

## Sustaining rehabilitation: A call to strengthen the building rehabilitation knowledge base

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# SUSTAINING REHABILITATION: A CALL TO STRENGTHEN THE BUILDING REHABILITATION KNOWLEDGE BASE

Ana Pereira Roders and Geert-Jan van den Brand; Eindhoven University of Technology, Faculty of Architecture, Building and Planning, Eindhoven, The Netherlands; [a.r.pereira@bwk.tue.nl](mailto:a.r.pereira@bwk.tue.nl) & [g.j.w.v.d.brand@tue.nl](mailto:g.j.w.v.d.brand@tue.nl)

## ABSTRACT

This paper addresses the need for an increased attention, to building rehabilitation in architecture and building science and education. In the past decades, rehabilitation is growing as a topic in building practice and is gaining policy support. In our perception the scientific field for building rehabilitation is still small and fragmented, especially if we compare it to the level of attention that is paid to design and construction of new buildings.

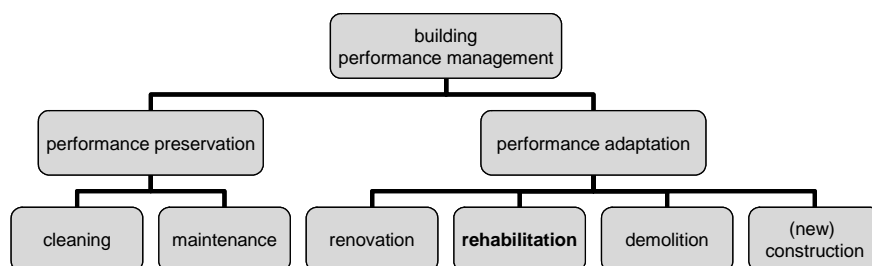
If we compare the number of tools available for new construction, with the ones available for rehabilitation work there is a clear gap. In the field of rehabilitation there are many worthwhile research initiatives, tuning of these individual actions is desirable. A stronger formalisation of knowledge in the field of building rehabilitation is necessary to raise awareness and support professionals, with tools and knowledge, to develop and execute sustainable rehabilitation plans for our existing building stock.

**KEYWORDS** rehabilitation, sustainability, lifespan, science

## INTRODUCTION

Since the beginning of our civilization reuse and adaptation of existing buildings has been common practice for all building professionals: designers, builders and owners. The public denomination as ‘rehabilitation’ has taken longer time to establish and it is still today vague, and variable according to the personal perspective of practitioner, policy maker or scientist. For many centuries, ‘conservation’ and ‘restoration’ have been the key terms in practice; (inter)national charters and recommendations. No longer do these cover the entire field of building interventions. For building intervention Henket has proposed a set of definitions that helps us to position rehabilitation (Figure 1). Henket chooses building performance management as a point of reference.

Figure 1 Performance management terms positioning building rehabilitation (Henket, 1988)



Pereira Roders (2006) has revised Henket’s set of definitions. Accordingly, rehabilitation is one of the seven intervention typologies. Scaled as intervention five, it is an intervention that beyond its evident improvement actions, partially integrates actions from the other types of intervention.

Table 1. The scale of intervention (Pereira Roders, 2006)

intervention			description	target					
				substance	function	performance	built	resources	
scale one	deprivation	passive abandon	leave the building fall into decay and obsolesce, without any concern	subtractions	original or current function	decrease	environment	none	
		active vandalism	contribute to the building's decay with destructive and intentional actions						
scale two	preservation	passive inventory	register, study and analyse the building (documental, oral and physical)	remainings		maintain	heritage		decorations and traces
		active prevention	clean and arrest decay in a routine basis to control degradation						
scale three	conservation	passive maintenance	repair small conditional damages in the general building context			sub. / rem. / add.	restore		
		active safeguard	repair medium damages and treat decays in the general building context						
scale four	restoration	passive restitution	repair large damages and consolidate punctual fissures / lacunas	additions		replace	newness		components / materials
		active reconstitution	consolidate and rebuilt lacunas according to the building aesthetics						
scale five	rehabilitation	passive reuse	combine earlier / later activities, subtract the exceeding and add the required forms and components	new function[s]	improve	environment	components / materials		
		active adaptation							
scale six	reconstruction	passive rebuilding	rebuild the building partially or totally, based on historic documents	additions	replace	newness	components / materials		
		active building new	build new buildings, reusing existing urban fabrics and infrastructures						
scale seven	demolition	passive reduce	demolish the building, but reusing or recycling the components / materials	additions	replace	environment	components / materials		
		active waste	demolish the building, without reusing or recycling the components / materials						

It embraces from both inferior scale – deprivation (scale one), preservation (scale two), conservation (scale three) and restoration (scale four); and superior scale – reconstruction (scale six) and demolition (scale seven). Rehabilitation has two sub-scales: passive and active, which are respectively related to the maintenance and replacement of the existent function.

Bernard M. Feilden (1982) while defining rehabilitation, sustained that “the best way of preserving buildings as opposed to objects is to keep them in use”, and that the “the adaptive use of buildings (...) is often the only way that historic and aesthetical values can be saved economically and historic buildings brought up to contemporary standards.”

The Burra Charter (ICOMOS, 1988) had also the same intention, but chose the terminology ‘adaptation’ as the intervention of “modifying a place to suit the existing use or a proposed use”. Accordingly, it should be “acceptable only where the adaptation has minimal impact on the cultural significance of the place, [and] should involve minimal change to significant fabric, achieved only after considering alternatives.”

Accordingly, James Douglas (2006), has also opted for the terminology ‘adaptation’, however he has stated that “there are many other different terms that are used to describe interventions to a building that go beyond maintenance. Words such as ‘refurbishment’ or ‘rehabilitation’ and restoration or restoration are occasionally taken as being synonymous with one another, even by some in the construction industry.”

## **POLICY RECOGNITION**

The term ‘rehabilitation’ was officially referenced in the European resolutions 68/11 and 68/12, adopted by the Ministers' Deputies, next to the conventional ‘preservation’, however it had as target, not common buildings, but “monuments, groups and areas of buildings of historical or artistic interest in urban and rural life” (Council of Europe, 1968b). In resolution 68/11, oriented towards the urban scale, rehabilitation should “aim the harmonisation of the old and the modern town” and “help to provide man with a framework and scale appropriate for his way of life”. Secondly, it should “under no circumstances be divorced from the general plan of development”; and thirdly, “be of educational value” and “reconcilable with the prospects of cultural tourism”. (Council of Europe, 1968a).

It was also recommended, to the governments of member states, in resolution 68/11, “the need to prepare their development plans in terms of a genuine rehabilitation or a better adaptation of these groups and areas of historical or artistic interest and of the monuments they contain [and] to the fact that such rehabilitation or adaptation will constitute an economic investment from both the human and the financial viewpoint”

The Declaration of Amsterdam (ICOMOS, 1975) enounced already, even if briefly the rehabilitation in the building scale, but stated that authorities should “facilitate the formation and efficient functioning of voluntary associations for restoration and rehabilitation”, and “methods and techniques of the restoration and rehabilitation of historic complexes should be better exploited and their range developed.”

In the IV European Conference of Ministers responsible for the cultural heritage (Council of Europe, 1996), it was recommended in Resolution n.2 - The cultural heritage as a factor of

sustainable development, the establishment of a “European methodology for heritage management in a framework of sustainable development”.

This would involve among other items “the formulating for public authorities and market partners decision-making criteria which highlight the long-term investment value of heritage programs and the fact that profitability in this area cannot be evaluated solely in economic terms but as a gain for society as a whole.” As well as “developing methods based on building stock life cycles to assess the environmental impact of rehabilitation of old buildings compared to buildings constructed according to modern production methods.” (Council of Europe, 1996)

## MARKET SHARE

In policy, rehabilitation appears to be a relevant issue. If we consider building research and education rehabilitation is still somehow neglected. Why would that be? Is there no market for development? The existing stock in every country comprehends built heritage and built newness, and the proportion, definitely makes built heritage a winner. The building stock is definitely asking for regard.

Just to illustrate, e.g. in Portugal, according to the Census (2001) around 60 % of the existing stock was built before 1980 and around 40 % of the total existing stock requires structural, roof, walls or framework interventions. This represents a universe of approximately 1.270.541 buildings needing for intervention. In The Netherlands, only in housing and in the next 5 years, about 500.000 dwellings in post-war residential areas will be renewed. Further on there is a structural vacancy of office buildings of about 1,2 million square meter. This is about 12 percent of the total office building stock that has functionally become obsolete (DTZ Zadelhof, 2005).

“The medium-term prospects are favourable, almost without exceptions, and over 150 million dwellings throughout Europe are 25 years old and more, and the same can be said of almost two thirds of the non-residential surface area.” (Euroconstruct, 2005) As seen by the evolution of the construction market segments (See Table 1), it is clear that it is expected a growth in the Building Renovation and Maintenance (R&M). “Renovation is not a market with great volume, but it also has prospects fro growth, albeit not spectacular, there are certainly very solid and apparently unlinked to the cycles which are manifest in new residential and non-residential building.”

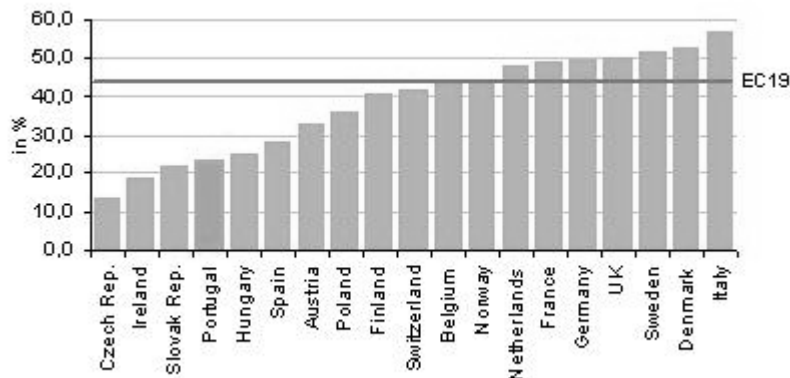
Table 1. Evolution of the construction market segments - % by volume (Euroconstruct, 2005)

	2002	2003	2004	2005 est.	2006 for.	2007 for.	2008 out.
Western countries							
New residential	-1,5	2,5	5,3	2,0	-0,5	-0,9	-0,4
New non-residential	-1,9	-3,3	0,9	0,0	1,5	2,0	2,3
Building R&M	0,1	0,8	1,4	1,0	1,7	2,1	2,3
Civil Engineering	2,2	2,2	0,8	1,3	2,4	2,3	1,9
Total construction output	-0,2	0,7	2,1	1,1	1,3	1,4	1,6

Figure 2 exposes the level of rehabilitation share in total construction output of European countries. We can verify that Portugal has approximately 23% which can be considered

considerably lower, when compared to other European members, e.g. the Netherlands with more than the EC19 average (44,8 %), and Italy almost reaching the 60%. (ITIC, 2005). Dutch figures by the research institute EIB show even higher rates for refurbishment and renewal, about 70% of the total construction turnover.

Figure 2. Renovation Share in Total Construction Output (ITIC, 2005)



Unfortunately, current legislation can be quite permissive regarding the mutation of existing buildings, especially if they do not have any specific classification (e.g. monuments). Instead, in cases of governmental or private safeguard, normally the inverse happens and buildings can become over-protected or “frozen” in their golden age. There should be a democratic way to solve this problematic of the total under- versus over-protection.

Rehabilitations or interventions should be controlled, and scaled according to the evaluation made from the building. After all, why, in our society, is it criminal and scandalous to destroy a building for political reasons in acts of deprivation (vandalism), while totally accepted when camouflaged in acts of deprivation (abandon), rehabilitation, reconstruction, and demolition? Do not society and future generations loose in both situations? Whom are we deceiving?

We believe that there is still a lot to do and to develop for sustaining the existing stock rehabilitation, not only regarding built newness (civil engineering, new residential and new non residential), but also to implement sustainability in built heritage. Facing the urgent need, and the market share increasing, we advise the cooperation among expertise for the development of tools to support interventions, to not regret afterwards and time forward that interventions done in the first quarter of the XXI century were made unconsciously and without expertise knowledge.

## DEFRAGMENTING RESEARCH

Due to its “newness” as official terminology and scientific perspective, rehabilitation interventions of built heritage – building stock built until the last generation (more than 25 years old) – are still secondary priority in the architecture education, as if they would require less effort from the architect.

CIB is the international forum for building research. They are divided into several working groups dedicated to actual themes in this scientific domain. There are numerous commissions, CIB has gathered them in three domains: 'building process', 'building technique' and 'buildings and the environment'. It is clear that rehabilitation is an issue in several working groups, notably W060, W70, W086, W100, W104, TG34, TG38. But, in fact rehabilitation deserves a working group of its own in order to efficiently assemble and defragment the research done in this field. This will help scholars all over the world to focus their particular research and to exchange their work with others. As a result, education and practice will profit from a more coherent development of knowledge and tools in this field. The foundation of such a work group is necessary, as we deduce from our inventory of market share and existing research.

Apart from CIB workgroups there are several initiatives worth to mention. Within the EU a dedicated research program called Cities of Tomorrow has delivered several outputs, among others the projects RESTATE and SUREURO (<http://www.cordis.lu/eesd/ka4/02-4.htm>). Fortunately in the academic world there are motivated scholars that persist on passing the message and recommend methodologies, so that students can alone open their eyes beyond the new construction illusionism. After all they are the professionals of the future, and if we cannot influence and improve this generation, maybe future generations will be more careful, intervening in their inherited building stock with lifespan consciousness.

## **TOOLS FOR SUSTAINABLE REHABILITATION**

It is remarkable the quantity of tools internationally developed to support sustainable development. The latest Annex 31 project report (IEA, 2001) presented a considerable list of energy modeling software, environmental LCA tools for buildings and building stocks, environmental assessment frameworks and rating systems, environmental guidelines or checklists for design and management of buildings, and environmental product declarations, catalogues, reference information, certifications, and labels. In total there were found 132 environmental tools and 55 were fully accessed in this report.

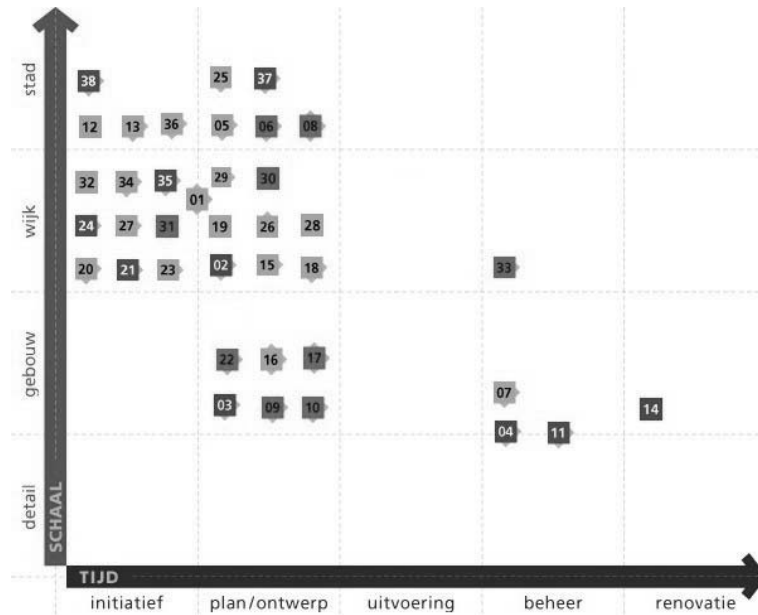
By only focusing in the Netherlands, the tool's universe (see Figure 3) inventoried by DUBO-centrum, we can already assess that there are available in the Dutch market 38 tools supporting the development of sustainable construction. But, what about the existing stock? Are rehabilitation designs also being covered by this wave of environmental awareness?

Unfortunately, and again giving the Netherlands as example, (see Figure 3), we can conclude that there is only one tool available to support building rehabilitation ('renovatie'). The tool identified with the number 14 is in reality a checklist entitled as Green Mortgage (Groene hypotheek), developed and controlled by the Government to rule, stimulate and finance sustainable building processes, both new construction and rehabilitations (Dubo, 2001).

There is clearly a considerable lack, in the Netherlands, but also in most countries of the world, on support tools for building professionals, when designing rehabilitation interventions. If we compare the market share to the output in terms of tools and scientific efforts, we can see an unacceptable dis-balance. Our existing building stock really needs a raised level of attention. It will be a great challenge for all people in building science to develop and foster this new field. We can build this field upon a large basis of practical experience and adopt many principles that are developed for science regarding new

construction. From the beginning of this development we can take into account the sustainability ambitions that are known to all of us nowadays.

Figure 3. Tool's universe for supporting a sustainable building process (Dubo, 2001)



## A NEW FIELD OF RESEARCH?

Rehabilitation is a true challenge for technology and creativity, because the architect will have to take conscious decisions regarding the building subtractions, remainings and additions; and their respective forms, components and materials. How to deal with such a complex process? How to determine what is subtracted and what remains? What to add and how? Should the rehabilitation aim to reach, independently from the building reality; the level establish by current legislation, aimed by the politicians; the level of comfort, aimed by the constituents; or the levels of sustainability, aimed by the experts?

Rehabilitation implies multidisciplinary competences, and consequently obliges the architect to embrace professionally a broader range of knowledge. Such knowledge is available in varied forms to support his design decisions, first for the architect's education as a student, and afterwards for the architect's support as a professional designer. Scholars have been developing, through the years, solutions for optimizing and providing knowledge to the architects and building experts, (e.g. books, manuals, guidelines, regulations, informatics programs, websites, etc.) and especially in the last years, tools have been emerging oriented towards an environmental "friendliness" that truly concerns XXI century society.

In macro-scale, the fast changing society is becoming more and more aware of the need to overpass political and economic values, but regarding the micro-scale, there is always much more inertia and barriers, regarding the global unconsciousness regarding energy and natural resources abusive usage and waste. There has been always the idea that the planet would provide all eternally, but in fact that is not the reality. Nobody knows the day of tomorrow. It was then, obviously necessary to raise the ecological weight, as it is necessary to rise as well in the rehabilitation's world, but this will be further explained in this paper.



So how can we build this research field? Apart from developing a strong theoretical framework and state of the art review we propose to start from actual societal and professional challenges. What are the main characteristics of our building stock and what are major drivers of change in our society? How to position sustainability, the ageing society and the growing need for safety (fear of terrorism)? What is lacking?

Existing tools focus on single issues, like energy use or costs. Most holistic tools remain to 'vague' (e.g. design principles). What do building professionals need? Something in-between: A framework with a reference to useful data and 'sub-tools'. To create an overview of a building analysis and decide what part has to be investigated more in detail.

## **DESIGN FOR LIFESPAN**

At the Eindhoven University of Technology the department of architectural design and engineering is executing a research program called 'Design for lifespan'. This program starts from the question how to materialise and re-materialise the buildings of today for proper use, now and in the future. Thinking in terms of lifespan can be traced back to research by Brand and Duffy.

Eindhoven started with the initiative of the SAR, resulting in Open Building. Later on, it has resulted in design and materialization of buildings for a certain life span, for example for 5 years (Kinderkunsthuis, Rotterdam) and for 20 years (XX Office building, Delft). It is expected that this question becomes more and more important. For example, office buildings satisfy for 15 years only and then the client wants a (drastic) change. To find specific answers to this question is a complicated but interesting issue.

'Design for lifespan' is exploring both new and existing buildings. It represents a research and design strategy that can be very useful in the field of building rehabilitation. This same program served as base for the PhD research proposal, Re-architecture: Lifespan rehabilitation of built heritage (2004-2007), funded by the Foundation of Science and Technology (FCT), Portugal. Ana Pereira Roders is researching a theoretical model that can frame a support tool for architects (website format), when developing rehabilitation designs.

Broadening the concept of lifespan towards rehabilitations of built heritage, lifespan embraces the building existence in the three temporal moments: past, present and future. The support tool for architects intends to supply, within the design process, guidelines, evaluation systems, and technical data. In another level, Pereira Roders is also complementing the earlier work developed by Damen Consultants and Rijksgebouwendienst, supported by our department, published by SBR (1995) as the report 'lifespan of building components' (Levensduur van bouwproducten).

We also investigate and develop methodologies to define and monitor building quality over time. Recently a method for maintenance planners called condition assessment ('conditiemeting') has been established as a Dutch standard NEN 2767 (2005). These data and methods nourish building practice from maintenance planners, facility managers to designers and investors. The Eindhoven University of Technology is participating and sharing their knowledge with regard to 'design for lifespan' in the following initiatives:

*IFD Building.* From 1999 until this year in the Netherlands an innovation program IFD Building (industrial, flexible, demountable) was running. This program was initiated by two ministries: Housing (VROM) and Economic Affairs (EZ). It aimed to increase the adoption of innovative techniques to support industrialization, consumer orientation and sustainability. In this program approximately 90 projects demonstrated the practical implementation of new products and processes in building. One of the projects in this innovation program concerned the re-use of existing portico-flats (Flexibele doorbraak; Hendriks 2002). Because of technical and functional reasons these type of flats are written-off for re-use. This project researched how load bearing internal walls could be removed in order to increase possibilities of reconfiguring apartments into the existing building structure.

*Building with Time.* The project mentioned above was one of the rare examples of rehabilitation projects in the IFD program. Nevertheless according the ministry of Housing (VROM) IFD is a useful strategy to intervene in the existing building stock. This is been further researched and described in Bouwen met Tijd ('Building with time' - SEV 2004). This report gives an overview of the Dutch housing stock, zooming in on two issues. The first is the coherence of lifespan on one side and functional and technical characteristics of dwellings. Second topic is the coherence between lifespan and sustainability. The research confirms the idea that rehabilitation for lifespan extension is a sustainable approach. It proves that extra measures for future flexibility of buildings, such as a surplus in space height and width, in the long term will pay off.

*Transformation of office buildings.* With regard to structural vacancy of office buildings two initiatives have been taken. A platform for transformation ('transformatieplatform'), containing building professionals in design, construction, finance and research, has been established. At the same time the Minister of Housing has announced measures to enable transformation of offices into housing for young starters (VROM 2005). These are financial, fiscal and legislative measures to enable quick transformation.

## CONCLUSION

We have shown that rehabilitation is an emerging field of interest, not only through its market share, but through its potential and daily impact to everyone's present. The issue has been neglected for a long time. In Europe for decades after WWII the main concern was adding new buildings in devastated areas. These 'post-war' building areas are now subject to major changes, societal and physical. This calls for a structured approach by all parties involved: policy makers, professionals (designers, builders and owners) and also the scientific community.

Even if certain countries, e.g. England, Sweden, etc. already began since the 80's with massive rehabilitation interventions in the existing stock, as well as, others in other scales, e.g. Italy; architects and engineers, should go beyond protected and unprotected classifications/judgements and face the exiting stock as a challenging "storehouse" of manufactured resources and culture, which would be insane to waste or neglect.

To conclude, the great challenge is to increase the formalisation of knowledge in the field of rehabilitation. It needs to be embedded in research and educational at building and architecture faculties. At the same time it needs the full support of government policy programmes and building professionals. This will shape the conditions to educate

professionals that are able to perform the important task of preserving our existing building stock in a truly sustainable approach, respecting their inherent cultural values.

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