Re-Architecture: Lifespan rehabilitation of built heritage

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ABSTRACT: Re-Architecture: Lifespan Rehabilitation of Built Heritage was born in 2002 as a concept and is now being developed in a PhD research in the BTO Department - TU/e; co-orientated by Prof. Ir. Jouke Post and Dr. Ir. Peter Erkelens. There was a mutual desire from all involved technicians; to join Architectural and Technological knowledge’s, and to develop a conscious building rehabilitation, that for its heritage value (architectural, technological, material or even economical) didn’t present the imperative need of being demolished.

This renewal system under development, consisting of methods and techniques as how to approach the problem of installing temporary structures and building components into built heritage, originally constructed without lifespan limit; will allow, beyond the research and design cases results, the development of a toolkit (containing procedures, guidelines and details specific for the intervened building) that can be used for all interested technicians, designers; but profit by promoters and consumers. Following this new concept, technicians believe in a true contribute for existent buildings interventions; more flexible, sustainable and with its life spanned; adaptive to consumer/user expectations and needs.

Conference Topic: 6 Recycled Architecture (re-use, upgrading and rehabilitation of buildings)

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INTRODUCTION

Over past two centuries and especially since Industrial Revolution, natural ecosystems of our planet have been progressively and alarmingly destroyed by Mankind. The rapid demographic explosion is one of the causes for this disequilibrium, but technology developments have been the main responsible, for enabling the population of means to transform the face of the earth.

"The ambient levels of carbon dioxide in the atmosphere have increased from 280 to over 360 parts per million in the past one hundred years. Mean sea level rose 4 to 8 inches in the XX century. The polar ice caps are melting. And earth’s average temperature has risen more than 1 degree Fahrenheit in the past hundred years." [1]

Mankind has been very wasteful generally, but particularly, in what concerns our thematic, has been very wasteful regarding new construction: housing, commercial facilities, industries, public buildings, etc., satisfying their needs and wishes of their families and businesses with an under-use of the existing building stock.

As Consequence, we face now, in most old world cities, a considerable percentage of buildings and urban areas that face obsolesce and degradation, abandoned in functions or care by its own society. Because of all this rationale reality, there is the urgent need to find ways to reuse these buildings and to revitalise these same spaces in order subvert this existent resources disequilibrium.

Lately some of this few interventions have been done, but unfortunately for varied motives as lack of knowledge, maintenance or unsuccessfully choice of materials and technologies, buildings appear more degraded just a few years after intervention.

2. SUSTAINABILITY VERSUS HERITAGE

Nowadays Sustainability had became a common word for our society syntax; nevertheless because of its complexity and wide-reaching concept not always its true meaning is really understood. I wouldn’t be fair to all interested individuals if I would say that little has still been done, so I’ll prefer to state that much has still to be done in order to compensate all ecological aggressions made over the past decades to our planet.
In 1972, United Nations introduced its Environment Program, and the Cocoyoc Declaration in 1974 recognized that humanity was in a critical turning point, and that environmental degradation and the rising pressure on resources would sustain the question whether the ‘outer limits’ of the planet’s survival wouldn’t be a risk to mankind.

The General Assembly of the United Nations established the World Commission on Environment and Development (WCED), known as the Brundtland Commission in 1983. The report, Our common future, defined sustainable development as the “process of change in which the use of resources, the direction of investments, the orientation of technological development and institutional change must all be in harmony with each other and increase all present and future possibilities to meet human needs and desires.”[2]

Even if all this past declarations and reports had a strong effect inside the scientific and technical world, only with the well known United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro – 1992, Sustainability and its Developments where taken to the vanguard of XX century global politics and consequently media and population.

Two documents have been produced in this international conference: Rio Declaration and Agenda 21. Rio Declaration recognized the value of equity between social ecology and economical development, calling the polluting nations to reason and demanding their contribution for the World Environment decontamination.

USA already refused to implement Kyoto Accord that grew from the Rio Declaration; nevertheless other nations are still trying to achieve the goals and strategies predetermined, in order manage ecologically continuing development strategies.

Agenda 21 acknowledged, “Humanity stands at defining moment in history. We are confronted with a perpetuation of disparities between and within nations, a worsening of poverty, hunger, ill health and illiteracy, and the continuing deterioration of the ecosystems on which we depend for our well-being.”[3]

Later, The Habitat conference in Istanbul - 1996, continued in the same line of thinking confirming same statements and important factors for the development of sustainability. It was pointed the need of promoting technological innovations and social evolutions. Raw materials should be renewed, so that energy and production of goods wouldn’t be wasted, but recycled as much as possible.

"Buildings, spaces, places and landscapes charged with spiritual and religious value represent an important element of stable and humane social life and community pride. Conservation, rehabilitation and culturally sensitive adaptive reuse of urban, rural and architectural heritage are also in accordance with the sustainable use of natural and human-made resources. Access to culture and the cultural dimension of development is of the utmost importance and all people should be able to benefit from such access.”[4]

3. HERITAGE VERSUS SUSTAINABILITY

The 4th Annual US/ICOMOS International Symposium in Philadelphia – 2001 came to prove that also sustainability is a common concern for the Conservation of the built environment. It was stated that conservation has always been much related to sustainability, because of it's mainly support in traditional technologies, allowing repair and reuse, instead of the constant and common wasteful cycles of destruction and rebuilding.

It was defended that conservation has always been thoughtful about the variety of values that people append to places and spaces, even if not always technicians and researchers have had the capacity to understand and recognize its priorities and concerns. Still, it has always been more about "present and the future rather than a nostalgic attachment to a past that we can never completely understand.”[5]

In this research, built heritage is considered as all the tangible cultural heritage regarding both
urbanism, architecture and art crafts; that time or society recognized within an inborn or proclaimed character; symbol of culture for the people, nation or world. It isn’t necessarily related to monuments, even if included, but to every ‘object’ from the past that doesn’t present the extreme need of demolition and waste.

Furthermore, even if these heritage living testimonies had always honoured the collective memory consideration of its false eternity and long-term structures, is now time to think about its real ephemeral circumstances. These same ‘objects’, will inevitably decay if not maintained, and this is one of the main reasons to its form and function mutations among time.

4. LIFESPAN REHABILITATION

Old buildings claim for a cultural survival and the Planet for ecological concerns. Couldn’t we avoid many building demolitions, if we could develop a sustainable design methodology to intervene in old buildings, taking into consideration the planned lifespan systems with consumer oriented priorities?

Existing building’s reuse is now very common, but the current method of rehabilitation is still very traditional, in such way that the building alterations are intended for the longest term possible, without the serious concern of the ephemerae characteristic of all related components. But if the concept of lifetime relation is taken into account, rehabilitation design in heritage buildings will mean avoiding costs and not sustainable demolitions, through the base of technical innovations, functional changes and user preferences.

Currently there are not any 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 parts and elements into existing buildings with different term layers.

With lifespan rehabilitation we will have consequently at the same Design Building different demands that can perfectly survive within each other:

I - Long Term level where the pre-existence building is preserved and reinforced where needed,

II - Mid Term level where structure is specifically designed to function during a certain time and

III - Short Term level with some demountable modules that would move and be used every time the owner felt like

All these three structures will be related and connected by research elements, theories and conclusions based on the Research knowledge’s achievements. Simultaneously we’ll be able to:

A – Rehabilitate the old structure, reusing the possible existent resources and taking in consideration both building and its environment;

B – Structure a new lifespan function, with its many installations, spatial forms and interior limits;

C – And finally present a contemporary and adequate living space with flexible and modular structures that beyond all the necessary mechanical and functional equipment can be changed or replaced, depending only on the consumer wishes and needs.

LEVEL I
LONG TERM

LEVEL II
MID TERM

LEVEL III
SHORT TERM

TOTAL
COMPOSITE SYSTEM

Figure 2: Lifespan rehabilitation technical taxonomy

An essential quality factor related to its cultural and ecological value/status will be integrated in the building design theory, essential and sustained by all this building concerns and influencing sciences. If one of these fields is forgotten, the achievement of the intervention won’t be taken for granted in its totality and research methods will be able to determine and scale which consequences can result from this lack.

Figure 3: Lifespan rehabilitation conceptual taxonomy
Environmental, Technological, Social and Human Sciences can together solve many disperse interests and Lifespan Rehabilitation Design will try to take profits from this multidisciplinary connection, very useful for the Architecture + Technical scientific development.

With the contribute of this global consciousness, misuse and destruction will strongly decrease in the construction industry, that often, is characterized by buildings with bad located implantations that totally destroy the Ecologic Pre-existence; bad chosen materials that after some years present their faults, bad technological and structural solutions, bad functional and consumer guidelines that make them change and waste first used materials, etc....

Concrete and its derivations are often unconsciously used in rehabilitation interventions as the solution for coverings, floors, walls, reinforcement of structure, etc. This technology is mostly chosen for economical motives, natural strengthens, commercial access facility and constructors experience. But with a non re-use status when demounted and with clear incompatible characteristics facing the traditional technologies and materials, this technical choices many times make the building suffer much more after intervention than before.

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Stone, Mud and brick walls traditionally built, present aggressive pathologies when covered by plastic and impermeable materials or transformed from resistant to concentrated structure (with concrete columns) transforming what once was structurally active to a simple wall filling. With a different mechanical behaviour both structures strike and the old one, many times weak, achieves a serious degradation and start to collapse. [6]

These interventions will affect directly the old structure that was the first motive to the building preservation and somehow the good initial intention is denied, even if unconsciously determined by the technicians involved.

Lifespan Rehabilitation projects will integrate spatial and technical flexibility adapted to temporary planned lifespan solutions and this may be the solution of the endless Heritage dilemma that daily sees its patrimony, from different centuries, being adulterated by the inadequate technologies.

As so many mistakes and defects in Built heritage interventions can be prevented with lifespan rehabilitation, specially the mechanical pathologies – created by human acts – that are generally born already in the project phase, when certain intervention methods are wrongly chosen. This flexibility and temporary planned lifespan solutions will also allow an acceptable error margin, because if the new integrated structure is demountable and flexible, wrong choices can be easily upgraded and improved.

Therefore this PhD research will contribute for the ecological and patrimonial objective of re-using existing buildings rather than creating new ones and for the technological development of such interventions so that, Built Heritage will have its concepts and technical structures preserved; and simultaneously adapted to the XXI century consumer’s needs.

An important matter to take also into consideration with this new investigation will be the introduction of ecological materials and technologies into heritage buildings, main motive why Lifespan methods where chosen, beyond many other studied ecological technologies.

European Commission current concerning ascend into the Sustainable Buildings and in the reduction of Construction and Demolition Waste and accordingly, this research will contribute for this important knowledge development; or wouldn’t be an ecological priority the preservation of used natural resources instead of demolishing and building with new resources.

Figure 4: Detail of an old stonewall complemetation in order to align gap places with cement mortar and pieces of ceramics

Figure 5: Detail of an old stonewall supporting structurally the new concrete structure
Figure 6: Lifespan Rehabilitation process description

So as long as technicians follow a conscious process during all the building lifecycle, improvements will be noticed. It’s time to think about serious matters that go beyond the concept, the aesthetics and the functionality of a building project. Lifespan rehabilitation process description synthesise all the phases of a rehabilitation-building project. It is expected from the technicians that they plan beyond the construction phase and that they take important factors into consideration.

RESEARCH METHODOLOGY

The methodology chosen to develop this research is the most suitable for solving the key research question and following, the sub-set research questions contain both qualitative and quantitative aspects. The key aspects are user preferences (perceptions, requirements), technological aspects (choice of materials, building parts and elements), environmental aspects (climate, life cycle, energy, waste & materials reduction), cultural aspects (history, heritage, context, traditions), and economical aspects (building and recurrent costs, maintenance, etc.).

The number of influences and aspects that have to be taken into account for the rehabilitation design process are numerous. Therefore, the factors in selection of this research project will be founded on results and conclusions that will evolve from literature review (state of knowledge, ‘best practices’, comparative study of design theories etc).

In addition, an extensive survey will be done (revealing user constraints, costs, technical assessments, and significant rehabilitation interventions), as well as test case development, design and analysis. For the selected methodology, the following research phases can be distinguished:

1. Rehabilitation Concept Modelling (project development; construction; use period; deconstruction; and rehabilitation)

2. Rehabilitation Design Development (Choice Model and Toolkit), which means based on phase (a), and elaborating on a design that is conceptualised in the earlier phase, as well as the development of rehabilitation design guidelines (ancillary to the Toolkit)

3. Design Model Testing, using varied selected cases studies (comparative study in Portugal and the Netherlands), that is assessing the developed rehabilitation design model with the use of selected design test cases

4. Rehabilitation Choice Model and Toolkit Evaluation, critically reviewing the developed models and designs, and the conclusions and the implications of this study as well as recommendation making for future research.
Figure 7: Old housing quarter converted into the BCP bank, Baixa – Lisbon, Portugal

Figure 8: Old Church and Convent converted into a Municipal Archive, Maastricht - The Netherlands

CONCLUSION

Architectural, historical and cultural building background won’t be damaged with planned lifespan ecological interventions, because both installations and its hierarchic systems are connected in such a way that, the building survives constructively and functionally appropriate to its new reality.

Many ecological materials and technologies can be used in the sustainable rehabilitation interventions, as long as the new structure, that reflects the XXI century living, is well integrated in the old structure, and the chosen materials respect both nature and existent technologies.

Planned lifespan can perfectly be integrated in old building structures. The only difference from the new buildings with planned lifespan is that we have already an existing building structure, besides the surroundings that can be used and architecturally preserved. Ecology related to the buildings life-span, such as other constructive techniques will allow that these spaces can be used during a certain period of time, and as when no more necessary or wanted, demounted and re-used again somewhere else (its renovation integration).

The current consumer oriented building is almost all the time part of a new urban plan, where there are many options that consumers can choose (colours, materials, more or less rooms, areas, balconies, garages, etc....). The new concept of integrating consumer orientation into lifespan rehabilitation will require possibilities of choice and flexibility in order to facilitate renewal and mutation, not only for the actual customer, but also for a future one, if changes occur within the planned lifespan.

The knowledge obtained with this research project will result not only into theoretical concepts, but also into design rules that can 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. It will be important to involve municipal authorities in this project, as well as the building owners. Also architectural and engineering offices, manufacturers and suppliers of construction materials for buildings rehabilitation and sustainable materials can profit with the success of this project.

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