

ADVICE REPORT - BENG ENERGY

3161 CB, Dorpsdijk 181, Rhoon



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Course: Architecture

Module: Energy & Installations

FOREWORD

As a student at NCOI, I was asked to make a BENG calculation for a ground-based house, built between 1930 and 1990. It concerns a house that has not yet had any renovations and does not yet have an energy label. I have chosen a corner house at Dorpsdijk 181 in Rhoon. This is a rental property, inhabited by an acquaintance.

This assignment is carried out on behalf of the NCOI institute, but can also be used as an advisory report to the owner of the property. Through this report, the house can be made energy efficient.

As students, it is important to have knowledge about making existing buildings more sustainable homes/buildings and new homes. Not only for the living environment of the residents, but also for the future of the environment, nature and animals (people, planet, profit).

I would like to thank my knowledge for the possibility of photographing and measuring the house. This has helped me a lot in making this report. To my disappointment, I was unable to obtain any information about the property from the municipality.

- Nadia Monsengo
The Hague, February 14, 2023

SUMMARY

This advisory report concerns an assignment in which advice is given on making the corner house at Dorpsdijk 181 in Rhoon more sustainable. In order to give advice, the following must happen beforehand:

Extract information from construction drawings. Because the municipalities do not have any structural information about the house, the house had to be measured and photographed. New floor plans have been made, but certain information such as the thickness of the walls has been estimated. Other general information about the house can be found on the internet. This information can be found in Chapter 1: Selected House.

Then calculations are made of the surfaces, RC and RM value and U value. Based on this, a temperature curve is made. The temperature curve shows how much the temperature rises per material per building component. In this case, only a temperature curve of the cavity wall has been made. This information can be found in Chapter 2. The calculations and outcomes are in the tables. In addition to the calculations, Chapter 2 also contains information about heating, ventilation, ventilation balance and flow. A floor plan has been made with the ventilation flow in the house. This can be found in the appendix.

A digital BENG calculation was also carried out in Chapter 2. The results of this are described in an analysis in Chapter 3. This answers the following questions:

- "Does the energy label match what you would expect?"
- "Where does most of the energy go?"
- "What about overheating (To; July)?"

Based on the above information, Chapter 4 provides a proposal with what exactly needs to be done with the house to make it more sustainable. How can the house be made more energy efficient? This looks at the insulation, heating method and frames and glass. It also indicates what the consequences are for the home when the measures are implemented.

The proposal for making the home more sustainable includes new calculations for ventilation and ventilation balance. These have been added in the appendix.

Finally, the last chapter also contains installation drawings for clarification. The installation drawings consist of floor plans, sections with pipe layout, duct layout, heat points, hot and cold water pipes, fan installation location and heating generation installation location. These drawings have also been added in the appendix.

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INTRODUCTION

To what extent are homes in the Netherlands energy neutral? BENG, which stands for Almost Energy Neutral Buildings, made its introduction in the Dutch construction world in 2021 and is an important aspect when we look at energy needs, fossil energy use and renewable energy.

Previously, the energy performance of a building was expressed in EPC, energy performance coefficient. Since 2021, this has changed to BENG. New buildings must meet the BENG requirements. A BENG calculation must be made for existing buildings. Based on a BENG calculation, a building or home receives an energy label.

A BENG calculation consists of 3 indicators:

1. "Building energy demand: the maximum energy demand in kWh per m² usable area per year.
2. Primary fossil energy use: the maximum primary fossil energy use, also in kWh per m² usable area per year
3. Renewable energy: The minimum share of renewable energy in percent."¹

In the case of an old building, the amount of energy that a building actually needs for cooling, heating, ventilation and hot water is examined, and what can be done to avoid wasting energy. The use of sustainable energy sources is also examined.

In this report, the house at Dorpsdijk 181 in Rhoo is taken as an example. This is an existing house built between 1930 and 1990 and has not yet undergone major renovations.

Initially, a calculation is made of the current energy state of the house. This involves looking at surfaces, R_c values, U values, temperature curve of the facade, heating, hot water and ventilation.

Subsequently, a BENG calculation is made via Uniec 3. This is a website with which BENG indicators can be calculated and energy labels can be made. Among other things, we look at what consumes the most energy in the home. To; juli is also part of this. To; Julie indicates, by means of a number, what the risk is for temperature exceedance. The higher the number, the greater the temperature exceedance.

Based on the results of the BENG calculation, a proposal for sustainability is made and advice is given. New calculations and construction drawings are made here and it is explained what the effect is if these adjustments are applied.

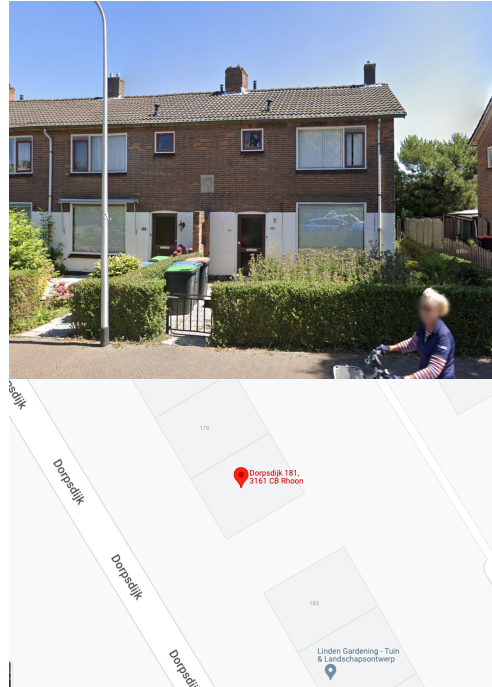
¹Wikipedia contributors, n.d. BENG, Retrieved on 20-03-2023 from <https://nl.wikipedia.org/wiki/BENG>

ASSIGNMENT

CHAPTER 1: SELECTED PROPERTY

Actual Information

- Address: Dorpsdijk 181
- Postal code: 3161 CB, Rhoon
- Surface area of the property: 78 m²
- Year of construction 1960
- Building type: Corner house - Terraced house
- Purpose: Residential function
- Plot Area: 1812 m²
- Date of registration plot BRK
(Basic Registration Cadastre): 19-12-2001
- Energy label: None
- Status: In use ²
- Municipality: Albrandswaard
- District: Rhoon-Zuid
- Province: South Holland



Plot: Rhoon A 2810

In connection with the assignment, contact has been made with the municipality. The municipality has indicated no

building drawings of this house. As a result, new measurements were taken and new building drawings were made. These can be found in appendix 1. Certain information such as the floor type and roof structure could not be determined. These are estimated in the drawings.

CHAPTER 2: BENG CALCULATION CURRENT STATE

CALCULATION OF SURFACES, RC VALUES AND U-VALUES

Surfaces in m²:

| Ground floor | | First floor | | Second floor | |
|--------------|-------------------|-------------|------------------|--------------|------------------|
| Living room | 27 m ² | Bedroom 1 | 6m ² | Attic | 45m ² |
| Hall | 8m ² | Bedroom 2 | 12m ² | | |
| Kitchen | 5m ² | Bedroom 3 | 14m ² | | |
| Toilet | 1m ² | Bathroom | 2m ² | | |
| Storage | 1m ² | Hall | 8m ² | | |

Material load-bearing inner cavity wall, inner wall and house separating wall is unknown. The following estimate has been taken for this:

- Inner cavity of sand-lime brick, 100 mm thick
- Inner wall of sand-lime brick, 150 mm thick
- House separating wall, 250 mm thick

Kadastralekaart.com, n.d. Dorpsdijk 181, KadastraleKaart.com, Accessed on 26-10-2022 from <https://kadastralekaart.com/adres/rhoon-dorpsdijk-181/0613200000157767>

Calculation Rm and U-value:

| <u>Rm</u> | | | |
|------------------------------|-----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| | <u>Cavity wall:</u> ³⁴ | <u>Inner wall:</u> | <u>Dwelling separating wall:</u> |
| Rm 1 | Brick, 100mm | Plaster layer, 10mm | Sand-lime brick, 100mm |
| Calculation: | $0.1(d) / 0.8(\lambda) = 0.125 \text{ m}^2\text{K/W}$ | $0.01(d) / 0.5(\lambda) = 0.02 \text{ m}^2\text{K/W}$ | $0.1(d) / 0.8(\lambda) = 0.125 \text{ m}^2\text{K/W}$ |
| <u>Rsp</u> | Cavity, 40mm | | Cavity, 40mm |
| Calculation: | $1/(0,5 \alpha_{gsp} + 0,5 \alpha_{csp} + 5 \alpha_{ssp}) = 0,17 \text{ m}^2\text{K/W}$ | | $1/(0,5 \alpha_{gsp} + 0,5 \alpha_{csp} + 5 \alpha_{ssp}) = 0,17 \text{ m}^2\text{K/W}$ |
| Rm 2 | Sand-lime brick, 100mm | Sand-lime brick, 150mm | Sand-lime brick, 100mm |
| Calculation: | $0.1(d) / 0.8(\lambda) = 0.125 \text{ m}^2\text{K/W}$ | $0.15(d) / 0.8(\lambda) = 0.187 \text{ m}^2\text{K/W}$ | $0.1(d) / 0.8(\lambda) = 0.125 \text{ m}^2\text{K/W}$ |
| Rm 3 | Plaster layer, 10mm | Plaster layer, 10mm | Plaster layer, 10mm |
| Calculation: | $0.01(d) / 0.5(\lambda) = 0.02 \text{ m}^2\text{K/W}$ | $0.01(d) / 0.5(\lambda) = 0.02 \text{ m}^2\text{K/W}$ | $0.01(d) / 0.5(\lambda) = 0.02 \text{ m}^2\text{K/W}$ |
| <u>Total Rm</u> | 0,44 m²K/W | 0,23 m²K/W | 0,44 m²K/W |
| <u>U-value</u> | | | |
| Brick calculation: | $0.8(\lambda) / 0.1(d) = 8 \text{ W/ m}^2\text{K}$ | | |
| Sand-lime brick calculation: | (inner cavity wall) $0.8(\lambda) / 0.1(d) = 8 \text{ W/ m}^2\text{K}$ | $0.8(\lambda) / 0.15(d) = 5.3 \text{ W/ m}^2\text{K}$ | $0.8(\lambda) / 0.1(d) = 8 \text{ W/ m}^2\text{K}$ |
| Plaster layer | $0.5(\lambda) / 0.01(d) = 50 \text{ W/ m}^2\text{K}$ | $0.5(\lambda) / 0.01(d) = 50 \text{ W/ m}^2\text{K}$ $0.5(\lambda) / 0.01(d) = 50 \text{ W/ m}^2\text{K}$ | $0.5(\lambda) / 0.01(d) = 50 \text{ W/ m}^2\text{K}$ |
| Total | 66 W/ m ² K | 105,3 W/ m²K | 66 W/ m ² K |

α_{gsp} = Conduction cavity
 α_{csp} = Convection cavity
 α_{ssp} = Radiation cavity

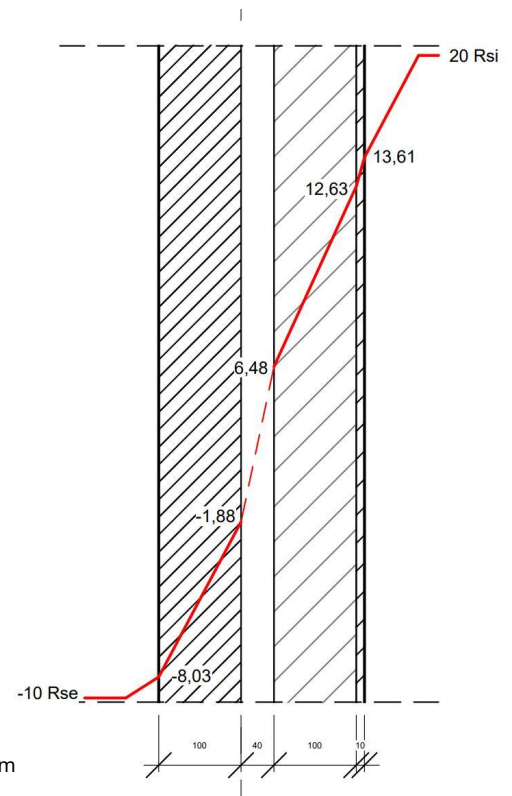
³ Kuijpers-Van Gaalen, I.M. 02-01-2017, Building physics, 8th edition, Meulemhoff
 JoostdeVree, n.d. Thermal conductivity coefficient λ , joostdevree.nl, Accessed on 06-11-2022 from <https://www.joostdevree.nl/shtmls/warmtegeleidingscoefficient.shtml>

Rc in U-value total:

| | Rm value [m ² K/ W] - Cavity wall | Rm value [m ² K/ W] - Interior wall | Rm value [m ² K/ W] - Party wall | Rc value total [m ² K/ W] | U-value total [W/m ² K] |
|--------------|----------------------------------------------|------------------------------------------------|---------------------------------------------|--------------------------------------|------------------------------------|
| Living room | 0,44 | 0,23 | | 0,67 | 66 + 105,3 = 171,3 |
| Hallway | 0,44 | 0,23 | 0,44 | 1,11 | 66 + 105,3 + 66 = 237,3 |
| Kitchen | 0,44 | 0,23 | 0,44 | 1,11 | 66 + 105,3 + 66 = 237,3 |
| Toilet | | 0,23 | 0,44 | 0,67 | 66 + 105,3 = 171,3 |
| Storage room | | 0,23 | 0,44 | 0,67 | 66 + 105,3 = 171,3 |
| Bedroom 1 | 0,44 | 0,23 | 0,44 | 1,11 | 66 + 105,3 + 66 = 237,3 |
| Bedroom 2 | 0,44 | 0,23 | | 0,67 | 66 + 105,3 = 171,3 |
| Bedroom 3 | 0,44 | 0,23 | | 0,67 | 66 + 105,3 = 171,3 |
| Bathroom | 0,44 | 0,23 | 0,44 | 1,11 | 66 + 105,3 + 66 = 237,3 |
| Hallway | | 0,23 | 0,44 | 0,67 | 66 + 105,3 = 171,3 |
| Attic | 0,44 | | 0,44 | 0,88 | 66 + 66 = 132 |

CALCULATION TEMPERATURE GRADIENT FACADE

| | Thickness [m] | λ [W/mK] | Rm [m ² K/W] | ΔT_m | T |
|-----------------|---------------|------------------|-------------------------|--------------|-------|
| Cavity wall | | | | | |
| Outside air | | | | | -10 |
| R se | | | 0,04 ⁵ | 1,97 | -8,03 |
| Brick | 0,1 | 0,8 | 0,125 | 6,15 | -1,88 |
| Cavity | 0,04 | - | 0,17 ⁶ | 8,36 | 6,48 |
| Sand-lime brick | 0,1 | 0,8 | 0,125 | 6,15 | 12,63 |
| Finishing coat | 0,01 | 0,5 ⁷ | 0,02 | 0,98 | 13,61 |



⁵ Kuijpers-Van Gaalen, I.M. 02-01-2017, Building physics, 8th edition, Meulemhoff

⁶ Kuijpers-Van Gaalen, I.M. 02-01-2017, Building physics, 8th edition, Meulemhoff

JoostdeVree, n.d. Thermal conductivity coefficient λ , joostdevree.nl, Accessed on 06-11-2022 from <https://www.joostdevree.nl/shtmls/warmtegeleidingscoefficient.shtml>

| | | | | |
|------------|--|-------------------|------|-----------|
| Yes | | 0,13 ⁸ | 6,39 | |
| Air inside | | | | 20 |
| Total | | 0,61 | | 30 |

HOME HEATING

The house is heated by a Vaillant combi boiler. See image on the right. This is a vr-combi boiler, which provides heating and hot tap water for the shower or kitchen. VR stands for improved efficiency. The temperature can be adjusted as desired. This boiler has a copper heat exchanger with stainless steel fins.



How does the technology work?

A combi boiler is part of a flow-through device. This means that, unlike a storage device, the water flows past the boiler and is heated. With a storage device, it is later stored at temperature for use at another time. . The device uses air from the same room.

A vr-combi boiler works about the same as a hr-boiler: With a central heating system, a lot of heat is still lost, for example through a chimney. Combustion gases still contain a lot of heat. With HR technology, these gases remain in the boiler and the energy from the combustion gases is reused. The gases are passed through the heat exchanger and condensed. The residual heat is then transferred to the heating heat.

HOME VENTILATION

The photos on the right show that the house contains both mechanical and natural ventilation. The house is ventilated in the following way:



1. VR1 - Living room: Via system A: _____
Natural supply, natural exhaust.
By means of 2 casement windows with ventilation grille and door to traffic area 1.
2. VR2 - Kitchen: Via system C: _____
Natural supply, mechanical discharge. By means of door, casement window and mechanical ventilation.
3. VR3 - Bedroom 1: Via system A: Natural supply, natural exhaust. By means of door and casement window with ventilation grille
4. VR4 - Bedroom 2: Via system A: Natural supply, natural exhaust. By means of door and casement window with ventilation grille.
5. VR5 - Bedroom 3: Via system A: Natural supply, natural exhaust. By means of door and casement window with ventilation grille.
6. Toilet - Ground floor: Via system C: Natural supply, mechanical exhaust. By means of

⁸Kuijpers-Van Gaalen, I.M. 02-01-2017, Building Physics, 8th edition, Meulehoff

⁹ Vaillant , z.d. ThermoCOMPACT Combi Boiler Vaillant, Accessed on 30-12-2022 from

<https://www.vaillant.nl/consument/producten/thermocompact-combiketel-2177.html>

¹⁰Bone, A.H.L.G. 30-04-2020, Basic Book of Architecture 1st edition, Thieme Meulehoff

¹¹ Vaillant, 11-02-2016, How does a Vaillant hr-boiler work?, "Video", Youtube, Accessed on 30-12-2022 from <https://www.youtube.com/watch?v=bviiHAed90g>

door and mechanical ventilation.

7. Bathroom - First floor: Via system C: Natural supply, mechanical exhaust. By means of door, mechanical ventilation and hinged window
8. Attic - Second floor: Via system A: Natural supply, natural exhaust. By means of hinged window and stairwell to the first floor.

VENTILATION BALANCE: CALCULATION + FLOOR PLAN (VENTILATION FLOW) The ventilation balance with ventilation flows are added in appendix 2.

EXPLANATION VENTILATION BALANCE

Attic: In the attic, 45dm³/s is supplied via the hinged window. Via the stairwell, this flows through to the traffic area on the first floor (VKR 2)

First floor: The ventilation coming from the attic (45dm³/s) spreads via traffic area 2 (VKR 2) over the first floor. Of the 45, 28.8 dm³/s goes to living area 2 (VG2). Of this, 6 dm³/s goes to living room 4 (VR3), 11 dm³/s to VR2 and 11.8 dm³/s to VR5. The ventilation that is supplied to these rooms is discharged to the outside via the "hinged window with ventilation grilles". Of this, 45 - 28.8 = 16.2 dm³ remains in the traffic area on the first floor. Of this, 14 dm³ goes to the bathroom via the door. The 14 dm³ is discharged in the bathroom via a hinged window and mechanical ventilation. In the traffic area on the first floor, 16.2 - 14 = 2.2 dm³ now remains. This goes to the traffic area on the ground floor (VKR 1) via the stairwell on the first floor

Ground floor: On the ground floor, 2.2 dm³/s comes from above and the rest is supplied via the kitchen and living room. The living room has 2 hinged windows with ventilation grilles. 62.8 is supplied at "hinged window with ventilation grille 1". Of this, 18.9 is removed via "hinged window with ventilation grille 2". 62.8 - 18.9 = 43.9. 43.9 dm³/s goes to the hall/traffic area (VKR 1). From VKR 1, 7 dm³/s goes to the toilet via the door. This is discharged to the outside via the mechanical ventilation. In traffic area 1, 43.9 - 7 = 36.9 dm³/s remains. There is no discharge in the storage room (0.9 dm³/s) and meter cupboard (80 dm³/s), so the number (36.9 dm³/s) remains the same, but (80+0.9) 80.9 - 36.9 = 44 dm³/s is still missing. 65 dm³/s is supplied from the back door and/or hinged window of the kitchen. Of this, 44 dm³/s goes to VKR 1. 65 - 44 = 21 dm³/s remains in the kitchen. According to the requirement (21 dm³ /s), that is exactly enough. The 21 dm³/s is discharged via the mechanical ventilation (MV) in the kitchen.

CHAPTER 3: RESULTS BENG CALCULATION ANALYSIS RESULTS

The results from the BENG calculation are largely

consistent with expectations about the house. The results are added in appendix 3. From the data entered in Uniec 3, energy label G was created, which means that the house has a lot of drafts and needs a lot of energy to heat the house. Energy consumption is more than 380 kwh/m² living space per year. The annual characteristic energy consumption is 73,209 kWh. Most of the energy to heat the house goes to gas heating. That is 53,789 kWh of the 72,010 kWh. Currently there is an HR boiler present and, but no working heating. Houses from the 60s



| | resultaat |
|--------------------------------|-----------|
| Behoefte [kWh/m ²] | 316,11 |
| Fossiel [kWh/m ²] | 938,59 |
| Hernieuwbaar [%] | 0,0 |
| TO _{juli;max} | 0,00 |
| Energie label | G |

Rekenen

are hardly or not at all insulated. This applies to the walls, roofs and floors. The large windows of these houses consist of single or double glazing, allowing a lot of drafts to enter. It is unclear whether the house has since been renovated with new glass and insulation. Probably not. The temperature in the house is very low. Most of the energy should go to the heating. This is currently not the case. The current resident does not use the HR boiler, but uses a portable electric radiator to heat a room. Due to the poor to no insulation, the heat escapes from the house through the roof, facades and windows.

NZEB Nearly Zero-Energy Buildings

A nearly zero-energy building must meet the following 3 requirements:

1. NZEB-1: the maximum energy demand in kWh per m² of usable floor area per year. This applies only for heating, cooling and lighting.
2. NZEB-2: the maximum primary fossil energy use in kWh per m² of usable floor area per year. This looks at everything that generates energy.
3. NZEB-3: the minimum share of renewable energy. The energy in the building must be partly generated by energy sources such as sun, wind and soil energy. ¹³

The house at Dorpsdijk 181 in Rhoon does not meet the three requirements.

To:July

To: July, an indicator of the NZEB requirements, indicates a result of 0 for this house. Technically, a number lower than 1 means that there is no or low risk of temperature exceedance.

Normally the outcome should be a number between 0.1 and 1.20. Each facade surface, in this case 3, because this is a corner house, should have such a value. The higher the number, the greater the risk of temperature exceedance. Given that this is not shown here, we should assume that the risk of temperature exceedance is low, but this is not entirely correct. Because the house has no or poor insulation, the temperature in the house will rise in the summer. So much so that it can feel like a sauna. It is therefore important that the house is insulated and provided with sun protection that can be partially removed in the winter so that the sun can heat the house.

CHAPTER 4: PROPOSALS FOR MAKING SUSTAINABLE

PROPOSAL SUSTAINABILITY

To make the home more sustainable, it is proposed to purchase and apply the following:

1. Cavity wall insulation, floor insulation and good roof insulation

The following insulation materials are an option for insulation: Flax panels, paper flakes, wood wool, hemp or cork panels. I suggest using wood wool. Wood wool can be used as floor-facade and sloping roof insulation. In addition, the material is moisture-resistant, vapor-permeable, sound-insulating and can store a lot of heat. Because it is cuttable, the material is easy to apply. The price is approximately 20 to 25 euros per m², which is cheaper than cork panels. Also a good alternative, but what more expensive. When applying insulation, please pay attention to the connections so that there are no air leaks and cold bridges arise.

¹²Hoe-Koop-Ik.nl , z.d. Insulation house 60s, Hoe-Koop-Ik.nl , Accessed on 02-01-2023 from

<http://www.hoe-koop-ik.nl/isolatie/huis-isoleren/isolatie-huis-jaren-60>

Netherlands Enterprise Agency, 15-08-2018, NZEB-3 Indicator, rvo.nl, Accessed on 11-02-2023 from

<https://www.rvo.nl/sites/default/files/2019/05/Eindrapport%20koude%20in%20BENG%203%20Harmelink.pdf>

2. New frames and insulated glass

The frames are in good condition. Replacing the frames is not necessary unless they are not suitable for HR++ glass, triple glass or vacuum glass. The current glasses must be replaced with one of these three glasses. Vacuum glass has a U-value of 0.4 - 0.7 in an existing frame, HR++ glass has a U-value of 1.0 - 1.2 in an existing frame and triple glass a U-value of 0.4 - 0.9. The lower the U-value, the better the glass insulates. Vacuum glass is the best choice, but a bit on the pricey side. For a cheaper option, triple glass is a good alternative. ¹⁴

2. Application of sun protection.

There are various sun protections on the market: The best sun protection for the home is an external sun protection, namely a roller shutter. A roller shutter lets no sun through and insulates well.

3. Balanced ventilation

A balanced ventilation supplies as much clean air as it extracts dirty air and heats the incoming cold air (hrv = heat recovery). With a bypass, the cold air is not heated. A balanced ventilation has a ventilation unit with 2 fans, one of which provides the air supply and the other for the air extraction. Air is supplied and discharged via ducts and valves. The doors must have at least 1.5 cm of space at the bottom. There are 2 types of balanced ventilation: A central balanced ventilation and a local/decentralized balanced ventilation. Because this house is an existing house I recommend installing a local/decentralized ventilation unit. This can be in multiple rooms be constructed. The warm air that remains can be used for hot water. ¹⁵

A shower-hrv heats cold water via a heat recovery unit. Hot and cold water flows past each other. Cold water takes heat from hot water.

EFFECT OF THE PROPOSAL

By applying the above to the home, the home will be improved on the following points:

1. Saving energy costs: When buying and installing a heat pump, a corner house saves approximately 650 euros per year on energy.
2. A better indoor climate: Less heat loss in the winter and a cool home in the summer.
3. Because you heat less, you take the environment into account, so less environmental impact and CO2 emissions.
4. Less noise from the environment.
5. Home is better resistant to burglary (insulating glass).

Appendix 4 contains the calculations of the measures implemented and added in a new ventilation balance and ventilation flow.

INSTALLATION DRAWINGS: FLOOR PLAN & SECTION

Finally, new construction drawings have been made in which the new installations for sustainability can be seen. The installation drawings are added in appendix 5.

¹⁴Milieu Centraal, z.d., Double glazing, HR glass, triple glass and vacuum glass, Milieu Centraal, Accessed on 20-02-2023 from <https://www.milieucentraal.nl/energie-besparen/isoleren-en-besparen/dubbel-glas-hr-glas-triple-glas/#vacuumglas-supergoed-isoleren>
¹⁵Milieu Centraal, z.d., Balanced ventilation, Milieu Centraal, Accessed on 20-02-2023 from <https://www.milieucentraal.nl/energie-besparen/ventilatie/balansventilatie/>
Milieu Centraal, z.d., Shower-hrv, Milieu Centraal, Accessed on 29-03-2023 from <https://www.milieucentraal.nl/energie-besparen/duurzaam-warm-water/douche-wtw/>

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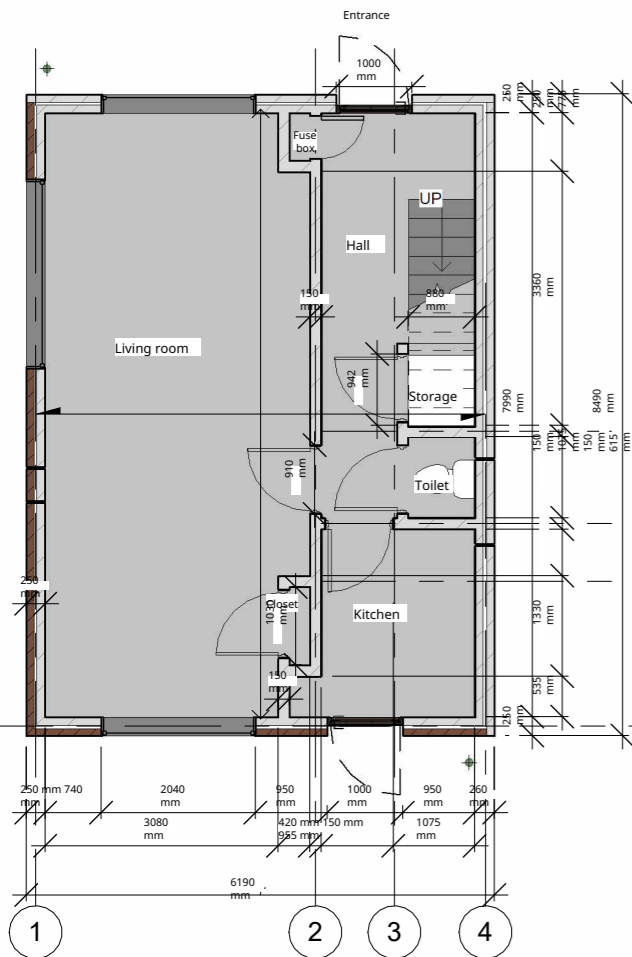
<https://www.milieucentraal.nl/energie-besparen/isoleren-en-besparen/dubbel-glas-hr-glas-triple-glas/#vacuumglas-supergoed-isolerend>

<https://www.nibud.nl/onderwerpen/wonen/huis-verduurzamen/>

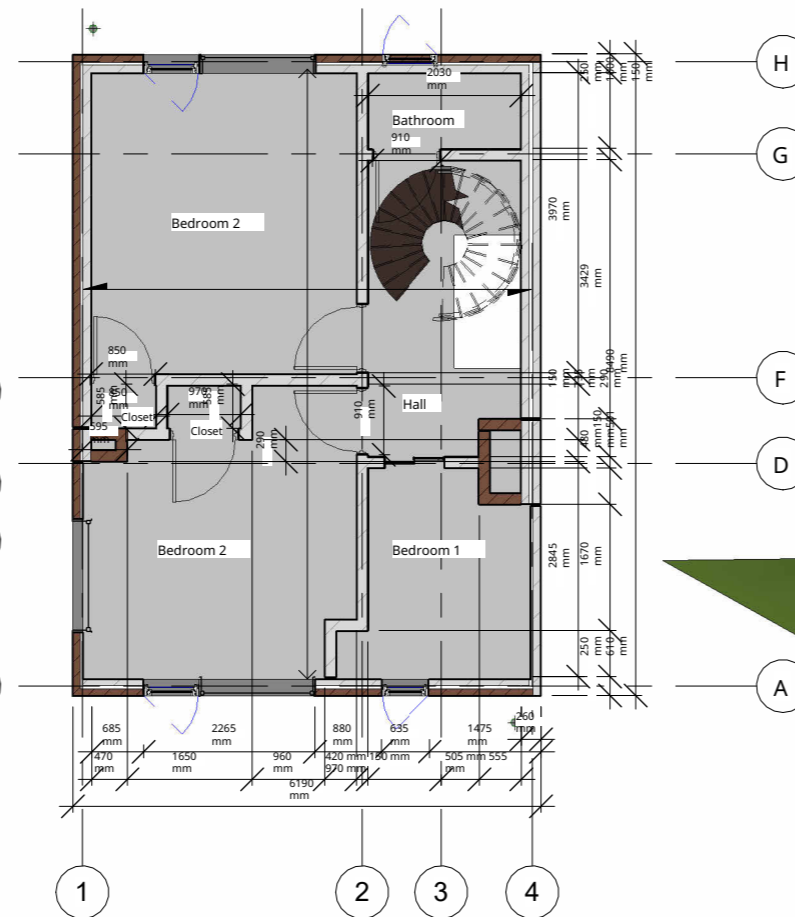
<https://dakisolatieprijzen.nl/milieuvriendelijke-dakisolatie/>

<https://www.milieucentraal.nl/energie-besparen/ventilatie/balansventilatie/>

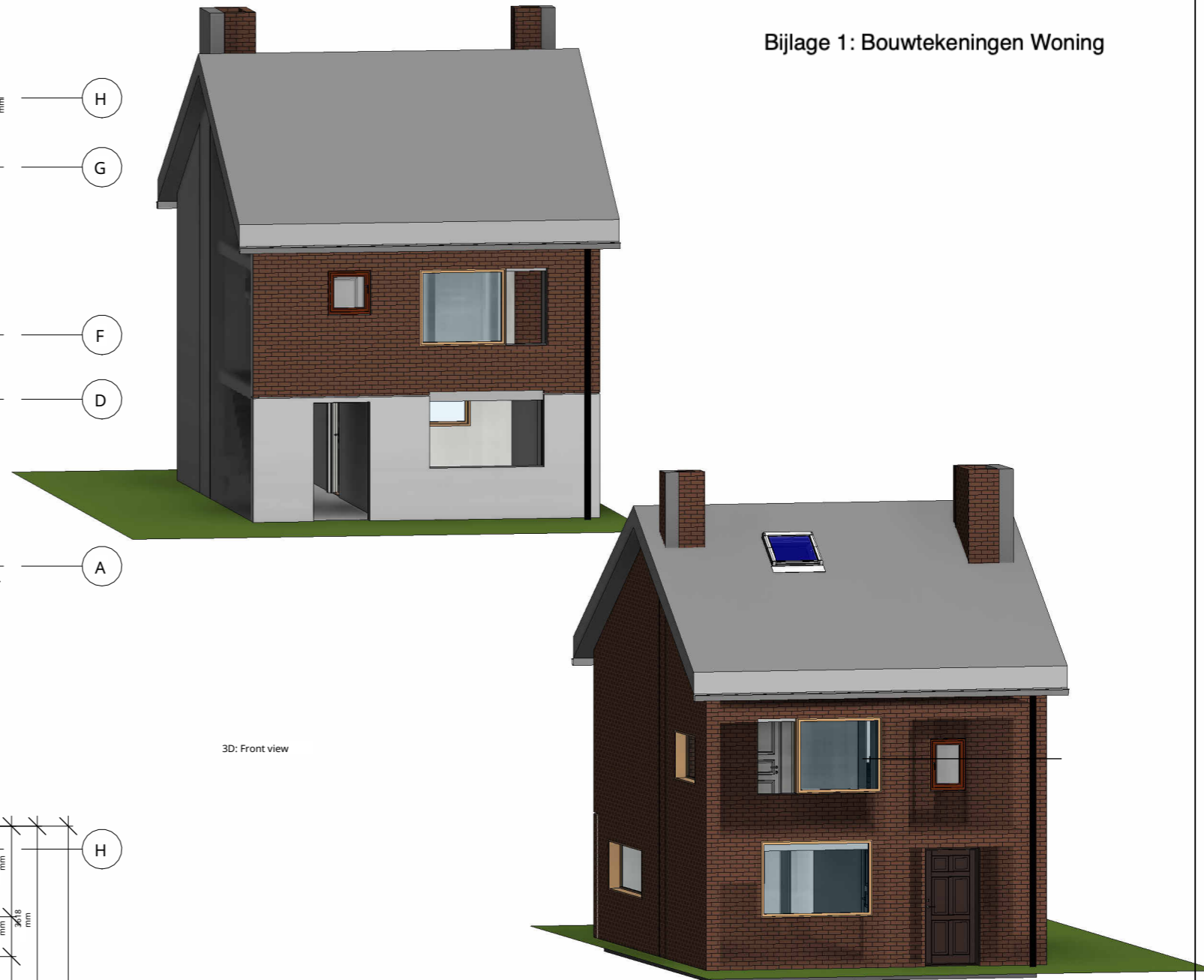
Bijlage 1: Bouwtekeningen Woning



Floor plan: Ground floor

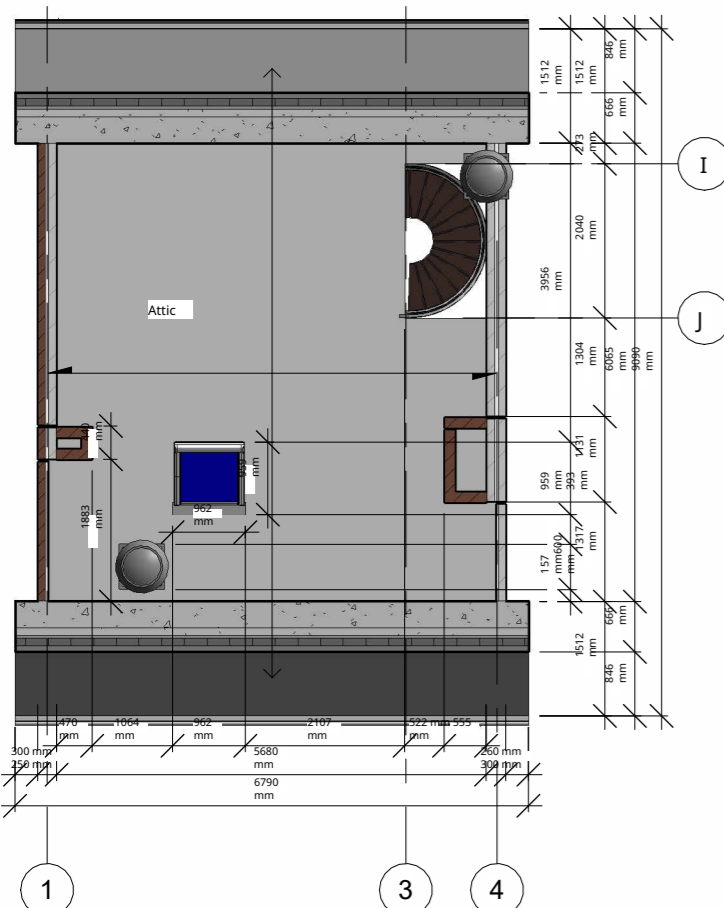


Floor plan: First floor

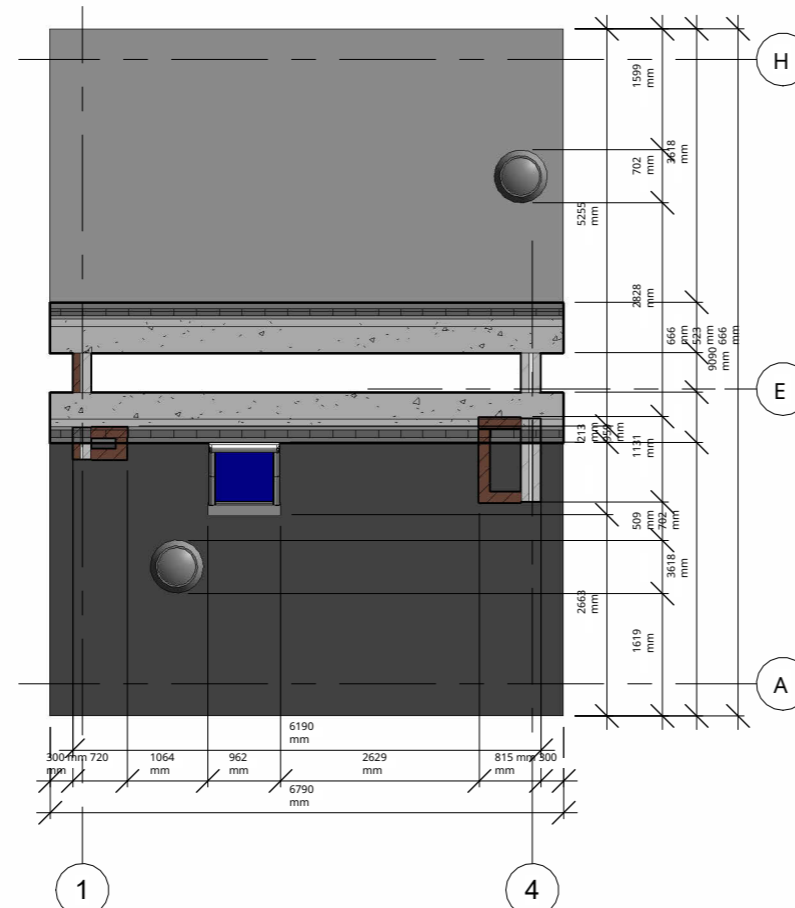


3D: Front view

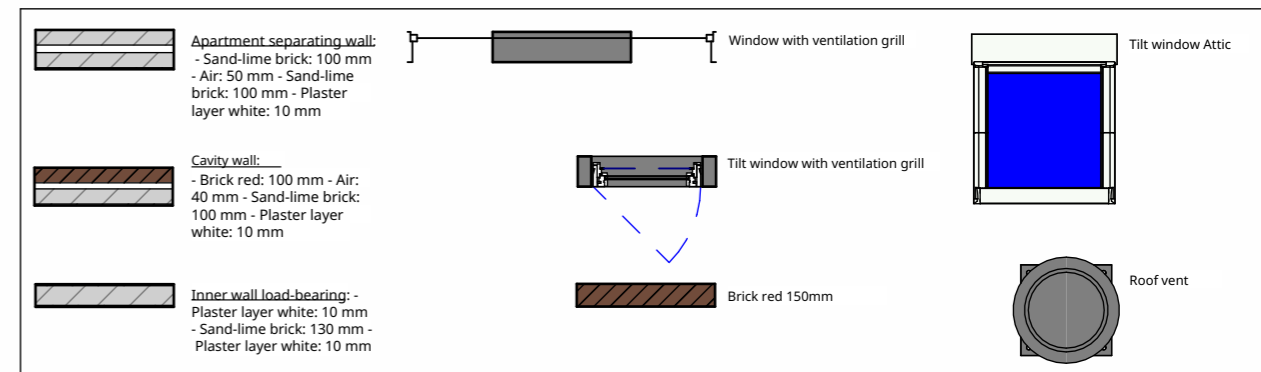
3D: Rear view



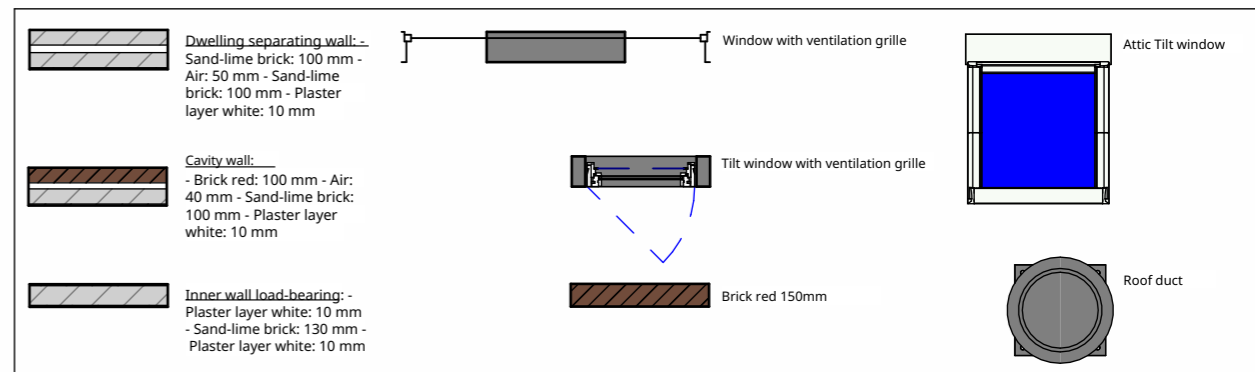
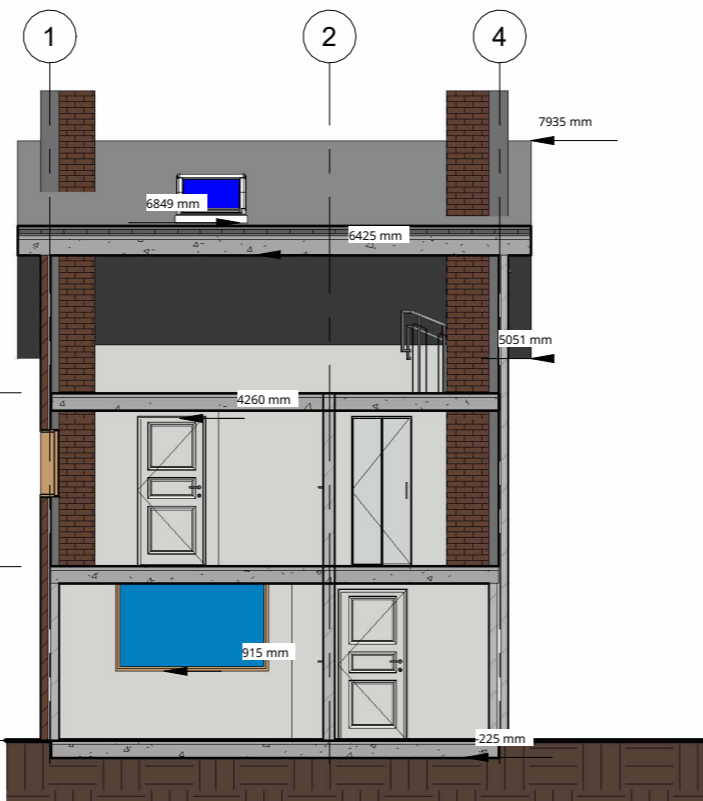
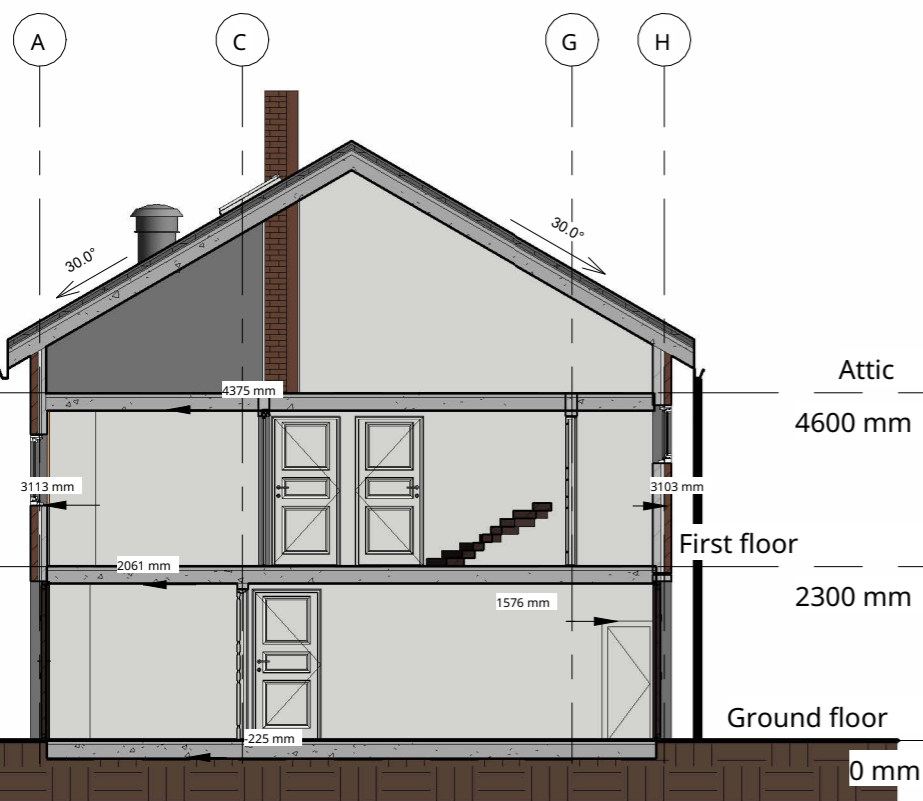
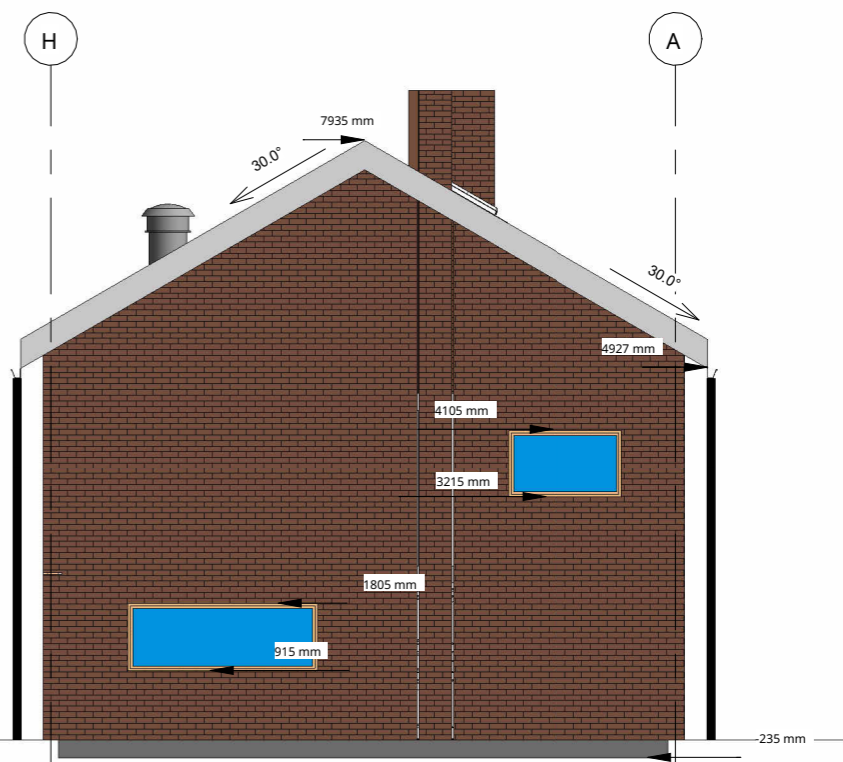
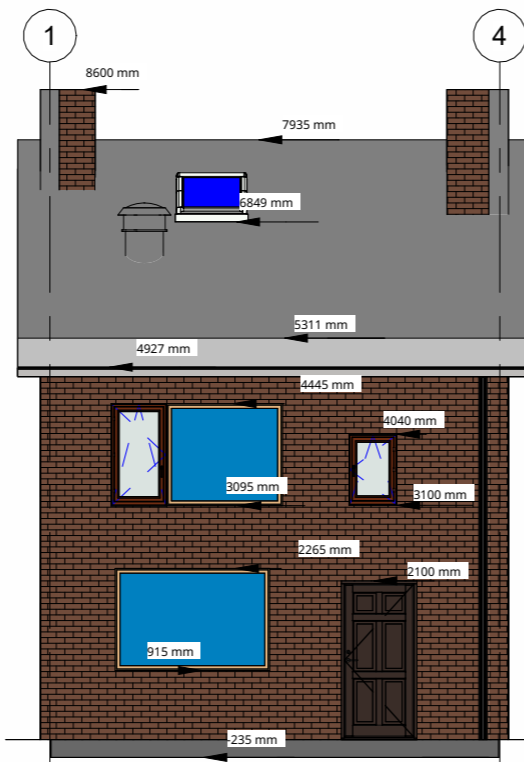
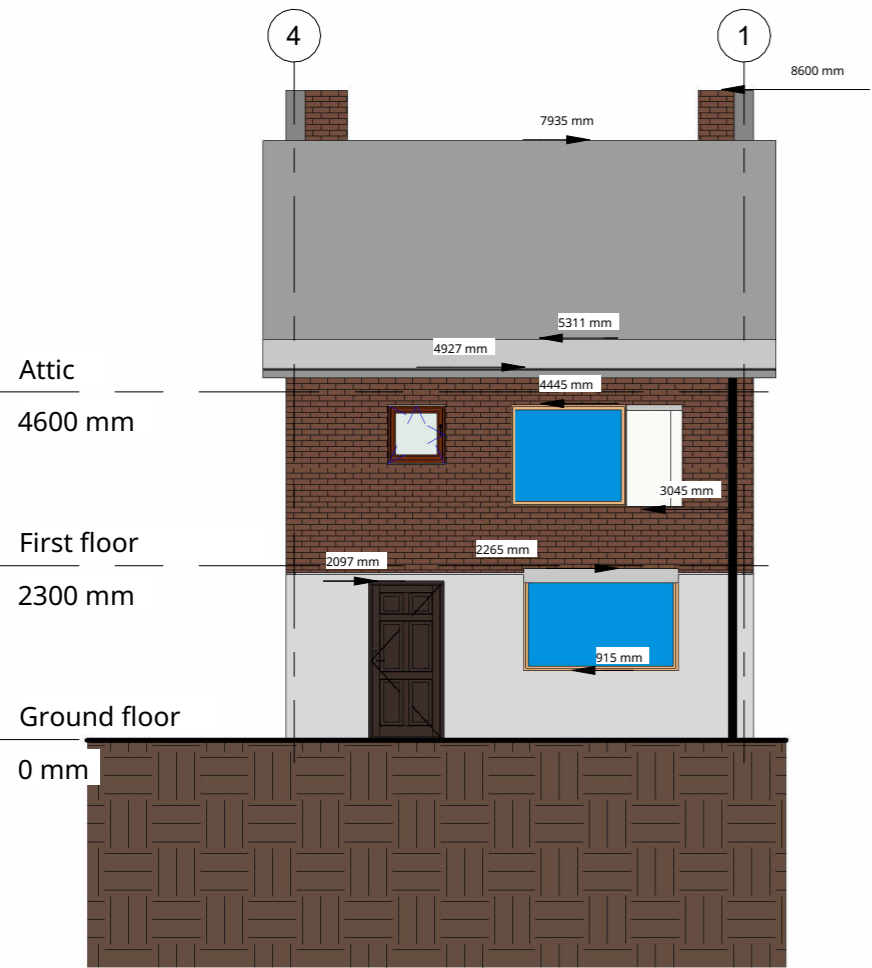
Floor plan: Second floor, attic



Floor plan: Roof



| | | | |
|------------------------|--------------|---------------------------------|----------------|
| NADIA MONSENGO | | Floor plans & 3D, Dorpsdijk 181 | |
| ENERGY & INSTALLATIONS | | Project number | 0001 |
| A3 - Sheet 1 | | Date | 30-01-2023 |
| Scale | As indicated | Drawn by | Nadia Monsengo |
| | | Checked by | NCOI |



| | | | |
|------------------------|--------------|-----------------|----------------|
| NADIA MONSENGO | | Section & Views | |
| ENERGY & INSTALLATIONS | | Project number | 0001 |
| A3 - Sheet 2 | | Date | 30-01-2023 |
| Scale | As indicated | Drawn by | Nadia Monsengo |
| | | Checked by | NCOI |

APPENDIX 2: VENTILATION BALANCE - CALCULATION

| Living areas | Surface area | Living rooms | Surface area | Other space | Surface area |
|---------------|------------------|---------------|------------------|------------------------------|-------------------|
| Living area 1 | 32m ² | Living room 1 | 27m ² | Unnamed space (ground floor) | 0.5m ² |
| Living area 2 | 32m ² | Living room 2 | 5m ² | Technical room | 0.3m ² |
| Living area 3 | 45m ² | Living room 3 | 6m ² | Toilet room | 1m ² |
| | | Living room 4 | 12m ² | Traffic area (ground floor) | 8m ² |
| | | Living room 5 | 14m ² | Bathroom | 2m ² |
| | | | | Unnamed space (attic) | 45m ² |

| Space | Area | Requirement | Required ventilation (dm ³ /s) | Supply Provision | To space | Cap. | Provision Discharge | To space | Cap. |
|-----------------------|------------------|----------------------------------------------------------------------------------------|-------------------------------------------|------------------|----------|------|-----------------------------------|------------------------|------|
| VG 3 - Attic | 45m ² | Unknown | | | | | | | |
| Unnamed space (attic) | 45m ² | > 1 dm ³ /s per m ² floor area plus min. of 7 dm ³ /s | 45 | Tilting window | Attic | 45 | Stairwell 2 | VKR 2 | 45 |
| VKR 2 | 8m ² | n.a. | 45 | - Stairwell 2 | VKR 2 | 45 | Doors first floor and stairwell 1 | VG2, bathroom and VKR1 | 45 |
| VG 2 - First floor | 32m ² | > 0.9 dm ³ /s per m ² floor area plus min. 7 dm ³ /s | 28,8 | | | | | | |

| | | | | | | | | | |
|--------------------|-------|------------------------------------------------------|------|-----------------------------------------|-------------------|------|------------------------------------------------------------|----------------------------------|------|
| VR 3: Bedroom 1 | 6m2 | > 0.7 dm3 /s per m2 floor area plus min. of 7 dm3 /s | 4,2 | Door | VR 3 | 6 | Tilt window with ventilation grille | Outside | 6 |
| VR 4: Bedroom 2 | 12m2 | > 0.7 dm3 /s per m2 floor area plus min. of 7 dm3 /s | 8,4 | Door | VR 4 | 11 | Tilt window with ventilation grille | Outside | 11 |
| VR 5: Bedroom 3 | 14m2 | > 0.7 dm3 /s per m2 floor area plus min. of 7 dm3 /s | 9,8 | Door | VR 5 | 11,8 | Tilt window with ventilation grille | Outside | 11,8 |
| Total | | | 22,4 | | | 28,8 | 45 - 28,8 = 16,2 | | 28,8 |
| Bathroom | 2m2 | > 14 dm3 /s | 14 | Door | Bathroom | 14 | **MV - Tilt window | Outside | 14 |
| Total | | | | | | | 16,2 - 14 = 2,2 | | 2,2 |
| VG1 - Ground floor | 32m2 | > 0.9 dm3 /s per m2 floor area plus min. 7 dm3 /s | 28,8 | | | | | | |
| VKR 1 | 8m2 | n.a. | n.a. | Stairwell 1 | VKR 1 | 2,2 | Doors VG1, door toilet room, door storage room and door MK | VG1, storage, toilet room and MK | 2,2 |
| VR 1: Living room | 27m2 | > 0.7 dm3 /s per m2 floor area plus min. of 7 dm3 /s | 18,9 | - Tilt window with ventilation grille 1 | VR 1: Living room | 62,8 | - Door VKR 1 | VKR 1 | 43,9 |
| Toilet room | 1m2 | > 7 dm3 /s | 7 | Door VKR 1 | Toilet | 7 | **MV | Outside | 7 |
| Unnamed space | 0.9m2 | > 1 dm3 /s per m2 | 0,9 | Door | Storage room | 0,9 | No drain so | VKR 1 | 0,9 |

| | | | | | | | | | |
|--------------------------|-------------------|------------------------------------------------------------------|----|--------------------------------|------------------|-----------|----------------------------------------------|------------------|----------|
| (Storage) | | floor area plus min. of 7 dm ³ /s | | | | | back through door to VKR 1 | | |
| **Technical room (MK) | 0.3m ² | ventilation opening of 200 cm ² /20dm ² | 80 | Door | MK | 80 | No drain so back through door to VKR 1 | VKR 1 | 80 |
| VR 2: Kitchen | 5m ² | > 21 dm ³ /s | 21 | - Back door - Hopper window | VR 2: Kitchen | 65 | - MV —> - Door VKR 1 —> | Outside VKR 1 | 21 44 |
| Total | | | | | | 215, 7 | | | 196,8 |

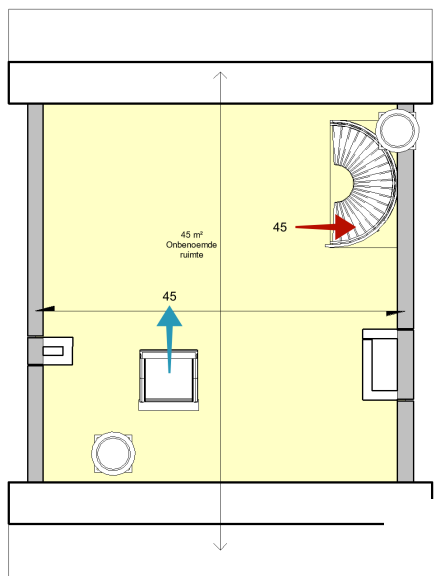
**Technical room: A meter cupboard must have a ventilation opening of 200 cm² at the top and bottom near the door according to the NEN 2768¹⁷ 200 cm² = 20dm². 20dm² x 4dm (thickness) = 80dm³

** The Building Decree does not set any requirements for an unnamed space (VG3). ** VKR 1 = Traffic area ground floor **
VKR 2 = Traffic area first floor ** MV = Mechanical ventilation

**Stairwell 1 = stairwell first floor

**Stairwell 2 = stairwell attic

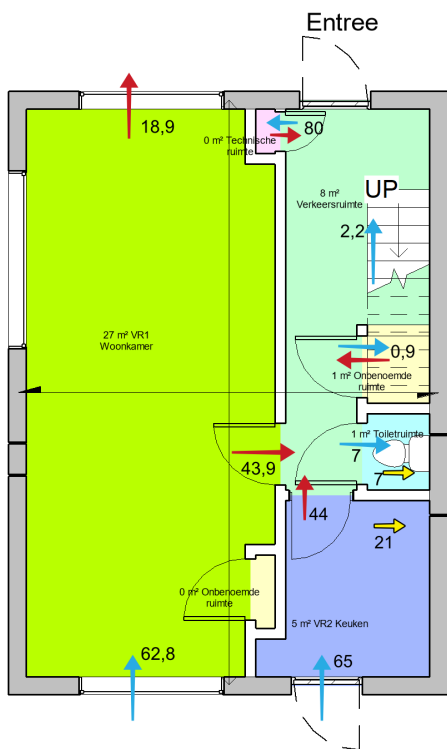
APPENDIX 2: VENTILATION BALANCE - FLOOR PLAN (VENTILATION FLOW)



Zolder

Ruimte en Gebieden

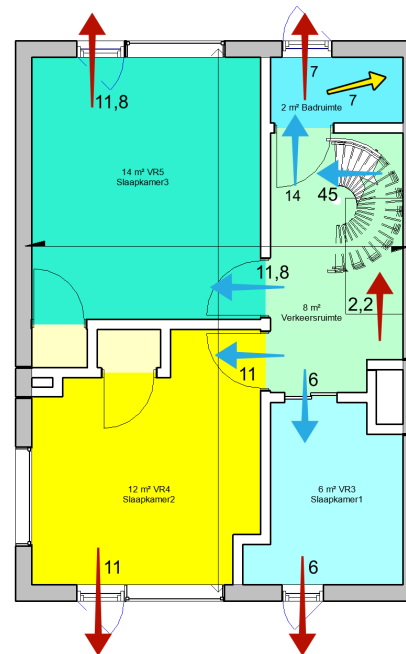
- Onbenoemde ruimte
- Natuurlijke aanvoer
- Natuurlijke afvoer



Begane Grond

Ruimte en Gebieden

- Onbenoemde ruimte
- Technische ruimte
- Toiletruimte
- Verkeersruimte
- VR1 Woonkamer
- VR2 Keuken
- Natuurlijke aanvoer
- Natuurlijke afvoer
- Mechanische afvoer



Eerste verdieping

Ruimte en Gebieden

- Mechanische afvoer
- Badruimte
- Onbenoemde ruimte
- Verkeersruimte
- VR3 Slaapkamer1
- VR4 Slaapkamer2
- VR5 Slaapkamer3
- Natuurlijke aanvoer
- Natuurlijke afvoer

APPENDIX 3: RESULTS UNIEC 3 - BENG CALCULATION

| Energieprestatie | | |
|--------------------------------|------------------------------|---------------------------|
| indicator | | resultaat |
| energiebehoefte | $E_{WtH+C_{ind,ventsys}=C1}$ | 316,11 kWh/m ² |
| primaire fossiele energie | E_{WPtot} | 938,59 kWh/m ² |
| aandeel hernieuwbare energie | $RER_{PrenTot}$ | 0,0 % |
| hernieuwbare energie indicator | $E_{wePrenTot}$ | 0,00 kWh/m ² |
| temperatuuroverschrijding | $TO_{juli,max}$ | 0,00 |
| energietabel | | G |
| netto warmtebehoefte (EPV) | $E_{Ejnd,net}$ | 478,00 kWh/m ² |

| Oppervlakten | | |
|----------------------------|-------------|-----------------------|
| totale gebruiksoppervlakte | $A_{g,tot}$ | 78,00 m ² |
| verliesoppervlakte | A_{ls} | 259,96 m ² |
| compactheid | | 3,33 |

| CO ₂ -emissie | |
|--------------------------|-----------|
| CO ₂ -emissie | 14.200 kg |

| Elektriciteitsgebruik op de meter | |
|-----------------------------------|-------------------|
| gebouwbonden installaties | 10.752 kWh |
| niet gebouwbonden installaties | 2.028 kWh |
| opgewekte elektriciteit | 0 kWh |
| totaal | 12.780 kWh |

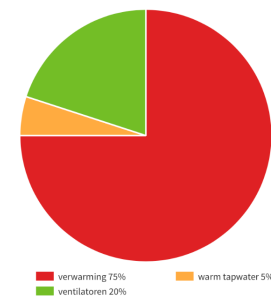
| Aardgasgebruik (exclusief koken) | |
|----------------------------------|----------------------------|
| gebouwbonden installaties | 5.897,9 m ³ aeq |

| TO _{juli} conform NTA 8800 | |
|-------------------------------------|-------------|
| rekenzone | RZ1 |
| TO_{juli,max} | 0,00 |

| TO _{juli} conform NTA 8800 | |
|-------------------------------------|------|
| rekenzone | RZ1 |
| noord | 0,00 |
| oost | 0,00 |
| zuid | 0,00 |

| Jaarlijkse karakteristieke energiegebruik | |
|-----------------------------------------------|-----------------------|
| primaire energiegebruik inclusief hulpenergie | 73.209 kWh |
| opgewekte elektriciteit | 0 kWh |
| jaarlijkse karakteristieke energiegebruik | E_{Ptot} 73.209 kWh |

| Jaarlijkse hoeveelheid hernieuwbare energie | |
|---------------------------------------------|----------------------|
| verwarming | $E_{Pren,H}$ 0 kWh |
| warm tapwater | $E_{Pren,W}$ 0 kWh |
| koeling | $E_{Pren,C}$ 0 kWh |
| elektriciteit | $E_{Pren,el}$ 0 kWh |
| totaal | $E_{Pren,tot}$ 0 kWh |



| Jaarlijkse hoeveelheid energiegebruik voor de energiefunctie | | | | | |
|--------------------------------------------------------------|------------|----------------------|-------------------|--------------------------|---------------------|
| functie | | energie niet-primair | energie primair | hulpenergie niet-primair | hulpenergie primair |
| verwarming | $E_{h,21}$ | | | | |
| | elektrisch | 0 kWh | 0 kWh | 827 kWh | 1.199 kWh |
| | gas | 53.789 kWh | 53.789 kWh | 0 kWh | 0 kWh |
| warm tapwater | $E_{h,22}$ | | | | |
| | gas | 3.830 kWh | 3.830 kWh | 0 kWh | 0 kWh |
| ventilatoren | $E_{p,23}$ | 9.925 kWh | 14.391 kWh | 0 kWh | 0 kWh |
| totaal | | | 72.010 kWh | | 1.199 kWh |

APPENDIX 4: VENTILATION BALANCE & VENTILATION FLOW 2

| Space | Area | Requirement | Necessary ventilation (dm ³ /s) | Supply Provision | To space | Cap. | Provision Discharge | To space | Cap. |
|--------------------|------------------|------------------------------------------------------------------------------------------|--------------------------------------------|-----------------------------------------------------|----------|------|--------------------------------------------------------|------------------------|------|
| VG 3 - Attic | 45m ² | Unknown | 31,5 | | | | | | |
| VR 6: attic | 45m ² | > 0.7 dm ³ /s per m ² floor area plus min. of 7 dm ³ /s | 31,5 | Tilting window & Decentralized balanced ventilation | Attic | 31,5 | Stairwell 2 | VKR 2 | 31,5 |
| VKR 2 | 8m ² | n.a. | 31,5 | Stairwell 2 | VKR 2 | 31,5 | Doors first floor and stairwell 1 | VG2, bathroom and VKR1 | 31,5 |
| VG 2 - First floor | 32m ² | > 0.9 dm ³ /s per m ² floor area plus min. 7 dm ³ /s | 28,8 | | | | | | |
| VR 3: Bedroom 1 | 6m ² | > 0.7 dm ³ /s per m ² floor area plus min. of 7 dm ³ /s | 4,2 | Door | VR 3 | 6,3 | Tilting window | Outside | 6,3 |
| VR 4: Bedroom 2 | 12m ² | > 0.7 dm ³ /s per m ² floor area plus min. of 7 dm ³ /s | 8,4 | Door and Decentralized balanced ventilation | VR 4 | 8,4 | Tilting window with Decentralized balanced ventilation | Outside | 8,4 |
| VR 5: Bedroom 3 | 14m ² | > 0.7 dm ³ /s per m ² floor area plus min. of 7 dm ³ /s | 9,8 | Door and Decentralized balanced ventilation | VR 5 | 9,8 | Tilting window with Decentralized balanced ventilation | Outside | 9,8 |
| Bathroom | 2m ² | > 14 dm ³ /s | 14 | Door and Decentralized balanced ventilation | Bathroom | 14 | Tilting window and Decentralized balanced ventilation | Outside | 14 |

| | | | | | | | | | |
|-------------------------|-------|------------------------------------------------------|-------|---------------------------------------------|-------------------|-------|-------------------------------------------------------|----------------------------------|-------|
| Total | | | 36,4 | | | 38,5 | | | 38,5 |
| GF1 - Ground floor | 32m2 | > 0.9 dm3 /s per m2 floor area plus min. 7 dm3 /s | 28,8 | | | | | | |
| VKR 1 | 8m2 | n.a. | n.a. | Stairwell 1 | VKR 1 | 127,8 | Doors GF1, toilet room door, storage door and door MK | GF1, storage, toilet room and MK | 127,8 |
| FR 1: Living room | 27m2 | > 0.7 dm3 /s per m2 floor area plus min. of 7 dm3 /s | 18,9 | Door and Decentralized balanced ventilation | FR 1: Living room | 120,7 | Door and Decentralized balanced ventilation | Outside and VKR 1 | 120,7 |
| FR 2: Kitchen | 5m2 | > 21 dm3 /s | 21 | Door and Decentralized balanced ventilation | FR 2: Kitchen | 120,7 | Door and Decentralized balanced ventilation | Outside and VKR 1 | 120,7 |
| Toilet room | 1m2 | > 7 dm3 /s | 7 | Door | Toilet | 7 | **MV | Outside | 7 |
| Unnamed space (Storage) | 0.9m2 | > 1 dm3 /s per m2 floor area plus min. of 7 dm3 /s | 0,9 | Door | Storage | 0,9 | **MV | Outside | 0,9 |
| **Technical room (MK) | 0.3m2 | ventilation opening of 200 cm2/20dm2 | 80 | Door | MK | 80 | No drain so back through door to VKR 1 | VKR 1 | 80 |
| Total | | | 127,8 | | | 457,1 | | | 457,1 |

Explanation ventilation balance 2

The green areas in the table are the adjustments made.

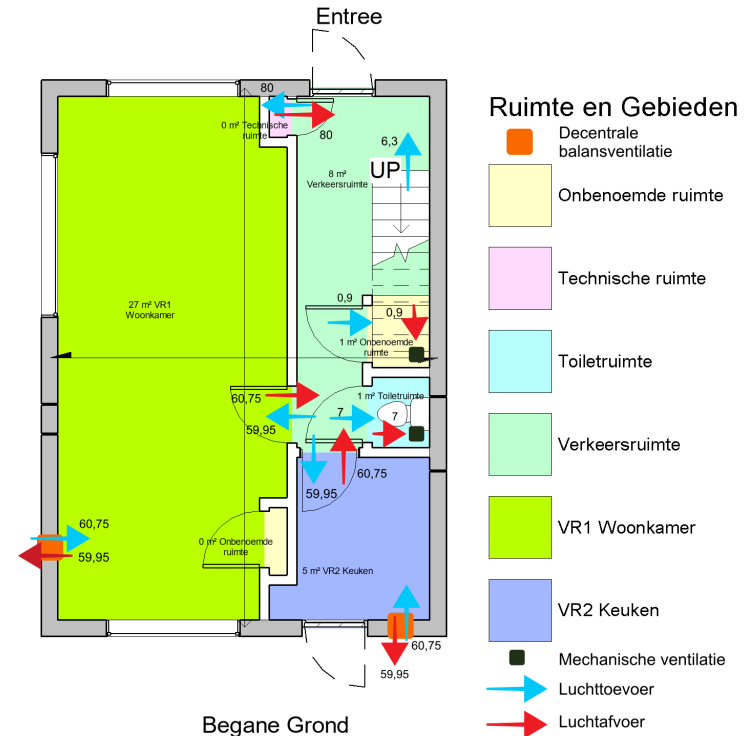
Attic: The attic has been converted into a living space. 31.5 dm³/s is supplied to the attic via the hinged window and decentralized balanced ventilation. This flows through the stairwell to the traffic area on the first floor (VKR 2).

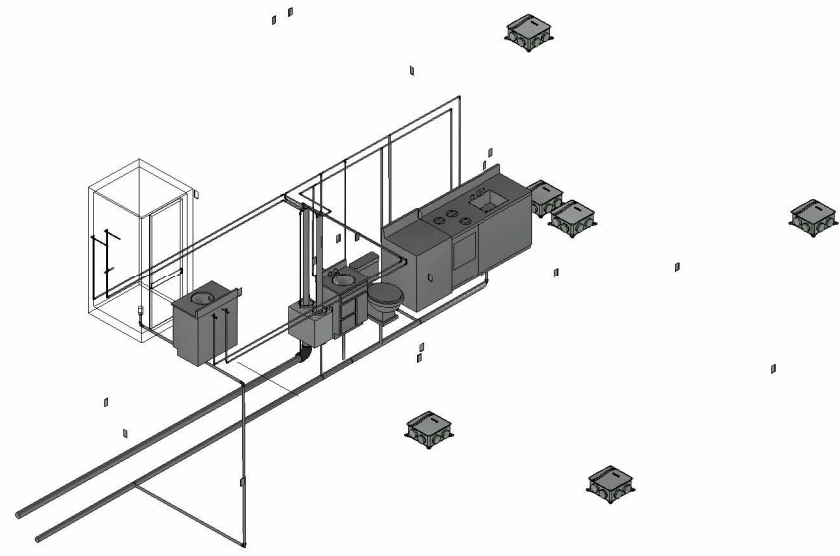
First floor: Air from the attic (31.5 dm³/s) spreads over the first floor via traffic area 2 (VKR 2).

A decentralized balanced ventilation system is installed in each bedroom. This means that air is supplied and discharged in these rooms. A total of 36.4 dm³/s is required for VR 1, 2 and 3 + bathroom. This means that an additional 36.4 - 31.5 = 4.9 dm³/s must be supplied on the first floor. Air enters each room through the door and decentralized balanced ventilation. 6.3 dm³/s goes to the ground floor via the stairwell. The necessary ventilation for bedroom 1 is 4.2 dm³/s. A decentralized balanced ventilation is not necessary. A hinged window is sufficient. Air is discharged through the hinged window. 8.4 dm³/s is required for bedroom 2. 8.4 - 6.3 = 2.1 dm³/s of air is missing. This is supplied via the decentralized balanced ventilation. 9.8 dm³/s is required for bedroom 3. 9.8 - 6.3 = 3.5 dm³/s is missing. This is also supplied via the decentralized balanced ventilation. 14 dm³/s is required for the bathroom. 14 - 6.3 = 7.7 dm³/s is missing here. This is also supplied via the decentralized balanced ventilation. 6.3 dm³/s ends up at VKR 1 on the ground floor.

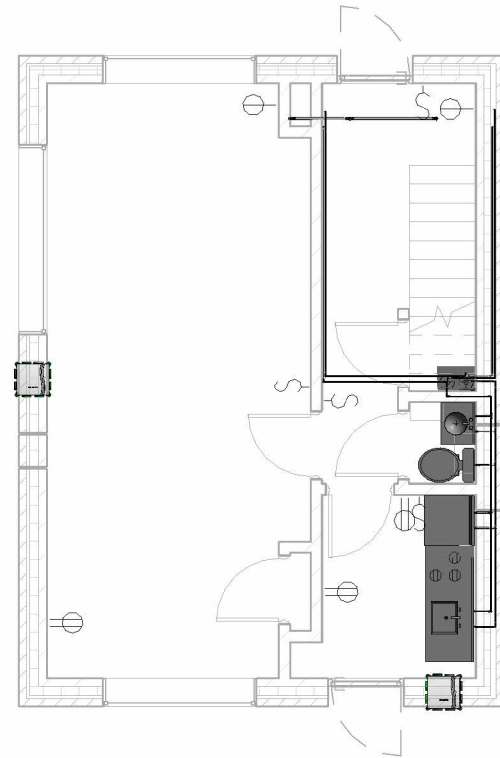
Ground floor:

A total of 127.8 dm³/s is required for the ground floor. 6.3 dm³/s of air flows from the first floor to the ground floor. This means that 127.8 - 6.3 = 121.5 dm³/s of air is missing. This must be supplied. This is done by the decentralized balanced ventilation in the kitchen and living room. A decentralized balanced ventilation is not possible in the toilet because it does not adjoin an outside wall. 121.5 / 2 = 60.75 dm³/s is supplied via decentralized balanced ventilation in the living room and 60.75 dm³/s in the kitchen. VKR 1 now has 121.5 + 6.3 = 127.8 dm³/s. Of this, 7 dm³/s goes to the toilet and is discharged via mechanical ventilation. 127.8 - 7 = 120.8 dm³/s remains. 0.9 dm³/s goes to the storage room and is also discharged via mechanical ventilation. 120.8 - 0.9 = 119.9 dm³/s remains. Of this, 80 dm³/s goes to the meter cupboard, but because the meter cupboard has no exhaust ventilation, the air returns to VKR 1. 119.9 dm³/s remains the same. 119.9 / 2 = 59.95 dm³/s is discharged to the kitchen and 59.95 dm³/s to the living room. It is discharged to the outside via the decentralized balanced ventilation.

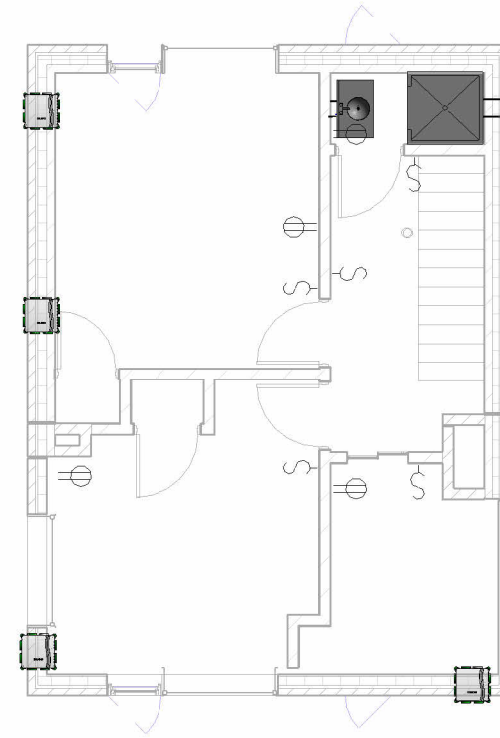




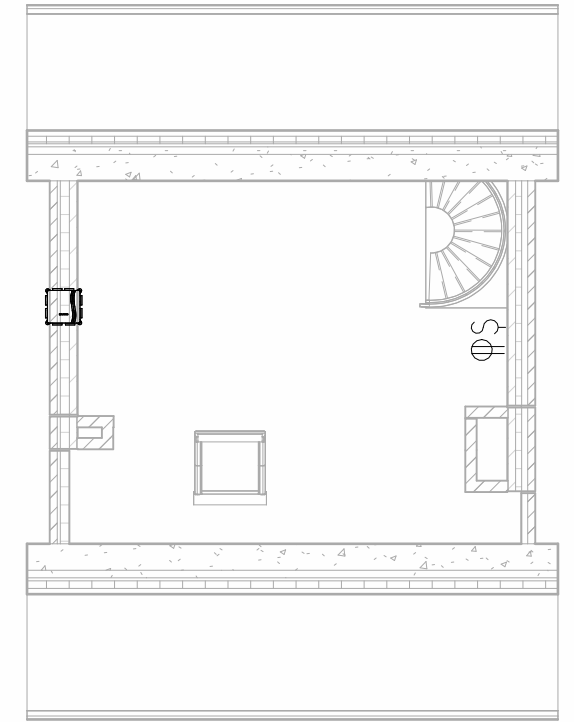
Installation - 3D



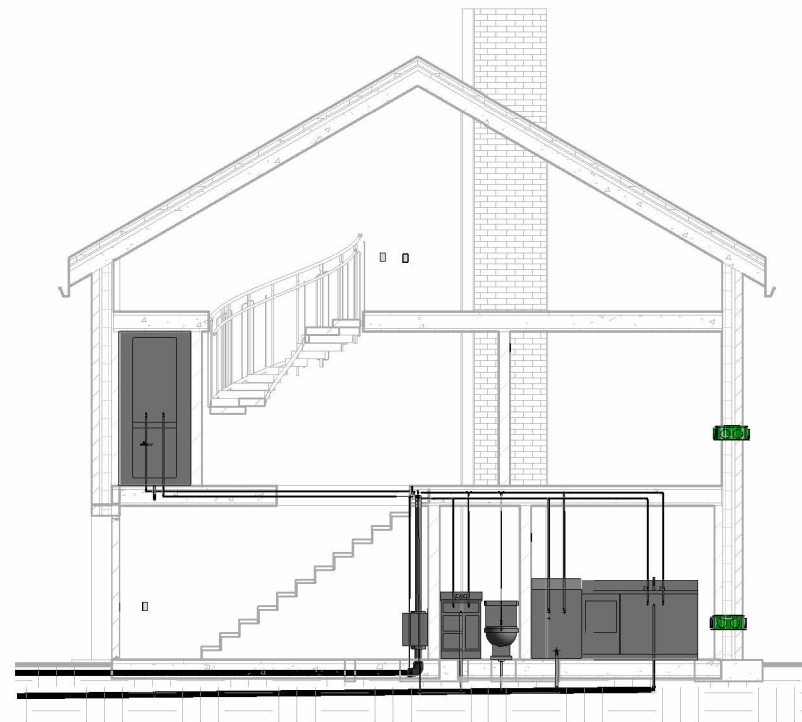
Floor plan - Ground floor



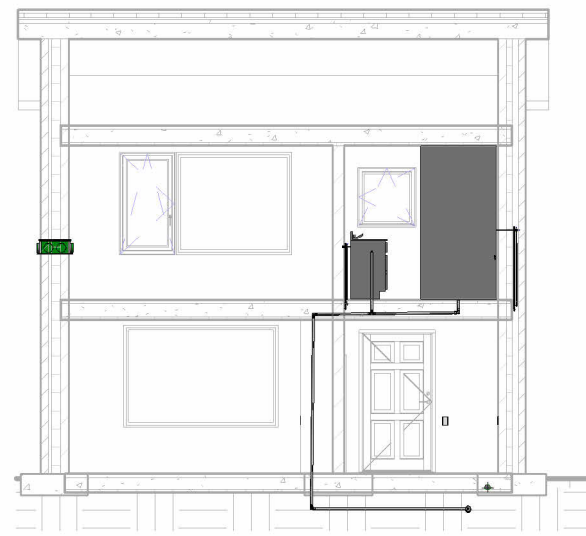
Floor plan - First floor



Floor plan - Second floor



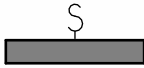
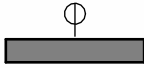
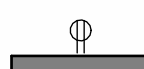

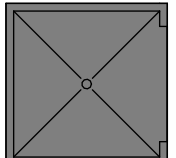


Installation - Section 1



Installation - Section 2



Installation - Section 3

| | |
|---------------------------------------------------------------------------------------|----------------------|
| Renvoi | |
|  | Single-pole switch |
|  | Socket single |
|  | Socket double |
|  | Exhaust fan Duco Box |
|  | Shower |
|  | Sink |
|  | HRU unit |

| | | | |
|--------------------------------|--|--------------------------------|------------|
| NADIA MONSENGO | | Energy and water installations | |
| ENERGY & INSTALLATIONS | | Project number | 0001 |
| Energy and water installations | | Date | 30-01-2023 |
| Scale | | As indicated | Checked by |
| | | | NCOI |