How sustainable rehabilitation designers really are

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ABSTRACT: RE-ARCHITECTURE is a design process support system that aims to support designers, when involved in rehabilitation design developments. Before getting access to the full content of RE-ARCHITECTURE, users were asked to contribute to a pre-survey, by answering online Questionnaire B1. The analysis of its results, intended to identify the category of designers, their design processes and guiding principles. As RE-ARCHITECTURE aims to contribute to a more sustained and lifespan conscious rehabilitation design development, this pre-survey is fundamental to understand how sustainable rehabilitation designers really are and how appropriate RE-ARCHITECTURE can be to sustain their aims. This paper synthesizes the pre-survey results, where such issues were most evident.

1 INTRODUCTION

RE-ARCHITECTURE is a design process support system that aims to support designers, when involved in rehabilitation design developments of one or more buildings, dated of more than one generation old. RE-ARCHITECTURE provides free and fast access to a wide range of technical sustenance - knowledge and tools - for the different stages, sub-stages and activities, common in such design processes.

Rehabilitation design developments are usually complex, in the sense that the designer has to deal with a pre-existence that should not be neglected or predominantly be destroyed. Otherwise, such intervention should no longer be called building rehabilitation. Eventually, it could be called urban rehabilitation or, even more specifically e.g. reuse of structural elements.

RE-ARCHITECTURE is the implementation of the design process theorised in the doctoral research *RE-ARCHITECTURE: lifespan rehabilitation of built heritage*; hosted at the Faculty of Architecture, Building and Planning, Eindhoven University of Technology (TU/e), The Netherlands; and funded by the Foundation for Science and Technology, Portugal since 2004.

2 METHOD

This research has now come to the test period, where designers - architects and architecture students - from the Netherlands and Portugal, with experience in rehabilitation design developments, were invited to register and get free access to RE-ARCHITECTURE, for a period of four months. As public invitation, some articles and short news items were published in both countries (paper and web-based). Among others, the Royal Association of Dutch Architects and the Portuguese Order of Architects were most cooperative. Several e-mails were also sent to those designers who had previously shown interest in RE-ARCHITECTURE.

After registering as a new user and before getting access to the full content of RE-ARCHITECTURE, users were asked to contribute to a pre-survey, by answering online Questionnaire B1. Then, their workflow was controlled through process mining techniques (Alves de Medeiros, 2006), researched at the Faculty of Technology Management, TU/e. In the end, they were asked to fill in a post-survey.

The pre-survey comprised a group of forty five questions; nineteen main questions and twenty six sub-questions. The analysis of its results, intended to identify the design processes and guiding principles of the designers, before being exposed to RE-ARCHITECTURE. It was fundamental to understand how sustainable rehabilitation designers really are.

Together with the post-survey, the pre-survey was essential to achieve accurate results and conclusions at the end of this research. Both surveys reveal the effective role and/or contribution of RE-ARCHITECTURE, as a support system that was proposed to support designers raising their lifespan consciousness in their rehabilitation design processes and the consequent sustainability of their designs.

3 RESULTS

3.1 *The sample*

The universe of RE-ARCHITECTURE users, was limited to those who simultaneously registered before April 1st, 2007 and submitted entries in the Pre-survey system (N_t=408). Among this universe, three categories of users were identified (Table 1): first, who filled in the Pre-survey accurately (complete, valid); second, who did not fill in the Pre-survey accurately (complete, invalid); and third, who did not complete the Pre-survey (incomplete).

Table 1. The universe of RE-ARCHITECTURE users

	Architects				Architecture students				Other occupations				Total
	CV	CI	I	***N*a**	CV	CI	I	***N*s**	CV	CI	I	***N*o**	***N*t**
Portugal	79	14	110	**203**	20	2	15	**37**	12	19	24	**55**	**295**
The Netherlands	25	5	30	**60**	27	3	2	**32**	2	2	1	**5**	**97**
Other countries	-	2	6	**8**	-	-	-	-	2	2	4	**8**	**16**
	104	21	146	**271**	47	5	17	**69**	16	23	29	**68**	**408**

*CV = Complete, Valid; CI = Complete, Invalid; I = Incomplete; *N* = Universe (total number)

The following chapters synthesize the answers of the RE-ARCHITECTURE users, who filled in the Pre-survey accurately. Moreover, it groups the users according to two fundamental variables; the country (values: Portugal, The Netherlands and other countries) and the occupation (values: architect, architecture student and other occupations). As this research aims to survey Portugal and The Netherlands; as well as, architects and architecture students only; the answers of the other users were left out of consideration.

Due to the fact that the variables and values differed in number of users; a sample was taken to enable accurate comparisons and disable deviation of results, when correlating the answers. The total number of architecture students (*N*pt/s=20), registered from Portugal – the smallest – was the limiting value for the sample of users (Table 1).

Therefore, a sample of twenty users was also selected from the other three groups (*N*pt/a; *N*nl/s; *N*nl/a). The rule was to select the first twenty users, independent from the quality of their answers. In total, the surveyed sample represents a universe of eighty users (*N*t=80). They characterize approximately twenty percent (20%) of the surveyed universe of users; and, forty-eight percent (48%) of the total number of users that have completed the pre-survey accurately.

The following chapters characterize this sample on four aspects: experience in developing rehabilitation designs (see section 3.2); interest of developing rehabilitation designs (see section 3.3); aims towards the building subtractions, remainings and additions (see section 3.4); as well as, percentual relation (see section 3.5). In order to effectively reveal the survey results that would indicate how sustainable rehabilitation designers really are; the researcher has selected some particular survey results for this paper.

3.2 *The experience in developing rehabilitation designs*

As already expected, fifty-two users (65%) confirmed their previous experience in developing rehabilitation designs. Unexpectedly, twenty-eight (35%) affirmed to have never developed a rehabilitation design. Either, because it is really true or because the users were just trying to make a shortcut and access faster the RE-ARCHITECTURE content; fact is that, this percent-

age of inexperienced users clearly reflects the current reality and sustains the urgent need for raising the attention towards the field of building interventions, rehabilitation included.

Just by comparing the percentage of built newness (buildings younger than 25 years old) with the percentage of built heritage (buildings older than 25 years old); an architect, even if he has never constructed a rehabilitation design development, should at least have simulated few of them, while being oriented and instructed as an architecture student.

The Architect's Council of Europe (CAE, 2005) is very clear about it and states in the *European Deontological Code for Providers of Architectural Services* that they "must respect and help to conserve and develop the system of values and the natural and cultural heritage of the community in which they are creating architecture. They shall strive not only to improve the environment through the highest quality of design but also to improve the quality of the life and the habitat within such a community in a sustainable manner, being fully mindful of the effect of their work on the widest interests of all those who may reasonably be expected to use or enjoy the product of their work".

How can society expect from architects to reach results of sustainable quality and lifespan consciousness while developing rehabilitation designs, if some of them have never been adequately oriented and instructed? It would be the same as placing yourself in the hands of a doctor for a heart surgery, when he did not learn nor practice enough. Would you feel safe? The building also, certainly not!

Back to the fifty-two users, that confirmed their previous experience on rehabilitation designs. They were respectively: fourteen architects (70%) and ten architecture students (50%), from the sample registered from Portugal; and sixteen architects (80%) and twelve (60%) architecture students, from the one registered from Netherlands. The following chapters shall only consider the answers of those users, slightly more Dutch (54%) than Portuguese (46%).

3.3 *The interest of developing rehabilitation designs*

All users (100%), from the four groups, qualified their own rehabilitation designs as interesting. This overall recognition clearly shows an interest from the designers for this category of design developments. The variety of the answers emerges, in the arguments used to justify their considerations, the advantage of the new existence versus the pre-existence and the most important factors that have clearly influenced their designs.

The designs of rehabilitation interventions of built heritage differs from the designs of built newness, mostly due to the fact that there is a pre-existent building or group of buildings; which designers are obliged to consider during their design developments. Along the design process, this pre-existence is converted into a new existence; harmonizing a universe of actions and inherent aims towards the building.

RE-ARCHITECTURE guides the subdivision of this universe in three groups: the actions towards what is being subtracted from the building (subtractions), the actions towards what remains in the building (remainings), and the actions towards what is being added to the building (additions). Accordingly, the degree of harmony between these three groups is directly related to the degree of the designer's lifespan consciousness, as well as, how he considers the building's past, present and future. (Pereira Roders, 2006)

These degrees are not only identifiable in the proposed design solutions, but also in the arguments used by the designers to justify their considerations. Therefore, the arguments used by the fifty-two users, to sustain why their rehabilitation design was considered interesting, were ordered according to their final target; the subtractions, the remainings and/or the additions.

Most answers (71%) could be ordered accordingly. However, there were five users (10%), one Portuguese and four Dutch architects, who placed the interest of the rehabilitation design in other targets rather than the building; however, non less valid. Those were respectively, the degree of sustainability of the intervention; the context as input / guideline (two users), the communication with the involved actors, the integration of past and future. Ten users (19%) did not exactly answer the question, so their arguments were considered invalid.

Table 2 summarizes the users' arguments, ordered according to their final target. It is interesting to verify that only one Dutch architecture student (2%) mentioned the subtractions as argument to sustain her interest for the rehabilitation design.

Table 2. The users' arguments ordered according to their final target

	Architects							Architecture Students						
	S	R	A	R+A	O	I	**T**	S	R	A	R+A	O	I	**T**
Portugal	-	6	1	3	1	3	**14**	-	2	2	4	-	2	**10**
The Netherlands	-	6	-	2	4	4	**16**	1	2	-	8	-	1	**12**

*S = Subtractions; R = Remainings; A = Additions; R + A = Remainings and Additions; O = Other arguments; I = Invalid answer

Far more users considered the remainings (31%) among their arguments. Even more were the ones, arguing both remainings and additions (33%). Surprisingly, the additions were only referenced individually by two Portuguese users (4%), one architect and one architecture student. Interestingly, independent from the country, architects mainly sustained their arguments in the remainings (40%), while the architecture students sustained their arguments in the remainings, combined with the additions (57%).

The users were also asked to describe the advantages the design (new existence) brought to the building + environment (pre-existence). To better synthesize, the universe of answers was ordered according to the five primary aims: decrease, restore, maintain, improve and replace. Again, three answers (6%) did not match such aims and four other (8%) were considered invalid, as they did not respond to the question.

The three that did not match the ordering referenced as main advantage of their design, the contribution to the environment with the building reuse; the art of blending – the remainings with the additions; and the fact that the design was not only made by the user, but also the owners contributed to its quality.

Table 3 summarizes the answers of the forty-five users (83%), ordered according to the five main aims and to the fact if it was a general or a directly consideration pointed to the building or to its environment. As some of the users described more than one advantage, the researcher was able to identify and order a total number of eighty-six advantages. There was a clear tendency to state advantages related to what the user improved (66%) and replaced (22%) with his design; rather than what he managed to maintain (12%), decrease (7%) and restore (1%).

First, the advantages related to what the user "improved" were the most homogenous among the four groups of users. Registered from Portugal; the architects described fifteen advantages (32%), related to the current needs / living standards and the building physics; while the architecture students described only nine (19%), framing both building and environment.

Registered from The Netherlands, the architects described only ten advantages (21%), equally framing the building and environment; while the architecture students described three more advantages (28%), mostly related to the current needs / living standards and the building physics, similarly to the architects, registered from Portugal.

Second, the advantages related to what the user "replaced" were equally considered by the users registered from Portugal (50%) and The Netherlands (50%). Difference is that now, the architects registered from Portugal described very few advantages (5%), compared with the architecture students (45%). This difference is weaker among the users, registered from The Netherlands, where the architects described seven advantages (32%), while the architecture students described only four (18%).

Third, the advantages related to what the user "maintained" were mostly described by the users registered from The Netherlands (70%). Registered from Portugal, only the architects described three advantages (30%), having maintained the tangible heritage within the building, as well as, the environment's history and image concept.

Fourth, the advantage related to what the user "restored" was only mentioned by one architect registered from The Netherlands. Accordingly, the use of "bio-ecological solutions as well as materials" would restore and replace their life cycles, implying the improvement of both building and environment.

Last, the advantages related to what the user "decreased" were exclusively presented by four architects, mostly registered from The Netherlands (83%). There was only one architect, registered from Portugal (17%); together with one architect, registered from The Netherlands who; described as advantage, the reduction of energy losses. The last one even described the reduction of money and resources. The two other users referenced the contribution to the decrease of demolition and to the decrease of little spaces.

Table 3. The advantages presented by the users, ordered by aim

			Portugal			The Netherlands			
			A	S	**T**	A	S	**T**	**T**
Decreases	loss of money		-	-	-	1	-	**1**	**1**
	demolition / loss of resources		-	-	-	2	-	**2**	**2**
	little spaces		-	-	-	1	-	**1**	**1**
	loss of energy		1	-	**1**	1	-	**1**	**2**
Restores	material lifecycles		-	-	-	1	-	**1**	**1**
Maintains	building	old and monumental values	-	-	-	1	-	**1**	**1**
		features and characteristics	-	-	-	1	-	**1**	**1**
		identity	-	-	-	1	-	**1**	**1**
		history	-	-	-	1	1	**2**	**2**
		form	-	-	-	-	1	**1**	**1**
		tangible heritage	1	-	**1**	-	-	-	**1**
	environment	history	1	-	**1**	1	-	**1**	**2**
		image concept	1	-	**1**	-	-	-	**1**
Improves	building	-	-	5	**5**	1	-	**1**	**6**
		coherence between exterior and interior	-	-	-	-	1	**1**	**1**
		current needs / living standards	4	-	**4**	1	2	**3**	**7**
		physics / comfort / light / acoustics / thermal behavior	6	-	**6**	1	3	**4**	**10**
		purpose	-	-	-	-	2	**2**	**2**
		living space / space	2	-	**2**	-	-	-	**2**
		functions / equipments	-	1	**1**	-	-	-	**1**
		aesthetics	-	1	**1**	-	-	-	**1**
		solutions / materials	-	1	**1**	1	-	**1**	**2**
	environment	-	-	2	**2**	3	4	**7**	9
		economic potential and social cohesion	-	-	-	1	-	**1**	1
		contribution for its humanization	1	-	**1**	-	-	-	**1**
		solutions / materials	-	-	-	1	-	**1**	**1**
Replaces	building	uses / functions	1	2	**3**	2	2	**4**	**7**
		image / façades	-	1	**1**	1	-	**1**	**2**
		processes	-	-	-	1	-	**1**	**1**
		identity	-	-	-	1	-	**1**	**1**
		relation with the environment	-	1	**1**	-	-	-	**1**
	lives /activities / dynamics		-	6	**6**	1	2	**3**	**9**
	material lifecycles		-	-	-	1	-	**1**	**1**

* A = Architects; S = Architecture Students; T = Total

The users were also asked to describe the most important factors that have clearly influenced their designs. This time, the answers were not particularly ordered, but grouped when describing the same factor. There were some factors that were specifically related to the building (59%), others to the environment (17%); and others generally related to factors involving both building and environment (24%).

From the universe of eighty-seven important factors there were few (17%) that were only referenced once. The building "accessibility", "surprise", "history", "relation with the environment" and the "involvement with experts and technical knowledge" was only referenced by the architects, registered from Portugal. The building "form"; "changeability"; environment "specifications", "identity", "materials" and "climate"; "time"; "prospects" and "cultural factors" were only referenced by the architects, registered from The Netherlands. Last, the building "condition" was only mentioned by an architecture student, also registered from The Netherlands.

However, the building structure/construction was the most important factor, referenced by fourteen users (27%) from the four groups of users. Referenced by half the number of users (14%), both building qualities/architecture and functions/performances/program were equally referenced; the first one more referenced by the users registered from the Netherlands and the second one more referenced by the ones from Portugal.

Even if few of the important factors described by the users could be part of a broad sustainable strategy, e.g. building, environment, etc.; sustainability was specifically referenced by three users (6%), one architect and one architecture student, registered from Portugal; as well as, one architect, registered from The Netherlands. Even if not considerably representative, it is already better, than no reference at all.

3.4 *The subtractions, remainings and additions*

When directly asked to scale the importance given in their design to the subtractions, remainings, additions, and particularly to the connections between the remainings and the additions; users could choose between a scale of five values; very low, low, reasonable, high and very high. Table 4 describes the scale of importance given by the users to the four realities.

The users registered from Portugal have mostly considered of reasonable importance; the subtractions (29%), the remainings (52%) and the additions (42%). With a slight advantage regarding the users who considered the connections between remainings and additions of reasonable importance (37%), they were mostly considered of very high importance (38%).

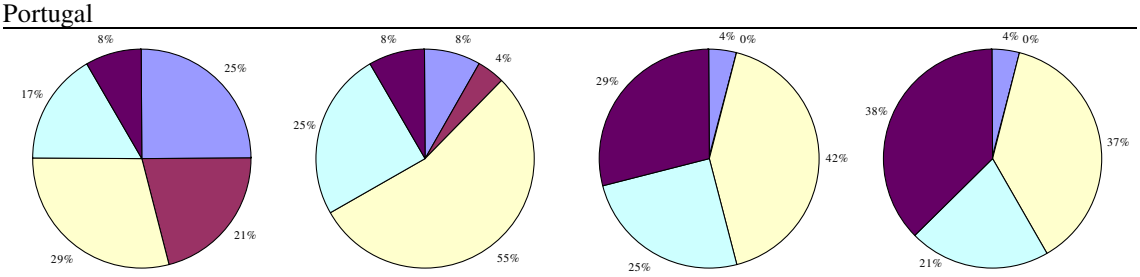
Instead, the users registered from The Netherlands have mostly considered of high importance the remainings (60%), the additions (39%) and the connections between remainings and additions (57%). Again, with a slight advantage regarding the users who considered the subtractions of high importance (36%), they were mostly considered of very high importance (39%).

When just focusing on what the users considered of very high importance; we can easily verify that the subtractions and remainings were less valued than the additions and connections (between remainings and additions), in both countries. Probably that is because, often designers do tend to overvalue what they add, rather than what they subtract and remain from the pre-existence; which is the first motive why they are involved in such a rehabilitation intervention.

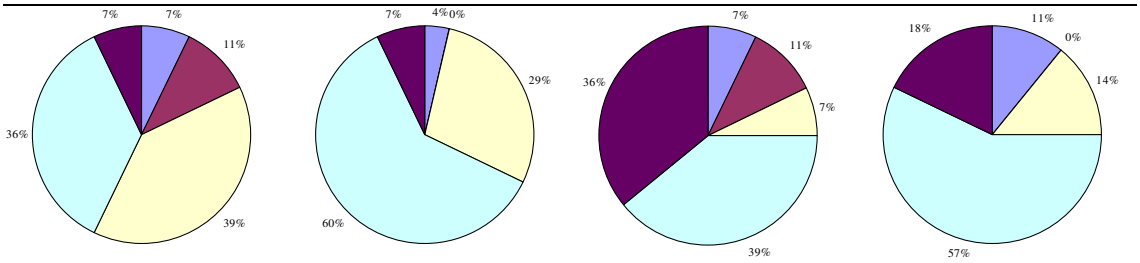
That is even shown more clearly in the following results: when asking if they did plan what to do with the subtracted, remaining, and added elements, as well as, with the connection between the remaining and added elements; users were also asked to select the classification that would better describe their main aim. Moreover, they should provide a justification, as well as, an example from their design that could illustrate this aim.

Table 4. The scale of importance given by the users in their design

Portugal



The Netherlands



Subtractions Remainings Additions Connections

* very low low reasonable high very high

The subtractions were part of the design plan considerations by twenty-five users (48%); comprising ten architects (71%) and four architecture students (40%), registered from Portugal; in addition to eight architects (50%) and three architecture students (25%), registered from The Netherlands. When asked about their main aim, most users selected "reuse" (64%), five selected "relocate" (20%) and four selected "recycle" (16%). "Reuse" was the main aim of most architecture students, registered from both countries and of the architects, registered from Portugal. Instead, "recycle" was the main aim of most architects, registered from The Netherlands.

More than the subtractions, the remainings were planned by thirty-seven users (71%). Except for the six architecture students (60%), registered from Portugal, more than seventy percent of the users, from the other three groups, planned what to do with the remained elements. All groups have selected "repair" as the classification that would better describe their main aim. However, while the users registered from Portugal equally selected the highest scale of classification, "consolidate"; the users registered from The Netherlands equally selected a lower scale of classification, "reinforce".

As foreseen, the additions were the most planned from the four realities, by forty-nine users (94%). Only one architect (7%) of the fourteen registered from Portugal; and two architecture students (17%), registered from The Netherlands; answered not to have particularly planned what to do with the additions. Probably, that had to do with their lower scale of intervention, where only minor additions were made. In the four groups of users, most additions (60%) were located "inside, connected" with the remainings. Nonetheless, there were already few users that planned their additions "outside, apart" from the remainings (20%); or "inside, demountable" (16%).

Less than the additions, the connections between the additions and remainings were planned by forty-three users (83%) comprising thirteen architects (93%) and eight architecture students (80%), registered from Portugal; in addition to fourteen architects (88%) and eight architecture students (67%), registered from The Netherlands. The architects registered from both countries have mostly selected the classification "punctually fixed" (23%), to classify their main aims. In contrast, most architecture students (15%) selected "totally fixed". Generally, most groups selected the classification "demountable" and "loose", except for the architecture students; respectively registered from The Netherlands and Portugal.

The second part of the sub-questions – its justification and example – had the particular purpose to verify the consistency of the first part of the sub-questions. Generally, when someone; would have planned particularly each of the four realities; would not have any problem finding the sustaining argument and/or an example within his design developments that could exactly illustrate how he managed to achieve such main aims.

Curiously, when considering valid only the answers that provided an example, a major number of users that initially affirmed to have had a particular plan for those four realities fall immediately into the group of users that had no particular plan for them. This reduction is quite considerable; of approximately fifteen users (30%) for the subtractions, remainings and additions; and of exactly thirty users (60%) for the connections between the remainings and connections. Nevertheless, the global overview of their main aims towards the four realities did not change so much.

There are, however, some interesting justifications for such main aims, among the answers given by all users, inclusive the ones that did not provide any example. With no reference to "reprocess" among the main aims towards the subtractions; there are, though, references to the "reuse of the existing structure to sustain the new elements", the "relocation of stone elements" and the "recycle of concrete and steel".

Again, with no reference to "arrest decay" as main aim towards the remainings, several were examples of main aims to "repair windows"; to "reinforce the construction / structure" and to "consolidate the finishings". For the additions, all main aims were illustrated with examples to add; "outside the building elements that would bring too much destruction to the building"; and to the inside the building; "fixed new floors", "demountable partition walls" and "loose volumes". Last, the examples illustrating the connections between the remainings and additions gave only more detail to the previous answers, without generalizing how they were aimed, for this particular design.

3.5 *The subtractions versus remainings versus additions*

Considering the pre-existence, users were asked about the percentual relation, between subtractions and remainings. Figure 1 illustrates their answers, filtered per group. Most users selected the relation fifty | fifty (33%); however, the second place is the relation seventy-five | twenty five (25%), followed by the relation ninety-five | five (19%). Only afterwards comes the relation twenty-five | seventy-five (15%); and as last, the relation five | ninety-five (8%).

Similar results were presented in figure 2, illustrating the answers of the users, also filtered per group, when asked to consider the new existence, and the percentual relation, between additions and remainings. There are however, some differing points. No architecture students registered from Portugal selected both relations five | ninety-five and seventy-five | twenty five; and no architect, registered from The Netherlands, selected the relation ninety-five | five.

Figure 1. The Subtractions versus Remainings

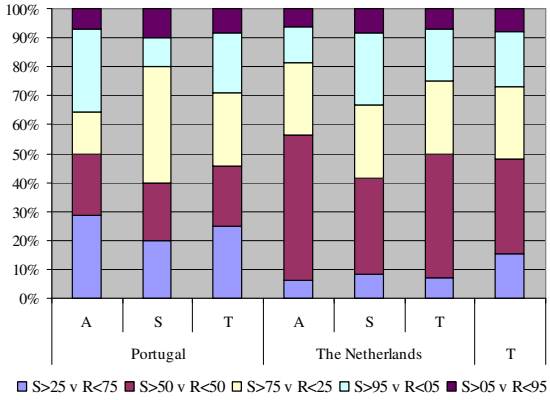
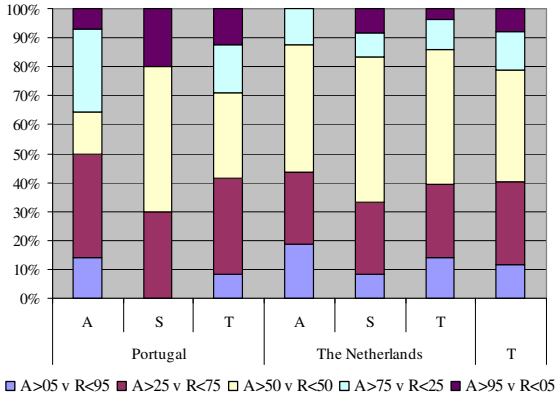


Figure 2. The Additions versus Remainings



4 CONCLUSION

One could argue that just by rehabilitating buildings from the built environment, designers are being already sustainable. That can be true, even in very high scales of rehabilitation, in the sense that the urban infrastructures and services are reused and it is not necessary to go to the natural environment and make it suitable to the current living, working and leisure needs.

On the other hand, rehabilitation interventions can cover serious degrees of lifespan unconsciousness, behind very modern and fashionable additions; neglecting its past, present or future. After the rehabilitation intervention is finished, too often, is impossible to discern what was subtracted, what remained and what has been added. Even more difficult is to understand the logic behind some design decisions, when simply comparing its advantages and consequences.

One needs to assess the effective relation and degree of harmony between these three realities, in order to determine how sustainable a rehabilitation intervention or its designer really is. There are no receipts to follow in every building, as various aims might seem totally sustained for one building, and result totally unsustained for others. It truly depends on the significance and condition of a building and respective environment identified during a pre-design stage.

Therefore, as a preliminary conclusion of the survey results, it can be stated that sustainability is a factor that is emerging into the world of the designers, from Portugal and the Netherlands, involved in rehabilitation developments. Nevertheless, this path is still long and requires the serious effort to recognize that not all design solutions that might initially seem very original are actually suitable. They might bring irreversible consequences, not only to the building, but to the natural and built environment. Future generations shall surely valorize the effort.

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