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THE LOCAL INFLUENCES OF SUSTAINABILITY IN HISTORIC CENTRES FOR BUILDINGS REFURBISHMENT AND FOR LIVING

Rui A. Oliveira[1]*, Jorge P. Lopes[2] and Maria Isabel Abreu[2]

1: Civil Construction and Planning Department
School of Technology and Management
Polytechnic Institute of Bragança
Campus de Santa Apolónia, 5300-253 Bragança
e-mail: roliveira@ipb.pt, web: http://www.estig.ipb.pt

2: Civil Construction and Planning Department
School of Technology and Management
Polytechnic Institute of Bragança
Campus de Santa Apolónia, 5300-253 Bragança
e-mail: {lopes, isabreu}@ipb.pt, web: http://www.estig.ipb.pt

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Abstract *The historic city centres are comfortable living places that also have architectural quality, cultural and historic heritage. These and other aspects have contributed to a sustainable behaviour and tourism attraction, which does not happen in recent residential areas. However, existing buildings in historic centres have many constraints which associate them to problems and make them less attractive, such as the proximity between buildings, less sun exposition and many others.*

This paper reports on a research project in which a toolkit with 50 parameters was developed to support decision-making in old building refurbishment projects in historic city centres. Each parameter includes technical regulations, constraints and best refurbishment practices. All solutions proposed by a parameter are ordered in 5 levels from the least to the higher sustainability benefits. The article describes a connection between the toolkit parameters about building localization aspects and their application as constraints during refurbishment works. In another perspective, it is shown the contribution of these parameters as good practices for living in city centres, tourism interest and building selection aspects for renting or buying.

The methodology adopted in the study comprises a case study involving the consultation of a set of 7 building refurbishment project designs. All project designs analysed do not present full information description in the majority of localization parameters of the toolkit, such as public transport, parking cars, commercial or services areas, technical infrastructures conservation, sports and gardens areas, and land reutilization. Some of the information on the building project designs analyzed were possible to ascertain through "in situ" research and part of the buildings has good location, proportional sustainability benefits and easier management practices during refurbishment works. The results suggest a lack of interest in the provision of relevant information for the part of design consultants concerned with building refurbishment projects. This aspect needs to be tacked in order to promote more sustainable construction practices and, consequently, a more efficient functioning of this segment of the construction market.

1. INTRODUCTION

Historic city centres are places which have specific characteristics, history, architectural and cultural richness. Over centuries, they have been under pressures of change and adaptation to the needs of each era. A historic centre which maintains its original urban area and architectural design must be preserved. In some Portuguese historic city centres, it witnessed a mixture of different interests regarding the location privilege. During daytime, they represent places to work, do business and walk, whereas in the evening they serve entertainment purposes. However, they are not considered attractive places for living. In historic city centres, are often found buildings which are uninhabited, vacant or derelict, whose state of degradation is conditioned by time (ageing), outdated materials, absence of maintenance practices, failure to keep up with technological evolution and with regulatory and social demands. These buildings are an integral part of historic centres, which is why, before refurbishing, it is important to raise the public's awareness regarding the advantages of living in these places, contrarily to current trends [1]. Many people look for quality of life in the outskirts of the city when they can find it in the historic centres, ending up spending hours on commuting, which contradicts sustainability requirements. Historic city centres have business, services, leisure and entertainment spaces as well as cultural diversity, which contribute to sustainable practices [2].

Intervention works which involve old buildings refurbishment should be dynamic, safeguarding and reusing buildings following the principle of minimal intervention [3]. This could be compatible with the guarantee of cultural, authenticity and reversibility safeguard, embellishing and protecting the surrounding area [2], as well as be sufficient as far as the inhabitability demands are concerned. On the other hand, the deeper intervention works are the higher the compliance with regulatory requirements is, but originality may be lost and costs may be higher [2] [3].

Intervention works in buildings which are located in historic city centres must be planned considering precautions regarding the site works management which result from the constraints of the surrounding area. In each intervention, a thorough assessment of all the surrounding constraints is needed, as well as a project design that reflects the best options so that the building site works management can be as effective and efficient as possible. For example, the existence of a bus stop next to the building under work may have different perspectives [4]. On the one hand, it represents a high score sustainability requirement regarding standard of living [5]. However, on the other hand, during the intervention works, it becomes a local constraint difficult to manage as far as security, noise and dust are concerned due to the concentration of people and to other aspects which make the normal mobility within the building site more difficult [4].

This paper focuses on technical aspects to be included in refurbishment project designs in historic city centres in order to create more environmental, economic and social benefits during the operational phase as well as to support the project stakeholders' decision-making. These aspects are part of the parameters integrated in a toolkit form named "Management system for building refurbishment projects located in consolidated urban centres", thereafter called management system [4]. The issues regarding the various parameters of the

management system were tested in 7 building refurbishment project designs, in which an omission regarding a significant part of those aspects could be considered a dominant feature [4]. The aspects that are contemplated in the project designs reinforce the interest of such issues, as they can be optimized. Also, the omitted aspects can be seen as relevant for inclusion in the design phase of the projects, thus addressing sustainability requirements and contributing to the successful management of investment projects [4].

2. ASPECTS OF LOCATION IN HISTORIC CITY CENTRES

Both the surrounding area and the building location itself are related to variables which must be managed and coordinated during the intervention works, as some of them are crucial during the operational phase. It is important to develop studies which characterize those existing variables, connecting the existing constraints with technical recommendations and procedures which address sustainability, thus turning them into benefits.

2.1. Constraints regarding the surrounding area and location

There are several constraints related to the surrounding area and location of old buildings in historic city centres, as shown in table 1.

Type (Code)	Description:
C1 Low interest	- The population's search for places with better comfort, sanity and safety conditions, which refrains the population renewal in city centres. - Low air renewal, causing characteristic smells and humidity and potential, though remotely, accumulation of radon gas.
C2 Traditional trade	- The change in pedestrian or automobile traffic routes and itineraries as well as the lack of parking spaces contribute to the closure of shops. - The opening of shopping spaces is conditioned by high rents, and those who resist tend to live off traditional trade and specialized shops.
C3 Morphology	- The local topography is often uneven and steep, with narrow streets and no car accessibilities or parking spaces, which conditions access by people with low mobility.
C4 Degradation	- Places associated with rundown and dangerous areas, inhabited by elderly or people with socio-economic problems.
C5 Public spaces	- Frequent use of the public space for the residents use.
C6 Unsanitary conditions	- Dirty and inappropriately used alleyways, common areas and other public spaces. - Proximity of opposite buildings (shadings, low sun exposure, low natural lighting and easy propagation in case of fire).
C7 Fire safety	- Lack of hydrants and of emergency and evacuation plans. - Places with potential larger damage and higher difficulty of control in case of fire, due to obstacles and materials combustibility.
C8 Faulty infrastructures	- Faulty volume of containers for urban solid waste (USW) and of recycling bins, or faulty refuse collection management. - Illegal disposal of waste in alleyways and uninhabited buildings. - Inexistent, degraded or outdated infrastructure networks.
C9 Urban space quality	- Frequent aspect of degraded surroundings and of inexistent maintenance operations. - Unsuccessful refurbishment operations which spoil the surrounding area.
C10 Scarce area	- Limited spaces and frequent inexistence of common areas which can be adapted for growing vegetables or for other uses.
C11 Illegal works	- Execution of surreptitious or illegal construction works which spoil the area.

Table 1. Constraints regarding the surrounding area and location in historic city centres

2.2. Contribution to sustainability

Within the field of sustainability, the development of several sustainability assessment systems applied to buildings have been witnessed such as: CEEQUAL; BREEAM; LEED; NABERS; BEPAC; HQE; CASBEE; SB Tool. In the case of Portugal, the existing systems are: LiderA, SB ToolPT, Domus Natura. All the systems contain parameters based on solutions proposed in guidebooks or in Life Cycle Assessment methods suggesting the use of products with an eco-friendly label or an environmental statement.

However, there are differences regarding the definition of criteria, performance scales and weighting between the various systems. Although there are several differences between sustainability assessment methods, there are often records of similar results. According to M. Silva (2010), there is a set of parameters that are common to various building sustainability assessment systems which are related to: local sustainability, transport, resources management, emissions, indoor air quality and sustainability of the exploration or operational phase [6].

Table 2 contains the analysis of the common issues between the systems Breeam, HQE, Leed, LiderA and SbToolPT environmentally applicable to the surrounding areas and location [5] [6]. These common issues have positive impacts and social benefits during the operational phase. However, in some cases, they may also have less positive reflections, thus highlighting what the Norm EN 15643-1:2010 refers to the "*determination of the impacts and aspects regarding the building and its building site"* [7].

Topic	Subtopic	Breeam	HQE	LEED	LiderA	SbtoolPT	Common parameter	Code
Land use	Reuse of previously built sites	√	√	√	√	√	√	S1
	Soil contamination and reuse	√	√	x	√	√	√	S2
	Building footprint	√	√	√	√	√	√	S3
Climate and risk	Minimization of diversified risks (e.g.: earthquakes)	x	√	x	√	x	√	S4
Building site	Building site with low environmental impact	x	√	√	x	x	√	S5
Comfort	Thermal comfort	√	√	√	√	√	√	S6
	Open-air space	√	√	x	x	√	√	S7
Accessibilities	Accessibility to public transport and services	√	√	√	√	√	√	S8
	Safe and adequate pedestrian paths	√	√	x	√	√	√	S9
	Safe and adequate cycling lanes	√	√	√	√	x	√	S10
	Promotion of the use of alternative means of transport	√	√	√	√	√	√	S11
Responsibility	Social interaction	x	√	x	√	√	√	S12

Table 2. Sustainable practices and solutions regarding the surrounding area and location in historic centres

2.3. Technical recommendations

Table 3 describes a set of technical recommendations which can be implemented in the surrounding area and location of historic city centres, reinforcing the response to its needs.

Code	Technical recommendations
R1	Improvement of the buildings inhabitability conditions.
R2	Promotion and modernization of the surrounding infrastructures.
R3	Rehabilitation of green spaces.
R4	Improvement of the surrounding accessibilities.
R5	Promotion of sustainability regarding the social, economic and environmental context.
R6	Thorough assessment of constraints regarding the building itself.

Table 3. Technical recommendations to be implemented in the surrounding and location of historic centres

3. MANAGEMENT SYSTEM FOR BUILDING REFURBISMENT PROJECTS LOCATED IN CONSOLIDATED URBAN CENTRES

The management system for building refurbishment located in consolidated urban areas represents a management system in the form of a toolkit to support the stakeholders' decision-making regarding old building refurbishment projects [4]. It is structured in 4 thematic areas covering 15 indicators, as shown in Table 4.

Areas	Indicators
Surrounding and location	I1.1 Mobility and amenities; I1.2 Local infrastructures; I1.3 Reutilization of urban land; I1.4 Sun exposure.
Conception	I2.1 Need for acknowledgment; I2.2 Architectural and sanitary organization; I2.3 Need for intervention in infrastructures, foundations and structural elements; I2.4 Materials; I2.5 Promotion of sustainability.
Execution of works and building site	I3.1 Works initial constraints; I3.2 Industrialization/ execution of works; I3.3 Risk and contingencies potential; I3.4 Other specificities resulting from the works.
Costs	I4.1 Costs of intervention; I4.2 Incentives and other costs.

Table 4. Areas and indicators of the management system [4]

The 15 indicators affect 50 parameters covering constraints and legal provisions with the best sustainability practices as well as with technical recommendations regarding each thematic area [4]. This paper deals only with the parameters of the management system regarding the area "Surrounding area and location". These are related to the achievement of greater environmental benefits during the operational phase [8] and to the constraints regarding the building site works during the construction phase. Table 5 contains the elements that are the basic components in the development of each parameter referred to in Tables 1 to 3.

Indicators	Parameters	Code Table 1	Code Table 2	Code Table 3
I1	P1 - Public transport	C1	S8, S11	R5
	P2 - Car parking	C3	-	-
	P3 - Local amenities	C2	S8	R5
I1.2	P4 - Outdoor fire fighting means	C7	-	R2
	P5 - Technical networks in public spaces	C8	-	R2
	P6 - Urban space quality	C3, C4, C7, C9, C11	S4, S9, S12	R2, R4, R5
I1.3	P7 - Land reutilization	-	S1, S2, S3	-
	P8 - Construction and soil sealing index	C5, C10	S7	-
	P9 - Green and leisure spaces	C1, C10	S7, S10, S12	R3, R5
I1.4	P10 - Sun exposure	C6	S6	R1, R6
	P11 - Sun orientation	C1	S6	R1, R6

Table 5. Parameters of the area "Surrounding and Location" and its basic components

For example, the compilation of data regarding “C2 – Traditional trade”, “S8 – Accessibility to public transport and services” and “R5 – Promotion of sustainability regarding the social, economic and environmental context within the areas to be rehabilitated” constituted the basis for parameter “P3 -Local amenities”. Each parameter aggregates 5 practices classified from 1 to 5. The practices classified as 1 are the worst ones, below what is considered as conventional practice and with no great benefits. Those classified as 2 are the usual/conventional ones, and those ranging from 3 to 5 ensure the achievement of more benefits for the management and are the most sustainable ones. As an example, Table 6 shows the practices classified as 2 and 5 within the parameters “ P2 - Car parking” and “P3 - Local amenities” [4].

Parameters	Practice	Description
P2 Car parking	2	Existence of parking spaces in parking lots within the urban area, supported by regular mobility ensured by public transport, with no parking space next to the building during the day and scarce parking space within a radius up to 500m.
	5	Existence of parking spaces or public or private garages in the building itself or in other places destined to nearby residents, in similar conditions to those found in the outskirts. In case of automobile traffic conditioned areas, existence of parking spaces in the street reserved to residents, and parking solutions reserved to disabled people and/or emergency vehicles.
P3 Local amenities	2	Possessing only the shops described in the sub-indicator within a radius of up to 500m.
	5	Shopping and services facilities located in that same building and/or nearby within a radius of less than 300m, and possessing other amenities in a number higher than 2 within a radius of up to 1000m.

Table 6. Practices classified with 2 and 5 within the parameters “P2-Car parking” and “Local amenities”

The management system was submitted to an opinion study which enabled to strengthen its thematic contents [9]. For that purpose, interviews guided through questionnaire were conducted with senior managers and consultants practising in old building refurbishment projects. The interviewees considered the contents of the management system to be pertinent, of interest and with practical application in old buildings refurbishment. They also suggested some adjustments which were taken into account.

4. CASE STUDY

The management system was applied in a case study [9] [10] with the documental review of 7 building refurbishment project designs (ordered from A to G) provided by the Urban Rehabilitation Society - Porto Vivo (see Figure 1).

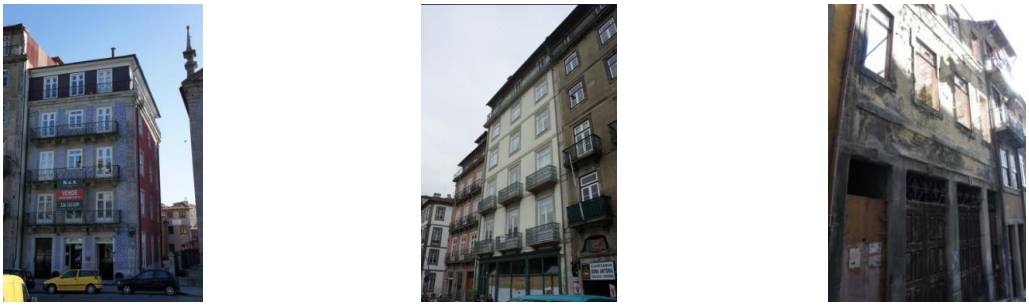

Figure 1. Example of building typology studied

The study was based on the analysis of the project data encompassed within the thematic areas of the parameters of the management system. The following results were obtained [4]:

- 100% of the project designs contain information regarding parameters P7, P8 and P11;
- 85.7% of the project designs contain information about parameter P5 and 28.6% about parameter P10. Data concerning the remaining project designs were obtained through "in situ" analysis;
- 100% of the project designs do not contain information regarding parameters P1, P2, P3, P4, P6 and P9, but such data could be obtained through "in situ" analysis.

As shown above, not all the project designs analysed contained the required information. However, according to law and regulations, it is compulsory that building project designs contain information regarding the following parameters: "P4 - Outdoor fire fighting systems"; "P5 - Technical networks in public spaces"; "P7 - Land reutilization"; "P8 - Construction and soil sealing index"; "P10 -Sun exposure"; "P11 - Sun orientation". The research also revealed that in some projects, the best solutions to maintain originality had not been explored, and choices had fallen on new construction practices. Also, in some cases, there was a lack of solutions with more benefits to sustainability, as shown in Table 7.

Parameter	Project designs							Main conclusions
	A	B	C	D	E	F	G	
P1	5	5	5	5	5	5	5	Very well located buildings regarding public transport.
P2	4	4	4	4	4	4	4	Well located buildings regarding parking spaces and parking lots.
P3	5	5	5	5	5	5	5	Very well located building regarding amenities.
P4	3	2	3	3	2	5	5	Good location of fire fighting means in five buildings, but two (classification 2) have their fire fighting systems within a greater distance than the regulatory limits.
P5	3	3	3	3	3	3	3	All buildings have technical networks, but less than 50% are recent.
P6	1	1	3	5	3	3	3	Two of the buildings are in streets without car accessibility (narrow and steep – classification 1), four of the buildings have what is considered normal car accessibility (classification 3), and one has very good conditions regarding this parameter.
P7	5	5	4	5	4	4	4	Reutilization of land previously reused (following sustainability practices).
P8	2	2	2	3	3	2	2	According to the City Centres Detail Plans, five buildings have 100% of the plot area soil sealed (classification 2) and the other two have common areas with permeable land (classification 3).
P9	4	4	2	5	3	4	4	All buildings have green and leisure spaces nearby; One also has them within its yard area (classification 3); Four have spaces for vegetable gardens nearby (classification 4); and one has such spaces within its yard area (classification 5).
P10	2	3	2	5	2	3	4	Some buildings do not present the best solutions, but these parameters depend on the location and shading caused by other buildings. It could assist improving building energy better conditions.
P11	3	3	3	3	2	2	2	

Table 7. Practices classified from 1 to 5 in each parameter of the 7 project designs analysed [7]

It is not compulsory to include in project designs contents regarding parameters "P1 - Public transport", "P2 - Car parking", "P3 - Local amenities", "P6 - Urban space quality", and "P9 -

Green and leisure spaces". However, a set of interviews which complemented the documental review revealed that all the fifteen interviewees saw pertinence and interest in the inclusion of these parameters in the design stage (see Figure 2). One of the interview questions addressed the referred parameters as constraints and the pertinence of considering them during the construction phase, which was confirmed with interest by all the interviewees [2].

Figure 2. Some "Surrounding and location" aspects to attend in the project designs

5. CONCLUSIONS

Some of the issues addressed in parameters of the management system regarding the surrounding area and location are not referred to in the project designs. It is important to refer them as they will increase the value of the project design and help in the management of intervention works as well as in the assessment of possible constraints to the works execution.

This paper suggests that some of the possible constraints during the construction phase can ultimately increase the sustainability requirements during the operational phase. The proximity to public transport, as well as amenities, urban space quality and green and leisure spaces require redoubled attention with regard to security, dust levels, noise, lighting, access control, among other disturbances during the construction phase. However, in the utilization phase, proximity to these places is a sign of comfort as well as of good location and sustainability levels.

Within this context, the contents of parameters P1, P3, P6, P7, P8, P10, and P11 represent weighting factors to sustainability. Parameters P2, P4, and P5 also do them in a indirect way, although they have a strong social component. Therefore, we suggest that information regarding these parameters must be taken into account within the design phase of projects, as they help in the management of intervention works with greater focus on sustainability, thus contributing to the successful management of old building refurbishment projects.

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