AN INTERACTIVE PROCESS TO MEASURING REMOUNTABILITY AND DESIGN FOR ADAPTABILITY WITHIN THE OPEN BUILDING TYPOLOGY

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I INTRODUCTION

As an architecture practitioner, there are a lot of questions to be asked and answered in order to give a coherent and verifiable solution to the immense amount of all kinds of challenges present within the built environment. Research-methodological awareness is indispensable in order to accompany the physical design with evidence-based backgrounds. According to Wang & Groat (2013), there is an increasing demand of architectural clients starting to ask for more researched-based design decisions. Thus, studying these subjects makes us more equipped in the later professional practice.

Within this field of architecture, correlations between Koolhaas' design studio OMA and the research studio AMO, as well as for 3XN(architectural design) and GXN(research) evidently show these statements of Wang & Groat (2013). The relation between design and research cannot be seen as each other's opposites, although they're also not equal. It is way more nuanced and might be seen as complimentary (Wang & Goat, 2013). As an architect it is thus important to be aware of this cooperation and consciously apply methods from both fields in order to acquire a holistic conclusion.

Within the architectural profession it is important to understand the framework in which we can conduct and categorize our research in order to give an evidence-based answer. Studying these techniques and frameworks are helpful to define the method for the design and research path, structuralize the vast amount of data available and to critically reflect on their quality. Within the course I realized how many research methods are already available and by learning from the literature I am now able to choose the most appropriate set of methods that will lead to the requisite result. It is a significance change from a more chaotic approach in the past to a structuralized path within the last phase of the studies and logically after.

Within the field of the built environment my fascinations lie within the more technical, engineering and applicable domain. Albeit not the only option to being able to research within this fields, I have chosen to deepen my knowledge within the chair of Architectural Engineering (AE). To be more specific, the research group I am working on is called 'One million homes' which can also be found in other chairs within the faculty of Architecture (e.g. Dutch Dwelling and Heritage). Wherein the lens within our studio is more of a technical character in comparison to the aforementioned studios (TU Delft.,z.d.).

Referring to technical challenges where AE is working on, the drastic transition from a linear- to a circular built environment is many times point of discussion within the studio. In order to achieve a circular future within the built environment, certain research has been written and made available for the students to acquire general knowledge about this subject. One of these documents, a study conducted by research department GXN in collaboration with the architectural office 3XN, shows the main principles and roadmap to a circular future within the built environment. One of these elements is the holistic design approach called 'Design for Disassembly' (DfD). This can be divided into 5 main principles: 'materials', 'service life', 'standards', 'connections' and 'deconstruction'. The main aim of this method in short is to let all buildings become material banks, wherein a circular business model can be implemented (GXN/3XN, 2018). Nationally there is also research conducted within this field, where 'remountability' is an important asset in order to achieve a circular built environment (Platform CB'23, 2019). For the research I will be focusing on parts of this subject, in order to create the technical design brief for a circular building on the chosen site.

II RESEARCH-METHODOLOGICAL DISCUSSION

In order to approach the research within the theme of 'Design for Disassembly', several methods have been applied. First of all, a literature study about the subject has been conducted. Within this, a group of students acknowledged that there wasn't a method of measuring 'DfD' within the built environment. The group of 4 students, including me, started to work on a literature study and practice-based research in order to develop a measuring system for remountability. Within the field of product design, there are some measuring systems available, which we used as a correlational research. By transferring these systems to the built environment, we had to make use of practice-based research. We used the scientific research from a different discipline, which makes the design of the created measuring method cross-disciplinary.

Looking at the provided scheme of GXN and 3XN (2018), in our group research we have been mainly focusing on measuring the remountability of connections. As previously mentioned, more elements are evident within this theory. To broaden the work, I wanted to study more about 'flexibility', a subtheme within the 'service life' principle, which GXN and 3XN describes as: "Making a flexible building design that allows the functions to adapt and change in the future" (GXN/3XN, 2018, p. 39).

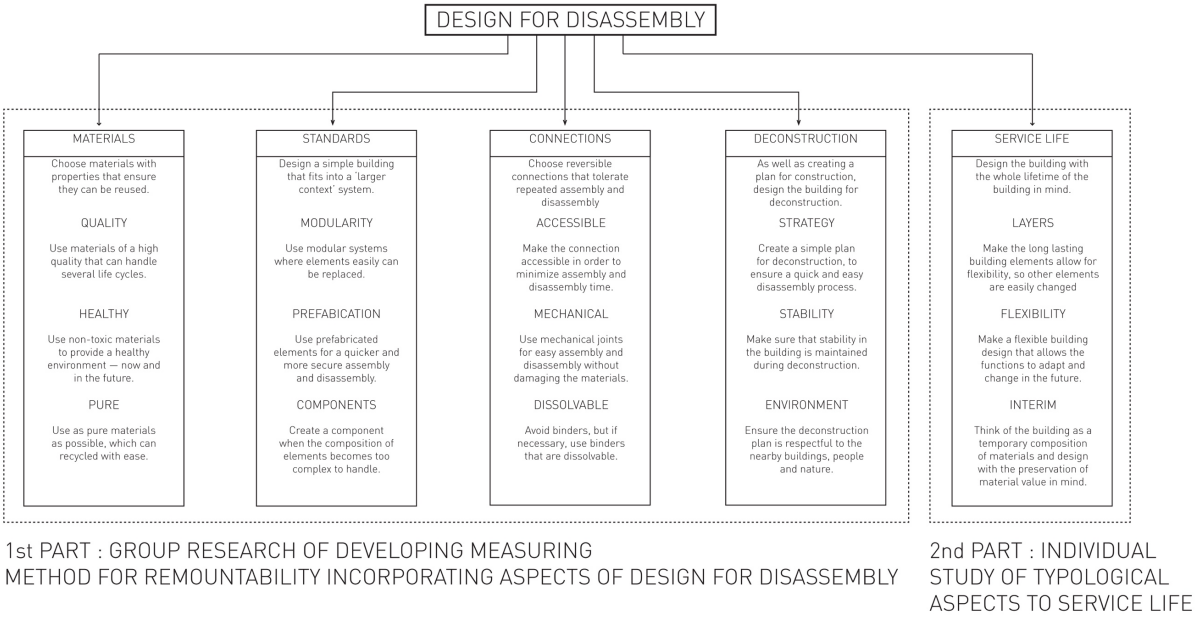

Figure 1. Framework of research paper, divided into two parts
Adjusted from "Building a circular future", by GXN/3XN., (2018). Retrieved from: https://gxn.3xn.com/wp-content/uploads/sites/4/2018/09/Building-a-Circular-Future_3rd-Edition_Compressed_V2-1.pdf

Within our studio there is been a renewed interest in the ‘open building’ legacy of John Habraken. In short this is a design approach to make buildings able to adapt or change in its lifetime, therefore, a fitting framework in order to research the ‘flexibility’ aspect that GXN and 3XN is referring to. By conducting case study research, an inquiry can be made in order to understand the main principles of the ‘open building typology’. Within the studio, multiple excursions have been organized by the ‘open building academy’. These excursions have been a praxeological way of conducting the first emic research, by a guided tour observation and interviewing the architectural practice responsible for the design which in some cases where also the developing party. The etic part was to analyze the drawings and diagrams provided by these parties. Epistemic research could be conducted by using these etic data and adding the framework of ‘Design for Disassembly’. The group work of a measuring system for remountability, together with the context-led research, where the context is referring to the contemporary open buildings examples, provides essential parts of the design brief for a remountable open building with scientific background.

In the AE studio, one can individually research and choose a specific site where the choices have to be substantiated. By proceeding literature studies, it is evident that the gross of the one million homes will be built in the existing urban fabric, densifying Dutch cities. Underused or unused areas are the main focus point, where functional changes are sometimes necessary and desirable. The chosen location is an underused area, close to the expanding city centre, where the municipality indicates in their vision report a functional change (from industrial- to a (mainly) dwelling area). Next to this contextual historical- and literature study, the site has been visited in a praxeological way by drawing on site and taking pictures.

Figure 2. Site visit, own work

III RESEARCH-METHODOLOGICAL REFLECTION

To highlight the process of the establishment of the measurement system, various research strategies can be reflected on. As described in the previous paragraph, this contained a group work where each individual afterwards added a certain part to broaden or test the developed method. For instance, the use of a correlational research was implemented. There were already Design for Disassembly measuring methods, which have been studied, although they were mostly in the field of Industrial Design or Product Design. The first step was to transfer the measuring criteria from this field to the built environment. Where the measurements of specific variables can be quantified and measured. As this literature study showed, most of the methods work with an interval scale to measure the various variables.

However, studying the book of Wang and Groat (2013), the experimental research is for instance about the performance of various components. As before mentioned, the main aim of the research is to measure various building components within the realm of design for disassembly. When we look in depth on this strategy, Wang and Groat (2013) are talking about the use of a treatment, or independent variable. In order to test the various 'connections' within our measurement system, we had to manipulate or control the variables: so they become treatments. These treatments refer to the various rating factors related to design for disassembly, which can all be assessed in a lab setting. The testing of empirically different building components in an iterative process was then resulting in an 'experiment'.

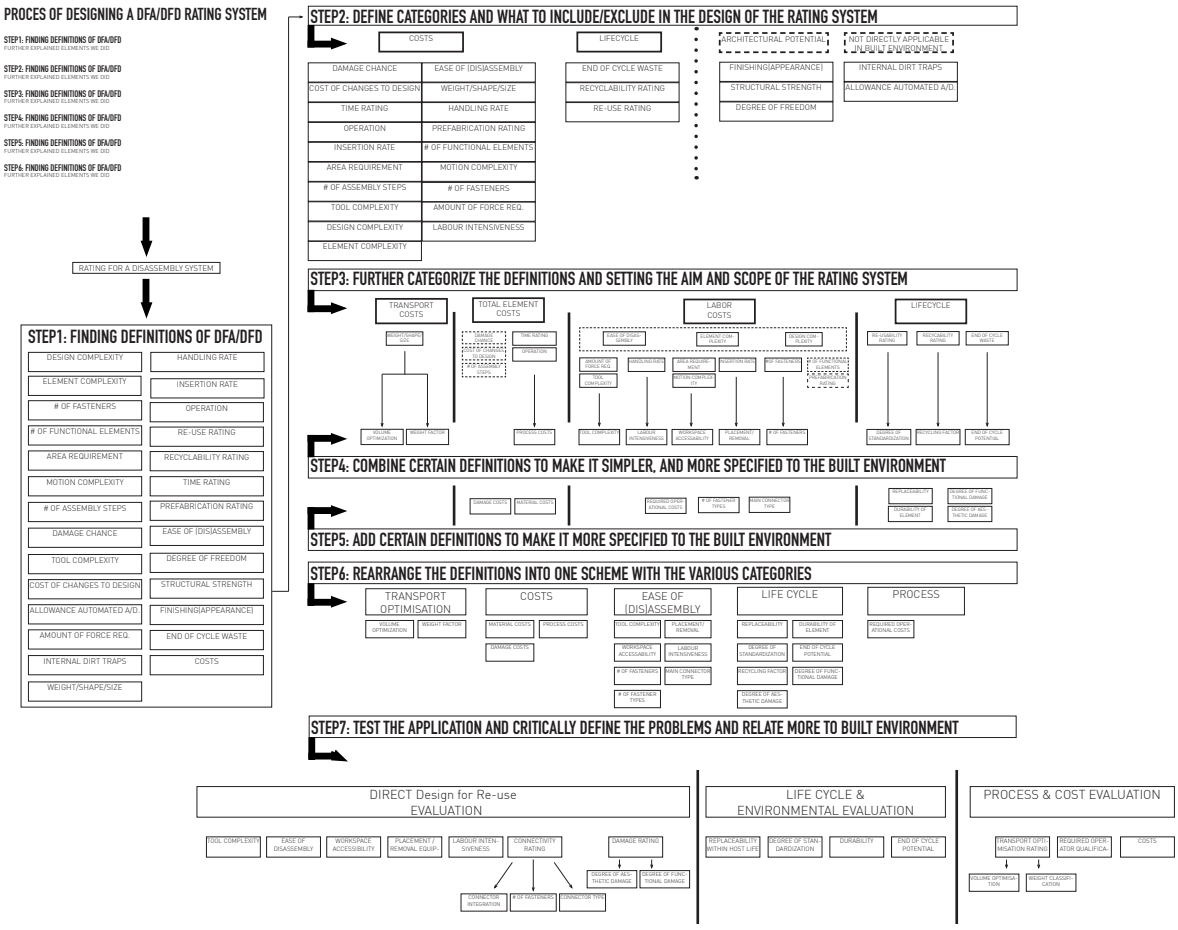

Figure 3. Overview of establishing a measuring system for remountability, own work

To implement a reflective scope to this strategy, several general critique points can be scrutinized. The efficacy of this experimental strategy is that it is mostly concerning sociocultural phenomena, however in our case it is less complex due to the lack of these subjective elements. All the criteria are relative and can be measured objectively, when the 'environment' changes, the measurements show these changes. The misapplication where Shulamit Reinharz is arguing about in the book of Wang & Groat (2013), reflects on important issues where this strategy is part of when misused. Again, these are mere social issues which are in our case not measured and taken into account. Lastly, also the ethical issues addressed by Wang & Groat (2013) are not applicable or not being measured in our, more technical, method of assessing.

Looking back at the provided framework by GXN and 3XN, the flexibility of future circular buildings was something I wanted to focus on as an additional part within the framework of design for disassembly research. This further research was conducted, among other things, with the use of so-called case studies. As Robert Yn puts it: "A case study is an empirical enquiry that investigates a contemporary phenomenon within its real-life context" (Groat & Wang, 2018, p. 418). For the use of case studies, several points can be reflected on. To start with the focus on cases in their context: cases in this sense mean 'contemporary open buildings' and the context or main notion is the 'flexibility' within the theoretical framework of design for disassembly provided by GXN/3XN. Wherein the term flexibility is further researched within literature, specifically in combination with open buildings. Where it resulted in an overarching definition of 'adaptability', where 'flexibility' can be seen as a subdivision (Schmidt, Eguchi, Austin & Gibb, 2010).

So, the terminology has been seen as equal in the two theoretical frames and thus this data is perceived and used in order to get more explanatory data on definitions. The purpose of the case study can be seen both as exploratory and descriptive. The idea was to make a small exhibition of the several case studies by analytical drawings and to show fellow interested minds the possibilities of adaptability within the contemporary open building typology, which is mainly explanatory.

The exploratory part has been done by critically assessing the case studies and reflecting on the ways to further improve certain elements of flexibility and thus design for disassembly. Within the use of case studies, it is important to have multiple sources of evidence. Apart from the floorplans and sections, several site visits have been done, pictures researched and talks conducted with the main designers. The reason to research multiple case studies was to find as much examples of the notion of flexibility within those projects, within a certain time limit. In this sense, we are talking about a literal case study although new elements (that also contribute to the notion of adaptability) can be found.

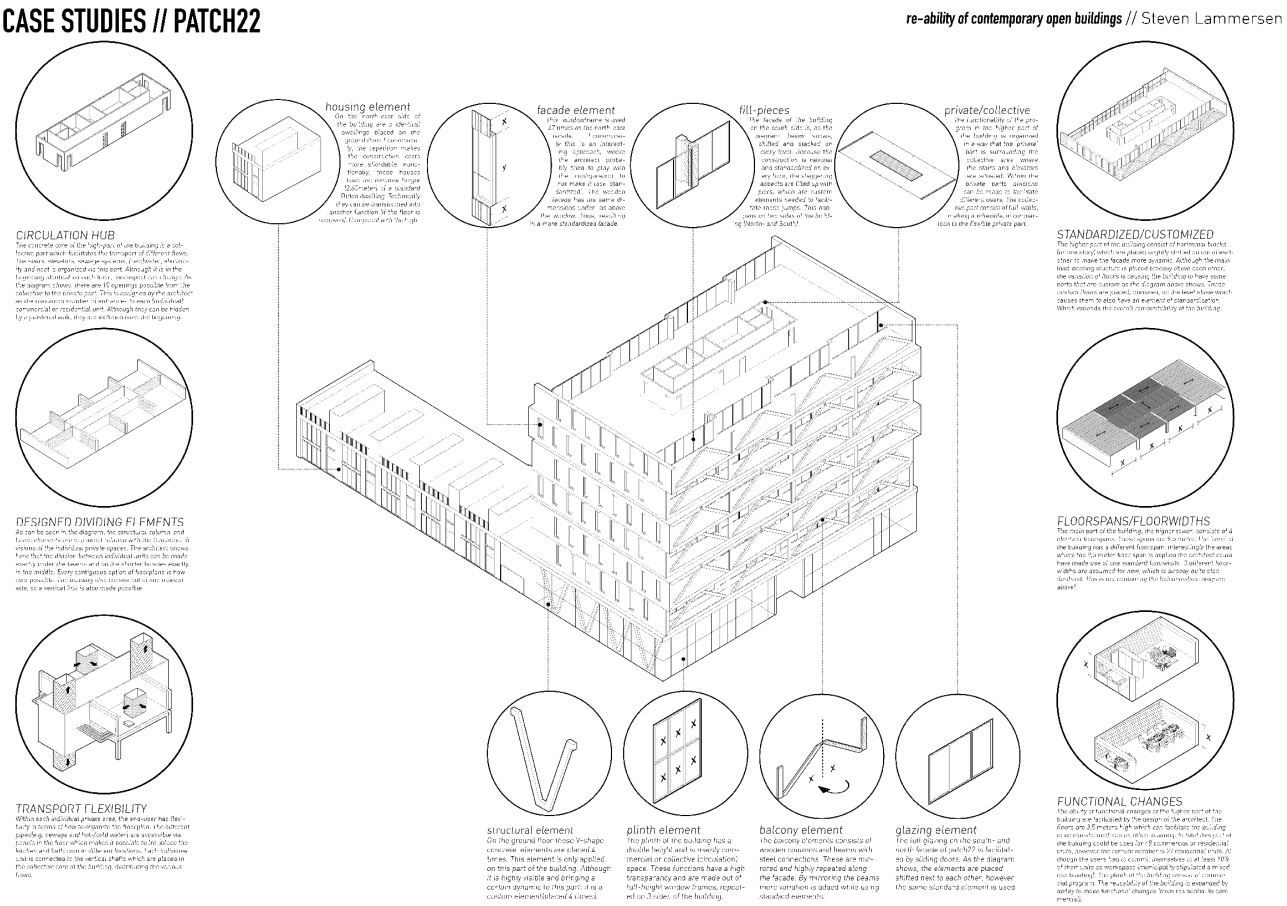

Figure 4. Adaptability of contemporary open buildings (case study), own work

To conclude, reflectively there can be a conclusion that a combined strategy is used with a mixed-methodological design. Multiple research strategies can be found in the development of the 'measuring method', probably because certain elements of each strategy were necessary in order to reach the intended goal. It is claimed as a weakness of this strategy that is not pure and quite unconventional, it was indeed sometimes necessary to reflect on the overall framework and see the essential need to combine several strategies.

IV POSITIONING

The ultimate goal of the graduation is to design an 'open building' which was circular in a technical, flexible and functional way because of its 'design for disassembly' and incorporating themes as adaptability. Although there are obviously a lot of other question, for the research part this was the main focus area. As described in the previous chapter, the case studies were an interesting tool in order to get specific data from this typology which has leaded to a practical guide on how to incorporate adaptability aspects in the later design phase. It was however important to understand the theoretical frameworks in order to find the specific aspects in the before mentioned case studies. Also, the established measuring system for remountability, transferred and altered from the product design sphere, is going to be a guideline in the further process. Albeit practical understandings of the relation between research and design, this is the complimentary type of research this project required. And I claim that the technical transition from a linear- to a circular built environment is proving a necessity for a lot of research which is similar to these kinds of experimental researches. Which is also evident in the research of Platform CB'23 (2019).

Taking position, I want to help to make this transition possible either more on the design or research part. Moreover, positioning myself in the research field of architecture these were mainly the experimental strategies that were explored. As Wang & Groat (2013) state as well, this is a controversial route which can be vague sometimes: in order to continue I am going deeper into this strategy in order to develop it further: because I believe in the beneficial qualities for the built environment. Especially for the upcoming technical transition to a circular economy.

Within our studio there is a strong emphasize put on discussing the entrepreneurial aspects of the future architects and their role. We have seen that during the site visits of the open buildings, where in some case the architects were also the developing party. In other cases the architects found themselves the end-users and set-up a so called 'CPO', where also the role of the architect was evolving. Reflectively, this is going to ask more of our generation of architects in terms of flexibility for instance. Discussing my individual position, I am looking forward to a more diverse role of the architect, with a more involved attitude within the complete process while on the other hand giving more access to external parties to decide within the design process. Because this is also something which defines the position within architecture I am willing to take. I think there are ways, also extensively discussed within our studio and part of the typology of open building, to include the end-user more in the design process. In what way can we give the end-user more the ability to be included within the process, gaining ownership over it. As described in the book of van der Werf (1993) within the school of thoughts of 'open bouwen', there was already a sense of this where people had more options to choose from within the design phases. Taking position, I firmly believe this is easily incorporated within the ideas of the architects' spatial concepts and adding a certain sustainable aspect to the design. Because these options could provide a certain involvement within the process, the idea is that they are more owner of the building and identify more, presumably enlarging the life cycle.

There are however evident downsides to this strategy, highlighted and discussed during the studio meetings. For instance, finding the balance between the guidance role of the architect and the scope of influence of the end-users within the final design. Finally, architects are educated and researched about high quality spatial solutions for the built environment. So, it is always important to have the right arguments why to avoid certain approaches. I strongly believe that virtual reality can have a beneficial asset to this via more immersive simulating research and design. Within my experience as a designer, it is evident that for people without architectural education and sense of scale and reading architectural drawings, this can be extremely challenging and leading to misunderstandings. I strongly believe that the role of the architect is (always) changing, for now more in an entrepreneurial- and diverse role, wherein we might need to give more freedom for end-users. Although maintaining the architectural quality which always should be protected and being able to add valuable critiques within a certain architectural approach, substantiated with architectural research.

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