

Reusing built heritage resources with sustainability

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REUSING BUILT HERITAGE RESOURCES WITH SUSTAINABILITY

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Abstract: Many old cities spread all over the world, face obsolete buildings, quarters or areas that urge for maintenance, re-adaptation or demolition. Among time, built heritage has always been re-used or recycled, suffering adaptations related to the living needs of its inhabitants and contemporary society context.

Commonly, building's lifespan regarding its survival and eventual disappearance, either partial or total, has scarcely been taken into consideration. But now, with the Ecological concerns as an imperative XXI century claim from our devastated planet, Society has to face existent buildings as a liable construction resource, that already occupies a considerable area of our cities and that would be foolish to waste.

Re-Architecture: Lifespan Rehabilitation of Built Heritage, born in 2002 as a concept and is now being developed in a PhD research; coordinated by Prof. Ir. Jouke Post and Dr. Ir. Peter Erkelens. This renewal system under development, will not only contribute for the quality improvement of existent buildings interventions; in flexibility, sustainability and lifespan assessment, adaptive to consumer/user expectations and needs; but also for the preservation of both built and environmental heritage.

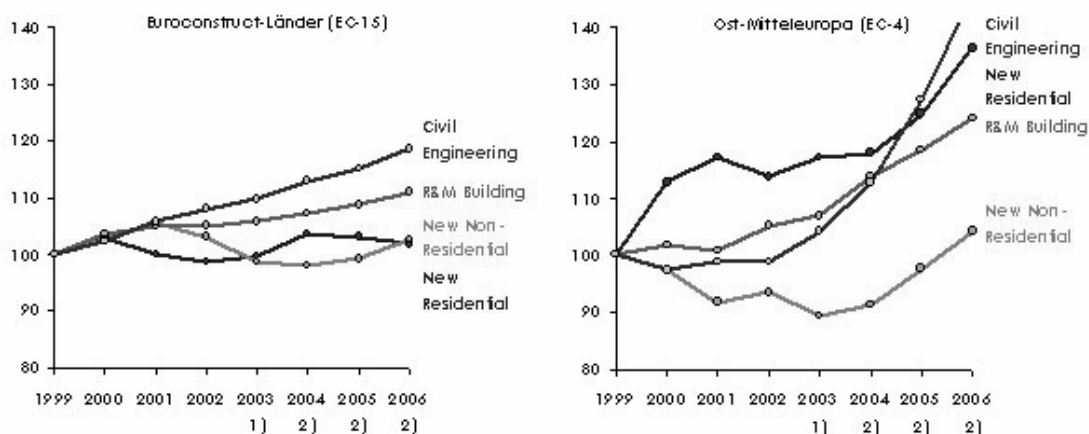
Keywords: Built Heritage; Sustainability; Lifespan buildings

Introduction

After some years of low achievements, construction industry is once again raising in the EU Economy. According to Euroconstruct latest forecasts, the total construction market will increase just about 1.9% this year. As we can see in the following figure, just below Civil Engineering, R&M (Renovation & Maintenance) role is increasing within investment, while current construction balances between increase and decrease.

Even if this represents a good progression in the construction sector, truth is that R&M are still below expectations, and unfortunately not always, this percentage of reusing existing building stock is taken forward with impartiality and authenticity; taking as guidelines the most suitable aims, values, stimulus, nor technologies.

Table 1 – Construction Sectors by Type, 1999 – 2006 (Euroconstruct 2004)



Reusing existing buildings from the urban stock is already *per si* an action based on sustainable guidelines. Nevertheless when time claims to change or upgrade, the alternative of constructing new spaces and buildings is always more favored by society than the simple reuse of existing buildings. Builders always complain about the cost – profit relation, much higher in the new construction than in rehabilitation interventions, but this statement is not that linear in truth.

The fact is that the resources exist already there and as long as you maintain, reuse or recycle the existent elements, structures or materials instead of wasting them, with the necessary adjustments, a huge percentage of costs could be spared. Our research target for lifespan rehabilitation is specifically this construction sector - built heritage and not the entire existing built stock.

Definitions

Built Heritage

Built heritage is the research denomination for all kind of existing buildings that passed down from one or more preceding generations, moreover the cultural heritage symbol of “outstanding universal value from the point of view of history, art and science” declared by Unesco in the Convention Concerning the Protection of the World Cultural and Natural Heritage, in the Paris meeting (1972, article 1).

We believe that every existing building, even if not interesting by any reason, represents always the daily environment of many generations and provide a sense of local continuity anchored in the past toward the uncertain future. Always associated to their inhabitants or actions, they represent past traditions of architectural design, craftsmanship, and ways of living and building, and somehow can contribute for the

development of future incoming generations, even if not in its totality, as an existing resource of structures, elements and materials.

Table 2 - Built heritage values and entities

BUILT HERITAGE					
Universal value from the point of view of resources preservation, use and recycling					
Values					
Cultural			Ecological		
Historic	Artistic	Scientific	Age	Social	Economic
Entities					
Urbscape			Buildings		
Territory	Surrounding	Site	Form	Technology	Aesthetics
Group of Cities	Neighborhoods	Urban Fabric	Elements	Structures	Decorations
Cities	Quarters	Buildings	Spaces	Materials	Traces

Rehabilitation of Built Heritage

The challenge of reusing built heritage with sustainability, imply varied fields that have to be taken into consideration. Beyond other intervention typologies, rehabilitation is our main field of study, combining renovation and re-adaptation, both integrating the contemporary needs. The main difference between these two concepts is functionality. While in renovation you renew the building with the same function, in re-adaptation you convert the building into a totally different function.

Normally re-adaptation requires a higher percentage of changes and transformations than renovation, because the building has to adjust and fit new functions with different needs and conditions. But mainly it depends on the existent space planning, its contemporaneity and state of degradation. Another big influence in rehabilitation is the technician and his philosophy regarding old buildings rehabilitations.

The following two examples of renovation and re-adaptation represented in Figure 1 and 2 show this duality in rehabilitation. According to Miralles and Tagliabue, the neo-classical Utrecht Town Hall was converted into a monument. “When the door opens it converts itself into part of the public space of the City. In the construction of the new wing we recycle material (brick, window ledges and lintel stones, etc.) of the demolition...to achieve a new building with quality materials.”¹

**Figure 1 - Renovation of the town hall of Utrecht – the Netherlands,
Enric Miralles e Benedetta Tagliabue (1996 – 1999)**



Hotel St. Maria do Bouro project was seen by Souto Moura (1996, p. 23) as a whole conceptual structure, where “ruins are more important than the actual ‘monastery’, since they represent available, open, manipulate material, just as the building itself has been throughout history.”²

**Figure 2 – Re-adaptation of a convent into a hotel, St. Maria do Bouro - Portugal,
Architect Eduardo Souto de Moura e Humberto Vieira (1989 – 1997)**

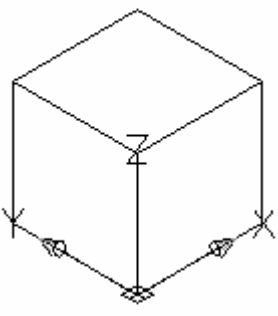










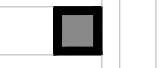























Beyond the functional factor, the spatial relation between old building and new intervention is also an influencing factor, fundamental for the development of varied technologies and materials adequate for the bonding points between such non-contemporaneous structures. Most Rehabilitation interventions embrace not only one of these categories, but a combination of them.

Most often we find past and current interventions with intercepted relations, especially in city centers when normally old buildings don't have many surrounding space free. This means that you would only intervene in the old building, restoring, replacing or simply changing the necessary circumstances to provide a contemporary use of the

building, with salubrity, functionality, safety, and comfort.

Table 3 – Spatial relation between the old building and new intervention



A PART  	A1 BACK   MOVE (-X,0,0)	A2 LATERAL   MOVE (0,±Y,0)	A3 FRONT   MOVE (+X,0,0)
C ONNECTED  	C1 UNDERGROUND   MOVE (0,0,-Z)	C2 UNDER   MOVE (0,0,-Z)	C3 ABOVE   MOVE (0,0,+Z)
 	C4 BACK   MOVE (-X,0,0)	C5 LATERAL   MOVE (0,±Y,0)	C6 FRONT   MOVE (+X,0,0)
I NTERCEPTED  	I1 INTERNAL   MOVE (0,0,0)	I2 EXTERNAL   MOVE (0,0,0)	I3 UNDEFINED   MOVE (0,0,0)

This category of spatial relation – Intercepted – has three physical diversions, two of them with a definite location for the new additions and characteristically denominated as:

I1 Internal – Emptying the interior of the building in case of high degradation or to better integrate the new intervention, preserving only heritage in the external façades – interesting mainly for the urban scale –reinforced by a total new interior, getting the old envelope a merely aesthetical function, just as the embalming of ancient Egyptians mummifications, but this time with the purpose of passing buildings towards the afterlife.

I2 External – Changing the exterior of the building for many general reasons, but many times is related to aesthetics, modernized by time and society. Some times the building itself doesn't see its original façade demolished, but the born of a second skin, as an extra-covering with new function and style, just as a contemporaneous facelift.

I3 Undefined – Punctual changing's in the exterior and interior of the building for many general reasons, but many times is related to the integration of the new function and its needs. In case of similar function, you may restore, replace or simply change necessary circumstances to provide a contemporary work of the building.

Figure 3 - Vertigo building before and after intervention (2000 – 2002)³



Vertigo building, that now hosts the Faculty of Architecture, Building and Planning, was originally the Faculty of Chemistry of TU/e (Eindhoven University of Technology). This intervention that started in 2000 is a good example for spatial relation typologies, because it combines punctual interior alterations with a total external renovation. Beyond the aesthetical facelift this new ‘curtain wall’ provides also air temperature regulation, through an ecological system of ventilated cavity that creates an optimal internal climate. Beyond all this alterations, also spatial extensions were structured connected at the front and backside of the building.

This integration of contemporary needs, elements, technologies and materials can be motivated by several aims and stimulus. These motions of improvement are not always related to the building performance, but also to their actor’s wishes, needs or demands. In a subjective dimension, Social and Economical factors are normally related building users and owners.

Nevertheless, in an objective dimension, technical factors like Function, Physics and Environment, stimulate intervention mainly by the real condition of the building. Then also under Legal auditions, salubrity, safety and comfort established by technical regulations and legislation, are demands that have to be achieved, either in ventilation, illumination, acoustic and climatic.

Table 4 -Changing factors that stimulate interventions

Social	Economic	Functional	Physical	Environmental	Legal
Human needs	Reduce utility expenses	Functional update	Deterioration and natural use damages	Ventilation – Air Quality	Planning policies
Upgrade the building	(energy and water)	Increase living or working space area	Inefficiency of elements, structures or materials	Domestic hot water systems	Legislation or technical regulations
Aesthetics	Increase value			Improve Daylighting	
Cultural requirements	Cost profit with a long term profile	Accessibility for both able and disabled people	Vandalism actions	Acoustic Insulation	Safety
Comfort			Urban blight	Thermal Comfort	Salubrity

Hence, in all this process we can find plenty opportunities to integrate sustainable technologies and materials. For example, the International Energy Agency, Solar Heating and Cooling Programme (IEA SH&CP) has developed from 1993 till 1998, with the Task 20, ecological strategies for the integration of solar energy into the rehabilitation process.

Task 20 renovated several buildings in many countries, such as Belgium, Denmark, Germany, The Netherlands, Sweden, Switzerland and the USA. Among many promising and technological options, they integrated solar collectors, glazed balconies and transparent insulation, contributing to the reconstruction of the building, users comfort and thermal performance.

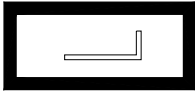
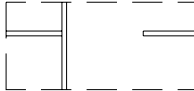

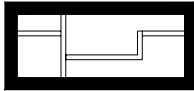
Lifespan Rehabilitation of Built Heritage

Even with sustainable rehabilitations spread all over the world, most of the interventions are still very traditional and without taking any particular consideration for the lifecycle analysis of the building, function and materials. Aesthetics and functionality still commands technician's decisions and most economical solutions still conquer the owner. Few are who intervene and sustain all this priorities related to ecology.

Lifespan analysis and developments are not a matter of time waste, but time control. Built heritage rehabilitations don't need to be synonym of wasted demolitions, but the base of technical innovations, functional changes and user preferences.

Until now we didn't find any developed design theories, methods, and instruments that support the rehabilitation and restoration of heritage buildings, seen from the perspective of the concept of lifetime responsive design of integrating temporary building elements into existing buildings, with different time layers.

Table 5 - Lifespan Rehabilitation technical layout system

LEVEL I LONG TERM	LEVEL II MID TERM	LEVEL III SHORT TERM	TOTAL COMPOSITE SYSTEM
			
SITE & BUILDING LOGISTICS BUILDING & SURROUNDINGS STRUCTURAL SYSTEM ARCHITECTURAL SYMBOLS	PLANNED LIFESPAN INTERIOR WALLS FLOOR & CEILING INSTALATIONS	FLEXIBLE STRUCTURE FURNITURE MECHANICAL EQUIPMENT FUNCIONAL SUPPLIES	PLANNED LIFESPAN BUILDING SUSTAINABLE REHABILITATED

Consequently with lifespan rehabilitation we have at the same building different design demands and intervention layout system that can perfectly live harmonized within each other. Each of them is directly related to the functional and physical lifespan of their building elements.

LEVEL I, structures the Long-term layout. This term is more related to the old building and its real condition, than the following two levels. Site, owners, users and buildings logistics will dictate necessary upgradings to the technicians. Rehabilitation will preserve, as most possible, the existent built heritage entities found in the preliminary inventory. Structural systems can be reinforced where needed, with the eventuality of having some new structures added in order to sustain the intervened building.

LEVEL II structures the Mid-term layout. This term is related to lifespan-planned structures integrated in the new intervention, with a more permanent and static scale than Level III. These structures can even be integrated in connection to level I elements, according to their designed function and time utility. They can be walls, floors, ceilings, roofs, installations (water, electricity, heating and cooling, ventilation), etc; everything that can be lacking in the existent old building.

LEVEL III structures the Short-term layout. This term is also related to lifespan-planned structures integrated in the new intervention, but mainly temporary and dynamic. These elements are demountable and flexible modules that can move and be used every time the owner needs, such as external spaces, internal space divisions, furniture, mechanical equipment or functional supplies.

Table 6 – Lifespan rehabilitation main characteristics

Convertible	Flexible	Expandable	Demountable	Disaggregate
Intervention allows change of use without much efforts	Intervention allows swifts in space planning without much efforts	Intervention can provide increases of volume without much efforts	Intervention can be safely and efficiently demolished	Components or materials after demounted can be reused or recycled
Ecologic	Life cycled	Energy efficient	Consumer Oriented	Profitable
New materials should be eco-friendly either in their nature or function	Components or materials have their lifecycle analyzed and maintenance planned	Lighting, warming and cooling are assured by Passive and energy-efficient technologies	Building Manual give to users and owners all utility, maintenance and change instructions	Reused buildings don't have immediate return as new ones, but all savings became profits in long term

Conclusion

Built heritage will not see damaged their cultural character due to lifespan rehabilitation interventions. Ecological principles will guideline such intervention, enabling both structures and hierarchic levels of elasticity even if connected to each other. This intervention respects and preserves already existent technologies and simultaneously reflects the XXI century living.

The main difference from lifespan buildings, as the XX project from Architect Jouke Post, is that building won't disappear when functional time ended, but the building components may vanish. Everything will be planned for its utility lifecycle. This means that these spaces and structures integrated with the renovation (level II – Mid-term and III – Short-term), can be used during the planned period of time, and when they are no more necessary or outdated, demounted and re-used again somewhere else.

The knowledge obtained with this research project will result not only into theoretical concepts, but also into a design decision support system that will be suitable for the building industry. At its last phase, two case studies in Portugal and the Netherlands will be selected to compare and verify the applicability of this new philosophy in practice.

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