Original Article

Rehabilitation and sustainability of buildings in Rio de Janeiro

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ABSTRACT This present work is intended to reflect on the aspects of sustainability versus urban regeneration, trying to indicate the criteria that enable the interface between construction and its future rehabilitation. For such a purpose, two examples in the areas of tourism and health care have been developed.

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INTRODUCTION

Rehabilitation is a need for large urban centers, since an indiscriminate replacement of urban improvements targeting renewal occurred in the last century, which took for granted patrimonial, cultural and environmental values. Thus, actions have been taken which affected the urban society, at different phases, in order to renew, make visual recycling, and achieve the standards of other societies.

Approximately two decades ago, it was found that the estate lost by means of indiscriminate property demolition and replacement could and should have been adapted to modern contingencies, with a responsible awareness that sustainability with recycling should come as first priority, followed by revitalization with rehabilitation.

However, all major capital cities have already experienced this problem, which this work brings off in the guidelines presented in *PATORREB 2009*, by two studies, related to rehabilitation in Rio de Janeiro city, following the principles of sustainability, respectively: *Sustainable Solutions in the Rehabilitation of Hotel Buildings* (Souza and Qualharini, 2009) and *Rehabilitation of Biomedical Research Laboratories: Strategies and Solutions Applied in Fiocruz – Brazil* (Machado and Qualharini, 2009).

Rio de Janeiro city is Brazil's second largest city, being over 400-year-old, having 6 093 472 inhabitants in 2007 (see IBGE), which corresponds to 95 per cent of the state's population, and its urban area comprises 1 283 427 residences, 188 643 commercial buildings, 5763 industrial buildings and 1617 other-purpose buildings, wherein 76 per cent thereof are over 40-year-old (see Table 1), which were built with an average user

Table 1: Amount of constructions in Rio de Janeiro (city) – Years of existence – Life cycle

	<i>Total units</i>	<i>0–20 years</i>	<i>21–44 years</i>	<i>45–59 years</i>	<i>60 or more</i>	<i>Ignored</i>
Subtotals	1 452 586	571 946	610 343	137 143	133 053	101
%	100	39.4	42.0	9.4	9.2	0

Source: Armazém de Dados do Instituto Pereira Passos – Tabela 1200.

lifetime of 80 years (Maffei, 1992), indicating that at least 90 per cent of the buildings will probably undergo some adaptation, reform, corrective maintenance or rehabilitation.

The significant amount of degenerated buildings that achieved higher degrees of average useful time indicates a shortage of guidelines for urban regeneration, which might conduct the adequacy of the buildings to the current requirements of sustainability and usability, being the aim of this work to complement the existing guidelines for such deficiency.

SUSTAINABILITY VERSUS URBAN RENEWAL

Evaluating the possibilities of sustainability in urban renewal means focusing the study on the expected performance of the various construction systems, including new elements and components, in addition to a retrospective study establishing the degree of degradation of existing improvements, including as variables the state of conservation and characterization of the spatial organization, based on the interventions, with emphasis on prospective aspects.

Therefore, rehabilitation of the mentioned elements requires a prospective vision of the possible benefits, as well as direct and indirect impacts that may occur with reoccupation of the central areas within the urban boundaries, characterized by the occupation of areas of the city that present a long-term lack of investment, instead of a peripheral urban expansion (Smith, 1996), generating a consequent emptying in behalf of areas having better infrastructure. Another aspect is the empty urban areas that remained unused, as a reserve for speculation, or even for the lack of infrastructure.

For such a purpose, interventions focusing on the sustainability of existing properties must comply with current requirements, of being, becoming or providing conditions for sustainable usability, in present and future interventions, providing that maintenance, restoration and preservation comply with the expected performance (Jensen, 1971).

URBAN BUILT UNIVERSE AND SUSTAINABILITY

Carelessness with urban areas creates a state of degeneration and obsolescence, which is a process wherein improvements lose the original characteristics of their performance, functionality and safety through continuous use and action of physical agents in its life cycle.

The trend of sustainable design is to become intrinsic to the planning, a routine in the project, and a functional system of the building. Thus, to potentiate existing improvements and those to be rehabilitated, systems should be created as to enable interventions in indicators known as ‘green certifications’, which are applied to existing conditions, offering the rehabilitated constructions means of intervention management in order to allow for future maintenance and usability. Therefore, the following systems can be cited:

- (a) LEED (*Leadership in Energy and Environmental Design*) – United States – it is a scoring system of the US Green Building Councils, to categorize a building in three

levels: gold, silver and platinum. It is subdivided into different building categories, such as: new commercial constructions and major renewal projects (LEED-NC), operations of existing buildings (LEED-EB), among others. The LEED for existing buildings (LEED-EB) evaluates a number of performance standards towards their sustainable operation. Such criterion foresees a modernization of the building systems and operations, wherein most of the inside and outside remain untouched. In this category, there is a concern on building maintenance as well as on efficiency of energy, water, and air quality standards and indoor lighting performance.

- (b) HK-BEAM – Hong Kong – it provides a ranking of the building quality with a label, in which the building may be new, refurbished or already in use. The referred label indicates the building performance and is intended to assess the building as to make it safer, healthier, and more comfortable, functional and efficient. It is applied to any sort of building and encompasses a set of design, construction and administration practices, in addition to building operation and maintenance practices.
- (c) BREEAM – England: it is a method for assessing Building Research Establishment (BRE) used to evaluate the environmental performance of new and old buildings. Credits are in accordance with each performance. The building is rated as ‘sufficient’, ‘good’, ‘very good’ and ‘excellent’. The granted license may be used for promotional purposes (Flemming and Qualharini, 2005).

Therefore, the aforementioned systems report the impacts of urban intervention aiming the integrated eco-management of products, systems and processes of construction, which associated to the use waste control and built space operation allow for decreased energy consumption and an adequate thermal, acoustic and sanitary comfort.

However, one of the great challenges of urban regeneration is balancing the carried out refurbishing, with use and time, which Choay (2001) classified as *mis-en-scène*, as it does not follow the processes associated with gentrification and, in general, the recovered areas return to a process of degradation and emptying (Castriota, 2003). Thus, reverting to this possibility means observing the propositions of the ‘green management’ and offering attractive conditions to owners and users so that the process of area conservation is stimulated, making it an individual value and not only one of collective imposition (Amorim and Coradi, 2004).

ARCHITECTONIC URBAN REHABILITATION PRACTICES IN RIO DE JANEIRO CITY

As a cosmopolitan city, an indiscriminate replacement of urban improvements took place in Rio de Janeiro during the twentieth century, wherein neighborhoods were eradicated, traditional areas were relocated, major traffic routes and avenues were built, resulting in a great cultural and environmental loss, since more than 10km² disappeared from the urban network favoring the construction of large sets of new buildings and parks. Therefore, there is awareness that urban regeneration must be present in all possible interfaces.

Among said interfaces, two examples can be described in tourism and the health-care sector, as follows:

TOURISM

Introduction

According to the Brazilian Association of Hotel Industry – Associação Brasileira da Indústria Hoteleira – ABIH (2002), the Brazilian hotel industry has now approximately

25 000 means of hosting, wherein 18 000 are hotels, bed and breakfast inns. Broadly, 70 per cent of the enterprises are small and a few are properly certified, but it is possible to achieve, by means of rehabilitation aiming sustainability, a new step in accreditation (star rating) of the hotel establishment.

About 2 million foreigners a year go to Rio de Janeiro, the main gateway to Brazil, beside the growth of the ecotourism, generating more than US\$ 2 billion, being half of such figure spent in small hotel establishments, which propose an association of stock, maintenance and retrofit programs related to the sustainability of inns, health spas and small hotels (under 50 rooms), represented by the following programs:

- Sustainable Tourism Certification Program (PCTS – *Programa de Certificação de Turismo Sustentável*); and
- Receive Well Program (Programa Bem Receber).

The aforementioned programs will implement a system of sustainable management to achieve certification. Herein, the ABNT standard NBR-15401 related to Media Hosting – The Sustainability Management System (Amorim and Coradi, 2004) provides guidelines, which may generate savings in electricity and water, by using taps and lamp timers, anti-noise walls, access/entry card systems with environmental messages, using split air conditioning (less polluting and more economical), in addition to the presence of natural light, in different environments, to reduce electricity consumption, which makes the hotel establishment sustainable.

Context of the proposal

The new Classification Matrix of ABIH (2002) and EMBRATUR (1996) positively scores the establishments from simple to super luxury, maintaining a monitoring report on energy consumption and solid waste reduction, reducing the impact on the environment. Thus, it is possible to work on related rehabilitation interventions in such small establishments. Therefore, the *Receive Well Program* represents a unique opportunity in sustainable management of hosting, with up to 50 hosting units around the city, by means of qualification and certification actions that had already achieved over 180 means of hosting in 2006, with NBR-15401 standard-based audits, enabling the establishments to suit their architectural spaces to 'Means of hosting' by means of rehabilitation actions, complying with the ABIH *Matrix Classification* and precepts of sustainability.

Considerations on tourism, sustainability and rehabilitation

The new assessment model (star scoring versus rehabilitation) is at a first stage, with a team of about 110 auditors validating the results, which will in turn be assessed to become the pilot model of a project that will be able to reach the entirety hotels in the country. The project which was cited is justified since the city is a candidate to host the Olympic Games in 2016, thus enabling it to comply with one of the requirements of the International Olympic Committee (IOC) for the 2014 World Cup in Rio de Janeiro, already confirmed.

HEALTH CARE

Introduction

Oswaldo Cruz Institute (Instituto Oswaldo Cruz – IOC), an organ of the Ministry of Health in Brazil, is a public institution located in Rio de Janeiro, which plays an essential

role in technological development and scientific progress in health and biosafety, at international level. IOC comprises 66 accredited biomedical research laboratories, having an infrastructure exceeding \$ 2 billion, with the objective of conducting research and development of medicines, vaccines and recognition of diseases from viruses and bacteria in all known forms. These laboratories are located in old pavilions and have complex environments, in differentiated spaces with specific requirements, which in turn make the expansion flexibility infeasible.

Pavilhão Carlos Chagas at IOC is presented in this report as a case study, emphasizing the refurbishing process of the biomedical research laboratory.

Conditions of the situation

In the current context, biomedical research institutions are adopting specific measures for biosafety, based on national and international standards regarding the conservation and handling of pathogenic micro-organisms. The implementation of national and international rules is justified in the gradual development of modern biotechnology, especially genetic engineering, the technological advancement of the research laboratory, and the potential risks and effective practice of manipulation of micro-organisms, clinical material, inoculated animals and transgenic plants (FUNASA, 2001).

However, the refurbishing of laboratory space and project development depends on guidance from the 'National Health Surveillance Agency' – (*Agência Nacional de Vigilância Sanitária* – ANVISA), the 'National Health Foundation' – (*Fundação Nacional da Saúde* – FUNASA) and the 'National Biosafety Technical Commission' – (*Comissão Técnica Nacional de Biosegurança* – CTNBio) that impose quality and biosafety requirements specific to biomedical research labs, further demanding a new physical infrastructure for conducting scientific activities, based on handled biological risks (CTNBio–FIOCRUZ, 2005; Vieira and Lapa, 2006).

Thus, in view of new technologies, it becomes necessary to propose actions that enable rehabilitation of old buildings, particularly laboratories, and to establish performance criteria for the building, combining quality, productivity, space optimization and biosafety requirements.

Historical context

The foundation of *Instituto Soroterápico Federal de Manguinhos*, also known as *Instituto Oswaldo Cruz* (Fiocruz), in 1900, consolidated the research in biomedical sciences. The Institute has been intended to be 'an institute for studying tropical infectious diseases, following the standards of the *Pasteur Institute* in Paris' (Lima and Marchand, 2005). Accordingly, *Instituto Oswaldo Cruz* participated directly in successive stages of scientific evolution, wherein areas of contention are necessary to manage the risks in specialized laboratories for developing medicines and vaccines (Schatzmayr, 2006).

In said laboratories, which now comprise 66 units in an area of over 500 000 m², it is an architectural assumption that space is an important aspect for the reliability of experiments, to protect either human health or the environment. As a result, the planning process of such buildings requires a joint effort by researchers, laboratory technicians, architects and engineers, in order to establish the architectural project, patterns and standards that ensure compliance with the safe space and environment conditions required for usability (Simas, 2002).

Moreover, the laboratory building has a very short user life cycle, becoming obsolete in 5–10 years. Therefore, it is noted a great difficulty in establishing the level of refurbishing to which these improvements should be submitted, consisting in a great

challenge for designers when refurbishing the constructions systems, versus the usage flexibility of environments, depending on the physical limitations of former laboratories.

Analysis of critical performance of laboratories

In 2003, it became necessary to have *Pavilhão Carlos Chagas* building refurbished so that it could be adapted and able to supply the current needs. Said building was originally designed in five stories and a basement, built in the 1940s, housing the *Hall of Pathology*, with a built area of 3014.66 m², (563.87 m² for each floor, 631.16 m² for the ground level and current vivarium, and 128.00 m² for the basement).

It was then noted that the laboratory environments were not in accordance with biosafety standards and recommendations, since the office areas were juxtaposed to the laboratory area because of the lack of retaining walls for secondary access to the laboratory areas.

It was also observed that the original coating materials used in laboratory spaces comprised ceramic tiles and acrylic painting, vinyl floors and laboratory furniture, composed by masonry benches covered with tiles.

Moreover, the physical infrastructure of supply facilities was in bad conditions, with apparent electrical and hydraulic installations, exposed aerial sewage pipes in laboratory areas and supply networks for fire fighting which were loaded, but inactivated.

Finally, the building did not have technical stories and the air-conditioning system comprised inappropriate individual units, as the existence of an insectary demands a constant temperature and humidity control.

Procedures for laboratory space refurbishing with biosafety

Regarding the process of modernization and refurbishing of the Pavilion, it is remarkable that the building is part of a strategic set of laboratories for worldwide vector control and, because of their singular activities, making it contemporary, incorporating technological advances by using state-of-the-art materials is essential (Barrientos and Qualharini, 2004). Thus, since the laboratory environment does not comply with biosafety standards and recommendations, administrative areas and office environments were defined apart from the laboratory, by developing physical barriers and interlocking systems for access doors, wherein the width of the hallways should be reduced without affecting the flow of people, to provide unique conditions of escape, in addition to emergency showers and eye-wash stations designed along the hallways.

Concerning compartmentalizing and coating in laboratory spaces, it has been used a continuous acrylic coating on the walls and vinyl blanket on the floor, with aluminum corners at wall and floor edges, in order to facilitate room sterilization. As for the laboratory furniture, specific projects have been developed and benches have been made and coated by laminated melamine and stainless steel and mounted on metal profiles. Furthermore, all existing building supply installations have been removed, as to allow installing of new networks and the new vertical plumbing was installed at the external rear facade of the building.

Regarding the facility improvement interface, it has been planned to build a utility center at the rear facade, comprising external technical level sections, with openings at the rear facade of the pavilion, connecting the stories of the building and allowing the installation of air conditioning system with air handling units and a cold water central to supply the laboratories.

Following CIBio (Fiocruz Biosafety Internal Commission) recommendations, all additional facilities have been enclosed by walls, and a cooler box has been built on the ground floor to collect water from the autoclaves in the laundry rooms and an exclusive box for diluting chemicals. Further, the fire fighting network has been restructured, including leak-proof and smoke detection control systems.

Considerations on rehabilitation and sustainability in laboratories and health-care buildings

The health-care buildings must be the first to worry about build sustainable buildings, the internal and external spaces must be healthy. After all they are responsible for the health of the population and this gives them the opportunity to demonstrate in actions the influence of the environment on people's health.

There are some methodological indicatives of categorization that are used in the quantification of sustainability and the qualification of those that could be fit as sustainable or 'green', like some existing systems in Canada (Canadian Coalition will be Green Health Care) and in United States, (LEED, Hospitals for a Healthy Environment (H2E), Health Care Without Harm), concentrating in the maximization of the natural light, the access to the external sight and the rehabilitation of the constructions (*Retrofit*).

Organization and distribution of laboratory environments have been transformed and reassessed at certain time points in light of new changes of scientific paradigms.

Constant physical adaptations and adjustments in biomedical research laboratories indicate the dynamics of such environments and a projective system, which complies with the emergencies and limits the risk for the work teams.

Therefore, as to enable this work to generate solution indicators that can be adopted in other buildings having the same purpose, either in Brazil or in any other international laboratories, a critical proposition of the study is listed below, for rehabilitation interventions in biomedical research laboratories:

- (a) cadastral survey of the building to bring off the development of original projects and construction records;
- (b) meetings and interviews with users to distinguish the characteristics of the activities developed in the biomedical research laboratories;
- (c) extensive consultation on biosafety regulations and handbooks;
- (d) prior definition of intervention procedures and methods;
- (e) development of a pre-design, evaluating the performance of novel materials in laboratory environments and focusing on sustainability and future refurbishing; and
- (f) making the predictive maintenance and executive projects compatible, focusing on biosafety.

FINAL CONSIDERATIONS

There are social, environmental or technical parameters recorded herein, which are intended to provide a paradigm change, which can lead to

1. maximizing building life cycle, increasing their useful time, in order to reduce consumption of new natural resources (energy, water and raw materials), delaying horizontal expansion of urban occupation, avoiding endangerment of environmental preservation areas;

2. designing new buildings with the highest architectural and structural flexibility, directing the project focus for possible future recycling and rehabilitation;
3. increasing the efforts to reduce the amount and volume of urban waste generated along the processes of rehabilitation, maintenance and restoration of buildings, therefore reducing new landfill areas;
4. encouraging the reuse of demolition materials, recycling to manufacture alternative products, thereby reducing the consumption of new resources;
5. prioritizing the determination of methods and techniques, which emphasize the life cycle of buildings, extending its useful time;
6. optimizing the study of proposals for recycling unused buildings, leading to the awareness that unused constructions could be spaces with potential use in the urban built environment;
7. considering the compatibility of usability of the rehabilitated estate with future maintenance, targeting sustainability; and
8. considering all examples, even the obvious and simple ones, for information on all interfaces of civil engineering production, consequently generating sustainable conducts in city rehabilitation.

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