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# RETROFIT FOR CONTINUITY! SUSTAINABILITY AND GENTRIFICATION OF TENEMENT APARTMENT BLOCKS IN DUTCH CITIES FROM INTER AND POST WAR PERIOD

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## INTRODUCTION

Increasing energy efficiency of the housing stock is one of the largest challenges in the built environment today. In line with the international Paris-Climate-Change-Conference 2015, Dutch cities have great ambitions to reduce CO<sub>2</sub> and to transform their cities into smart and climate neutral cities. In accordance with the transition from the use of fossil energy towards renewable energy, Dutch housing association organization Aedes have promised that their average housing stock is going to have Energy Performance Certificate (EPC) B in 2020. The recently published *Woonagenda 2017-2021* of Aedes speaks about zero carbon housing stock for all housing associations in 2050.<sup>1</sup> Moreover, refurbishment of the existing housing stock is broadening and including more social and feasible themes: providing affordable and attractive housing for young people in the rapid growing Dutch cities; encouraging local and self-governance; improving quality of life; green space, change of behaviour of tenants before and after the transformation and cultural heritage.<sup>2</sup>

However, in current practice the emphasis is on energy efficient renovation approaches for row-housing. Besides that, current design solutions are mainly supply-driven, being developed by contractors for professional clients who have a focus on technological aspects. Parameters like aesthetics, heritage, behaviour and user preferences are not explicitly addressed in current innovative programs.<sup>3</sup> The complex transformation of tenement apartment blocks in city regions are not taken into account. There are some risks with the refurbishment of this housing stock.

First, there is a performance gap in the prediction of energy consumption before and after the deep renovation because of changing use of the dwelling by tenants.<sup>4</sup> Second, the consequence of transformation is an inevitable house expense increase. Since the renewed Housing Act of 2015, houses are only being assigned to tenants with appropriate low incomes. According to the new *Woningwaarderingstelsel*, the rent of refurbished dwellings increase could rise above the so-called 'Social Housing' limit (€92,55 and €635,05). Hence, the apartments will become unaffordable for individual tenants since they will no longer be eligible for state income subsidies when residing in more expensive housing. Third, when speaking about refurbishment, there are issues to be considered

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like whether a building has heritage or narrative value. In addition, according to the Dutch Housing Act 70% of the tenants of a block must agree to the refurbishment. For this reason there is a need for a more integral vision and approach to deal with deep renovation of tenement apartment blocks.

The research group Beyond the Current<sup>5</sup> of Delft University of Technology is aimed to develop a feasible General Transformation Framework (GTF) for affordable tenement apartment blocks of three to five storeys in Dutch city areas from inter war (1916-1925) and post war period (1946-1965). Characteristics of these tenement blocks are. Each stair well has no lift and between 4 to 8 apartments. The apartments are between 50 and 70 square meter. The different units are always a part of housing block, the housing blocks are always a part of a coherent urban ensemble.

All together there is estimated that 480,000 of these apartments are in the city regions of Amsterdam, Rotterdam, Den Haag and Utrecht.<sup>6</sup> A more thorough conceptualization of transformation of these blocks and clearer correlation between and within the parameters energy efficiency, user preferences and cultural heritage is yet to be developed for the coming period. For each time period new goals are established, which means that the transformation of buildings will be adapted to the requirements of that time. Our foremost aim and assumption is that an apartment building stays affordable and can be retrofitted to sustainable housing, instead of being demolished for new building. The present paper describes the first phase and explains the method of the research project.



*Figure 1: Tenement apartment blocks are sometimes designed by well-known modern architects as Michel de Klerk, Gerrit Rietveld, Michiel Brinkman*

## **RESEARCH THROUGH DESIGN METHOD**

### **Research framework**

The aim of the project is to develop a more generic General Transformational Framework (GTF) in refurbishing the tenement housing stock with respect to the parameters heritage, user preferences and reduction of CO<sub>2</sub> emission. The method to achieve that is Research Through Design (RtD). This is an approach to scientific inquiry that takes advantage of the unique insights gained through design practice to provide a better understanding of complex and future-oriented issues in the design field. RtD is not a new approach.<sup>7</sup> This method with the use of case studies is necessary to develop attractive and feasible GTF and design models for architects for this more complicated part of the housing stock. With our method we make it possible to repeat our research.

Case study is defined as an empirical inquiry that investigates a phenomenon within its real-life context.<sup>8</sup> The cases should be studied in their real-life context, provide multiple sources of evidence and provide the opportunity to generalize a theory.<sup>9</sup> To this end, the project will focus on the tenement apartment blocks, which represent a relatively large proportion of the non-row housing stock in the cities in the Netherlands.

This is a multi-disciplinary research with different tools (Heritage Assessment, Energy Assessment, Life Cycle Costing, Discrete Choice Modelling). Each field of research has its own method. Design alternatives will be developed for renovation of a selection of housing types, and will be tested for user preferences by employing a discrete choice modelling method with 3D virtual design models, resulting in design solutions that are likely to be accepted by the users. Validation of our RtD-method and GTF will be done with test cases.

### **Object of research, a survey**

The research object is the tenement apartment blocks from the interbellum and post war period in the city regions. A survey is important on the one hand in order to identify the relevant building types and subtypes, resulting in the selection of design cases. On the other hand, understanding an existing building is essential for the proposed feasible design interventions. We have sought to include types that share both similarities and differences. The similarities can be useful to render the solutions comparable and therefore applicable to larger parts of this housing stock. The differences, on the other hand, help to identify specific architectural, technological and social challenges. The present research proposes a systematic way to categorize the buildings and assess the development of the typology in their context. Heritage assessment is a more or less objective tool developed for building historians to assess cultural, architectural and urban historic aspects of a building. The transformational framework is a subjective tool for architects developed at the Delft University of Technology, Heritage & Architecture by professor Wessel de Jonge to deal in a broader sense with the transformation process of old building and urban ensembles.<sup>10</sup> With this assessment, the different options are designed by an experienced architect and a GTF will be developed. Once the design is produced, an energy assessment and life-cycle-costing are calculated.

### **Energy Assessment and Life Cycle Costing**

The energy demand of existing buildings is usually calculated with standard formula's dealing with energy labels. This is a limited and imprecise way to calculate energy use. For the purpose of the present study, the output is related to the information needed for the users to choose their preference. To this end, a dynamic energy calculation is used as a means to determine the energy demand, translated into energy costs/month. Accurate data of the building's size and construction, location climate and occupancy based on the building's function were used as input to calculate the rental price. In this study we use life-cycle-costing (LCA) as a tool to estimate the cost of the transformation and to calculate the rent as a so-called cost-price-rent. In addition we check whether this cost-price-rent is in accordance with the *Woningwaarderingstelsel*.<sup>11</sup> LCC provides a systematic approach to estimating costs during the whole life cycle of a product, such as a building. In case of buildings, we use the model conform NEN-standard 2699.<sup>12</sup> In this standard, several costs are taken into account, such as: cost of the site or an old building and a site, construction or transformation costs, taxes, financing the transformation, maintenance of the building in use etc. This data is used to calculate the cost of the transformation and the new rent. Together with the Energy Assessment, which calculates the cost of energy each tenant is paying each month, the information is presented via questionnaires in the next step: Discrete Choice Modelling.

### **User Preferences Assessment (Discrete Choice Modelling)**

The design alternatives will be tested by Housing Associations for household preferences by employing a discrete choice modelling method with 3D models.<sup>13</sup> Respondents will be asked to choose between several pairs of images of design proposal. Sets of images will be created from the design alternatives; while systematically varying combinations of design attributes of renovation measures, materialization, duration of renovation, costs, and energy savings. Subsequently, household preferences are determined by employing a multinomial logit model resulting in a selection of design solutions that are most likely to be accepted by households for the various types of dwellings.<sup>14</sup> This is a quantitative and visual method for collecting data about user preferences tested design models.

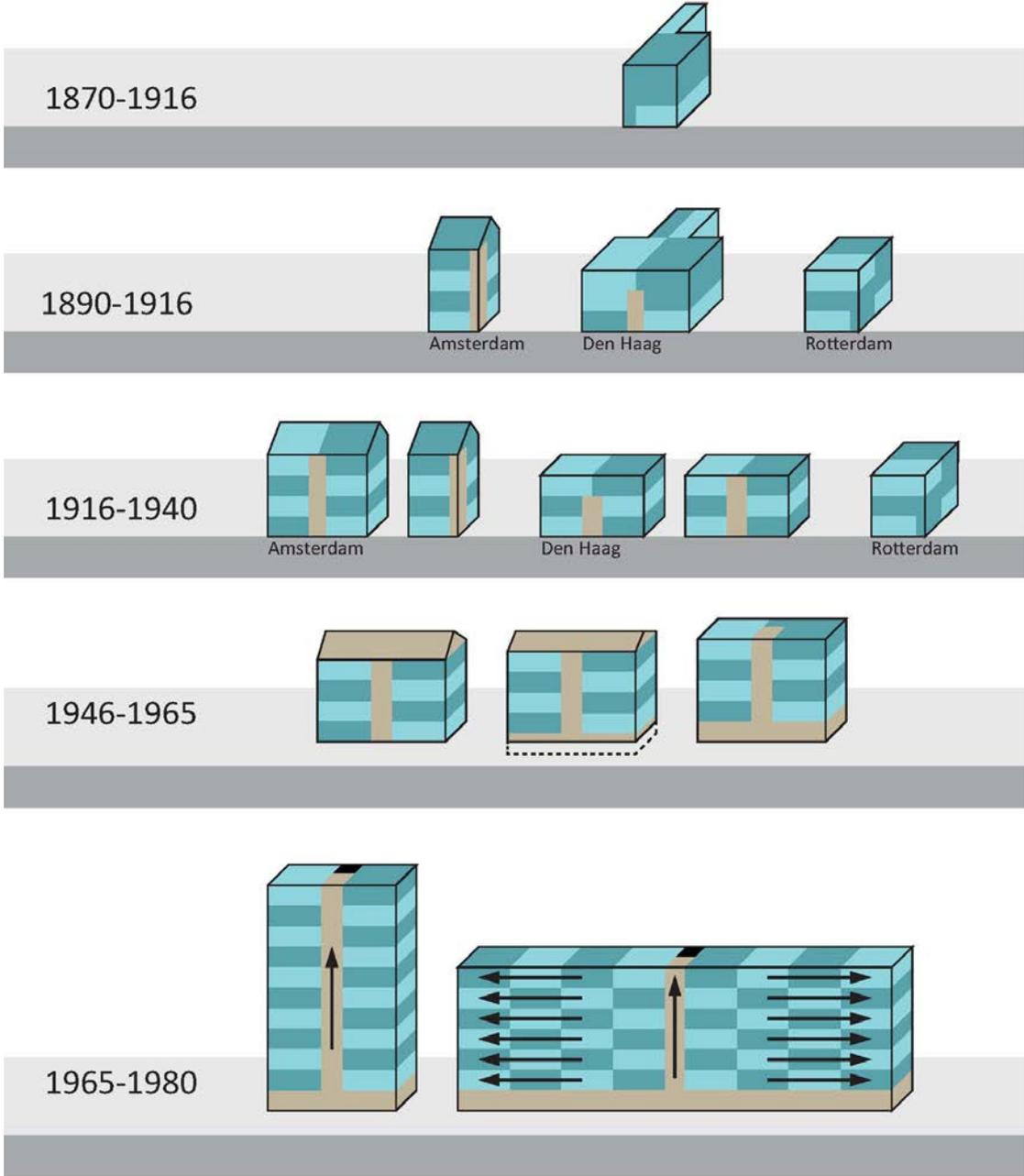


Figure 2: Subtypes tenement apartment blocks of the Netherlands, only subtypes from inter war (1916-1940) and post war period (1946-1965) are assessed in this research.



*Figure 3: Four subtypes tenement apartment blocks; left above subtype 1 inter war Amsterdam, left right subtype 2 inter war Den Haag, left below, subtype 3 post war mix traditional and construction system, right below subtype 4 post war dry prefabricated construction system*

## **HERITAGE ASSESSMENT AND TRANSFORMATION FRAMEWORK**

First step is to provide data with a building-inventory, including the categorization and interpretation of tenement building types in Amsterdam, Rotterdam, Den Haag, and Utrecht. Several criteria were developed and buildings were selected. For the survey we used primary literature sources from the inter war and post war period, and special books or articles exhibiting ‘good examples’ of tenement apartment blocks. Additional literature was examined to get a historical impression. The inventory does not claim completeness but it is an overview with insight into the development of the building type, used materials and service systems. Implicitly, we assume that protocols from the period in question, among other factors, have had a big significance on the architecture and certainly on the readability of the buildings. As a result, four subtypes of tenement apartment blocks, each with their own characteristics, are derived from the period we are assessing. Others subtypes are excluded from this research. Two from the interbellum: subtype 1 ‘Inter war Amsterdam’ and subtype 2 ‘Inter war The Hague’ and two from the post war period, subtype 3 ‘Post war mix traditional and construction system’ and subtype 4 ‘Post war dry prefabricated construction system’. Result of this first step is the selection of the cases.

Second step is to develop a General Transformational Framework (GTF) with the parameters heritage, user aspects and energy efficiency. Architects can use this framework for deep renovation of one of the subtypes. The framework categorizing objectives and makes it possible to give several aspects of parts of a building a value. Some subtypes and some buildings have great transformational potential and others less. The framework determines the band width of the potential changes. When the GTF is established, the program of the building owners and maybe that of tenants can be developed by the architect, and building and exploitation costs can be determined for a case.

Third step is the assessment of the selected design cases. To recognize qualities, a quick-scan-tool for tenement apartment blocks was developed, based on the approach of the Cultural Heritage Agency<sup>15</sup> and the municipality of Amsterdam.<sup>16</sup> There will be an assessment of external cultural historic values, internal architectural historic values and internal urban historical values. All of these will have a value.

Fourth step is documentation of the information about the building historical assessment. Three situations are compared and documented; the original state of the building, the current state and possible interventions in the future. In the current situation there is given a value to certain building elements.

Fifth step are the four design cases. Subsequently, the designing process can start. Energy assessment and life cycle costing are done and the consequence for increase or decrease of the rent is clear for tenants if they choice for a certain intervention.

At last, each design cases will be evaluated, and with the results of the users preference assessment the GTF will be perfected with each design case to a feasible refurbishment tool.

*Table 1: General Transformation Framework GTF these interventions are used in the questionnaires of the user's preference assessment.*

<b>Heritage</b>	Façade change and details with respect of the original character of the building. Interior change and details with respect of the original character of the dwelling.
<b>Energy efficiency</b>  <i>zero carbon / all electric in the exploitation of the renovated dwellings</i>	Improve the skin of the building and reduce energy demand. Aim is applying low temperature heating LTH and mechanical ventilation, if possible with demand control ventilation DCV.  Use renewable energy sources, in relation to apartment. <ul style="list-style-type: none"> <li>• Central block heating</li> <li>• Air Source (to water) Heat Pump ASHP with indoor water tank for central heating and domestic hot water. The source could be air from the ventilation system or from outside. A small electric heater is still necessary in winter time.</li> <li>• Demand Controlled Ventilation DCV</li> <li>• Mechanical ventilation with Exhaust Air Heat Pump EAHP</li> <li>• Mechanical Ventilation Heat Recovery MVHR</li> <li>• Photovoltaic panels (with battery).</li> </ul>
<b>User preferences</b>	Change kitchen-bathroom (make a connection) Change living-bedrooms (change the place of the living and bedrooms) Change living-kitchen (make connection) Extension dwellings (serre on the garden side) Extension balcony (garden side) Improve accessibility dwellings (lift en gallery garden side)
<b>Improve quality and safety</b>	Acoustic insulation between dwellings Fire safety between dwellings (wooden floors)
<b>Change or add new functions</b>	New apartment on the roof Change ground floor from storage space to apartments

## CONCLUSIONS

It is too early to draw conclusions. At the moment the user preference assessment are executed by Housing Associations, and the GTF is improving to a feasible design tool. The result will be statistically analysed to result in generalised user preferences. At the moment we are dealing with the problems such as the user's preferences and the performance gap in the prediction of energy consumption before and after the transformation because of changing use of the dwelling by tenants. And we are dealing with the problems related to the refurbishment in relation to the expenses and the rent since the renewed Housing Act of 2015. The practice of deep renovation changed. Our research will conclude in June 2018.

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- 3 <http://www.energiesprong.nl/>
- 4 Majcen 2016
- 5 Beyond the Current is a multi-disciplinary research group of Delft University of Technology: A+BE Architecture and the Built Environment organised by professor Vincent Gruis of the chair Housing Management, professor Thijs Asselbergs of the chair Architectural Engineering and professor Wessel de Jonge of the chair Heritage and Design. This research is financed by NWO/STW/SIA.
- 6 <http://statline.cbs.nl/>
- 7 Godin and Zahedi, 2014
- 8 Yin 1994
- 9 Groat & Wang 2013
- 10 De Jonge, Quist and Zijlstra 2017
- 11 <https://www.rijksoverheid.nl/onderwerpen/huurprijs-en-puntentelling>
- 12 De Jonge 2005; Van den Dobbelsteen 2006;  
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- 13 Kwak, Yoo, & Kwak, 2010; Orsborn, Cagan, & Boatwright, 2009; Riccardo, et al., 2012; Van Oel & Van den Berkhof, 2013
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