MATERIALS AND RESOURCES	5,4%	9,9%	4,4%	7,3%	7,8%	8,0%
8- WASTE AND EMISSIONS	9,0%	10,8%	5,8%	13,1%	9,0%	12,0%
9- QUALITY OF LIVING	0,0%	0,0%	2,1%	2,1%	5,2%	6,0%
10- MANAGEMENT AND MAINTENANCE	2,7%	7,2%	3,0%	15,4%	4,2%	6,0%
11- INNOVATION IN DESIGN	2,7%	5,5%	1,5%	7,4%	0,0%	0,0%
12- REGIONAL PRIORITY	3,6%	3,6%	0,0%	0,0%	0,0%	0,0%
TOTAL	64,8%	100%	53,2%	100,0%	76,3 %	100%
SCORE	69	110	73	136		

With a the result between 60 and 79 points, LEED provides for the building the classification GOLD. Finally follows BREEAM, with the lowest percentage, equal to 53.2%, corresponding to 73 points. Nevertheless, the classification of BREEAM assign to the building the value of Excellent, having obtained a score between 70 and 85. From a preliminary observation on the collected data, it seems that the ITACA Protocol is the best way to assess the sustainability of the analyzed building because applying all claims it assigns the highest percentage. However, this assessment is not correct, because the different factors that have negatively affected the other two protocols and favored ITACA have to be taken into account.

Looking at the results of the comparison of the percentages obtained in the case study and available (Fig. 9) if the categories "Innovation in projects" and "regional priorities" (which are surplus to LEED and BREEAM) are ignored, it might be noticed that the percentages obtained from the systems in the various categories are quite high, amounting to about three quarters compared to those obtained with some exceptions. BREEAM in the "Site", "Wastes and emissions" and "Management and Maintenance" and LEED in the "Energy" and "Management and Maintenance" have a collapse, with the percentages obtained which amount to half or even less than those obtainable.

The reasons are as follows: LEED and BREEAM assess the sustainability of a building in the three phases of design, construction and building management. The ITACA Protocol, on the contrary, is limited to the first two. The research compared the systems only with respect to the design of the building, with only some considerations on the construction phase; for this reason, the credits required for LEED and BREEAM, which also take into account the period of one to five years of life of the building, has been assigned a value zero. This is not due to a deficiency of the certification system, but because the works have not yet been implemented and therefore the phase is not evaluable. Considering in particular the category "Energy" ITACA also have a relatively low score. ITACA provides analysis of the different energy contributions separately, without taking into account the mutual relations and without obtaining a result of the overall energy efficiency. The approach of LEED and BREEAM, in contrast, considers the overall balance of the contributions. ITACA also includes only the performing of a quasi-static calculation of the energy performance of the building. LEED and BREEAM accept the calculation both in steady state and in dynamic conditions. Considering that the aim of the research is to be able to assess all three systems and not only the one obtaining the highest possible score, it was decided to perform an energy simulation in steady state with the TerMus[14] software in order to obtain results analyzable in all systems. While BREEAM in the score to be assigned is indifferent to the choice of the calculation methodology of the energy performance, in contrast LEED gives up to maximum 3 points at the steady state and 19 points to the dynamic. As

[14] TerMus (Acca software) is a software for the energy certification of the buildings and for verification of their energy performances, certified CTI from 2009 for the conformity to calculation with UNI TS 11300 regulation.

consequence, if in the case study was carried out the dynamic calculation of energy performance, LEED would have got an overall percentage probably higher than ITACA. Based on the results obtained by the analysis of the case study, in retrospect, it can be said that the best choice is LEED. That assertion is not based solely on the quality and strengths of the certification system, but by its ability to be continuous implementation. For recovered buildings it is definitely the most appropriate protocol.

5. CONCLUSIONS

The environmental certification systems are tools for assessing the sustainability of buildings, born independently from each other, without uniformity neither in contents, nor in the application methodology. The presence of several tools confuses the designer, for the reason that he wonders what is the environmental certification system most suitable both in new construction and especially in the case of building recovery. The trend is to prefer one system over another on the basis of the spread on the national territory or of his personal skills. If a professional has already applied a system once he is brought to apply the same also for subsequent projects, as is familiar to the issues addressed and to the evaluation methodology. Drejeris and Kavolynas (2013) note that is absent a group of economic-financial criteria (initial amount of investment, payback period, value of the project, system usage charges). In the comparison among systems, looking at the various topics, it is noticed that there is no system that considers all categories and all aspects. None of the most popular and known systems of sustainability certification guarantees to address simultaneously towards all three aspects of sustainability the performance of the building from the environmental, social and economic point of view (Hirigoyen, Ratcliffe and Davey-Attlee, 2008).
As is clear in the literature, several researchers have compared these systems, because in view of different applied methodologies and criteria was born the need to understand what is the influence of the choice of the certification system on the project proposal in the case of the existent recovery. From the study carried out have emerged weaknesses in the application of environmental certification systems for the object of intervention of recovery building, because it was observed that the three systems of environmental certification chosen interact in a different way with the building object of study and not all take into account the existing in the same way.
It is also noted that if the three systems were applied individually, outside of the comparison carried out, these would have addressed the design choices in three different directions. For example for the macro-area "Quality of living" criterion "Secure access", only BREEAM requested to recognize and encourage effective design measures to encourage low risk and secure access to the building. As a result, within the project area have been planned several walking trails: the trails to take advantage of green spaces with a width of 1.2 m and sidewalks around the building with a width of 1.8 m which allow the pedestrian access at different points. On the south side of the new extension of the building has been disposed a special area for the recycling of wastes, right off the service road, which allows a quick disposal. Other systems do not take into account this policy, and then the designer may fail to design solutions that consider this input.
In the present work the three systems considered have been applied in a neutral manner, so that to meet the demands of everyone, without favoring one system over another. In order to allow for a comparison, the goal was not to get the most from every certification but identify for each macro-area how this was evaluated for each system. At the end of the work it cannot be said that one system is better than the other or more "sustainable", because the partial comparability has produced different answers to the same choices made. The application of these environmental certification systems has allowed to understand how important is the choice of the evaluation system to be used in the case of the building object of recovery, since the various credits strongly address the design choices and it cannot get a similar result by taking different strategies.
Finally it is observed that precisely in the relationship with the existing building these tools have proved not only to have limitations, but also stiffness: an existing building has limitations due to the fact of being already built and the choice of the intended use binds greatly the project, therefore obtaining the proposed credits is more complex to achieve.
In conclusion, in order to achieve a sustainable building it is not enough to rely on a single environmental certification, only because it is the most used or because it is what one knows better. The professional has to carry on a preliminary analysis, highlighting what are the peculiarities and the characteristics of that building-case study and, based on the results obtained, has to proceed to the choice and the application of the appropriate certification system. For a conscious choice it is appropriate to consult a technical expert in application of more environmental certification systems, which can address the designer to the most suitable system, capable of enriching the design choices and make the most of the existing building. From the undertaken study and the above considerations emerges that, at the same time of a procedural innovation, is desirable the creation of a new profession: that of technical expert in the application of environmental certification systems. This professional, will have to support the designer in the preliminary phase of choice of the certification system in order to

identify the most appropriate to the specific project that the designer is ready to process.

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