P2 report – January 2019

Where lies the optimum of energy renovations in corporation owned staircase entrée flats?

Britt van der Drift
Student nr. 434.89.23
brittvanderdrift@live.nl

Mentors:
Dr.ir. S.C. Jansen
Ir. K.B. Mulder

Mentor van Wijnen:
Frank Reijnen

External examiner:
Dr.ir. M.C. Stellingwerff

Building Technology Graduation | TU Delft

Graduation plan | P2 progress check

Goal

The location of this research is the Netherlands, with special attention to the city of Amsterdam.

The posed problem is that the housing stock needs to be made sustainable. NoM renovations are costly and label B renovations will not always improve the comfort of the resident much. Renovating enough for LTH can be an outcome. As it will not cost as much as NoM renovations, will reduce the energy consumption and can afterwards be made much more sustainable by improving the appliances (for example change the CV for a heat pump). The problem of this is that there is not enough research to know what is the minimum required for using LTH.

The main research question is: Where lies the optimum of energy renovations in corporation owned staircase entrée flats: concerning costs, energy saving, possibility of low temperature heating and practical implementations?

The sub questions required to answer the main question are:

- What is the current housing stock, concerning staircase entrée flats and with what ideals and regulations are these buildings shaped?
- What are the different materials for renovation that are currently used and that could in the future be used?
- What are the possibilities on detail level concerning façade insulation?
- What is necessary for the different renovation possibilities?
- How do the different renovation possibilities perform on the 4 aspects (cost, energy, LTH and implementation)?

Answering this questions will result in an overview with different options on how to achieve a low energy consuming building.

Process

To descripe the method used for this research:

Data will be received using: literature study, case study, analyses with dynamic tools (trnsys, uniec2 and delphin) and heat loss calculations. This will be done in different phases. The first phase will result in an inventory of what is there now. The second phase will be an approach which will result in products to use for the analyses. The third phase is the development in which the information of the second phase will be tested and analysed. The outcome of this phase will be used in the next phases.

Reflection

The social relevance of this research has to do with the energy agreement for 2050. This gives the difficult task of drastically renovating the current housing stock. In this report research will be done on how to achieve this with less costs.

Because there is still little research on what is necessary this report will also have a scientific relevance.

Content

1. Introduction
This document is a plan of action, required for the P2, for the graduation of the Building Technology master at the department of Architecture of the Technical University of Delft. Among other things it will include the background, research questions and products. In the second chapter a summary of the conducted literature study can be found. A summary of the points shown on the P2 form is found on the second page.

1.1 Background

1.1.1 Global context
The energy and climate agreement are current topics.
For the climate agreement of Paris in 2015 174 countries have agreed to stop the heating of the earth. In this agreement stated that the earth should not heat-up more than 2°C and that there should be a reduction of the CO_2 emission of 80 to 95%. (Boonstra, 2017)
In the energy agreement of 2013 is stated that in 2050 everyone should live in an energy neutral house where there will be no total CO_2 emission per year. They want this done by minimizing the energy need and generating the still necessary energy sustainably. There is also stated that the energy consumption should be reduced with an average of 1,5% each year. An energy saving of 100 petajoule per 2020. And an addition of the sustainable energy production to 14% in 2020 and 16% in 2023. (Schilder, Middelkoop & Wijngaart, 2016; Sociaal-Economische Raad, 2018)
The Netherlands has some covenants, goals and deals which help achieve the goals of the energy and climate agreement. (Schilder et al., 2016)
One of them was is the 20-20-20 goal of 2008. Which means that in 2020 the CO_2 emission should be reduced with 20% of that of 1990 (which means a reduction of 22.5 megaton CO_2), 20% of the energy should be generated sustainable, and 20% reduced amount of energy consumption. (Schilder et al., 2016)
Another one is the covenant 'Meer met Minder' of June 2012. Which has a goal to each year upgrade a minimum of 300.000 buildings 2 energy steps. This could result in an energy saving of 21 petajoule. (Schilder et al., 2016)
In 2012 the covenant 'Energiebesparing Huursector' stated the goal for housing corporations to achieve an energy-index of 1,25 (label B) on average . This will reduce the energy consumption with 23 petajoule. (Schilder et al., 2016)

In addition 6 housing corporations and 4 builders introduced the deal 'stroomversnelling' in June 2013. For this they will renovate 11.000 rental houses to NoM till 2020. Followers of this deal stated that, with success, they will expand this with 100.000 houses. A year later in September 2014 this deal was introduced for bought houses. (Schilder et al., 2016)

1.1.2 Staircase entrée flats owned by corporations

In 2016 there were 799.560 staircase entrée apartments, making up for 10,5% of the total housing stock of the Netherlands. These are divided into 4 types:

- Interbellum with construction methods from Amsterdam (like Amsterdamse school)
- Interbellum with construction methods form Den Haag (like nieuwe Haagse school)
- Post-war made with both traditional and prefabricated elements
- Post-war made with construction systems (like piling, pouring and dry prefabricated)

Each type has different characteristics but is also comparable to the others. (Gruis, 2018) After these post-war flats not much staircase entrée flats are constructed. The reason for this is the change in conditions stated in Voorschriften en Wenken in 1965. This made it obligatory for apartments with a floor above 11,2m to have an elevator. Because of this only staircase entrée flats of 3 stories without storage on the ground floor were possible. Therefore the standard staircase entrée flats were no longer feasible to make, and gallery apartments had their entrance. (Centrale directie van de volkshuisvesting en de bouwnijverheid, 1965)

In this thesis the focus will be only on the post-war staircase entrée apartments made with construction systems. The reason for this will be given in chapter 2.2: Different types of staircase entrée flats present in the Netherlands. (Oorschot, et al., 2018)

Corporations own 31% of the total housing stock, including a lot of staircase entrée apartments. Because of the profit margin corporations have, it is easier for them to invest in renovations and therefore also likely they will try to make the first step. (Schilder et al., 2016)

To ensure this, corporations set their own goals for 2050. They made a covenant in which is stated that before 2021 the average energy-index (further mentioned as EI) of the rented housing stock needs to be 1,25 (this is an energy label B). This covenant was set in 2008. Back then the EI was 1,80. The reduction from 1,80 to 1,25 in the EI will reduce the energy consumption of these buildings with 23 PJ. To achieve the goal of this covenant two options are considered:

- Upgrade 1.131.000 houses to label B
- Upgrade 508.000 houses to NoM

The costs of these options are not that different from each other. With € 12,3 billion for the label B and € 15,2 billion for the NoM renovations. Therefore both are an option for corporations, since NoM renovations also achieve the goal for 2050 and will save more money due to reduction energy consumption (see table 1). The money invested in the renovation can be retrieved with EPV (energieprestatievergoeding, translated: energy performance compensation). (Schilder et al., 2016)

Energielabel		**Besparing € / mnd**
Van	Naar	
G	B	28
F	B	26
E	B	21
D	B	16
Gemiddeld	B	20
G	NoM	119
F	NoM	127
E	NoM	119
D	NoM	116
Gemiddeld	NoM	119
Totale besparing		**€ mln / jr**
Opwaardering label B		248
NoM-woningen		680

Table 1: Savings on energy costs of tenants, per type of renovation (Schilder et al., 2016)

1.2 Definitions

1.2.1 Energy label and energy-index

The energy labels are based on the energy-index (further mentioned as EI). This is a instrument that measures the energy performance of a home. Although the calculation method used for generating energy labels is based on the calculation method used for EI, there is a difference between the two. (Rijksdienst voor ondernemend Nederland, 2018 [2])
The first difference is the target audience. The energy label is a fast and understandable way for the owner to become aware of the energy performance of his or her building. The EI is more used by landlords of social rental houses. These homes have a maximum rent which is connected to the points a home is worthy of[1]. A better EI (lower number) gives more points which then generates a higher maximum rent.
The second difference is the method. Since the energy performance should be fast and understandable it uses the 10 most important aspects of a home to generate a label. The EI has a more difficult method in which 150 aspects of the home a used to generate a EI number. A EI can therefore only be generated by a certified energy advisor. The energy label and EI are often not much apart, but this can happen when a building is especially good or bad at an aspect that is not considered in the energy label calculation. In table 2 the connection between energy label and EI number is shown. A lower EI means a more sustainable home. (Rijksdienst voor ondernemend Nederland, 2018 [1]; Rijksdienst voor ondernemend Nederland, 2018 [2])

Energy performance	**Threshold value EI for homes**
A	Smaller of even too 1.20
B	1.21 – 1.40
C	1.41 – 1.80
D	1.81 – 2.10
E	2.11 – 2.40
F	2.41 – 2.70
G	Bigger then 2.70

Table 2: Energy label connected to EI number. (Rijksdienst voor ondernemend Nederland, 2018 [2])

[1] These points are written in the ‘woningwaarderingsstelsel’ (WWS), literally translated to home rating system. A home gets points for their square meter, the outside space, the location, etc and also for the EI it has. (Rijksdienst voor ondernemend Nederland, 2018 [2])

1.2.2 NoM and Net ZEB

NoM stands for Nul-op-de-Meter (in English Zero on the meter). These are buildings that with average consumption of a year keeps the energy meter zero. During this year there will however be periods where the resident uses energy of the energy company, because the generation of energy is less. Also there will be periods where more energy will be generated and the resident this energy transmits to the energy company. Therefore net the meter will end up zero. (Schilder, Middelkoop, & Wijngaart, 2016)
Net ZEB is the English version of this. The definition of the Net ZEB is a little different, partly because the Net ZEB definition has a stratification of 4 aspects:

- Net Zero Site Energy
- Net Zero Source Energy
- Net Zero Energy Costs
- Net Zero Energy Emission

This stratification does not apply to the NoM. (Torcellini et al., 2006)
Because the thesis researched Dutch staircase entrée flats with the Dutch regulations there is chosen to use the definition of the NoM.

1.2.3 EPV

EPV stands for energieprestatievergoeding (English: energy performance compensation). This is a compensation for the renovation the lessor can ask from the tenant. There are two requirements that need to be fulfilled to be able to ask for EPV. The first one is that the building should be well insulated. This is measured in the heat demand of the building. This is the energy needed to heat the house with average consumption and a normal winter. The maximum for this is 50 kWh/m2 per year.
The second requirement is to generate sustainable energy. This should be enough to heat the house (the heat demand) and to provide the installations (like ventilation). Also it should provide an additional minimum 26 kWh/m2 per year of electricity for electric devices (with a minimal of 1.800 kWh and a maximum of 2.600 kWh) and a minimum of 15 kWh/m2 per year for hot domestic water. (Rijksoverheid, 2018 [1])
Only when the building fulfils these requirements EPV can be asked from the tenants. This should make the rent not or barely higher. The additional costs of the tenants on EPV will be approximately the same as the savings on the energy bill. The maximum EPV is registered for 3 categories: rental houses who generate their own energy; rental houses who are connected to the heat grid; and rental houses who use natural gas. Table 3, 4 and 5 show the maximum EPV depended on the net heat demand. (Rijksoverheid, 2018 [1]; Rijksoverheid, 2018 [2]; Rijksoverheid, 2018 [3])

Net heat demand [kWh/m2 per year]	Euro EPV/m2 per month
From 0 to 30	€ 1,42
From 31 to 40	€ 1,22
From 41 to 50	€ 1,02

Table 3: EPV for rental houses who generate their own energy (Rijksoverheid, 2018 [2])

Net heat demand [kWh/m2 per year]	Euro EPV/m2 per month
From 0 to 15	€ 0,71
From 16 to 30	€ 0,61
From 31 to 40	€ 0,30
From 41 to 50	€ 0,05

Table 4: EPV for rental houses who are connected to the heat grid (Rijksoverheid, 2018 [2])

Net heat demand [kWh/m2 per year]	Euro EPV/m2 per month
From 0 to 15	€ 1,17
From 16 to 30	€ 1,07
From 31 to 40	€ 0,86
From 41 to 50	€ 0,61

Table 5: EPV for rental houses who use natural gas (Rijksoverheid, 2018 [3])

1.2.4 Costs

For the costs of a renovation different aspects will be taken into account in this thesis. The biggest costs is that of the renovation itself. Extra costs of additional renovations before 2050 to meet the demand will also be approximated. The savings of the energy bill and how the corporations can get this money will also be examined.

1.2.5 Energy consumption

The energy consumption will be measured in joules. This makes it possible to compare both electricity and natural gas. To convert m3 of natural gas to joules the heating value of the gas is used. In this report the lower heating value is used. This is the most common value to use. In America they use the higher heating value which means that the generated outcomes should be recalculated it used in America.
With a heating value of 31,65 MJ/m3 the energy of natural gas will be converted to joules
The electricity consumption is normally shown in kWh. One kWh is equal to 3,6 MJ. This is calculated with the sum: E [J] = P [W] * t [s]. Since kWh means a kilo Watt (so 1.000 Watt) in one hour (so 60*60=3.600 seconds). Therefore the outcome of the sum is 1.000 * 3.600 = 3.600.000 joule, which is 3,6 MJ. (NVON, 2013)

1.2.6 Low temperature heating

The energy consumption on European buildings accounts for 40% of the total primary use. Of this 70-73% is used for heating. Which generates lots of potential in energy savings for heating. (Hesaraki & Holmberg, 2013)
Low temperature heating (further mentioned as LTH) to save energy for heating. This is because, as the name says, it works with low temperature water supply of only 45°C in comparison to 70°C water supply for normal heating. (Hesaraki & Holmberg, 2013)
Research of Mythren and Holmberg described in Hesaraki & Holmberg, 2013 further shows that a combination of LTH and a heat pump was more thermally efficient compared to the high temperature heating (further mentioned as HTH). This is because the heat pump perforce better with lower temperature supply water. This is shown in the coefficient of performance (COP), which improves with 1-2% for each degree reduction of the temperature of supply water.

1.2.7 Practical implementation

For practical implementations of the product the adjustments to the building will be taken into account. Also the residents will be taken into account. With a focus on what the influence of the renovation will be on their home.

1.3 Problem statement

1.3.1 Main problem statement

- There is a gap between the two choices of renovations (label and NoM).

  When a corporation wants a label renovation this is either a renovation to label B or A. These renovations can sometimes even be achieved with barely improving the insulation of the building by only changing the appliances and adding solar panels. This will save on the energy bill, but will not save much of the energy consumption.

  For a NoM renovations the trias energetica is often used. First the consumption needs to be minimized via insulation and with more effective appliances. Then the still necessary consumption needs to be fulfilled with sustainably produced. The last step of the trias energetica says to use natural gasses an effective as possible.

  A step between these two which will require insulation, but not yet needs to cut of gas seems appropriate. This will make it possible to postpone buying new appliances. This can be especially useful when the old appliances still work correctly.

- There is a lack of knowledge on what is the minimum needed for LTH.

  As mentioned before 70-73% of our energy consumption is used for heating. (TU Delft, n.d.)

  With LTH a lot of energy can be saved. But not yet has someone researched what is required (concerning Rc-values) for this. We know that in badly insulated buildings LTH is not wanted, since it produces less heat, than the conventional HTH systems. Too much heat will get lost and a comfortable room temperature will not be achieved in the winter. Though case studies some information can be found about this.

  A minimum Rc-value will give the opportunity to test other insulating materials (like aerogel) or know how big the cavity needs to be when filling with PUR to make LTH possible and more. It can give opportunity to a new goal of research.

- Staircase entrée flats are old buildings which are in need for renovation.

  The post war staircase entrée flats are in general admired for there functional floorplan. This makes them still very useful for living. Most of these buildings already had a small renovation to upgrade to double glazing. But a big renovation is now about time after 50 years. This gives a perfect opportunity to make the building more sustainable.

1.4 Objectives

14.1 General objective

- Explore what is necessary for the LTH renovation.

  Since LTH has a lower heating capacity than HTH the building should have some amount insulation. This can be tested by looking at the indoor surface temperature, during the coldest months. When this is comfortable, the building is insulated enough for LTH.

- Explore how LTH renovations will compare to label B and NoM renovations.

  How will LTH renovations be as a step in between a label B renovation and a NoM renovation. This need to be tested on 4 aspects:

  - The costs

    The investment, the savings on energy, the income of EPV and the raise of the rent
  - The energy consumption
  - The possibility of LTH of each renovation
  - The practical implementation

1.4.2 Sub objectives

- Include new techniques/products as options to the renovations.

  As mentioned before the possibility of insulating for LTH can be a goal. Maybe when the cavity is filled with aerogel instead of PUR, mineral wool or polystyrene it will be enough or a high performance PUR can be an outcome. There is also stucco with aerogel on the market, maybe a combination will suffice. An analyses of some of the possibilities will need to be done.

1.4.3 Boundary conditions

The research is limited to the (1) renovation of (2) post-war staircase entrée flats.
(1) As mentioned in the background, renovation of the existing building stock is key to reach the goal of an energy neutral housing stock. Energy neutral buildings are easier realised in new buildings. This thesis therefore focussed only on renovation of post-war buildings. These are the only buildings where it is possible to perform a deep renovation in inhabited state, which brings challenges with the residents and the practical implementation of improvements. (Oorschot, et al., 2018)
(2) The case study building is a staircase entrée flat build in 1958, a very common typology of houses in the Netherlands. Different types can be distinguished especially in the building system that is used for the post-war houses. The case study building is build using one of the most frequently used building systems (RBM). Other building systems have lots of similarities with the RBM system. RBM has always given a lot of problems, therefore solutions will be suited for many other systems as well. (Oorschot, et al., 2018)

1.5 Research questions

1.5.1 Main research question

Where lies the optimum of energy renovations in corporation owned staircase entrée flats: concerning costs, energy saving, possibility of low temperature heating and practical implementations?

1.5.2 Sub research questions

- What is the current housing stock, concerning staircase entrée flats and with what ideals and regulations are these buildings shaped?
- What are the different materials for renovations who are currently used and that could in the future be used?
- What are the possibilities on detail level concerning façade insulation?
- What is necessary for the different renovation possibilities?
- How do the different renovation possibilities perform on the 4 aspects (cost, energy, LTH and implementation)?

1.5.3 Final products

To answer the main research question, several products will be necessary. These products will be the answer to the different sub questions.
The first sub question 'What is the current housing stock, concerning staircase entrée flats and with what ideals and regulations are these buildings shaped?' will need the following products:
- An overview of the possible building systems and their characteristics.
- An overview of the regulations and goals for post war corporation owned buildings.

For the second sub question 'What are the different materials for renovation that are currently used and that could in the future be used?' a table of the different materials with their price, lambda value, thickness and implementation will be needed.
The third sub question 'What are the possibilities on detail level concerning façade insulation?' will need analyses of different options for insulation and a comparison of these. The products needed will be:
- An analyses (with delphin software) of the thermal bridges, possible moisture problems and heat loss.
- An overview in which the results of the analyses can be compared.

For the fourth sub question 'What is necessary for the different renovation possibilities?' some analyses will need to be done:
- An analyses in trnsys in which the radiator will get a lower capacity to perform like a LTH. The result will be a graph showing the indoor surface temperature during the whole year. The minimum required will is found with the ATG graph which says during winter approx. 20°C is comfortable for 95% of the residents. The requirement is that 99% of the hours this level of comfort needs to be achieved. (Beek, 2006)

- An analyses of possibilities to meet the requirement for indoor temperature.
The fifth sub question 'How do the different renovation possibilities perform on the 4 aspects?' will need the following two products:
- an overview of the renovations and their costs, energy consumption of the building, possibility for LTH and practical implementations
- a roadmap of the different options for renovating and which label will be achieved with these options.

1.6 Approach and methodology

The four methods used during this research are: literature study, a case study, a dynamic tool (trnsys and delphin) and static calculation tools (excel and uniec2[2]).
To answer what is necessary for label B renovations and NoM renovations uniec2 will give the label and energy outcome when using different materials and products. This will be the guideline for the literature research into the costs and implementation of these kind of renovations. Van Wijnen will also provide an overview of what products and materials are used, how they can be implemented and what a renovation like that normally costs. They also provide the case study for this report. This is the Karel Klinkerbergstraat in the city of Amsterdam. A series of staircase entrée buildings of the housing corporation the Key (see appendix 2).
The possibility of LTH needs to be tested with trnsys, using the method earlier described. A maximum capacity of the heater will be provided to the program in which the Rc-values for the renovation are entered. The output of the program will be a graph with the indoor surface temperature. If this is below 20°C in the winter LTV is not advised, since it will not make the room comfortable in in terms of temperature.
To answer what is necessary for a LTH renovation literature research on the capacity and possibilities will be done. After that the room will be put into trnsys. By adjusting the thermal insulation of the facades a minimum Rc-value for the whole façade will be found. With some basic thermal calculations materials can be found which can provide this Rc-value. In figure 1 the method to generate the final products is shown.

[2] Unfortunately uniec3, which works with the NTA 8800, will not be available till the summer of 2019. Therefore I will update the outcome of uniec2 to the NTA 8800.

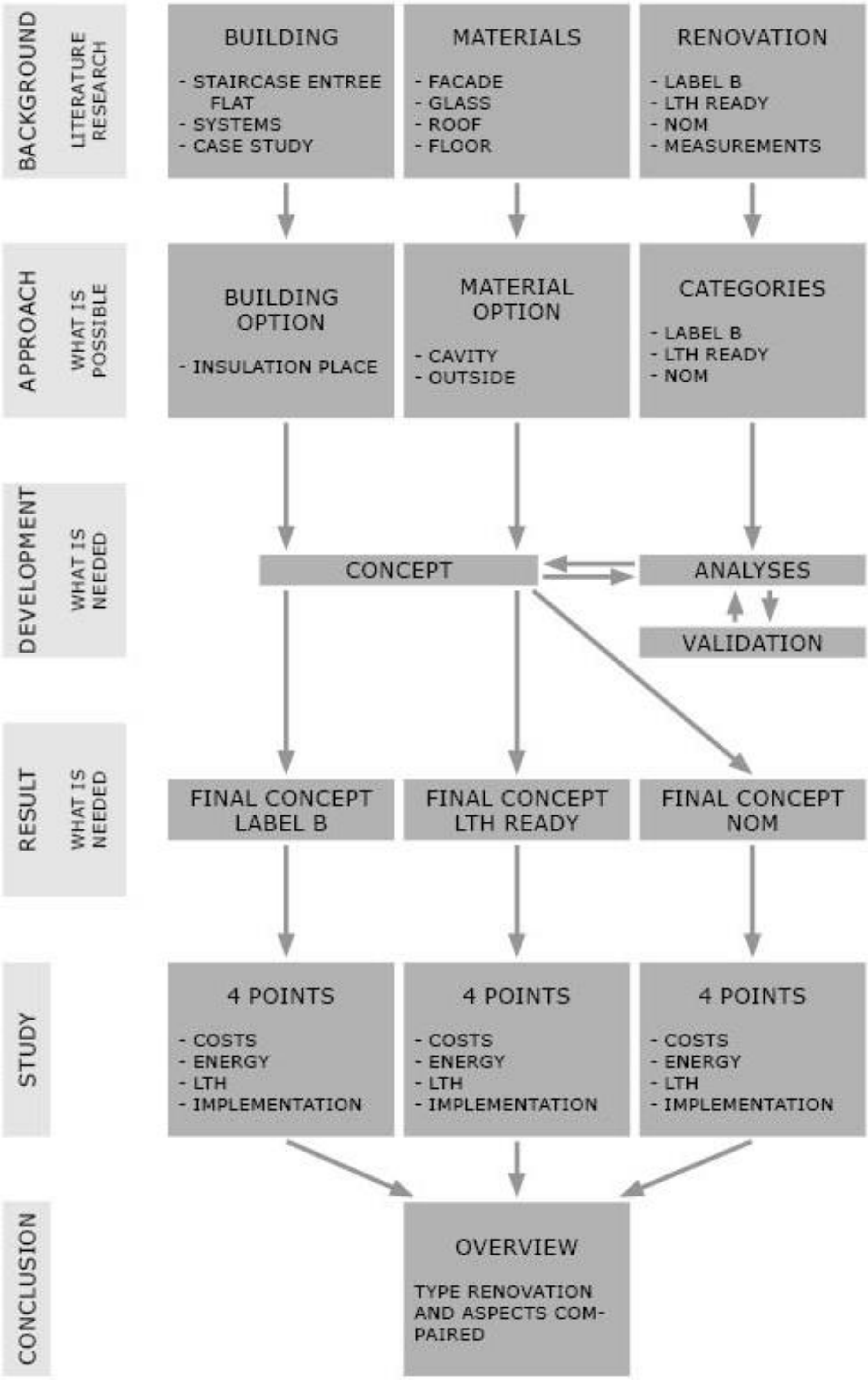


Figure 1: Working method

In the figure above is shown that the research starts with a literature study. This includes 3 themes: building, material and renovation. The first stage is mainly an inventory of what is now existing.
The second phase is the approach. This will include literature studies and case studies on what is possible now and in the future with their values.
In the development phase a concept is formed with the building properties and possible materials options. This will be analysed so it can be assigned to one of the 3 renovation categories. This analyses will be done with uniec2 to find the EI and with trnsys to see if it is possible to have LTH. A validation of the calculation in trnsys will be done with a static calculation in excel.
Multiple concepts will be made to eventually generate the best one for each renovation category. This is done in the result phase.
In the study phase these concepts will be studied on 4 points: costs, energy consumption, LTH and practical implementation.
The final phase is the conclusion. In a big overview the 3 concepts will compared to each other on the aspects found in the previous phase. From this a conclusion can be drawn when different aspect are made most important.

1.7 Planning and organisation

In the planning the same order as in the methodology is seen. Starting with the background, then approach, then development, then result, then study, and finishing with the conclusion phase. The background phase will be finished after the P2. The approach phase will then already been started. This phase will also include learning the software. This will start as early as possible. There are 3 software programs that need to be understood: trnsys, uniec2 and delphin. The first analyses will be validated as soon as possible via a static calculation in excel. When it is approved other analyses will follow with the same validation via excel. The result, study and conclusion phase will follow after. For each one month is taken into account, with a week overlap.
The planning can be seen in figure 2.

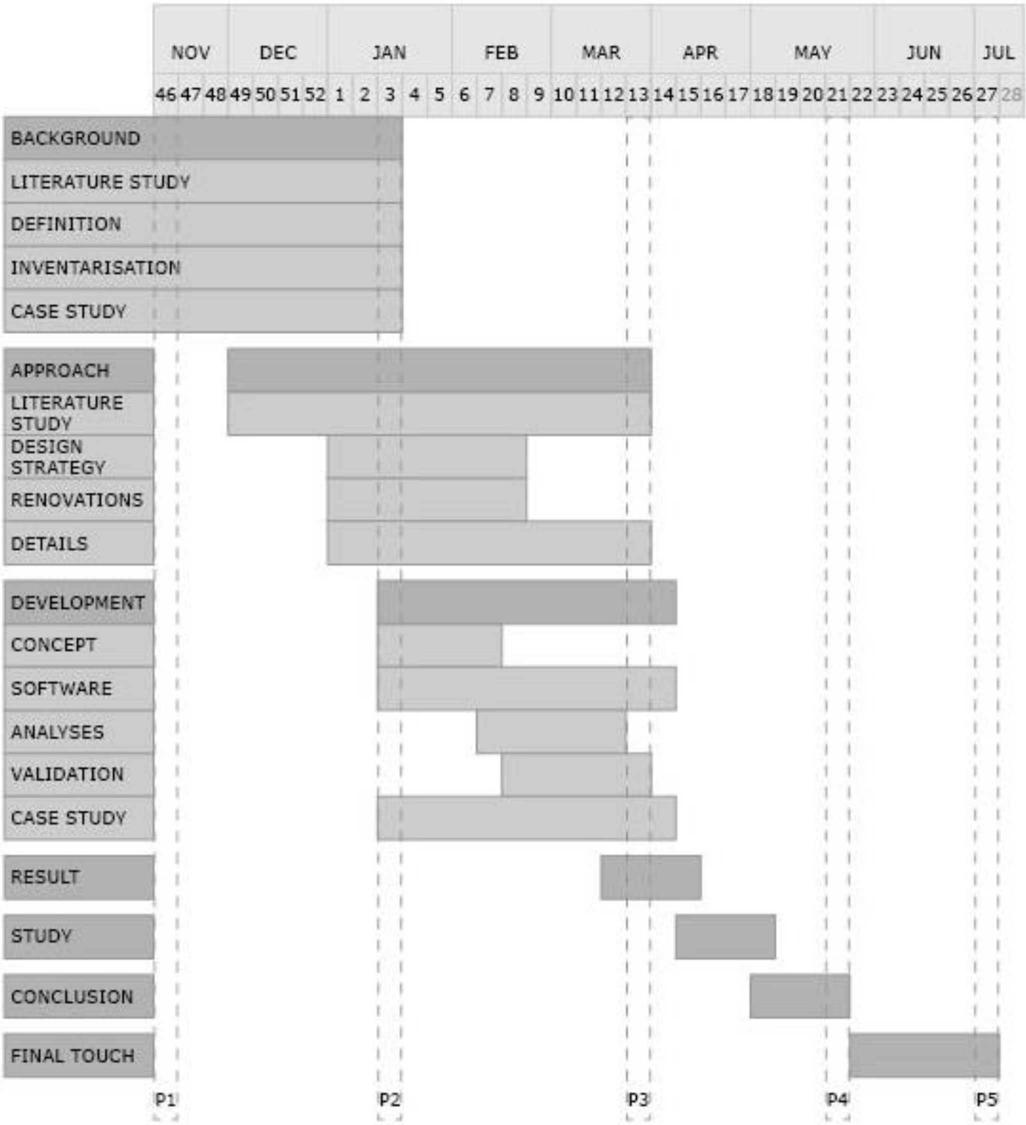


Figure 2: overview of the planning

1.8 Relevance

The social relevance of this research has to do with the energy agreement for 2050. This gives the difficult task of drastically renovating the current housing stock. In this report research will be done on how to achieve this with less costs.
Because there is still little research on what is necessary this report will also have a scientific relevance.

2 preparation

The preparation work done so far consists of these background studies:

- The current housing stock regarding staircase entrée flats
- Different types of staircase entrée flats present in the Netherlands
- The regulations and ideals that shaped staircase entrée flats
- The renovations currently done
- Different materials applicable for renovation
- Renovation on detail level

2.1 The current housing stock regarding staircase entrée flats

Multi-family homes are 2.753.595 of 7.740.984 = 36% of total housing stock. (CBS, 2018 [1])
53% (=1.253.000/2.382.000) of the total corporation stock are multi-family homes. Only 26% (=591.000/2.382.000) of that are staircase entrée apartments. (AEDES, 2018 [1])
Building year 1945-1955 multi-family homes 5% (=113.408/2.285.884) of the total housing stock. Building year 1945-1955 multi-family homes 31% (=113.408/361.997) of housing stock of 1945-1955. (CBS, 2018 [2])
Building year 1945-1959 corporation houses 13% (=300.000/2.383.000) of total corporation houses. (AEDES, 2018 [2])

2.2 Different types of staircase entrée flats present in the Netherlands

L. Oorschot et.al. stated there are 4 types of staircase entrée buildings:
- Interwar from Amsterdam
- Interwar from Den Haag
- Postwar with mixed construction
- Postwar with construction systems

Of the last type 20% of the postwar housing stock is build. This type was celebrated for its comfort, but is now denigrated for its sober appearance. There were as much as 23 different construction systems used in the Netherlands: Airey, PéGé, Pronto, Coignet, BMB, Intervam, Vaneg, WILMA, Rottinghuis, Welchen, Muwi, RBM, Polynorm, ERA, Korrelbeton, Bakker, BBB, PLN, B-G, Tramonta, EBA, Smit, Bouwvliet. (Gruis, 2018; Platform 31, 2013)

These systems can be divided in 3 construction methods: piled, poured and dry prefabricated. This is shown in table 6 for the systems which are used the most. These systems are also shown in figure 3 and 4 on the next pages. They are divided into 2 groups: system A; and system B. This is done considering the possible problems for renovation in the detail. (Platform 31, 2013; Oorschot et al., 2018)

Piled	**Poured**	**Dry prefabricated**
MUWI	Korrelbeton	Coignet
RBM	RBM	BMB
Pronto	Wilma	Rottinghuis
		VAM
		Airey

Table 6: systems divided into categories

For this research the decision is made to focus on the post war apartments built with construction systems. This is because by far the most staircase entrée buildings are built with a construction system. Also for pre war apartments it can be very hard to renovate. Due to the status the building has it is often not possible to insulate on the outside which will cut a substantial part of the research.

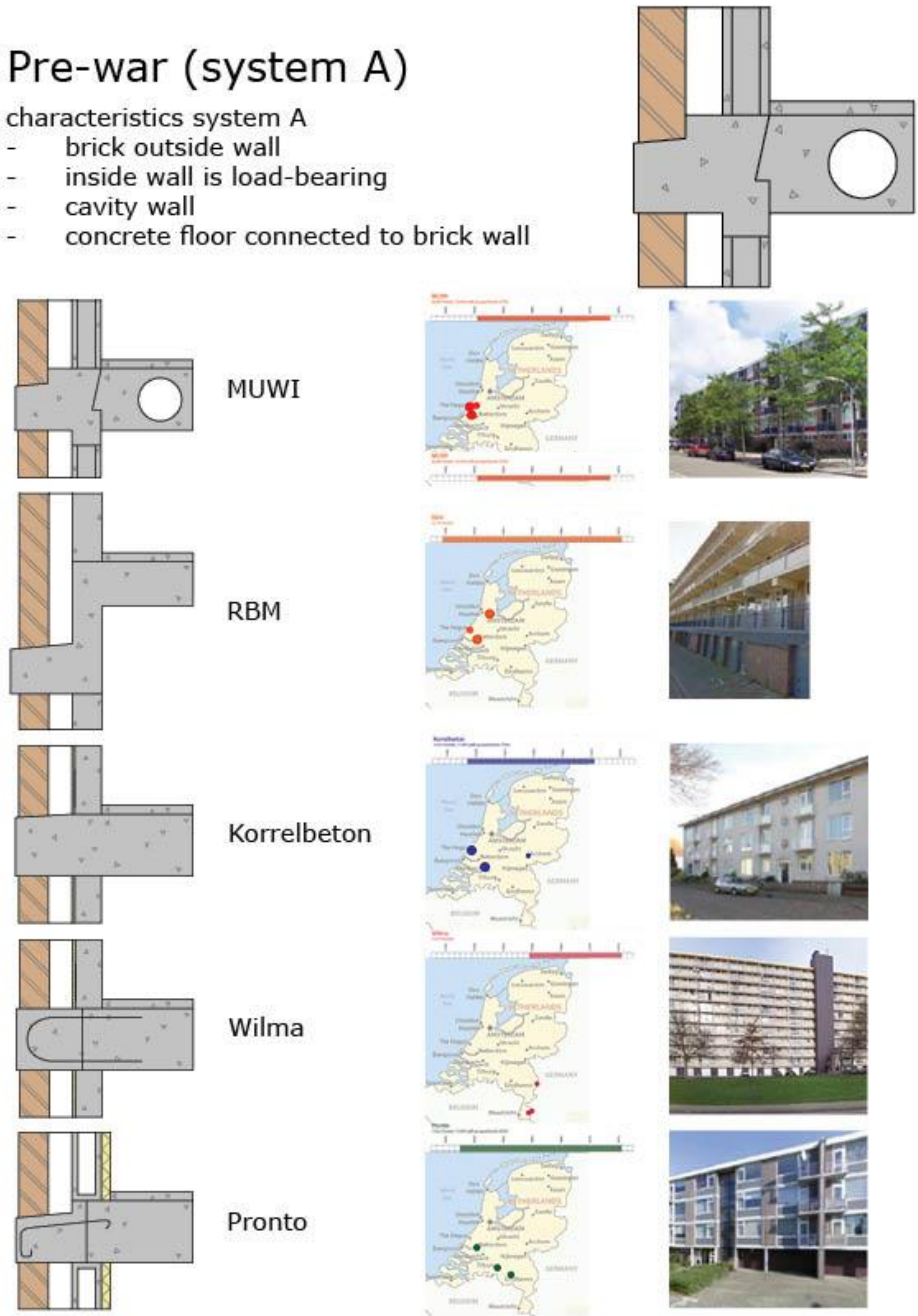


Figure 3: Post war staircase entrée building with system A

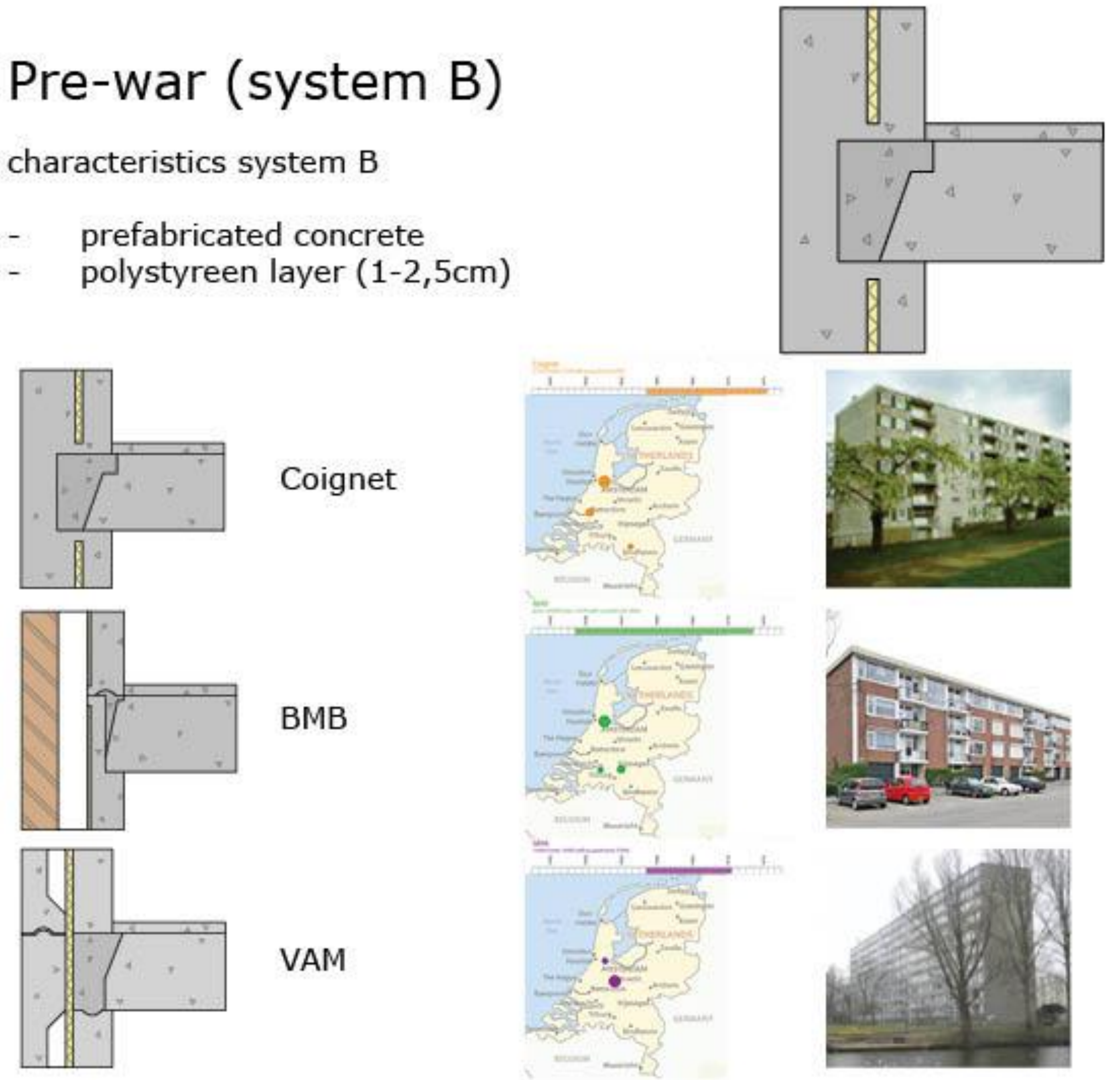


Figure 4: Post war staircase entrée building with system B

2.3 The regulations and ideals that shaped staircase entrée flats

2.3.1 Ciam ideals

The task facing the architects was to produce dwellings responsive to the practical and emotional needs. It was believed this should be achieved with rationalisation. In the Netherlands this became the style: nieuwe zakelijkheid.
As answer to the problems of the current housing stock CIAM advertises the development of housing that is favourable in terms of topography, green areas, sun and climatic circumstances. Respecting the fact that modern techniques of concentrated high-rise buildings on distance of each other, allows the realization of green areas (parks) in between.
Dwellings were to be rethought and re-designed according to the criteria of scientific efficiency laid down by Taylor's *Principles of scientific management (1911)*, with kitchens and floor-plans that were as efficient as factories. Ideas from the past about form, aesthetics, sentiment, were irrelevant: what was needed was the "Wohnford" or ford-dwelling.
Living conditions were improved. In the Netherlands houses were built with less drastic solutions in social housing schemas. These were only a transformational phase of the enclosed perimeter block to the CIAM's ultimate goal. (Collins & Swenarton, 1987; Mumford, 2000)

2.3.2 Voorschriften en wenken

A minimum surface for the living room, kitchen and other rooms was set. This was related to the occupancy of this room.
Also, it is recommended for multi-family homes to have an elevator for the apartments with their floor above 8,6 meter. But it is required to have an elevator for apartments with their floor above 10 meter, measured from the surrounding outside area of the main entrance.
And to improve the standardization of building elements sought to have matching sizes between different elements.
At last, the windowsill should be high enough for a radiator to be placed there in the future. (Centrale directie van de volkshuisvesting en de bouwnijverheid, 1965)

2.4 The renovations currently done

There are 2 main options for renovating: label renovation; and NoM renovation.
For a label renovation normally the wall cavity is insulated and the glazing will be replaced by double glazing. Then some appliances will be upgraded. Most of the time PV panels will be placed.
For the NoM renovations external insulation or second facades are placed, glazing is replaced by triple glazing, balconies are packed or renewed, a mechanical ventilation system (with heat recovery), a heat pump and PV panels are placed. To finance this there is often sought for a way to fit more appartments in the building. Ground and top floor storage can be converted into apartments. (Konstantinou, 2015; van Wijnen, 2018)

2.5 Different materials applicable for renovation

The shell of a building can be separated into different aspects. For this research we only take into account the façade, the glass, the roof and the floor. For the façade we take two different categories: cavity insulation or inside insulation and outside insulation. This is done because outside insulation often has a higher ambition level, since the thickness is not that important.
Some materials, who are introduced in the following overview, are not much used. This can be because of their costs or the maintenance needed. These materials are currently researched and in the future it is expected they will costs less and will need less maintenance. Hoping it will follow the same trend as the PV cells. Therefore they are incorporated in the research.
The materials used for this research are shown in figure 5 on the next page.

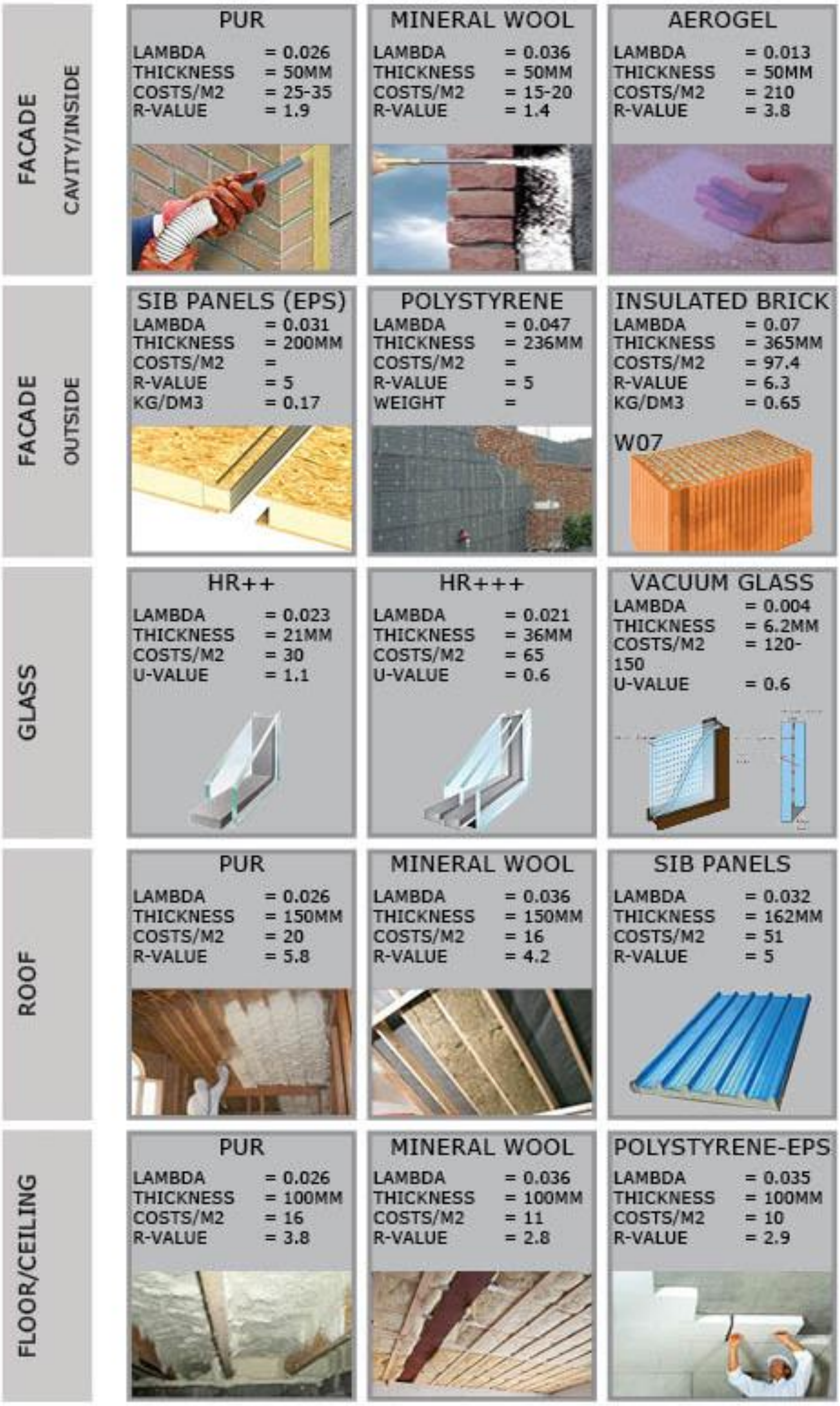


Figure 5: Materials used in this research

2.6 Renovation on detail level

When we look at post war staircase entrée buildings there are some buildings that have details worth protecting and other that don't have that. For this case there is looked at the Commissie Ruimtelijke Kwaliteit (translated: commission spatial quality) of the city of Amsterdam.

The buildings in Amsterdam who are in the algemeen uitbreidingsplan or AUP[3] (translated: general expansion plan) are valued based on four aspects resulting in an order. Each aspect can be given 1-5 points. The aspects are:

- The internal organization and the typology (this can be a staircase entrée flat, gallery apartment, etc)
- The spatial design of the building
- The urban development
- The contribution of the building to the quality of a garden city and the relation to the green outside space.

Resulting from the points gained on these four aspects, four different orders can be assigned. See table 7 for the description of the different orders. On the site https://maps.amsterdam.nl/ordekaart_aup/?LANG=nl is seen in which order a building is placed and how high it scored on the four different aspects. (Gemeente Amsterdam, 2016)

Order	**Description**
Basis order	Low value A building without architectonic or urban added value.
Order 3	Middle high value A building with a characteristic form, typology or important contribution to the composition of the urban development.
Order 2	High value A building with a characteristic architectonic form or typology. Who also contributes to the composition of the urban development.
Order 1	Monumental value A building that (on basis of typology) has a special of characteristic form and position in the urban development or its contribution to the urban development has the status of government or municipality estate.

Table 7: Order description of buildings belonging to the AUP of the city of Amsterdam

[3] AUP neighbourhoods are neighbourhoods who are build based on the AUP. In Amsterdam they can be found in district West (Bos en Lommer), districs Nieuw-West (Slotervaart, Overtoomseveld, Osdorp), district Zuid (Zuidamstel), district Oost (Watergraafsmeer) and district Noord. (Gemeente Amsterdam, 2016)

The above mentioned orders consider the form, typology and urban development the building is part of. The building is also valued for its architecture alone. This is done in the Welstandskaart Architectuur or WA (translated: architecture prosperity map). It is focussed on how the changes are proportioned to the existing architectonic qualities. The categories and their description is shown in table 8. (Gemeente Amsterdam, 2016)

WA	Façade typology			
	Masonry with holes	Masonry with holes and ornaments	Rim, pilaster strips and completion	System facade
WA-basis	Insulation on the inside or outside. New materials and new proportions or open/closed are possible.	Insulation on the inside or outside. New materials and new proportions or open/closed are possible.	Insulation on the inside or outside. New materials and new proportions or open/closed are possible.	Insulation on the inside or outside. New materials and new proportions or open/closed are possible.
WA 3	When insulating on the outside, brick strips are used.	When insulating on the outside, mineral brick strips are used and recovery of the ornaments should be done.	When insulating on the outside the existing plasticity and transition should be taken into account. Using new materials is possible.	When insulating on the outside it is possible to use new materials. Recovery of the façade is desired and her-interpretation is possible.
WA 2	When insulating on the outside ceramic brick strips are used. Window details remain and care should be taken into the transition of the roof and façade. Ref.: Bosleeuw	Take care of recovery of ornaments, plasticity and slenderness of ornaments. With ornaments on the façade, insulation on the inside is strongly advised. Window details remain. Ref.: Dudokhaken	Insulation on the inside is strongly advised, because of the plasticity and dimensioning of columns and concrete rims. Window details remain and care should be taken into the transition of the roof and façade. Ref.: Klarenstraat	Insulation on the inside is strongly advised. Window details remain. Take care of the plasticity and rhythmics of the existing façade and of the transition of the roof and façade.
WA 1	Insulation on the inside. Window details remain. Take care of the	Insulation on the inside. Preservation or recovery of the	Insulation on the inside. Preservation of the plasticity of	Insulation on the inside. Window details remain. Take care of the

	depth of the nag and the slenderness of the profiles.	existing ornaments and plasticity. Window details remain. Take care of depth of the nag and slenderness of the profiles.	the façade. Window details remain. Take care of the depth of the nag and the slenderness of the profiles.	depth of the nag and the slenderness of the profiles. Recovery and carefully cleansing of the system façade. Ref.: Aireystrook

Table 8: WA categories by typology, translation of table in (G.J. te Velde, 2016)

Bibliografie

AEDES. (2018 [1], 11 12). *Wat zijn de kenmerken van de gemiddelde corporatiewoning?* Opgehaald van aedes: https://www.aedes.nl/feiten-en-cijfers/woning/hoe-ziet-de-gemiddelde-corporatiewoning-eruit/hoe-ziet-de-gemiddelde-corporatiewoning-eruit-jan-15.html

AEDES. (2018 [2], 11 12). *Hoe ontwikkelt de woningvoorraad van woningcorporaties zich?* Opgehaald van aedes: https://www.aedes.nl/feiten-en-cijfers/woning/hoe-ontwikkelt-het-bezit-van-corporaties-zich/hoe-ontwikkelt-het-bezit-van-corporaties-zich.html

Beek, M. v. (2006). *Adaptieve temperatuurgrenswaarden: Praktijkonderzoek naar de nieuwe Nederlandse richtlijn voor de beoordeling van het thermische binnenklimaat in kantoorgebouwen.* Delft: TU Delft; VROM.

Berg, M. v. (2013). *Considerations of Dutch housing associations on the adoption of energy/efficient retrofit concepts.* Twente: Universiteit Twente.

Boonstra, M. (2017). *De ontwikkeling van duurzame warmtenetten in wijken van gemeenten in Nederland.* Amsterdam: Vrije Universiteit Amsterdam.

CBS. (2018 [1], 11 12). *Voorraad woningen; woningtype, oppervlakteklasse, regio*. Opgehaald van statline.cbs: http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=83704ned&D1=0&D2=a&D3=0,2,4,6,8&D4=0,75,190,365,416&D5=a&VW=T

CBS. (2018 [2], 11 12). *Voorraad woningen; gemiddeld oppervlak, woningtype, bouwjaarklasse, regio*. Opgehaald van statline.cbs: http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=82550ned&D1=a&D2=a&D3=1,5,9,11-12&D4=0,75,190,365,416&D5=a&VW=T

Centrale directie van de volkshuisvesting en de bouwnijverheid. (1965). *Voorschriften en wenken voor het ontwerpen van woningen.* 's-Gravenhage: Ministerie van volkshuisvesting en ruimtelijke ordening.

Collins, C., & Swenarton, M. (1987). CIAM, Teige and the housing problem in the 1920s. *Habitat INTL*, Vol. 11, No. 3, pp. 153 - 159.

Commissie Ruimtelijke Kwaliteit. (n.d.). *Mooi verduurzamen.* Amsterdam: Gemeente Amsterdam.

G.J. te Velde. (2016). *Welke gevelaanpak bij verduurzaming?* Amsterdam: Commissie Ruimtelijke Kwaliteit.

Gemeente Amsterdam. (2016). *De schoonheid van Amsterdam.* Amsterdam: Gemeente Amsterdam.

Gruis, V. (2018, 11 12). *Typologie van portiekwoningen*. Opgehaald van tudelft: https://www.tudelft.nl/beyondthecurrent/benadering/typologie/

Hesaraki, A., & Holmberg, S. (2013). Energy performance of low temperature heating systems in five new-built Swedish dwellings: A case study using simulations and on-site measurements. *Building and environment*, 64 (2013) 85-93.

Konstantinou, T. (2015). *A facade refurbishment toolboxsupporting energy upgrade of residential building skin.* Delft: TU Delft .

Mumford, E. (2000). *The CIAM discourse on urbanism, 1928-1960.* Cambridge: The MIT Press.

NVON. (2013). *BiNaS* (6e druk ed.). Groningen: Noordhoff Uitgevers B.V.

Oorschot, L., Spoormans, L., Messlaki, S. E., Konstantinou, T., Jonge, T. d., Oel, C. v., . . . Jonge, W. d. (2018). *Flagships of the Dutch welfare state in transformation.* Delft: TU Delft.

Platform 31. (2013). *Documentatie systeemwoningen '50 - '75.* Eindhoven: BouwhulpGroep.

Rijksdienst voor ondernemend Nederland. (2018 [1], 12 25). *De energie-index en het energielabel*. Opgehaald van rvo: https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/wetten-en-regels-gebouwen/bestaande-bouw/energie-index/verschil-energie-index-en-energielabel

Rijksdienst voor ondernemend Nederland. (2018 [2], 12 25). *Energie-index*. Opgehaald van rvo: https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/wetten-en-regels-gebouwen/bestaande-bouw/energie-index

Rijksdienst voor ondernemend Nederland. (2018, 12 25). *De energie-index en het energielabel*. Opgehaald van rvo: https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/wetten-en-regels-gebouwen/bestaande-bouw/energie-index/verschil-energie-index-en-energielabel

Rijksdienst voor ondernemend Nederland. (n.d.). *Nul op de Meter: ervaring van vernieuwers in de woningbouw.* Utrecht: Rijksdienst voor ondernemend Nederland.

Rijksoverheid. (2018 [1], 12 20). *Wat zijn de regels voor de energieprestatievergoeding (EPV) van mijn huurwoning?* Opgehaald van rijksoverheid: https://www.rijksoverheid.nl/onderwerpen/huurwoning/vraag-en-antwoord/regels-energieprestatievergoeding-epv-huurwoning

Rijksoverheid. (2018 [2], 12 20). *Hoe hoog is de maximale energieprestatievergoeding (EPV) van mijn huurwoning?* Opgehaald van rijksoverheid: https://www.rijksoverheid.nl/onderwerpen/huurwoning/vraag-en-antwoord/maximale-energieprestatievergoeding-epv-huurwoning

Rijksoverheid. (2018 [3], 12 20). *Hoe hoog is de maximale energieprestatievergoeding (EPV) voor huurwoningen op aardgas?* Opgehaald van rijksoverheid: https://www.rijksoverheid.nl/onderwerpen/huurwoning/vraag-en-antwoord/maximale-energieprestatievergoeding-epv-huurwoning-op-aardgas

Schilder, F., Middelkoop, M., & Wijngaart, R. v. (2016). *Energiebesparing in de woningvoorraad: Financiële consequenties voor corporaties, huurders, eigenaren-bewoners en Rijksoverheid.* Den Haag: Planbureau voor de leefomgeving.

SLuijs, P. (2017). *Nul-op-de-Meter.* OTB wooncongres.

Sociaal-Economische Raad. (2018, 12 15). *Energieakkoord: Informatie voor belanghebbenden.* Opgehaald van ser: https://www.ser.nl/

TABULA WebTool. (2018, 11 27). Opgehaald van webtool.building-typology: http://webtool.building-typology.eu/#bm

Tigchelaar, C., & Menkveld, M. (2013). *Achtergronddocument bij doorrekening SER energieakkoord - sector gebouwde omgeving.* Petten: ECN.

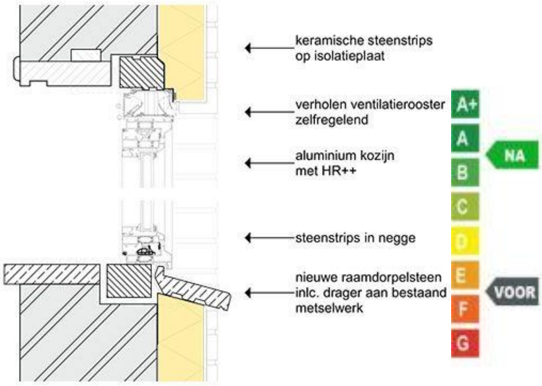
Torcellini, P., Pless, S., Deru, M., & Crawley, D. (2006). *Zero energy buidlings: a critical look at the definition.* Denver: National renewable energy laboratory.

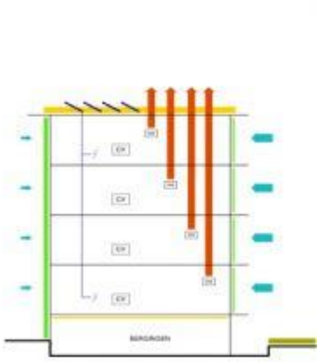
TU Delft. (n.d.). *Hoeveel energie gebruik ik en waarvoor?* Delft: TU Delft.

Appendix 1

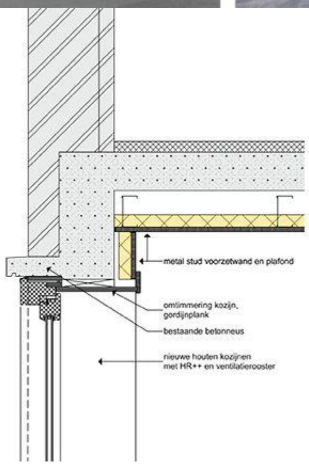
References of the WA categories of Amsterdam

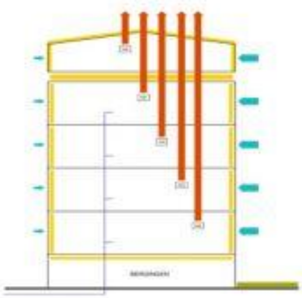
Bosleeuw | order 2, WA 2 (masonry with holes)



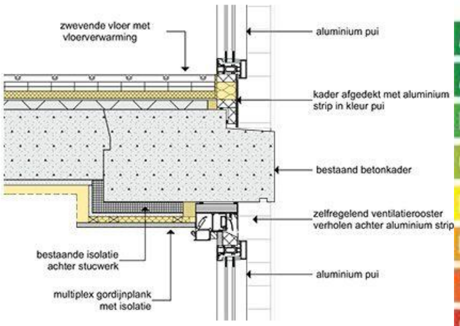


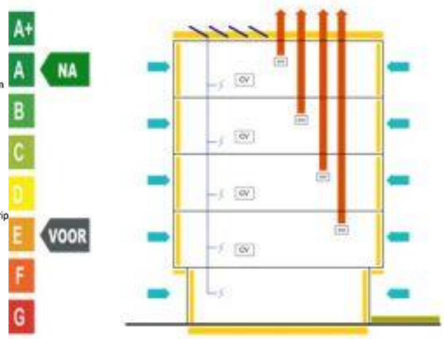
Dudokhaken | order 2, WA 2 (masonry with holes and ornaments)



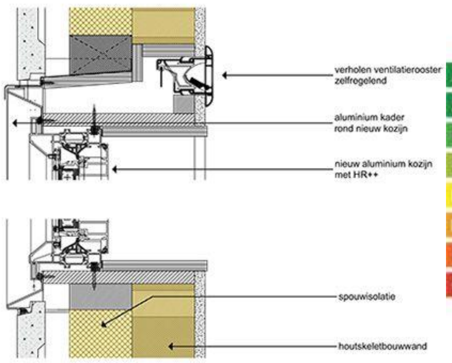


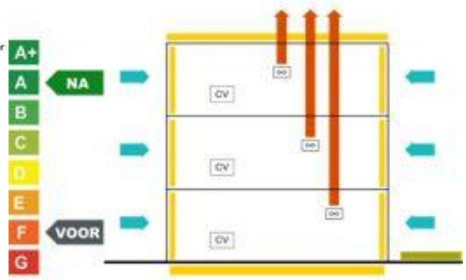
Klarenstraat | order 2, WA 2 (rim, pilaster strips and completion)





Aireystrook | order 2, WA 1 (system façade)



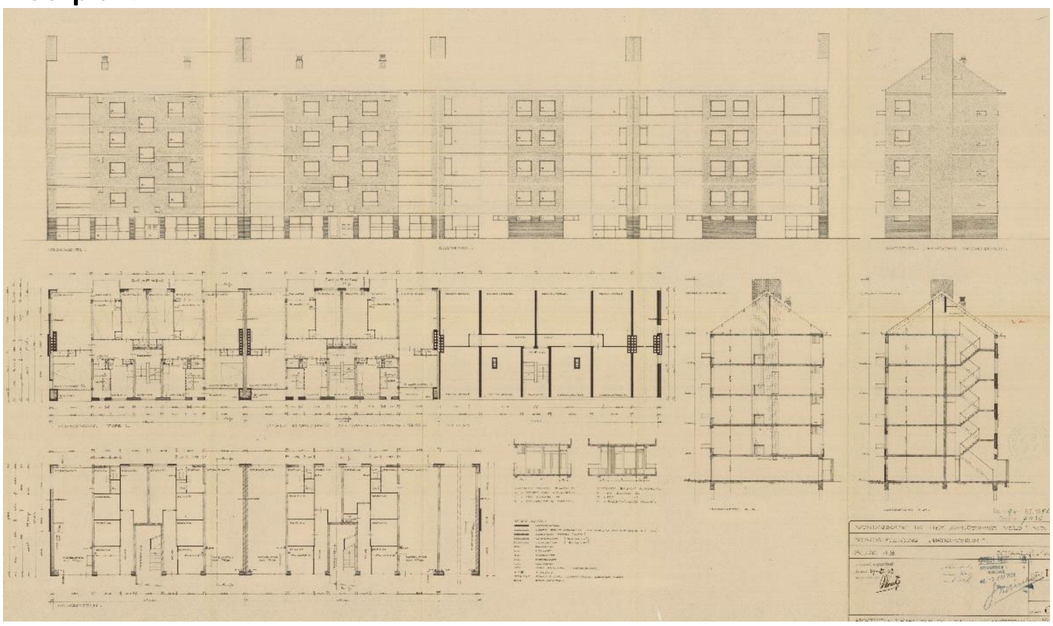


(Commissie Ruimtelijke Kwaliteit, n.d.) (Gemeente Amsterdam, 2016)

Appendix 2
Case study | Karel Klinkerbergstraat in Amsterdam

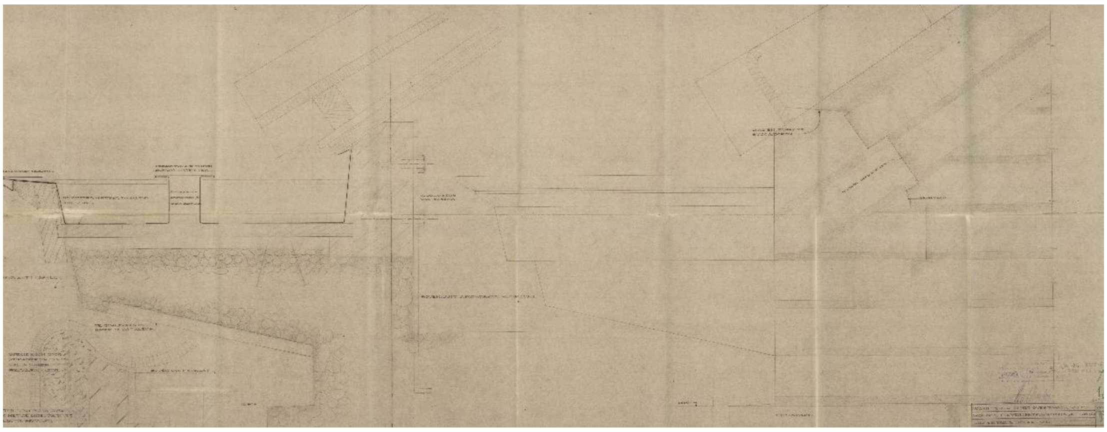
Photos:

Floorplan:



Details:

Gutter



Window frame