

Carlos Vaño Navarro

**409731**

Thesis Supervisor: Vincent Inja  
Hanze University Groningen



Reader:  
Gerrit Ribberink  
Hanze University Groningen



Client:  
Marteen Vieveen  
Hanze University Groningen,  
Research Centre, Area development



## Content

1. Introduction
2. Building Analysis
  - 2.1 monuments in Holland
  - 2.2 Existing building history
  - 2.3 Research on the current state of the existing building
3. Regulation monument protection
  - 3.1 History monument protection
  - 3.2 In what ways is the building legally protected
  - 3.3 Monument protection laws
    - 3.3.1. Dutch law
4. Energy efficient
5. How to calculate Energy efficient
  - 5.1 Calculation programs
  - 5.2 Enorm
  - 5.3 Possibilities of the program
6. Architectural measures to update Energy efficient without compromising historical value
7. Architectural measures regulation
8. Installation-technical measures
9. Installation-technical measures regulation
  - 9.1 How a photovoltaic solar energy system can be applied in the NEN 7120?
  - 9.2 Autonomous systems
  - 9.3 Commercial construction
  - 9.4 Energy Yield
10. Architectural value criteria.
  - Valuation criteria
    - I. Cultural and historical values
    - II. Architecture and art historical values

III. Situational and ensemble values

IV. Integrity and recognizability

V. Rarity

11. Bibliography

12. Annex

I. Appendix 1. Development of the monument system

II. Funding historic buildings the dutch way

III. NEN 7120-2011-c2-2011

## 1. Introduction

Since February 2014, I have worked at my final thesis at Hanzehogeschool Groningen University of Applied Sciences. The major topic of my work is Energy Efficiency of a Historical building from Franeker.

Since 1988, the city of Franeker has many historic and listed buildings. The law guarantees maintained all these monuments. These buildings often do not meet the comfort requirements demanded by the user and also with the current standards. Current users are now facing the problem of using a lot of energy to acclimate their homes, which results from high costs on their bills.

In this city, Franeker, an initiative was born to preserve historical buildings and to invest in improved comfort and sustainability. Due to this fact, a group called WERF was created and it started to be interested in the ideas of students' projects. The Hanze University suggests a connection between this group and the students with final thesis, in this case, me. The building with which I work is located on the street Eise Eisingastraet 10 and it is owned by one of the people who formed the WERF group.

My idea is to resolve this problem, through energetic measures and to reduce consumption. In this study, it is illustrated all the possible variants and the best option for each case. Moreover, it has explanations and a clear view that the used solution respects the historical values. The problem described above leads us to ask the following research question:

“How can we update the energy efficiency of an historical building without compromising the architectural value of the building?” (In the house in Eise Eisingastraart 10)

In this study I will answer the next Sub questions:

When is a house energy efficient?

Which (calculation) method can I use to determine the amount of energy?

Which literature controls the structural measures that care about historical values?

Which literature controls the installation-technical measures that care about historical values?

On which criteria is the architectural value property based on?

The thesis is a closer look at the various studies, analyzes and reports that are designed to answer the main and sub-questions during the graduation period

## **2. Building analysis**

### **2.1 The monuments in Holland**

It is called a monument in the Netherlands, a building or object, or the remainder thereof, when is of general interest because of the beauty , the significance of the scientific or cultural value. A more accurate formal designation is "protected monument" as defined in the 1988 book.

Until 2012, a monument that was built 50 years ago, it was able to be eligible for protection. On January 1, 2012, this criterion expired.

Municipalities and provinces often protect monuments (which we refer to as municipal and provincial monuments).

Netherlands has about 61,000 entries (52,000 objects) with monument status, of which approximately 1,500 archaeological national monuments are .

The building located in Eise Eisingastraet 10 has historical elements like: the façade, roof and also we can see interesting parts as decorative element found above the main door.

### **2.2 History existing building**

#### **Introduction**

The Street building Eise Eisingastraet number 10 is a very old building, built in the year 1617. During that time there have been major developments and the house has many different uses. The most important are the reforms in 1985 and 2000. Is also important the prior use of the house, who was a police station, and therefore was remodeled and adapted to their new roles. After all this history the building has undergone and is worn, and now the most important to be preserved include roof and facade, because the originals are kept and therefore has

great significance.

### **History**

The historical house was a Police Comisary, but in 1984 a restoration was made to change the use of the house. The work consisted of the restoration of the property to change it in a home.

Also in 2010 another restoration was made, but this affected only the back part of the house. The isolation in walls and windows were improved.

In 1804, the owner was a timber merchant ,Jan Annemagreet and he was the grandfather of famous dwarf Jan Hannemahuis , nicknamed Tom Pouce Tromp .

In 1985, the Foundation purchased this neglected patrician house. It was half a century as a police station. Led by architects office, N.J.Adema Franeker left the Foundation then grounding the building restored by the construction company Franeker M.E.v.d.Zee .

Due to this it succeeded in restoring the façade, at 18 th century fashion bricked in red stone, and there was peace and security around the house. The person who built the existing facade, which existed for centuries, was Peter Altena Been. As stated by Mr. H.M.Kreger, Peter was the owner and the occupant of the property in 1720.



The style and some ornaments located in the cornice of the gutter triglyphs (squares in which three vertical grooves) and artfully carved gutter brackets are all imitations of the Greek Doric style. From this we can conclude that this front has been established at the beginning of the 18th century.







Another important value to preserve is in the door. It was introduced during the 18th century practice. It was with the objective to decorate the house. The ornament is an Igdrasil. Normally, we can see it above the front door of a house. The belief is that Igdrasil branches have the power to connect the world with the heaven.

### **2.3 Research on the current state of the existing building**

#### **Description**

The monument consists of a spacious house with an alley next to the “girl’s home”, which is suitable as a workshop or guesthouse. The house has a deep, sunny garden (40 meters deep) with beautifully decorated borders and terraces. With wood and stone floors, the fireplace, the spacious living room and cozy kitchen of the house exudes comfort and atmosphere. Now, this empire includes many original parts and has a rich history with distinguished residents, including a mayor and notary.

#### Ground floor:

There is a big living room and kitchen overlooking the garden

Through the vestibule you enter a long corridor with stone floor, which also has a toilet and a fine staircase. On the front you will find the spacious, cozy living room (approx. 55 sqm ) with beamed ceiling, fireplace and wooden floor .

Through the living room you walk into the middle room, which is furnished as a library and music room. The middle room is also equipped with a wooden floor.

At the rear of the ground floor is the spacious kitchen with wood floors, beamed ceilings and modern kitchen including a kitchen island, From the kitchen overlooks the beautiful, spacious garden with, terraces and wooden barn (2001).

#### 1st floor:

Five bedrooms and a comfortable bathroom.

This home offers all the space on the first floor to the residents. So you will find the spacious landing with wooden floors and exposed beams a wet cell. In front of the house is the master bedroom, a spacious bedroom with an adjacent bathroom. The bathroom (2003) offers all the comforts: bath, under floor heating and shower.



Historic facade



Facade Anchors



Wood beam determining degrees of

This building is classified as a living monument and important people lived such as: the mayor or the notary. It has a unique past and it is also considered a national monument.

### 3. Regulation

#### Content

#### 3.1 History monument protection

#### 3.2 In what ways is the building legally protected

#### 3.3. Monument protection laws

##### 3.2.1 Dutch law



### 3.1 History monument protection

To understand the actual legislation about monument protection, first we should know about her history.

The most important person of the organised conservation in The Netherlands is Victor de Stuers (1843-1916). At the end of the 19<sup>th</sup> century he and a small group of volunteers wanted to slow down the demolition activities of many valuable old buildings. And in the 1873 born the “De Stues”, without legislation, but the government started to give money. He started to care about some churches and really old buildings, but without good results. Later, in the 1947 is created the Netherlands Department for Conservation. This department is a renowned treasure house of knowledge and information about the national built heritage. This knowledge covers historical buildings, city and townscapes and man-made landscapes. They judge the cultural and historical values of a building, both architectonically as well as from the viewpoint of urban development.

After several decades of preservation without legal basis was in 1961 the first Monuments established. In the first years after the Second World War, the country focused on reconstruction. The sadness of the war had to be processed, housing shortage solved and there was a great need to look ahead and modernize. On a massive scale was demolished; The 1961 Monuments Act was therefore mainly aimed to protect the most

valuable buildings and structures from before 1850.

Objects and town and village were now legally protected by the state. The desire of the government and administrative partners to decentralize the monument scheme is detailed in the Note of Monuments in 1984. This is also the basis for the National Restoration established that low-interest loans to building owners to refurbish their premises. They also released a new subsidy system for maintenance and restoration.

In 1988, the Monuments, after a process of reflection and consultation for many years has been updated. Significant changes were decentralization and the new role of the Department for Conservation (RDMZ) as a knowledge institution with statutory duties.

In 1994, the Strategic Plan for Conservation was presented. For the first time, the positive financial side effects of preservation were also identified and quantified. The National Investment Bank demonstrated in two studies that the preservation realm nothing cost: each euro invested pays for itself. That had an effect. In 1995 there was regular extra money available for historic preservation, including through the Work Plan Trust. After publication of the report Landmarks Scaffolding in 1998, more money was available for restoration of so-called biggies (great monuments).

Since 1996, the national and provincial investment was used helping a little number of monuments.

In 2000, research showed for the first time that not

all municipalities were calculated on their monument task. In 2002, Mr van der Ploeg decided that houses from the National Restoration and other monuments through the new National Service for Archaeology, Cultural Landscape and Built Heritage (RACM) would be served.

And at the end of 2006, as a result of a fusion between the Dutch International Service for Archaeological Heritage (ROB), with the Department for Conservation, one institute named the Department for Archaeology, Cultural Landscapes and Historic Buildings (RACM) will be responsible for the protection of Dutch Heritage on the ground, underground and underwater.

This institution was renamed Instituut Collectie Nederland (ICN) in 2009, and is located in the National Office of Cultural Heritage.

### **3.2 In what ways is the building legally protected?**

The Franeker city hall is a nationally designated monument, a rijksmonument. This legal status exists to protect privately-owned buildings and structures of significant cultural and historical value, by restricting the ways in which they can be altered. Hence, we found necessarily to research what kind of changes of the city hall would or would not be allowed. After all, an environmentally friendly idea isn't very useful if it can't legally be put into practice.



### 3.3. Monument protection laws

#### 3.3.1. Dutch law

Unlike many Dutch laws, laws concerning protection of monuments are not overly complex. The relevant law states that “It is forbidden to damage or destroy a protected monument.” Permission is required to “demolish, disrupt or in any aspect alter” a monument (Rijksoverheid sd).

This limits many major renovation options, which means it is not possible to bring the building up to modern standards, but such ideas are not possible without significantly damaging the building’s historical character, anyway. Replacing the glass of the windows is one measure we examined, and which would likely require permission. This permission has to be given by the College van B&W of the municipality; because the glass in the windows is not original (it is about a century old). It is required for permission for the glass which we propose to replace.

About laws for historic buildings in the Netherlands: these in general only effect listed buildings. The basis of Dutch heritage preservation, including buildings (and objects such as: fences, infrastructural works and memorial statues), is found in the Dutch heritage Act. which states that listed buildings should be preserved and that damaging the building can have consequences in court. So the owner is legally responsible for preserving the listed building. Damage is demolishing (building parts) on purpose or by modifying the building in a wrong way.

There are not specific rules for modifying listed buildings, but there are some basis design ideas which in general in the Netherlands are

more or less accepted:

- the historic qualities are most important, so modifications must be designed refined and not ask to much attention in the overall image of the building. So, replacing a detailed historic window for a new window is, in most cases, unacceptable; or changed detailing of the roof (at the gutters) because of high quality (thicker) insulation.
- to prevent noise in what is old and what is new, it is suggested to design new building components in a contemporary style instead of building it in the historic style. For example: a new door entry can be accepted when designed in a contra story style, and not in a historic style.
- preserve as much old material as possible, reversible modifications are preferred in most municipalities. For example: when insulation, do not use materials that damage historic material (when removing the new material in the future). To know when the building was constructed and modified can help in determine what building components may be modified more or less, or in a different way. For this you can make an inventory the historic qualities and building/modification periods comparing plans in the archive, searching for old pictures, talk to owners and (local) historic experts)

#### 4. Energy efficient

To explain when a building is energy efficient, I will describe the Bouwbesluit 2012.

The functional requirement of Article 5.1, first paragraph, says that building is energy efficient, when the functional requirements of section 5 of the Building Act 2003 is met. Moreover, now no more talk of "sufficient energy efficient" but of "energy efficient". This is the hard necessity of energy better expressed.

A functional unit has a NEN energy performance coefficient of the value shown in Table 5.1. Certain 7120

2. Notwithstanding the first paragraph, if there has a building or part thereof that is no more than one plot with several functions, it is applicable an energy performance coefficient. This coefficient is total characteristic of energy, determined by NEN 7120, that does not exceed the total energy, according to NEN 7120 certain allowable energy. The allowable energy use is a used function based on the value specified in Table 5.1.

3. If through the application of NEN 7120 using NVN 7125, we found that the coefficient of performance of energy is not enough, then use a maximum of 1.33 times the figures shown in Table 5.1.

| Use function                   | Members of application      |   |   | limit                       |
|--------------------------------|-----------------------------|---|---|-----------------------------|
|                                | energieprestatiecoëfficiënt |   |   | energieprestatiecoëfficiënt |
| article                        | 5.2                         |   |   | 5.2                         |
| member                         | 1                           | 2 | 3 | 1, 2 and 3<br>[-]           |
| 1 Living Function              |                             |   |   |                             |
| a caravan                      | 1                           | - | 3 | 1.3                         |
| b other residential function   | 1                           | 2 | 3 | 0.6                         |
| 2 Meeting Function             | 1                           | 2 | 3 | 2                           |
| 3 Cell function                | 1                           | 2 | 3 | 1.8                         |
| 4 Health Function              |                             |   |   |                             |
| a with bedgebed                | 1                           | 2 | 3 | 2.6                         |
| b other health care function   | 1                           | 2 | 3 | 1                           |
| 5 Industrial function          | -                           | - | - | -                           |
| 6 Office Function              | 1                           | 2 | 3 | 1.1                         |
| 7 Guest Feature                |                             |   |   |                             |
| a in an accommodation building | 1                           | 2 | 3 | 1.8                         |
| b Other accommodation function | 1                           | 2 | 3 | 1.4                         |
| 8 Education Function           | 1                           | 2 | 3 | 1.3                         |
| 9 Sports Feature               | 1                           | 2 | 3 | 1.8                         |
| 10 Shop Function               | 1                           | 2 | 3 | 2.6                         |
| 11 Other functional            | -                           | - | - | -                           |
| 12 Building no building being  | -                           | - | - | -                           |

Table 5.1

## Article 5.2 Energy Performance Coefficient

### In Building

The EPC requirement is expressed as a limit on the energy performance coefficient and indicates the degree of energy efficiency of a building. This determination method gives much design freedom and it is an incentive for the integrated design of airframe and systems and the generation of energy-efficient building concepts. It follows from Section 5.5 that this article does not apply to use functions that are not intended to be heated for the purpose of

use by people.

The limits for the EPC differ per user function. The first paragraph above refers to Table 5.1. The calculated EPC must be lower than the value defined in the table. It is noted that since January 1, 2011 a coefficient for the caravan apply (1.3). At that time also the EPC for the "other residential function» tightened to 0.6.

The second paragraph shows how to calculate the energy performance coefficient in a building with multiple uses; because many buildings contain a mix of uses such as: an office with a canteen (gathering function) and kitchen business (industry function). This is then compared to the characteristic energy. The characteristic energy and the allowable energy are needed for domestic purposes in a building with uses of different types (so this is not a purely residential building) are calculated according to NEN 7120. Modes of operation for which EPC requirement applies, as the industry position, continue with the calculation into account.

The third paragraph provides the ability to use a use in so-called area-based measures for returns on heating, hot water and cooling in NEN 7120 indicated using a calculated value. Only on the basis of the calculation without NVN 7125 determines whether the building-related measures such as: the NVN can be applied. If the result of this calculation, a maximum of 1.33 times the value shown in Table 5-1, then the energy efficiency ratio can then be determined on the basis of the facts, to calculate by means of the pre-standard, value. Application of NVN 7125 thus provides the opportunity to go out with a favourable return on area-based measures than contained in BS 7120 reference efficiency. Note that area-based measures that have not been included on the basis of equality in NVN 7125 (see section 1.3) may be applied.

So after all this information, we arrived to the conclusion that a house is called energy efficient when the EPC is less than 0'6.

## **5. How to calculate Energy efficient**

The Decree refers to the NEN 7120 as assay method for the energy performance coefficient (EPC). The EPC integral evaluates the energy efficiency of a home / residential building or industrial building. This is based on building characteristics, facilities and standard user behaviour.

It doesn't matter what energy saving measures to be taken, as long as the required energy is realized. NEN 7120

- Energy Performance of Buildings (EPG). In this standard, the method described on the schematization of the building and calculate the energy consumption of building installations. The energy consumption of the ventilation BS 7120 refers to the NEN 8088-1 - Ventilation and air permeability of buildings. In addition, it is now possible to field level to upgrade energy saving measures. For this, the BS 7120 refers to the NVN 7125 - Energy Performance measures at field level (EMG).

### **5.1 Calculation Programs**

The calculation of the EPC, according to the NEN standard 7120 can be measured by several calculation programs available .

Suppliers of EPG software:

- Bink
- Vabi
- Earth energy advice
- The Two Pike
- Enorm
- W / E consultants

## 5.2 ENORM

Since July 1, 2012, the new energy performance standard BS 7120 EPG force and make architects, engineering consultants and municipalities use the new energy software HUGE. This package is the logical sequel to the successful software EPU NPR NPR EPW 2917 and 5129, as developed in recent years. DGMR through in collaboration with NEN

ENORM allows you to perform, for example, the building energy from a calculation in a simple way. These modern techniques can be measured to achieve EPC requirement. The results of a calculation are always clearly presented. In the context of the review of the planning application the HUGE program connects seamlessly with the new EPCheck program of the municipalities. The use of the ENORM program fits in well with the NEN NPR software as it was used till July 1, 2012 . This allows to get started quickly with the new HUGE software.

## 5.3 Possibilities of the program

The ENORM program is very user-friendly layout. The input data is always checked for accuracy, and to assist in entering data, the user is included specific help information in several places. The EPC is immediately recalculated after each change in the input data and displayed (live). Both residential and commercial buildings and are seamlessly integrated into one program.

After all this information we arrive to the conclusion that to know the amount of energy, we need calculate the EPC, and we can do this with

a software, for example “Enorm”. I will calculate the EPC for my historical building, and then I will make some improvements for see the benefits.

## **6- Architectural measures to update Energy efficient without compromising historical value**

I explain in a next chapter all the construction procedures, In every measure is explained goal, degree of applicability, influence of energy demand, technical implementation, energy effect and how this measure affect the historical value.

## **7-Architectural measures regulation.**

-NEN 1068 Thermal insulation

This standard gives calculation methods for the determination of the heat loss coefficient by transmission (HT) of buildings or parts of buildings, the heat resistance of individual partitions (Rc) and the thermal insulation index (It) of a building. All this under the following assumptions: - the heated indoor space has a uniform temperature; - There prevails a thermal steady state; - Heat losses are considered to fall apart from determining ventilation losses in unheated rooms or via lump" imposed" values outside the scope through ventilation.



-NEN 2686 Air permeability of buildings

This standard describes a method for the determination of air permeability of buildings or parts of buildings.

The envelope structure of a utility function shows naturally a certain amount of air through. The purpose of this section is to ensure that this air permeability is reduced, that there was also only a limited degree of heat loss as a result of excursion occurs at strong wind.

So the requirement for the reduction of air permeability as well as the requirement for thermal insulation (Article 5.3), a vangnet is to use functions which an EPC requirement applies. Whatever the outcome of the EPC calculation, including the air permeability plays a role, the air permeability can not be greater than the value specified in this article.

When renewing or partially change or increase a building's energy requirement (Article 5.2) does not apply and is valid for thermal insulation (5.3) and air flow (Article 5.4) the level obtained legally. If the level obtained in law for the heat resistance is less than  $1.3 \text{ m}^2 \cdot \text{K} / \text{W}$ , then when renewing partially or changing or increasing the building a thermal resistance of at least  $1.3 \text{ m}^2 \cdot \text{K} / \text{W}$  are held

Article 5.6 Extension

### **In building**

When renewing or partially change or increase a building's energy requirement (Article 5.2) does not apply and is valid for thermal insulation (5.3) and air flow (Article 5.4) the level obtained legally. If the level obtained in law for the heat resistance is less than  $1.3 \text{ m}^2 \cdot \text{K} / \text{W}$ , then when renewing partially or changing or increasing the building a thermal resistance of at least  $1.3 \text{ m}^2 \cdot \text{K} / \text{W}$  are held.

The new **second paragraph** of Article 5.6 (renovation), Stb. 2013, 75, is a specific requirement for so-called new dormers and associated structures included. Establish at all or completely renovating a dormer or an associated structure as referred to in Annex II of the Environmental Law Decree (Bor) the new level is used for thermal insulation in full. Under a corresponding structure as referred to in Annex II to the Bor means the extension of a main building or a functional on the same plot standing main building connected there with or without built building, or other structure, with a roof. Founding under all or completely renovating a corresponding structure for example include the development of a living room or kitchen and placing a roof. It should be noted that in the associated structures in the sense of the Bor not only works on the ground but also in terms of building works on floors or roof construction. With new dormers and to install or remove may therefore in derogation from the general rule (any rule, was now the first paragraph) not by the level obtained legally, except for purposes of Article 5.4 (air flow) where it may be assumed the level obtained legally. This new regulation is a response to a commitment to Parliament (Parliamentary Papers II 2011/2012, 32 757, 40).

Article 5.6 (renovation) are at Stb. 2013, 244 to implement Article 7 of the revised EPBD added two members.

The **third paragraph** provides that, notwithstanding the first paragraph on a major renovation as defined in Article 2 of the revised EPBD Article 5.2 (the energy coefficient) does not apply and Articles 5.3, first to fourth paragraph, and 5.4 shall apply, where only with regard to the application of Article 5.4 may be obtained by the level of law. This means that the new building regulations for thermal insulation apply for a major renovation.

The **fourth paragraph** of Article 5.6 provides that detailed rules may

be given on the restoration referred to in the third paragraph by ministerial regulation. These modalities cover over the choice of a method for determining the "major renovation."

Article 2 of the revised Directive provides Member States wishing to choose a method that is based on 25% of the value of the building, the possibility of assuming 25% of the surface of the building envelope which is being renovated. Netherlands has chosen the surface method. There is a major renovation as referred to in the third paragraph where more than 25% of the surface of the building envelope, renovated, altered or enlarged, and this renewal change or increase the overall building envelope concerns. The scheme is a methodology for calculating the area designated. If it is determined that there is a procedure that relates to more than 25% of the surface of the building envelope, it must then be determined whether this surgery involves the complete building envelope. Only to the extent that there is, to the operation in question is the new level of thermal insulation. For example, a complete renovation of the building envelope is when a roof or façade is fully exposed and renewed, so it is possible to bring that meets the nieuwbouweis simultaneously.

Insulation It is noted that there will be an activity for which a permit to build is required so that the competent authority can assess the activity and exercise. Supervision in general with a far-reaching renovation referred to in this Article In those exceptional cases where major renovation license-free, construction activity for the competent authority will still be visible outside the building, which, if necessary, enforcement can occur. Even in cases, when adjustments not related to the integral building shell, even when it comes to renovating more than 25% of the building-shell, no mention of major renovation. Examples of changes which do not relate to the overall building envelope are: after insulation of a cavity wall, after isolation of

single brick exterior walls on the inside or outside, after insulation under roof tiles or against the roof boards. Such adjustments is no alteration of the external division and therefore are under the first paragraph of Article 5.6 also no requirements for the thermal insulation at least realize.

When renovations that do relate to the overall building envelope (the external partition is grown so) but in terms of area less than 25% of the building envelope, has to be fulfilled at the first paragraph of Article 5.6.

It is further noted that Article 1:12 that Article 5.5 in alteration applies. Under Article 5.5, Articles 5.2 to 5.4 do not apply when there is construction of a utility function that is not intended to be heated or if the heater is intended for a purpose other than the stay of persons only. See also the notes to Article 1.12 of the Building Act 2012 in which the system of cultivation requirements are explained.

I arrive to the conclusion that we need different kinds of literature that controls the implementations of the structural measures:

- NEN 1068 Thermal insulation
- NEN 2686 Air permeability of buildings
- Bouwbesluit 2012

## **8. Installation –technical measures to update Energy efficient without compromising historical value**

I explain in a next chapter all the installation-technical procedures. In every measure is explained goal, degree of applicability, influence of energy demand, technical implementation, energy effect and how these measures affect the historical value.

## **9. Installation –technical measures regulation**

### **Solar energy systems serving housing**

#### **9.1 How a photovoltaic solar energy system can be applied in the NEN 7120?**

Solar cells or photovoltaic (PV) cells convert striking (sun) light through a physical process into electricity. There are three types of cells: amorphous, monocrystalline and multicrystalline silicon solar cells. Multicrystalline solar cells are most commonly used, they are cheaper and easier to create than solar cells of monocrystalline. The efficiency of these cells was also lower in general. Also systems with amorphous solar cells used. In broad terms, two types of systems distinguished: autonomous and grid-connected PV systems.

#### **Grid-connected systems**

In homes typically grid-connected systems are implemented. In these systems, the excess generated electricity to the national grid supplied (the meter is 'back'). The yield is based on, among residents and electricity agreed-feed rates deducted from the post of the electricity energy bill. The advantage of a grid-connected system is that at times when the sun electricity is not enough, is supplied by the grid electricity. This ensures a reliable system.

## 9.2 Autonomous systems

Autonomous systems have batteries where excess electricity is stored. These systems are for example in summer cottages. These homes are usually not connected to the national electricity grid. Solar cells are connected in series switched and supply direct current.

Other versions are: solar cells processed in blinds or glass roof, like a film strip tiles, as an element that when a row of tiles between the different pans can be placed as cell per tile, and strip incorporated in synthetic membranes (flat roof) and as a film on a metal roof. The yields vary widely.

## 9.3 Commercial construction

In non-residential PV systems are often placed on roofs. However, it is also possible to place to solar cells to be used in facades and as shading. The proceeds of such a PV system is not the optimal orientation, generally lower than that of a well drafted roofing system.

## 9.4 Energy Yield

In solar cells, there is a power yield. This is expressed in a annual yield. In the EPG method, the annual yield of the solar cells is deducted from the total energy per year. When solar cells produce more energy than what normally occurs annually (also, the gas consumption is offset), then the building is seen as energy-generating. The EPC may in this situations, therefore even be less than 0. The annual yield of the PV system must be calculated and depends on:

- the annual amount of incident solar radiation, depending on orientation and inclination;
- the type of PV system (reduction factor RF). The reduction

factor can be determined. If a different value is used it must be down rounded up to a multiple of 0.01;

- the type of PV cell; data (eg Watts peak power per m<sup>2</sup>) can be requested from the manufacturer. BS 7120 gives (safe) focuses numbers

ranging from 55 Wp/m<sup>2</sup> (amorphous) to 135 Wp/m<sup>2</sup> (monocrystalline);

- the surface of the PV cells;
- any shading system.

## 10. Architectural value criteria

### Valuation criteria

It is virtually impossible to objectively establish standards for the preservation of monuments and other, for their historic or architectural significance of buildings deemed value. Almost all the criteria that can be measured for boil down to an opinion, a view with which one can agree or not.

However, criterion can be derived from the value which attach to people with buildings.

The State Service for Cultural Heritage has developed a standard for valuing architecture. Thus the monumental value of a building can be clearly and unambiguously identified. The valuation plays a leading role in the identification of a building as a monument, and when changing the protected building.

The valuation is based on five main criteria, which are divided into sub-

criteria. The fields of art and history form the basis of the valuation of the built heritage. But also spiritual, geographical, socio-economic, administrative and technical developments play a role in the valuation, in addition to integrity and rarity. Each building has its own range of values.

## I . Cultural and historical values

1. Importance of the property / complex as a particular expression of (a) cultural, socio-economic and / or administrative / policy and / or mental development (s);
2. Importance of the property / complex as a particular expression of (a) geographic, scenic and / or historical-spatial development; **(In this point I want to explain the importance of the scenic. In Eise Eisingastraet we can see different kind of houses, and some are similar. This is a important value to preserve, and our house is similar than other historical buildings in this street, for example to the house on Eise Eisingastratt 17)**
3. Importance of the property / complex as a particular expression of (a) technical and / or typological development (s);
4. Importance of the property / complex due to innovative or pioneering nature value;
5. Importance of the property / complex due to special recall value.

## II Architecture and art historical values

1. special interest of the property / complex for the history of architecture and / or engineering;



2. special interest of the property / complex for the work of a master builder, architect, engineer or artist;
3. importance of the property / complex because of the aesthetic qualities of the design;
4. importance of the property / complex due to the special materials, the ornamentation and / or monumental art; ***(Another important value to preserve is in the door. It was introduced during the 18th century practice, with the objective to decorate the house. The ornament is an Igdrasil. Normally we can see it above the front door of a house. The belief is that Igdrasil branches have the power to connect the world with the heaven. )***
5. importance of the property / complex because of the special relationship between exterior and interior (parts).

### III Situational and ensemble values

1. meaning of the object as essential (cultural-historical, functional and / or architectural history and visual) part of a complex;
2.
  - a) special, iconic significance of the property for the appearance of its surroundings;
  - b) special significance of the complex for the prestige of his surroundings, neighborhood, city or region;
3.
  - a) special significance of the complex due to the high quality of the building in relation to the mutual historical and spatial context and in relation to the associated landscaping, roads, water, soil and / or archeology;
  - b) special significance of the object because of the way allotment / decor / amenities.

#### IV Integrity and recognizability

1. Importance of the property / complex because of the architectural integrity and / or recognition of former and / or interior;
2. Importance of the property / complex because of the material, technical and / or structural integrity; ***(Another important element to consider is the distance between the inside window frame and the facing wall. If we are going to modify the interior or exterior adding wall insulation, we must take into account that we are going to update this important value.)***
3. Importance of the property / complex if still well recognizable expression of the original or an important historical function;
4. Importance of the complex due to the accumulation of valuable interesting historical construction and / or use phases;
5. Importance of the complex due to the damage and recognizability of the entire ensemble of the constituent parts (head and outbuildings, fences, landscaping, etc.);
6. Importance of the property / complex in relation to the structural and / or visual integrity of the urban, village or rural environment.

#### V Rarity

1. Importance of the property / complex because absolute rarity in historic architecture, building technology, typological or functionally;
2. Exceptional importance of the property / complex due to relative rarity.

## 11. Bibliography

-NEN7120

-<http://www.bouwbesluitonline.nl/Inhoud/docs/wet/bb2012/hfd5>

-<http://dgmsoftware.nl/nen7120.php>

NEN 1068 Thermal insulation

-NEN 2686 Air permeability of buildings

-Bouwbesluit 2012

## 12. Annex

### Annex i

## **Annex II**

## Annex III